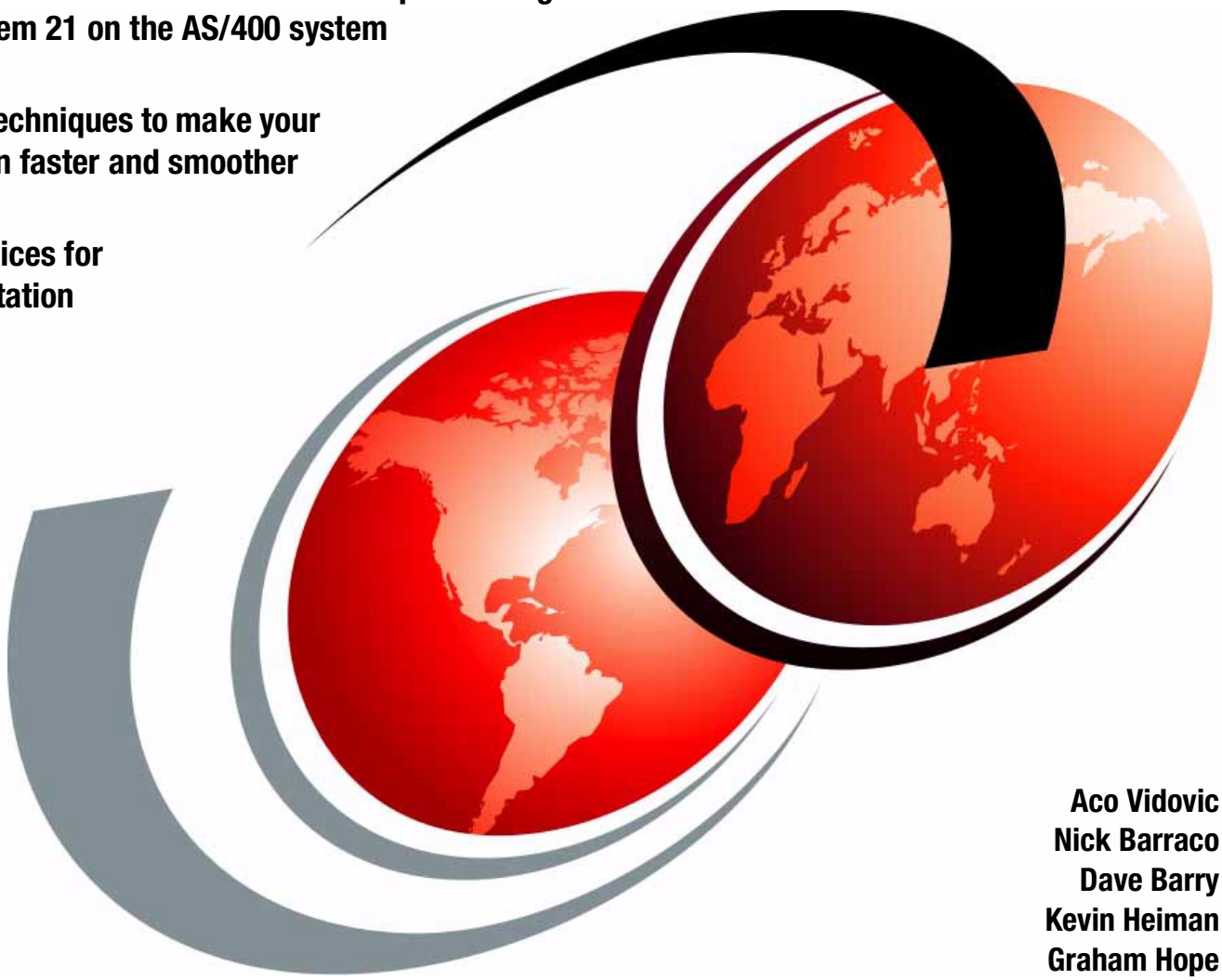
IBM

Geac System 21

Implementation for AS/400

- Concepts and tasks associated with implementing Geac System 21 on the AS/400 system
- Tips and techniques to make your system run faster and smoother
- Best practices for implementation



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Geac System 21
Implementation for AS/400

September 2000

Take Note!

Before using this information and the product it supports, be sure to read the general information in “Special notices” on page 581.

First Edition (September 2000)

This edition applies to Version 4, Release 4 and Version 4, Release 5 of IBM OS/400, Program Number 5769-SS1 and Version 3.5.2 of Geac System 21.

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Preface

This IBM Redbook offers a collection of knowledge gained from Geac consultants, customers, and AS/400 professionals who have experience with System 21 and the AS/400 system. This detailed guide explains the concepts, and the specific tasks associated with implementation of System 21 on the AS/400 system. This redbook is designed to assist technical people among Geac System 21 customers, business partners, and service representatives. It targets these professionals who are directly involved with the implementation of a total business solution consisting of AS/400 hardware, OS/400, DB2 UDB for AS/400 database, Geac System 21 solutions, and supplemental solution products.

The contents of this redbook are divided into four parts:

- Part 1 contains concepts and other basic knowledge that are necessary to understand the structure, features, and functions of System 21 and the AS/400 system. This part is especially helpful if you are a beginner in the AS/400-System 21 area or if you want to gain more insight into how System 21 works on the AS/400 system.
- Part 2 describes the implementation tasks and techniques necessary to install and properly set up System 21 on the AS/400 system. All System 21-AS/400 customers will benefit from the topics described in this part.
- Part 3 covers some advanced topics that will be of interest to those who want to optimize their System 21-AS/400 system to run smoother, faster, easier, and so on.
- Part 4 contains appendices with complementary information.

The team that wrote this redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization Rochester Center.

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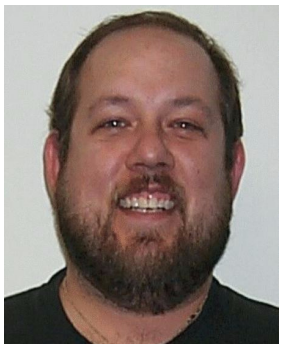

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Part 1. Concepts and architecture

This part presents the concepts and other basic knowledge necessary to understand the structure, features, and functions of System 21 and the AS/400 system. We recommend that you read this part if you are a beginner in the AS/400-System 21 area or if you want to gain more insight into how System 21 on the AS/400 system works. This part includes:

- Chapter 1, “Introduction to Geac System 21” on page 3, which provides an overview of System 21 solutions.
- Chapter 2, “Introduction to IBM AS/400” on page 21, which describes the AS/400 system key concepts, architecture, technology, and functions.
- Chapter 3, “File system and database” on page 43, which reviews the concepts and terminology of DB2 UDB for AS/400, SQL, System 21 database and library system, and locking mechanisms.

Chapter 1. Introduction to Geac System 21

Geac Enterprise Solutions Inc. provides mission-critical software and system solutions to corporations around the world. Geac solutions include:

- Cross-industry enterprise business applications:
  - Financial administration
  - Human resources functions
- Enterprise resource planning applications:
  - Manufacturing
  - Distribution
  - Supply chain management

Geac also provides several industry-specific mission critical business applications to the hospitality, property, banking, and publishing marketplaces. It also offers a wide range of applications for libraries and public safety administration.

Geac System 21 (formerly known as JBA System 21) is the application that satisfies the needs of a broad range of industries and contains sector-specific functionality to cater for the requirements of the apparel, food, drink, and automotive component industries. System 21 supports @ctive Enterprise technology to facilitate continual process improvement and business transformation. System 21 is based on IBM AS/400e servers. Today there are almost 2,000 mid-market organizations, based in over 50 countries, using System 21 to run their business.

For more information on System 21, visit the Geac System 21 Web site at:
`http://system21.geac.com`

1.1 About System 21 solutions

System 21 provides robust industry solutions across several segments of information and process management that include:

- Business applications
- @ctive Enterprise Framework: The infrastructure used to manage and use the applications
- Business Intelligence systems

1.1.1 Business applications

System 21 is an integrated suite of applications that offer Manufacturing, Financial, Customer Service, and Logistics, as well as sector-specific industry variants.

As shown in Figure 1 on page 4, end-user access to the business applications is supported through a number of user interfaces. These interfaces are delivered to the desktop via Geac products, Web browsers, and third-party business intelligence tools.

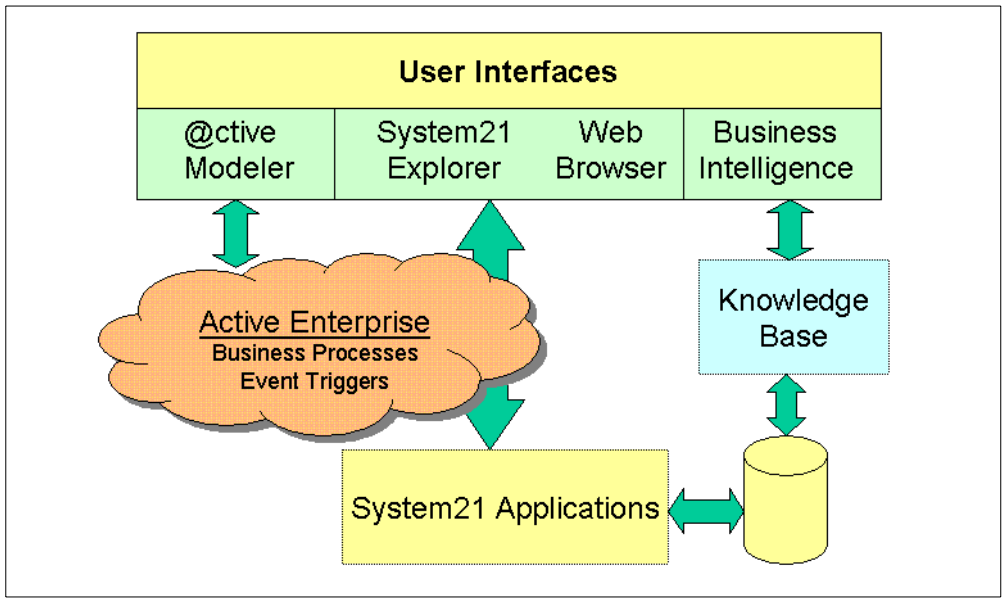

Figure 1. Business applications overview

The business applications provide the functionality to support the business requirements. This functionality can be further exploited by using the @ctive Enterprise products within System 21.

1.1.2 @ctive Enterprise Framework

In addition to providing the business applications, System 21 delivers the infrastructure products to manage and use the applications on the AS/400 server. These products are known as the *@ctive Enterprise Framework*.

The @ctive Enterprise Framework products consist of the AS/400 server and client software products.

1.1.2.1 Server products

The AS/400 server products, commonly referred to as System Manager, consist of:

- Application Manager
- Administration Functions
- Machine Manager
- Network Manager
- Housekeeping
- Conversion Utilities

The System Manager modules provide security and application management for the infrastructure of an organization. They are flexible and open to allow user customization and integration of applications not delivered by System 21. With System Manager, System 21 delivers one common security and management solution. Application Manager and Administration Functions provide the core elements for System 21 products in the area of user definition, application definition, security, application logging, and software licensing.

For full details of each of the System Manager modules, refer to their product guides. The product guides can be found on the installation Visual Documentation CD-ROM as Windows Help text.

System Manger modules are further explained in 1.1.2.3, “Application Manager” on page 7, through 1.1.2.7, “Network Manager” on page 11.

Note

Application Manager and Administration Functions are pre-requisites for all System 21 software.

As shown in Figure 2, all user requests must pass though the System Manager control.

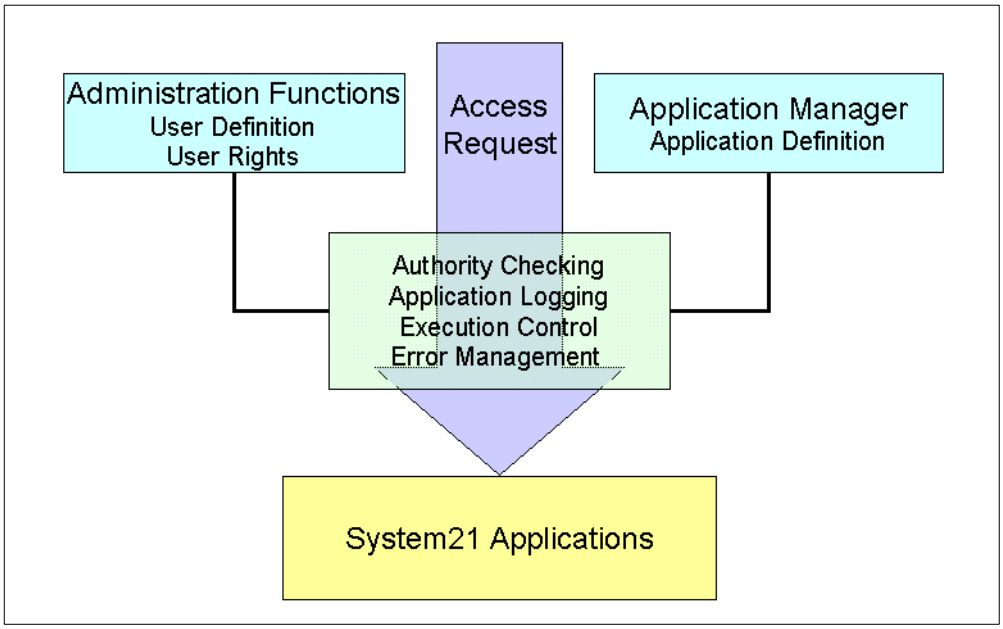

Figure 2. Application Manager and Administrative Functions

System Manager ensures that authorities are enforced and environment controls are in place for running the application.

1.1.2.2 Client products

The @ctive Enterprise Framework client products are:

- System 21 Explorer
- @ctive Modeler

System 21 Explorer is the primary user interface for System 21 application products. Every request from the user desktop to perform functions in System 21 applications is requested by System 21 Explorer. Users can be notified via the System 21 Explorer action list when the application from a business process requires user input. External documents can be attached to elements in the System 21 database via the System 21 Explorer document viewer.

With the advanced offerings in the @ctive Enterprise Framework, System 21 is transformed from the traditional passive ERP role, into an active role that drives the business processes. This is accomplished by defining the business processes with @ctive Modeler, followed by mapping software and events into the model. With these models in place, the Work Management engine executes the business processes based on events in the business. The events communicate with the user via the desktop wherever user interaction may be required. This communication can be in the form of actions in the System 21 action list, e-mail, or other Back Office solutions. Business processes can be time dependant to support ongoing changes in the organization.

Bringing the business applications and @ctive Enterprise Framework together provides the active enterprise solution. As shown in Figure 3, the user interfaces and events in the System 21 are the driving forces of the business processes which, in turn, execute the appropriate applications to deliver the business function.

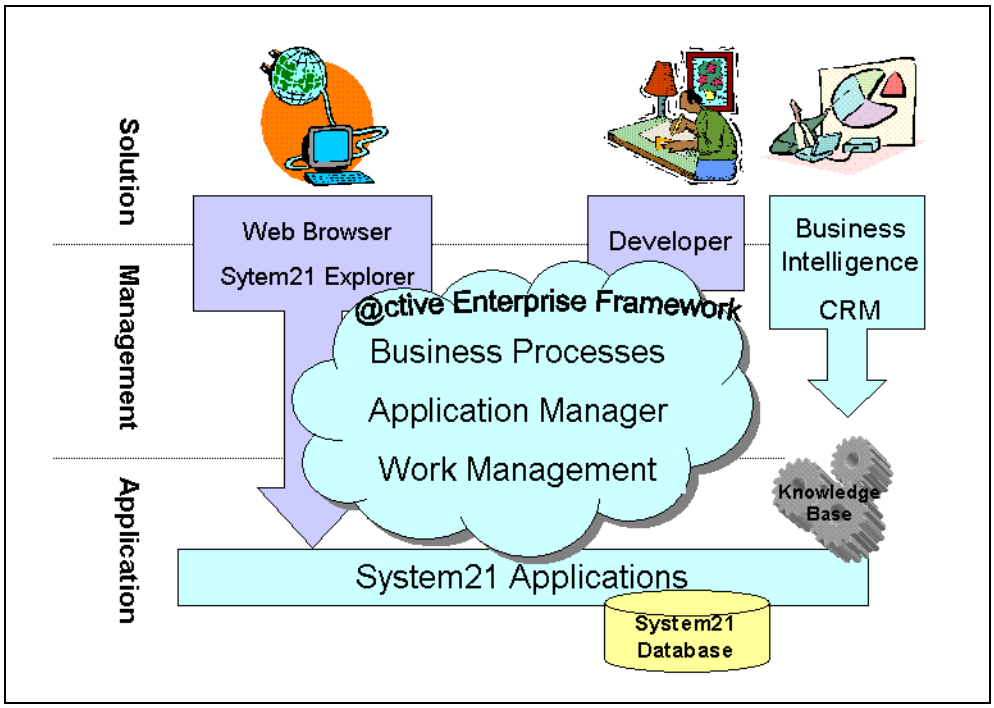

Figure 3. System 21 overview

As with System Manager, the @ctive Modeler and System 21 Explorer support the incorporation of non-System 21 applications. This allows in-house development and third-party software applications to be integrated into the total solution.

A key part of the @ctive Enterprise Framework is the Work Management Engine, which is delivered in the Application Manager product. This is a separately licensed product that will not inhibit the use of System 21 when it is disabled.

The Work Management Engine delivers the execution of the business processes, causing them to become more than just diagrams on a work space. The interaction of the @ctive Enterprise Framework is illustrated in Figure 4.

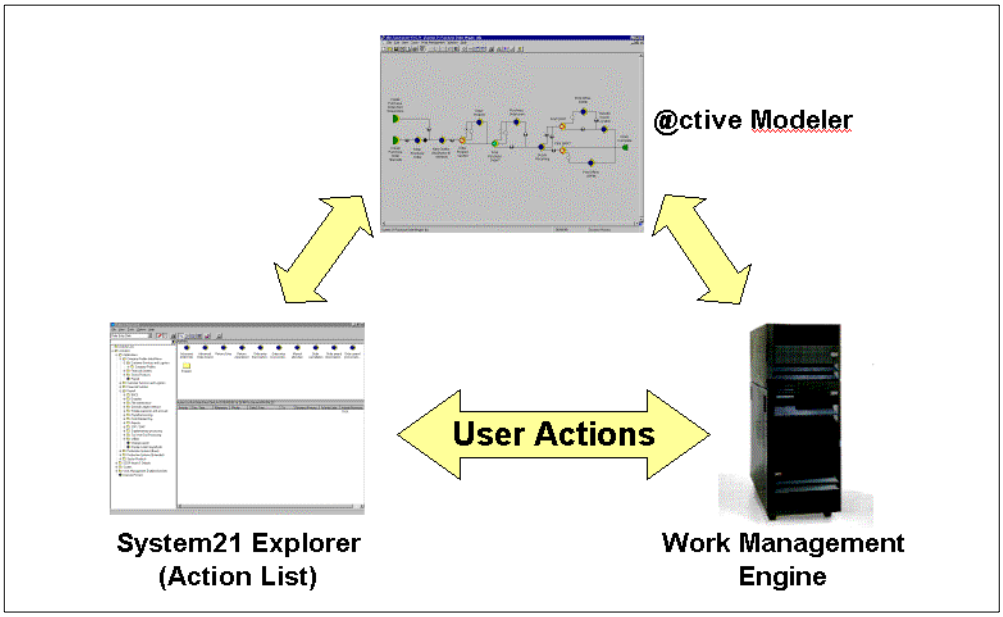

Figure 4. @ctive Enterprise Framework interaction

@ctive Modeler is a desktop Business Process design tool. The results are activated on the server Work Management engine. Then, it is used in conjunction with business events to execute business activities automatically and via System 21 Explorer where user interaction is required.

For more information about System 21 client products, refer to 1.1.2.8, “System 21 Explorer” on page 13, and 1.1.2.9, “@ctive Modeler” on page 14.

1.1.2.3 Application Manager

Application Manager provides application definition and management components with a flexible, security-conscious infrastructure for business applications.

Application Manager is used to:

- Set level security from company level down to specific tasks
- Find out which terminal is processing which job
- Add tailor-made functions to your business
- Perform Work Management functions in conjunction with @ctive Modeler
- Control the job queues and print queues for submitted jobs
- Control of the multi-language environment for all standard applications
- Review application usage and errors

The main entry panel for Application Manager is shown in Figure 5 on page 8.

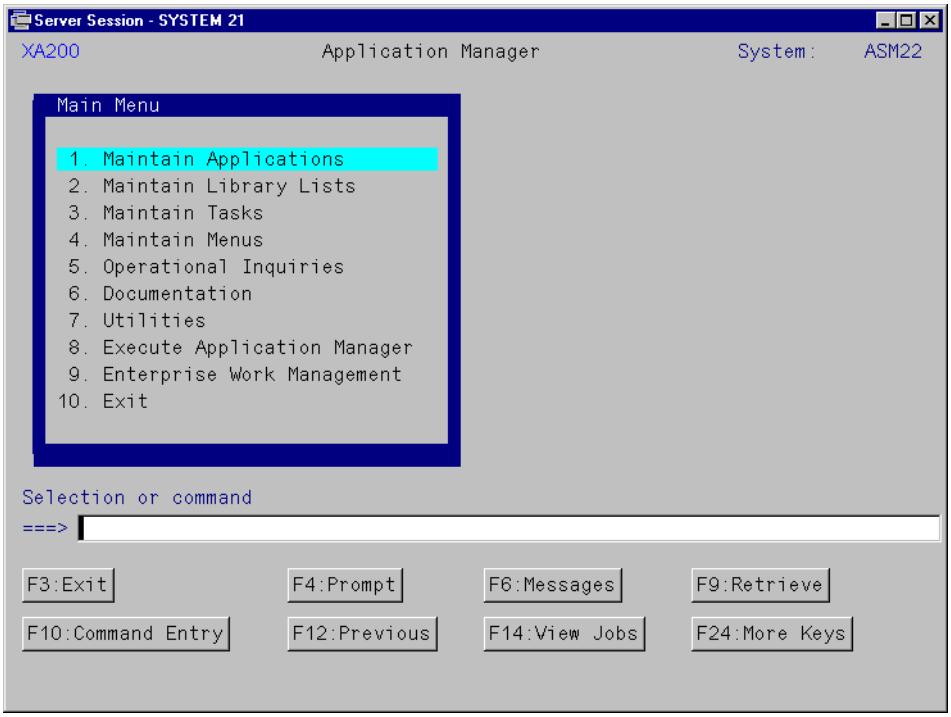

Figure 5. Application Manager Main Menu

1.1.2.4 Administration Functions

Administration Functions provide the user and security definition to System 21. This security is implemented in addition to the native OS/400 security.

The options available within Administration Function are used to maintain parameters that are common across all System Manager modules.

Administration Functions are used to:

- Create and define users
- Assign application level security
- Assign company level security
- Establish companies
- Apply authorization codes
- Define installed languages
- Define soft options for commands

Note

Access to Administration Functions are controlled by System 21 User Profiles.

The Administration Functions Menu is shown in Figure 6.

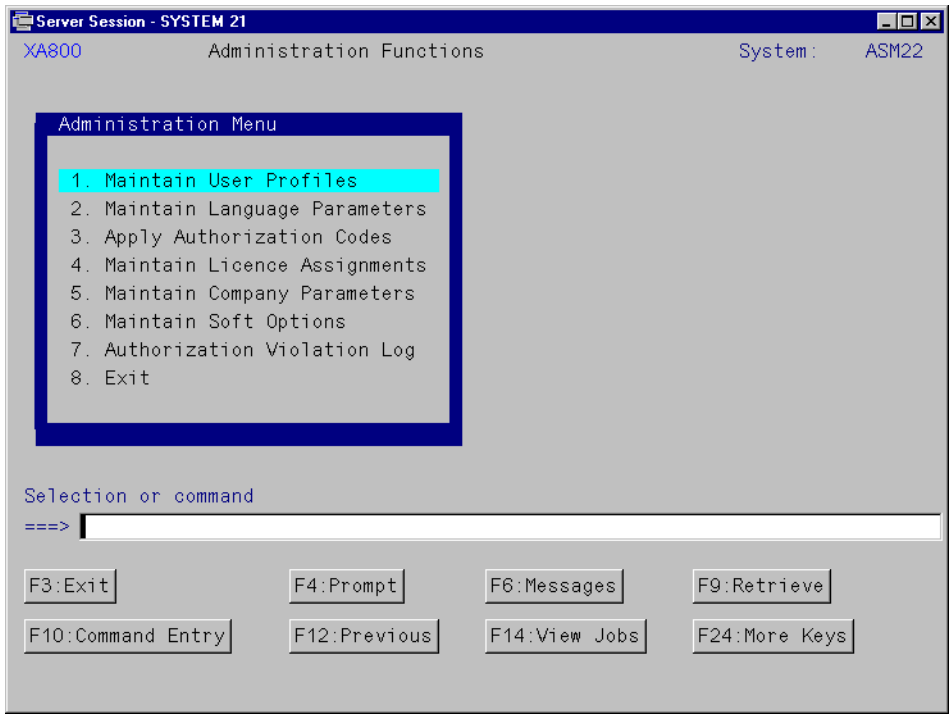

Figure 6. Administration Functions menu

1.1.2.5 Machine Manager

The Machine Manager module performs tasks, which fall into two broad categories:

- Housekeeping tasks
- Scheduled tasks

Housekeeping tasks

These tasks are normally performed when all or most of the interactive users have finished with the system at the end of the business day. Tasks that fall into this category may include the re-organization of database files, the securing of the offline storage of the system's programs and data, or the production of some reports, which might, for example, be scheduled to run on a weekly basis.

The time at which these overnight activities are initiated is decided by the user. At any time, this value may be modified permanently or altered merely for the current night's trigger time.

Jobs schedule for overnight execution may be set up and "masked" to run on any night (or each night) of the week, or to run on specific dates. The "mask" may be temporarily overridden for a particular night. The facility to schedule the date on which a job runs is also available. For example, you may want to run a task or a set of tasks on the tenth of each month.

After the completion of all tasks that were scheduled for overnight running, the machine can be optionally powered off. On successfully re-starting (IPL) the system, Machine Manager runs through a list of tasks that may be similarly scheduled. Re-starting the AS/400 system is fully automated and unattended. Therefore, the machine is ready for the users when they arrive on the following business day.

Scheduled tasks
Some tasks in your business require their initiation to be scheduled for a specified time. The tasks that fall into this category might include sending a message to a users, producing a report, or initiating a high resource task during an inactive period.

In addition to controlling the initiation of tasks, Machine Manager provides a fast and user friendly method of setting up standard tasks. For example, a task from the Inventory Management application or a task from the Housekeeping module, such as compressing libraries, can be run as part of your day-end routines.

The initial Machine Manager menu is shown in Figure 7.

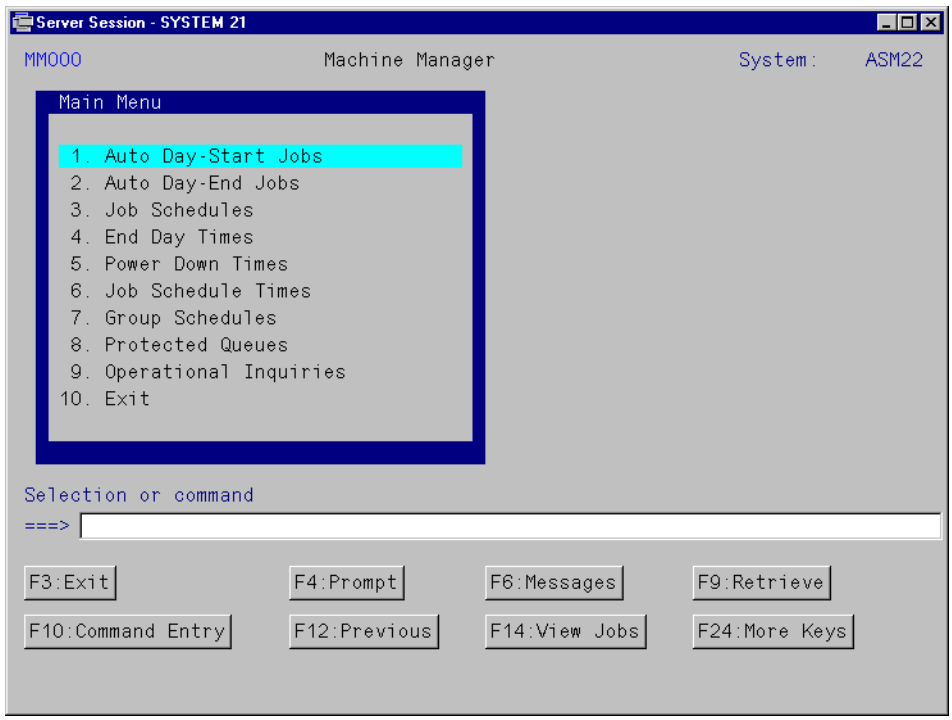

Figure 7. Machine Manager menu

1.1.2.6 Housekeeping
For each AS/400 computer installation, there is a need to ensure the timely saving of the system's libraries and folders to offline storage. The Housekeeping module provides the tools and utilities to perform and manage these activities.

The user specifies, for each library or folder, the desired save frequency (the number of days required between saves). The process of saving to offline storage involves two phases:

- In the first phase, the libraries that need to be saved are identified. This is done by comparing the date on which the library was last saved with today's date and calculating the number of elapsed days since the last save was made.
- The second phase, the actual saving to offline storage, will differ system by system depending on system-level decisions having been made for each AS/400 installation. This process supports saving to offline media as well as saving to disk.

In addition to the these facilities, which provide timely saving to offline storage and the identification of potentially obsolete libraries, the Housekeeping module also provides graphic representation (bar charts) of library size information. These bar charts display how the size of a library has changed over a period of six months or so. They help to plan future secondary storage (disk) requirements for the AS/400 installation.

Other key features provided by the Housekeeping module are:

- Creation of libraries
- Archiving libraries prior to deletion
- Media control
- Library compression
- File re-organization

The initial menu for Housekeeping application is shown in Figure 8.

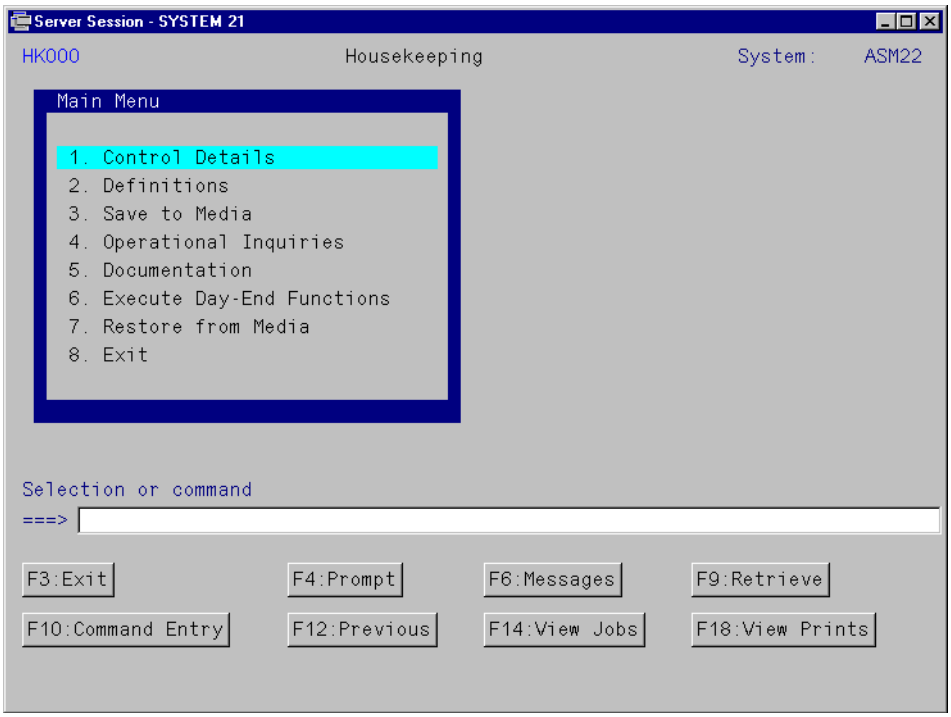

Figure 8. Housekeeping menu

1.1.2.7 Network Manager

Network Manager builds upon the advanced networking capabilities of the AS/400 System Network Architecture Distribution Services (SNADS) to distribute objects (folders, libraries, etc.), messages, and spooled files to other systems linked in an Advanced Peer-To-Peer Communications (APPC) or Advanced Peer-To-Peer Networking (APPN) network.

Network Manager offers a user-friendly method of configuring and maintaining your network. Network Manager also provides audits and logging of the distributions as they are occurring on the systems.

Sending objects

Network Manager allows the transmission of:

- A document or an entire folder from your system to a specific folder on any target system in the network. You can also compress the data on the document or folder before it is transmitted.
- An entire library from your system to any library on any target system in the network. You can pre-check the object, save access paths, and compress the data.
- One object from your system to any library on any target system in the network. You can also specify an object pre-check, save access paths, and enable data compression.
- A single source member from your system to any library on any target system in the network.
- A source library. If you need to send more than one source member from a library, it is easier to send the entire source library from your system to any target system in the network.

Sending spooled files

If you use Network Manager to configure your network, two output queues are created for each system. One queue is for users to send spooled files to each remote system from the local system. The second queue is for users to send spooled files from a remote system to the local system.

Spooled files placed on these queues will be moved to the target system at user-defined intervals.

The Network Manager menu is shown in Figure 9.

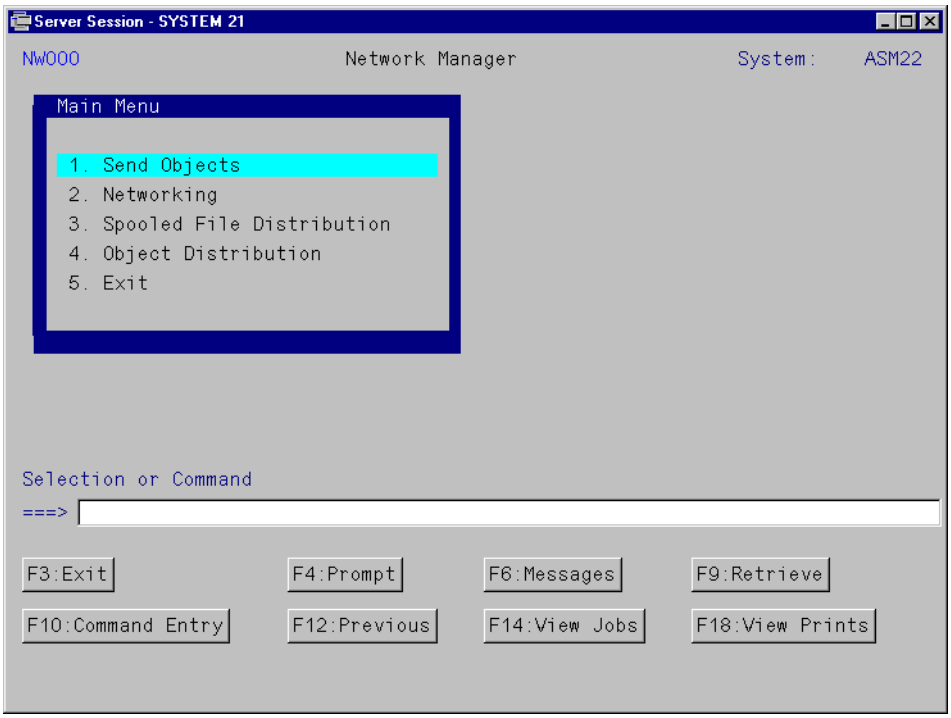

Figure 9. Network Manager menu

1.1.2.8 System 21 Explorer

System 21 Explorer provides the user interface to use the System 21 application set. While System 21 currently supports character-based terminal emulation, as well as System 21 Explorer, there are many advantages to System 21 Explorer, including features of Work Management that are not available in character emulation.

The System 21 functions available in System 21 Explorer are also available in the Web browser environment.

As shown in Figure 10, this client application is built on the Microsoft Explorer model to provide a natural integration to Microsoft desktop users.

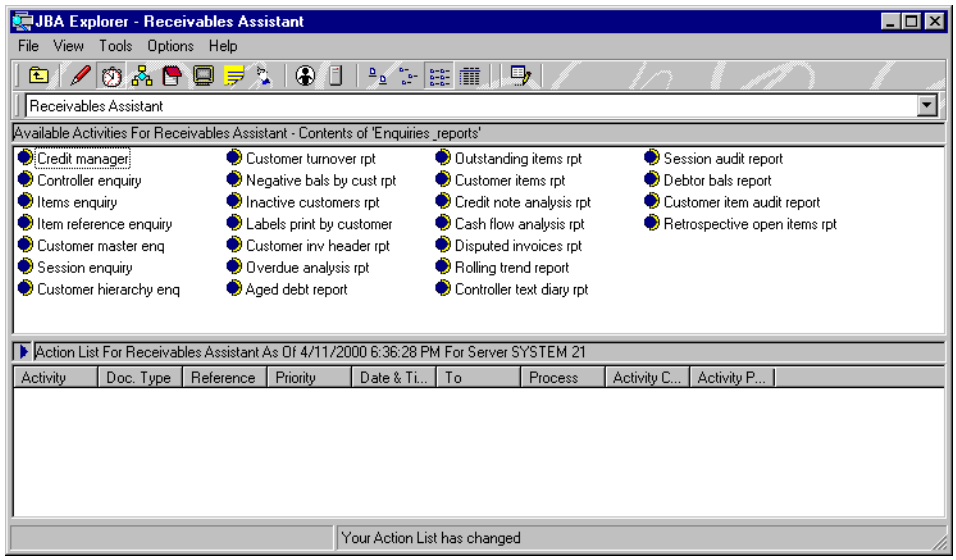

Figure 10. System 21 Explorer interface

Applications are launched from a series of Role Menus, designed to reflect the activities performed by the people within the organization. For example, there could be one Role Menu for all the Sales Order Clerks, another one for the Inventory Clerks, and so on. These roles can be customized as needed by the business.

Activities generated by the Work Management engine as a result of business process execution are delivered to the user or role via the System 21 Explorer Action List. The action list allows the user to focus on activities that are awaiting their interaction.

The System 21 Explorer provides:

- The definition of a users' activities into roles.
- Terminal emulation to support execution of the user activities.
- Presentation of the users' action list from Work Management.
- Connection to multiple servers.
- Support for activities beyond System 21.
- Explorer administration tools to configure the Explorer interface for the users individual preferences.

- Integration to other applications built upon Microsoft technologies.
- Role Menu Designer enables you to design Role Menus to tailor your system to meet your business needs, so that individual users can be screened from sensitive applications.
- Explorer Designer enables you to reformat the application windows.
- User Role Maintenance enables you to maintain a list of users in the database and a list of authorized Role Menus for each user.
- Action Tracker enables you to view the current status of any Business Object.
- Document Viewer enables you to maintain a database of documents that can then be linked to System 21 Application Windows, Elemental Activities, or third-party programs.
- Currency Conversion enables you to perform currency conversion calculations and display results for any Application Window value field.

For further details on the System 21 Explorer product, see the following Geac books: *System 21 Explorer Product Guide*, *@ctive Enterprise Framework Tips and Techniques Guide*, and the *Explorer Setup Guide*. Also refer to Chapter 5, “Installation and set up” on page 87.

1.1.2.9 @ctive Modeler

@ctive Modeler is a powerful, yet simple to use, graphical business process modelling product designed. It was developed to enable business users to model the organizational elements, key processes, and systems within their enterprises. @ctive Modeler is a PC-based Geac product.

By modelling its business, a company can understand how its business works, how the company is structured, identify key relationships, and highlight flaws in the processes.

Through the use of @ctive Modeler, business, software, and execution models can be produced and deployed. This provides a clear and concise method to define what a business does, how it does it, what software is used to support its processes, and how activities are carried out and by whom. Once the models are deployed, business metrics can be reported for the effectiveness of the business processes, allowing refinement and continual improvement.

@ctive Modeler supports four distinct stages in the successful application of a software solution to achieve business performance improvement.

- Reference Model
- Business Model
- Software Model
- Execution Model

The work space dialog of @ctive Modeler is shown in Figure 11.

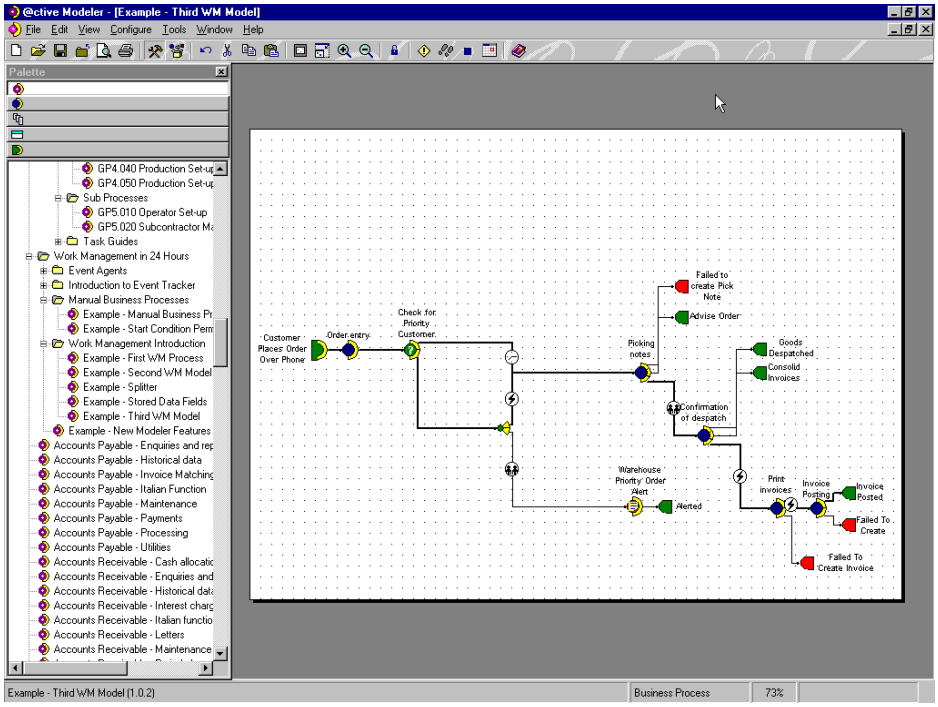

Figure 11. @ctive Modeler interface

The @ctive Enterprise products support current modeling and process execution features such as:

- Swim lanes
- Escalation and delegation
- Costed path
- E-mail
- Process reporting

For more details on the @ctive Modeler product, see the *Geac @ctive Enterprise Framework Tips and Techniques Guide* and the *@ctive Modeler Product Guide*. Also review Chapter 12, “Work management” on page 435.

1.1.3 Business Intelligence

To provide best of breed solutions in Business Intelligence, Geac partners with the leaders in the various environments of the evolving Business Intelligence marketplace.

Business Intelligence builds upon the System 21 reporting capabilities by delivering:

- Simple queries
- Report writing
- Score cards
- Web publishing
- Multi-dimensional analysis

Geac-delivered knowledge bases provide high level views to the System 21 database and the relationships in the database.

1.2 System 21 concepts

The name of each System 21 application module is controlled by a two-character mnemonic code, followed by a version. An example of this would be IN 03, which represents Inventory Version 3. Versions and applications are described in more detail in this section.

The ability to create custom applications allows for the integration of all AS/400 applications under one management tool. Applications have libraries, tasks, menus, and companies as part of their definition.

1.2.1 Versions

System 21 can be identified by its version, release, and modification level. This redbook covers System 21 Version 3.5.2 with Service Pack level 3. System 21 Service Packs are released on an approximate six-month cycle.

Geac also provides Fix Packs, which can be used between Service Packs to correct urgent defects.

For further information on Service Packs, see Chapter 6, “Operations” on page 143.

1.2.2 Environments

System 21 architecture supports the concept of Environments. Environments, which are tailored by the Application Manager, provide the ability to execute several System 21 entities in parallel. With this support of Environments, System 21 can accommodate a dynamic range of execution scenarios, such as:

- Development testing
- Education
- New release or option configurations
- Multiple language sets

For further details on Environments, see Chapter 11, “Customization” on page 389.

1.2.3 Languages

System 21 and the AS/400 system support many national languages. Contact your local Geac office for the current System 21 language availability.

Geac translates the software with a Language Translation module. This module inputs the display file and printer file source code, translates text via a dictionary and rule, and then outputs a new source file and object.

The implementation of languages is performed via configuration in Application Manager. Languages are implemented at runtime by the application job using a library list containing the translated display files and printer files. Multiple languages can be implemented on the same instance of System 21, allowing all users to work with applications in their native language.

For more information on national languages, refer to Chapter 14, “National language support” on page 495.

1.2.4 Companies

System 21 supports Companies throughout all tables. Definition of Companies is managed by Application Manager, while security is managed by Administration Functions. Support of company security is carried into all Environments as well.

All tables in System 21 come with a predefined data set for demonstration, testing, and education. The companies shipped in the database include:

- Z1 for Core products (also Z2, Z3, and Z4; not much used)
- Z5 for Style
- Z6 for Drinks
- US (US Data) for education
- U2 for US Style Data

Note

The predefined company Z1 must remain in the tables.

For more information regarding the System 21 database an tables, see Chapter 3, “File system and database” on page 43.

1.3 System 21 vertical industry variants

System 21 is available in several variants that cater for specific industry verticals. All of the variants are based on the standard core applications and provide extended functions for such areas as:

- Style
- Automotive
- Food
- Drinks

These variants replace base application programs where needed, extend the database schema for additional tables, and implement additional activities in Application Manager and Administration Functions.

This redbook covers the System 21 base application set and does not explore the vertical specifics.

1.4 Geac business partners

Geac has business partnerships with many of the world's leading information technology companies. These partnerships provide System 21 customers with extended functionality, while Geac focuses their efforts on designing, building, and maintaining System 21.

Geac has a long-standing and continual relationship with IBM as business partners and Strategic Alliance partners. For more information on the IBM strategic alliance, refer to the Geac Web site at: `http://system21.geac.com`

Also visit the IBM Web site at: `http://www.ibm.com`

Since business partners are a core part of the markets that Geac serve, it is essential for Geac to select high quality partners that fit with their overall

business strategy. To ensure this, Geac has a central team to manage partner relationships as well as local managers focused on those partners that are specific to their geographic requirements.

Together with its partners, Geac provides a range of solutions that can be implemented quickly and provide early benefit through use of meta data layers, for easy integration to System 21.

For further details of Geac partnerships, contact your local Geac office, or visit the Geac Web site at: `http://www.geac.com`

1.5 System 21 e-business solutions

The Geac ERP Product Center has partnered with Jacada Inc., a leading supplier of e-business infrastructure solutions, to secure the transition of System 21 to full e-business compliance.

In deploying a series of proven, industry-standard technologies, the Web-enablement of System 21 is completed, and the foundations are laid for the incorporation of successor ERP components currently in production.

As shown in Figure 12, by using the Jacada Inc. technologies, Geac can address the diverse user-access requirements to System 21 applications. Potential users of System 21 range from today's traditional transactional and managerial users within the customer's business itself, to trusted partners in an extranet environment.

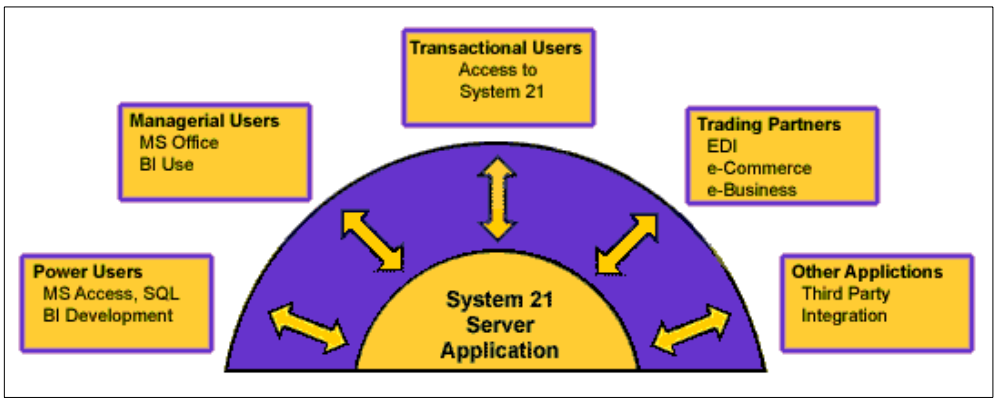

Figure 12. System 21 interface architecture via Jacada

The definition of a user can also be extended to trading partners of Geac customers accessing System 21 via a Web page or portal, and other third-party applications that integrate with System 21.

Geac will be making this technology available through the following series of products:

- System 21 Jacada Connects
- System 21 Jacada Software Development Toolkit
- System 21 Jacada for Java
- System 21 Jacada for Visual Basic

Jacada for Java provides Java applets for use in a thin client scenario. An example of an applet is shown in Figure 13.

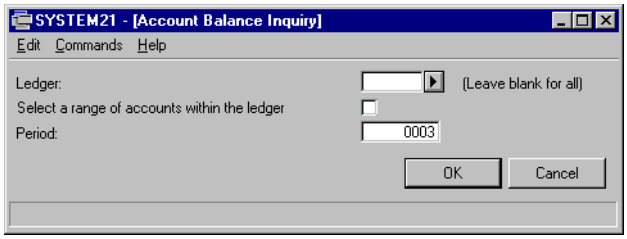

Figure 13. Sample Jacada for a Java applet

1.6 Account support

Geac strives to provide the best in customer satisfaction and offers support via the support desk, local project managers, and local dedicated Account Management teams:

- The support desk is used as explained in Appendix D, “Support” on page 573.
- Local project managers are assigned during times of implementation activity or customization work.
- A local account manager is assigned to all accounts and will be continually available to advise in software and hardware solutions.

To achieve optimum satisfaction, you should contact your assigned Account Team to help you manage and escalate any issues as appropriate.

Chapter 2. Introduction to IBM AS/400

This chapter provides an overview of the AS/400 platform: key concepts, architecture, technologies, and functions.

The IBM AS/400 system has a long and successful history worldwide. By the end of 1999, there were more than 650,000 AS/400 systems shipped to over 150 countries. There are more than 30,000 AS/400 business applications available worldwide, including over 2,700 applications for e-business. The reason for this success is founded in six basic factors, which are described in the following list:

- **Architecture**: The AS/400 system has a layered architecture that is divided into the actual user interface (operating system OS/400) and a Technology Independent Machine Interface (TIMI). This architectural concept has allowed the AS/400 system to undergo several fundamental technology changes while protecting the customer's investment in information technology. Refer to 2.1, "AS/400 architecture" on page 23, for more information.
- **High level of integration**: One of the key factors that differentiates the AS/400 system from other systems is the level of hardware and software integration. For example, in a UNIX environment, customers are required to select software components from different vendors (operating system, database, system management software, and so on). They are also required to integrate them to build a working environment for System 21. The AS/400 system takes a different approach. Hardware, microcode, the operating system, and IBM middleware are tightly interlaced allowing maximum exploitation of all available computing resources. The operating system includes a complete range of "licensed programs" (middleware) and offers the highest level of integration. By effectively reducing the extent of integration required to be performed during implementation, the AS/400 system approach minimizes implementation costs, increases reliability, and provides customers with the highest level of "ease-of-use".
- **Interoperability**: The AS/400 system offers a wide range of communication capabilities and functions that enable the AS/400 system to communicate with other IBM and non-IBM systems.

  Communications protocols supported by the AS/400 system include:

  – TCP/IP
  – SNA
  – OSI
  – NetBIOS
  – IPX/SPX
  – AnyNet

  Data link protocols supported on the AS/400 system include:

  – Ethernet
  – Token-Ring
  – Asynchronous Transfer Mode (ATM)
  – ISDN
  – FDDI
  – Synchronous Data Link Control (SDLC)
  – X.25

- **Client/server capability**: The AS/400 server can operate with the following client platforms:
  - Microsoft Windows 3.1, Windows 3.11, Windows 95, Windows 98, Windows NT, and Windows 2000
  - UNIX (IBM-AIX, HP-UX, SUN-SPARC)
  - Apple MacIntosh
  - IBM OS/2
- **Scalability**: AS/400 systems cover a wide range of performance capacities. AS/400e servers 1XX, 2XX, 7XX, and 8XX provide many processor options to choose from based on the performance requirements. At the high end of these servers, the AS/400e server 840 with 24 central processors provides 330 times the performance boost over the smallest model 250. Figure 14 shows the performance span of the newest AS/400 Models 250, 270, 820, 830, and 840, measured in Commercial Processor Workload (CPW).

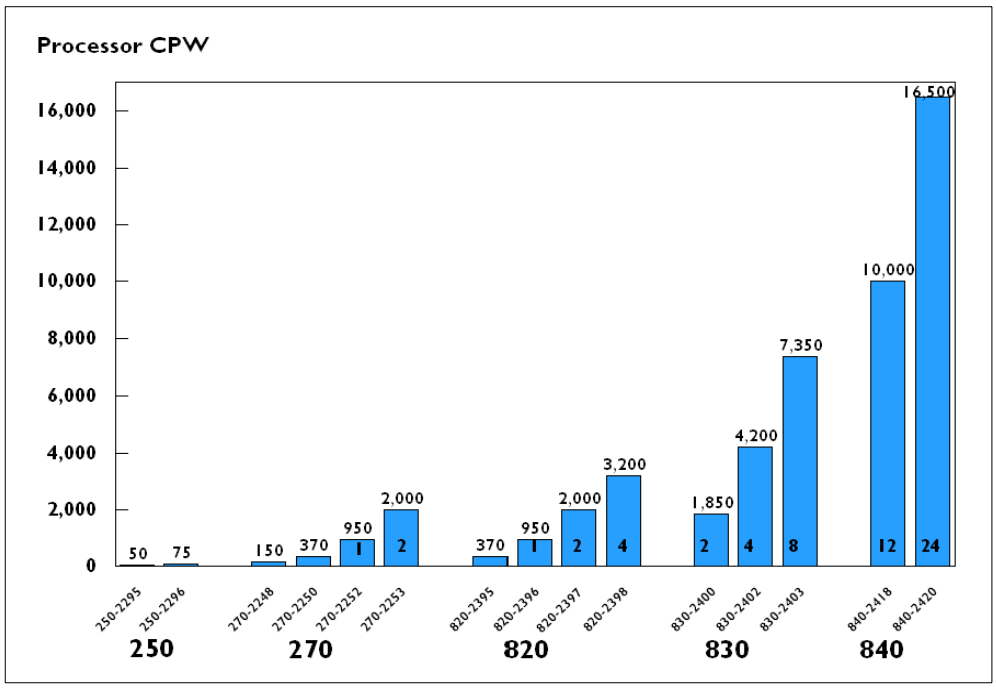

Figure 14. AS/400 scalability

For Geac System 21 customers, this means an AS/400 system can support environments in the size of a few users to thousands of users. Many of these AS/400 system models are field-upgradable to more powerful models, which provide an exceptional degree of customer investment protection. It is one of the contributing factors to the AS/400 system's low cost of operation in the long term.

- **Price/performance**: Many independent analysts have confirmed that the AS/400 system represents a cost-effective platform in the long run. The AS/400 system's extensive integration yields significant cost advantages.

2.1 AS/400 architecture

One of the key differentiators and contributors to the commercial success of the AS/400 system is its integrated architecture. This integration includes the hardware, operating system, and middleware. It is illustrated in Figure 15.

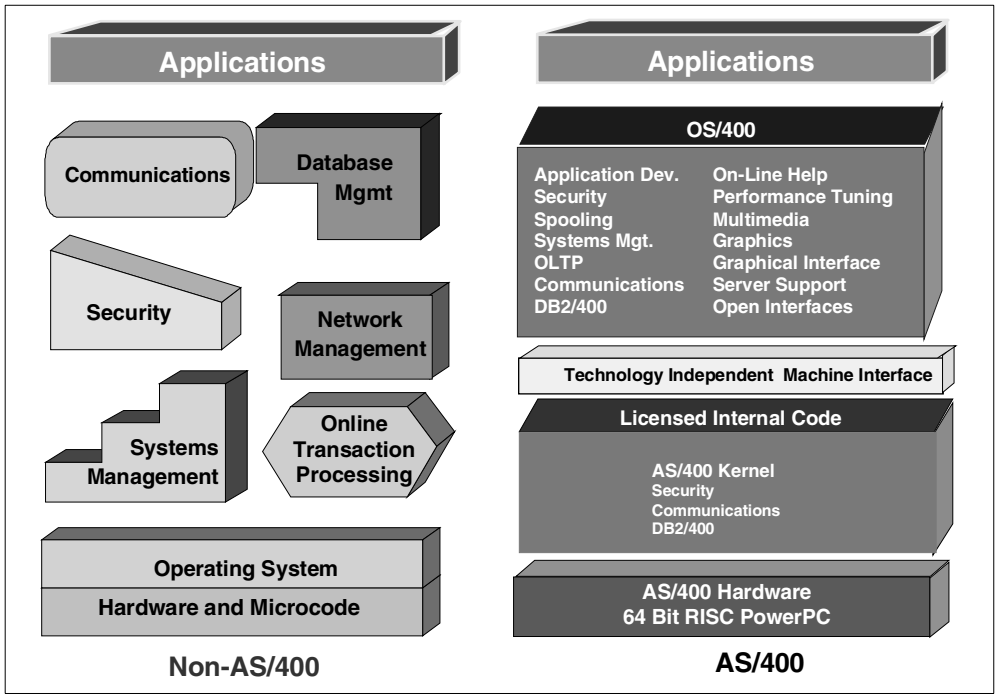

Figure 15. AS/400 system: An integrated system

The IBM engineers designed and built the AS/400 hardware to integrate it with the operating system (OS/400). OS/400 includes a wide array of middleware components including a relational database, an Internet server, system management facilities, built-in facilities for change management, backup and recovery, and print handling. It also includes communication capabilities (such as TCP/IP, SNA, and IPX), a POP3 mail server, and client support (Windows clients, MacIntosh, OS/2, and some UNIX clients). As a part of OS/400, these middleware products share the same packaging, user interface, installation, maintenance, security, and management facilities.

The integration and testing of these components in the IBM lab ensures that the AS/400 system does not need a skilled systems integrator at the customer site. The AS/400 system arrives ready to start. This integration is the reason why the AS/400 system delivers a low cost of ownership.

2.1.1 High level machine interface

Technology Independent Machine Interface (TIMI), shown in Figure 16 on page 24, is a design boundary that separates the hardware with Licensed Internal Code (LIC) from the operating system (OS/400). This permits the instructions used by the compilers of high-level languages to be generic and machine (hardware) independent. These instructions are translated to a specific hardware instruction set as part of the back end of the compilation process. Hardware dependencies are absorbed by LIC (internal microcode).

The ability of the AS/400 architecture to accommodate the smooth transition from Complex Instruction Set Computing (CISC)-based processors to Reduced Instruction Set Computing (RISC)-based processors is one example of *technology independence* provided by TIMI.

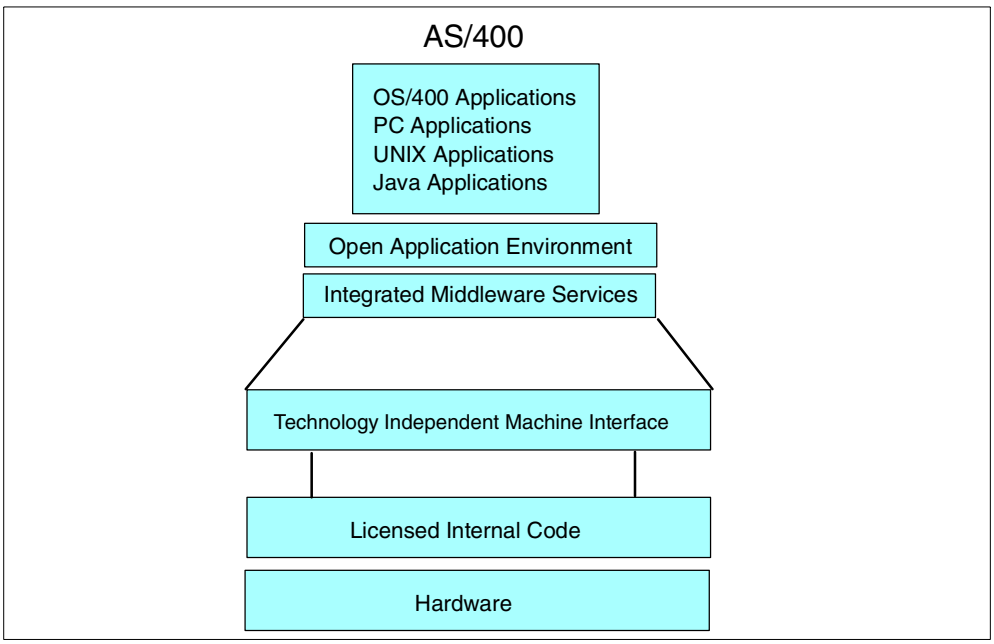

Figure 16. AS/400 advanced application architecture

2.1.2 Hierarchy of microprocessors

In addition to its central system processor (CPU), the AS/400 system has a range of other processors, each dedicated to a particular input/output (I/O) device type. A single large AS/400 configuration can have well over 200 processors.

When the CPU (which itself can be comprised of up to 24 separate processors) encounters a request for data to be read from or written to an I/O device, such as a disk, it delegates the request to the particular microprocessor dedicated to that I/O device. While the I/O processor processes the I/O operation, CPU can continue executing another application program. Since CPU is much faster than I/O devices (nanosecond - 10^{-9} second is the unit of time used to measure CPU clock speed, as opposed to I/O operations measured in milliseconds - 10^{-3} second), this means that by delegating its work to I/O processors, CPU avoids unnecessary wait time.

This design provides the AS/400 system with its outstanding performance in the commercial, transaction-based, environment which is I/O-intensive, rather than compute-intensive.

This design also gives the AS/400 system an elegant method of integrating diverse environments into a single, harmonious customer solution. The microprocessors that look after a particular I/O device are accommodated on I/O cards that fit into slots on the AS/400 system bus. One of these cards can be the Integrated Netfinity Server. This PC on a card fits into an AS/400 slot and enables the AS/400 system to run PC software, such as a Windows NT and Windows 2000 server or Novell Netware.

2.1.3 Object-based architecture

Objects are the means through which information is stored and retrieved on the AS/400 system. This concept is different from typical byte-string and file manipulation in many other systems. Object orientation is part of the architecture and affects both the operating system implementation and high-level language interaction with the system.

As previously mentioned, the TIMI is a boundary (set of instructions) that separates the hardware and LIC from the operating system. The AS/400 system instructions have an operation code and operands. Unlike many other systems, the operands are objects, and the instructions act on objects.

Objects have operational characteristics and a defined set of operations that can be performed on them. Objects are addressed through 16-byte pointers (eight bytes are used for a machine address. The other eight bytes are used for information about the object pointed to and for reserved space). In addition to providing addressability to the object, pointers provide access to the associated storage and are used to ensure data integrity and security.

Below the TIMI, LIC provides a tag bit for each *quadword* (16 bytes that must be aligned on a 16-byte boundary) within main storage. This bit is not addressable by the TIMI instructions used to address storage (that is, programs above the TIMI have no direct access to the tag bit). The bit identifies quadwords in storage containing TIMI pointers. The tag bit is turned on by LIC when a pointer is set and turned off by the hardware anytime the quadword is modified. This procedure allows the system to detect invalid pointers and prevent illegal use of a pointer. An attempt to subsequently use this data as a pointer results in an exception and the instruction is not completed. It is not possible to counterfeit a pointer or to modify a pointer in an invalid way. This provides for increased integrity of the machine against intentional or unintentional software actions.

2.1.4 Single level storage

One of the key resources on any computer system is the disk space that stores the data, applications, and programs. The management of this storage space is critical to having an efficient and high performance server installation. Storage management on the AS/400 system is automated. The AS/400 system takes care of selecting the physical disk drive (sometimes referred to as Direct Access Storage Device (DASD)) to store the data, spreads the data evenly across the disk arms, and continues to add records to files until specified threshold levels are reached.

AS/400 system storage management uses single level storage. With single level storage, there is a single, large address space for all storage (both main storage and disk storage). Storage is addressed using a 64-bit (8-byte) addressing structure. When an object is created, it is defined in a unique virtual address space. There is a single page table (sometimes referred to as a *page directory*) that maps all virtual addresses to corresponding physical addresses.

Application programs on an AS/400 system are unaware of underlying hardware characteristics because of the TIMI. In the same way, they are also unaware of the characteristics of any storage devices on the AS/400 system because of single level storage.

As with TIMI, the concept of single level storage means that the knowledge of the underlying characteristics of hardware devices (in this case, the hardware storage devices—main storage and disk storage) reside in the System Licensed Internal Code (SLIC). Programs work with objects, and objects are accessed by name, never by address. No user intervention is ever needed to take full advantage of any storage technologies.

The AS/400 system can address the number of bytes that 64 bits allows it to address. For example, 2^{64} is 18,446,744,073,709,551,616. Therefore, the AS/400 system can address 18,446,744,073,709,551,616 bytes, or 18.4 quintillion bytes.

Single level storage enables another extremely important AS/400 benefit, *object persistence*. Object persistence means that the object continues to exist in the memory system forever. An ordinary machine requires that information be stored in a separate file system if the information is to be shared or if it is to be retained for a long time. The persistence of objects is extremely important for future support of object-oriented databases. Objects need to continue to exist even after their creator goes away. The AS/400 system is uniquely positioned to exploit this characteristic of object persistence, where ordinary systems use a less-elegant mechanism that requires them to store their persistent objects in a separate file system with all the attendant performance implications.

The benefits of single-level storage include:

- All applications use one address space on the AS/400 system. Switching processes (for example, from database to Internet) requires little time. There is no need to flush out one address space and bring in another one.
- With single-level storage, there is no need for swap or paging space. When data needs to be moved out of memory, it goes directly to its permanent location on disk. It is not written first to a swap file and then its permanent location. AS/400 system disk space is not wasted for swap files.
- With single-level storage, all information is in one large address space regardless of it being in memory or on disk. All objects appear to be in memory. When a program wants to reference data, it simply references it by its address. There is no need for the program to translate addresses or go through a lengthy process to determine where the file exists on disk.

  With disk and memory managed through a common address space, the system can take advantage of increased memory without needing any complex memory management activity.
- Single-level storage also holds tremendous promise for object-oriented programs such as Java. With the ability to have shared persistent objects, the AS/400 system can eliminate the processing required on other systems to hydrate and dehydrate objects.

Single-level storage is a key reason why the AS/400 system is easy to develop applications for, can support multiple applications, and is scaled to support a large number of users. Single-level storage, combined with the automated storage management capabilities, make the AS/400 system an easier system to manage.

The AS/400 system customer can manage disk space on the AS/400 system as a single entity. The disk space can be used by all of the applications. The system

determines when and where to extend individual files and spreads the data across the disk arms to maximize performance. The system keeps track of the disk usage and warns the AS/400 system administrator when the disk space in the system auxiliary storage pool (ASP) reaches a specified threshold value. Advanced AS/400 system installations can deploy other disk management options to increase control of the space management process.

OS/400 has sophisticated space allocation routines to create and store information in the right size spaces. These routines look for the right sized block as opposed to selecting the first available block, regardless of size. The objective of these routines is to effectively use the disk space by reducing file and free space fragmentation. The AS/400 system automatically consolidates disk space fragmentation where possible and also has a separate disk fragmentation utility.

2.2 64-bit technology

Today, AS/400 systems use 64-bit PowerPC processors that have 64-bit registers. OS/400 is a 64-bit operating system, and its instructions perform 64-bit operations. Functional units can sort, compare, load, add, and subtract values that are 64-bit. Storage addressing uses 64-bits. Data paths move data from one location to another, 64-bits at a time (for example, from the cache to the processor).

OS/400 middleware is also 64-bit, including the database (DB2 UDB for AS/400). This middleware exploits 64-bit support in the operating system and hardware.

All AS/400 system applications exploit the new 64-bit architecture. Older AS/400 system applications are automatically migrated to run under 64-bit RISC technology. They do not have to be recompiled or rewritten to support 64-bit addressing, 64-bit data paths, or 64-bit registers.

Complete 64-bit support is a key enabler for delivering performance to demanding applications, such as data warehousing, data mining, or Enterprise Resource Planning (ERP) software like Geac System 21.

2.2.1 Copper chip technology

The newest AS/400 Models 270, 820, 830, and 840 use Pulsar and Istar processors with copper-chip technology. This is the sixth generation of AS/400 Power PC 64-bit RISC processors. Northstar processors used in prior AS/400 systems deploy aluminum for on-chip wiring.

Copper's better conductivity permits thinner wires to be used, which enables the transistors to be packed closer together. This new denser technology allows for additional micro architecture methods to improve performance. Denser processor technology also permits more on-chip cache.

2.2.2 Silicon on Insulator (SOI)

Istar processors used in AS/400 Model 830s, 840s, and some of the Model 820s are the first processors in the industry that use the Silicon on Insulator (SOI) processor technology. The addition of SOI alone can increase performance up to 20 to 30 percent beyond the use of copper by protecting the millions of transistors

on a chip with a blanket of insulation, reducing harmful electrical leakage that wastes power.

The transistors are built within and on top of a thin layer of silicon that is on top of an insulating layer. The insulating layer is fabricated by implanting a thin layer of oxide beneath the primary silicon surface of the wafer. This allows the high-end AS/400 Model 840 to be 3.6 times faster than the previous high-end AS/400 Model 740.

2.3 Hot-plugging

The term “hot-plug PCI” is used by the computing industry for a wide range of purposes. Primarily, hot-plug PCI refers to the technology that allows users to install and remove Peripheral Component Interconnect (PCI) devices while the computer is running.

PCI hot-plugging is available on the newest AS/400e servers with V4R5 on all 8xx models and some of the 270 models. Hot-plugging in the AS/400e is made possible by power control to individual card slots, so that PCI input/output processors (IOPs) or input/output adapters (IOAs) can be added, removed, or replaced while the system remains active. In most cases, IOA configurations can be changed while other IOAs on the same IOP remain operational.

2.4 High speed link (HSL)

In the hardware of a server, there are many factors that affect performance. Bandwidth and configuration of the I/O system have a big effect, especially in commercial environment, as does the network connecting the computers. New AS/400 processors supported by OS/400 V4R5 with more on-chip cache, a faster memory bus, a super-fast data cross-bar switch complex (with speeds up to 36 GB per second), faster disks, and much faster I/O processors and I/O adapters necessitate a new data transportation mechanism to keep processors of the AS/400 system busy.

HSL is capable of transporting massive amounts of data from the I/O towers with their attached devices to the processor at a speed of up to 1 GB per second, which is up to 10 times faster from the previous solution.

2.5 Integrated relational database (DB2 UDB for AS/400)

The integrated relational database manager has always been one of the most significant facilities that the AS/400 system has provided. Relying on a database manager integrated into the operating system means that almost all of the user data on the AS/400 system is stored in a relational database and that access to the database is implemented by the operating system itself. Some database functions are implemented at a low level in the AS/400 system architecture and some are even performed by the hardware to improve performance.

The integrated database, DB2 Universal Database for AS/400 (DB2 UDB for AS/400), provides stability and compatibility of previous releases of the AS/400 database with the standards-based technology required for a heterogeneous computing environment. DB2 for OS/400 provides compliance in the area of

standards compliance, coupled with advanced function, distributed capabilities, and performance. DB2 for OS/400 provides the following features:

- Structured Query Language (SQL) standards conformance supplies the industry standard database access language conforming to the IBM SQL Version 1, ANSI X3.135.1992, ISO 9075-1992, and FIPS 127-2 standards. Support is provided for embedded static, dynamic, and extended dynamic SQL, together with IBM Distributed Relational Database Architecture (DRDA), Microsoft Open Database Connectivity (ODBC), and Apple Data Access Language (DAL). A Call Level Interface (CLI) server mode is also provided that allows developers to write applications that perform database serving for multiple users.
- Encoded Vector Indexes (EVI) can be created using SQL. EVIs cannot be used to order records, but in many cases, they can improve query performance.
- Declarative referential integrity preventing conflicting data from being entered in the database.
- Stored procedures allowing the distribution of application workloads between a client and an application server.
- Triggers that cause automatic program execution before and after database modifications.
- Two-phase commit transaction management to allow access to multiple heterogeneous databases simultaneously.
- Data replication automatically in a distributed DB2 family environment.
- System-wide database catalog allowing applications to query information concerning all objects on a system using a single system catalog.
- Multiple-level concurrency control providing read stability, cursor stability, uncommitted read, and no commit isolation levels.
- National language support to store data in a preferred language, character set (single and double byte), and a sort sequence.

For more information, refer to Chapter 3, “File system and database” on page 43.

2.6 Data management

AS/400 system applications communicate with system resources by using objects. For example, they use *display file objects* to communicate with traditional, Non-Programmable Terminal (NPT) display devices, *printer file objects* for printer devices, and *database file objects* for AS/400 database files.

The AS/400 system display file has a record format that contains screen field definitions and other screen control parameters. The screen field definitions can optionally obtain their attributes from a database file field through a reference function.

Data Description Specification (DDS) is used to define the display file record and database file record and field attributes. When a standard DDS file is used, AS/400 system workstation management is responsible for formatting the device dependent data streams on output and unformatting on input. The AS/400 system database file object defines record field definitions and optionally identifies key

(index) fields. The database field definitions can also optionally be defined by referencing other database file field definitions.

In most AS/400 system applications, the workstation and database field definitions are integrated during the compile (create program) step. This is referred to as *externally described file support*.

In addition to display, printer, and database interfaces, the AS/400 system provides message queues, data areas, data queues, and other interfaces, including Portable Operating System Interface Standard (POSIX) compliant.

2.7 Security, user profiles, and authority management

The AS/400 system has an outstanding reputation as a mission-critical commercial server. Part of this reputation is due to the security of the AS/400 system. OS/400 has a single integrated security model. This security model is shared by the operating system, database, mail, systems management, the Internet, and communications functions. You can add a user once to OS/400, and they can have access to all the appropriate components. These include Windows NT, OS/2 Warp Server, and Novell NetWare on the Integrated Netfinity Server or Domino for AS/400 running natively on the AS/400 system.

OS/400 has a single directory, which is the system distribution directory. This directory is used by OS/400 e-mail (POP3 and OfficeVision) and Domino for AS/400.

The AS/400 system has a C2 security certification from the U.S. Department of Defense and is the only computing system to have received certification for both a database and operating system as a unit. The AS/400 system configuration that was certified was a functional configuration that included non-programmable terminals.

The AS/400 system has an object-based system architecture (see 2.1.3, “Object-based architecture” on page 25). Everything is an object (including data, programs, files, and so on) and is subject to object rules. These rules describe what can be read, changed, deleted, or added, and by whom or what. The AS/400 system checks those rules before it touches any object. This basic and underlying capability provides AS/400 system customers with a powerful security capability within their system. In addition, program objects have special rules that do not allow them to run unless they are properly encapsulated by the system. This makes the AS/400 system extremely virus resistant. AS/400 system objects, including programs, files, and databases, are protected by the OS/400 security mechanisms. When correctly implemented, this protection cannot be compromised by someone who merely has access to the machine.

System authorization management is based on user profiles that are also objects. All objects created on the system are owned by a specific user. Each operation or access to an object must be verified by the system to ensure the user's authority. The owner or appropriately authorized user profiles may delegate to other user profiles various types of authorities to operate on an object. Authority checking is provided uniformly to all types of objects within a file system.

The object authorization mechanism provides various levels of control. A user's authority may be limited to exactly what is needed.

For more information on security and user profiles, refer to Chapter 7, “Security” on page 209.

2.8 Integrated file system (IFS)

To enable the AS/400 system as a *server-of-choice* serving the major clients such as PC clients, UNIX clients, and the AS/400 system clients themselves, it was necessary to implement each client's file system on the AS/400 system as natively as possible.

The integrated file system (IFS) is a part of OS/400 that supports input, output, and storage management similar to the PC and UNIX operating systems. At the same time, it provides an integrated structure over all information stored in the AS/400 system. The key features of the IFS are:

- Support for storing information in stream files
- A hierarchical directory structure
- An integrated interface to access stream files, database files, documents, and other objects stored in the AS/400 system

A diagram of the IFS is shown in Figure 17.

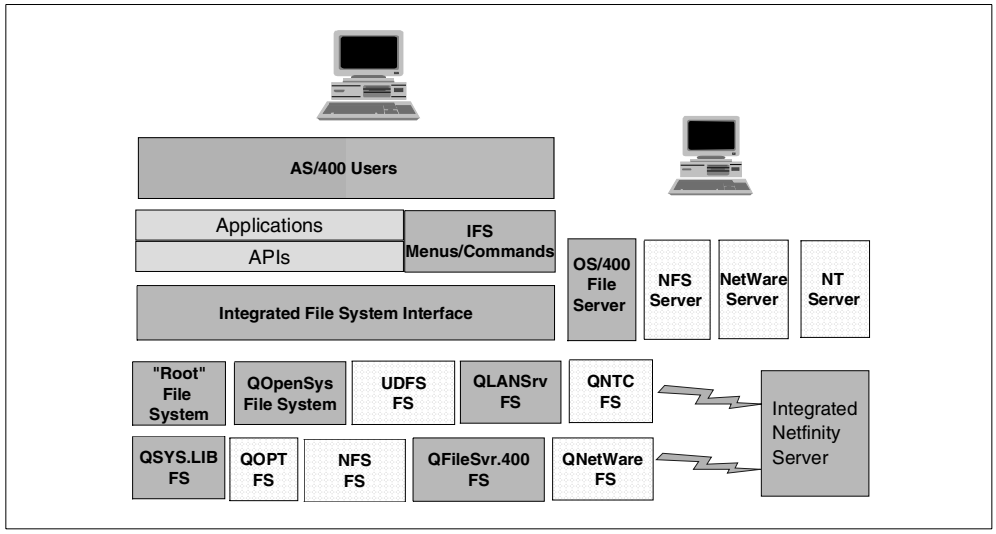

Figure 17. Integrated file systems

For more information on IFS, refer to *OS/400 Integrated File System Introduction Guide*, SC41-5711.

2.9 Logical Partitioning (LPAR)

Logical Partitioning (LPAR) allows multiple independent servers, each with its own processors, memory, and disks, to run within a single symmetric multiprocessing AS/400 system.

The end objective of LPAR, released with OS/400 V4R4, is to provide users with the ability to split a single AS/400 system into several independent systems capable of running applications in multiple, independent environments simultaneously. For example, Logical Partitioning makes it possible to run an

application such as System 21, using different sets of data on separate partitions, as if it was running independently on separate physical AS/400 systems.

2.9.1 LPAR scenarios

The range of scenarios possible with Logical Partitioning is limited only by the customer's imagination. The following sections explore a few of the most promising scenarios.

2.9.1.1 Multiple production environments

A company that offers outsourcing services to its customers can use a multiprocessor high-end AS/400 system with enough resources to create several completely independent logical partitions to meet customer requirements. These partitions can operate as independent machines. For example, some partitions may run client/server workloads, while others run purely interactive workloads, and still others may run mixed workloads. The permutations are endless.

2.9.1.2 Mixed production and test environments

Generally, production and test environments should be kept separate. LPAR achieves this objective in a simple way.

One or several partitions can be allocated for production only. Others are set up to handle application testing, either to validate application changes or to test applications under new releases of system software.

Without LPAR, the only practical way of testing a new version of an application would be to purchase additional hardware and software. However, the disadvantage may be that the hardware and software may not be subsequently required. Note that system software is currently charged at the physical machine level. Therefore, it can be run on several independent partitions, without an additional charge.

Partitioning provides a solution by making it possible to use an independent partition for testing. When testing is over, the resources allocated to this partition can be returned to the production partition or elsewhere as required.

2.9.1.3 Implementing an archiving solution

In this scenario, the customer has a very large database containing a mix of live and historical data. Most of the interactive and batch jobs use the live records on the database. However, the customer needs to access the historical data both interactively and in batch mode from time to time, with reasonable response times. Furthermore, they also need to reduce their backup time, without jeopardizing data security. Assuming that the application can distinguish between live and historical data, one possible solution is to create a three-partitioned configuration as shown in Figure 18.

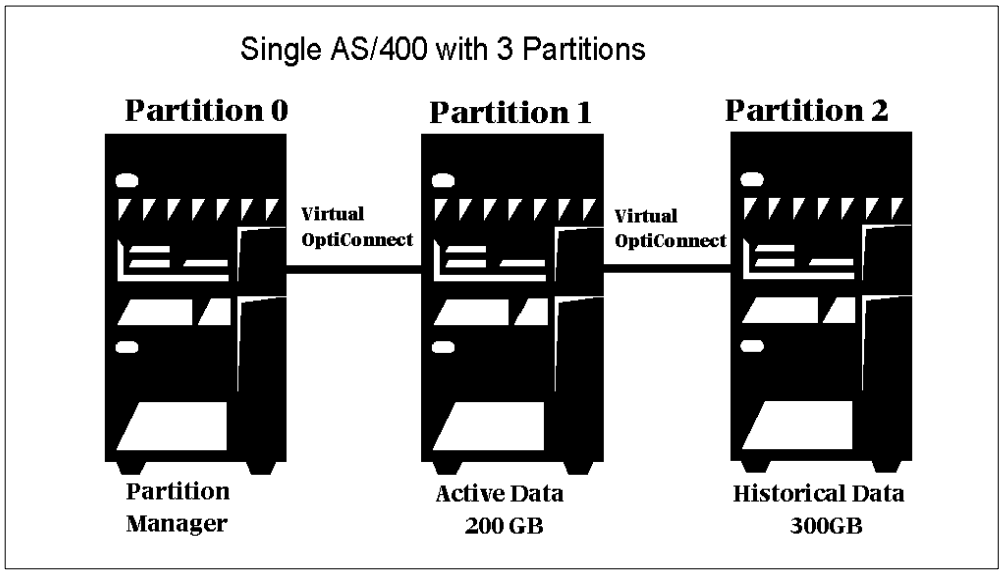

Figure 18. Setting up an archiving solution

The outcome of this implementation would be:

- Faster updates of live data because of reduced database index tables.
- Seamless access to historical data through high-speed inter-partition communication.
- Reducing the size of the database also reduces the size of the database index tables and, therefore, the amount of work the CPU has to do to update these tables.
- Overall improved response times.
- Reduced backup requirements. Only live data needs to be backed up at frequent intervals. Backing up archived data needs to be performed only at the time when live data transitions to archived status.
- Report consolidation through DB2 Multisystem or Remote SQL over high-speed inter-partition communication.

2.9.1.4 Server consolidation

Today's AS/400e server offers over 300 times the performance range from the smallest to the largest servers. Many companies are taking advantage of the high degree of scalability by consolidating existing AS/400e applications onto fewer systems, often in regional data centers.

Still many companies are attracted to the concept of distributed computing, in particular on the AS/400, UNIX, and Windows NT servers. The attraction of distributed servers is due to the low initial investment costs and the flexibility of deploying applications customized to the needs of specific departments. However, the realities of managing distributed UNIX and Windows NT platforms proved far more difficult and costly than initially imagined.

In response, many companies are now investigating opportunities to consolidate their decentralized and distributed systems to regain both financial and administrative control of their IT resources. This trend in the industry is referred to as *server consolidation*.

With its strengths as both an enterprise and distributed server, the AS/400 system has a unique position as a server consolidation platform for AS/400 consolidation, Domino for AS/400, and Windows NT Integrated Netfinity Server.

For more information on server consolidation, see the IBM Web site at:
`http://www.as400.ibm.com/sc`

2.9.1.5 Multi-database applications

Some businesses may require running the same application against independent databases. It may be that, because of naming conventions or other internal restrictions, the application cannot be run against multiple independent databases on the same physical machine. The solution before Logical Partitioning would be either to purchase additional hardware or modify the application.

With Logical Partitioning, each instance of the application can be run within its own independent partition. In addition, communications between the independent partitions can be used for consolidated reporting if required.

2.9.1.6 Minimizing backup and recovery windows

The imperatives driving today's businesses demand total machine availability, 7 days-a-week, 24 hours-a-day (7 x 24). On the other hand, data security demands that a foolproof backup strategy be in place to meet unforeseen contingencies. A third ingredient in this situation is the relentless growth of databases as businesses become more complex. Logical partitioning can provide one solution to balance these conflicting needs.

Let us look at a scenario where backup is becoming so time consuming that the production window is decreasing fast. Figure 19 illustrates a possible solution to minimize backup of the production database. Incidentally, this scenario also facilitates recovery.

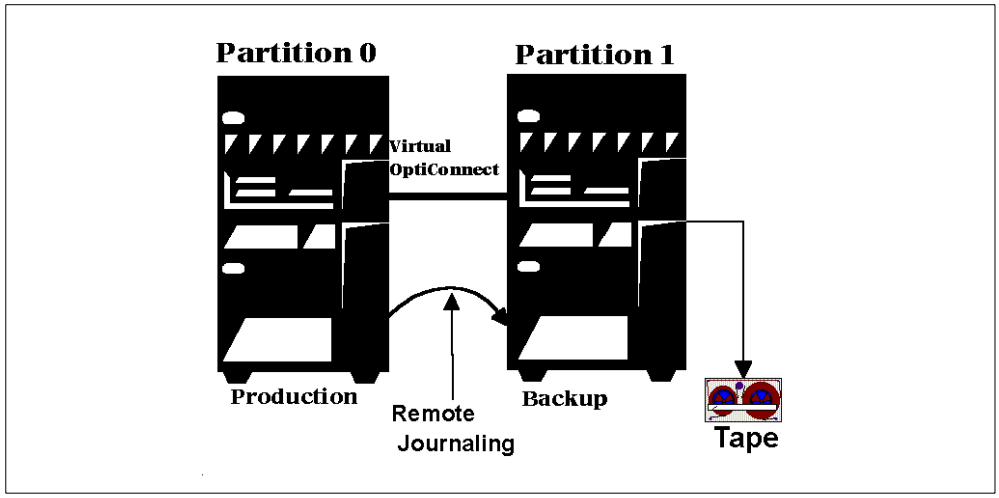

Figure 19. Minimizing backup

In this scenario, production is running on partition 0, and all updates are replicated on partition 1, using remote journaling. At preset intervals, the partition 1 update is suspended, and the partition database is backed up. After

the backup, the partition 1 database is re-synchronized with partition 0, by applying all accumulated journal entries from partition 0 to partition 1.

This scenario provides for recovery of the production database onto the same partition or a different physical machine, with minimum inconvenience.

2.9.1.7 Consolidating worldwide operations

If a customer's business needs different time zones on a single AS/400 system, there are no AS/400 system values available to support them. For example, if a customer has a system located in Hong Kong and has offices located in the US, the users signing on to that system from the US offices will always have the Hong Kong time. The application has to manage the different time zones for users, which may be located around the whole world. Even if they can manage the different time zones by the application, they still need to find a way to manage their downtimes. Their system cannot be saved while the users in the US are still running their interactive applications. They need to have batch windows for running batch programs.

One way to provide different time zones to users is to split the AS/400 system from a single system image to a system with logical partitions.

2.9.1.8 Three-tiered application architecture

Several types of AS/400 applications use a three-tiered architecture with a desktop PC, an application server, and a back-end database server. With the availability of AS/400 Logical Partitioning, customers can put the database server in the primary partition and the application servers in secondary partitions within the same system. This can reduce footprint and maintenance costs. Furthermore, the database server can communicate with the application servers through the virtual OptiConnect function available between the partitions.

2.9.1.9 A perfect combination with Domino clustering

E-mail and groupware software, such as Lotus Domino for AS/400, becomes more and more critical in daily business operations. Customers cannot afford to have their Domino servers fail for hours. This may affect customer service levels.

Lotus Domino for AS/400 has already taken advantage of the reliability and availability features of the AS/400 system, such as RAID-5, mirrored disk units, and integrated backup capability. With the AS/400 system's Logical Partitioning and Domino clustering, the level of availability is further enhanced.

Putting the Domino servers into two different AS/400 logical partitions isolates them from software errors affecting both servers. Plus, it also provides the ability to have high-speed cluster replication between the two AS/400 partitions using the virtual OptiConnect function.

2.10 Clustering

Logical Partitioning creates independent systems within a single physical box. Clustering can be seen as a superset of Logical Partitioning in that it provides a single resource view that binds together two or more physical AS/400 systems. These can, in turn, be logically partitioned if required.

Clustering offers increased high availability of applications and data. It does this by providing automated recovery facilities across several combined AS/400 systems (defined as nodes in the cluster). For example, through clustering, an application can be set up to run on a primary node, with a secondary node defined for quick failover switching, when the primary node becomes unavailable. The switchover would include the automatic switching of communications to the secondary node.

It is also possible to imagine a cluster containing logically partitioned nodes. An application can run in one partition, in its own primary node, and have its backup secondary node ready on a logical partition in another node somewhere in the cluster. Figure 20 illustrates the concepts of clustering.

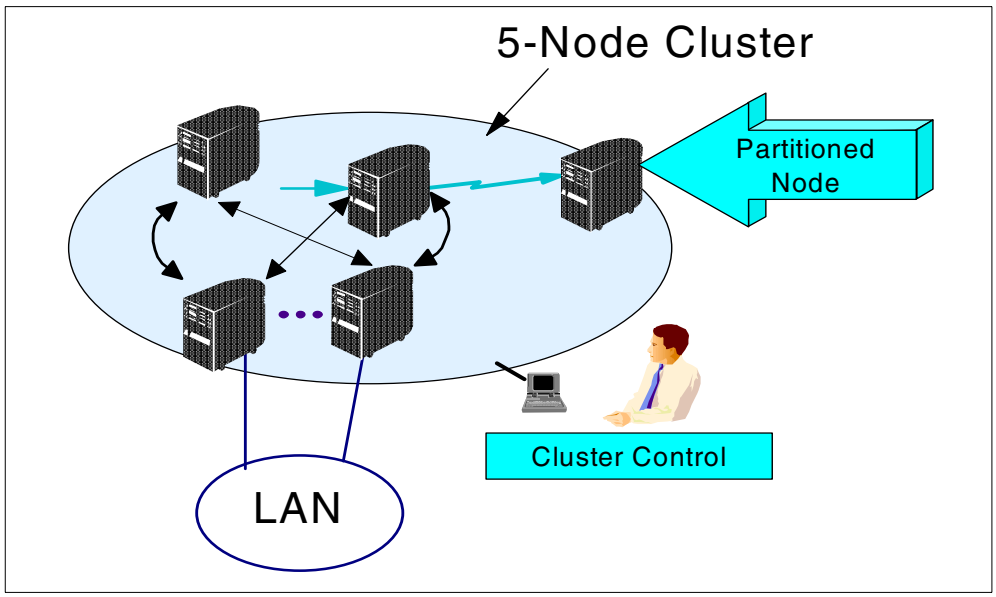

Figure 20. Clustered configuration with a partitioned node

2.11 System management

Integrated with OS/400 are a number of system management functions that are key to lowering the cost of ownership of the AS/400 system solution. These functions include:

- **Job management**: OS/400 includes an environment to manage jobs for users, operators, and programmers. An operator can look at all of the jobs running on the system or select only those associated with a specific queue or user. An operator can sort them by CPU usage, view their properties, change their priority, stop them, or delete them within the limitations of authority granted to the operator.
- **Printer management**: The AS/400 system has a print output environment. An operator can select what output to see: either all of it by printer, user, or queue. With the printer management facilities, an operator can route the output to a different printer, change the number of copies, print only selected pages, or print duplex copies. AS/400 system print jobs can also be sent or mailed to other AS/400 systems and users. Plain text print output can be viewed on the AS/400 system before being printed. When using Advanced

Function Printing (AFP), a user can see the actual AS/400 printed output (text, forms, or graphics) before it is printed. For more information, refer to Chapter 8, “Printing” on page 231.

- **Backup and recovery**: OS/400 has a backup scheduling application that allows an administrator to easily create a daily, weekly, and monthly backup plan along with other scheduled tasks. The administrator selects what to back up, where to back it up, and when to back it up. For more information, refer to Chapter 9, “Backup and recovery” on page 251.
- **User management**: When a new user is added to OS/400, besides entering the user ID and password, an administrator can specify the maximum amount of disk space the user can use to store information, the maximum priority at which any of their jobs run, and accounting information for tracking AS/400 system resource consumption by the user and several other attributes. The administrator can also specify the output queue and message queue for the user, the language and sort order for the user, and integrate the user ID and password with Windows NT, Novell NetWare, or OS/2 Warp Server for AS/400 running on the Integrated Netfinity Server (or Integrated PC Server) or with Domino for AS/400 running on the AS/400 natively.
- **National language support (NLS)**: The AS/400 system has national language support for over 50 languages and can support multiple languages, sort sequences, and character sets per system. With this support, one user can interact with the system, for example, in the German language, while another user converses in French. Unicode (UCS-2) support is also available. For more information on national language support, refer to Chapter 14, “National language support” on page 495.
- **Problem management**: A complete problem management application is included with OS/400. This support allows administrators to track, analyze the causes of, prioritize, and report to IBM the problems associated with the computing environment. The AS/400 system keeps track of the installed products, release levels, and program temporary fixes (PTFs) that were applied.
- **Software fixes**: Individual software fixes or PTFs can be applied to LIC, OS/400, and licensed programs either permanently or temporarily. The benefit of applying a fix temporarily is that it can be applied, tested, and removed if it is appropriate to do so.

2.11.1 Electronic Customer Support (ECS)

ECS is a direct electronic link to IBM marketing, administration, technical, and service operations. ECS gives users and technical staff online advice and provides configuration management assistance, problem determination, and other service needs. ECS simplifies the PTF ordering procedure by enabling the speedy receipt and application of PTFs and quicker problem resolution. The Copy-Screen facility permits a more accurate user-to-specialist problem description, and direct electronic contact with AS/400 system specialists. ECS support is provided for software problems (LIC, operating system, licensed programs and third party applications), as well as for hardware problems.

In addition to ECS, AS/400 system customers under warranty or an IBM maintenance agreement may receive Service Director support. Service Director monitors the AS/400 system in real time. When an error is entered into the problem log, it is immediately and automatically analyzed and reported to IBM

through the ECS function on the AS/400 system. The problem is fed into the IBM remote technical assistance information network, and IBM resources are used to evaluate the situation. If a PTF is available that corrects the problem, it can be downloaded to the AS/400 system. This can significantly reduce overall downtime.

In addition to these system management facilities, additional IBM and third-party products are available to manage larger and distributed AS/400 system environments. These products provide support for software distribution, client management, performance analysis, capacity planning, and more.

2.11.2 Management Central

A suite of system management functions, known as Management Central, includes system management functions such as collection services, object packaging, PTF management for distributed environment, and inventory on multiple systems.

2.11.3 System management facilities

A variety of tools and functions that provide system availability and management are available in the AS/400 system. Some are discussed in this section:

- **System Managed Access Path Protection (SMAPP)**: SMAPP supports and automates the process of selecting which access paths should be protected. The system uses the EDTRCYAP value to estimate the amount of journaling to perform. The shorter the time that is in this value, the more journaling takes place, which impedes system performance, but it leads to shorter IPLs. The longer the value is, the longer IPLs are. However, the impact of journaling on CPU and DASD utilization is less.
- **Expert Cache**: Expert Cache provides a disk cache tuner option, which allows the AS/400 system to take advantage of available main storage capacity. It dynamically responds to system jobs to cache pages of data in main storage to reduce the time to process disk I/O.
- **Integrated hardware disk compression**: Beginning with OS/400 V4R3, the compression of data on disk is supported by OS/400. Data is dynamically compressed and uncompressed by the AS/400 DASD controller as data is written to and read from disk. Disk compression does not affect the main CPU utilization since this function is performed by the DASD controller IOP.

  Support for Integrated Hardware Disk Compression is only provided by PCI DASD controllers (#2741, and #2748) and SPD DASD controllers (#6533 and #9754). In V4R3, the 17.54 GB drives are not supported. However, V4R4 of OS/400 adds support for compression on 17.54 GB drives. Compression is limited to user ASPs.
- **Hierarchical Storage Management (HSM)**: OS/400 includes HSM APIs that are used by Backup and Recovery Media Services (BRMS), 5769-BR1, to provide HSM functions. These APIs can also be used to develop custom HSM applications. The APIs are documented in the *AS/400 Hierarchical Storage Management,* SG24-4450. Refer to the following Web site for more information on BRMS and HSM: `http://www.as400.ibm.com/hsmcomp`
- **PTFs available on Internet**: Beginning with V4R3, AS/400 customers can download PTFs over the Internet. The client hardware needed is a PC with Windows 95 or Windows NT, a TCP connection to the AS/400 system over a

LAN, and access to the Internet. The various configurations and set up information are documented on the Web at:
`http://as400service.rochester.ibm.com`

Except for the medium of transport (Internet), the functionality is the same as the ECS method of transport. The user selects the PTFs and options using a Web browser and submits the order. At the referenced Web site above, the user can also search on PTF cover letters and read them before the order is even placed. The same entitlement rules that apply on the ECS connection are enforced. In other words, if a user can acquire PTFs electronically over the ECS, they can acquire PTFs over the Internet.

2.12 AS/400 advanced technologies

With the introduction of OS/400 V4R2, the AS/400 system offered important new capabilities in such key areas as Java, Web serving, Lotus Domino, and Business Intelligence solutions.

2.12.1 Java

Java is a key application development environment for the AS/400 system. As Java technology evolves from Sun, the AS/400 system takes advantage of the new functions and features of this environment.

The AS/400 Developer Kit for Java supports Sun's Java 2. With the concurrent Java support shipped as part of the V4R4 AS/400 Developer Kit for Java, you can install Java 2 on systems where JDK 1.1.6, 1.1.7, or 1.1.8 are already installed. A Java Virtual Machine (JVM), which resides *below* the Technology Independent Machine Interface (TIMI), and therefore, very close to hardware, enables fast interpretation and execution of Java code on the AS/400 system. JVM on the AS/400 system also includes two types of compilers:

- **Just in Time Compiler (JIT)**: Generates non-persistent 64-bit RISC machine instructions from Java bytecodes.
- **Class transformer**: Generates persistent machine instructions.

These two compilers enable the direct execution of Java on the AS/400 system without the overhead of interpretation.

High-performance garbage collection is provided by OS/400 to improve the performance and the scalability of Java. An advanced garbage collection algorithm allows Java to scale to the large numbers of objects expected when running enterprise applications on the server. As opposed to some other platforms, the AS/400 system does not require stopping all other applications and threads while running garbage collection.

OS/400's unique single-level-store architecture is also exploited to give Java objects on the AS/400 system an advantage that is not available on any other platform. Java objects on the AS/400 system can be full-fledged system objects that allow them to be persistent, shared, secure, backed up, and restored. This allows the AS/400 system to offer persistent Java objects with performance and support that is unparalleled in the industry. The AS/400 single-level-store technology permits Java objects to be stored in their object form without the performance and maintenance overhead of two-level-store operating systems.

Java applets and applications that access AS/400 programs and data from client workstations (or a Java-enabled server) can be written using the AS/400 Toolbox for Java. Java classes on the client can be used to access existing AS/400 applications and data using low-level APIs. This provides easy entry into Java development while leveraging what already exists on the AS/400 system today.

2.12.2 Web server for e-business

Typically, e-business solutions for companies begin with posting information on the Web and connecting employees via e-mail. This grows into taking core business systems and extending their reach and value by enabling them for the Web. Eventually, employees, distributors, suppliers, and customers are all connecting with each other through Internet-based systems that let them dynamically share data and applications.

The HTTP server is at the core of all Web applications and services. The IBM HTTP Server for AS/400 is the foundation for AS/400 e-business solutions. The IBM HTTP Server for AS/400 combines the basic functions of a Web server with expanded functionality that allows for greater flexibility in establishing a Web presence.

OS/400 V4R4 provides support for Lightweight Directory Access Protocol (LDAP) in the HTTP Server for AS/400, which defines a protocol to access directory services on a network. A new Domino plug-in is also provided that allows the HTTP Server for AS/400 to access documents stored in Notes.

AS/400 Web serving capabilities include support for the IBM WebSphere family. There are several components in the WebSphere family:

- **IBM WebSphere Application Server**: Provides a framework for consistent, architected linkage between HTTP requests and business data and logic. IBM WebSphere Application Server is intended for organizations that want to take advantage of the productivity, performance advantage, and portability that Java provides for dynamic Web sites.
- **IBM WebSphere Studio**: A set of PC-based tools to help developers create WebSphere applications.

IBM Net.Data allows the creation of interactive Web applications with “macros” to add logic, variables, program calls, and report writing to HTML. These macros combine the simplicity of HTML with the dynamic functionality of CGI programs, which makes it easy to add live data to static Web pages. Live data includes information stored in DB2 for AS/400 (locally or remotely), databases on other systems, REXX programs, C and C++ programs, programs in other AS/400 languages (such as CL, RPG, and COBOL), and other sources.

AS/400 Web serving capabilities have also been extended with a powerful, full-text search engine through the implementation of NetQuestion in OS/400 Version 4 Release 3. NetQuestion provides the tools to build a centralized Internet search service. NetQuestion can index both plain text and text with HTML markup and provides CGI scripts and HTML forms for searching and administration.

AS/400 Web serving capabilities allow businesses, such as a shop, a service, or a distributor, to open an electronic storefront on the Web with WebSphere Commerce Suite V4.1 for AS/400. WebSphere Commerce Suite, which is a

replacement for Net.Commerce, provides a complete e-commerce solution from catalog and storefront creation to payment processing and integration with back-end systems.

2.12.3 Lotus Domino

Lotus Domino is the world's leading workflow, messaging, groupware, and Web software. Lotus Domino enables you to communicate with colleagues, collaborate in teams, and coordinate strategic business processes on and off the Web.

Domino for AS/400 is the Lotus Domino server product running on a 64-bit AS/400 RISC processor. It requires OS/400 Version 4 Release 2 or later. Domino for AS/400 provides all the functionality of the Lotus Domino server that runs on other platforms, and more. Domino for AS/400 includes integration between Lotus Domino databases and DB2 UDB for AS/400 databases. Both real-time and scheduled integration of databases are available to meet a variety of application needs.

Automatic synchronization between the Domino Public Address Book and the AS/400 System Distribution Directory provides a powerful, integrated mail server for organizations with multiple e-mail products, including OfficeVision/400, POP3, JustMail, and Internet mail.

The Lotus Enterprise Integrator option to synchronize authorizations between DB2 UDB for AS/400 databases and Domino databases is platform exclusive.

2.12.4 Business Intelligence solutions

Business Intelligence (BI) turns corporate data into decision support information. BI solutions have become much more affordable due to new innovations in software and hardware. One of these key technologies is data warehousing. Data warehouses provide the plumbing for BI applications and the advent of data warehouse technology and industry specific BI applications have made implementations meaningful and cost effective.

2.12.4.1 AS/400 enabling technology

The AS/400 system is the only hardware and software enabled for 64-bit relational database processing. This system has been optimized for a business intelligence environment with customized hardware (AS/400 servers) and optimized software (DB2 UDB for AS/400, SMP for DB2 UDB for AS/400, DB2 Multi-System, and Data Propagator Relational). These hardware and software functions combine to make a powerful business intelligence server, which is easy to install, manage, and use.

With the AS/400 system's open interfaces, hundreds of tools can be used to provide BI solutions accessing DB2 UDB for AS/400 data transparently. Such tools include desktop analysis tools, like Business Objects, and sophisticated multi-dimensional analysis (commonly referred to as OLAP) tools, such as Essbase/400, with no special programming required.

Symmetric Multiprocessing (SMP) for DB2 UDB for AS/400 provides parallel query processing. This allows multiple processors in a single AS/400 system to collectively work on a single query or one processor to work on multiple queries, which can improve query performance by as much as 400%. DB2 Multi-System support provides clustering for the AS/400 system and allows up to 32 AS/400

systems to be “clustered” together into a single system. This clustering provides almost unlimited scalability and unparalleled performance for AS/400 customers.

Data replication is an important technology to facilitate the automated loading of data warehouses while cleaning up or summarizing data for integrity and performance purposes. DataPropagator/400 provides asynchronous data movement between OLTP systems and Business Intelligence systems. Data Propagator allows fields to be summarized, derived, or aggregated into the data elements necessary in your data warehouse.

Data mining is a BI application that utilizes mathematical algorithms to scan potentially large amounts of data to find the golden nuggets of information. Intelligent Miner for AS/400 provides the most advanced data mining application for AS/400 customers. Intelligent Miner provides advanced computer models to “discover” data relationships previously unknown. The models include algorithms for clustering, information classification, predictions, associations, sequential pattern recognition, and time sequence patterns. This analysis provides executives with insight that truly can be a competitive advantage.

2.12.4.2 Business Intelligence tools and applications

Virtually every major BI tool is supported on the AS/400 system. That includes tools for moving and cleansing data, such as DataMirror and ETI Extract. It also includes tools for organizing data in a multi-dimensional and relational format, such as Essbase/400 and DataTracker, and multi-dimensional analysis tools like Analyzer, Business Objects, and Cognos Powerplay. These tools allow customers unlimited flexibility in building their own Business Intelligence applications. They also allow applications to use AS/400 data and non-AS/400 data.

While there are many technical advantages for using the AS/400 system for your Business Intelligence server, the overwhelming reason why customers use the AS/400 system is the combination of its power and simplicity. The AS/400 system provides a full range of tools, applications, and hardware on a single integrated platform, that help to make rapid implementation a reality. Large and small businesses alike agree. This is the ideal Business Intelligence server.

The AS/400 system provides outstanding database technology, which supports rapid access to large amounts of data. The AS/400 system supports a wide range of Business Intelligence solutions including small departmental applications and large Business Intelligence environments. The benefits of this application are measured by the better decisions that can be made as a result of having better information, and information in a format to support the decision-making processes of a company.

Chapter 3. File system and database

This chapter reviews the concepts and terminology of DB2 Universal Database for AS/400 (DB2 UDB for AS/400) and the Geac System 21 database file system.

3.1 DB2 UDB for AS/400: An overview

This section provides an overview of the major features of DB2 UDB for AS/400, the integrated database management system (DBMS) for the AS/400. A full description of the functions that are mentioned in this section can be found in several IBM manuals, including:

- *Distributed Data Management*, SC41-5307
- *DB2 for AS/400 SQL Programming Guide*, SC41-5611
- *DB2 for Database Programming*, SC41-5701
- *Data Management*, SC41-5710
- *DDS Reference*, SC41-5712

3.1.1 An integrated relational database

Integration has been one of the major elements of differentiation of the AS/400 platform in the information technology marketplace. The success of the AS/400 system indicates that integration is a clear advantage of this platform. Security, communications, data management, and backup and recovery have all been designed in an integrated way on the AS/400 system. These components are handled by OS/400 through control language (CL) commands.

Virtually all user data on the AS/400 system is stored in a relational database, and access to the database is implemented by the operating system itself. The relational database manages the location of all data files (tables), their access paths (views and indexes), and their fields (columns).

In the relational database, each file has a description that describes the file characteristics and how the data associated with the file is organized into records (rows). Using the Display File Description (DSPFD) command for a file, you can view information and statistics on the file. The fields within a file can also be displayed using the Display File Field Description (DSPFFD) command. Using the Display Data Base Relations (DSPDBR) command shows all logical files, including SQL views and indexes, for a physical file.

DB2 UDB for AS/400 is the part of the operating system that controls the storing and accessing of data by an application program. The data may be on internal storage (for example, a database), on external media (diskette, tape, optical), or on another system. Data management provides the functions that an application uses in creating and accessing data on the system. It also ensures the integrity of the data according to the definitions of the application.

Data management provides functions that allow you to manage files (create, change, override, or delete) using CL commands. The functions also allow you to create and access data through a set of operations (for example, read, write, open, or close). Data management also provides you with the ability to access external devices and control the use of their attributes for creating and accessing data.

3.1.2 File types

The data management functions support the following types of files:

- **Database files**: Files whose associated data is physically stored in the system.
- **Distributed data management (DDM) files**: Files that allow access to data files stored on remote systems.
- **Intersystem communications function (OS/400-ICF) files** (hereafter referred to as ICF files): Allow a program on one system to communicate with a program on the same system or another system.
- **Save files**: Files that are used to store compressed data on disk (without requiring diskettes or tapes).
- **Device files**: Files that provide access to externally attached devices, such as displays, printers, tapes, diskettes, and other systems, that are attached by a communications line. The device files supported are display, printer, tape, and diskette files.

Each file type has its own set of unique characteristics that determine how the file can be used and what capabilities it can provide. However, the concept of a file is the same regardless of what type of file it is. When a file is used by a program, it is referred to by name, which identifies both the file description and, for some file types, the data itself.

A file can be used in many ways on the AS/400 system. For example, it can be accessed through a high-level language such as COBOL, RPG, C, or by CL. One other way, which is becoming the standard in the computing industry, is through SQL.

3.1.3 DB2 UDB for AS/400 basics

As we already mentioned, the major distinguishing characteristic of the AS/400 database manager is that it is part of the operating system. In practice, this means that the majority of your AS/400 data is stored in the relational database. Not only is your relational data stored in the database, but also non-relational information such as source physical files, which store source files for application programs.

3.1.3.1 Physical files

Data on the AS/400 system is stored in objects called *physical files*. Physical files consist of a set of records with a predefined layout. Defining the record layout means that you define the data structure of the physical file in terms of the length and the type of data fields that make up the layout.

These definitions can be made through the native data definition language of DB2 UDB for AS/400, called *Data Description Specifications* (DDS). If you are familiar with other relational database platforms, you are aware that the most common way to define the structure of a relational database is by using the data definition statements provided by the *Structured Query Language* (SQL). This is also possible on the AS/400 system. The SQL terminology can be mapped to the native DB2 UDB for AS/400 terminology for relational objects as shown in Table 1.

3.1.3.2 Logical files

Through the use of DDS, you can define logical files on your physical files. Logical files provide a different view of the physical data, allowing column subsetting, record selection, and the joining of multiple database files. They can also provide the physical files with an access path when you define a *keyed logical file*. Access paths can be used by application programs to access records directly by key or sequentially in a predefined order. Keyed logical files can also be used for ensuring the uniqueness of records in a file.

Table 1. DB2 UDB for AS/400 and SQL terminology mapping

DB2 UDB for AS/400 term	SQL term
Physical file	Table
Join and union logical files	View
Keyed logical files	Index
Record	Row
Field	Column
Library	Collection

3.1.3.3 DB2 UDB for AS/400 in a distributed environment

It is becoming more and more common for companies and businesses to organize their computing environment in a distributed way. The need to access remote data is constantly growing, DB2 UDB for AS/400 provides several options for operating with remote platforms.

The *Distributed Data Management* architecture (DDM) is the basis for distributed file access. You can created a DDM file on your AS/400 system and have it direct your data access requests to a remote database file. This remote file can be another DB2 UDB for AS/400 database file or a CICS managed data file residing on a host platform. Only native data access is allowed for DDM files.

The AS/400 system provides several other interfaces for client platforms to access DB2 UDB for AS/400 data. Client Access Express is a rich product that allows broad interoperability between a PC client and the AS/400 system. For database access, Client Access Express provides the PC user with:

- A sophisticated file transfer function that allows subsetting rows and columns.
- Remote SQL APIs that you can embed in your PC programs to access data stored in DB2 UDB for AS/400 files.
- An ODBC interface to DB2 UDB for AS/400 data that allows applications that use this protocol to access the AS/400 database.

3.1.4 AS/400 database catalog

This section describes the views contained in a DB2 for AS/400 catalog. The database manager maintains a set of tables containing information about the data in the database. These tables are collectively known as the catalog. The catalog tables contain information about tables, parameters, procedures, packages, views, indexes, and constraints on the AS/400 system. Table 2 on page 46 shows a subset of catalog tables and their purpose. All catalog tables are kept in the QSYS library.

Table 2. DB2 UDB for AS/400 catalog table names for physical and logical files

Catalog table name	Purpose
QADBXREF	Cross reference of all files by name and library
QADBFDEP	Logical file dependencies
QADBIFLD	Cross reference of all fields by file and library
QADBKFLD	Access path definitions for all logical files by field, file, and library name

3.1.5 Helpful AS/400 database commands

Table 3 shows some AS/400 commands to help locate and display database file attributes. With all commands, type the command name in the AS/400 command line and press the F4 key to display a list of input parameters.

Table 3. AS/400 database commands

Command	Purpose
DSPOBJD	Find objects; display their description
DSPFD	Display the attributes of a file
DSPDBR	Display all logical files of a physical file
DSPFFD	Display the list of fields in a file
DSPPGMREF	Display the list of files, called programs, and data areas used by a program.

3.2 System 21 database

The System 21 database consists primarily of physical and logical files stored on a single file server—the AS/400 server. To access the database for reporting and performance tuning, it is import to understand how the database is implemented on the AS/400 system.

For businesses with multiple legal identities or companies, the database is designed to support the separation of information with a two-character company code field in the majority of System 21 files. System support files do not require a company code. This company code field is generally the first field used to define access paths to the physical file.

3.2.1 Files

This section describes the naming convention and the characteristics of physical and logical files.

3.2.1.1 Naming conventions

The naming convention used for physical files is a four-part nomenclature as illustrated in Figure 21.

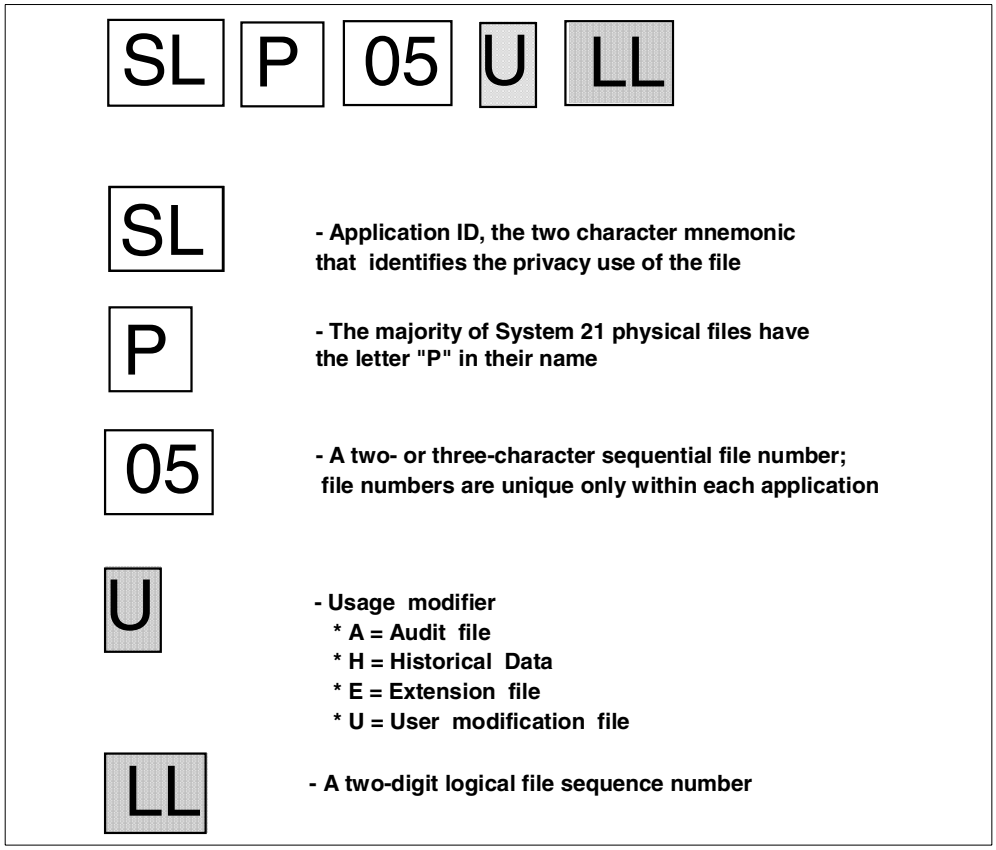

Figure 21. File naming convention

In this example, the customer master file, SLP05 is used. The audit file for SLP05 is called SLP05A.

The majority of System 21 physical files follow this standard. The exceptions are:

- Files used to interface with other business partner applications
- Job Management application, which does not use the letter “P” and uses JM, and not JC, for the application ID
- General Ledger application, which uses FL, and not GL, for the application ID
- Service Management application, which uses SS, and not S2, for the application ID
- Other work files
- Application Manager files
- EDI files

The naming convention for logical files varies. An old standard uses a descriptive name, for example, CUSNAMES. The current standards use the letter “L” for the usage code and a two-digit sequence number on the end, for example, SLP05L01.

3.2.1.2 Physical files

Generally, System 21 physical file are non-keyed files. This means that the file definition does not identify any one field in the file as the primary access path to

the records. All access paths are defined with logical files (see the following section on logical files).

Apart from the layout definition of the files, several file attributes are assigned when the file is created. These file attributes further define how the file is used and maintained by the system. Table 4 shows the most significant settings used to create System 21 physical flies.

Table 4. Physical file attributes

Attribute	Value
Maximum number of members	1
Member size	*NOMAX
Allocate storage	*NO
Contiguous storage	*NO
Records to force a write	*NONE
Share open data path	*NO
Max% deleted records allowed	*NONE
Reuse deleted records	*NO
Record format level check	*YES

3.2.1.3 Logical files

Logical files are used to define keyed access paths to physical files to support application programs. Table 5 shows the most significant settings used to create System 21 logical files.

Table 5. Logical file attributes

Attribute	Value
Maximum number of members	1
Access path size	*MAX4GB
Access path maintenance	*IMMED
Force keyed access path	*NO
Records to force a write	*NONE
Share open data path	*NO
Record format level check	*YES

To determine existing logical file dependencies over a physical file, use the AS/400 `DSPDBR` command. To determine the physical file link over logical file, use the AS/400 `DSPFD` command.

3.2.2 System 21 file types

The objective of the System 21 database is to find a balance between performance and the reduction of redundant data. For those who are familiar with the process of database *normalization,* understand the process taken to achieve *Third Normal Form* relational databases. Most System 21 files conform to the set

of rules for a third normal form. However, for performance reasons, some redundant data fields exist in the design.

In the normalization process, specific file types have been defined:

- Master files
- Balance files
- Transaction files
- Special files

These file types are described in the following sections.

3.2.2.1 Master files

Master files store static information and depend on a primary key. Examples of typical master files are:

- Company profiles
- Item master
- Customer address master
- Manufacturing routes and structures
- Chart of accounts

3.2.2.2 Balance files

There are a number of files that store balance information as an extension to master files. The balance record may have a one-to-many relationship with the master record or a many-to-one relationship.

An example of a one-to-may relationship is the *Customer Account Summary Balance* file. Here a single record stores the current balance information for all like *Customer Address Master* records. An example of a many-to-one relationship is the *Customer Period Balance* file. Here the balance file stores individual period balances for each *Customer Account Summary Balance* record.

Here are some other examples of balance files:

- Stockroom balance file
- A/R item master
- Supplier account balances
- A/P item master
- G/L account balances
- WIP inventory balances

3.2.2.3 Transaction files

Transaction files record transactions that are used for detail reporting and analysis. Transaction files support the information found in the balance files. Examples are:

- Inventory movements
- Sales orders
- A/R transaction details
- General Ledger journal entries
- Purchaser receipts

3.2.2.4 Special files

Two additional file types exist to support the application but are not part of the normalization process. They are audit files and work files.

Audit files
Audit files are used to keep track of changes to key application files. The audit file records the user ID of the user who added, updated, or deleted the record with a date and time stamp. The audit file stores a before and after snapshot of the record that can later be used by a program to compare each field of the before and after record to determine what was changed. If a record has an after record without a before record, the record was added. If a record has a before record without an after record, the record was deleted. This is very useful when you want to see when a record was changed by the system. This approach is true for most master files as well as some transaction files such as sales order files.

Users need to monitor these files to prevent them from becoming too large and using up too much disk resource. We recommend that you period purge after you print appropriate audit reports. For more details, see 6.6, “Archive and purging” on page 175.

Work files
A number of other database files are work files, used by both interactive and batch programs. Generally the key to these files is a job number taken from the LDA field L#JOBN. The naming convention for work files follows the naming standard for application files with a sequential designator ranging from WA to WZ, for example, OEPWA and OEPWB.

Extension files
Extension files are created to extend the database of a master file without changing the record layout of that master file. The primary access path to the master file is duplicated in the extension file making the access to both files the same.

Runtime files
Runtime files are created when a particular function is executed. These runtime files are subsequently deleted when the function finished. The source for runtime files is stored in source files called INRUNTIME.

3.2.3 Fields

The naming convention used for System 21 field names is described in Figure 22.

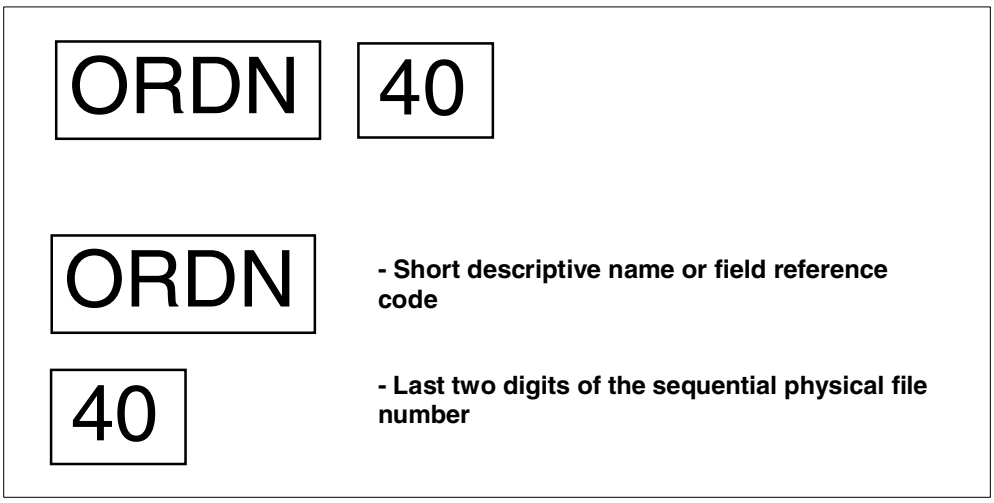

Figure 22. Field naming convention

In this example, the field name for *Order Number* ORDN40, from the Order Header file OEP40, is used. ORDN is the field reference code for Order Number and is used when defining the same field in other files.

Most applications have their own field reference file. A field reference file is a database file that contains a list of all the short field names used by an application to define database files, display files, and printer files. These field reference files may by used when designing your own interfaces and applications. The naming convention for field reference files is *AA*REF, where *AA* is the same application ID used to define physical files.

Two points to note about field names:

- Not all applications use the same field reference code to describe the same field. For example, in the OE application item, number fields are referenced by the name CATN, while in the IN application, they are referenced by the name PNUM.
- Many of the General Ledger files contain fields with only the field reference name and without the two character file number. When writing your own reports, be sure to qualify the duplicate field names with the source file name. For example, in files FLP007 and FLP008, the four field names that logically link these two files together are named CONO, TXSRCE, TT, and DOCREF in both files. In addition, the field names do not always follow the four-character field reference naming rule.

3.2.4 Frequently used System 21 database commands

Table 6 illustrates a list of System 21 database commands that are available on all AS/400 System 21 installations. These commands are located in the OSLSYS library. You can list the installed commands using the `TOOLS` command.

Table 6. System 21 database commands

Command	Purpose
DLTDEP	Delete all logical files of a physical file
DLTOBJ	Delete an object
DSPDEP	Display all logical files of a physical file
DSPFLD	Display a file's layout
DSPKEY	Display a file's access path
DSPLIBDEP	Display library dependencies where physical and logical files are kept in separate libraries
PRTDBR	Print the database relationship of all files in a single library
PRTFLD	Print a file's layout
PRTLIB	List all objects in a library sorted by three user-selected fields

3.3 System 21 library system

The System 21 product consists of many application modules. Each application module is controlled by a two character mnemonic. Each application is supported by two or more application libraries, which store the application programs, display

files, printer files, data files, and so on. The following section describes how these libraries are used.

3.3.1 Application libraries

The System 21 application code is the basis for many of the naming standards used in its development. This section provides an overview of the library naming convention.

Libraries are the key organization mechanism used to distribute and organize the software. Geac uses the naming convention illustrated in Figure 23 for their application libraries.

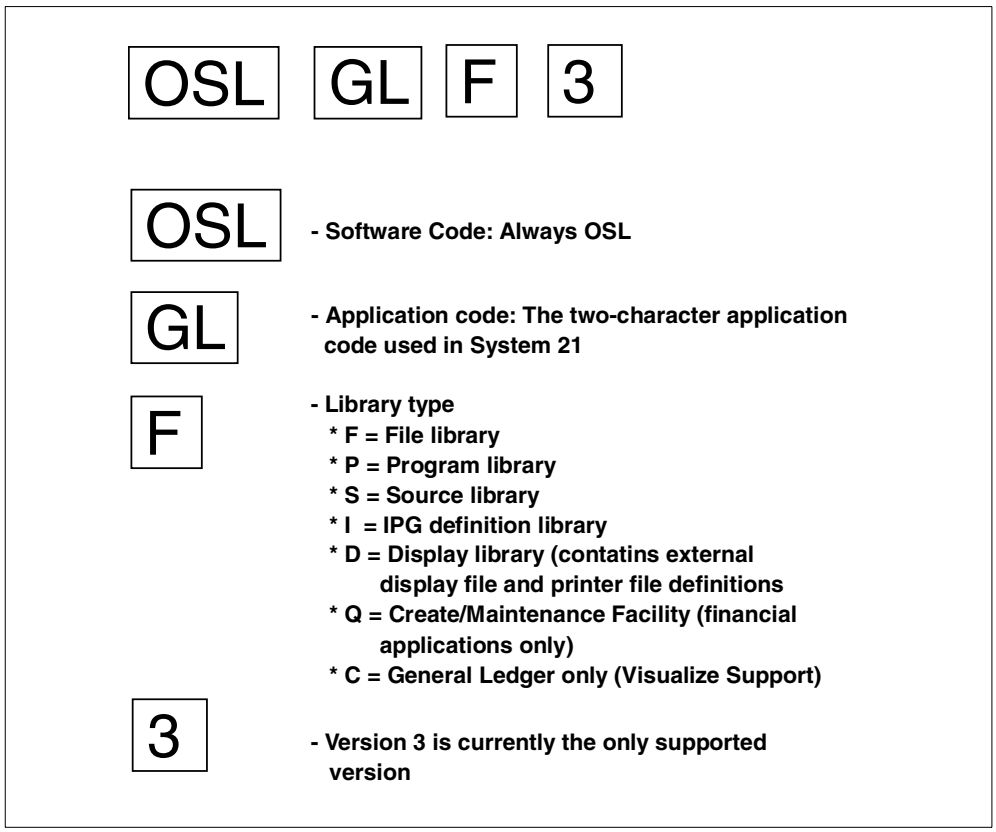

Figure 23. Application naming convention

The list of application libraries is extensive. For a complete list, review your installation documentation or type the following command on the AS/400 command line.

```
DSPOBJD OBJ(QSYS/OSL*) OBJTYPE(*LIB) OUTPUT(*PRINT)
```

3.3.2 Library consolidation

Each application is designed to have a separate library for program objects, display and printer files, source code, and data files. In some cases, some of the objects have been consolidated into a single library:

- All distribution file libraries have been combined into two libraries: OSLD1F3 and OSLD2F3.

OSLD1F3 contains the application files for applications: AO, OE, IN, PM, SA, and CN.

OSLD2F3 contains the application files for applications: AI, AC, AG, AS, CR, DR, DY, FC, TP, TS, US, VS, WH, and WT.

- All manufacturing application files are found in OSLPDF3.
- All program object libraries have been consolidated with the display libraries for all financial applications: SL, PL, GL, FI, RW, and CS. System 21 application code is the basis for many of the naming standards used in its development.

In all cases, the static objects (programs, display files, and printer files) are always separated from file objects.

3.3.3 @ctive Enterprise Framework libraries

All System 21 applications are executed by Application Manager, one of the System 21 @ctive Enterprise Framework modules. Table 7 contains a list of libraries that make up the @ctive Enterprise Framework.

Table 7. @ctive Enterprise Framework application libraries

Library name	Description
IPGAMD4	Application Manager DSPF Library
IPGAMF4	Application Manager Files Library
IPGAMP4	Application Manager Program Library
IPGCFD4	Common Functions DSPF Library
IPGCFF4	Common Functions Files Library
IPGCFP4	Common Functions Programs Library
IPGCID4	Common Interface PGM/DSPF Library
IPGCIF4	Common Interface Files Library
IPGHKD4	Housekeeping DSPF Library
IPGHKF4	Housekeeping Files Library
IPGHKP4	Housekeeping Programs Library
IPGMMD4	Machine Manager DSPF Library
IPGMMF4	Machine Manager Files Library
IPGMMP4	Machine Manager Program Library
IPGNWD4	Network Manager DSPF Library
IPGNWF4	Network Manager Files Library
IPGNWP4	Network Manager Program Library

3.3.4 IPG libraries

The IPG libraries are libraries with the “I” library type. They contain files that are used by application tasks written by either the Interactive Program Generator (IPG) or by the Interactive Report Generator (IRG). IPG and IRG are

programming tools, which Geac has used to create some of the application programs. When a program is written with one of these tools, the IPG library for the application must be in the library list used to execute the task.

3.4 Locks

The locking of objects is a fundamental practice in all software systems. Locking an object ensures that no other operation can change that object until the operation that has the locked object completes and releases the lock. The system does this to ensure that multiple users do not use the object in conflicting ways. The type of lock varies based on the type of operation performed on the object.

For example, the AS/400 system does not allow you to delete a file while an application program is using it. The system does this by placing a lock on the file when it opens. The delete file operation also attempts to obtain a lock on the file and is unsuccessful because the program using the file still has the lock from when the file was opened, and the locks conflict. These automatic locks occur throughout the system.

The different types of object locks on AS/400 system are:

- **Exclusive lock (*EXCL)**: The object is allocated for the exclusive use of the requesting job; no other job can use the object.
- **Exclusive lock, allow read (*EXCLRD)**: The object is allocated to the job that requested it, but other jobs can read the object.
- **Shared lock, allow read and update (*SHRUPD)**: The object can be shared either for read or change with other jobs.
- **Shared lock, read only (*SHRNUPD)**: The object can be shared for read with other jobs.
- **Shared lock (*SHRRD)**: The object can be shared with another job if the job does not request exclusive use of the object.

Optionally, you can apply a manual lock with the Allocate Object (ALCOBJ) command.

3.4.1 Record locks

The AS/400 database has built-in integrity for records. For example, if program A reads a database record for update, it locks that record. Another program may not read the same record for update until program A releases the record, but another program could read the record just for inquiry. This way, the system ensures the integrity of the database.

The system determines the lock condition based on the type of file processing specified in your program and the operation requested. For example, if your open options include update or delete, each record read is locked so that any number of users can read the record at the same time, but only one user can update the record.

The system normally waits a specific number of seconds for a locked record to be released before it sends your program a message that it cannot access the record you are requesting. The default record wait time is 60 seconds. However, you can set your own wait time through the WAITRCD parameter on the Create,

Change File, and Override Database file commands. If your program is notified that the record it wants is locked by another operation, you can have your program take the appropriate action. For example, you could send a message to the operator that the requested record is currently unavailable.

The system automatically releases a lock when the locked record is updated or deleted. However, you can release record locks without updating the record.

System 21 does not use the database management system (DBMS) record locking facility. System 21 implements a record locking methodology described in 3.4.2, “System 21 application record locks” on page 55.

Note

Using commitment control changes the record locking rules. See *Backup and Recovery,* SC41-5304, for more information on commitment control and its affect on record locking rules. System 21 does not use commitment control.

3.4.2 System 21 application record locks

When a master file record or a set of transaction records is maintained by a user, or by the system, records are “locked” to prevent maintenance by other users or programs. This lock is not the same type of lock performed by the AS/400 system when a program updates a database file record. The record locks performed by System 21 are soft locks because the physical record is not locked using the DBMS. Normally, DBMS locks apply for a short period of time during reads and updates, but not for the period of time in which the record is being maintained. The record is marked as being in use by a user and is not available for maintenance.

There are two methods used to mark records that are in use. These methods are described in the following sections.

3.4.2.1 Application file record locking fields

This method uses a database field within the file’s record layout to mark the record when it is being used. When a program first reads the record into the program, a non-blank character (usually the letter A) is moved into the field and the record is updated. Other maintenance programs check first if the record is available for update by comparing this field for blanks. When the maintenance is completed, the field is set back to blanks. This method is commonly used with master files and group files that consist of a header and detail files, such as Sales orders and Purchase orders. The header record is marked, which tells other applications that all records related to this particular record are also locked from maintenance. Table 8 lists the most common application files that use this method.

Table 8. Application file record locking fields

Application file	File name	Locked record status filed
Sales Order Header	OEP40	ACTF40
Inventory Item Master	INP35	ACTF35
Purchaser Order Header	PMP02	ACTF02

Application file	File name	Locked record status filed
Customer Master	SLP05	INUS05
Supplier Master	PLP05	INUS05
Item Stockroom Profile	INP60	STAT60

3.4.2.2 Record locking control files

The second method uses record locking control files to note when a record is in use. Records in these files contain information on records in other files that are currently in use by application programs. Typically, the locking control file contains the following details: the name of the physical file name or a code, the company code, the user ID of the person executing the job, the date and time the lock was started, and the full key of the record being maintained. This is the most common method of record locking used by System 21.

As an example, an inventory item master record is maintained by a user. The program first verifies whether the item number exists in the record locking control file INP99. If it does not exist, the program writes a record to INP99 as shown in Figure 24. When maintenance is completed, the record is deleted from the control file after the master file record has been updated.

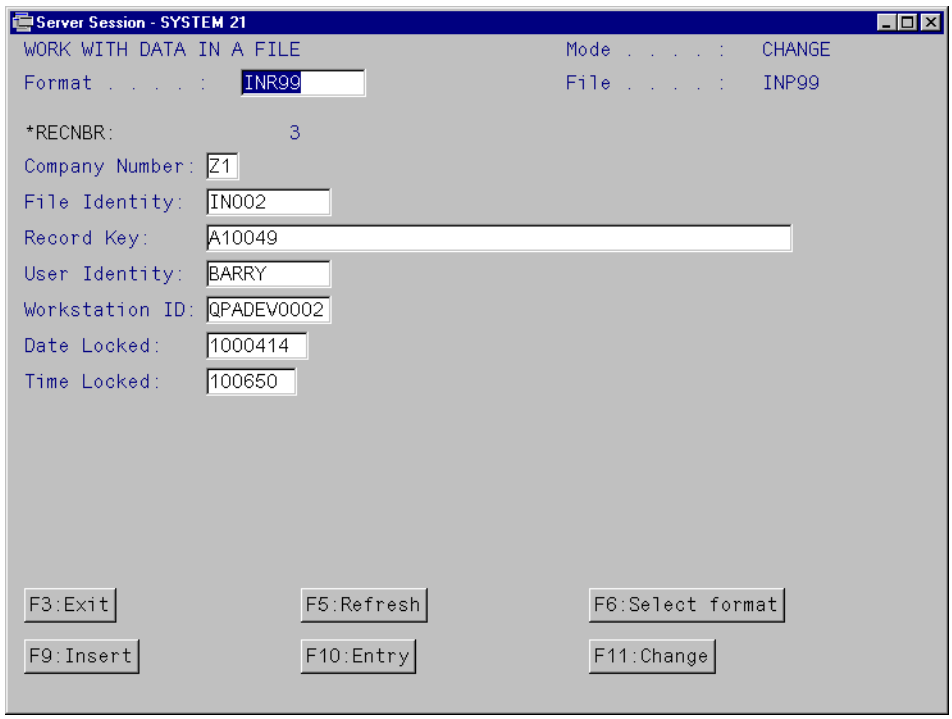

Figure 24. INP99 record locking control file

Table 9 lists the record locking control files used by each application.

Table 9. Record locking control files

Application	Record locking control files used
Accounts Payable	PLP99
Accounts Receivable	SLP99

Application	Record locking control files used
Advance Order Entry	INP99
Advance Receiving	INP99
Advance Shipping	PMP99
AFI	FIP99
Capacity Planning	MPS99
Cash Management	CSP99
Configurator	CNP99
Customer Returns	CRP99
Document Processing	DYP99
DRP	DRP99
EDI	AIP99
Financial Manager	RWP99
Forecasting	FCP99
Forecasting	SAP93
General Ledger	FLP099
Inventory Management	INP99
Master Production Scheduling	MPS99
Material Requirement Planning	MSP99
Product Data Management	CHP99
Purchase Management	PMP99
Requisitioning	PMP99
Sales Analysis	SAP93
Sales Order Processing	INP99
Service Management	SSP99
Transport Planning	INP99
Vendor Scheduling	INP99 and PMP99
Warehousing	WHP99 and INP99
World Trade	WTP99
Enterprise Work Management	WFP99

3.4.3 System 21 Application Manager locks

Some application functions require special exclusivity rights to run them. These may be application specific (across one or more applications) or company specific. Each time a new task is launched, it checks the exclusivity requirement of the task. If the task requires exclusive company use, no other jobs in the system using the same company in the same application module can be active. If

a job is found, the new task cannot be launched. When an application task is launched, a record is written to APG01PHY and APG02PHY files. These files are used to track which application tasks and companies are in use.

The available exclusivity codes are:

- **Blank**—Share company
- **C**—Exclusive company use
- **S**—Exclusive system use
- **1-9**—Share classes

Share class enables you to specify tasks that can be run concurrently and those that cannot.

If a task requires company or system exclusivity across multiple applications, an Exclusivity Group number is assigned to the task. Exclusivity Groups are predefined lists of applications grouped together for the purpose of checking exclusivity across multiple applications. See the *Application Manager Guide* for more information on maintaining Exclusivity Groups.

An illustration of the different share classes and the use of Exclusivity Groups is shown in Figure 25.

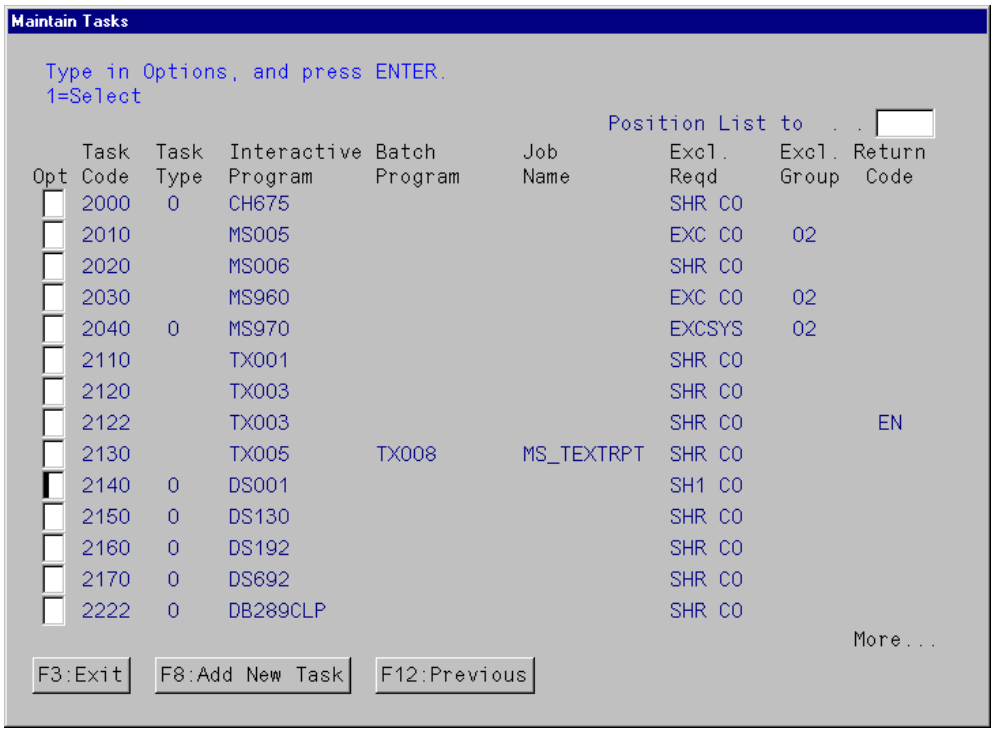

Figure 25. Task code maintenance panel

When the tasks finish, the record in APG02PHY is updated as complete. If an error occurs during the execution of the program, the application lock is not removed.

3.4.4 Clearing locks

Clearing locks is an internal support function that should be centrally controlled by the internal support group. Because it requires the use of database

maintenance utilities, that requires a technical background, the responsibility of clearing locks should not be given to the user community.

3.4.4.1 Clearing application record locks

Whenever there is a program failure, the soft record locks described in 3.4.2, “System 21 application record locks” on page 55, remain intact. To clear the lock you must edit the appropriate file using a database utility program. For example, Data File Utility (DFU) can be used to update record in-use flags and delete records from locking control files.

3.4.4.2 Clearing Application Manager locks

In addition to the application record lock, you must clear the Application Manager lock. We recommend that you do this task daily.

To remove application locks for batch and completed interactive jobs, run *Verify Allocations* by performing the following steps:

1. Start Application Manager by entering the `STRIPGAM` command.
2. Select option **7** (Utilities).
3. Select option **4** (Verify allocations).

To remove an application lock for an aborted interactive job, you must release the lock through the Active Jobs inquiry in Application Manager by performing the following steps:

1. Start Application Manager with the command `STRIPGAM`.
2. Select option **5** (Operational Enquiries).
3. Select option **2** (Active Jobs).
4. Find the failed job. Page through the list of active jobs until you see the list of active jobs under the application code where the failure occurred. Find the job by user and terminal.
5. Select the job to be de-allocated.
6. Click **De-Allocate** or press F13.
7. Click **Refresh** or press F5 to see that the job is no longer on the active job enquiry screen.

3.5 System 21 Technical Reference

The Technical Reference is a database that provides a complete cross-reference of server application programs, databases, activities, and menus for Geac System 21 applications. It is designed for you to explore, in detail, the technical structure of the System 21 product.

Technical Reference is primarily intended for designers who want to perform an impact analysis. For example, you might want to use an existing field in the Item Master File and know all the programs that use this file. You could use Technical Reference to find out the names of all the programs that use the Item Master File. A sample of such an inquiry is shown in Figure 26 on page 60.

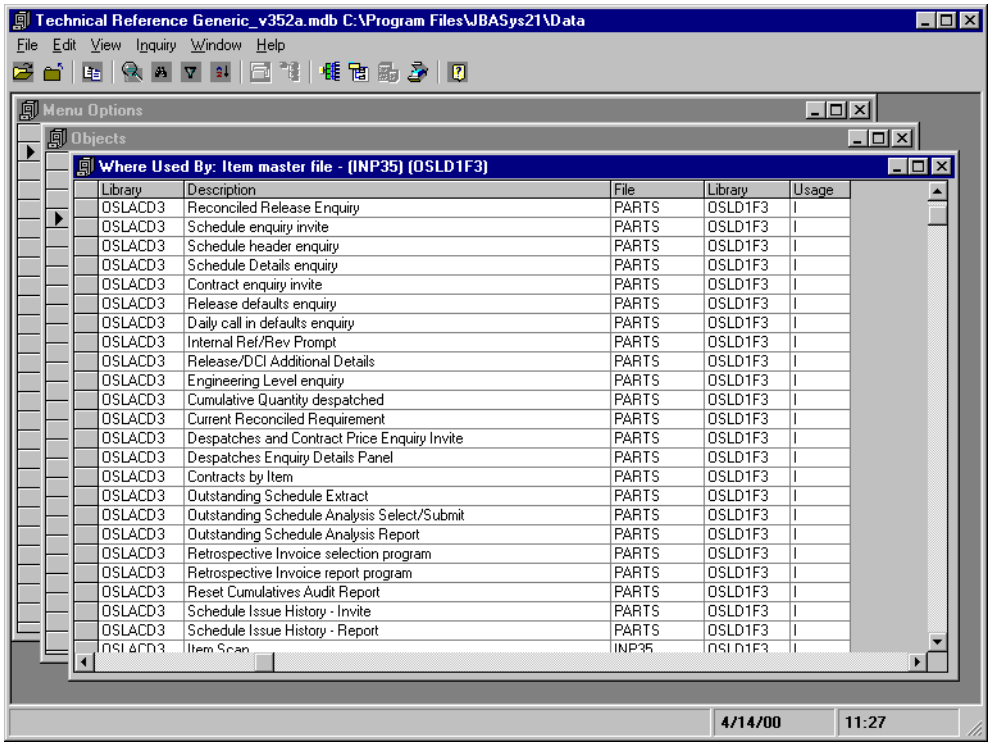

Figure 26. System 21 Technical Reference database

To access Technical Reference from your PC, click **Start->Programs->JBA System21->JBA Technical Reference**. You can navigate freely in Technical Reference and make inquiries of numerous logical levels.

You can copy information from the Technical Reference database to your clipboard, but you cannot update the database in any way.

For installation instructions, see Chapter 5, “Installation and set up” on page 87.

3.6 System 21 knowledgebase for Business Intelligence

The purpose of this meta data is to enable users of Business Intelligence software to implement the products and write queries and reports over the Geac System 21 database with only a minimal amount of technical database knowledge. The knowlegebases are built to include the most commonly used data files with established file links over the normalized database. Therefore, when you create a sales order report, for example, information such as customer name and item description are automatically linked by the customer number and item number. The knowledgebase and the Business Intelligence tools reside on the client PC and interact with the database manager on the AS/400 server.

Included with the metadata layers are sample reports that illustrate various areas within each product, which are designed for general use to all customers. However, you may want to modify these reports to tailor them to your specific requirements.

The metadata layers are provided as a plug-and-play solution so that users can instantly start writing reports and retrieving data from the System 21 database. It

is assumed, that these metadata layers are starters (albeit significant starters), which customers can build upon and develop further. This can include adding other areas of System 21 not currently available and databases from custom and third-party applications.

3.7 Key application database files

For pre-conversion planning and ad hoc reporting, this section provides a quick list of the common system and application database files used by System 21.

Attention

Be aware that some columns or fields in the databases listed below may not be used as described by their attributes. Some fields maybe obsolete and no longer used, used for other purposes, or reserved for future development. Therefore, when developing reports or other programs, it is important that you verify the source of all data elements being used. See 3.5, “System 21 Technical Reference” on page 59, for additional information.

3.7.1 Application Manager

Table 10 provides you with a list of key files used by Application Manager.

Table 10. Key Application Manager files

File name	Library	Description
APG01PHY	IPGAMF4	Application allocation transactions
APG02PHY	IPGAMF4	Application function allocating
APG05PHY	IPGCFF4	User Profile definition
APG11PHY	IPGAMF4	System defaults
APG13PHY	IPGAMF4	Company definition
APG15PHY	IPGAMF4	User company authorizations
APG24PHY	IPGAMF4	Version-to-version library mapping
APG25PHY	IPGCFF4	Library list details
APG26PHY	IPGCFF4	Library list header
APG30PHY	IPGAMF4	User function authorizations
APG35PHY	IPGAMF4	Application task definitions
APG45PHY	IPGAMF4	Application files re-organization file
APG55PHY	IPGAMF4	User menu option authorizations
APG60PHY	IPGAMF4	Company dependency
APG70PHY	IPGAMF4	User function overrides
APGAPPHY	IPGCFF4	Application definitions
ICFPGTMP	IPGCFF4	Profile groups

3.7.2 Applications

Table 11 provides a list of key files used by application modules.

Table 11. Key application files

File name	Library	Description
FLP003	OSLGLF3	General ledger chart of accounts
FLP004	OSLGLF3	General ledger period balances
FLP007	OSLGLF3	General ledger journal header
FLP008	OSLGLF3	General ledger journal detail - Debits and credit details for journal header
FLP055	OSLGLF3	Period budgets
FLP083	OSLGLF3	Currency description
FLPUK2	OSLGLF3	VAT basic details
INP35	OSLD1F3	Inventory item master
INP56	OSLD1F3	Inventory pick note header
INP57	OSLD1F3	Inventory pick note details
INP60	OSLD1F3	Item stockroom balance profile - Tracks balance and availability of items
INP65	OSLD1F3	Inventory kits lists
INP80	OSLD1F3	Item Lot/Batch/Serial No. control - Tracks balance and availability of Lot/Batch/Serial No. items
INP90	OSLD1F3	Item stockroom weekly history - A weekly summary of item transactions
INP95	OSLD1F3	Stock movement transaction details
MSP04	OSLPDF3	Production item master - Planning and manufacturing details for inventory item master records
MSP20	OSLPDF3	Manufacturing routing and BOM header
MSP24	OSLPDF3	Manufacturing routing details
MSP28	OSLPDF3	Manufacturing component details - BOM details at each routing step
OEP40	OSLD1F3	Sales Order Header - Sales order header details
OEP50	OSLD1F3	Sales order and invoice charges - Additional charge details organized by order and invoice number by charge sequence number; sequence number 01 through 03 for order charges and 41 through 43 for invoice charges
OEP55	OSLD1F3	Sales order details - Sales order details organized by order line number

File name	Library	Description
OEP65	OSLD1F3	Invoice Header - Sales invoice header details.
OEP70	OSLD1F3	Invoice detail - Sales invoice line details organized by order and order line number
PLP05	OSLPLF3	Supplier master - A/P control account records and ship-from addresses
PLP06	OSLPLF3	Supplier current A/P balance
PLP10	OSLPLF3	Supplier period A/P balances
PLP15	OSLPLF3	AP item details
PLP45	OSLPLF3	Supplier payment details - Payments made both automatic and manual
PLP50	OSLPLF3	Item payment details
PMP01	OSLD1F3	Supplier item details
PMP02	OSLD1F3	Purchase order header
PMP03	OSLD1F3	Purchase order lines
PMP09	OSLD1F3	Purchase receipt transactions
PMP17	OSLD1F3	Purchase requisitions
SLP05	OSLSLF3	Customer master - AR account control records and customer ship-to and invoice-to address file
SLP06	OSLSLF3	Customer current AR balance
SLP10	OSLSLF3	Customer period balances
SLP15	OSLSLF3	AR item details

Part 2. Implementation basics

This part describes the implementation tasks and techniques necessary to install and properly set up System 21 on the AS/400 system. All System 21-AS/400 customers will benefit from reading about the topics described in this part. It contains these chapters:

- Chapter 4, “Sizing System 21 on the AS/400 system” on page 67, discusses the System 21 sizing process and how it accommodates a customer’s business and workload requirements.
- Chapter 5, “Installation and set up” on page 87, outlines the steps required to install and setup System 21.
- Chapter 6, “Operations” on page 143, covers System 21 maintenance routines such as period end updates, purging and archiving of historical data, and applying PTFs.
- Chapter 7, “Security” on page 209, describes basic AS/400 security concepts and offers recommendations on how to set up System 21 security.
- Chapter 8, “Printing” on page 231, provides an overview of AS/400 printing and printing setup in the System 21 environment.
- Chapter 9, “Backup and recovery” on page 251 covers backup and recovery policies and tasks.

Chapter 4. Sizing System 21 on the AS/400 system

Determining the correct configuration for a System 21 implementation in terms of the AS/400 model, processor feature, main storage, disk arms (and capacity), and configuration design is a complex task. Each configuration must be established based on individual customer requirements. Experience has shown that while two customers may use the same System 21 modules, their implementation and usage may be entirely different.

All recommendations discussed in this chapter assume that System 21 is the only product implemented on the AS/400 platform. The implementation of third-party products may substantially impact the nature and complexity of the sizing.

4.1 Introduction

So, why do we need a sizing process?

System 21 currently supports an extensive range of application modules, which are detailed in Appendix B, “System 21 products and dependencies” on page 561. Each module is capable of processing an array of business transactions that generate an AS/400 transaction workload.

Configuration and usage of the modules can have a substantial impact on sizing. Using specific features can substantially increase or decrease the interactive/batch workload components.

The nature and composition of the transaction workload can also vary substantially by module. Applications, such as Telesales, are primarily interactive in nature. Conversely Warehousing is fundamentally a batch-based application.

Recently, the use of Business Intelligence tools introduced an additional workload component. The ability for users to generate “ad-hoc” reports from their workstation has resulted in a substantial file serving workload.

Accommodating key customer business requirements can impact the size of a system. For example, processing 20,000 EDI orders daily between 7:00 a.m. and 8:00 a.m. may require a specific system configuration. These are “critical success factors”, which the system needs to achieve for the implementation to succeed.

Business transaction profiles also influence system sizing. A company that processes 80% of its annual order throughput in one month will require a different configuration than one that has a uniform order profile for the whole year. The same concept can also be applied to daily and weekly order profiles.

The following sections review how the System 21 sizing process tries to accommodate customer-specific business and workload requirements.

4.2 AS/400 architecture

AS/400 Advanced Servers and AS/400e servers are intended for use primarily in client/server or other non-interactive work environments. 5250-based interactive work can be run on these servers, but with limitations.

The underlying performance structure of the AS/400e custom servers is the same as that of the AS/400 Advanced Servers and the AS/400e servers. AS/400e custom servers are designed to provide optimally balanced performance in non-interactive and interactive environments as required by specific ISV software.

The primary environment addressed is one that runs significant interactive 5250 applications and is migrating toward a client/server “graphical” version of 5250 applications, as well as new client/server applications. Depending on the interactive feature installed, the new Model 8xx servers are designed for non-interactive work and a variable amount of 5250-based interactive activity.

Note

For the purpose of this discussion, “AS/400 architecture” refers to the Model 270 and 8xx series that run OS/400 V4R5.

4.2.1 AS/400 server model behavior

The following section reviews how the AS/400e servers handle transaction throughput in a mixed workload environment.

4.2.1.1 Overview

The AS/400e servers are intended for use in a mixed workload environment that supports client/server applications and varying levels of a traditional interactive workload.

The server models are designed to provide balanced capacity and performance for a combined interactive and client/server workload.

Important

In the context of this review, the term *client/server* refers to any workload not classified as traditional interactive.

4.2.1.2 AS/400e server 270

The AS/400e server 270 models provide improved processor performance. Each model is supported with a base feature code (no interactive workload capability) and an interactive feature code. While the interactive capability of the Model 270 has not improved on the capability offered by the Model 170, the client/server capacity has increased substantially.

With earlier models, system overhead began to affect the overall capacity of the system when interactive utilization exceeded one-third of the total interactive capacity. With the second generation 170 models, the system overhead did not occur until the published interactive capacity was exceeded. This allowed the 170 models to operate more smoothly in interactive and mixed environments. The *maximum* interactive throughput on the 170 models could be determined by multiplying the interactive Commercial Processing Workload (CPW) figure by a factor of seven-sixths. At this point, no system resources were available to support a client/server workload.

The maximum interactive capacity supported on the 270 models is determined in the same manner. However, the client/server capacity is no longer reduced to zero when the published interactive CPW rating is exceeded.

4.2.1.3 AS/400e 8xx models

The AS/400e 8xx models can be configured to meet a wide range of performance requirements. The system runs mostly back-office applications, client/server applications, interactive applications, or a mixture of all three. In each case, the performance of the 8xx servers can be customized to match business needs.

Each model includes a base processor and interactive performance feature. Optional processor and interactive performance features can be selected to balance the server performance for a given workload. Increasing performance on installed servers can be done simply and with minimal business disruption.

The AS/400 8xx servers offer two Commercial Processor Workload (CPW) ratings to allow performance to be customized for a given workload:

- *Processor CPW* represents maximum relative performance for a processor feature running commercial processing workloads. This value can be used to compare relative performance between various processor features. Processor CPW was referred to as Client/Server CPW in prior OS/400 releases.
- *Interactive CPW* represents the relative performance available to support interactive workloads. The amount of Interactive CPW consumed reduces the available Processor CPW by a corresponding amount. Interactive CPW for a specific processor is changed through the installation of optional interactive feature cards.

The key feature of 8xx servers is that, depending on a customer's requirements, various levels of interactive throughput capacity can be configured when ordering the system. The 270 servers do not support corresponding interactive features.

4.2.1.4 AS/400e server throughput

All AS/400e servers have two published throughput ratings measured in CPWs. The larger value represents the total throughput capacity of the model in a client/server environment. The smaller CPW value represents the interactive throughput capability. For certain system configurations, both values may be equal.

The AS/400e server is capable of supporting a client/server workload, an interactive workload, or a combination of both. Throughput capacity (CPWs) used by an interactive workload is not available for client/server processing. This is illustrated in the example in Table 12.

Table 12. Client/server and interactive capability for AS/400e Model 820 #2396

Total CPW capacity	Client/server capacity	Interactive capacity
950	915	35 (FC #1521)
950	880	70 (FC #1522)
950	830	120 (FC #1523)
950	710	240 (FC #1524)
950	390	560(FC #1525)

In each instance, the interactive capacity is the maximum associated with each specified feature code (FC).

In OS/400 V4R4 and above, IBM provides additional interactive capability beyond the limit of each interactive feature code (unless the interactive and client/server ratings are equal). An additional one-sixth of the capacity of the interactive feature code is available for interactive workload processing.

For the 170 and 7xx models with OS/400 V4R4, using the additional interactive capacity reduces the effective client/server capacity.

On the 270 and 8xx models, using the additional interactive capacity does not have the same impact. The additional workload dedicated to interactive processing is no longer available to client/server processing, but there is no associated reduction in client/server processing capability. This is controlled by the System Licensed Internal Code (SLIC) tasks, known as CFINTnn (where nn can be a number from 01 to 24, depending on a number of AS/400 CPUs), which are part of Dynamic Priority Scheduler support available since OS/400 V3R6. CFINTnn decreases the priority of interactive jobs if their processor usage reaches the threshold value. This causes the interactive work to be inhibited as a result of getting fewer processor cycles. In turn, this allows for an increase in client/server throughput.

To take full advantage of this feature, client/server jobs should have a run priority between 20 and 35 and the system value QDYNPTYSCD (Dynamic priority scheduler) should be set to 1.

4.3 Workload components overview

Workload components form the basis of sizing workload profiles. System 21 workloads generally contain an interactive component, a batch component, and a server component. This broad catergorization serves to simplify the sizing process.

4.3.1 Interactive component

Interactive jobs are associated with a 5250-type data stream. This allows users to directly interact with a job running on the AS/400 system. The throughput of interactive jobs depends on the availability of requests from users (assuming there are no computer system resource constraints). A particular system configuration can have a throughput capacity limit depending on the hardware, operating system, application software, and how the application functions are used.

In general, the request reaches the AS/400 system through a communications controller or a workstation controller. Each request results in the job actively using processor cycles over a short period of time. There are relatively long periods during which there is no demand for processor cycles, attributed to user key think time.

4.3.2 Batch component

Batch jobs are initiated by users, but run with little or no interaction with the user that initiated the job. The throughput of batch jobs depends on the availability of

system resources, such as disk (which provides data in response to an application request) and CPU cycles, that process the data. A typical batch job has no external agent to restrain its progress to completion and is usually active over long periods of its elapsed time. Short wait times (compared to interactive jobs) between periods of processing are characteristic of batch jobs running in an unconstrained environment.

4.3.3 Server component

These AS/400 jobs respond to an external event such as a request from a client device. When the AS/400 system is functioning as a server by responding to requests from a client device, the server job on the AS/400 system is reported by the Performance Tools as a non-interactive job without any recognition of a request/response boundary.

However, these server jobs exhibit some “interactive” characteristics such as:

- Job activity is initiated by an external event (a client request).
- Progression of the job can be interrupted by user key think time.
- A unit of activity is represented by a user initiated request (from the client) and a response (from the server).

4.3.4 Sizing and job types

It is necessary to distinguish between interactive and non-interactive workloads, so you can associate the workload with the throughput capacities published by IBM for the various AS/400e server models. This is critical when trying to determine the interactive and client/server CPW configuration to support the anticipated workload.

The System 21 sizing process produces a requirement for both interactive and non-interactive workload components. This simplifies the selection of the appropriate AS/400e servers to support the consolidated profile.

4.4 Transaction-based versus user-based sizing

System sizing can be undertaken by adopting a “transaction”-based or “user”-based approach. Both are valid methods, but yield distinctly different results. In general, transaction based sizings are more accurate. However, for low transaction volumes, or where insufficient business transaction details exist, user-based sizing may provide an acceptable result.

4.4.1 User-based sizing

Within System 21, users have two distinct classifications:

- **Attached**: One or more sessions on the AS/400 system, no transaction processing
- **Active**: One or more sessions on the AS/400 system, processing transactions

User-based sizings are always based on the anticipated “active” user population.

Standard System 21 workload profiles have been established for a variety of user classes within an application module. Some user classes may comprise functionality from more than one application module. These workload profiles

represent the use of specific business functionality and have a corresponding transaction rate. The transaction rate reflects such factors as the number of lines per sales order or the number of picks per sales order line.

To accurately use user-based sizing techniques you need to fully understand the profile of the business user in the organization you are modelling. This includes the functions they will typically run and the nature of the transaction data. Obtaining this level of information in a new sales situation is generally unrealistic.

Depending on the applicability of the workload profiles, a system may be correctly sized, oversized, or undersized.

User-based sizing with consolidated workload profiles is generally less accurate. Consolidated profiles contain transaction activity for more than one business application area. A consolidated distribution profile may contain inventory processing, order entry processing, and purchase order management. This approach tends to over estimate system requirements except on small systems.

User-based sizing is not the preferred method for sizing System 21.

4.4.2 Transaction-based sizing

Within System 21, the term “transaction” refers to the occurrence of a specific business metric. Experience has shown that occurrence of a particular activity generates workload throughout the installed application modules.

For activities involving the receipt of sales orders, the business metric has been the sales order line. For example, on receipt of a sales order, the following activities may take place:

- The stock is allocated (batch or interactive).
- Purchase orders may be raised for “out of stock” items.
- Work orders may be raised to manufacture additional stock.
- The order line is priced and discounted.
- The customer may exceed their credit limit.
- Stock may be received against a purchase order.
- The pick note is raised for the order.
- The pick quantities are confirmed.
- The order is processed through dispatch confirmation.
- A customer invoice is raised.
- The invoice details are posted to the General Ledger.
- Financial reporting takes place over the GL.

System 21 modules, such as Service Management, have a business metric other than sales order lines.

System 21 sizing has been fundamentally transaction based. Profiles exist to represent consolidated workload activity and specific transaction activity. These profiles have an associated AS/400 transaction rate, which is used by the BEST/1 modelling tool.

Workload modelling in BEST/1 provides a useful “sanity” check. Having entered the AS/400 transactions to represent the business volume, BEST/1 recommends an active user requirement. This should be compared to the user population specified by the customer. If there is a considerable variation, further investigation is required.

4.5 Business workload profiles

A clear understanding of the customer's business workload profile is key to the sizing process. This entails an understanding of:

- The composition of the workload
- The throughput rate of the respective streams of work that make up the total workload

The best way to do this is to ask the questions:

- What are the sources of the work that the AS/400 server is required to carry out?
- At what times of the day do they occur?

Once you have established a customers business workload profile, you can more accurately determine the nature of their processing requirements.

4.5.1 Rate of work: The workload profile

Determining the "rate of work" is often referred to as determining the "workload profile". In existing customer installations, this can be more readily determined from the collection of performance data. Associated business volumes can be extracted from key application files, and a transaction throughput can be calculated.

For new installations, a profile of the key business transactions needs to be compiled. Once this is complete, anticipated transaction volumes can be allocated to the functions to generate a workload profile.

Business workload profiles do not remain consistent. They are influenced by a number of external factors. To determine the most appropriate system configuration, daily, weekly, monthly, and seasonal variations need to be considered.

4.5.2 The daily workload profile

Typically, the working day means between 08:00 and 18:00, although this can vary. The "peak hour" is the hour when the amount of high priority CPU is greatest, and where high priority CPU is taken to be the total CPU required to run all the time-critical work. Clearly this includes all work required to run the interactive and system jobs. However, it can also include high availability work and work required for time critical batch work (such as production of pick slips or EDI order receipt).

Depending on the geography and business type, traditional daily order profiles exhibit two distinct peaks. Normally, sustained activity is observed between 10:00 and 12:00 and from 14:00 to 16:00. The composition of the workload may vary in these two intervals, depending on the business sector. A workload profile with these characteristics usually results from a situation where the interactive workload is at its peak in the morning due to customers phoning in their orders and making inquiries on deliveries. In the afternoon, interactive activity may decrease, but batch work increases. These are the batch processes to support order processing tasks, such as picking, dispatching, and invoicing.

There may be considerable variation between daily workload profiles:

- Certain business activities may only occur on a particular day.
- The receipt of orders may be heavier for a particular day.
- Public holidays may affect order and dispatch cycles.

These variations need to be determined to develop a representative daily workload profile.

Transaction entry volumes in the peak hour may also vary substantially. One business may process 20% of its daily order volume in one hour, while another business may process 60% in the same time. This will have an enormous impact on the daily workload profile.

All of these factors need to be considered as part of the definition of the daily workload profile.

4.5.3 The weekly workload profile

Increased demands on business availability have influenced the weekly workload profile. The traditional working profile was five days by eight hours. This has now been increased and in many installations extends to 7 days by 24 hours (7 x 24). Operating an AS/400 system in a 7 x 24 scenario requires additional considerations.

Organizations have traditionally experienced a “busy week” in the month. This has generally been associated with month-end requirements. Certain financial transactions and reports are only required at month’s end.

When placing orders, some customers favor the last week in the month. This may be associated with accounting or cash-flow requirements. This may have a considerable impact on the workload profile.

The receipt of orders in the week immediately preceding a public holiday may also be artificially high. Retail outlets may place considerably more orders in the week prior to Christmas, particularly for consumable products.

Once again, all of these factors need to be considered when establishing a weekly workload profile.

4.5.4 The monthly workload profile

The monthly workload profile is an extension of the daily and weekly profiles. Depending on the business sector, some organizations may experience an increase in transaction processing during a particular month.

For example, one TV and video rental company processed 60% of its annual order throughput in October. This peak was associated with students returning to college.

Such factors as these need to be investigated in establishing the monthly workload profile.

4.5.5 The seasonal workload profile

Seasonal workload profiles are industry specific. They relate to the supply of products associated with a particular event. Examples of this include holiday cookies or decorations and fireworks for Independence Day celebrations.

In these examples, orders are processed in a finite time scale after which there will be minimal system activity. As such, the workload is “event driven”. However, workloads of this nature tend to be very concentrated and consequently artificially high.

4.5.6 The business metric for the workload profile

In discussions with the organization, it is important to identify the “business metric” by which their organization quantifies its level of activity, for example:

- Production volume (measured financially or in units of output) for a manufacturing company
- Customer order lines or picking lines for a distribution company
- Patient admissions for a hospital
- Customer transactions for financial organizations

Regardless of the type of metric, it is also important to consider it as a “rate” (the number produced in a unit of time).

Organizations are usually aware of their busiest month in the year and their busiest week in the month (from an accounting perspective.) However, they may not be aware of their busiest hour in the day or their busiest day in the week for their computer systems because these can be affected by factors not visible to non-IT professionals such as a large amount of batch work that has been time shifted from the external events that caused it in the first place.

In summary, it is important to identify:

- The busiest hour in the working day
- The busiest day in the week
- How the month when the data was collected relates to the busiest month of the year in terms of a business metric rate that is in common usage within the organization

Consider this example in a customer installation. The busiest hour of the busiest day in the month has a level of activity of 15,000 transactions per hour, which corresponds to a level of high priority CPU utilization of 60%. Also, the month of the performance data collection results in 120,000 order lines, but the busiest month in the year is expected to result in 160,000 order lines.

In this case, an estimate of the “peak” level of activity in the “peak” hour of the year is 20,000 transactions per hour. Further work can be done to estimate the system requirements for this level of activity.

4.5.7 Daily business operations schedule

At a daily workload level, some organizations prefer to represent their business activities pictorially in a daily business operations schedule. This generally takes the form of a spreadsheet that identifies their key business processes and the

times of the day during which they occur. Activities are represented on the x-axis, and hours of the day are shown on the y-axis.

This approach highlights any potential resource conflicts and the period of the day with the peak processing requirement. Both new and existing customers find this approach beneficial.

4.6 Critical success factors

Critical success factors form an important part of the sizing process. They represent activities that must be achieved in a time frame for the business to function effectively. Failure to address these requirements normally results in an unsuccessful implementation.

Responsibility for identification of these factors rests with each individual organization. They are obviously business specific.

Critical success factors are defined as a component of the workload definition process because they are usually dependent. From a sizing perspective, they refer to achieving a particular business goal in a specified time frame. To quote a previous example, the goal may be “to process 20,000 order lines in to Sales Order Processing between 07:00 and 09:00 daily”.

System resources to support this type of requirement may be sized separately or form part of a consolidated requirement.

4.7 The System 21 application sizing questionnaire

As part of the standard System 21 sizing process, Geac supplies a tool called the “application sizing questionnaire”. This is a spreadsheet application used to capture basic business details about an organization.

You need to complete a sizing questionnaire for each of the following cases:

- New implementation of the System 21 product set
- The addition of application modules to an existing implementation
- Supporting additional companies as part of an existing implementation

If you intend to support more than one Company, a sizing questionnaire should be completed for each one. Data volume and retention requirements may vary significantly by company and should be considered as separate entities.

The application sizing questionnaire also provides an estimate of disk storage requirements for each company. This number should represent 60% of the available storage capacity on the AS/400 system. This is assuming that System 21 is the only product being supported.

Important

The disk storage requirements generated by the application sizing questionnaire are an approximation only. The figures may not be realized in a production environment due to a number of operational factors.

The questionnaire is divided in to the following sections:

- **Customer information**: The customer name, the date the questionnaire was completed, and the signature of the nominated customer representative.
- **AS/400 system details**: Hardware components, OS/400 and Licensed Program Product (LPP) requirements, attached devices, and communications requirements.
- **System 21 applications**: A list of available System 21 modules. Modules forming part of the implementation must be selected.
- **General business details**: Business-specific questions relating to each System 21 application module selected.

The questionnaire is normally completed with the assistance of an application and technical pre-sales consultant from Geac, because some of the questions are System 21 specific.

You also need to provide the information outlined in 4.5, “Business workload profiles” on page 73, as part of the application sizing questionnaire review process.

4.8 The IBM/Geac sizing tool

The IBM/Geac International Competency Center (ICC) is comprised of a group of experienced professionals dedicated to providing high quality sales support for IBM platforms running System 21 software. In addition to a Competency Center manager, the team includes server platform technical specialists, a sizing specialist, a network specialist, and a marketing specialist. With the assistance of Geac sizing specialists, they are responsible for the development of the tool described in the following sections.

4.8.1 The sizing tool

The tool used for sizing the System 21 and IBM AS/400 solution was developed by the Competency Center team. This tool is based on an analysis of the performance characterization data collected during the performance benchmark test runs for the AS/400e servers.

The current tool supports both user-based and transaction-based sizing. The supporting questionnaire is designed to collect details of a customer’s user population. Data from the application sizing questionnaire provides the supporting business volume metrics.

The tool supports implementations of standard System 21 products at the latest supported software release level. The tool is intended for use in a new business scenario. It is also used to confirm system configurations for existing implementations. It is not intended for use in upgrade scenarios. In this case, BEST/1 remains the accepted sizing and modelling tool.

4.8.2 Tool methodology

The sizing tool is currently used to support the implementation of System 21 core applications, which include Finance, Distribution, and Manufacturing. Development is currently being undertaken to extend the coverage to System 21 industry verticals.

The development methodology for the tool is explained in the following sections.

4.8.2.1 Determining business workload profiles

The ICC team visited a number of existing System 21 installation sites that were using the standard product set. Customers were asked to identify business roles that were key to their overall business process. Once the roles were defined, the System 21 transactions required to support these roles were established. This level of information is readily available within System 21.

The sampled information was collated and a series of “standard” business profiles were defined.

As part of the analysis process, business transaction rates were also captured. This is key to ensuring that the workload models generated from the benchmark represent a true business scenario. Transaction rates also include typical “key to think” time associated with a business process.

4.8.2.2 Establishing a test database

Use of a representative database is key to any benchmarking activity. Files that contain ten item codes and five customers seldom yield accurate performance numbers.

Databases were obtained from existing System 21 customers for the core applications. This was done after consent from the customers and with the appropriate revisions to the data. Customers considered to have an average size database were selected.

4.8.2.3 Production of test scripts for business functions

The Mercury Interactive suite of tools was used to define the business workload profiles. Once the test scripts were developed, they were run in a simulated business environment.

Initial tests were based on a simulation of up to one hundred users. However, this was extended to support up to 500 active users.

User “key to think” times were varied for certain business profiles, but particularly in Order Entry. This was done to represent the variance in transaction rates between a *transcriptional* user and a *conversational* user. In this context, conversational relates to telephone-based transactions and transcriptional applies to paper-based transactions.

AS/400 performance data collection services were used to capture the workload generated by the test scripts. Once extracted, this data was used to generate the measured profiles.

As part of the process, the concept of a *Standard System 21 User (SSU)* was introduced. This is an arbitrary rating against which all measured business profiles can be compared.

4.8.2.4 Tool enablement

The business workload profiles are available for use with the BEST/1 modelling tool. They have also been incorporated in to a Web-based sizing tool that is available for use worldwide by the Geac field force.

4.8.2.5 Tool applicability

It is important to remember that workloads generated for benchmark testing may vary significantly from the actual workload of any given customer for the same business workload profile.

For example, the order entry component of a measured profile may be based on an average of five lines per order. Using this profile for a customer with an average of one hundred lines per order may seriously understate the workload requirement. Alternatively using a workload profile that represents full regenerative Material Requirements Planning (MRP) may overstate the requirements for a customer looking to use net change MRP.

While measured profiles are used to represent a business scenario, they never truly reflect a live implementation. Additional workloads need to be accommodated on a production system that are not accounted for in measured profiles. A good example is an IT-based workload such as online development. To address this issue, Geac and IBM recommend that each customer revisit server sizing a number of times during the implementation process when more details about how they will actually use the System 21 applications are known.

Important

In any *phased* implementation of System 21, you should review the resource requirements of the initial phase, and use this as a basis for the requirements of the next phase. You will need to capture AS/400 performance data and associated transaction volumes for the initial phase. You can then use BEST/1 to forecast future system resource requirements.

4.8.3 Tool output

The ICC sizing tool produces up to three hardware configurations, depending on the application workload requirements. The configurations include:

- An AS/400 model
- Processor and interactive feature details
- The number of disk arms for performance based on a specified workload
- The number of disk arms for performance based on the maximum workload supported by model
- Main storage requirement
- AS/400 software group for processor/interactive feature

Note

The disk arm recommendations are based on the use of the 10,000 rpm 8.58 GB disk drives and the #2748 RAID disk controller.

From this basic information, the Geac technical pre-sales consultant has the primary components needed to produce a fully configured AS/400 system.

4.9 The BEST/1 sizing tool

BEST/1 is the capacity planning and workload modelling tool supported on the AS/400 system. This product is available in the IBM Performance Tools for AS/400 (5769-PT1) as part of the Manager feature. BEST/1 is a sophisticated modelling tool, which requires a high degree of expertise to use and to interpret the results it produces. No further explanation of the product and its usage will be given in this section.

Note

BEST/1 Capacity Planning Tool, SC41-3341, covers the use of the modelling tool. More examples of using BEST/1 can be found in *AS/400 Server Capacity Planning*, SG24-2159.

4.9.1 System 21 measured workload profiles

An extensive number of measured workload profiles is available to support the System 21 core application modules. Some of the profiles were developed from internal benchmark activity, while others were generated from customer performance data.

The profiles represent either single or consolidated business activities, which may include the use of one or more application modules. One or more profiles may be used to represent a customer's business workload requirements.

4.9.2 Customer performance data

Sizing existing AS/400 customer installations requires the collection of performance data. This is used to generate either consolidated or specific workload profiles. The prerequisites of the performance data collection exercise are listed here:

- Application work management must be correctly configured.
- The business workload profile must be established.
- The IT environment must be optimally tuned.
- Tuning adjustments should not be made during the data collection.
- Historical performance data should be available.
- The details of new applications should be known.
- Workload growth data needs to be available.

If these prerequisites are not in place, the accuracy of the workload models may be adversely affected.

4.9.3 The sizing process

This section outlines the sizing requirements that are addressed with BEST/1:

4.9.3.1 New system implementation

The following inputs are required to generate a new system sizing:

- Application sizing questionnaire
- Daily, weekly, monthly, and seasonal workload profiles
- Peak hour details
- Projected business growth

- Key business metric
- Critical success factors
- BEST/1 measured workload profiles

Applying the details in the first six points to the modelling process generates a system sizing. One or more workload profiles may be required to represent a customer's business requirements.

4.9.3.2 Existing system implementation

The following input is required to generate system sizing for an existing installation:

- Application sizing questionnaire (for the new workload)
- Database analysis from customer system (PRTDSKINF)
- Daily, weekly, monthly and seasonal workload profiles
- Peak hour details
- Projected business growth
- Key business metric
- Critical success factors
- Workload profile from customer data
- BEST/1 measured workload profiles

Using the information in the first seven points, in conjunction with customer workload profiles and System 21 measured profiles, it is possible to determine a revised system configuration. IBM and Geac strongly recommend that you use this approach when producing an upgrade sizing for an existing system.

Note

An existing system may support products other than System 21. System 21 measured profiles can be combined with customer workload profiles to produce a consolidated BEST/1 model.

4.9.4 BEST/1 output

The Display Analysis Summary from the BEST/1 modelling process is shown in Figure 27 on page 82. It includes details for CPU, Disk IOP, Disk Controller, and Disk Arm utilization.

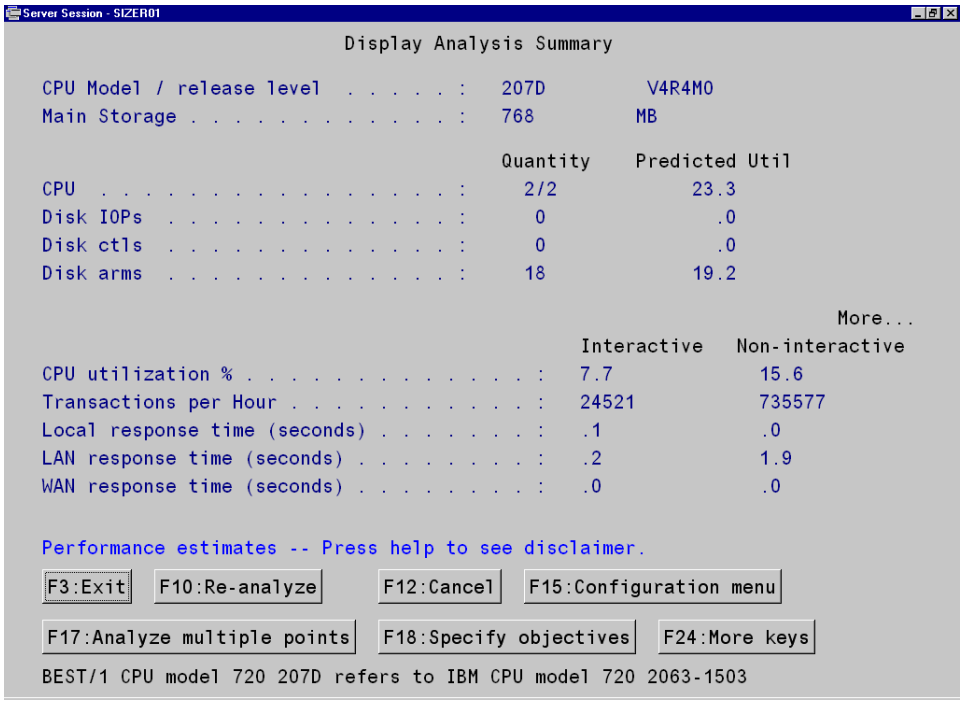

Figure 27. BEST/1 modelling output (Part 1 of 2)

Figure 28 illustrates the second screen, which has values for Multifunction IOPs, Disk IOAs, LAN IOAs, WAN IOAs and IPCS IOAs.

CPU utilization values for the interactive and batch workload components, with the associated hourly transaction throughput rates, are also displayed.

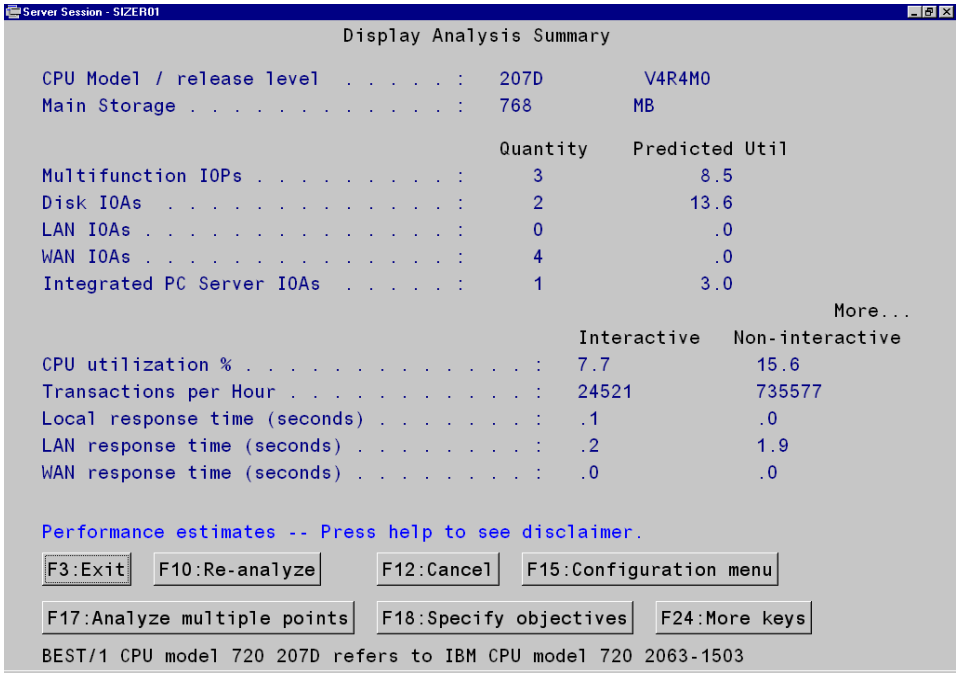

Figure 28. BEST/1 modelling output (Part 2 of 2)

At the top of each screen, the CPU model, main storage, and OS/400 release level are shown. The CPU model for 7xx and 8xx servers is in the form of a BEST/1 reference code. This is expanded at the base of the screen. In this example, the CPU model was a 720, #2063/#1503.

A detailed analysis of the utilization of each hardware component is available as part of the BEST/1 output.

4.10 The iterative sizing approach

System sizing must not be considered as a finite process. It is a series of approximations that serve to represent the implementation of an organization's key business processes on a computer system.

In today's rapidly evolving commercial environment, organizations need to be able to react to changes in market requirements. Consider the emergence of e-business for a classic illustration. Responding to these changes has a continual impact on hardware and software.

Advances in hardware technology also bring considerable commercial benefits. This can easily be substantiated by reviewing the increased price performance of the AS/400 system over the past two years.

Developments in software function have also increased in complexity. As products become more "functionally rich", their resource requirements increase accordingly.

As a result of these factors (and many more), organizations are adopting an iterative approach to sizing. They are purchasing a system to accommodate the initial phase of their implementation. IT resources are then reviewed at specific intervals and enhanced as required. This reduces technological exposure and, at the same time, maximizes return on capital investment.

This approach may not be appropriate for every implementation. However, we strongly encourage you to use it where it is considered suitable.

4.11 Third-party products

System 21 can co-exist with third-party products on a single AS/400e server implementation. Geac maintains a number of strategic alliances with third-party software solution providers, and actively encourages this approach.

Standard System 21 sizing does not, however, include workload components for third-party products. The specification of system resources remains the responsibility of each solution provider. However, Geac will provide workload models for inclusion in a consolidated business model if required.

Important

The coexistence of third-party products on a single AS/400e server may lead to performance degradation in the System 21 application. Be sure to perform Benchmark testing before introducing a new software component to a production environment.

4.12 IBM performance validation services

IBM provides the services described in the following sections to support customers who need to maintain specific workload requirements.

4.12.1 IBM Benchmark Center

In exceptional circumstances, traditional sizing tools are inappropriate to complete sizing. This generally applies to one or more of the following types of organizations:

- Organizations with a very large database
- Organizations with a high user population
- Organizations with a transaction workload that exceeds the capability of a single AS/400e server
- Organizations with a mission-critical throughput requirement in a restricted time frame
- Organizations that intend to distribute to more than one geographical location while maintaining a single database image

To gain an initial understanding of resource requirements, you may elect to use one of the IBM AS/400 Customer Benchmark Centers.

The centers provide custom batch, interactive, and client/server benchmark services on custom AS/400 hardware configurations. Remote dial-in support is also available in Rochester for batch benchmarks.

At the AS/400 Benchmark Center, you can:

- Run your application on any model of the AS/400 product line
- Build a matrix that tells you what the response time is for your product with various numbers of users
- Determine transactions/hour, response time, and batch throughput

The Benchmark Center operates on a cost-recovery basis. The benchmark fees vary depending on the length of time for the benchmark, type of benchmark, number of systems, and type of configurations needed.

More information on the Benchmark Centers can be found on the Web at:
`http://www.as400.ibm.com/developer/cbc/`

4.12.2 AS/400 Teraplex Integration Center

The AS/400 Teraplex Integration Center, one of five centers that IBM operates for its major platforms, is a facility to investigate, research, and demonstrate very large data warehouse implementations. The Center is located with AS/400 Research and Development in Rochester, Minnesota. The Teraplex Integration Center is focussed on investigating Very Large Database (VLDB) applications. This involves discovering the considerations, planning techniques, and technical challenges of supporting very large data warehouse applications.

To perform this testing, IBM uses some of the largest AS/400 servers built to date. Each machine runs the latest OS/400 versions and has the following configuration:

- 12- to 24-way SMP processors
- 40 to 96 GB memory
- An average of 2 TB of attached usable DASD

All the machines are connected in a massive parallel processing configuration using OptiConnect and DB2 MultiSystem.

In addition, there are large sets of high performance PC workstations available. These machines are connected to the AS/400 systems through Token-Ring and Ethernet, which enables testing of almost any client application. Load Runner, from Mercury Interactive, is used in the PC lab. This is a testing application that supports the simulation of thousands of AS/400 users.

Geac has selected the Load Runner tool from Mercury Interactive as its preferred workload simulation tool for the AS/400 platform. This enables IBM to use custom workload scripts produced by Geac in either the Benchmark or Teraplex Center.

More information on the Teraplex Integration Center can be found at:
`http://www.as400.ibm.com/developer/bi/teraplex`

Chapter 5. Installation and set up

This chapter outlines the steps required to install and perform an initial test of System 21. The installation process is comprised of these steps:

1. Prepare for the installation to ensure that all prerequisites and AS/400 preparation is completed.
2. Perform the following tasks on the server:
   a. Load the server installation software.
   b. Load the desired System 21 server applications.
   c. Initialize the server software.
   d. Back up the server.
3. Following the server installation, the PC client software and additional client components are then installed on the PCs.

5.1 Overview

System 21 is distributed on CD-ROM as discrete application modules that equate to application functionality. Each application module contains the application programs, display files, print files, and tables grouped into a set of libraries on the AS/400 system that form the respective module. Figure 29 shows the structure of the Accounts Receivable application.

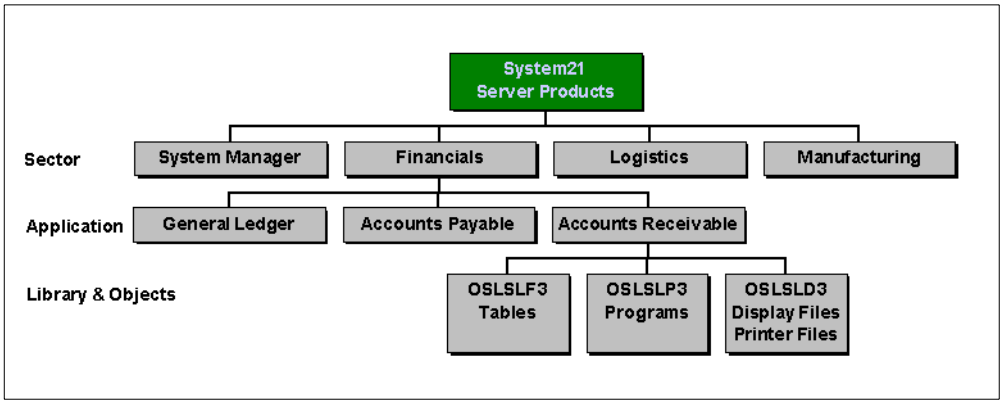

Figure 29. Example of the Accounts Receivable application

As the applications are installed and initialized, the interfaces between the modules are also set. These application modules are grouped to perform one of two basic functions:

- System management and utility function
- Business function

5.1.1 System management and utility function

The system management and utility functions cover a number of modules that deliver application, user, and system functionality. Some of the more commonly utilized modules include:

- **Administration Functions (CF)**: User and license management
- **Application Manager (AM)**: Management, configuration, and logging of the Business modules
- **Machine Manager (MM)**: Job scheduling

These application modules have library names that generally start with the letters IPG and are usually placed in the system portion of the library list during System 21 execution. The structure of System Manager is shown in Figure 30.

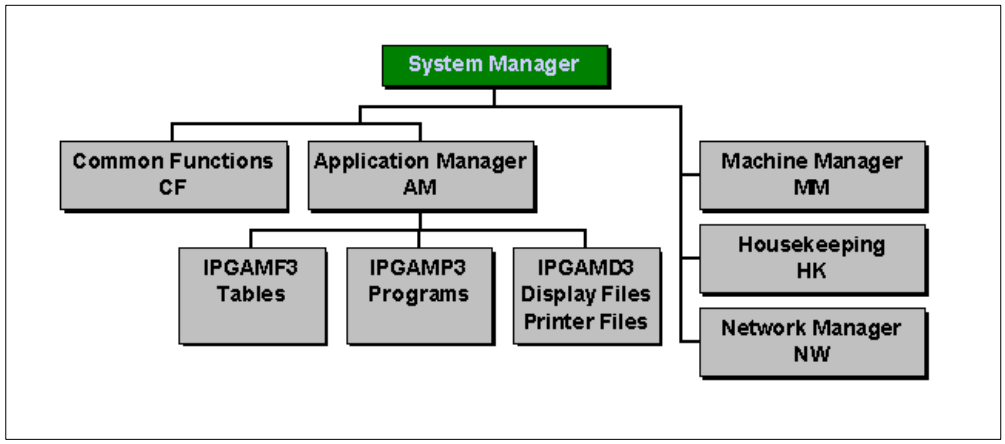

Figure 30. System Manager

5.1.2 Business function

These functions consist of application modules that provide the business functionality. Some examples would be:

- Inventory (IN)
- Sales Order Entry (OE)
- Accounts Payable (PL)

These application modules have library names that generally start with the letters OSL and are usually placed in the user portion of the library list at runtime.

For further details on the libraries per module, refer to the *Installation and Setup Guide*. Additional information regarding the library schema can be found in Chapter 6, “Operations” on page 143.

5.2 Preparation

Perform the following preparation activities prior to the System 21 software installation tasks.

Note

As of July 2000, the supported configuration of the AS400 system must be running OS/400 V4R3 or greater. All Geac software is distributed on CD-ROM and intended for AS/400 RISC models only.

5.2.1 Skills

You should be familiar with your display station or terminal emulation software and its controls. There are also some elements of the display and certain keys on the keyboard that are standard, regardless of the software that is currently running at the terminal or to which hardware system the terminal is attached. Some of these keys are:

- Cursor movement keys
- Function keys
- Field Exit keys
- Insert and Delete keys
- The Error Reset key

You should know how to operate the terminal when it is attached to the server and running server software. This requires some knowledge of OS/400 and the Command Language to perform such tasks as:

- Signing on and signing off the terminal
- Interacting with displays panels
- Using Help
- Entering control commands and procedure commands
- Calling utilities
- Responding to messages
- Reviewing job activity

The above information is contained in *AS/400 System Operation*, SC41-4203.

5.2.2 Media

Ensure that you have the required set of CD-ROMs to perform the installation. The CD-ROMs that are required for installation depend on the modules to which your site is licensed. The *Installation and Setup Guide* that accompanies your media shipment will contain documentation about the CD-ROM contents.

Note

Media labels and content can change in subsequent releases of System 21. Use the most current distribution package and instructions as supplied by Geac.

As a guideline, you should have the following CD-ROMs:

- **@ctive Enterprise Framework January 2000 Edition (or later)**: The application management and administration function PTFs, System 21 Explorer, and @ctive Modeler client products
- **Geac Explorer Customizer**: User desktop installation of application module activities for the System 21 Explorer product
- **Visual Documentation**: Adobe PDF documentation of the System 21 Product Guides
- **Infobase**: General and context-sensitive System 21 Application module help in the Windows Help format
- **PTF Management System**: A module to load and maintain the PTF level of application modules on your system

- **System Products and AS/400 tools**: Application Management and Administration Functions, Electronic Customer Support, Fax, and copy source modules
- **Customer Service & Logistics**: All modules relating to Customer Service and Logistics
- **Financial**: All modules relating to System 21 Financials
- **Manufacturing**: All modules relating to System 21 Manufacturing
- **Service Pack**: May be included with your shipment depending on the support fix activity occurring upon your installation release

Note

The *Installation and Setup Guide* contain the contents and label identification for all CD-ROMs. If a System 21 vertical product has been licensed, the Manufacturing and Customer Service & Logistics CD-ROMS will be labeled accordingly.

5.2.3 Documentation

Much of the System 21 documentation is in Adobe Acrobat format. If you do not have the Adobe Acrobat reader installed, an installation copy is provided on the CD-ROM that contains the System 21 documentation. Before attempting the installation, ensure that the following materials are available and that you have read them:

- **Installation and Setup Guide**: This guide contains the instructions for installing System 21, as well as the disk sizing requirements and module dependencies.
- **License agreement**: A copy of the licensed application modules is useful in the installation process to identify which modules should be selected for installation.
- **Information Sheets, Function Briefs, and Alerts**: In addition to the *Installation and Setup Guide*, any latest software update bulletins may be included in the shipment. These are referred to as Function Briefs, Information Sheets, and Alerts. Read these prior to loading the software.
- **PC requirements**: Ensure that you have the proper hardware and software installed for your desktop/client computers. Geac publishes a Certified Configuration report that outlines the requirements for PC hardware and networking components.
- **Application documentation**: Documentation for the System Management Utilities and the Business Applications can be found on the Infobase and Visual Documentation CD-ROMs in a Windows Help format. These help files can be installed on a PC prior to the software installation or opened directly from the CD-ROM with Windows Explorer.

  If you are new to the Infobase help system, open the IBDEMO3.exe file in the INFODEMO directory of the CD-ROM. The System Management applications are covered in the Infobase in the Windows Help file INFOV.HLP (shown in Figure 31). This section will be useful as a reference later in the installation.

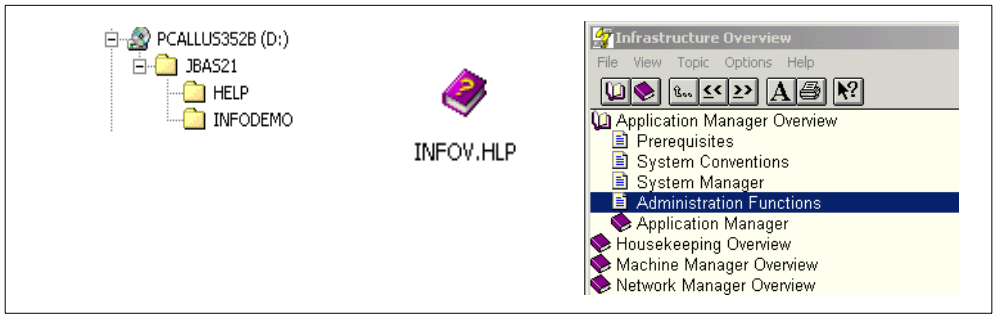

Figure 31. InfoBase - Infov.hlp file

The Visual Documentation files (Figure 32) are in the Adobe Acrobat form of all user manuals. The System Management manuals can be found by launching the CONTENTS.PDF file.

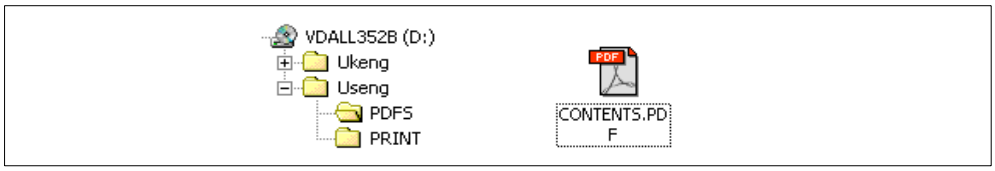

Figure 32. Visual Documentation - CD-ROM

Review the Application Manager, Common Functions, and System 21 Explorer product guides before attempting to administer and use the software.

- **@ctive enterprise Framework**: The @ctive Enterprise Framework CD-ROM contains instructions in Adobe Acrobat format for the installation and configuration of the @ctive Enterprise server and client products.

  The CD-ROM includes documents regarding fixes and new functions for the current release.

5.2.4 System access

Installing the software will require access to the CD-ROM on the AS/400 system. To install the system products and AS/400 tools, the user profile QSECOFR password is required.

5.2.5 Application dependencies

System 21 is packaged in application modules that are selected during the installation process. Some application modules depend on other modules that need to be installed and loaded first.

Refer to the *System 21 Installation and Setup Guide* for a complete listing of the application dependencies for the current installation.

5.2.6 Network connection

System 21 Explorer requires either a native TCP/IP connection or SNA router connection to the AS/400 system.

Note

Refer to the certified configurations from Geac for details on the network connections that they support.

Depending on your network configuration, you are required to have details of your connection type and network addressing information for the AS/400 server during the configuration of System 21 Explorer.

5.2.7 National language considerations

If more than one national language is to be installed, additional CD-ROMs for each language will be required in addition to those listed previously. If the additional languages are not available at the time of installation, they can be loaded at a later time.

5.2.8 Authorization codes

The installation requires Geac authorization for each licensed System 21 module. These should be included in the shipment package or be provided via an alternative form. Ensure that you have the authorization codes for the modules you expect to install.

Some applications have extended functions that are enabled via a manually created application module and authorization code. These application modules do not require software to be loaded since the function is already in the application programs that are loaded. The extended functions are then activated when the authorization code is present.

The authorization codes are AS/400 model and serial number dependant. Ensure that the codes that are distributed match the model and serial number of your AS/400 system.

The authorization codes can also be date dependant. Check the expiration dates of any authorization codes that have date dependencies.

Authorization codes are not required for the software installation, but will be required for configuration and testing, which is discussed later.

During installation, the three-character customer number assigned by Geac is required to entered in the “environment code” prompt. The Geac Customer Number is located on the Authorization Codes sheet as well.

5.2.9 Environment considerations

System 21 supports a concept of multiple parallel versions of the application base running on the AS/400 system, referred to as environments. Generally environments will be set up for training, development, and testing. Environments are identified by a three-character code. The base environment code for all installations is the Geac customer number.

This chapter does not cover the installation instructions for environments beyond the base installation. For more information on environments, refer to 11.8, “Operating environments” on page 400.

5.2.10 Consolidation

System 21 supports library consolidation. Certain application configurations require library consolidation depending on configuration. This chapter does not cover consolidation. For more information on library consolidation, refer to 11.5, “Consolidating libraries” on page 396.

5.2.11 Disk space requirements

Table 13 shows estimated base sizing for an installation of all modules belonging to the relevant product sector.

Table 13. Application estimated sizing

Sector	Approximate size (MB)
Application manager	292
Financial	637
Customer Service	900
Production	325

This is only the size required to restore the applications, not to perform day-to-day transactions. For details on individual modules sizes, please refer to the *Installation and Setup Guide*.

5.2.12 Installation time

Ensure that you have the proper amount of time to perform the installation for each of the modules selected. Each application can be loaded from the CD-ROM individually.

The time required for installation depend on the AS/400 model, main memory size, disk availability, and system activity. General guidelines for installing on a dedicated machine are shown in Table 14.

Table 14. Installation time guidelines

CD-ROM	Minutes
System Products	9
Financial	20
Customer Service and Logistics	45
Manufacturing	12

5.3 Server installation

The System 21 application modules and database are installed on the AS/400 server.

Note

Refer to and follow the Geac System 21 *Installation and Setup Guide* for current details regarding your installation scenario.

Each CD-ROM contains the System 21 installation software required to restore the applications from the CD-ROM to the AS/400 system. The installation software library, DSTSHIPLIB, includes meta data regarding the CD contents. The server installation requires these basic steps:

1. Loading the System Manager and Business Module libraries
2. Initializing System Manager
3. Initializing the Business Modules (using the AMINSAPP command)
4. Applying Authorization Codes
5. The Initial Setup of the Business Modules

These steps describe an installation process overview. Use the *Installation and Setup Guide* to install the software.

We recommend that you do not perform the installation from the AS/400 console because this device runs at a higher priority on the system. System performance and error recovery may be impacted when using the system console for the installation.

5.3.1 Loading the server software

This section describes the loading of the system management and business application libraries from the CD-ROMs to your AS/400 system.

Sign on to the AS/400 system as QSECOFR. Then, issue a series of commands to install and execute the distribution tools. The Select Applications to Load panel appears as shown in Figure 33.

```
D#002          JBA Software Products Limited         User QSECOFR       4/05/00
                                                     Term GEAC01       15:55:38
Select Applications to Load

   App/Rls Application Description
Opt  Library    Library Description                                 Exists?
 _ CF/V3 - System Manager Admin. Functions
     IPGCFP4    Common Functions Programs                            No
     IPGCFF4    Common Functions Files                               No
     IPGCFD4    Common Functions Dspf/Prtf/Msgf        '             No
 _ AM/V3 - Application Manager
     IPGAMD4    Application Manager Dspf Library                     No
     IPGAMF4    Application Manager Files                            No
     IPGAMP4    Application Manager Program Library                  No
   G#/V2 - IPG/400
     OSLCOPYSRC Standard Routines for use with /COPY.                Yes
 _ HK/V3 - System Manager Housekeeping
     IPGHKD4    Housekeeping Display files library     '             No
     IPGHKF4    Housekeeping Files                                   No
     IPGHKP4    Housekeeping Programs Library                        No       +


1=Select
F3=Exit    F5=Refresh    F10=Command entry    F12=Previous    F19=Rewind media
```

Figure 33. Selection of applications to install

Note that there are more modules available for installation as indicated by the “+” symbol in the lower right of the display. Press the Page Down key to see the additional modules.

Note

There is no need to install all the modules that are on a volume. You need only install those modules that are licensed to your site and any modules that are prerequisites or co-requisites for them. A list of module prerequisites is in the appendices of the *Installation and Setup Guide*.

At completion of the installation, a listing of the job activities is produced. This should be collected and available for reference following the installation.

Repeat this process for each CD-ROM that contains the server applications that you intend to use. Upon completion of the installation of all modules needed, continue to the Initialization section.

5.3.2 Initialization

Once the software has been loaded, software initialization must be performed for System Manager, PTF System, and all business application modules.

5.3.2.1 Initializing System Manager

This section provides instructions for initializing System Manager.

Note

Refer to the Initialization chapter in the *Installation and Setup Guide* for details on performing the system and application initialization.

The System Manager applications require that certain objects are permanently available. To ensure this, you must create a new library to hold these objects and place it in the system library list. By default, this library will be OSLSYS.

The System Manager initialization clears all system level files and inserts default data into the tables. This is performed as directed in the *Installation and Setup Guide*. A sample of the initialization screen is shown in Figure 34.

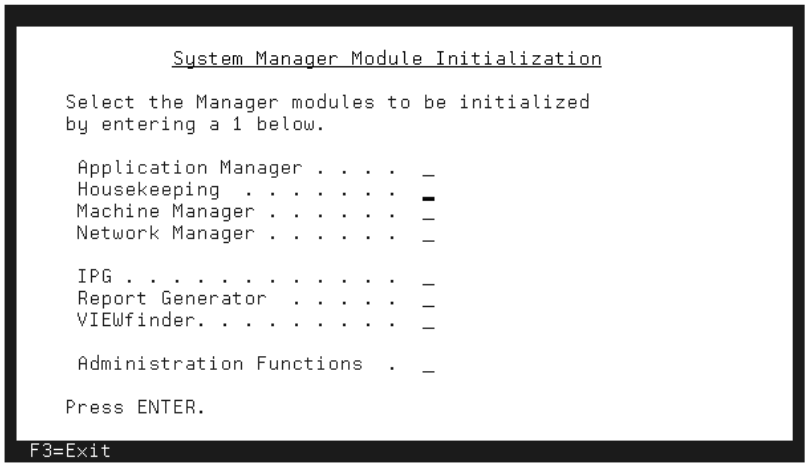

Figure 34. System Manager Initialization selection

During the initialization, Geac commands are copied to the OSLSYS library. These commands are useful tools in the development and management of System 21. You can see a list of these tools after the installation is complete by typing in the command:

```
OSLSYS/TOOLS
```

5.3.2.2 Initializing Business Applications

Following the initialization of System Manager, the Business Applications can be installed. Follow the instructions as outlined in the *Installation and Setup Guide*.

Each System 21 business module has its own initialization routine. You need to run the routine for each business module you have loaded.

Dependencies

Due to the integrated nature of the System 21 applications, it is important that all application libraries that you require are loaded before any applications are initialized. If you need to install another application later, you must re-initialize any application that interfaces with it once it is installed. A list of application dependencies is located in the appendices of the *Installation and Setup Guide*.

User Environment Code

When initializing your System 21 modules, you need to know your environment code. If you are a new user, your software support organization will supply you with the three-character customer/environment code you need. If you are an existing user, you may verify your environment code by using the following command:

```
DSPDTAARA DTAARA(IPGAMP4/AMCUSCODE)
```

The codes of JBA and OSL are reserved for internal use. If these are present in your software, contact your support desk for assistance to change them.

AMINSAPP

Follow the AMINSAPP instructions in the *Setup and Installation Guide* for the remaining installation details. This command updates application-specific menus, tasks, and library lists. It also prepares the modules for use by System Manager. This step must occur for each module before proceeding to test the software.

A sample of the AMINSAPP command display is shown in Figure 35.

```
                    Install AM Application (AMINSAPP)

Type choices, press Enter.

Application Source . . . . . _           Character value
Application Code . . . . . __            Character value
Release Level  . . . . . __              Character value
Application Version  . . . . . ___       Character value
Library  . . . . . _________             Name

                          Additional Parameters

Install TO Version . . . . . *VRSN       Character value, *VRSN
Install Options  . . . . . *ALL          *ALL, *LIBL, *TASK

Library Mapping Option . . . . . *NOMAP  *NOMAP, *PROMPTMAP, *AUTOMAP

                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 35. AMINSAPP command prompt

5.3.2.3 Initialization of the PTF system

Following completion of the application installation, the PTF system must be initialized.

The PTF Management System allows for updating the System 21 modules when new versions (Product Updates) are released. The PTF system is initialized under the profile of QSECOFR. The instructions for the PTF initialization are found in the *Installation and Setup Guide*.

5.3.2.4 Authorization codes

A valid authorization code must be in place for each application that is to be used. This section describes how to apply authorization codes.

Authorization codes should have been issued to your company by the software support organization. Application and user authorization codes are required for each installed module.

Before attempting to apply authorization codes, you must ensure that the following processes are completed:

- The Administration Functions module (CF) has been loaded and initialized on your machine.
- The application to be authorized is loaded onto your machine.
- The application to be authorized has been initialized with the AMINSAPP command (if required).

Note

Some applications are manually created in Application Manager as described in the *Installation and Setup Guide*. In this situation, the software is not loaded the application is not initialized.

To apply authorization codes, follow these steps:

1. Go to the System Manager Main Menu, shown in Figure 36, by entering the following command:

```
STRM400
```

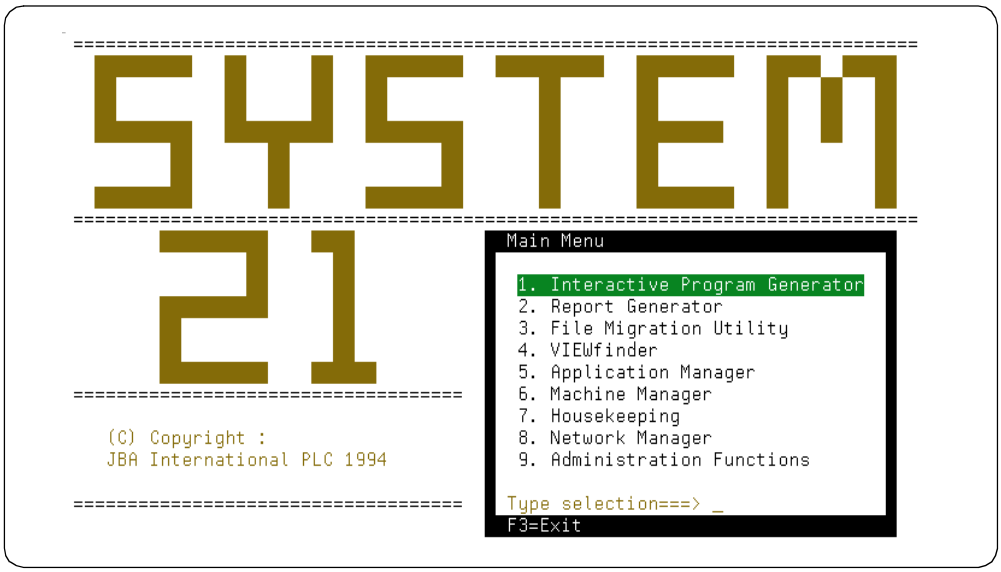

Figure 36. Manager 400

2. Enter option 9 (Administration Functions) from the menu to enter Administration Functions. Then enter option 4 to apply authorization codes.

The workstation displays the serial and model number of the machine and all the applications that are currently defined to Application Manager as shown in Figure 37.

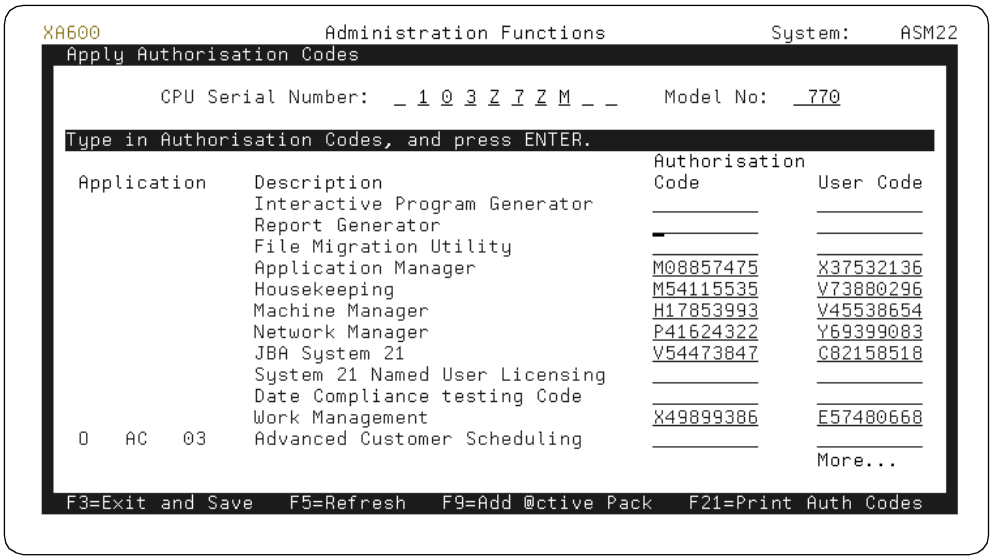

Figure 37. Authorization code entry

The *Installation and Setup Guide* and the *Administration Functions Product Guide* provides full details of the Apply Authorization Codes function.

Note

After the authorization codes have been entered, use menu option 3, Authorization Codes, to return to Apply Authorization Codes. Press F21 to print a list of the codes. This list can be checked to identify any authorization codes that have been entered incorrectly and kept for your records.

5.3.2.5 Demonstration data

The demonstration companies, Z1, Z2, Z5 and Z6, have been set up and provided for familiarization of the software. The demonstration data is enough to provide sufficient information to enable verification of successful loading of the application. However, the data does not fully imitate the total setup of the software, because the setup has to be tailored to specific business environment.

Two additional education companies, US and U2, are included. These are specifically for demonstration of the core applications (US) and style applications (U2) for US-based installations.

Refer to the *Installation and Setup Guide* for the complete steps on setting up companies.

5.3.2.6 Geac Electronic Customer Support (ECS)

Geac supports direct dial-in connections for electronic support. ECS installation is not mandatory at this stage of the installation. The ECS dial-in connection is installed and configured by a Geac Technical Consultant or Software Service Consultant. For more information, see Appendix D, “Support” on page 573.

5.3.2.7 Service Packs

The next step is to use the PTF management system to apply any Service Packs included with your shipment. Instructions for installation and documentation of the Service Pack will be included with the shipment, as well as on the CD-ROM.

5.3.3 Post installation backup

At this time, we recommend that you back up the System 21 software. This can be achieved by following the instructions in Chapter 9, “Backup and recovery” on page 251.

This concludes the installation of the System 21 software on the AS/400 server. The next step is to install the System 21 Explorer product on a client computer.

5.4 Client installation

System 21 client products are used to access the System 21 product set. It allows access to the business functionality, as well as the OS/400 functions. The main product of the client products is System 21 Explorer, which is a prerequisite for all other desktop-based products.

The basic steps to installation of the client products are:

1. Install
2. Configure
3. Install Customizer

The instructions outlined in this section intend to give an overview of the process. To actually perform the installation, review and use the System 21 installation instructions.

A typical simple TCP/IP network is assumed for this overview.

5.4.1 System 21 Explorer

The System 21 Explorer is installed from the CD-ROM labeled @ctive Enterprise Framework January 2000 Edition. The instructions for the installation are included on the CD-ROM in Adobe Acrobat format. To view the help document, open the WI.PDF file on the Explorer CD-ROM using Windows Explorer.

System 21 Explorer is installed via a standard Install Shield installation interface. There is an additional option on the installation for the administrative tools. This option provides a tool to configure and authorize the functions of System 21 Explorer.

To start the System 21 Explorer installation procedure, place the System 21 Explorer CD-ROM on your PC CD-ROM drive. Then, run the setup.exe program from the ExpJan2000 directory. The Install Shield prompt appears as shown in Figure 38.

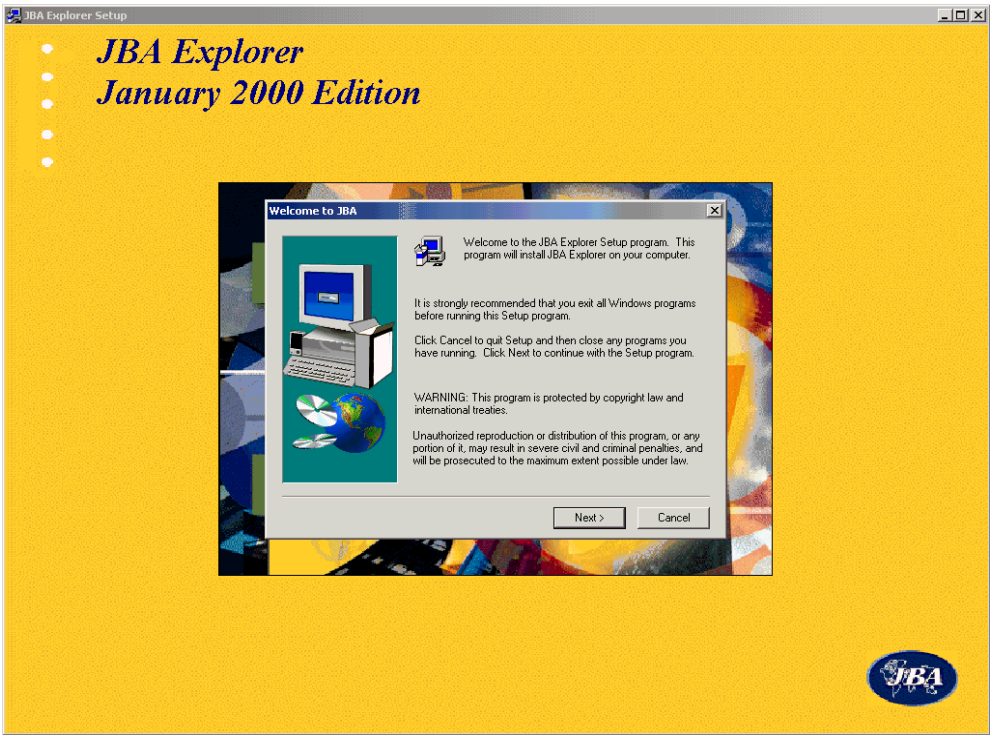

Figure 38. Install Shield installation prompt

Following the prompts, be sure to read the readme.txt file.

On the Select Components display (Figure 39), you see the option for Administration Tools, which provide the ability to launch the System Configuration tool.

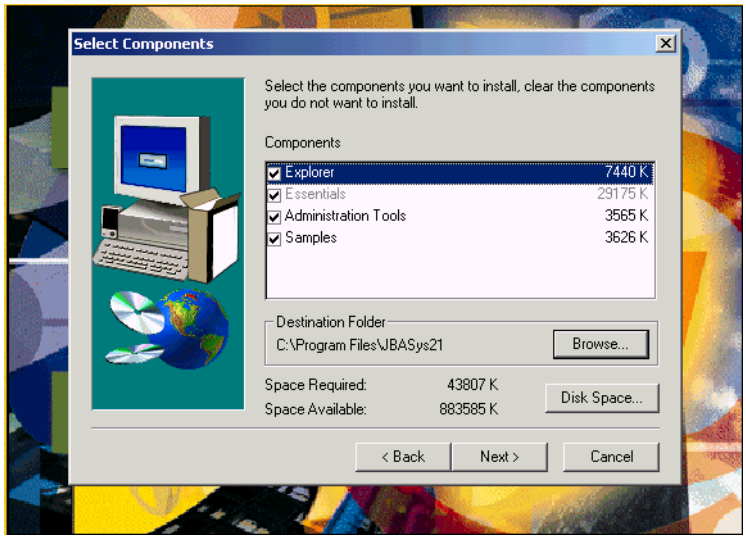

Figure 39. System 21 Explorer - Install Shield options prompt

Administration Tools should be selected for this installation. They are used later in this section to configure the System 21 Explorer desktop.

Follow the Install Shield prompts to install the software.

Upon completion of the installation, System 21 Explorer should be installed onto your PC. The default installation is to the C:\Program Files\JBASys21 directory.

The contents of the directories are shown in Table 15.

Table 15. System 21 Explorer directory contents

Directory	Content
JBASys21	Program executables, DLLs, default initialization file (jbasmg.ini), read-me text files
Data	Local databases used for the currency-conversion feature and other common functions
Default	Base structure used as the default for a new System21 Explorer Application Version.
DVRes	Resources required for the Document viewer function
ExpSamples	Samples for exploring the interfaces and advanced functions for System 21 Explorer.
Fonts	Fonts for Explorer sessions. Note that this is where the zero-dot font is located.
Help	Windows-based help files.

The configuration of System 21 Explorer is described in 5.5, “Setting up System 21” on page 107.

5.4.2 PC Uplift installation

PC Uplift is an optional client component. Full installation instructions for PC Uplift are included on the PC Uplift CD-ROM.

5.4.3 Geac Visualize installation

Visualize is an optional client component. Full installation instructions for Visualize are included on the Visualize CD-ROM.

5.4.4 Customizer

Customizer delivers the current business function definitions that are available for System 21. These business functions are represented in System 21 Explorer as activities that the user will manage to perform daily functions.

The Customizer is delivered on the Geac Explorer Customiser CD-ROM. The current CD-ROM contains Version 3.5.0 through 3.5.2 SP3 of System 21 applications.

Follow the Install Shield prompts to obtain the dialog for the version selection as shown in Figure 40.

Figure 40. Customizer installation - Select version

Select the System 21 version that is installed on the AS/400 server.

A dialog to choose components to be installed is presented. This list is further subset by selecting a component and clicking the Change button. The result is a list of System 21 applications that belong to the components as shown in Figure 41.

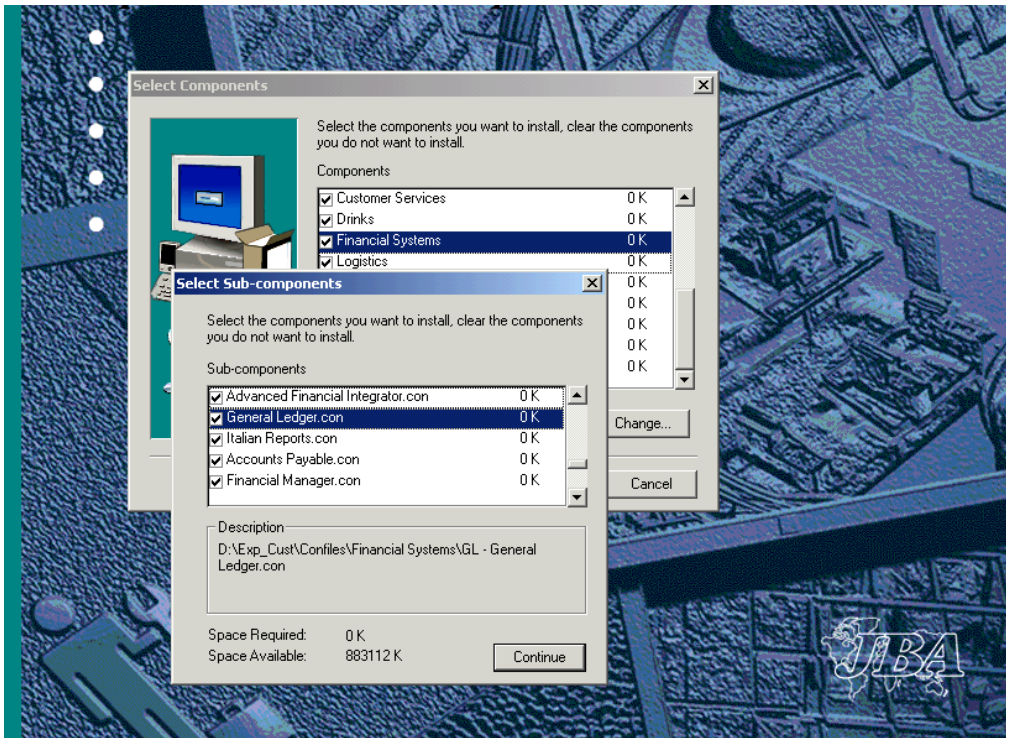

Figure 41. Customizer - Custom installation

Each application delivers the activities needed to support the application to the Explorer interface.

In this example, select the default of all applications, and click **Continue**.

If this is a new installation, a prompt for copying Demonstration Roles is presented as shown in Figure 42 on page 104.

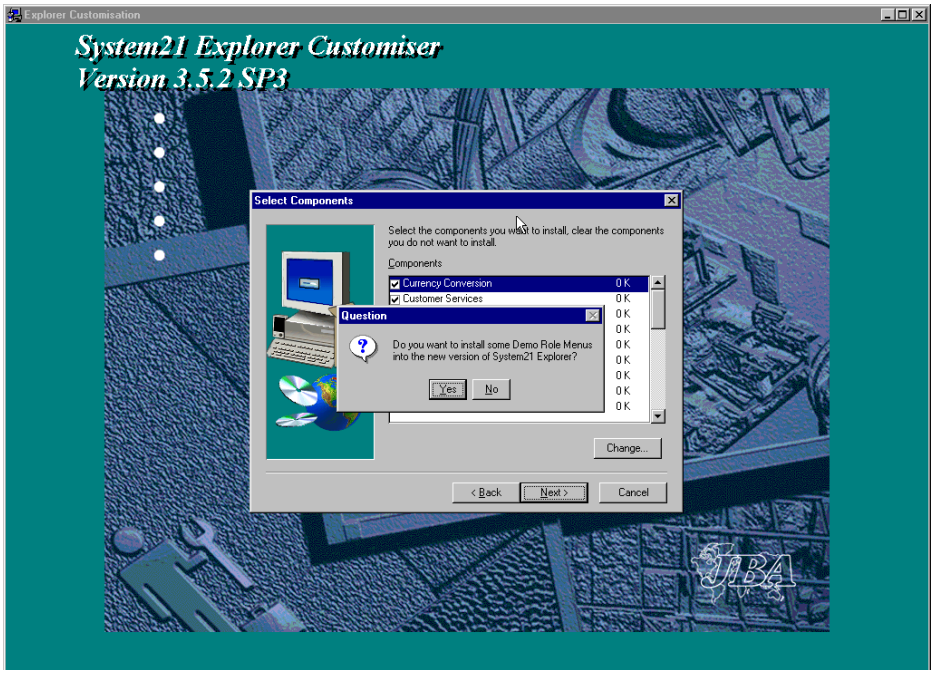

Figure 42. Selection of Demonstration Roles

For this installation, click **Yes**, and then select all of the demonstration roles presented.

Follow the dialogs to complete the installation.

At the end of the installation, the dialog shown in Figure 43 appears.

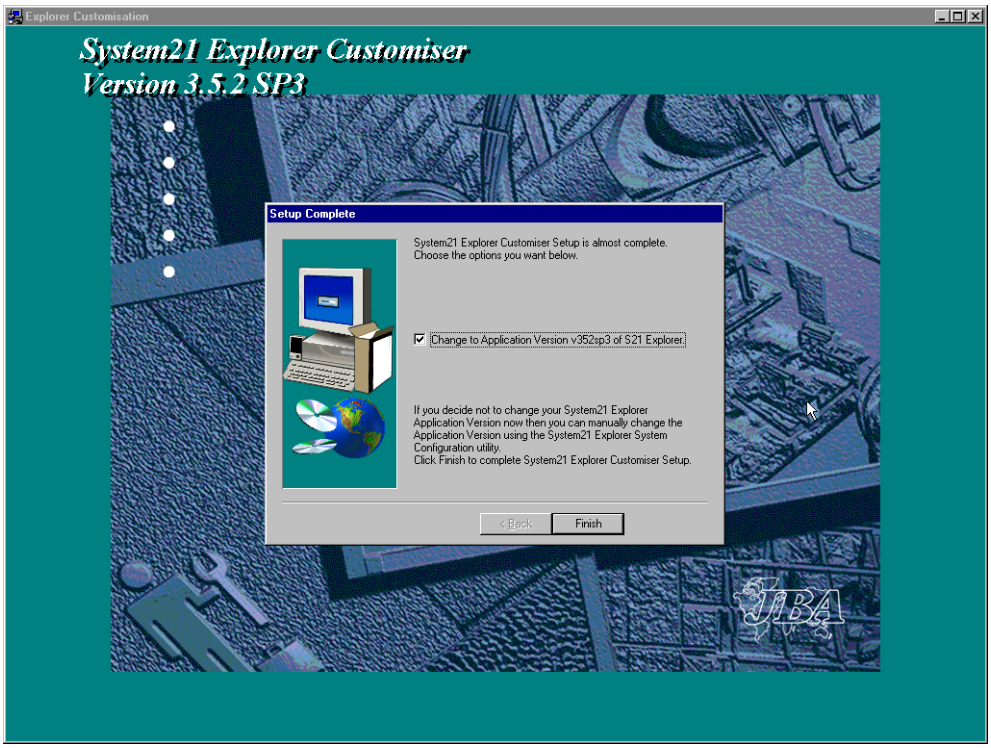

Figure 43. Customizer switch to application

Select the check box to allow Customizer to switch the Explorer default application.

5.4.5 Documentation and help

Documentation for System 21 is available in two products:

- Visual Documentation
- Infobase

5.4.5.1 Visual Documentation

The Visual Documentation CD-ROM contains the product guides for all of the System 21 products. Also included are overview sections with links to related manuals. These product guides are in Adobe Acrobat format on the Visual Documentation CD-ROM.

The Adobe Acrobat Reader installation is included on the CD-ROM if it is needed.

There is no installation required for the product guides. They can be read directly from the CD-ROM or copied to a hard disk drive or to a network server.

As a starting point, open the Contents.pdf file as shown in Figure 44. This file allows navigation out to all of the product guides.

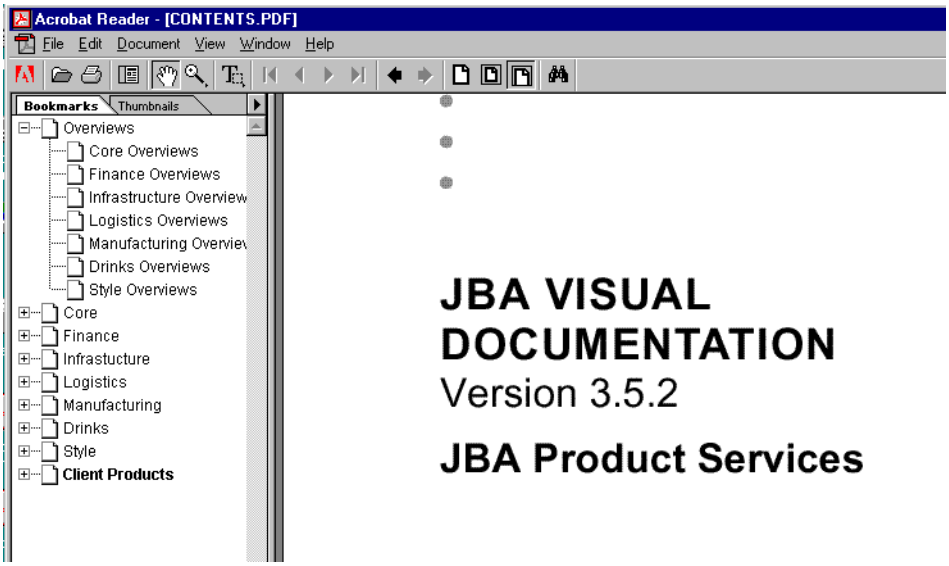

Figure 44. Visual Documentation Contents.pdf file

5.4.5.2 Infobase

The Infobase CD-ROM contains the documentation for System 21 applications in the Windows Help format. This documentation is not stored on the AS/400 system with the System 21 applications. The Infobase Start menu is shown in Figure 45 on page 106.

Figure 45. InfoBase Start menu

A sample Infobase is shown in Figure 46.

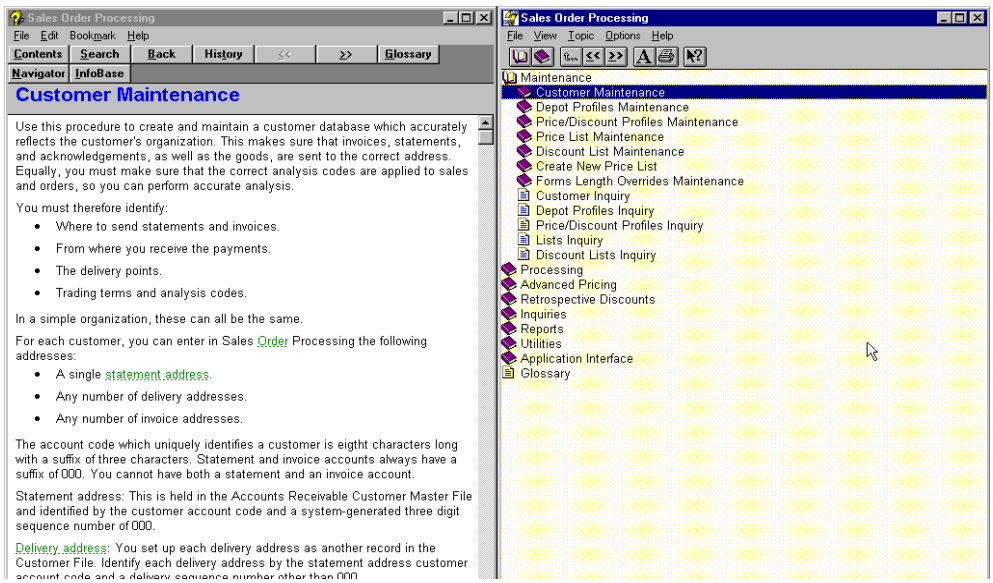

Figure 46. Sample Infobase

There are three scenarios for installing the Infobase:

- Installation to a PC as Windows Help
- Installation of the index file to associated context level help to the Explorer interface
- Reading help files directly from the CD-ROM

The installation is described in the Readme.txt file located on the CD-ROM and is performed via standard Install Shield interfaces. A demonstration of Infobase is included in the installation that can be viewed from the CD-ROM by running the Ibdemo3.exe file in the Infodemo directory.

5.5 Setting up System 21

System 21 can now be tested to ensure it is working functionally as configured.

System 21 Explorer is used to test the software. This section explains the steps necessary to perform the final minimum configuration of System 21 Explorer and System 21 Administration. This is followed by the System 21 activity test.

5.5.1 System 21 Explorer configuration

The System Configuration tool is installed together with System 21 Explorer when the Administration option is selected. This allows access to the protected configuration options in System 21 Explorer.

A deployment decision is required as to how System 21 Explorer will be installed in the user environment. Typically the configuration tool is not installed on the user desktop. System configuration, access options, and activity definitions are generally managed at a central or departmental level and then deployed to the user desktop.

In the following example, System 21 is installed locally on the PC, and the System 21 Explorer Administration tool is selected as an option during the installation.

5.5.1.1 Configuration steps

To configure System 21 Explorer, perform the following steps:

1. Launch the System Configuration tool from the Windows Start menu by clicking **Start->Programs->JBA System21->System Configuration Tool**. The dialog in shown in Figure 47 appears.

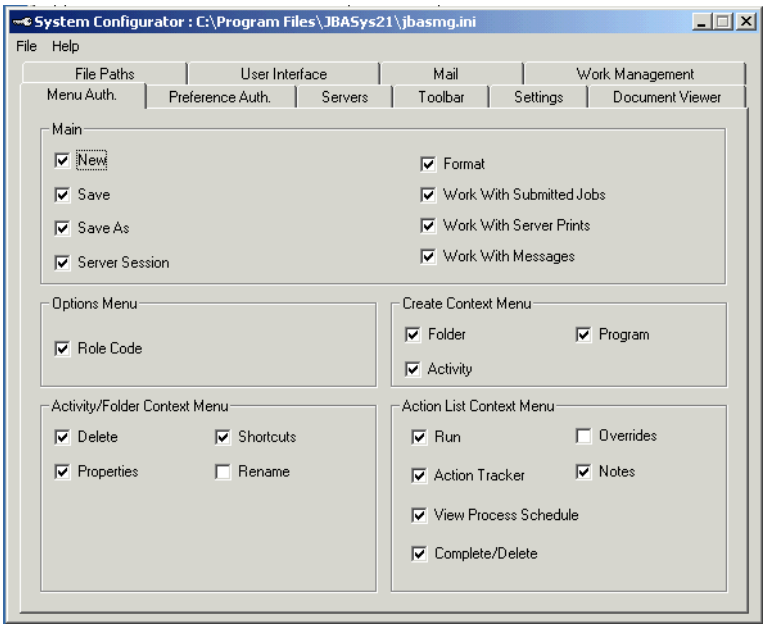

Figure 47. System 21 Explorer Configuration Tool - Menu Authorization

2. Select the **Servers** tab near the top of the dialog. The Servers dialog is shown in Figure 48 on page 108.

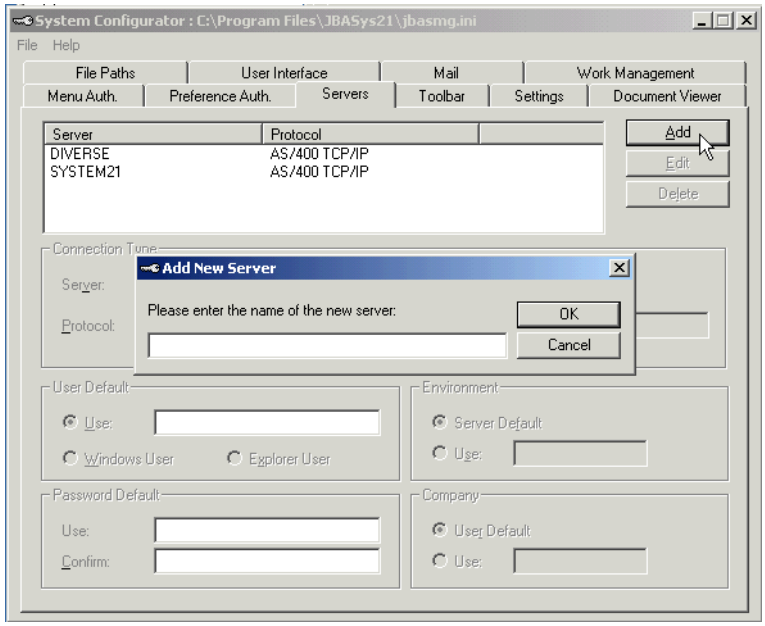

Figure 48. System Configuration tool - Add New Server

3. Click the **Add** button. Enter the name of your AS/400 server, and click **OK**. The full server dialog appears as shown in Figure 49.

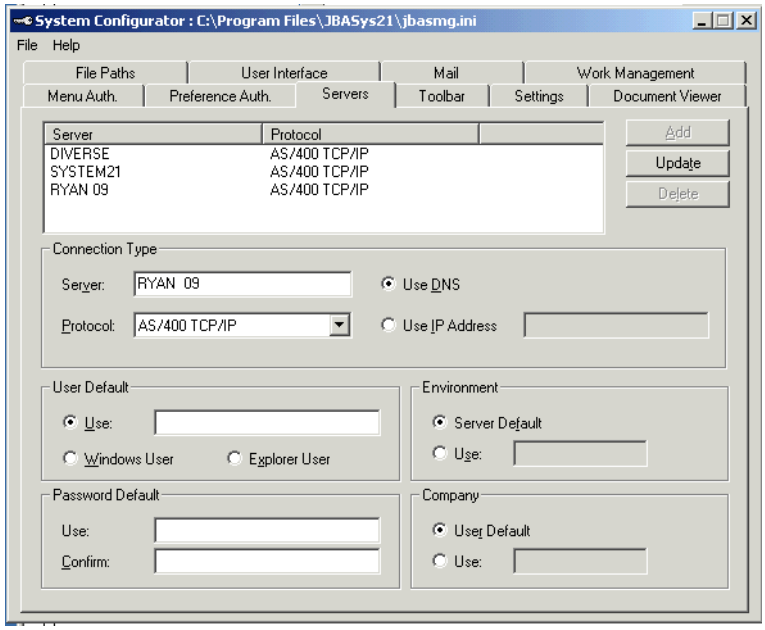

Figure 49. System Configuration Tool - Server definition dialog

If you are not using DNS on your network, select **Use IP Address** to enter an IP address directly.

For this sample, ensure that AS/400 TCP/IP protocol is selected, and click the **Update** button.

4. System 21 Explorer allows new roles to be created and existing roles altered if users are authorized. Because new roles are required in the setup, click the **Settings** tab.
5. Select the Role Menu options to enable Role Menu Designer and Allow Activities to be moved as shown in Figure 50.

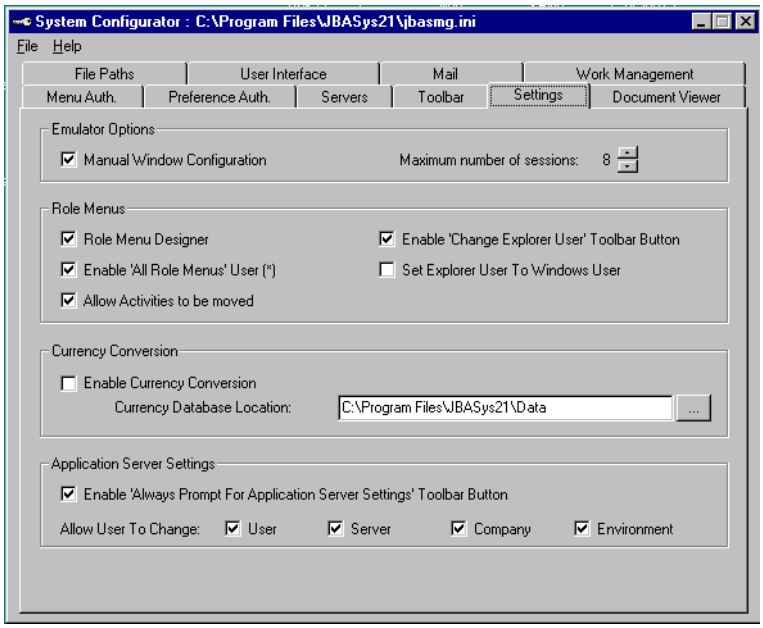

Figure 50. System Configuration tool - Settings

The creation and maintenance of roles also need access to functions on the System 21 Explorer interface for optional menus.

6. Click the **Menu** tab. Select all options in the Main, Create Context, and Activity/Folder Context as shown in Figure 51.

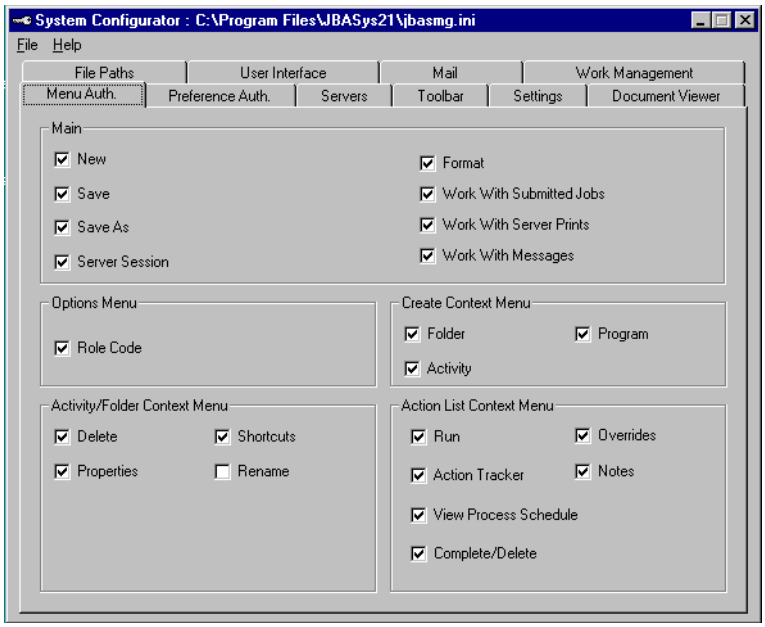

Figure 51. System Configuration tool - Menu Authorization

7. Save the data from this change by selecting **File->Save**. Then close the Configuration Tool by clicking **File->Exit**.

This completes the configuration of Explorer. The next step is to set up a simple role to use in Explorer.

5.5.2 Role setup

The installation of Customizer should have provided Demonstration roles. In this section, the Role Menu Designer function of System 21 Explorer is used to create a new role.

Roles are user-defined segments of your business to which users can be assigned. Roles are defined by your organization to reflect the structure and usage of System 21 Explorer. Each role has System 21 activities assigned to it. This, in effect, provides each user with a subset view of System 21 that is appropriate for their respective needs. A user can belong to multiple roles if they perform in cross-functional areas.

Figure 52 shows System 21 Explorer with a Role, Role Menu Designer, and the Activity List opened.

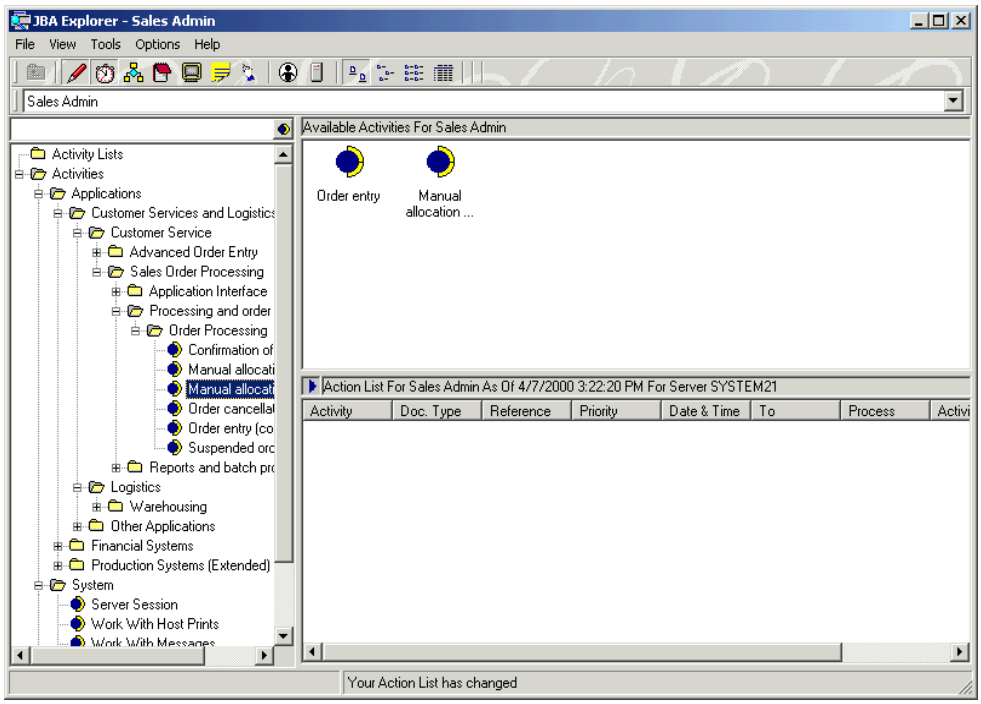

Figure 52. System 21 Explorer roles

Roles do not equate authorization. Belonging to a role does not authorize the user to the activities in the role. Authorization is always checked on the server prior to executing the activity.

To set up roles, perform following steps:

1. Start System 21 Explorer by clicking **Start->Programs->JBA System21-> JBA Explorer** from Windows.

2. Create a new role by clicking **File->New**. There should now be a blank role titled Role Menu Designer(1) on the work space. Activities can be added to the new role by using the Role Menu Designer. This is added to System 21 Explorer by selecting **Tools->Role Menu Designer**. If the Role Menu Designer option is not present, review the 5.5.1, “System 21 Explorer configuration” on page 107.
3. From the Role Menu Designer, click **Activities->Applications->Customer Service and Logistics->Logistics->Inventory Management->Enquiries** as shown in Figure 53.

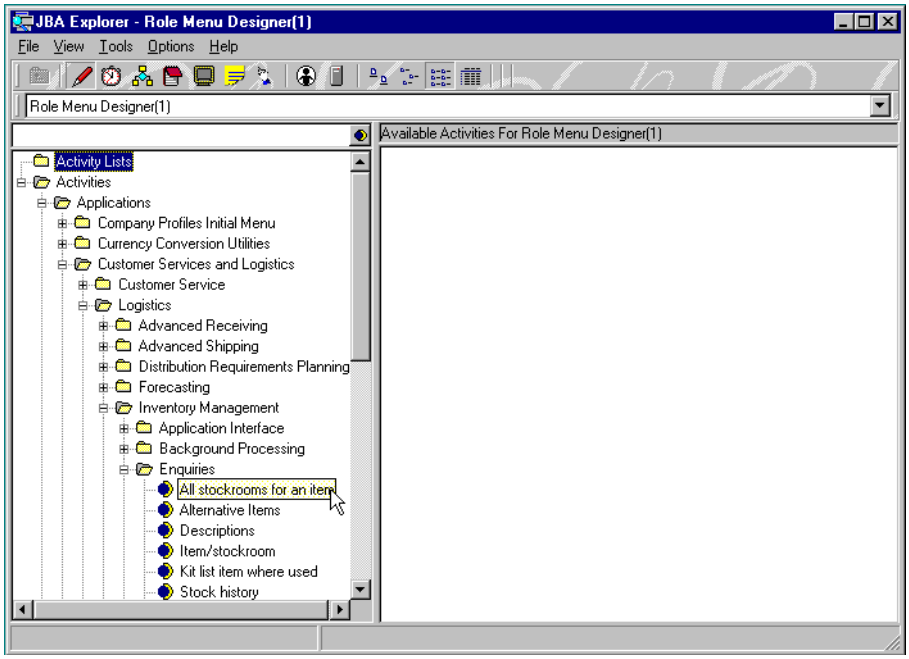

Figure 53. Role menu design - Drag activity

4. Drag **All stockrooms for an item** to the activities work space on the right.
5. Select **File->Save** and enter a name for the new role.

Other activities can be added via Role Menu Designer and by right-clicking in the activities work space as shown in Figure 54 on page 112. This presents context-sensitive options that are also controlled by the System Configuration tool.

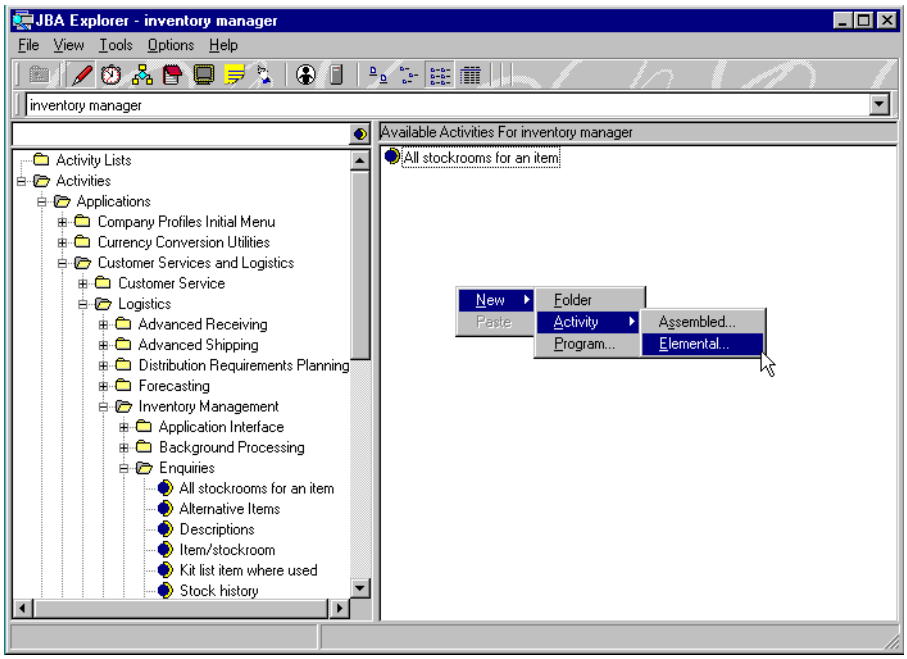

Figure 54. Role maintenance - Additional activities

Using these menus provides for the organization of activities into folders as well as launching native windows applications and objects from the System 21 Explorer interface.

Role Menu Designer can now be removed from the work space by clicking **Tools->Role Menu Designer**.

5.5.3 Setting up a System 21 user for an initial test

System 21 applies a layer of security and controls inclusive of OS/400 security. This section provides an overview of the setup of a user for System 21 that is used in the initial test of the software.

This section provides an example of creating a default user that is used to test few primary System 21 functions. This is not an extensive review of the user setup process. Details of user setup are outlined in the *Administration Functions Product Guide* in conjunction with the *Application Manager Product Guide*. Security aspects are explained in Chapter 7, “Security” on page 209.

The default System 21 user, QPGMR, is initially authorized to access all business functions and all demonstration companies. Access to Administration Functions is restricted and is controlled by your Application Manager user profile. When shipped, Application Manager is set up to allow access to the system security officer (QSECOFR). The QPGMR user can be copied to create new user profiles.

Perform the following steps:

1. Sign on to the AS/400 system using the QSECOFR profile.
2. At a command prompt, type the Start IPG Common Functions command:

```
STRIPGCF
```

3. Press Enter. The Administrative Functions menu is presented as shown in Figure 55.

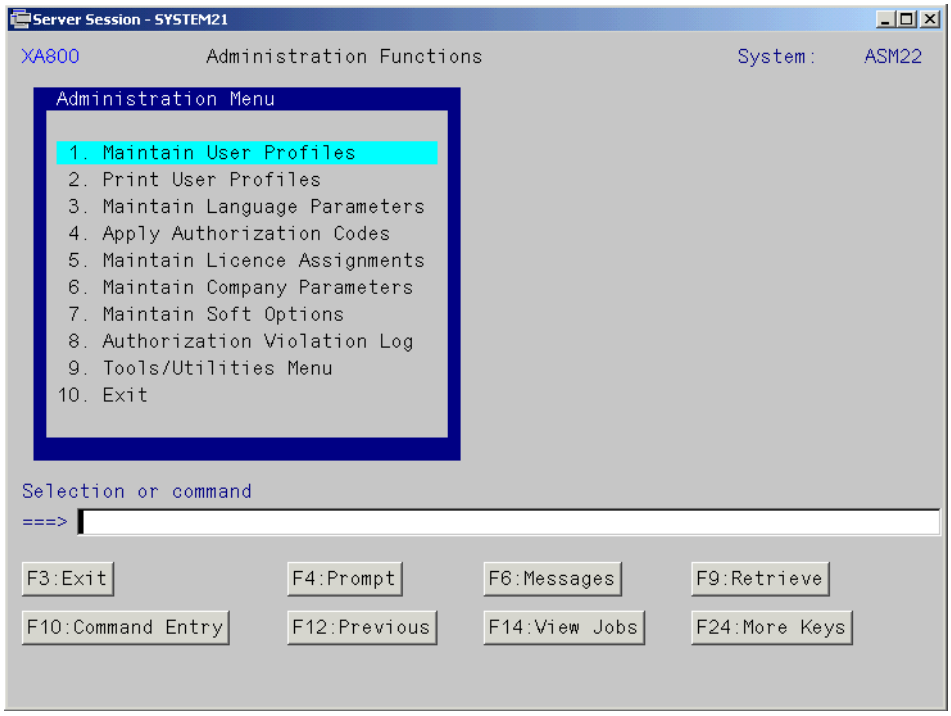

Figure 55. STRIPGCF Common Functions panel

4. Enter option 2 (Maintain User Profile) to proceed to user profile maintenance.

   The first panel presented allows you to select the user to be maintained as shown in Figure 56 on page 114.

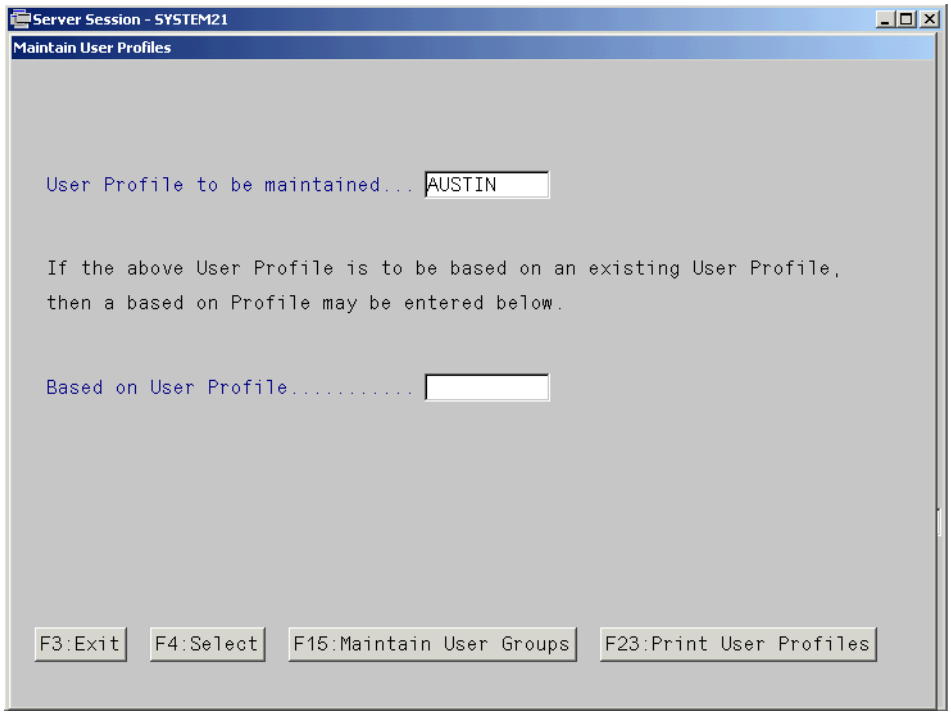

Figure 56. Maintain System 21 User Profile

The System 21 user profile equates to the OS/400 user profile name. Generally, all users of the AS/400 system need to be defined to System 21 Common Functions.

5. To review users that are already defined to System 21, click the **Select** button. This presents a list of users from which you can choose (Figure 57).

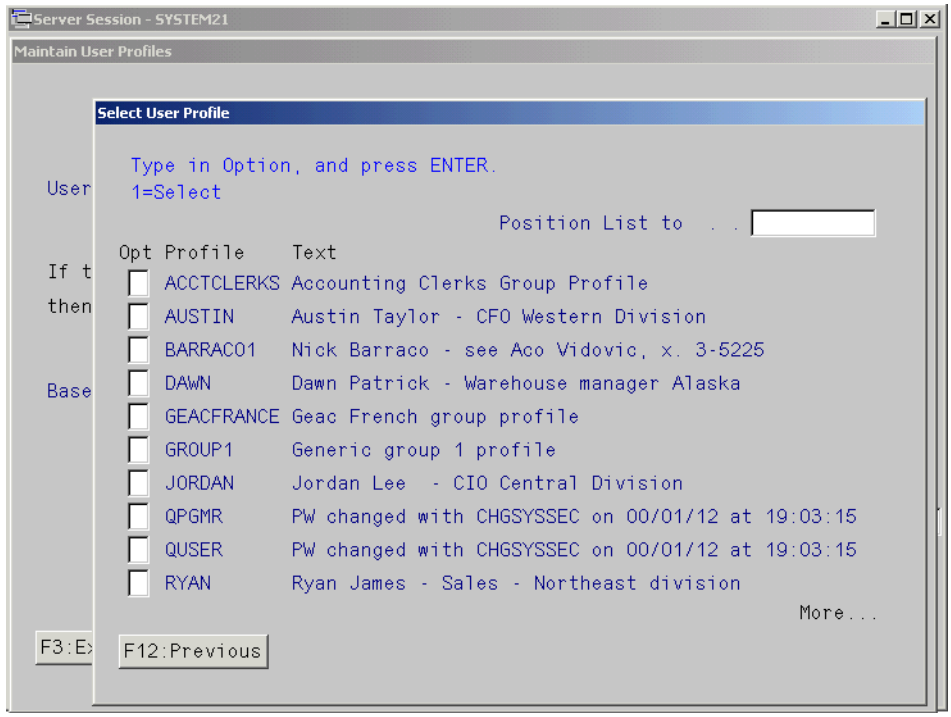

Figure 57. User Profile selection prompt

6. System 21 User Profile Maintenance supports the copying of group or user profiles during the creation of a new user. To create the new user based on another user, position the cursor to the Based on entry, and click the **Prompt** button. This also presents the same list as shown in Figure 57.
7. For this initial setup and test, enter QPGMR into the Based on user profile field as shown in Figure 58. Press Enter to create a user.

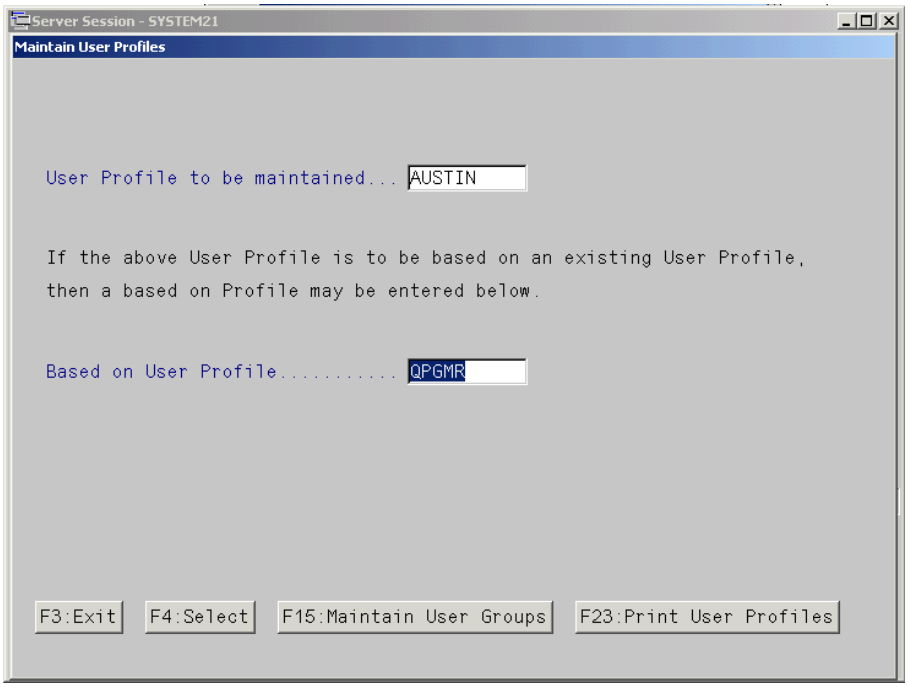

Figure 58. Creating a user based on QPGMR

This creates a new System 21 user based on QPGMR and copies all rights and settings from QPGMR. Since QPGMR has access to all application activities and companies, this new user will as well.

The User Profile Maintenance panel is displayed. If the user has not been defined to OS/400, the text for the user text is shown as “User not defined to OS/400”.

8. The QSECOFR profile has the rights to create the OS/400 user at this point. This can be done by clicking the **More Keys** button to present additional function keys, which are shown in Figure 59 on page 116.

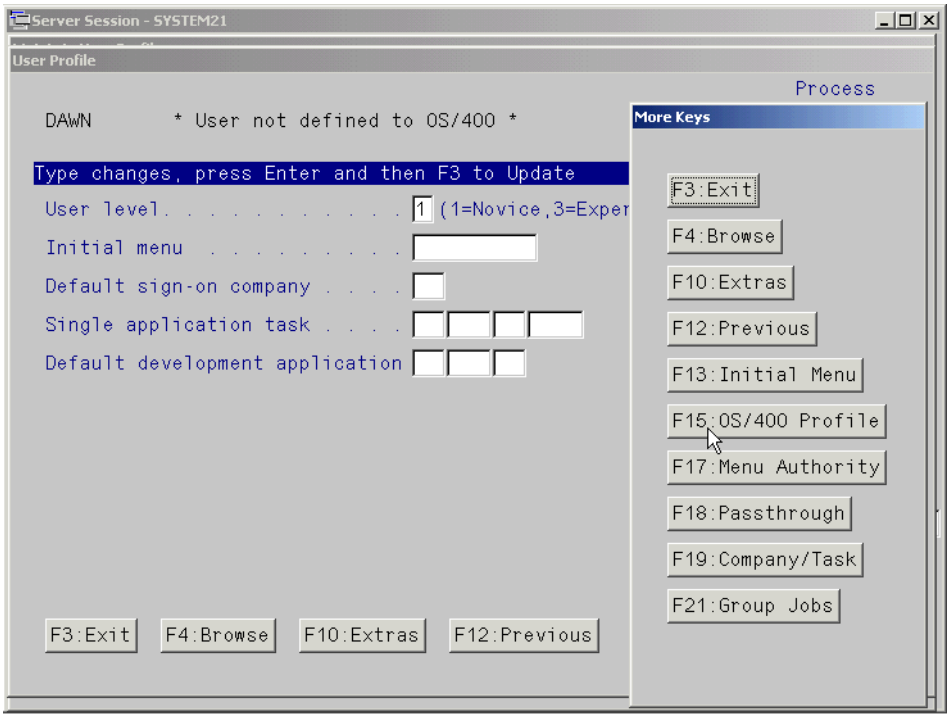

Figure 59. Common Functions - User not defined

The OS/400 Profile button requests creation of a new OS/400 profile via the Create User Profile (CRTUSRPRF) command. If the OS/400 profile already exists, it will request maintenance of the user profile via the Change User Profile (CHGUSRPRF) display as shown in Figure 60.

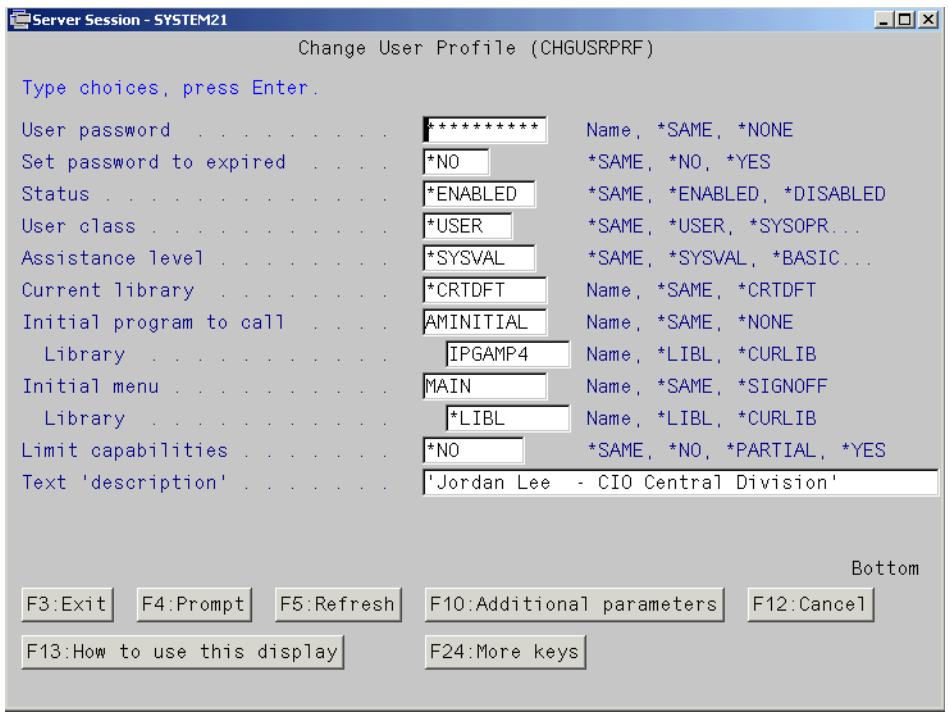

Figure 60. User Profile creation via Common Functions

When creating the OS/400 profile, it is useful to enter text into the description entry.

9. Following the create or change of the OS/400 profile, the System 21 user profile maintenance panel is presented. To reveal the full user profile details as shown in Figure 61, click the **More keys** button, followed by clicking the **Extras** button. Alternatively, you can press the F10 (Extras) key.

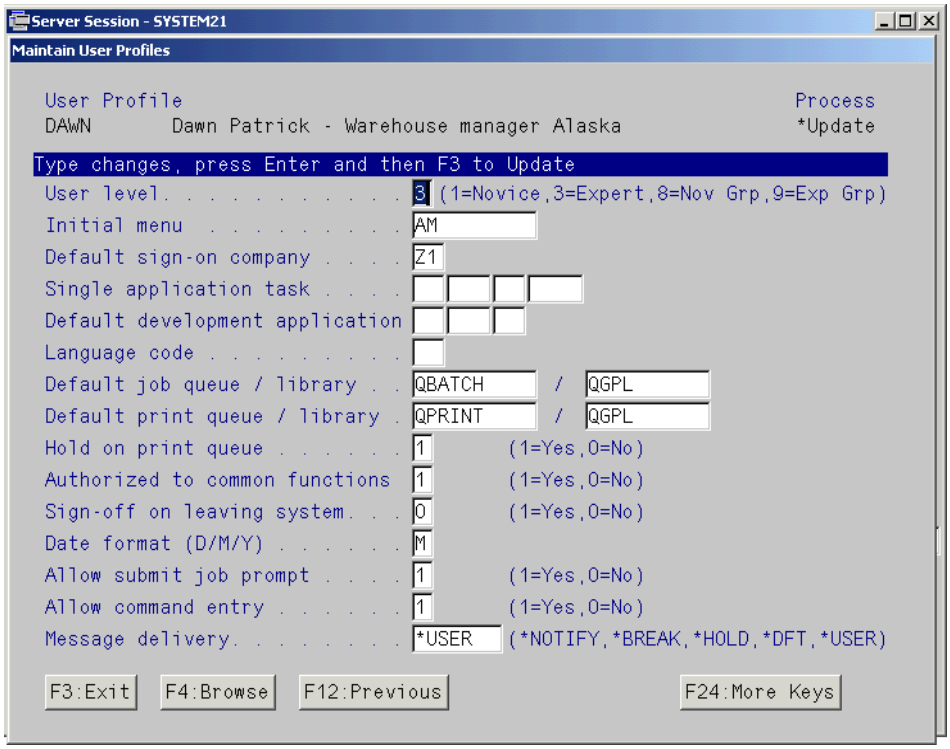

Figure 61. System 21 user profile maintenance

For details about the options provided here, refer to the *Administration Functions Product Guide*.

10. Click the **Exit** button to complete the changes, and save the user profile.

5.5.4 Testing an activity

At this point, System 21 should be ready for testing in the default shipping configuration. Perform the following actions:

1. If System 21 Explorer is not active on the desktop, start System 21 Explorer by clicking **Start->Programs->JBA System21->JBA Explorer**.

   The role created in 5.5.2, “Role setup” on page 110, should be active in the work space. This should provide an activity to all stockrooms for an item inquiry as shown in Figure 62 on page 118.

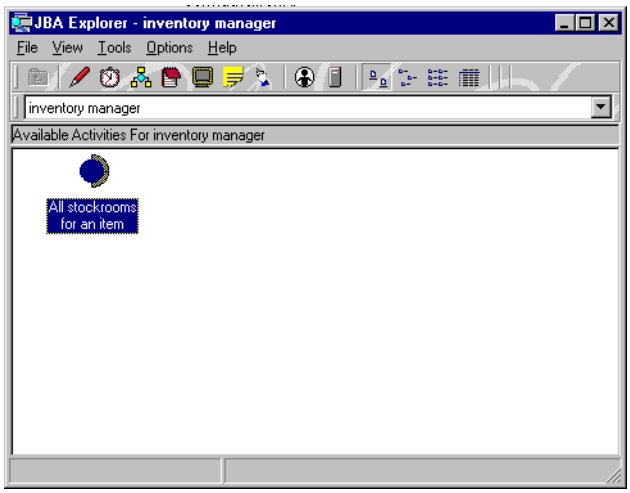

Figure 62. System 21 Explorer activity

2. Double-click the activity icon to start the activity. A logon panel for the AS/400 server should appear in the Application Server Settings dialog as shown in Figure 63.

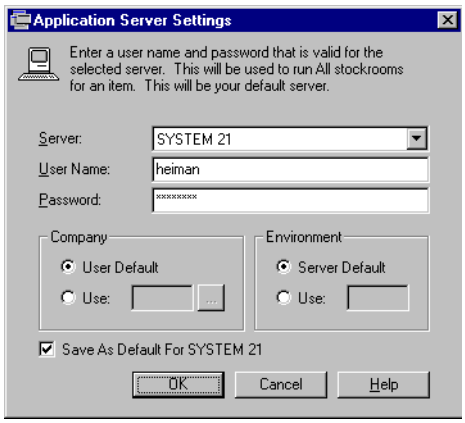

Figure 63. System 21 Explorer logon

3. Enter the user ID and password. Click the **OK** button to continue the logon process. At this point, the user interface for the activity is presented as shown in Figure 64.

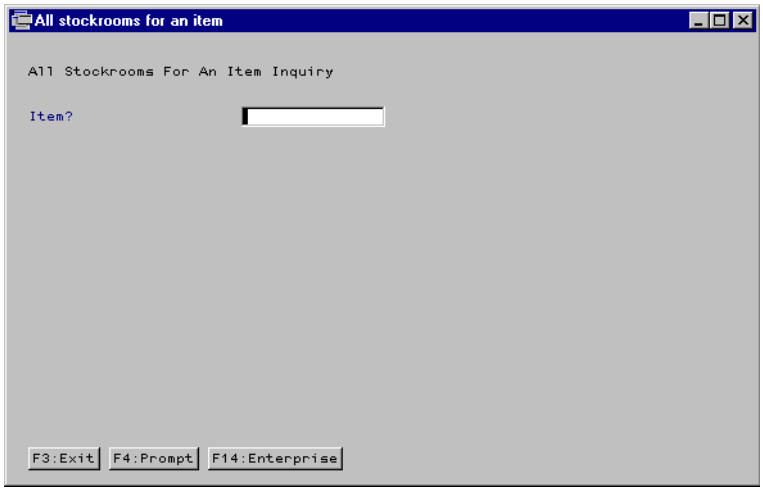

Figure 64. Active System 21 Explorer activity

Now, the basic configuration and test of the installation are complete.

5.6 System 21 Explorer advanced set up

This section only explains how to use a few of the commonly used System 21 Explorer functions, since there are too many options to cover. Read the *System 21 Explorer Product Guide* and the System 21 online help text to learn about many other options available to your site.

Note

When using dialogs in System 21 Explorer, help text is available to explain the options being presented.

5.6.1 Explorer desktop preferences

System 21 Explorer allows each user to customize preferences according to their working environment. From the System 21 Explorer menu bar, click **Options->Preferences**, which produces the dialog in Figure 65 on page 120.

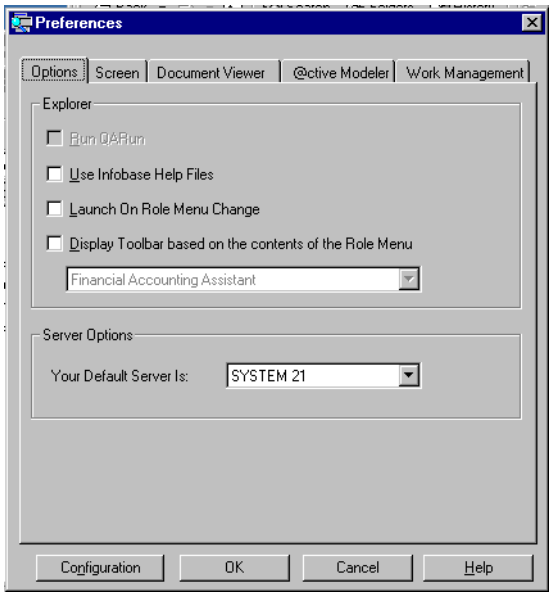

Figure 65. Explorer Preferences - Options

All changes made here, with the exception of activating Designer, will take effect immediately in the current Explorer session. Explanation and tips for using some of these preferences are listed here:

- **Options tab**

  Display Toolbar based on the contents of a Role Menu option: Select this option if you have three or four common activities that you need to access readily.

  Default Server option: Set the default server for your connection. If you want to change the default server for your logon, the name of the server can be set here.

- **Screen tab**

  The Function Key Text Only option removes the function key from the text on all function keys in the emulator. For example, the F3=Exit button would become Exit.

  The Clip Top and Bottom System Wide Settings cause the screen emulator to remove the number of designated lines from the top and bottom of all panels being emulated. In System 21, these are set to the two top lines to remove the Title lines of all panels, giving the result a more Windows standard look.

  The Remove Stops (periods) setting adjusts all screens that have System Application Architecture (SAA)-type field prompts to remove the “.” characters. An example of this is shown here:

  `Customer Number ........ _____` will become

  `Customer Number         _____`

  If the Stops are preferred, be sure that this option is not selected.

- **Document Viewer tab**

  Call Document Viewer for all Linked Fields requests Document Viewer to evaluate the existence of documents attached to elements in the System 21

database. Document Viewer is described in 5.6.5, “Document Viewer” on page 123.

5.6.2 Explorer workspace manipulation

The main space of System 21 Explorer is referred to as the work space for the role. In the work space, controls can be created, edited, and removed for the definition of the role. The workspace supports shortcuts to:

- Any Windows application or file
- Folders for organizing the workspace
- Shortcuts to OS/400 commands

Use the Folders option to keep the role organized and provide structure to the user for roles that have many activities. The properties of the Elemental activities allow the creation of the AS/400 connection to start:

- System 21 task from Application Manager
- OS/400 commands
- Server sessions

5.6.3 Toolbar

The toolbar in System 21 Explorer can be altered to add user options and local applications. Figure 66 shows an example of how access to the Windows calculator and Customer service procedures have been added to the toolbar.

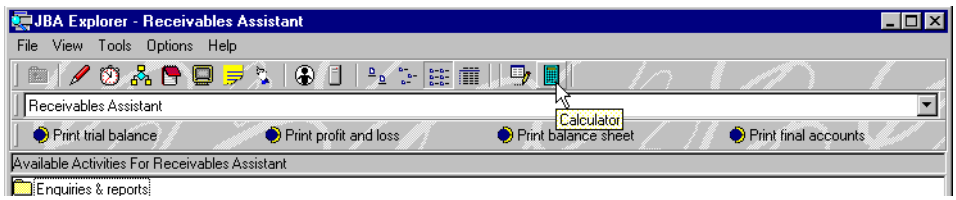

Figure 66. Explorer toolbar with modifications

Modifications to the toolbar can be done with the System Configuration tool as shown in Figure 67 on page 122.

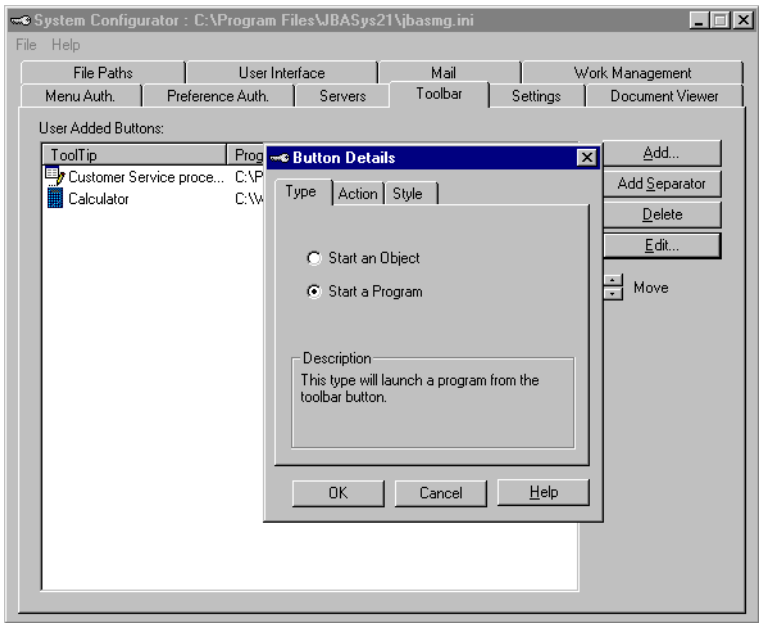

Figure 67. System Configuration - Toolbar

The applications that can be added to the toolbar are any executable files or any Microsoft Object Linking and Embedding (OLE)-compliant Dynamic Link Library (DLL) files. The default radio button is *Start an Object*. Using this option, a DLL can be invoked from the toolbar. The server and class must be specified on the Action tab for this option. The more common option is to start a program in which any Windows executable can be invoked. Using this option, the path to an executable file must be specified.

On the Style tab of the Add Buttons dialog, add the icon desired and the tip text to be used with the added application.

System 21 Explorer needs to be restarted for the changes to take effect.

5.6.4 JBA activity toolbar shortcuts

If you need an AS/400 program on the toolbar, use the program JBAShCut.exe and its relevant parameters. An example for using Display Messages is:

```
"C:\Program Files\JBASys21\JBAShCut.exe" "TASK21   CMDSPMSG"     "Work With
Messages"
```

The way to find the appropriate parameters is to use System 21 Explorer to select the role and task you want, and then right-click. To create a shortcut, perform the following steps:

1. Select **Shortcut**. Then, allow System 21 Explorer to create the shortcut on your Windows desktop.
2. Right-click on the desktop icon created by System 21Explorer, and select **Properties**.
3. From the Properties panel, click the **Shortcut** tab. Copy the shortcut string to the toolbar set up.
4. In the System Configuration tool, click the **Toolbar** tab. Click **Add** to add a new toolbar entry.

5. Select **Run a program**, and click the **Action** tab. Paste the entry to the Program field on the dialog.

5.6.5 Document Viewer

Document Viewer enables you to maintain a database of documents that can be accessed in a variety of ways. The Document Viewer database is a list of references to documents and does not hold the documents themselves. The actual documents may be held anywhere on your system.

You can configure Explorer to show these links using the System Configuration Document Viewer window. The documents you can view may be:

- PC files of any type, including executable files. For this, you must have an associated viewing program on your machine. For example, if the document is a bitmap, you can use Microsoft Paint as the viewing program.
- Web URL files. For this, you need Internet Explorer installed on your machine. Document Viewer will not work at all without this.

Documents may be attached to elements in the database as they are presented on panels, activities on the desktop, and activities in a work management business process.

The help text found in System 21 Explorer and in the *Explorer Product Guide* provides a full description and a tutorial for attaching documents to elements on a System 21 application panel.

5.6.6 Tips and Techniques documentation

The *JBA Tips and Techniques Help Guide* contains many common adjustments and error troubleshooting points. This help guide can be found by clicking **Start->Programs->JBA Help->JBA Technical Information** (Figure 68).

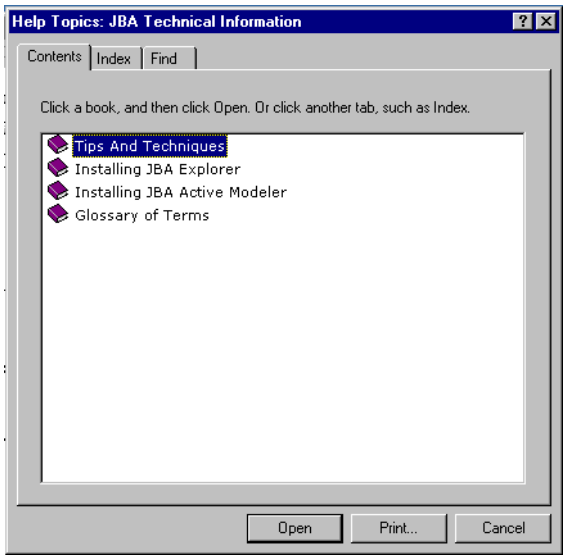

Figure 68. Technical Information Help text

This JBA Technical Information Help covers:

- Troubleshooting and troubleshooting checklist
- Trace configuration and collection
- Windows configuration for the initialization file (jbasmg.ini)
- Customizing the keyboard and colors
- Linking external Windows applications to Explorer screens

5.6.7 Windows NT Terminal Server

System 21 Explorer is certified on Windows NT Terminal Server Edition. This section outlines the steps needed to install and configure System 21 Explorer on Windows NT Server 4.0 - Terminal Server Edition.

System 21 Explorer should be installed and configured by someone with experience using Windows NT Terminal Server. The differences in Windows NT Server and Windows NT Terminal Server require understanding and expertise to be successfully implemented. This overview assumes that you have this knowledge.

5.6.7.1 Installing Explorer

Make sure you install System 21 Explorer either as the Administrator or as a user who is a member of the Administrators group. You must install System 21 Explorer using the Add/Remove Programs in the Windows NT Control Panel.

Perform the following actions:

1. From the Add/Remove Programs Properties, click **Install**. Then, browse to the Setup.exe file in the System 21 Explorer installation folder of the CD-ROM.
2. When prompted, keep the default **All users begin with common application settings** as shown in Figure 69.

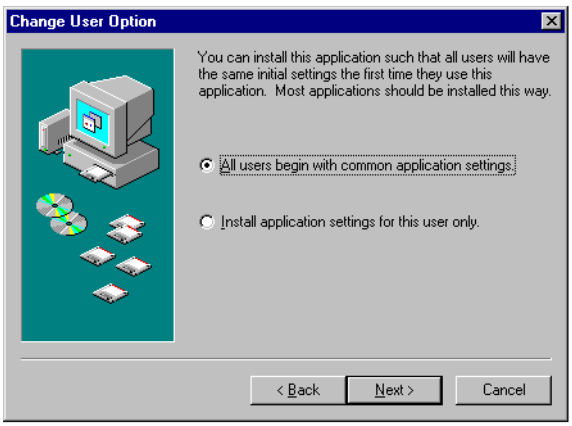

Figure 69. Install - Change User Option

3. Complete the installation by following the instructions within the dialog boxes. Be sure to select **Standalone** for the type of System 21 Explorer installation you require. Select all components of the System 21 Explorer.
4. When asked to restart your computer at the end of the System 21 Explorer installation, select **No**, and click **Finish**.
5. Complete the Terminal Server installation wizard as shown in Figure 70. Then, restart your computer.

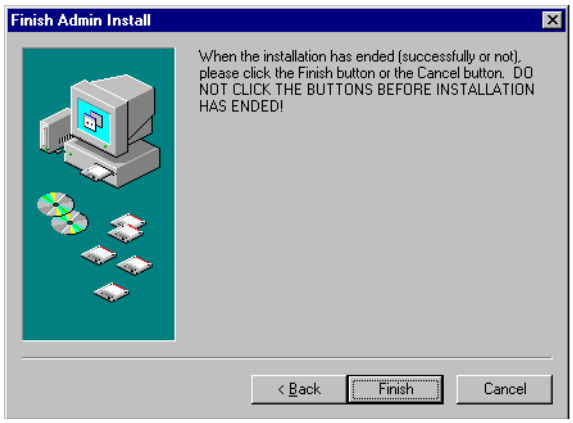

Figure 70. Completing the Terminal Server installation wizard

System 21 Explorer is now installed on the Windows NT Terminal Server machine. The next step is to create a user and set up the initialization file.

5.6.7.2 Setting up the initialization file

Create a user with User Manager for Domains for each client user that will use System 21 Explorer.

Initialization file

System 21 Explorer always attempts to locate the initialization file (jbasmg.ini) in the System 21 Explorer installation directory. The installation directory is typically C:\Program Files\JBASys21. If it is not found there, the user is prompted to find a location. This location is then stored in the registry for future access.

The initialization file can have any name as desired by your requirements. Examples of valid names are:

- jbasmg.ini
- Austin.ini
- Accounting managers.ini
- Shipping and warehouse.ini
- Jordan.Sep 00

Perform the following tasks:

1. Start the JBA System Configuration utility (installed by System 21 Explorer) by clicking **Start->Programs->JBA System21->System Configuration**. Initialization files can be opened, edited, and saved using the file option as shown in Figure 71 on page 126. Note that the currently opened initialization file is shown in the title bar. This utility updates the initialization file with the options desired for the end users. We recommend that you create a backup of the original initialization file first, by clicking **File->Save As**.

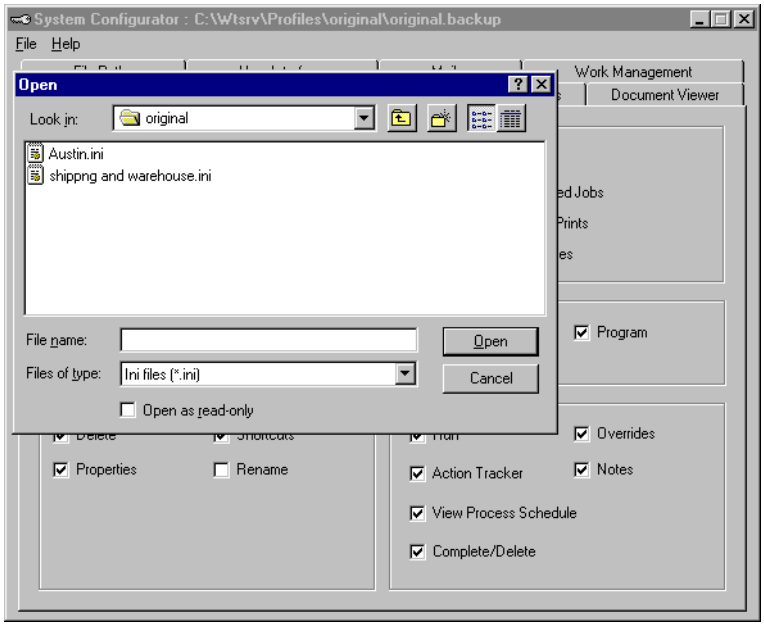

Figure 71. System Configuration - Open initialization file

Note

If you want users to have different configurations, create an initialization file for each user by clicking **File->Save As**. Be aware that no user can use the same initialization file. Therefore, every user that wants to use System 21 Explorer with the Terminal Server Client must have their own initialization file.

2. Create a directory for each user, and copy their configured initialization file into that directory. It is a good idea to use the user directory created when you sign on as the user. For example, if you created a user called TSUSER1, they would have a directory C:\Wtsrv\Profiles\TSUSER1 after the user logged on for the first time. We recommend that you create a backup directory.
3. Rename the jbasmg.ini file in the installation directory (for example, jbasmg.ini to jbasmg.org; this could be the original backup). The default installation directory is \Program Files\JBASys21. This causes System 21 Explorer to find an alternate initialization file.

Logging on to the client

To log on to client, perform the following steps:

1. Start System 21 Explorer from the Windows Start menu. Because the default initialization file (jbasmg.ini) does not exist in the installation directory, you are asked to locate the initialization file as shown in Figure 72.

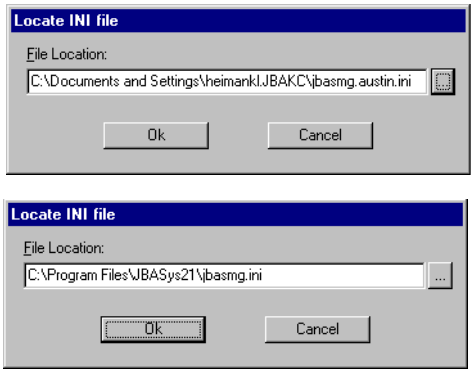

Figure 72. Selecting a custom initialization file

2. Click the **browse** button, and find the User directory where the intended initialization file exists (as created earlier).

   This updates the System Registry for the location of the initialization file for the current user. Every time that user starts System 21 Explorer, it will automatically point to this location. Therefore, the mapping of the initialization file only needs be carried out once. If the location or name of the initialization file is changed, the same prompts will assist in finding an initialization file again.

Note

To restrict the access to shortcuts on the Start menu for the end users, cut the System 21 shortcuts to restrict from the All Users start menu and paste them to the Administrators directory. This will give the administrator access to the restricted functions.

5.6.7.3 Setting up program shortcuts

The System 21 Explorer installation builds the shortcuts on the All Users start menu as shown in Figure 73.

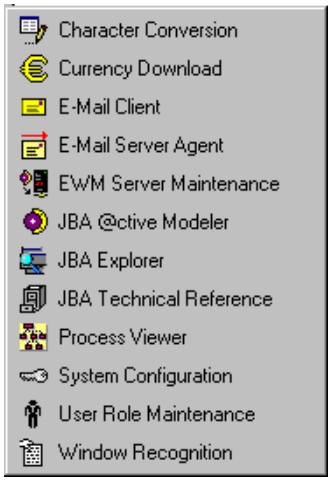

Figure 73. System 21 Explorer menu options

Most of the options should not be made available to the average user. If you are using Windows Explorer, we suggest that you move all of the options, except the Geac Explorer shortcut, to the Administrators start menu. This will allow users to see and access System 21 Explorer. It also gives the administrator access to the tools to maintain System 21 Explorer.

The administrator does not have to be the Windows Administrator user, but rather the person responsible for maintenance. This can be several users if necessary.

5.6.7.4 Creating a Terminal Server User example

The following example offers a quick-step guide for creating one terminal server user named TSUSER1.

On the server

Perform the following steps on the server:

1. Log on as the Administrator or with a user that belongs to the Administrators group.
2. Install System 21 Explorer on Windows NT Terminal Server. Make sure that you use Add/Remove Programs in the Control Panel.
3. Move the menu shortcuts from the All Users start menu from C:\Wtsrv\Profiles*All Users*\Start Menu\Programs to C:\Wtsrv\Profiles*Administrator*\Start Menu\Programs, with the exception of the Geac Explorer option.
4. In User Manager for Domains, create a user TSUSER1.
5. Log off as Administrator, and log on as TSUSER1 to create the C:\Wtsrv\Profiles\Tsuser1 directory. Log off as TSUSER1.
6. Log on as the Administrator.
7. Using the System Configuration utility, click **File->Save As**. Create an initialization file called jbasmg.org to backup the original file.
8. While in the System Configuration utility, click **File->Save As**. Create an initialization file called tsuser1.ini in the user home directory (example: C:\Wtsrv\Profiles\Tsuser1). Configure the user options for the user TSUSER1 that are desired, and save the tsuser1.ini file before exiting the configuration utility.

On the client

Complete the following steps on the client:

1. On the client PC, log on as TSUSER1.
2. Open System 21 Explorer.
3. Within the Locate INI dialog box, click the **browse** button, and find the directory C:\Wtsrv\Profiles\Tsuser1. Select the initialization file copied previously. Click **OK** to save and close the file.

On the server

Rename jbasmg.org to jbasmg.ini in the JBASYS21 directory if desired.

5.6.8 Network versus local installation

System 21 Explorer supports both single client installation and network server installation.

Under either installation, System 21 supports a soft definition for program transient data. The transient data is in three general areas:

- The jbasmg.ini file, which contains configuration and preferences per user
- Microsoft Access databases containing panel recognition and changes
- Role definitions

5.6.8.1 Network consideration

Typically a network installation is chosen by sites that have other applications stored on a back-office server and have network capabilities to deliver applications to the users as needed. The network installation offers less software delivered to the desktop, providing easier installation, upgrade, and maintenance of the desktops. With the current system management software and available hardware, this scenario is generally declining.

Under a network server installation, the server is installed first. All client desktops are then installed from the server.

5.6.9 Silent and automatic installation

Silent and automatic installation are covered in the *System 21 Explorer Installation Guide*. It offers more details, including sample script and initialization files that are to be used.

5.6.9.1 Silent installation

Instead of entering all the installation details when prompted, as you would for a normal installation, you put all your responses into a Silent Response File and let the software take them from there. You receive no prompts and enter no data. Because of this, the installation is faster.

The format of response files resembles that of an *.INI file. A response file is a plain text file consisting of sections containing data entries.

No messages are displayed during a silent installation. Instead, a log file named Setup.log captures installation information, including whether the installation was successful. You can review the log file and determine the result of the installation. Any error messages that would normally be displayed are written to the Errors.log file.

Silent installation consists of two stages:

1. Create the Silent Response file. You can do this either by setting one up from scratch or by modifying one of the samples issued by Geac. Geac recommends that you use the second method where possible.
2. Use the Silent Response file on any number of PCs to run a silent installation.

5.6.9.2 Automatic installation

The automatic installation gives you more control over the installation than the silent installation. You receive no prompts and enter no data. However, you can see the progress indicator, so that you can monitor the progress of the installation. Also, installation stops at the Finish/Reboot window to give you the chance to reboot immediately or later.

To run Automatic installation, perform the following steps:

1. Run Setup.exe with the -a option.

   The automatic installation gets its responses from the Automatic Response File. There is no way of generating this file. You must use one of the sample files provided with the appropriate settings.

2. Use the -f3 parameter to specify the name of the response file. If this parameter is omitted, the setup will look for the Setup.isa file in the same directory as Setup.exe.

During automatic installation, no messages are displayed. Any error messages are written to the Errors.log file instead. If any errors have been recorded, you are notified and referred to the log file.

5.6.10 Session information

There are several areas that involve the manipulation and interaction of the System 21activity sessions as presented by System 21 Explorer.

5.6.10.1 Desktop shortcuts

Activities can be launched directly from the Windows desktop with System 21 Explorer being active. These are created as regular Windows shortcuts. To create a shortcut, right-click **Activity** in System 21 Explorer, and select **Shortcut**.

This action creates an icon on the Windows desktop. This icon can then be moved to the Windows Start menu or any other native Windows directory. This shortcut can be started by double-clicking, as with all Windows shortcuts.

5.6.10.2 Modal windows

Whenever a selection window that is not a full screen is presented, System 21 Explorer presents the window to the user as a *modal window*. This allows the user to move the window by dragging it via the title bar of the window. This reveals the screen details of the session that are below the window.

5.6.10.3 Mouse actions

You can perform many functions using the mouse.

Mouse enter

Double-clicking on any open space of a session window performs the same action as pressing Enter.

Menu select

When you are at a traditional AS/400 screen menu via a Server Session, you can double-click the menu options, rather than type them. In the menu shown in Figure 74, option 3 (Display Messages) is double-clicked. This is the same as typing option 3 and pressing Enter.

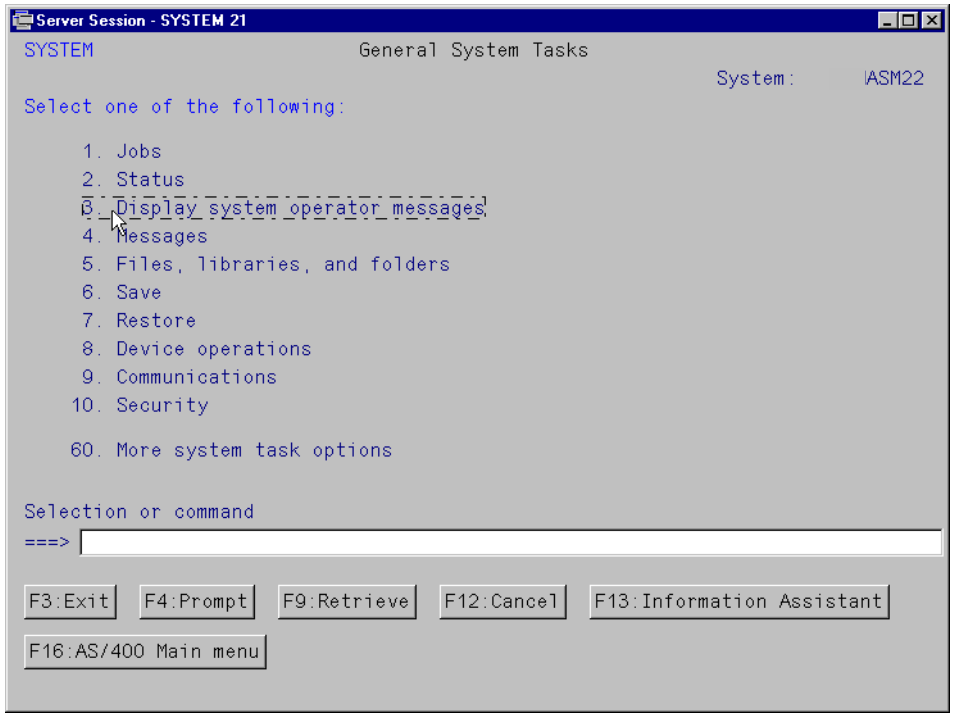

Figure 74. Double-clicking on a menu option

Subfile select

If a subfile list with option is present in a session window, you can enter the option can via the mouse. First, click on the desired location for the option to be entered, and then double-click the option.

This is shown in Figure 75 on page 132, where the “FOC” line is to have a “1” (Select) entered in the box.

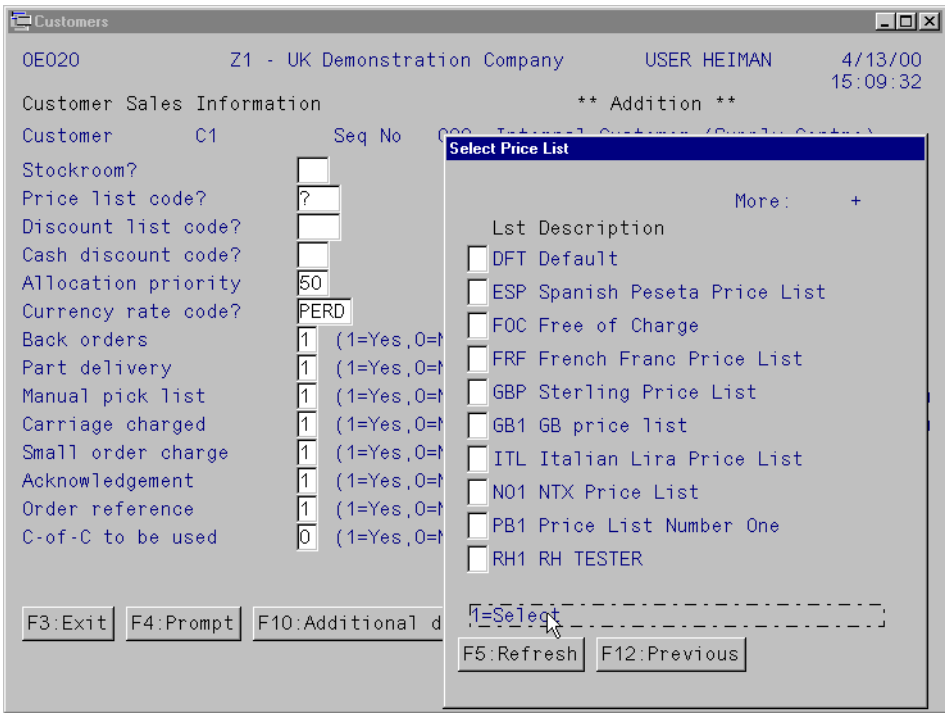

Figure 75. Subfile selection

5.6.10.4 Cutting and pasting

The data in any session can be copied as text to the Windows clipboard. Similarly, text can be pasted into any input capable field on the session interface from the Windows clipboard.

To copy text from the session, right-click and hold on the session interface. Drag a box around the text to be copied. When the box is drawn, release the right mouse button. Then, a context menu is presented. Choose the Copy option from the menu as shown in Figure 76.

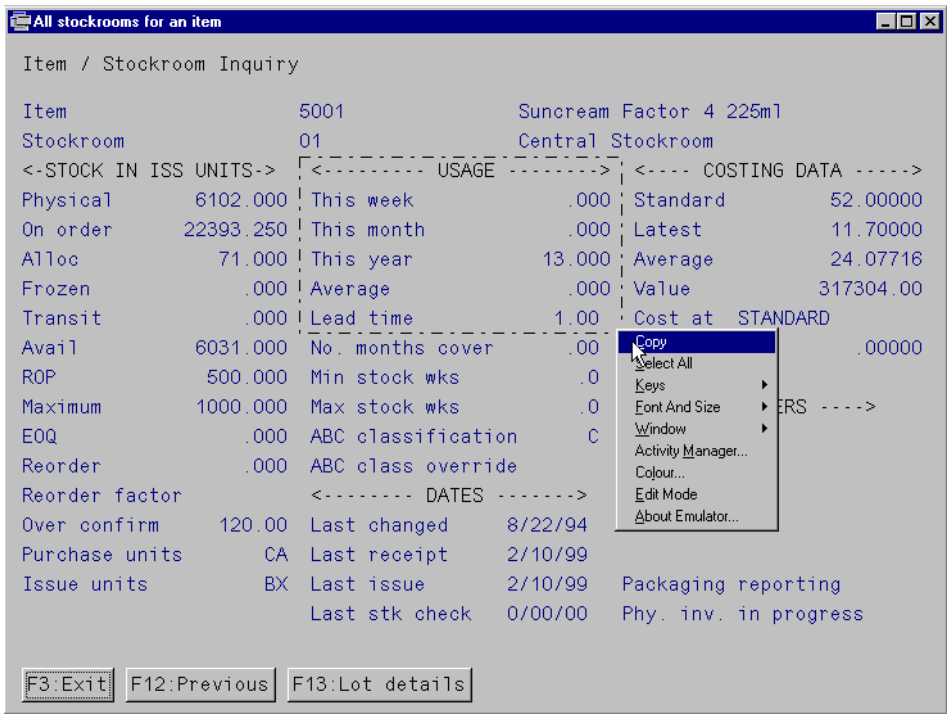

Figure 76. Right-clicking Copy

5.6.10.5 Activity Manager

Activity Manager provides a review of the activities running from the System 21 Explorer. You can switch to the activity by double-clicking the desired activity.

Additional System 21 activity information can be shown if relevant, such as Company and Environment, as shown in Figure 77.

You can start Activity Manager by right-clicking on a session or by selecting **Activity Manager** from the System 21 Explorer File menu option.

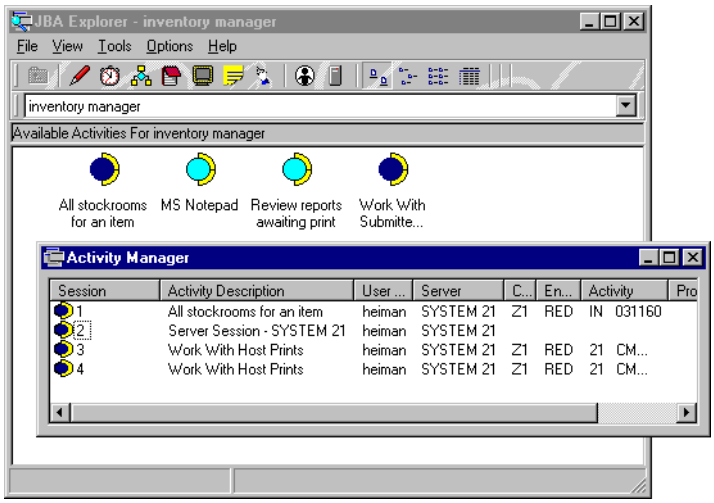

Figure 77. Activity Manager

5.6.10.6 Screen printing

System 21 Explorer only supports Windows native printing by using the Print Screen key. With this action, you copy the active Windows display or entire desktop image to the Windows clipboard. Then, you paste it into any application and print.

There are numerous shareware and third-party products available on the Internet to facilitate printing.

5.6.10.7 Session context menu

The System 21 Explorer configuration supports options available in regular terminal emulation functions. These options can be invoked by right-clicking any emulator session as shown in Figure 78.

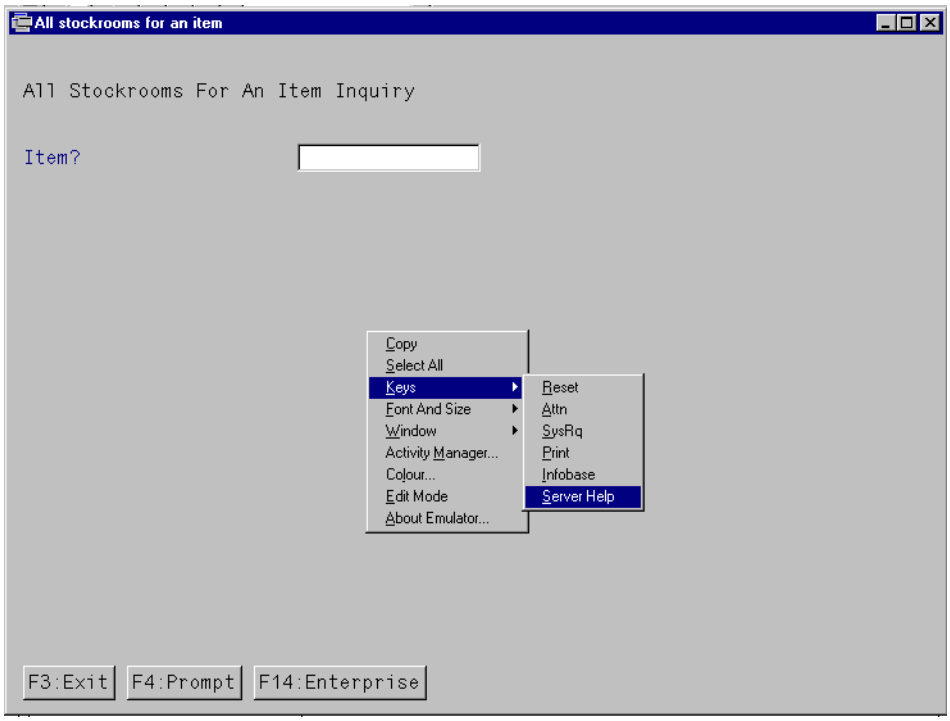

Figure 78. Session context menu

The options on this menu provide:

- **Copy** and **Select All**: Copies data from the session as discussed in 5.6.10.4, “Cutting and pasting” on page 132.
- **Keys**: Allows access to common terminal emulation function keys.
- **Font** and **Size**: Adjusts the font being used in this session.
- **Window**: Reveals information about the window that the session emulator has discovered. Also links to the Windows recognition tool to correct borders for non-standard windows.
- **Activity Manager**: Launches the Activity Manager.
- **Color**: Provides options to change the color attributes of the session.

- **Edit Mode**: Switches from destructive cursor mode to non-destructive cursor mode.
- **About Emulator**: Shows the current version of the emulator.

5.6.11 Initialization file

The Windows initialization file for System 21 Explorer is located by default in the JBASys21 directory as the jbasmg.ini file. This file is used by System 21 Explorer at startup to load the configuration options and preferences.

This file is divided into six areas, in this order:

- First Manual Update Only Area
- Preferences Area
- System Configuration Area
- Second Manual Update Only Area
- Translation Area
- Client-specific Area

The majority of the file is maintained by System Configuration settings. It is important that you do not override these manually. System Configuration is a standalone utility that you can access from the Start Menu, or from within Explorer or Active Modeler from a button on the Preferences window.

You can update the file manually. However, we strongly recommend that you confine your editing to those areas marked as Manual Update Only, unless under direct supervision from Geac support.

The initialization file contains useful comments. If you need more information about various sections of the initialization file, please refer to the Glossary section of the Geac Technical Information Help file.

The more commonly used sections of the manual area are:

- **TranslationLanguage=eng**

  This language is used by System 21 Explorer and all Geac client products installed with System 21 Explorer.

- **Title=System 21 Explorer**

  This is the title shown at the top of the System 21 Explorer application in the Windows title bar.

- **MaxSessions=8**

  This option applies a limit on the number of server activities that the user can have open on the desktop. The range is 1 through 17.

- **SessionSize=0.72**

  A range of 3 to 1 indicates the initial size of the System 21 Explorer session window as it is drawn on the desktop following an activity request.

- **Program=CWSINITIAL**

  This setting is used during the logon process. The value here is placed into the initial program prompt on the AS/400 signon panel.

- **Device=JOHNPC**

  When using a TCP connection, this option allows the device created on the AS/400 system to be named, instead of generated. If this line is commented out, the name will be generated as QPADEV00xx under TCP.

  This can be a name of up to eight characters or set to the value “1” to use the computer name (Win32 only).

- **SessionIDLetter=S**

  To make each device name unique, Explorer appends two characters to the device name.

  – The first is a user-defined character that can be set using the SessionIDLetter=. By default, the character “N” is used.

  – The second is the session number. If this is greater than 9, it is substituted with a letter starting with A.

  For example, if Device=PCJOHN and SessionIDLetter=Z, the device name for session 1 will be PCJOHNZ1.

- **Trace=0**

  Provides a trace file for diagnostics. The content is set by the Trace settings options as outlined in the Tips and Techniques help file.

- **LueDbg=**

  Provides settings for diagnosing Display issues, and communication and memory issues.

- **JvnDbg=**

  Provides settings for diagnosing a TCP/IP connection to the AS/400 system.

- **JvwDbg=**

  Provides settings for diagnosing an EHNAPPC router connection to the AS/400 system.

- **LckDbg=**

  Provides settings for diagnosing timing issues.

- **CloseActivitySession=1**

  Allows activity sessions to be closed by clicking the control box.

All System 21 Explorer registry entries are located in the following paths:

- `HKEY_CURRENT_USER\software\VB and VBA Program Settings\JBAEXplorer`
- `HKEY_CURRENT_USER\software\VB and VBA Program Settings\JBASession Manager`

5.6.12 Limit capabilities

System 21 Explorer logs onto the server by placing the user ID, password, and program or procedure into the OS/400 signon panel.

When a user has limit capabilities specified in the user profile, an entry is not allowed into the program or procedure field. In this case, you must complete these tasks to allow System 21 Explorer to use the OS/400:

1. Change the initial program option in the jbasmg.ini file to Program=*NONE.
2. Change the user profile to have an initial program of AMINITIAL or CWSINITIAL.

Use the CWSINITIAL program if the user will only signon via System 21 Explorer. AMINITAL is for users that would use both System 21 Explorer and a standard terminal emulation.

5.6.13 System 21 Explorer sample applications

There are several System 21 samples that can be optionally installed during the installation. These samples provide text documents and Visual Basic (VB) applications for various external interfaces that System 21 Explorer supports. These interfaces allow for:

- Integration of Windows applications with the sessions and session data
- Data to be read from and written to a session via the interfaces
- OLE examples with MS Office
- Navigation of a session via function keys from a VB application
- Document Viewer advanced integration
- Toolbar VB button applications

They are located in the directory shown in Figure 79.

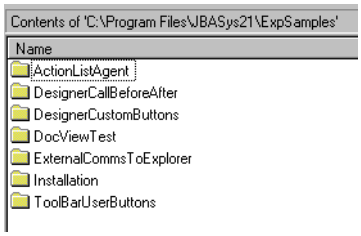

Figure 79. Samples directory

5.6.14 System 21 Explorer Designer

System 21 Explorer has a component that allows the alteration of the panels presented and their interaction with external Windows applications. This component is named Designer.

Designer supports:

- Presentation changes to panels (bold, dimension, hide, move)
- Default data to be entered or passed from panel to panel
- Panels to be hidden from view
- Interaction of panels with Visual Basic application DLLs
- Definition of links to a document viewer
- Definition of links to Help text
- Adding auto prompt support

The Designer function requires you to complete four basic configuration steps before you can use it:

1. Set up the application code and enter an authorization code to provide access to the Designer function. This is outlined in the *Setup and Installation Guide*.

The application is created in Application Manager as DG V3 as shown in Figure 80. The application source code should be the letter O.

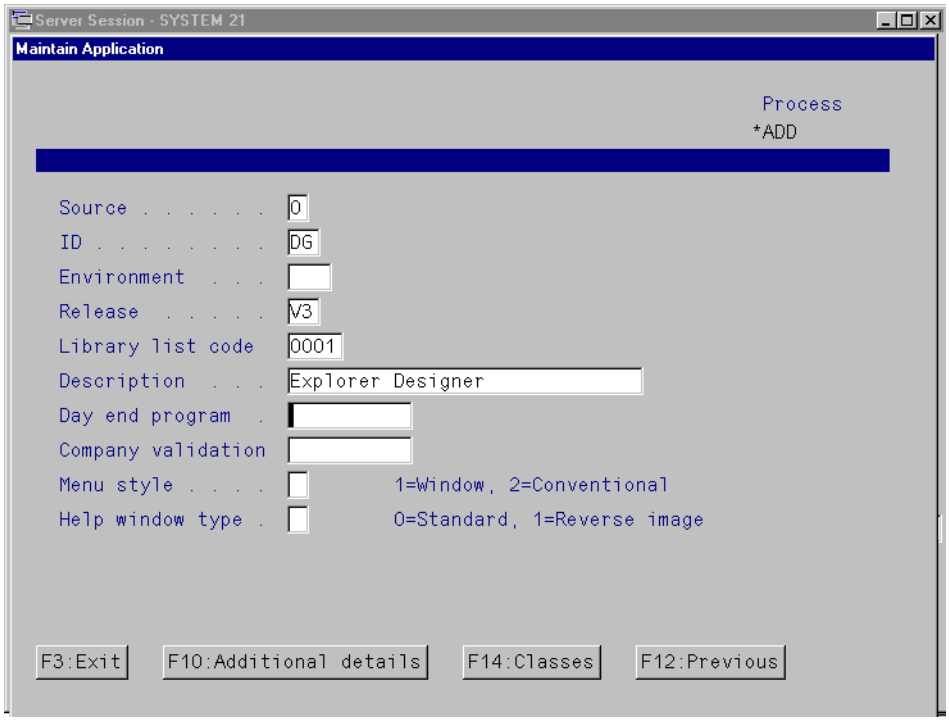

Figure 80. Create Designer application

2. Enter the authorization code in Administration Functions.
3. The user that wants to use Designer must have their System 21 Explorer configuration changed to allow access to Designer. This is performed in the System Configuration utility of System 21 Explorer as shown in Figure 81.

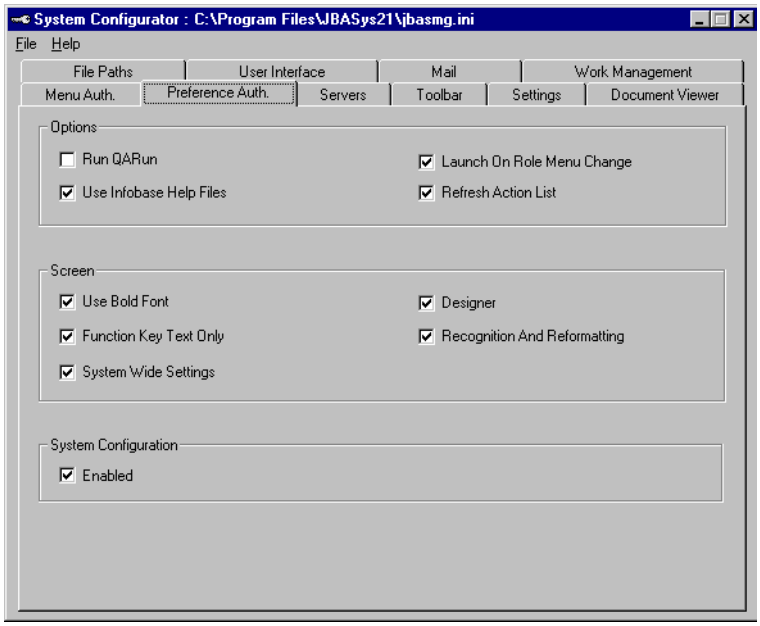

Figure 81. System Configuration for Designer access

4. Set the preferences in the User desktop for System 21 Explorer as shown in Figure 82.

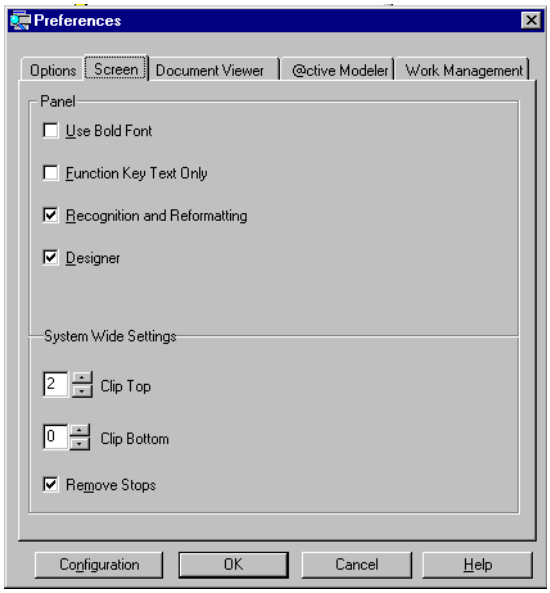

Figure 82. System 21 Explorer preference for Designer

You should now have access to the Designer function for panels.

Note

Access to the user preferences Designer check box on the Screen tab is restricted after any activities have been started. You must end and restart System 21 Explorer to regain access to the setting.

When using Designer, only one activity is allowed to be started. The Designer icon will be removed from the toolbar if subsequent sessions are started. As the sessions are ended down to one, the Designer icon becomes available again.

Designer is limited by user license. Enable only the number of users allowed in your license. If the usage limit is exceeded, then additional System 21 Explorer session will not be allowed for those users with Designer activated in their preferences.

File locations

Designer stores the editing in tables located in the file path that is specified in System Configuration under Run Time Database. Users can have various versions of this file depending upon the system requirements. The file locations are shown in Figure 83 on page 140.

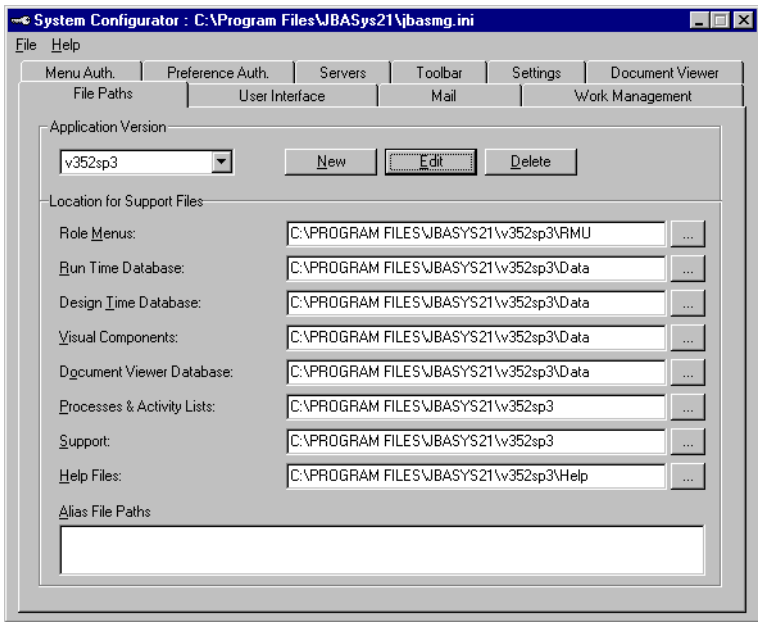

Figure 83. Designer file locations

Designer will be available on the System 21 Explorer toolbar when any panels are presented that have the coding for Designer. The toolbar is shown in Figure 84, where the Designer function is represented by a white easel icon.

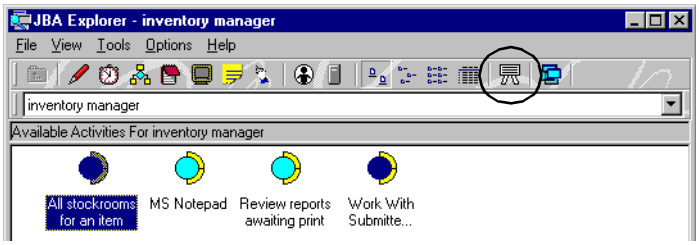

Figure 84. System 21 Explorer toolbar

An example of the Designer toolbars are shown in Figure 85 and Figure 86 on page 142.

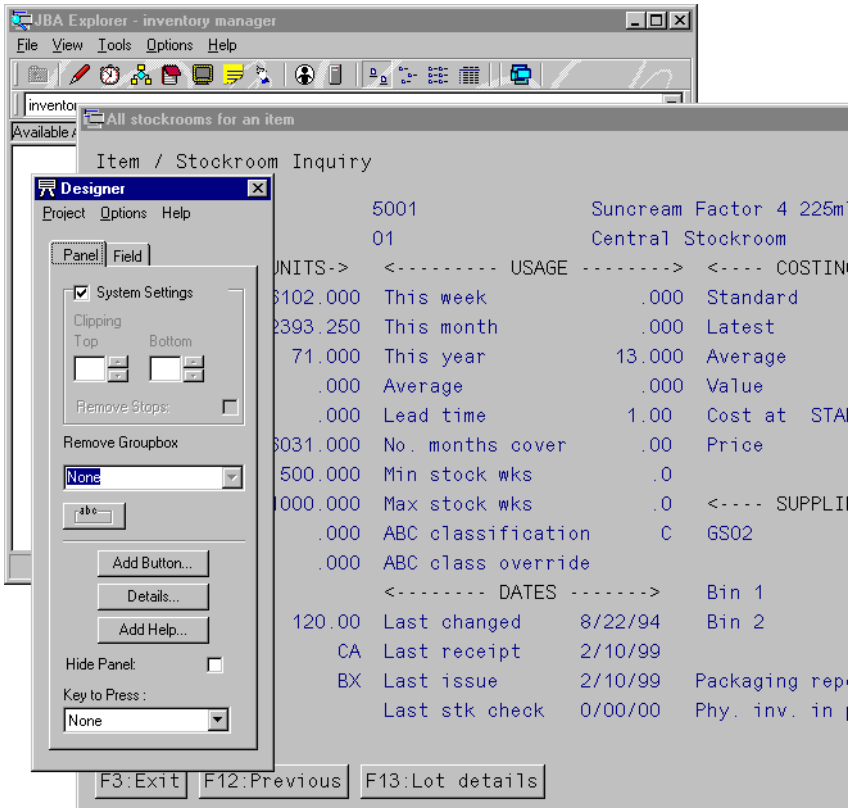

Figure 85. Designer toolbar - Panel

The Designer Panel toolbar allows for the Designer functions that impact the entire panel to be performed. These changes will impact only the current panel being edited. The defaults for clipping come from the system-wide setting in the System 21 Explorer user preferences settings.

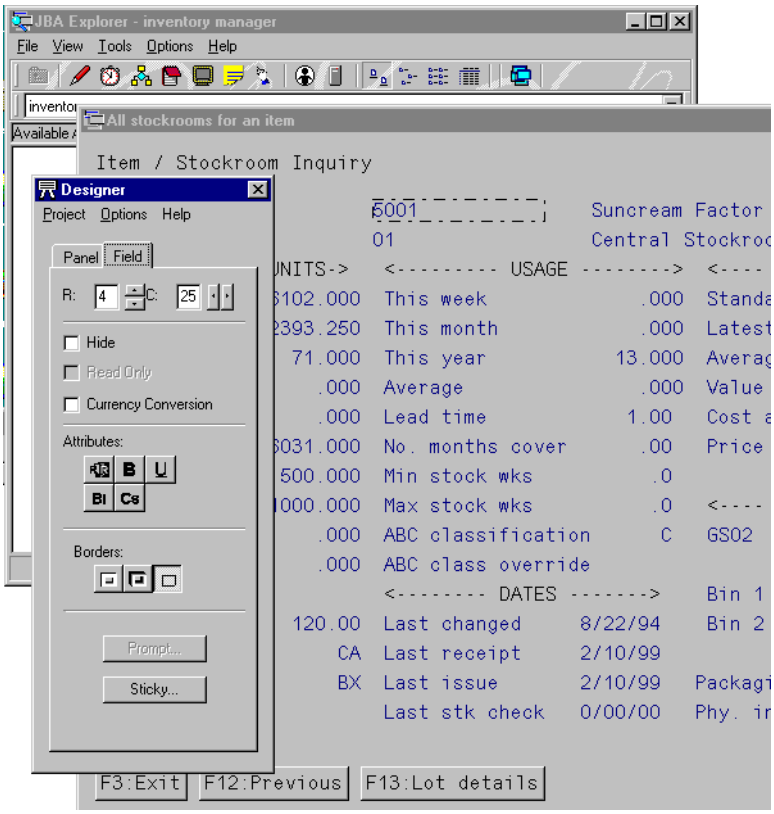

Figure 86. Designer toolbar - Field

Field-level options affect the elements on the panel that are escalated at the time of editing.

To change a setting, follow these steps:

1. Select the element on the panel first.
2. Right-click the panel to reveal context-sensitive options for the area of the selected panel.

Further details on using Designer are discussed in the online help and product guides.

5.6.15 Creating new activities in System 21 Explorer

The System 21 Explorer design time database holds the activities that are used to build the Activity tree when Role menu designer is active.

If a user needs to add activities to the tree, they need to be created in @ctive Modeler and exported as *.con files. These files can then be imported to the server for deployment to the user base. The import utility is ConImport.exe in the System 21 Explorer installation directory.

Chapter 6. Operations

The implementation of any system or integrated software package can be compared to the purchase of a new automobile. For example, an automobile manufacturer provides a customer with a routine maintenance schedule to assure the best vehicle performance and reliability.

Your AS/400 and System 21 software also require periodic maintenance to assure the best computing performance and reliability. Many of these maintenance routines can be automated by using the System 21 Machine Manager. Other maintenance functions include period-end updates, purging and archiving of historical data, and applying program temporary fixes (PTFs).

6.1 Using System 21 Machine Manager

System 21 Machine Manager is designed to provide a scheduler with integration into System 21 Application Manager. This allows you to run application tasks with a certain degree of automation. An example of such application tasks is a daily business process such as invoicing.

Machine Manager allows you to schedule tasks to run on one or many days of the week, at specific times in the day. You can also define group schedules, which are a calendar of days when a job or number of jobs are scheduled to run.

6.1.1 What is Machine Manager

Machine Manager is an application within the System 21 set of infrastructure applications. It consists of these four functional components:

- Day-start activities
- End-of-day activities
- Scheduled daily activities
- Power-down schedules

The Machine Manager application libraries are: IPGMMP4, IPGMMD4, and IPGMMF4.

Key files within Machine Manager are shown in Table 16.

Table 16. Key Machine Manager files

Files	Description
AMM05PHY	Scheduled jobs file, which drives the JOBSSCH program
AMM10PHY	Day Start and Day End jobs definition
AMM15PHY	Standard MM jobs
AMM90PHY	Machine Manager Audit Log

Key commands used within Machine Manager are shown Table 17.

Table 17. Key Machine Manager commands

Command	Description
DSPDAYHST	Display MAchine Manager Log for a specific date
DSPDAYSCH	Display jobs that will run on a specific date (useful if you want to know if your schedule is set up correctly
DSPMNGLOG	Display the Machine Manager log
MNGJOBSCH	Work with today's scheduled jobs
MNSENDDAY	Manage End of Day process
RUNADSJOB	Run Auto Day Start Routine (Start Schedule and Day Start routines)
SBMENDDAY	Submit the Day End job to the Scheduler
SBMJOBSSCH	Start the Job Scheduler
SMPWRDWN	Submit the Power Down job to the PWRDWNSYS jobs queue
STRIPGMM	Launch Machine Manager Main Menu

6.1.2 Scheduler

At the heart of Machine Manager is the Job Scheduler, which drives the processing of Machine Manager. The diagram in Figure 87 illustrates the cycle through which System 21 should run during a 24-hour period.

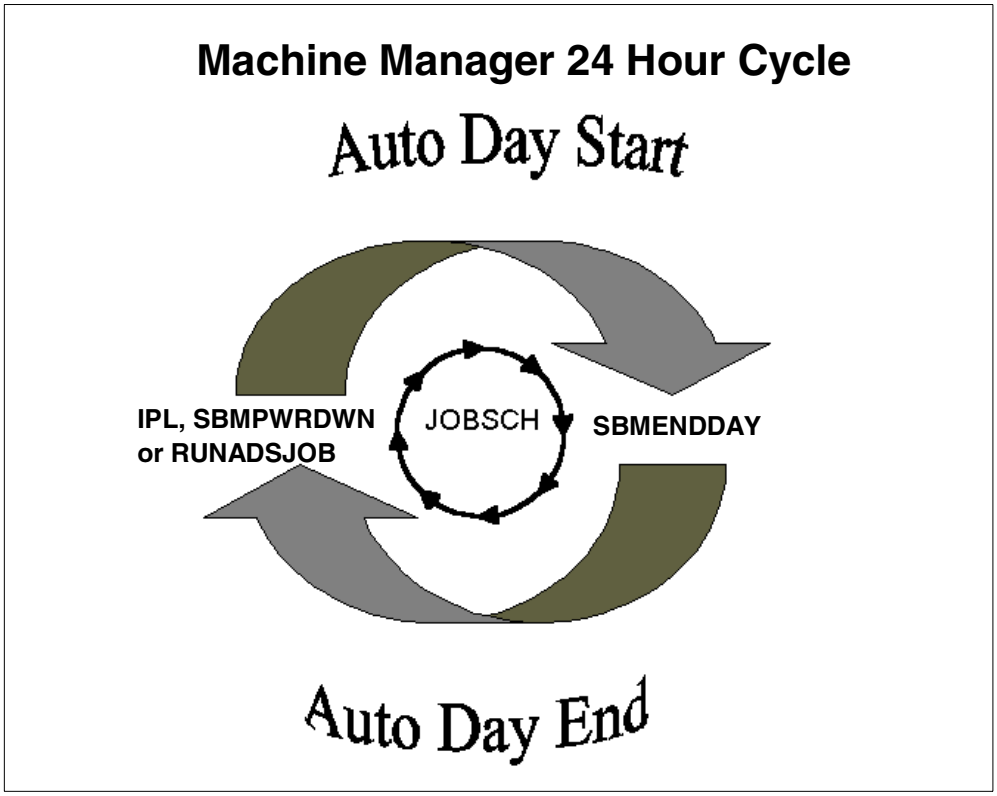

Figure 87. System 21 Job Scheduler cycle

The cycle begins when the system's Initial Program Load (IPL) runs the program MMSTRPGM, which starts the Job Scheduler (JOBSCH) and the Auto Day Start (ADS) routine. ADS executes a string of jobs that prepares the system for a new day of processing. The final step in ADS is to run the SBMENDDAY command. This perpetuates the cycle of daily processing by placing a job in the schedule to run the Auto Day End (ADE) jobs at the specified time for starting end-of-day processing. ADE executes a string of jobs that complete the day's processing. The final step in ADE is to initiate a system power down or the ADS routine when an IPL is not needed.

Job Scheduler stays active throughout the day checking for jobs that are scheduled to run at specific times in the day including the start of Auto Day End.

The Work with Subsystem Jobs screen (Figure 88) shows the JOBSCH job running in subsystem QCTL. This job can be activated by running the Submit Job Scheduler SBMJOBSCH command. Use the Work Subsystem Job command to view this screen:

```
WRKSBSJOB QCTL
```

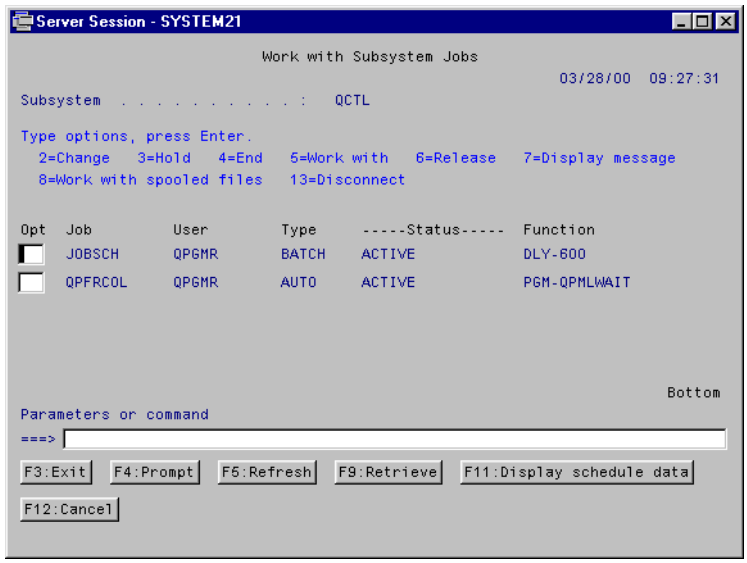

Figure 88. Viewing the JOBSCH job using the Work with Subsystem Jobs command

Figure 89 on page 146 shows an example of how tasks are defined in Machine Manager.

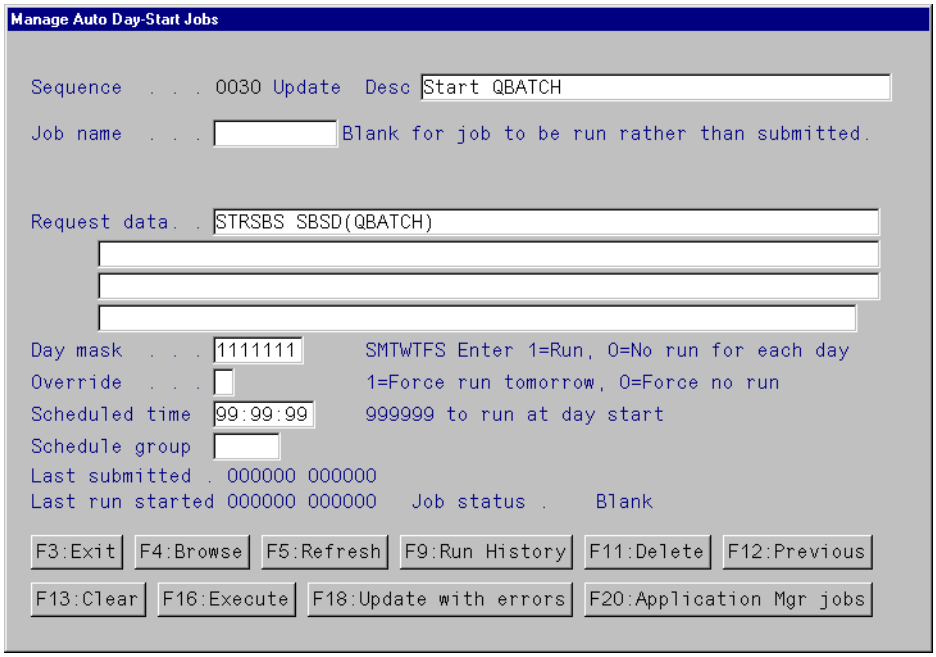

Figure 89. Machine Manager Auto Day Start task definition screen

Note

The day mask tells the scheduler on which days of the week this task should run. The day mask is relevant to the time when the Day Start and Day End process begins. For example, a weekly job is expected to run in the evening between Saturday and Sunday during the Day End process. If the day end is scheduled to start at 2:00 a.m., the day mask should be set to run on Sunday, not Saturday.

6.1.3 Accessing Machine Manager

You can access Machine Manager in two ways:

- Use the `STRIPGMM` command.
- Use the `STRM400` command, and then select option 6.

Table 18 lists the Machine Manager options in the main menu and the commands that you can use to access these functions directly.

Table 18. Machine Manager options and commands

Option number	Main menu option	Command
1	Auto Day Start Jobs	MNGADSJOB
2	Auto Day End Jobs	MNGADEJOB
3	Job Schedules	MNGJOBSCH
4	End Day Times	MNGENDDAY
5	Power Down Times	MNGPWRDWN
6	Jobs Schedule Times	MNGSCHTIM

Option number	Main menu option	Command
7	Group Schedules	None
8	Protected Queues	None
9	Operational Enquiries	None
10	Exit	None

6.1.4 Setting up parameters

Within Machine Manager, there are configuration parameters that control when specific tasks should and should not happen. There are three main parameter groups within Machine Manager that are accessed using the menu options or commands as described in Table 18:

- Job schedule times
- End of Day Times
- Power Down Times

6.1.4.1 Job schedule times

Figure 90 shows the Job Scheduler Time parameter maintenance screen, which displays the status of the job scheduler. You access this display by typing the Manage Job Schedule (MNGJOBSCH) command.

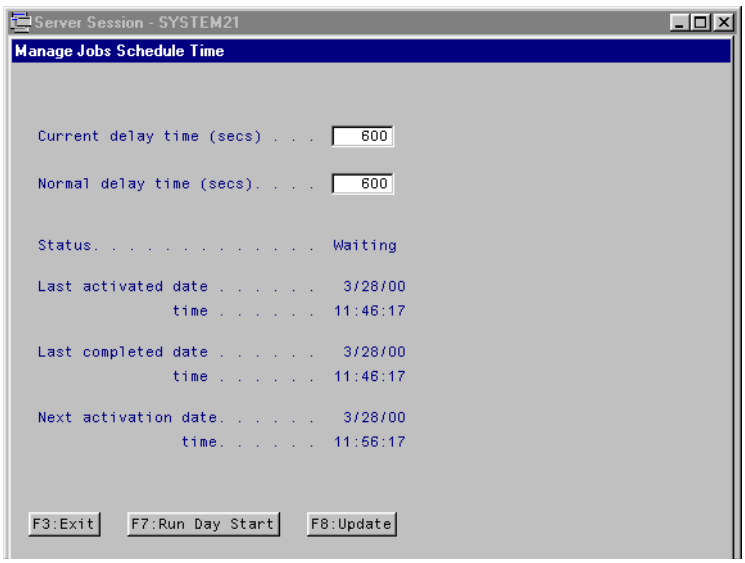

Figure 90. Job schedule times parameter screen

Use the normal delay value to set the interval in which the Job Scheduler will check for scheduled jobs to be executed. Be sure to specify a delay time in seconds (for example, 600 seconds is a 10-minute delay). Use the current delay value to override the normal value for the active job schedule program.

6.1.4.2 End-of-day times

Figure 91 on page 148 shows the End Day Initiation parameter maintenance screen, which can cause the status of the end-of-day job. You can access this display by running the Manage End of Day Jobs (MNGENDDAY) command. In this example, the end-of-day jobs are scheduled to start at 2:00 a.m.

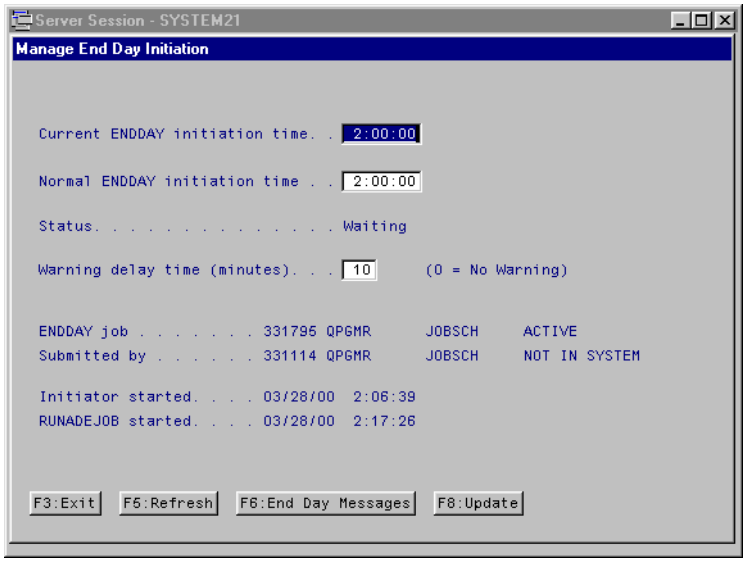

Figure 91. End-of-day time parameter screen

Use the Normal End Day Time Initiation to control when the Day End routines are started. You can define a number of minutes delay for a warning message to be sent to all users informing them that Day End is about to run.

To change the warning message that is delivered by the end-of-day job, you must alter the second level message text on MSGID UM#0024 in the IPGMMD4/MM file.

6.1.4.3 Power-down times

Figure 92 shows the Power Down parameter maintenance screen. In this example, the system is set to power down at 5:30 a.m. and avoids power down between 6:30 a.m. and 11:30 p.m.

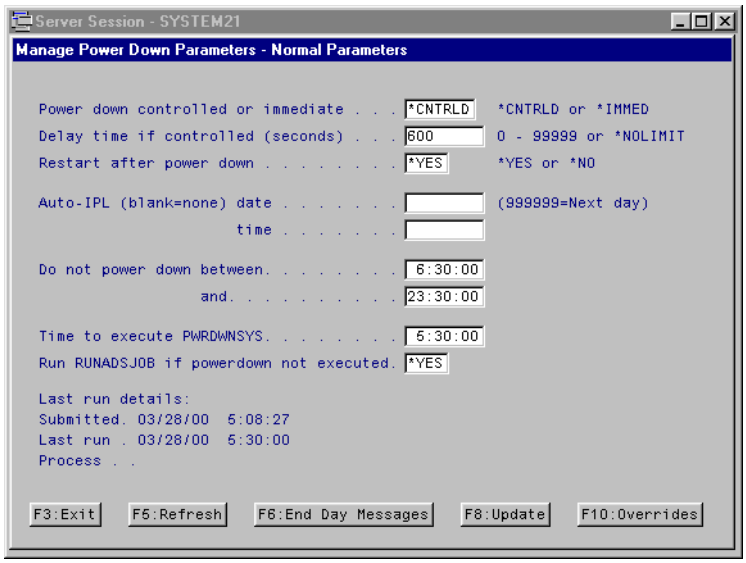

Figure 92. Power-down times parameter screen

Use this function to control parameters associated with the Submit Power Down Jobs (SBMPWRDWN) command used by Machine Manager. You can control the type of IPL because it holds the default parameters with which the AS/400 Power Down System (PWRDWNSYS) command is executed.

You can specify a specific IPL date and time, which modifies the system value QIPLDATTIM (an operating system function).

To restrict the use of the PWRDWNSYS command from the general user community, you should revoke all public authority to the command with this command:

```
RVKOBJAUT OBJ(PWRDWNSYS) OBJTYPE(*CMD) USER(*PUBLIC)
```

You can prevent the SBMPWRDWN job from running during working hours by specifying a time range between which power down should not run if it is submitted.

If the power down job is executed outside the working day, and you have entered a specified time to execute a power down, it will wait until the “Time to execute PWRDWNSYS” message appears before it runs the PWRDWNSYS command. If the SBMPWRDWN command runs during working hours, it will not run, but you have the option to run the Auto Day Start jobs instead.

To override the parameter for the next scheduled power down jobs, click **Overrides** or press F10 to display the override time screen.

The power down parameters for your processor are held in the MMPWRDWN data area in library IPGMMP4. This is a 250-character data area containing the normal and override parameters.

6.1.5 Making Job Scheduler work

In order for the Job Scheduler to work, there are several AS/400 configuration issues to consider. If you want to use Machine Manager to power down and IPL the machine, perform the following steps:

1. The Power Down job is submitted to the PWRDWNSYS job queue. Add this job queue to the QBATCH subsystem job queue entries. Do this by following these steps:
   a. Enter the command:

      ```
      DSPSBSD SBSD(QBATCH)
      ```

   b. Select option **6** to display the job queue entries and not the sequence numbers used.
   c. Enter the command:

      ```
      ADDJOBQE SBSD(QBATCH) JOBQ(OSLSYS/PWRDWNSYS) SEQNBR(number)
      ```

      Here, the sequence number is a number higher than those previously noted.
2. Change the job queue used by the job description PWRDWNSYS. To do this, ensure the subsystem QBATCH is inactive, and then enter the command:

   ```
   CHGJOBD JOBD(OSLSYS/PWRDWNSYS) JOBQ(OSLSYS/PWRDWNSYS)
   ```

There are several more job descriptions that you can check when configuring Machine Manager: ENDDAY, IPGMMP, MMJOBSCH, and PWRDWNSYS.

Note

Be aware that the Job Queue and Job Description for System Manager products are copied to the OSLSYS library. Changing the version in IPGMMP4 will not affect Machine Manager functions. The version in OSLSYS is picked up first in the library list.

6.1.6 Initiating Job Scheduler

After you set up the desired parameters, you need to initiate Job Scheduler (JOBSCH). This can be done in several ways:

- Change the AS/400 system startup program to IPGMMP4/MMSTRPGM. This activates the scheduler after the system IPL and runs the Auto Day Start routine. The MMSTRPGM program simply runs the SBMJOBSCH and Run Auto Day Start Job (RUNADSJOB) commands. Run the following commands:

  1. `ADDLIBLE IPGMMP4`
  2. `CHGSYSVAL SYSVAL(QSTRUPPGM) VALUE(MMSTRPGM)`

  Note

  If the machine is in a restricted state, and the system value QSTRUPPGM is set to IPGMMP4/MMSTRPPGM, start the controlling subsystem. This will achieve the same result as running an IPL.

- Start the scheduler on the command line. If the AS/400 system is operational, type the `SBMJOBSCH` command to start the Job Scheduler in QCTL.
- From the Manager Jobs Schedule Time parameter screen (Figure 90 on page 147), click **Run Day Start** or press F7 to initiate the Job Scheduler and the ADS job stream.

When the Job Scheduler is active, you can expect to see a job called JOBSCH in the controlling subsystem. QCTL is usually the controlling subsystem. The current job number for that active JOBSCH job is held in the data area IPGMMP4/MMJOBSCH. Whenever the SBMJOBSCH command is used, the current job is cancelled and a new job is started.

6.1.7 Security and the scheduler

By default, access to the Machine Manager commands are not restricted. If the JOBSCH job is submitted by a user with special authority, a user can add a job to one of the schedules that executes a command to which they are not authorized.

We recommend that you restrict the Machine Manager commands to QSECOFR or other suitable authorized users.

6.1.8 Ways to schedule a job

Within Machine Manager and System 21, there are five distinct ways to schedule a job:

- **Auto day start**: Use the Manage Auto Day Start Job (MNGADSJOB) command or Auto Day Start Jobs menu option to maintain the list of jobs to be run in the Day Start schedule.
- **Auto day end**: Use the Manage Auto Day End Job (MNGADEJOB) command or Auto Day End Jobs menu option to maintain the list of jobs run in the Day End schedule.
- **Automatically scheduled**: From either the Day Start or Day End schedule, you can enter a job that is to commence at a specific time. The task is added to the Job Scheduler, which is then monitored by the JOBSCH job, and is executed at the prescribed time of day.
- **Manually scheduled**: From the MNGJOBSCH panel, click **Add** or press F8 to add a task to be run at a specific time. You can also use the EXCAMTASK command to run an application Manager task at a specific time.
- **Menu scheduled**: From a System 21 application menu, if you are running a batch function, you can press the F4 key instead of the Enter key to launch the task. When you do this, after you confirm the submission of the job to batch, you are shown a screen that allows you to enter a time when you want the job to run.

6.1.9 Types of schedules

Within Machine Manager, it is possible to schedule jobs on any of three different time scales:

- **Time scheduled tasks**: These tasks are set to run at a specific time in the day. They are scheduled by either the auto day start routine, the Auto Day End routine, or manually. See 6.1.8, “Ways to schedule a job” on page 150.

  The Scheduler Job (JOBSCH), better know as the “sleeper” job, remains dormant for the period set in the Job Scheduler time parameters. See 6.1.4, “Setting up parameters” on page 147. When it becomes active (“wakes up”), it will process any jobs that are scheduled for any time between the last time it was active and the present. This includes scheduled jobs for “immediate” processing (scheduled time equals 99:99:99). These jobs are then executed by the Scheduler job or submitted to a job queue as defined by the task or user.
- **Day-start and day-end tasks**: These tasks are started during the runs for ADS or ADE. The tasks are defined with a scheduled time of 99:99:99. They are run in order of their sequence number and based on their day mask. Tasks with a job description name are submitted to a job queue. Tasks without a job description are run as part of the job stream.
- **Calendar scheduled tasks**: These tasks are executed during the run for ADS or ADE on a specific day of the month. These tasks belong to a group schedule that defines calendar dates for when these tasks should run. The calendar can be built manually or by specifying a start date and then an interval for each date thereafter. See Figure 93 on page 152.

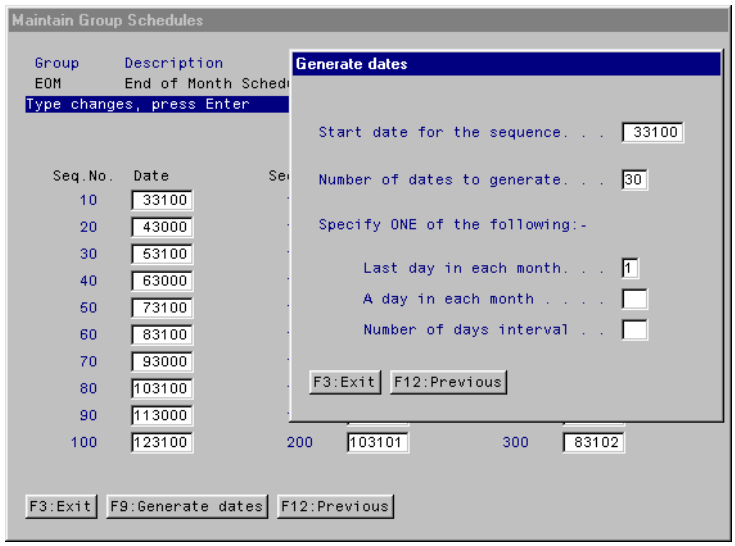

Figure 93. Defining a group schedule

6.1.10 Defining a new task

Follow these steps to define a Machine Manager task:

1. Use the commands defined in 6.1.3, “Accessing Machine Manager” on page 146, to access either the Auto Day Start or Auto Day End.
2. Click **Add** or press F8 to add a new task.
3. Enter the sequence number of the new task. Try to use sequence numbers in increments of 10 or 100 to allow other tasks to be easily inserted at a later time.

> **Note**
>
> You can re-sequence the task numbers by pressing F22 on the ADS and ADE task screen.

4. Complete the information shown in Figure 94.

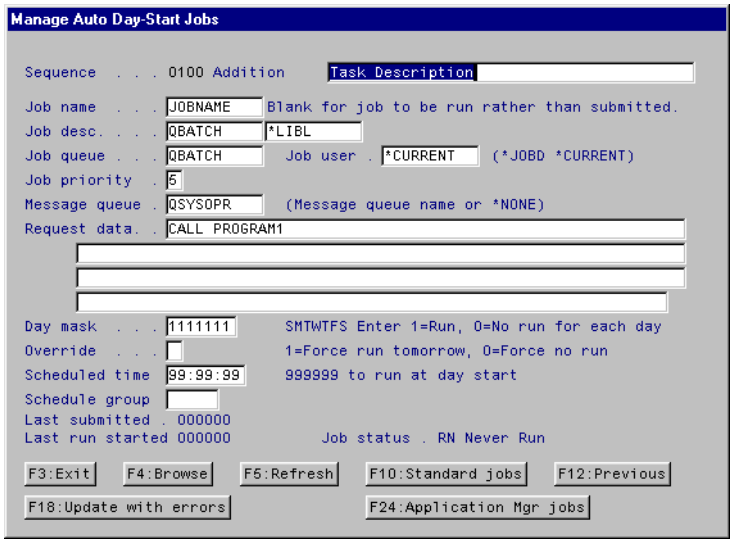

Figure 94. Machine Manager task maintenance screen

5. Press Enter to update the screen. If you specify a job name, you are asked to specify a job queue, job description, user profile, message queue, and job priority. Press Enter again.
6. A confirmation screen appears. Press Enter to update the task, or click **Previous** or press F12 to return to the maintenance screen.

There are three different types of job that can be scheduled:

- **AS/400 commands**: AS/400 commands can be entered in the Request data field. Any command that can executed in batch mode can be specified. Press the F4 key to invoke the AS/400 command editor.
- **Standard Machine Manager tasks**: Click **Standard Jobs** or press F10 to see a list of standard tasks that are delivered with the System 21 Application Manager, Machine Manager, Housekeeping, Common Functions, and Network Manager applications.
- **Application Manager tasks**: Click **App Mgr Job** or press F24 to select a task code from Application Manager. In doing this, Machine Manager displays any prompt panels that require data entry to run the batch task. The details of the LDA are then stored in the Machine Manager schedule record (AMM10PHY) for use when submitting the batch element of the task. Note that you specify a user under which the task will run, and this user must be authorized to the task.

For more information on how to schedule jobs, refer to the System 21 *Machine Manager Product Guide*.

For a list of suggested ADS and ADE jobs, see Appendix C, “Suggested schedule for Machine Manager” on page 567.

6.2 AS/400 cleanup tasks

To control unnecessary clutter on your AS/400 system, use automatic cleanup routines and encourage system users to regularly delete unnecessary objects.

Machine Manager has three standard tasks for clearing output queues, message queues, and job queues. By using a day mask and specifying queues that are protected, you can control when and which queues are cleared. Each type of queue is cleared by a separate command.

Attention

If you create a new queue and forget to add the queue name to the list of protected queues, the queue will automatically be cleared the next time the clear command is executed.

The AS/400 system has an automated cleanup procedure that removes old messages, spooled files, system journals, and OfficeVision/400 calendar items. With the AS/400 system you specify the number of days to keep these items. For the AS/400 cleanup tasks, you set up the parameters in the AS/400 system and submit the job through Machine Manager. Because the automatic cleanup program on the AS/400 system offers more flexibility and functionality than Machine Manager, we recommend that you implement this program rather than using Machine Manager.

If there are specific queues you want to clear regardless of how new the entries are, you can manage this task by issuing the appropriate AS/400 command in either the ADS or ADE jobs.

6.2.1 Setting up AS/400 automatic cleanup

To clean up your AS/400 system, use the Cleanup Tasks (CLEANUP) menu. To display this menu, type `go cleanup` on any command line. Follow these steps to complete the setup:

1. To set the cleanup options for your system, select option **1** (Change cleanup options).

   Security consideration

   To select option 1 (Change cleanup options), you must have *JOBCTL, *ALLOBJ, and *SECADM authorities. You also need to have a user class of security administrator (*SECADM).

   Figure 95 shows the Change Cleanup Options display.

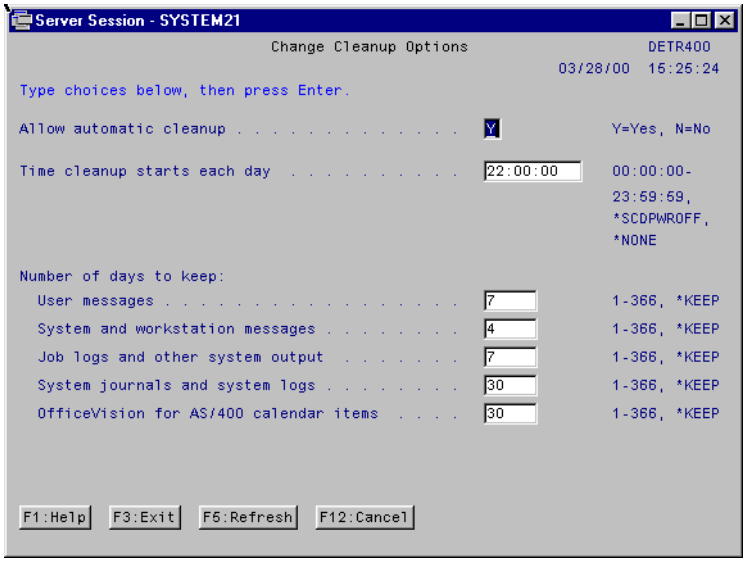

Figure 95. Change Cleanup Options display

2. Verify that automatic cleanup is set to Yes.
3. Set the time when the cleanup starts each day. Be sure to specify a time using the 24-hour clock format (for example, 17:00:00 is 5:00 p.m.).
4. Specify the number of days to keep old messages, job logs, system logs, and OfficeVision calendar items. Specify *KEEP if you do not want a specific item to be cleared.
5. Press Enter to update the settings.
6. Add a task to Machine Manager as shown in Figure 96.

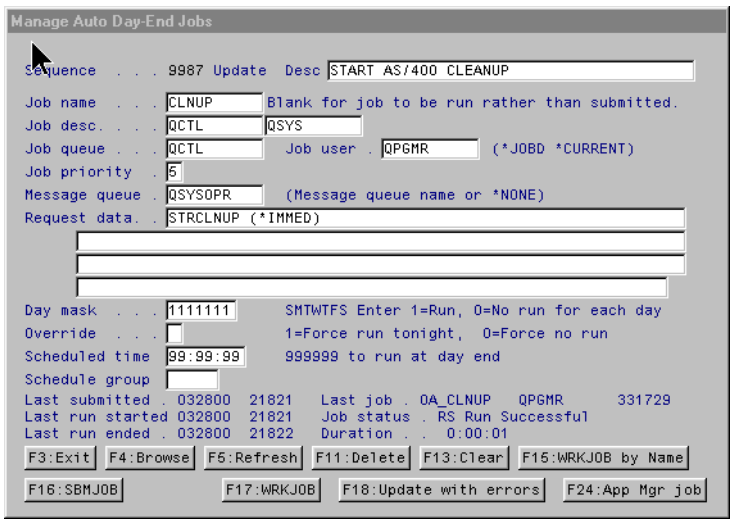

Figure 96. Setup for scheduling the AS/400 Cleanup Task in Machine Manager

On the STRCLNUP command, you can specify either *SCHED or *IMMED. If you specify *IMMED, the start time of the cleanup is based on Machine Manager scheduled time. If you specify *SHED, the start time of the cleanup is first based on the Machine Manager scheduled time and then on the cleanup start time.

Security consideration

To start or end cleanup, the job user assigned to the task must have a user class of system operator (*SYSOPR).

6.2.2 Cleanup activities you should perform

The automatic cleanup function takes care of many objects that can be accumulated on your system. However, you should also perform these additional activities to ensure that your system is running smoothly:

- Clean up the security auditing journal (QAUDJRN).
- Clean up the user printer output.
- Clean up OfficeVision for OS/400 items.
- Clean up the recovery library (QRCL).
- Organize physical files.
- Perform an IPL regularly.
- Manage journal receivers.
- Clear save files.
- Reset the message queue size.
- Reclaim spool storage.

For more details on how to perform these additional activities, see the *Basic System Operation, Administration, and Problem Handling* manual.

6.2.3 Performing an IPL regularly

Many AS/400 systems run 24 hours a day, 7 days a week and are rarely powered down for any type of maintenance. However, you can improve performance by performing an IPL periodically, perhaps monthly.

Several tasks occur during an IPL:

- More disk storage is made available because temporary libraries are deleted and work control blocks are compressed.
- Unused addresses are made available to the system.
- The job logs for each active subsystem are closed when you power down the system, and new ones are created when you IPL.

One way to gauge whether you should IPL is to observe the % of addresses used field on the Display System Status (DSPSYSSTS) display (Figure 97). To see this field, press F21 (Select assistance level) to switch to the intermediate assistance level on the Display System Status display. The percent of addresses used should not exceed 90. To reset the percent of addresses used threshold, you must perform an IPL to the system. To determine the total percent of addresses used, add the permanent and the temporary percent figures together.

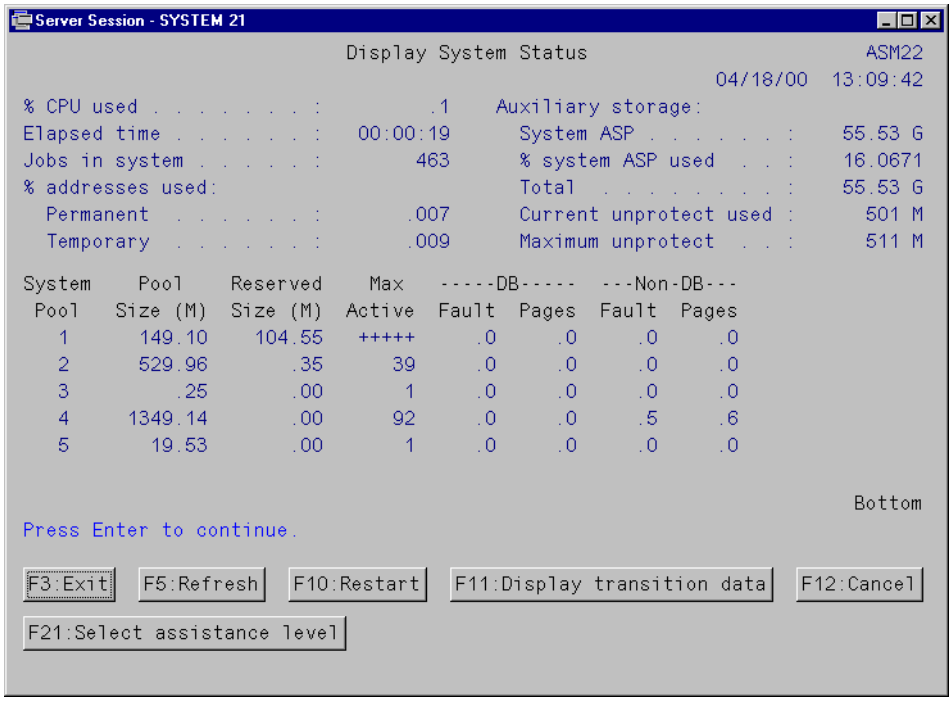

Figure 97. DSPSYSSTS display panel

Another indication that you should IPL is the percent of system storage used. Avoid running your system with a small amount of disk space left. If you cannot avoid this, perform an IPL on your system more frequently. Keep a record of the percent of auxiliary storage used before and after you IPL. Table 19 shows the percent used and how often you should IPL.

Table 19. IPL frequency guidelines

% Used	IPL frequency
95%	Daily
90%	Weekly
Below 90	as necessary

The system sends a warning message to the system operator's message queue (QSYSOPR) whenever the percent of addresses used exceeds 90 or if an object distribution object is sent to your AS/400 system and the size of the object exceeds the amount of storage you currently have. Take measures to make disk space available as soon as you receive this message. If the message is ignored, the system eventually stops with a system reference code (SRC) displayed on the control panel.

For more information, refer to *AS/400 System Operations,* SC41-4203.

6.3 Day-to-day processing

This section provides an example of what jobs should be executed on a daily, weekly, and monthly schedule to keep your system running effectively and efficiently. Keep in mind, that this is not a definitive list valid for all customer situations. You may not need to run all of these jobs, or you may want to run other

reports that are not detailed here. Refer to the individual application product guides for additional details.

Most of the daily and weekly procedures can be automatically executed using the Auto Day Start and Auto Day End jobs within Machine Manager (see 6.1, “Using System 21 Machine Manager” on page 143).

The following applications are covered in this section:

- Inventory Management
- Accounts Receivable
- Accounts Payable
- Cash Management
- General Ledger
- Purchase Management
- Sales Analysis
- Sale Order Processing

6.3.1 Daily processing

This section contains a list of tasks that should be executed on a daily basis.

6.3.1.1 Inventory Management

The recommended daily processing activities for Inventory Management are discussed in the following sections.

Allocation Reconciliation

Use this option to reconcile the stockroom balance allocation totals to sales orders, stock transfers, and production orders. This produces an exception report.

The Allocation Reconciliation option calls program IN916 and, if specified, updates the stockroom balances file INP60 with the correct number.

When you first install and initialize Inventory Management, run this option daily. Once you are satisfied the system is working correctly, you might consider running this option weekly or whenever it is needed.

On Order Reconciliation

Use this option to reconcile the stockroom balance record on order totals to purchase and production orders.

The On Order Reconciliation calls program IN917P and, if specified, updates the stockroom balances file INP60 with the correct number.

When you first install and initialize Inventory Management, run this option daily. Once you are satisfied the system is working correctly, you might consider running this option weekly or whenever it is needed.

6.3.1.2 Accounts Receivable

The recommended daily processing activities for Accounts Receivable are explained here.

Update credit manager statistics
This batch program analyzes all of the sessions posted to the system since the last time the job was executed. It also updates the statistics displayed by the Credit Manager Trends inquiry.

Session Audit Report
This audit report is the fundamental transaction audit report and helps you find any errors immediately. It produces a hard copy of all items posted for each session number.

You must run this report daily and then reconcile it to the appropriate General Ledger control account. Investigate and resolve any discrepancies immediately. This report should be part of your Auto Day End routine.

Note

Check the session inquiry to make sure that all sessions, created before today, are posted with a status of C (cancelled) or P (processed). If there is any other status for a session earlier than today, you may need to run the recovery option. Sessions created today can legitimately be waiting for updates.

6.3.1.3 Accounts Payable
The recommended daily processing activity for Accounts Payable is the Session Audit Report. This is the same report that you generate for Accounts Receivable. See “Session Audit Report” in the previous section.

6.3.1.4 Sales Analysis
The recommended daily processing activities for Sales Analysis are summarized here.

Sales history update
This batch job updates the Sales History Database with the details from invoices in the Sales Order Processing application. The program selects all invoice details for OEP70, where the ACTF70 field is blank.

Daily analysis update
The Daily Update function selects and print reports that have been specified for production at the end of the day.

6.3.1.5 Sales Order Processing
The recommended daily processing activities for Sales Order Processing are presented here.

Reconcile orders allocated but not shipped
As part of credit management, it is necessary to value the immediate commitment in terms of the allocated stock to a customer. This is the value by which a customer's credit will increase if no process is taken to stop it. This value is held, with the other financial balances for the customer, in Accounts Receivable.

This utility calculates the value of stock allocated to customers, both printed on picking notes and not yet printed, and compares the result with the total held on the customer's Statement Account Balance, in Accounts Receivable. The

Accounts Receivable balance is updated if any discrepancies have been found. It can run in two modes, each with its own menu option. These modes are:

- Report only
- Report and update

The discrepancies found are listed on a report.

When you first install and initialize Sales Order Processing, run this option daily. Once you are satisfied the system is working correctly, you might consider running the option weekly or whenever it is needed.

Reconcile orders shipped but not invoiced

As part of credit management, it is necessary to value the immediate commitment in terms of customer orders shipped, but not invoiced. This value is held with the other financial balances for the customer, in Accounts Receivable.

This utility calculates the value of stock shipped to customers, but not invoiced (for example, orders that are consolidated to produce weekly or monthly invoices), and compares the result with the total held on the customer's Statement Account Balance, in Accounts Receivable. The Accounts Receivable balance is updated if any discrepancies have been found. It can run in two modes, each with its own menu option. These modes are:

- Report only
- Report and update balances

The discrepancies found are listed on a report.

When you first install and initialize Sales Order Processing, run this option daily. Once you are satisfied the system is working correctly, you might consider running the option weekly or whenever it is needed.

Reconcile back order

A back order is an order that should have been allocated to meet the customer’s delivery date, but has not. The sum of the back orders at any time is held on the stockroom balance record for the item per depot. This balance is used in the calculation of *expected* stock. This utility can calculate the total of back orders for all depots and update the inventory stock balance totals. It can run in two modes, each with its own menu option, these are:

- Report only
- Report and update

The report lists the discrepancies found between actual back orders and the stock balance total.

When you first install and initialize Inventory Management, run this option daily. Once you are satisfied the system is working correctly, you might consider running this option weekly or whenever it is needed.

6.3.1.6 General

Depending on your operations and available down time (a period of time when the system is not in user for processing transactions), you may want to start and end the various application subsystems and background processing jobs.

See C.3, “Subsystems and background jobs” on page 570.

You should also schedule a daily backup of all database libraries. If you are running a 24-hour operation, give special consideration on how to perform save while active backups. See Chapter 9, “Backup and recovery” on page 251.

6.3.2 Weekly processing

This section contains a list of tasks that should be executed on a weekly basis.

6.3.2.1 Inventory Management

The recommended weekly processing activities for Inventory Management are presented here.

Week-end update

This option performs the following tasks for each product and stockroom combination:

- If the usage cycle on the company profile is set to W, for weekly, it recalculates the average weekly usage.
- Stores the physical and in transit stock at the end of the week in a separate field Stock At Start of Week.
- Sets the usage this week to zero.
- Increments the current week number on the calendar file by 1. If this reaches the end of year, it sets the week number to 1.

Calculate ROP, Max Stock, and EOQ

This option calculates the RPO (Re-order price), Maximum Stock, and EOQ (Economic order quantity) values.

Run this option weekly after the weekend update to pick up the latest average usage figures.

6.3.2.2 Accounts Receivable

The recommended weekly processing activities for Accounts Receivable are highlighted here.

Debtor Balance Report

This option helps you reconcile your General Ledger control account balances to their related customer accounts for any period—past, present, or future.

You can run this report at a summary level for the current period. Then compare the report to the General Ledger balance to help you run the weekly reconciliation.

Unprocessed transactions

This option produces a list of Accounts Receivable transactions, posted before the system date, and not yet updated in General Ledger. The listing includes full transaction details in session order.

Use this report to help with the weekly reconciliation.

6.3.2.3 Accounts Payable

The recommended weekly processing activities for Accounts Payable are discussed here.

Creditor Balance Report
This option helps you reconcile your General Ledger control account balances to their related customer accounts for any period—past, current, or future. The report uses the opening balance for a control account in the General Ledger to add the Accounts Payable movements and calculate a closing balance for the General Ledger control account. It then checks and reports on any variances.

You can run this report at a summary level for the current period. Then, you can compare the report to the General Ledger balance to help you perform the weekly reconciliation.

Unprocessed transactions
This option lists the Accounts Payable transactions that were posted before the current date and have not yet been updated in General Ledger. The listing includes full transaction details in session order.

Use this report to help with the weekly reconciliation.

6.3.2.4 General Ledger
The recommended weekly processing activities for General Ledger are explained here.

Unprocessed transactions
This option lists the transactions that were posted before the system date, and have not yet been updated in General Ledger. The listing will include full transaction details in session order.

Use this report to help with the weekly reconciliation and catch possible balancing problems prior to month end.

Trial balance
This option produces a trial balance report for the company, for top level accounts. You should review the report to make sure there are no out-of-balance differences in the General Ledger.

Account inquiry
Use this option to review the rounding error account and the Advanced Financial Integrator suspense accounts. These accounts should have a zero balance.

If System 21 posted an entry to the rounding error account, a spooled file (GL161PT) is sent to the user defined in the Start/End Balances update option. The report (GL161) shows why System 21 made the entry.

6.3.2.5 Sales Analysis
The recommended weekly processing activity for Sales Analysis is Weekly Update.

Weekly Update
The Weekly Update function is used to select and print reports that have been specified for production at the end of the week. The function also increments the week number held on the company profile.

6.3.3 Monthly processing

This section contains a list of tasks that should be performed on a monthly basis.

6.3.3.1 Inventory Management

The recommended monthly processing activities for Inventory Management are presented here.

Inventory month end

Use this option to produce stock valuation and reorder reports, and to update the usage figures.

It performs the following tasks for each product and stockroom combination:

- If the usage cycle set on the company profile is M, for monthly, it recalculates the average monthly usage.
- Sets the usage period to zero.
- Sets the number of sales orders this period to zero.
- Sets the number of substitutions this period to zero.
- Stores the current physical stock.
- Calculates and stores the stock value.

Movements Audit Report

The Movements Audit Report clears INP96 (Movements) of all transactions processed by AFI since a report last produced. Run this option after the inventory AFI extract is complete for the month and after the Inventory month end procedure.

Note

The Movements Audit Report is a prerequisite for running the Negative Stock Report. If you need to run the Negative Stock Report on a daily or weekly schedule, you must run the Movements Audit report on the same schedule. Only after closing the inventory month, records from INP96 are cleared.

6.3.3.2 Purchase Management

The recommended monthly processing activity for Purchase Management is to run the Accruals Report.

Accruals (receipts not invoice) Report

This report provides an analysis of receipts that have not yet been invoiced.

All receipts are analyzed by the general ledger account code associated with the order line against which the receipt was recorded. For stock orders, this will have derived from the item master file, as set up in Inventory Management. For non-stock orders, this code will have been entered in order entry.

This is a time-sensitive report and should run after all receipts for the month have been reported and all invoices for the month have been posted, but before any new activity for the new month has been entered.

6.3.3.3 Fiscal period end

Perform the period-end functions for the following applications:

- Accounts Receivable
- Accounts Payable
- Cash Management
- General Ledger

See 6.4, “Fiscal-period and year-end checklist” on page 164, for more details

6.3.3.4 Sales Analysis

The recommended monthly processing activity for Sales Analysis is to run the Period End Update function.

Period End Update

The Period End Update function is used to select and print reports that have been specified for production at the end of the period.

The function also increments the period number on the Company Profile. If the job is run at the end of the last period in the year, the period number is re-set to “1” and the year increment.

6.3.3.5 Forecasting

The recommended monthly processing activities for Forecasting are discussed in this section.

Transfer last period history

You use this option to transfer the last period sales/demand quantities from Sales Analysis and Service Management (if Service Management is installed) into each forecasting model. This is done for all items having a group or item profile.

The last period demand quantities are accumulated for each item within a group and also transferred.

You should select this option before invoking the period-end run and just after processing the current period in Sales Analysis.

Period end update

You use this procedure to generate forecasts for the next year in each forecasting model. Forecasts are generated for all groups of items and individual items having profiles in this application.

This is achieved by evaluating the performance of each forecast method over a simulation period. This program selects the best method, and uses this to project forecast quantities for the coming 12 or 13 periods.

6.4 Fiscal-period and year-end checklist

Period-end and year-end checklists give you ordered checklists for the jobs that we strongly suggest that you need to complete before running both the Period End and Year End routines.

Please keep the following points in mind:

- Refer to 6.3, “Day-to-day processing” on page 157, to plan your work according to the module, for example, to follow through all the General Ledger jobs.
- Use this section to verify that jobs across all the applications, which need to be completed before running Period End and Year End, have been run in the correct sequence.
- Period End and Year End are pre-defined and pre-planned routines that can (but are not restricted to) be run exactly at the end of the month or at the end of the year.
- You can cross-reference between the two sections when running the monthly and yearly procedures.

6.4.1 Fiscal period end

Before running a Period End, you must:

- Complete all the daily, weekly, and monthly procedures detailed in 6.3, “Day-to-day processing” on page 157.
- Complete the jobs and checks in the order given on the checklists in this section.
- Make sure there is nobody logged on to System 21.

Period End checklists are included for the following modules:

- Inventory Management
- Accounts Receivable
- Accounts Payable
- Cash Management
- VAT (Value Added Tax)
- General Ledger

Attention

You must run the Inventory Management month end first. This is because the Inventory calendar dictates the posting period of invoices posted to Accounts Receivable. You *must* close the Inventory period to post to a future period in Accounts Receivable. If you do not close the period in Inventory, all posting continues for the previous period and is, therefore, incorrect.

6.4.1.1 Inventory Management checklist

Run the Month End Update.

6.4.1.2 Accounts Receivable checklist

Perform the following steps:

1. Use the Session Enquiry to check that there are no incomplete sessions (Status I) or sessions that are posted but not updated (Status F).
2. Run the Accounts Receivable (AR) reconciliation report for the current period to reconcile transactions to details and summary balances. The four-part report highlights transactions, customers, or sessions that may need to be individually researched for errors.

3. Run the Overdue Analysis Report. The Overdue Payments Report lists outstanding debt by due date of outstanding items. Use either this or the Debtor Balances Report to compare subledger balances to the General Ledger control account balances to help with the reconciliation.
4. If there are differences between Accounts Receivable and the General Ledger control accounts, run the Unprocessed Transactions option. Recover any sessions using the AR utility option, Recover Incomplete Sessions. If necessary, use reconciliation to identify the problem transactions.
5. You can generate reports for sessions in error only. This option checks that all the General Ledger postings agree with the Accounts Receivable postings and produces a report of transactions that have not been posted to the General Ledger.
6. Use the Assign Statement Overdue Messages option to print a message on a customer's statement to remind customers of any payment that is overdue.
7. Use the Print Statements option to print statements for customers.
8. If you have completed all of the above checks, you should be able to close the current Accounts Receivable period. If there are any errors, a message is displayed. You must investigate the errors and correct them before you can try to close the period again. You cannot post to the ledger until you open the next period.
9. Use the Open Next Period option to either open a new period or open the period you just closed. Only open the next period if you have fully completed the Period End procedures. You cannot re-open a period if you closed Cash Management for that period.

6.4.1.3 Accounts Payable checklist

Perform the following steps:

1. Use the Session Enquiry to check that there are no incomplete sessions (Status I), sessions that are posted but not updated (Status F), or sessions being updated.
2. Run the AP reconciliation report for the current period to reconcile transactions to details and summary balances. The four-part report highlights transactions, customers, or sessions that may need to be individually researched for errors.
3. Run the Overdue Analysis Report to list outstanding payments by due date of outstanding items. For reconciliation, use either this or the Creditor Balances Report to compare subledger balances to the General Ledger control account balances.
4. Use the General Ledger Account Enquiry to compare the General Ledger Balance of the Accounts Payable control account with the subledger reports.
5. Run the Verify General Ledger Interface. If there are differences between Accounts Payable and the General Ledger control account, use this option to identify the differences at session level. You can generate reports only for sessions in error. This option verifies whether all the General Ledger postings agree with the Accounts Payable postings and produces a report of transactions that have not been posted to the General Ledger.
6. If you have completed all the above checks, you should now be able to close the current Accounts Payable period. If there are any errors, a message is

displayed. You must investigate and correct the errors before you can try to close the period again. You cannot post to the ledger until you open the next period.

7. You can use the Open Next Period option to either open a new period or open the period you just closed. Only do this if you have fully completed the Period End procedures. You cannot re-open a period if you closed Cash Management for that period.

6.4.1.4 Cash Management checklist

Perform the following steps:

1. Complete all the check runs.
2. Run Payments and Remittances. This option prints the documentation for manual payments. Make sure that there are no payments waiting for you to assign check numbers.
3. Use the Bank Account enquiry option to help you reconcile bank accounts in Cash Management with the General Ledger.
4. Reconcile your bank accounts with the statement supplied by your bank. Review this option to check that you have completed all reconciliation routines. If your bank supplies your statements on magnetic tape, you can carry out your reconciliation using the Automatic Bank Reconciliation options. You cannot complete the Period End if a bank statement session is suspended.
5. Verify that all transactions for the period have been processed.
6. Run Period Close. This option both closes the current period and opens the next period. It creates a new period balance record for each bank account. updates the calendar file with the opening date for the new period. The period number is held in the Cash Management company profile.

6.4.1.5 General Ledger VAT checklist

When you close your Value Added Tax (VAT) period, depends entirely on the periods you have set up in your VAT calendar. Complete these tasks:

1. Close the VAT period. Select from 3/GLC on the standard General Ledger menu. This automatically opens the next VAT period.
2. Run the VAT final report.

6.4.1.6 General Ledger checklist

Before you start the General Ledger period end, make sure that Cash Management is in a future period. Then, complete these steps:

1. Run the Suspended Journals Report. This lists all the journals suspended during transaction posting sessions. Use this option to make sure that there are no suspended journals.
2. Check for the following items:
   - There are no outstanding suspended journals.
   - Any dependent ledgers are set to a future period.

- Any General Ledger companies that consolidate into this company are set to a future period.
- If you use Advanced Financial Integrator (AFI), its postings to the General Ledger must be complete for this period.

3. Run the Final Close option to close the current period and prevent further postings into the General Ledger for that period (except prior period journals).
4. Run the Open Next Period option. This option checks that you have completed the Period Close procedures, and you have defined the net profit and opening balance accounts on the company profile. The values held for each account at the end of the current period are added to any values already held for the next period to give an opening balance for the next period.

6.4.2 Fiscal Year End

Before running Year End, you must:

- Complete the period end and the yearly procedures detailed in Chapter 7.
- Complete the jobs and checks in the order given on the checklists.
- Make sure there is nobody logged on to System 21.

These are the applications and options for which there are Year End checklists:

- Inventory Management
- Sales Analysis
- Accounts Receivable
- Accounts Payable
- Cash Management
- General Ledger
- Financial Calendars Required for New Year
- Fixed Assets
- World Trade

Note

- Sales Order Processing does not require any year end processing. Make sure that all your order processing sales have been posted to AR and General Ledger (GL).
- Except for Inventory and Sales Analysis, year close is carried out through the period close option, which recognizes the year close from the number of periods specified on the application's company profile. You may process applications in the same order as Period End or in the order of the above list.

6.4.2.1 Inventory Management Year End checklist

You must run Inventory Management Year End first. That is because the Inventory calendar dictates the posting period of invoices to Accounts Receivable. You must close the inventory year to post to a future year in Accounts Receivable. If you do not close the year in Inventory Management, all posting continues for the previous year and is, therefore, incorrect.

Follow this checklist:

1. Make sure that next year's calendar has been set up (in period/week end control, months, and weeks). As a general rule, your inventory calendar should be defined for the current year and the next year.
2. Check that calendar maintenance displays the current year, last month, and last week in the year, for example: 99 12 52.
3. Run Week End Update. This changes the calendar week to 1.
4. Run Month End Update. This changes the calendar month to 1.
5. Run Year End Update. This automatically increments the calendar year.

   This produces a stock valuation report, a reorder report, and updates the usage figures. It also increments the Inventory year. These could be valuable reports for audit purposes.

   Note also that the inventory yearly usage figures are set to zeroes.
6. Check that calendar maintenance now displays the new year, month 1 and week 1.

> **Note**
>
> It is important to do this before any posting commences.

6.4.2.2 Sales Analysis checklist

For Sales Analysis, complete the following checklist:

1. Make sure that next year's calendar has been set up.
2. Run Sales History update for last period.
3. Verify that company profile maintenance displays the current year, last month, and last week in the year, for example: 99 12 52.
4. Run Week End Update. This changes the current week to 1.
5. Run Year end update. This must be run before Month End Update.
6. Run Month End Update. This automatically increments the company profile year and changes the current month to 1.

6.4.2.3 Cash Management checklist

When you complete the normal monthly and Period End procedures for the last period in a year, the Year End automatically occurs. All Year End processing is transparent to the user.

6.4.2.4 Accounts Receivable checklist

You set up the number of periods in a year in the Company Profile. When you complete the normal monthly and Period End procedures for the last period in a year, the Year End automatically occurs.

All Year End processing is transparent to the user.

Follow this checklist:

1. Check for failed or incomplete sessions. You could run the Unprocessed Transactions option (14/ARU). Make sure that these are recovered or updated as normal.
2. Run Close Current Period.
3. We recommend that you print the following reports, but it is not mandatory:
   - Aged debt (required for audit)
   - Debtor balances
   - Session audit
   - Overdue analysis
   - Cash flow analysis

   You may also find the following reports useful:
   - Customer turnover
   - Outstanding items
   - Inactive customers
   - Credit note analysis
4. Reconcile the above reports to the GL debtor control accounts as per a normal period end.
5. Print the statements required for the audit.
6. Run Open Next Period.

6.4.2.5 Accounts Payable checklist

You set up the number of periods in a year in the Company Profile. When you complete the normal monthly and Period End procedures for the last period in a year, the Year End automatically occurs.

All Year End processing is transparent to the user.

Follow this checklist:

1. Check for failed or incomplete sessions (Run Unprocessed Transactions 14/APU). Make sure that these are recovered or updated as normal.
2. Run Close Current Period.
3. We recommend that you print the following reports, but it is not mandatory:
   - Aged credit required for audit
   - Creditor balances.
   - Session audit
   - Overdue analysis
   - Cash flow analysis

   You may also find the following reports useful:
   - Supplier revenue
   - Outstanding items
   - Inactive suppliers
   - Vendor payment analysis
4. Reconcile the above reports to the GL creditor control accounts as per a normal period end.

6.4.2.6 General Ledger checklist

This process explanation assumes that you do not use Year End journals. You specify in the Company Profile whether you use Year End journals. This is only required for certain countries, for example, France and Italy.

The Company Profile defines the Fiscal Year End. When you close the last period in the year, it runs a reconciliation to verify the Accounts Receivable and Accounts Payable control accounts. If there are any discrepancies, the close is not completed.

When you run the period open, the income statements are closed out and the entry to retain earnings is made. You do not need to intervene in the process.

1099 processing

You specify whether you want to use 1099 processing in the Maintain Country Specific parameters. If you are using this option, you must run the following jobs early in January:

- Analysis Report
- 1099-MISC Register and Forms
- Transaction Exceptions
- Supplier Exceptions

Review the reports, and make any necessary changes using the Transactions Maintenance option.

Print the final 1099s through the 1099-MISC Register and Forms option and send them before January 30. If required, send the tape before February 28.

Note

Items 6, 7, and 14 refer to the VAT system within GL. These items are only necessary if the VAT year end coincides with the GL year end and may be processed independently at another time.

Complete this checklist:

1. Make sure that next year's calendar has been set up. This is maintained from Audit control and other maintenance.
2. Make sure that next year's VAT calendar has been set up.
3. Confirm any suspended journals. Use the suspended journals report.
4. Check that the rounding errors account, specified on the company profile, and any suspense accounts are cleared.
5. If Advanced Financial Integrator is in use, make sure that all AFI sessions are posted to GL.
6. Run the VAT final report, which will prevent further posting to the current VAT period, provided that prior-period posting is flagged to off for the VAT code. See the note above regarding VAT year end.
7. Reconcile the VAT period balances to the GL VAT accounts. See the note box above regarding VAT year end.

8. We recommend that you print the following reports for auditing purposes:
   - Transaction postings
   - Session controls
9. Print and check the Trial Balance report.
10. Print statutory reports:
    - Profit and Loss
    - Balance Sheet
    - Final accounts
11. Reconcile the Profit and Loss report total to the net profit memo account balance. This account is identified in the company profile. If this cannot be reconciled, please call the Geac Help Desk.
12. Run a final close. A report is produced that reconciles AR and AP ledgers to their control accounts in GL. Year close is not permitted unless the reconciliation is correct.

> **Note**
>
> In the event that this report does not reconcile and you have reconciled AR and AP to GL already, please contact your local help desk.

13. Run Open Next Period.

    If the year close journal is not used, the following process takes place:

    a. Profit and Loss ledger is cleared.
    b. Balance Sheet ledger balances are rolled forward into the new year.
    c. The net profit memo account balance is added to the opening balance account, or retained earnings account, which is identified on the company profile. It is then cleared for Profit and Loss.
14. Run VAT Period End. See the note box on the previous page regarding VAT year end.
15. Print and check the Trial Balance report.
16. If you specified an adjustment period in the company profile, this may now be posted to using prior-period journals. The balance changes from these journals are rolled forward into the new year.

6.4.2.7 Financial calendars required for new year

You must define the following calendars for the new year:

- **General Ledger Financial calendar**: This is used by all financial applications.
- **VAT calendar**: You must define this for every company, even if they do not use VAT processing.
- **1099 calendar**: Use this calendar if you use 1099 processing with the company.

As a general rule, your financial calendar should be defined for the current year and next year.

6.4.2.8 Fixed Assets checklist

Complete this checklist for Fixed assets:

1. Make sure there are no unprocessed GL postings and that all Fixed Asset processing for the current year is complete. The year end involves substantial calculations (see manual for details) that may not be reversed once initiated.
2. Run Close Period/Open Next Period.

6.4.2.9 Cash Management checklist

Follow this checklist for Cash Management:

1. You may find it helpful to print the following reports:
   - Suspended items
   - Unpresented items
   - Statement of balance (this should be reconciled to the GL bank accounts)
2. Make sure that there are no check numbers yet to be allocated.
3. Run Period End.

6.4.2.10 World Trade checklist

World Trade does not require a Period End or Year End process.

Geac recommends that you complete the following steps before transaction processing in the new year:

1. Print Intrastat and ESL reports
2. Make sure that next year's calendars have been set up. These calendars determine the time-span covered by the above reports. They are maintained in Period maintenance.

6.5 System 21 cleanup

This section highlights other tasks you can perform on a regular basis to ensure that some system database files do not become too large or out of sync.

6.5.1 Application Manager day end

The Application Manager day-end routine performs the following tasks:

- Runs the individual application day-end routines as specified by means of the Maintain Applications option
- Archives the Application Manager jobs initiated since the last day-end
- Clears any unfinished jobs in the system
- Re-organizes the Application Manager files

This process is controlled by the IPGAMP4/XA803CLP program and can be added to Machine Manager using the F10 key when adding a new task.

Parameters for the job are held in the IPGAMP4/AMDAYEND data area and are controlled from Application Manager Utilities.

The Application Manager job history is archived into a new member in the IPGCFF4/APG02ARC file each time this job is run. It is important that the

APG02PHY file is reorganized to recover disk space. It is also important that the members in APG02ARC are deleted when they are no longer required.

> **Note**
>
> While the day-end job is running, there must be no users signed on to Application Manager.

6.5.2 Administration Functions day end

This process is controlled by the IPGCFP4/ICF706CL program. You add it to Machine Manager by pressing F10 when adding a new task. It validates the user register and clears records from it for completed jobs. This means that it reduces the records in ICF04PHY, which is the user register, and maintains a record for each task executed by a user within the System 21 Menu System. It is good practice to run this command to ensure that cancelled jobs do not register as active jobs.

6.5.3 Clear Machine Manager log

This process is controlled by the IPGMMP4/MM220CLP program. You can add it to Machine Manager by pressing the F10 key when adding a new task. It purges records from the Machine Manager log file (AMM90PHY) according to the Number of days to save parameter on the CLRMNGLOG command.

6.5.4 Clear Machine Manager history log

This process is controlled by program IPGMMP4/MM260CLP and can be added to Machine Manager by using the F10 key when adding a new task. It purges records from the Machine Manager history log file (AMM95PHY) according to the number of days to save parameter on the CLRMNGHST command.

6.5.5 Inventory database integrity

This option verifies that a header record exists for every detail record in the Inventory Database. Geac recommends that you run this option using Bottom Up Validation.

The Database Integrity option calls the IN900CLP program, which calls IN900. No files are updated by this task.

If you have written a program that automates the creation of item master records, or are implementing lot, serial, or batch number controls, you should run this option weekly. Once you are satisfied the system is working correctly, you can run this option monthly or whenever it is need.

6.5.6 Rebuild inventory item search

Use this option to rebuild the item search key words. You should run this function to account for any changes made to the item description and text during the month.

6.5.7 Renumber inventory item search words

Use this option to renumber the search words associated with each item.

6.5.8 Advanced order entry system files

As part of the day-end processing, you should clear the system file OSLAOP3/@CPIUAO. This file holds details of the last order generated for each Advanced Order Entry session. Clearing this file results in a performance increase especially if you use a large number of Advanced Order Entry sessions on a daily basis.

6.6 Archive and purging

This section describes the various archive and purge routines available within System 21. It also outlines the steps required to archive and purge information from the various System 21 modules. It's imperative that proper backup and recover procedures be in place before taking on the tasks of archiving and purging System 21 data files. We recommend that you re-organize purged physical files to maximize disk utilization.

6.6.1 Inventory Management

The following sections list the archive and purge routines available to the Inventory Management module.

6.6.1.1 Delete History and Movements

This function clears INP90 (History) and INP95 (Movements) based on the number of weeks to retain data supplied by the user. Take great care over the control of history deletion, because the Stock History is used to determine average usage. No report or secondary file is produced or created. See Table 20 for specifications.

Table 20. Inventory history and movements purge specifications

Where, what, and when	Details
Menu Option	22/INU
Suggested Frequency	Monthly
Suggested Retention	22-3 years or 104-156 weeks
Purged Files	INP90 and INP95

6.6.1.2 Movements Audit

This function clears INP96 (Movements) of all transactions processed by AFI since the last report was produced. A report is produced detailing transactions deleted from the file. No secondary file is created. See Table 21 for specifications.

Table 21. Inventory movements audit purge specifications

Menu option	31/INR
Suggested Frequency	Monthly after IN month end before first AFI extract of the new period
Suggested Retention	No options
Purged Files	INP96

6.6.1.3 Delete FIFO and Lot Details

This procedure purges data from the FIFO Detail files. FIFO records with zero balances, and batch/lot records with zero balances and no stock movements, are deleted. Cut-off dates for the deletions are selected. Only records up to and including the cut-off dates are considered for deletion. No report or secondary file is produced or created. See Table 22 for specifications.

Table 22. FIFO and lot details purge specifications

Menu option	23/INU
Suggested Frequency	Monthly
Suggested Retention	6 months
Purged Files	INP80, INP83, INP84, INP88, INP89, INP87

6.6.1.4 Purge Stock Counts

This function facilitates the purge of completed counts by individual count number or a range of count numbers. The count headers and their associated count recommendations are deleted with full auditing to system standards. In addition, the associated count lists and details are deleted.

Optionally, incomplete outstanding counts can be purged, resulting in associated items being taken off count (for item-based counts) and associated locations being taken off count (for location-based counts). See Table 23 for specifications.

Table 23. Inventory stock count sheet purge specifications

Menu option	24/INU
Suggested Frequency	Monthly
Suggested Retention	3 months
Purged Files	INP58, INP75, INP77, INP73

6.6.1.5 Purge Count Details and Action Lists

This function facilitates the purges of completed count list details, by date.

Count lists and all associated details are deleted when their date of creation is less than or equal to the date entered. This utility is intended to allow the removal of completed count details in isolation of the original recommendations (which can be purged with full audit via the purge counts option). See Table 24 for specifications.

Table 24. Inventory count details and action lists purge specifications

Menu option	25/INU
Suggested Frequency	Monthly
Suggested Retention	3 months
Purged Files	INP58, INP75, INP77, INP73

6.6.1.6 Delete Shipment Receipts

This option deletes all confirmed shipment receipts from INP05. These are shipment receipts generated from the DRP module and from internal stock

transfers. No report or secondary file is produced or created. See Table 25 for specifications.

Table 25. Inventory shipment receipts purge specifications

Menu option	27/INU
Suggested Frequency	Monthly
Suggested Retention	No Option
Purged Files	INP05

6.6.1.7 Item Deletion

The option allows a job to be submitted to delete those items from the database previously flagged for deletion in Item Master Maintenance up to a specified effectively date. This is can be done in two steps or all in one step (step 2):

1. Select option 15/INU - Build Item Deletion Logical Files. This creates the necessary technical requirements to allow the system to process the item deletion.
2. Select option 26/INU - Item Deletion. This option physically removes the items from the database.

Step one can be done while the system is in use. Step two requires a dedicated system. Step two runs step one automatically if it was not done manually.

Step two produces two reports: items not eligible for deletion and item deleted. Validation reports, produced by individual application areas, explain why an item is not eligible for deletion. Confirmation reports, produced by individual application areas, list deleted item details. For deleted items, an entry is written to the Item Master Audit file (INP35A), and a record is written to the Sales Analysis Delete Item file (INP34). See Table 26 on page 178 for specifications.

The application areas that are checked are:

- Order Entry Price List (does not include advance pricing details)
- Purchase Management Item Details
- Warehousing Item Details
- DRP Item Details
- Forecasting Item Details
- Transport Planning Item Master Details
- Telesales Item Details
- World Trade Item Details
- Production Item Details
- US Sales Tax Item Details

Note

To prevent the deletion of an item or stockroom with any existing stock movement, the code IDMP should be set up in the Inventory Descriptions file under Major Type MISC. The IDMP Rate field should specify the number of periods back from the current period, during which time deletion will not be allowed. If IDMP is not defined in the Descriptions file, all items flagged for deletion are deleted during the Item Deletion Routine.

Table 26. Inventory Item Master archive and purge specifications

Menu option	26/INU
Suggested Frequency	Yearly or as needed
Suggested Retention	Based on retention periods in related databases
Purged Files	INP60, INP65, INP45, INP38, INP36, INP06, INP07, INP40, INP87, INP35, INP68 OEP80, OEP85, PMP01, PMP11, PMP40, PMP07, PMP13, WHP45, WHP50, WHP55, DRP04 CRP01 TPP48 TSP15, TSP16, TSP90, TSP35, TSP36 WTP25, WTP20 MSP04, MSP05, MSP06, MPS02 USP39
Archived File	INP34

6.6.1.8 Audit File Purge

The Audit File Purge Utility allows you to predefine the number of days to keep audit file entries for each audit file in the core distribution application set. A separate option is used to submit the job to conduct the purge. This job can also be automated through Machine Manager. No report or secondary file is produced or created. See Table 27 for specifications.

Table 27. Audit File Purge specifications

Menu option	28/INU
Suggested Frequency	Monthly
Suggested Retention	3 Months
Purged Files	User defined from maintenance option

6.6.1.9 Item Master Maintenance Audit report

Printing the Item Master Maintenance Audit report automatically deletes reported audit records from INP35A. See Table 28 for specifications.

Table 28. Inventory Item Master Audit file purge

Menu option	11/INR
Suggested Frequency	Monthly
Suggested Retention	No option
Purged Files	INP35A

6.6.1.10 Stockroom Profile Maintenance Audit report

Printing the Stockroom Profile Maintenance Audit report automatically deletes reported audit records from INP60A. See Table 29 for specifications.

Table 29. Inventory Stockroom Profile Audit file purge specifications

Menu option	12/INR
Suggested Frequency	Monthly
Suggested Retention	No option
Purged Files	INP60A

6.6.2 Production Management

This section lists the archive and purge routines available to the Production Management modules (see Table 49 on page 188 for specifications).

6.6.2.1 Delete Production Transactions

Delete Production Transactions clears the production transaction records created on or before the date supplied by the user and AFI has flagged them as being posted to the ledger. No report or secondary file is produced or created. See Table 30 for specifications.

Table 30. Production Transaction purge specifications

Menu option	34/MDU
Suggested Frequency	Monthly
Suggested Retention	6-12 months
Purged Files	PCP52, PCP56, PCP58. PCP62, PCP93, PCP59

6.6.2.2 Archive Production Orders

This facility allows completed production orders to be archived. An archived version of the order header is created, and the live production file records are deleted. Canceled orders are simply deleted and not archived. When each order is archived, the following actions may happen, depending on how the Company Profile has been set up:

- A report is printed for the production order.
- Booking history is deleted.
- Stockroom transactions are archived.

See Table 31 on page 180 for specifications.

Table 31. Production Order purge and archive specifications

Menu option	32/MDU
Suggested Frequency	Monthly
Suggested Retention	6-12 months
Purged Files	MSP40, MPS41, MPS42, PDP46, MSP02, MSP60, PCP61, PCP62, PCP53, PCP54, PCP62, PCP65, PCP94, PCP96
Archived Files	MSP40A, MSP41A, MSP42A, PDP46A, MSP50A, MSP02A, MSP60A, PCP61A, PCP62A, PCP65A, MPS65A, MSP58A, MSP59A, PCP63A, INP95A

6.6.2.3 Delete Held Inventory References

This utility deletes all held inventory detail records with a zero remaining quantity (field QTYD54=0). These records were used to reflect held Work in Process (WIP) inventory quantities prior to being scrapped, released, or transferred. See Table 32.

Table 32. Production Held Inventory purge specifications

Menu option	33/MDU
Suggested Frequency	Quarterly
Suggested Retention	No option
Purged Files	PCP54

6.6.2.4 Delete Workstation Schedules

The purpose of this function is to remove historical workstation schedule records based on a range of date supplied by the user. The system does not purge these records automatically. Retention of these records serves only to support the Schedule Adherence Report. See Table 33 for specifications.

Table 33. Production Workstation Schedule purge specifications

Menu option	35/MDU
Suggested Frequency	Monthly
Suggested Retention	6 months
Purged Files	PCP97, PCP84

6.6.2.5 Delete Subcontractor Shippers

This utility deletes all closed (field STAT96=2) shipper records. These records are used to track inventory that was sent to a subcontractor. See Table 34.

Table 34. Production Subcontractor purge specifications

Menu option	36/MDU
Suggested Frequency	Quarterly
Suggested Retention	No option
Purged Files	PCP96

6.6.3 Warehousing

This section lists the archive and purge routines available to the Warehousing module. Keep in mind that all Warehouse purge routines are warehouse specific.

6.6.3.1 Movement Records

You use this procedure to delete movement records that are no longer required. All records up to and including the entered date are deleted. See Table 35 for specifications.

Table 35. Warehousing Movement purge specifications

Menu option	31/WHU
Suggested Frequency	Monthly
Suggested Retention	6 months
Purged Files	WHP90

6.6.3.2 Event and Action List Records

You use this procedure to delete event and process records that are associated with put-away, pick, and move transactions that have been completed and are dated up to and including the cut-off date. See Table 36 for specifications.

Table 36. Warehousing Event and Action List purge specifications

Menu option	32/WHU
Suggested Frequency	Monthly
Suggested Retention	6 months
Purged Files	WHP75, WHP76, WHP77, WHP73

6.6.3.3 Location Details With Zero Balance

Use this procedure to delete location detail records from the database that have a zero inventory stock balance. See Table 37 for specifications.

Table 37. Warehousing Zero Balance location purge specifications

Menu option	33/WHU
Suggested Frequency	Yearly
Suggested Retention	No options
Purged Files	WHP35

6.6.4 Sales Order Processing

This section lists the archive and purge routines available to Sales Order Processing module.

6.6.4.1 Archive Orders/Invoice

Archive Orders/Invoices clears completed order details and invoice history processed by AFI based on a cut-off date that you supply. This option then copies the files that were cleared from production to a history file. No report is produced. See Table 38 on page 182.

Table 38. Sales Order Processing purge and archive specifications

Menu option	22/OEU
Suggested Frequency	Monthly
Suggested Retention	1-2 Years
Purged Files	OEP40, OEP45, OEP50, OEP55, OEP65, OEP70, INP20, OEP20
Archived Files	OEP40H, OEP45H, OEP50H, OEP55H, OEP65H, OEP70H

6.6.4.2 Price Type Purge request

Purging advance pricing details is a three-step process:

1. Create the work file

   This Order Entry function enables you to select non-effective price types for subsequent purging via the price Type Purge Update routine. The option builds a work file (OEP15W). A report of price types to be purged is produced.

2. Price Type Purge amend

   This allows you to remove items from the work file that you choose not to purge.

3. Price Type Purge update

   The Price Type Purge process rechecks the work file to verify the effectiveness of each price type. If the price type is still ineffective, it is deleted. If the price type is found to have effective lines, the purge is halted and the line is written to an exception report. A report of price types deleted is also produced. See Table 39 for specifications.

Table 39. Advance pricing purge specifications

Menu option	23/OEU
Suggested Frequency	Yearly
Suggested Retention	1 Year
Purged Files	OEP14, OEP15, OEP16, OEP19

6.6.5 Purchase requisitioning

Requisition Purge deletes inactive requisitions dated on or before the date supplied by the user for a specific company. An audit report is produced. See Table 40.

Table 40. Purchase Requisitions Purge specifications

Menu option	1/RQU
Suggested Frequency	Monthly
Suggested Retention	6 months
Purged Files	PMP17

6.6.6 Sales Analysis

Sales Analysis data is purged one year at a time. You can delete old data that is no longer of interest, or simply remove unwanted test data. No report is produced, or secondary file is created by this utility. See Table 41 for specifications.

Table 41. Sales Analysis purge specifications

Menu option	7/SAU
Suggested Frequency	Yearly
Suggested Retention	2-3 Years
Purged Files	SAP20

6.6.7 Purchase Management

This section describes the archive and purge routines that are available to the Purchase Manage module.

6.6.7.1 Canceled Order Purge

Canceled Order Purge deletes PMP02, PMP02F, and PMP20 for canceled purchase orders. A single order number can be entered or left blank for all canceled orders. A report is produced. See Table 42 for specifications.

Table 42. Cancel Purchase Order purge specifications

Menu option	3/PMU
Suggested Frequency	Monthly
Suggested Retention	No option
Purged Files	PMP02, PMP02F, PMP20

6.6.7.2 Purchase Order Purge

Order clearance deletes PMP03, PMP09, PMP11, PMP20 (if all transactions for an order line have been flagged for deletion),PMP02, and PMP02F (if all order lines have been flagged for deletion). You are given the option to enter an invoice match date from which to purge. Records selected for deletion will have been matched prior to the date entered. An option is also given to retain a minimum number of matched transactions per item/supplier. A report of purged items is produced. See Table 43 for specifications.

Table 43. Purchase Order Purge specifications

Menu option	4/PMU
Suggested Frequency	Quarterly
Suggested Retention	12 months
Purged Files	PMP02, PMP02F, PMP20, PMP03, PMP09, PMP11

6.6.8 Accounts Payable

The Delete Redundant Data function clears items where the outstanding balance is zero. The posting period is prior to the limit specified on the company profile, and the remaining transactions exceed the minimum number of transactions specified on the company profile. You are given the option to archive to an offline

media where it may be restored for inquiries and reports. This option also removes vendors that have been flagged for deletion and no longer have activity in the system. No report is produced.

Before selecting this option, you must ensure that the Accounts Payable subsystem (PLBACK3) is inactive.

The following purge options are available:

- Ledger Items
- Inactive Names & Addresses
- Company Profile Audit file
- Names & Addresses Audit file
- Payment Details
- Period Calendar
- Reason Code Audit file
- Location Codes Audit file

Removing ledger items is linked to the *Purge No of Months* and the *Purge No of Trans* fields in the company profile. The *Purge No of Months* field specifies the number of periods of data that should be retained. The *Purge No of Transactions* field specifies the number of transactions that should be retained for each supplier. You should check these parameters prior to running the archive.

Records in the Names & Address Audit file are only removed after they have appeared on a Customer Audit report (35/APM).

The archive data is copied into a separate library, which can either be left on the computer or backed up to tape and deleted. See Table 44.

Table 44. Accounts Payable purge and archive specifications

Menu option	31/APU
Suggested Frequency	Yearly for transactions Monthly for audit files
Suggested Retention	3 Years for transactions 3 months for audit files
Purged Files	**Audit files**: PLP00A, PLP05A, PLP35A, PLP40A, PLP41A **Transactions files**: PLP15, PLP20,PLP30, PLP12, PLP21, PLP84, PLP18 **Inactive Supplier**: PLP05, PLP06, PLP07, PLP10, PLP11, PLP30 **Payment Details**: PLP45, PLP46, PLP47, PLP50, PLP51, PLP52, PLP53, PLP65
Archived Files (Archive files are created in a separate library)	**Transactions files**: PLP15, PLP20,PLP30, PLP12, PLP21, PLP84, PLP18 **Inactive Supplier**: PLP05, PLP06, PLP07, PLP10, PLP11, PLP30 **Payment Details**: PLP45, PLP46, PLP47, PLP50, PLP51, PLP52, PLP53, PLP65

6.6.9 Accounts Receivable

The Delete Redundant Data function clears items where the outstanding balance is zero. The posting period is prior to the limit specified on the company profile, and the remaining transactions exceed the minimum number of transactions specified on the company profile. You are given the option to archive to offline media where it may be restored for inquiries and reports. This option also removes customers that have been flagged for deletion and no longer have activity in system. No report is produced.

This procedure enables you to delete redundant data in order to free storage space on the system. You can also choose to archive (save) it to an offline medium from which it may be restored, as required, for inquiries and reports.

Before selecting this option, you must ensure that the Accounts Receivable subsystem (SLBACK3) is inactive.

The following purge options are available:

- Ledger Items
- Inactive Names and Addresses
- Company Profile Audit file
- Names and Addresses Audit file
- Reason Codes Audit file

Removing ledger items is linked to the *Purge No of Months* and the *Purge No of Trans* fields in the company profile. The *Purge No of Months* field specifies the number of periods of data that should be retained. The *Purge No of Transactions* field specifies the number of transactions that should be retained for each supplier. You should check these parameters prior to running the archive.

Records in the Names & Address Audit file are only removed after they have appeared on a Supplier Audit report (41/ARM).

The archive data is copied into separate libraries, which can either be left on the computer or backed up to tape and deleted. See Table 45 for specifications.

Table 45. Accounts Receivable purge and archive specifications

Menu option	31/ARU
Suggested Frequency	Yearly for transactions Monthly for audit files
Suggested Retention	3 Years for transactions 3 months for audit files
Purged Files	**Audit files**: SLP00A, SLP05A, SLP40A **Transactions files**: SLP15, SLP20, SLP30, SLP57, SLP18, SLP14, CSP37 **Inactive Customer**: SLP05, SLP06, SLP07, SLP10, SLP11, SLP30, SLP87, SLP08, SLP88, SLP67, SLP84, SLP85

Archived Files (Archive files are created in a separate library)	**Transactions files**: SLP15, SLP20, SLP30, SLP57, SLP18, SLP14, CSP37 **Inactive Customer**: SLP05, SLP06, SLP07, SLP10, SLP11, SLP30, SLP87, SLP08, SLP88, SLP67, SLP84, SLP85

6.6.10 Cash Management

The Delete Redundant Data function clears bank details up to a specified cut-off period. You are given the option to archive to offline media where it may be restored for inquiries and reports. No report is produced.

The following purge options are available:

- Transactions
- Collection Documents
- Period Balances
- Statement Details
- Company Profile Audit
- Bank Details Audit

The archive data is copied into separate libraries, which can either be left on the computer or backed up to tape and deleted. See Table 46 for specifications.

Table 46. Cash Management purge and archive specifications

Menu option	35/CSU
Suggested Frequency	Yearly for transactions Monthly for audit files
Suggested Retention	3 Years for transactions 3 months for audit files
Purged Files	**Audit files**: CSP00A, CSL10A, CSP11A **Transactions files**: CSP20, CSP21, CSP52. CSP54, CSP48, CSP49 **Collection Documents**: CSP21, CSP40, CSP40A, CSP41, CSP46, CSP42 **Period Balances**: CSP12 **Statement Details**: CSP30, CSP50, CSP53
Archived Files (Archive files are created in a separate library)	**Audit files**: CSP00A, CSL10A, CSP11A **Transactions files**: CSP20, CSP21, CSP52. CSP54, CSP48, CSP49 **Collection Documents**: CSP21, CSP40, CSP40A, CSP41, CSP46, CSP42 **Period Balances**: CSP12 **Statement Details**: CSP30, CSP50, CSP53

6.6.11 General Ledger

This section presents the two archive and purge routines available to the General Ledger module.

6.6.11.1 Purge and Archive Data

Purge and Archive Data transfers purged data to files in an archive library. The module automatically generates this library and informs you of its name. The system keeps track of the data that is archived and the libraries in which it was stored to allow for future reviews and reports. You determine which period balances and transactions are to be purged. The system does not allow you to purge activity for the current fiscal year. You have the option to produce a report when complete. See Table 47 for specifications.

The following purge options are available:

- Transactions
- Period Balances
- VAT Details
- Analysis Details

Table 47. GL purge and archive specifications

Menu option	31/GLW
Suggested Frequency	Yearly for transactions Monthly for audit files
Suggested Retention	4 Years for transactions 3 months for audit files
Purged Files	**Analysis detail**: FLP018 **VAT transaction detail**: FLPUK4 **Posting transactions**: FLP007, FLP008, FLP010, FLP114, FLP30, FLP065, FLP077, FLP078, FLP165 **Period Balances**: FLP004, FLP044, FLP045, FLP046, FLP054, FLP055, FLP055A, FLP064, FLP094, FLP098,
Archived Files (Archive files are created in a separate library)	**Analysis detail**: FLP018 **VAT transaction detail**: FLPUK4 **Posting transactions**: FLP007, FLP008, FLP010, FLP114, FLP30, FLP065, FLP077, FLP078, FLP165 **Period Balances**: FLP004, FLP044, FLP045, FLP046, FLP054, FLP055, FLP055A, FLP064, FLP094, FLP098,

6.6.11.2 Delete Unused Accounts

This procedure enables you to remove accounts from your chart of accounts. You may remove either account for which all transactions and period balances have been archived or those that have been created in error. The selection is by ledger code and range of either account level codes or report level codes. Refer to the

System 21 Infobase for additional execution parameters. A report of a deleted account is produced. See Table 48 for specifications.

Table 48. Delete Unused Accounts specifications

Menu option	36/GLW
Suggested Frequency	As needed
Suggested Retention	As needed
Purged Files	FLP003, FLP004, FLP026, FLP063, FLP051, FLP054, FLP055

6.6.12 Advanced Financial Integrator (AFI)

The Archive Data function enables you to delete and list data that has been posted by AFI. You choose which source application transactions are to be archived. You are not given an opportunity to choose the periods to remove. Items are moved from FIP45 to an archive file. The user decides if a report is generated. See Table 49 for specifications.

Table 49. AFI archive specifications

Menu option	2/FIU
Suggested Frequency	Quarterly
Suggested Retention	6 months
Suggested Backup	FIP45 and FIP51
Archived Files (Archive files are created in a separate library)	FIP45, FIP51

6.7 System 21 PTF and new release installation

This section explains how to install the PTF Management System and how to apply new releases and program fixes to System 21. You sequentially go through each stage of this process.

6.7.1 What a PTF is

PTF is the acronym for program temporary fix. This is a slightly misleading name because Geac use PTFs when they need to distribute enhancements to their software and to fix a problem. Geac distributes cumulative PTFs every two months to correct known application problems, either electronically via a network, or on media, such as tape or CD-ROM.

PTF libraries are shipped containing all the objects necessary to fix one or more problems, to introduce an enhancement, or both. There are three types of PTFs:

- **General Availability (GA)**: When program changes are needed to fix a critical problem with the software, a GA PTF is produced. GA PTFs are only issued for problems above the current Service Pack (SP) level. These can be downloaded from the GA PTF repository by Geac Distribution centers only.
- **Fix Pack (FP)**: An FP is released every two months. The FP includes all GA PTFs released above the current SP level. When released, a Fix Pack is ordered through normal ordering channels.

- **Service Pack (SP)**: A Service Pack is a series of PTFs that you use to move your System 21 applications to the next version level. Service Packs include all GA PTFs since the last one, plus enhancements to the application.

The PTFs are issued for an application. That is, an Order Entry PTF contains only Order Entry objects. For SP PTFs, multiple PTF libraries may be created for each application, with each library containing different groups of objects. All PTFs are shipped with supporting documentation that contains details of problems fixed, enhancements made, database changes, and Application Manager changes. With the exception of dummy physical files for new logical files, only changed and new objects are shipped in a PTF library.

There are three different PTF library groupings:

- **Program PTF group**

  Within a Program PTF exist all objects related to a change to a program, which could include:

  – Program files
  – Display files
  – Print files
  – Help files
  – Message files

- **Database PTF group**

  This contains:

  – New and changed physical files
  – New and changed logical files
  – Dummy physical file shipped with new or changed logical

- **Menu PTF group**

  This is sometimes called an AMINSTALL PTF. This contains all the changes to tasks, library lists, and standard menus.

6.7.2 How PTFs are named

PTF libraries are shipped using the naming convention described in Table 50.

Table 50. PTF library naming convention

Character positions	Value
1-2	P#
3-4	Application code or E* for GA PTFs prior to 3.5.2 SP3
5-6	PTF type: “52” for GA PTFs after 3.5.2 SP3 “FP” for cumulative Fix Packs “V3” for cumulative Service Packs
7-10	PTF number

For example, P#OEV30001 refers to PTF 1 for application OE Version 3.

PTFSHIPLIB is the name of the library shipped with the PTFs to enable the loading of PTFs from media.

Note

PTF libraries have special authority and can only be seen by PTFOWNER and QSECOFR or profiles with *ALLOBJ authority.

6.7.3 Setting up the PTF management system

This section forms the starting point for all the tasks that you need to perform to upgrade System 21. It explains how to set up the PTF Management System and display the main menu screen.

Follow these three steps to display the PTF Management System main menu screen:

1. Restore the following libraries, which are shipped with your software:
   - OSLPTD1: This contains the display and printer files.
   - OSLPTF1: This contains the data files.
   - OSLPTP1: This contains the programs.
2. Initialize the PTF Management System. Enter the following command:

   ```
   OSLPTP1/PTI
   ```

   This automatically creates the user profile, PTFOWNER. This is the user profile you use to restore and install most System 21 PTF libraries. It also creates the PTF receiving library, OSLPTR1.

   On the user profile, check the following points:

   - User Class must be *PGMR.
   - The special authorities must be *ALLOBJ, *JOBCTL, and *SAVSYS.
   - The group profile must be QPGMR.
   - The owner must be *GRPPRF.
3. Logon to the PTF Management System.

   Normally you access the PTF system by logging on to the server as PTFOWNER. However, you can also access the PTF system using this command:

   ```
   OSLPTP1/MNGPTF
   ```

   Figure 98 shows the PTF Management System main menu.

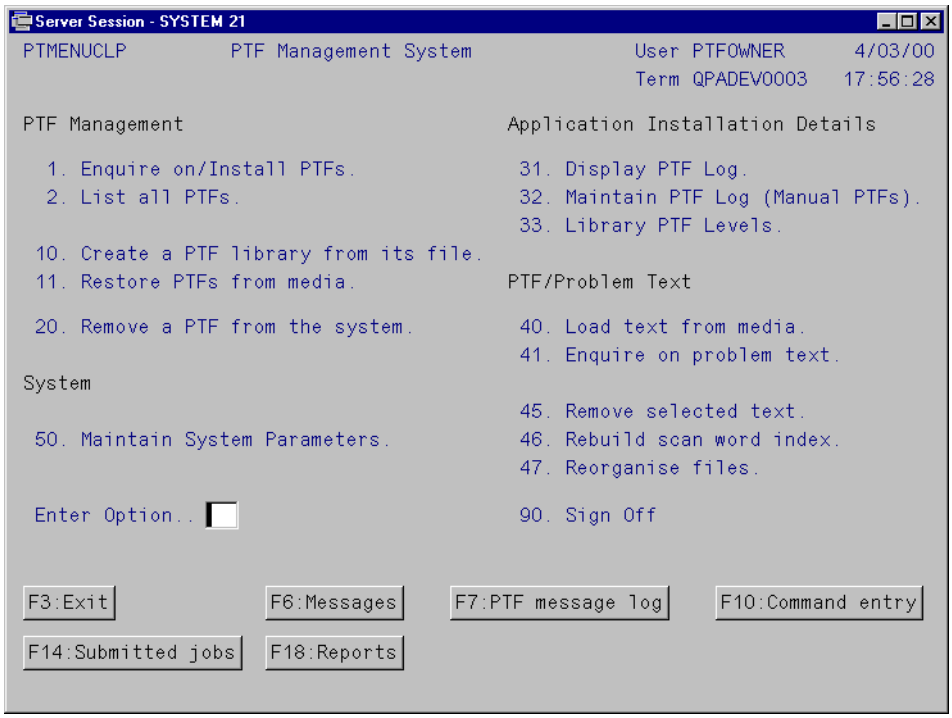

Figure 98. PTF Management System main menu

6.7.4 Maintaining system parameters

After you set up the PTF Management System and before you install any PTFs, you should configure the PTF loading system to meet your requirements.

Perform the following steps:

1. Log on as `PTFOWNER`.
2. From the PTF Management System Main Menu screen, select option **50** (Maintain System Parameters).

   This displays the Maintain System Parameters screen (Figure 99 on page 192).

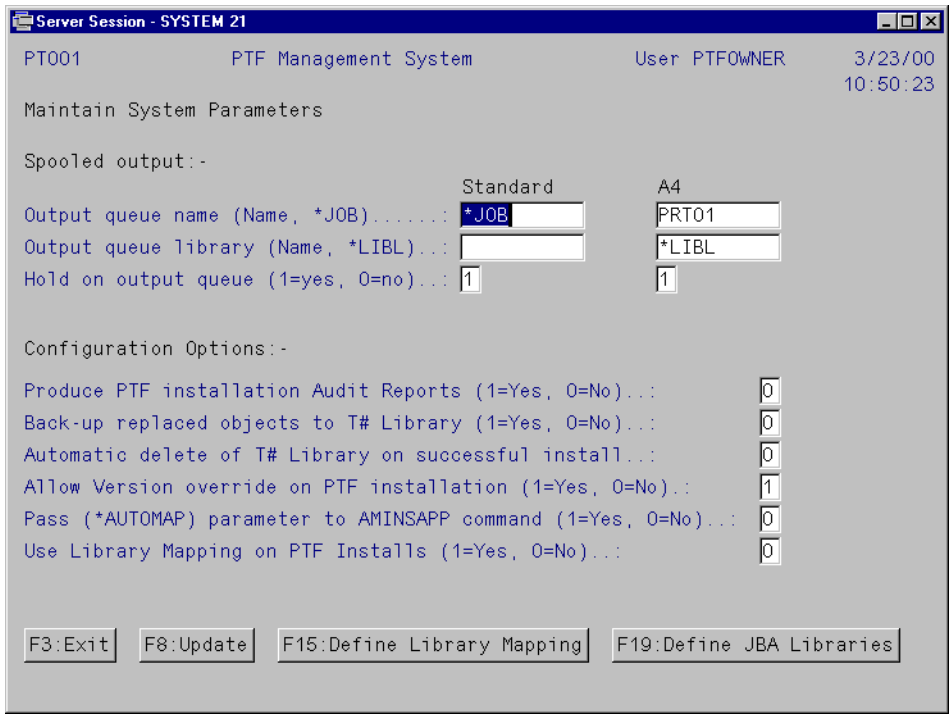

Figure 99. PTF Management System parameters set up sceen.

3. Enter the required information:
   a. In a spooled output queue, specify the output queues and library names for standard and A4 prints produced by the PTF Management System.
   b. To automatically hold the output queue, type `1` in the Hold On Output Queue field.
   c. To produce the PTF installation audit reports every time a PTF is installed, type a `1` in the Produced PTF installation Audit Report field. The audit report details the Install-To libraries before and after the installation. You can use this report to help verify that the PTF has installed correctly.

      Note

      Producing an audit report increases the time needed to install the PTF.

   d. To create a backup of objects that the PTF installation will change, type a `1` in the Back-up replaced objects to T# Library field.

      Note

      This does not back up the database or installed PTFs before installing the PTF. You must still make sure you have a sufficient backup before installing any PTF to your system.

   e. To automatically delete the backup library after a successful installation, type a `1` in the Automatic delete of T# Library on successful install field. If you choose not to delete the library, you are asked to delete the library after every successful PTF installation.

f. To allow version override on PTF installation, type a `1` in the Allow Version override on PTF installation field. This turns on the library mapping feature for installing PTFs to other environments in System 21. See Chapter 11, “Customization” on page 389, for information on creating environments.

g. When you install a PTF to a version and you want the system to map library list changes to version-specific libraries, type a `1` in the Pass (*AUTOMAP) parameter to the AMINSAPP command field.

> **Note**
>
> Before you can use the *AUTOMAP option, you must set up the version-specific library list in Application Manager. Use the Maintain Library Lists option in Application Manager.

h. When you install a PTF and want the default install PTF libraries to be installed into the version’s mapped libraries, type a `1` in the Use Library Mapping on PTF Installs field (see the following set of steps).

i. Click **Update**, or press F8 to update.

If you plan to create other versions, you need to define the PTF management system library mappings as explained here:

1. Click **Define Library Mapping,** or press F15 on the Maintain System Parameter screen (see Figure 99).
2. Enter the version into which you are defining. If you are defining the default version, leave this field blank.

> **Note**
>
> The version code should be the same as the version code used in Application Manager.

This displays a list of the standard System 21 libraries and a list of libraries to which to map. When you first use this option, the To Libraries default to the standard System 21 libraries is shown (Figure 100 on page 194).

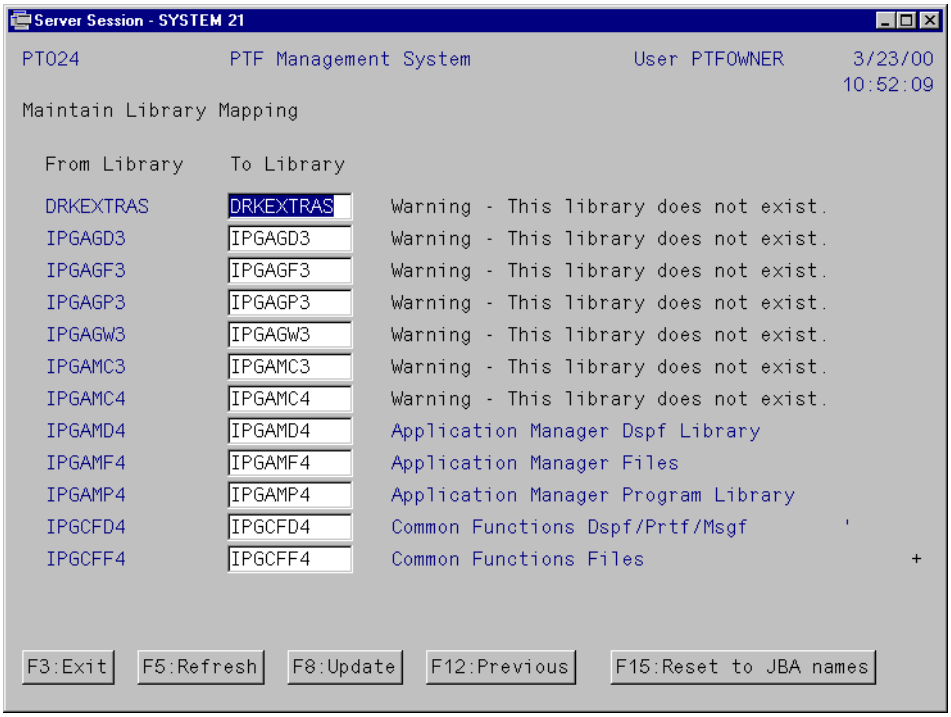

Figure 100. PTF management library mapping maintenance display

3. Wherever your default library is different from the displayed library, enter the new library in the To Library field.
4. Press Enter to check the list of libraries.

   If the library does not exist, a warning is displayed on the right-hand side of the screen. You are still allowed to update the screen, but the mapping will not work correctly when you apply a PTF to the version being mapped.

5. Click **Update**, or press F8 to save the details.

Note

To add or delete a library in the From Library list, click **Define Libraries,** or press F19 on the Maintain System Parameters screen. See Figure 99 on page 192.

6.7.5 Installing a PTF

Before you install a PTF, complete these pre-installation checks:

1. Check the current PTF level.
2. Check whether the PTF is loaded or installed.
3. Restore the PTFs from the supplied media.
4. Read the PTF documentation.

   Within the PTF documentation, you must:

   a. Check into which libraries the PTF automatically installs the objects.

   b. Read the special loading instructions and important information.

c. Check the PTF prerequisites, and then make sure that your system meets these requirements.

   The documentation also lists the objects replaced and the problems fixed by this PTF.

> **Note**
>
> For product updates, this information is contained in the *Product Update Guide*.

d. Back up the standard OSL libraries and any other version libraries.

After you make all these checks, you can either auto-install the PTFs (see 6.7.11, “Auto-installing the PTF” on page 201), or manually install them (see 6.7.13, “Manually installing the PTF” on page 205).

6.7.6 Checking the current PTF levels

There are two ways to determine the current PTF level of an application:

- Display the PTF log from the PTF Management System Main Menu.
- Display the PTF level of all application libraries using the PTF Enquiry (PTFE) command.

6.7.6.1 Displaying the PTF Management System PTF log

This method shows the history of all objects changed by a PTF in a single library. Perform the following tasks:

1. Log on as `PTFOWNER`.
2. From the PTF Management System Main Menu, select option **31** (Display PTF Log).
3. Enter the name of the library that you are checking.
4. By default, the list is sorted in descending order of installation date (see Figure 101 on page 196). The first entry is the last PTF installed and the current PTF level of that library.
5. To sort in ascending order of PTF number, click **Sequence by PTF,** or press F15.

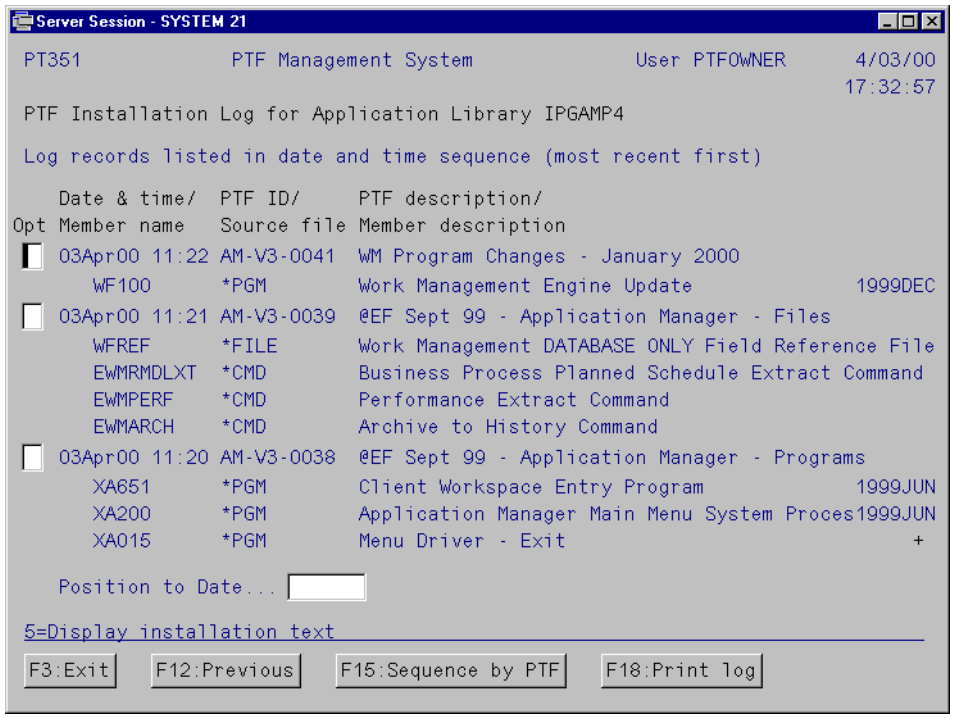

Figure 101. PTF Installation Log inquiry screen

6.7.6.2 Using the PTFE command

This method shows the PTF level of all System 21 application libraries for a selected version (Figure 102). Perform the following steps:

1. Log on as `PTFOWNER`.
2. From the PTF Management System Main Menu, select option **33** (Display PTF Log).
3. Enter the version number or leave the field blank to accept the default version.
4. Enter the option to either produce a hardcopy report or display the information on the screen. By default, the option produces a report for the default version.

Optionally, you can run the `OSLPT1/PTFE` command on the AS/400 or System 21 command line.

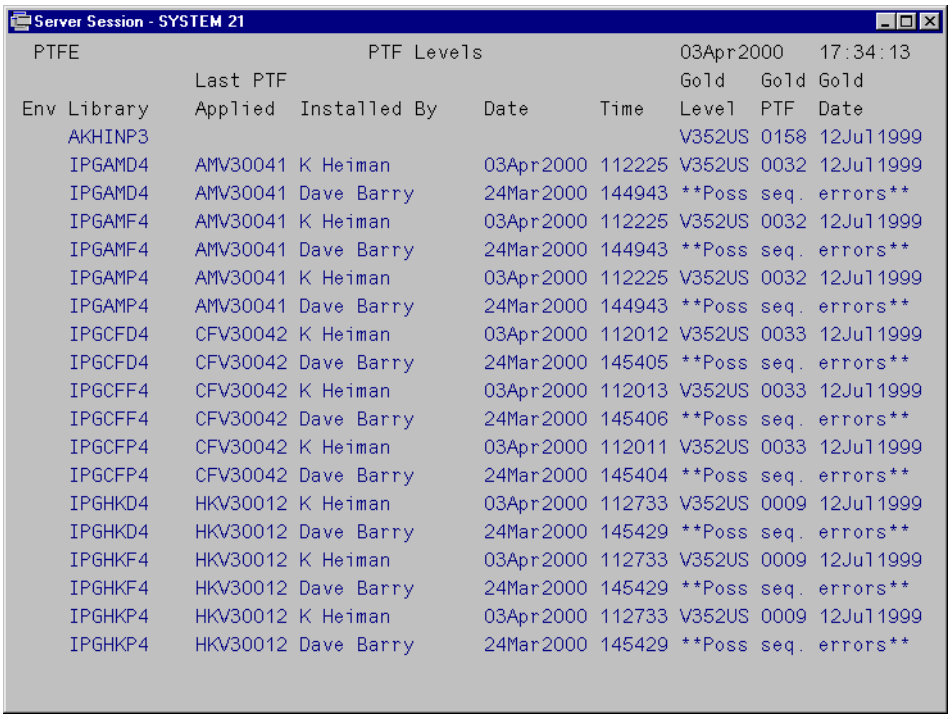

Figure 102. Sample output for the PTFE command

6.7.7 Checking if a PTF is restored or installed

You can list each PTF on the system to verify whether you previously installed a particular PTF. To do so, follow these steps:

1. Log on as `PTFOWNER`.
2. From the PTF Management System Main Menu, select option **1** (Enquire On/Install PTFs). If you just restored a PTF library, you have to regenerate the PTF directory as shown in Figure 103 on page 198.

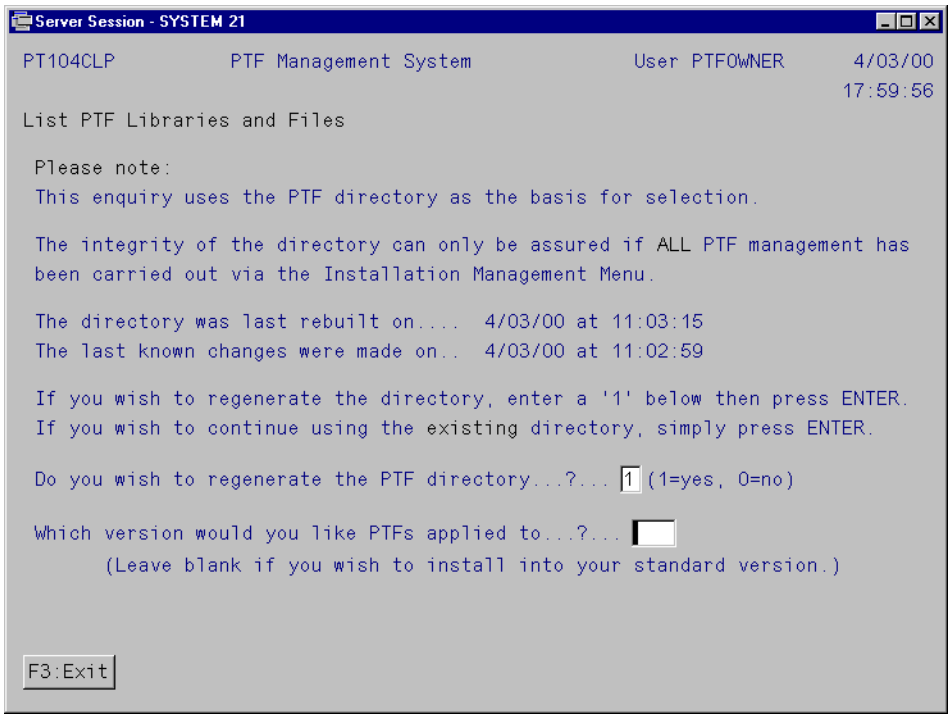

Figure 103. Regenerate PTF directory option display

Note

Information relating to PTFs is contained in the PTF Directory. When you choose the option to rebuild the directory, you retain only the information that relates to those PTFs, which still exist as libraries on the system. Any other information relating to previously installed PTFs is removed when the PTF library is removed.

If a PTF is installed, it is marked with the installation date. If a PTF is restored on the system, but is not installed, the PTF date is blank. If it is not restored or was deleted, it will not appear in the list.

6.7.8 Restoring PTFs

Follow these steps to restore the PTFs:

1. Log on as `QSECOFR`.
2. Start the PTF Management System with the command:

   `OSLPTP1/MNGPTF`
3. Select option **11** (Restore PTFs from media).
4. Enter the name of the device from which you want to load the PTF. Then specify whether you want to overwrite any existing PTFs with the same name, as shown in Figure 104.

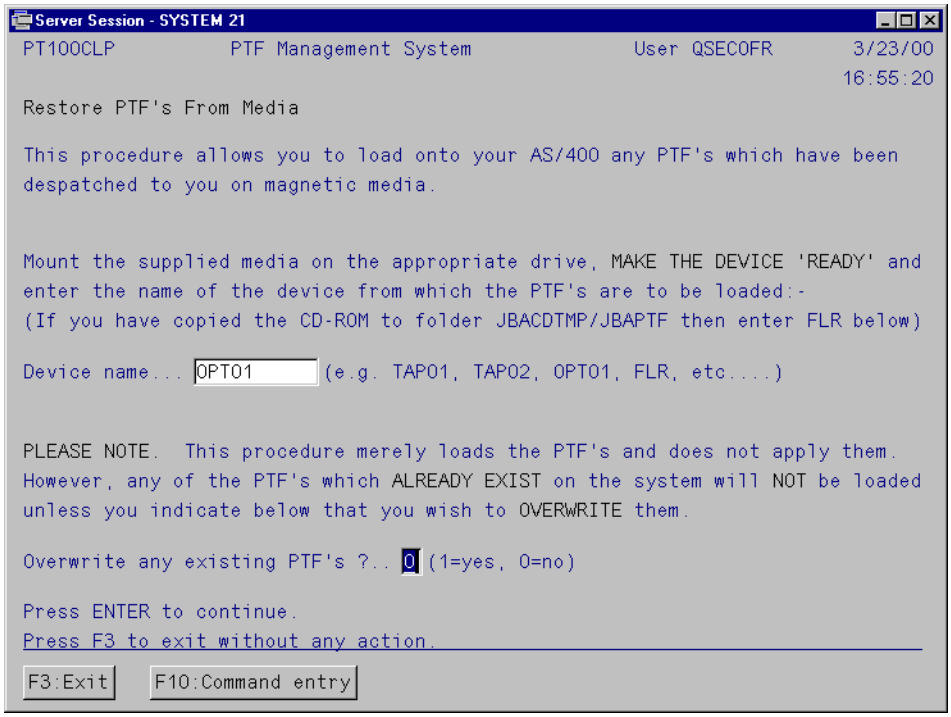

Figure 104. Restore PTF From Media display

5. Press Enter to display a list of PTFs included on the media (Figure 105).

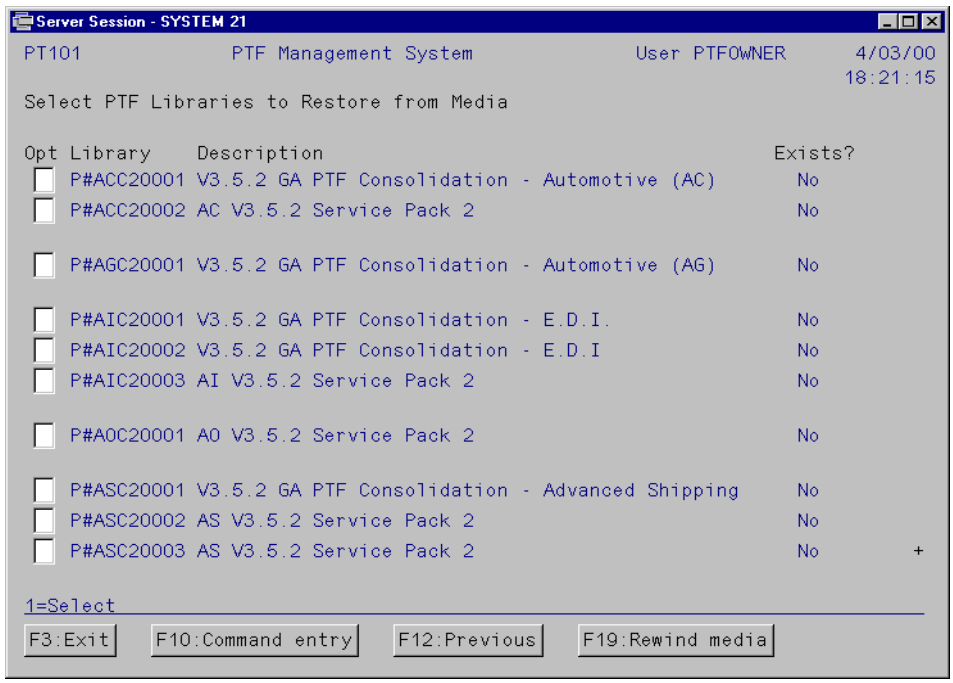

Figure 105. PTF Restore from Media list

6. Type a `1` next to each PTF that you want to install.
7. Press Enter to start restoring the PTFs.

Please refer to the *Product Update Guides* for detailed information about restoring the PTF libraries from the supplied media.

6.7.9 Displaying the PTF documentation

Follow these steps to display, or print, the PTF documentation:

1. Log on as `PTFOWNER`.
2. From the PTF Management System Main Menu, select option **1** (Enquire On/Install PTFs).
3. If you restored PTFs onto your system, set the Do You Wish To Regenerate The PTF Directory field to `1` (Yes). See Figure 103 on page 198.
4. Press Enter to display a list of all the PTS currently on your system. Any PTFs with an installation date are already installed on your system.
5. To select the PTF, choose either option **5** (Display Text) to display the documentation or option **7** (Print Text) to print the documentation.

Note

Before you can display or print the PTF installation document, you must restore the PTF from the supplied media on to your system. For the product update, this information is contained in the *Product Update Guide*.

6.7.10 Understanding the PTF documentation

There are several sections to the PTF documentation supplied with the PTF by Geac. The actual order and content of these sections can vary between PTFs. The sections are:

- **PTF Details**: This section lists the PTF number, description, and other details. Check here to make sure that you can automatically install this PTF.
- **Install To Libraries**: This section lists the libraries to which the PTF automatically installs the fixed objects.
- **Impact On Your Business**: This section displays the important information for this PTF. This information can include special loading instructions and any new menus or enhancements included in the PTF.
- **PTF Prerequisites**: This lists all the PTFs you must install before you can load this PTF.
- **Fixed Objects**: This section lists all the objects this PTF replaces.
- **Special Instructions**: These are sometimes listed under the Impact On Your Business section, or under the title Installation. These are the instructions unique to this PTF. You must follow them very carefully when loading this PTF.
- **Problems Fixed**: This section briefly describes all the problems fixed by this PTF.

This section is relevant only to GA PTFs. Service Pack PTFs do not contain this information.

6.7.11 Auto-installing the PTF

Attention

Before installing the PTF, make sure that you have:

- Maintained the system parameters
- Completed the pre-installation checks

6.7.11.1 Before running the auto-install

Make these last minute checks before running the auto-install:

- No application users are using System 21. You can check who is using the system by using the Application Manager Enquiry options.
- You have an adequate backup of the applications to which you are applying the PTFs. If you have any doubts, save all the user libraries by using the library. See Chapter 9, “Backup and recovery” on page 251.
- Your system definitely meets all the PTF prerequisites.

If the fixed objects list includes any objects that you have modified, you *cannot install this PTF* until you have completed an impact analysis study and have taken the proper actions to ensure that the installation will not fail or cause the system to fail. Please contact your support organization for help.

6.7.11.2 Installing the PTF

Follow these steps to install the PTF:

1. Sign on as `PTFOWNER`, unless instructed by the installation documentation to sign on as `QSECOFR`.
2. From the PTF Management System Main Menu, select option **1** (Enquire On/Install PTFs). Set the Do You Wish To Regenerate The PTF Directory field to `1` (Yes), and enter the version into which you want to install the Application Manager Data Change PTFs. This version is the default, but you can change it for each individual PTF.
3. The next screen (Figure 106 on page 202) lists all the PTFs. If a PTF has an “A” displayed next to it, it is already installed into the version you selected on the previous screen.

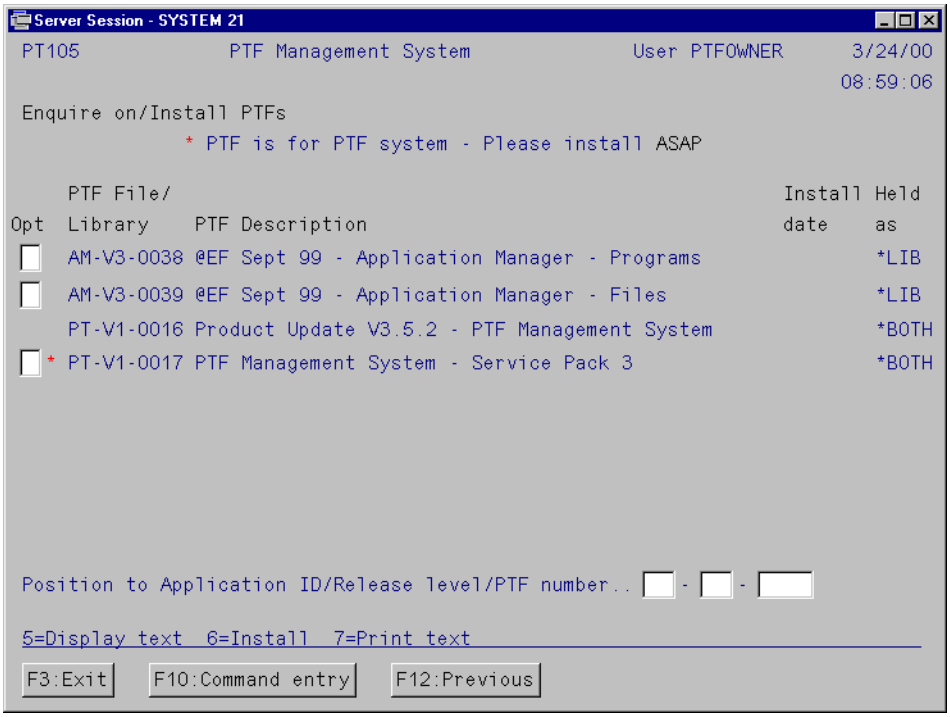

Figure 106. PTF Inquiry/Install display

4. Type option `6` (Install) next to the PTF you want to install.
5. If a warning appears, carefully read it and then perform one of the following tasks:

   - Click **Install**.
   - Press F8 to continue with the installation procedure.
   - Click **Previous**.
   - Press F12 to return to the PTF selection screen.

   After you select the install option, a screen appears that shows the PTF selected and the libraries to which this PTF is installed (Figure 107).

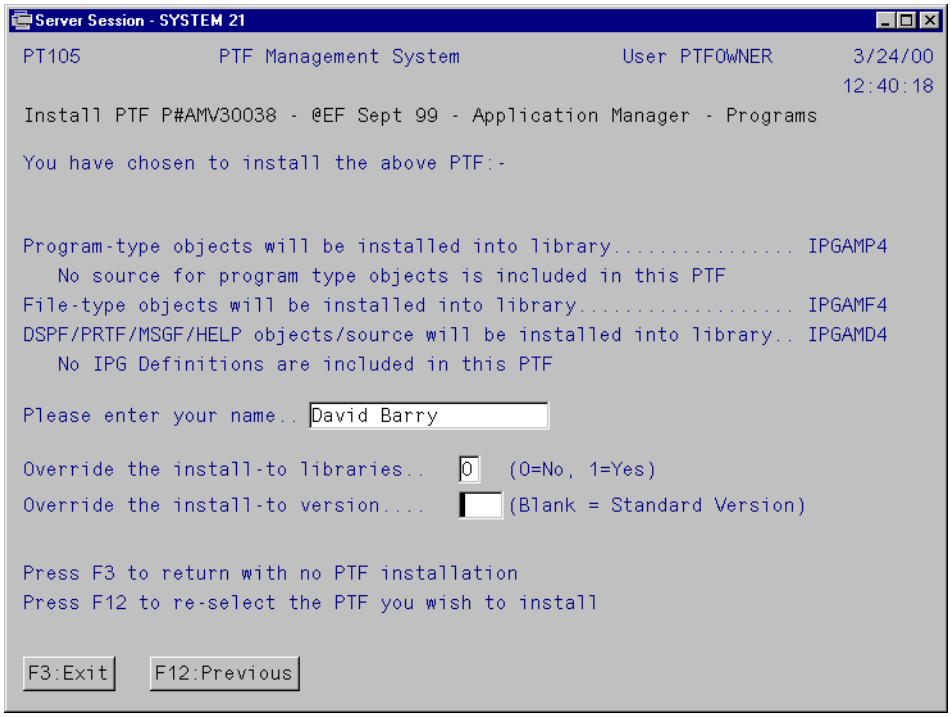

Figure 107. PTF installation display

6. If you want to override the installation to the libraries, type `1` (Yes) in the Override the install-to libraries field. Press Enter. Then, enter the new libraries on the list that appears. Press Enter to confirm the new entries and return to the previous screen.
7. To override the installation to the version, enter the version you require in the Override the install-to version field.

> **Note**
>
> Some PTFs do not allow you to Override the install-to libraries or install-to version.

8. Press Enter to continue with the installation. The display in Figure 108 on page 204 shows the list of objects that are installed.

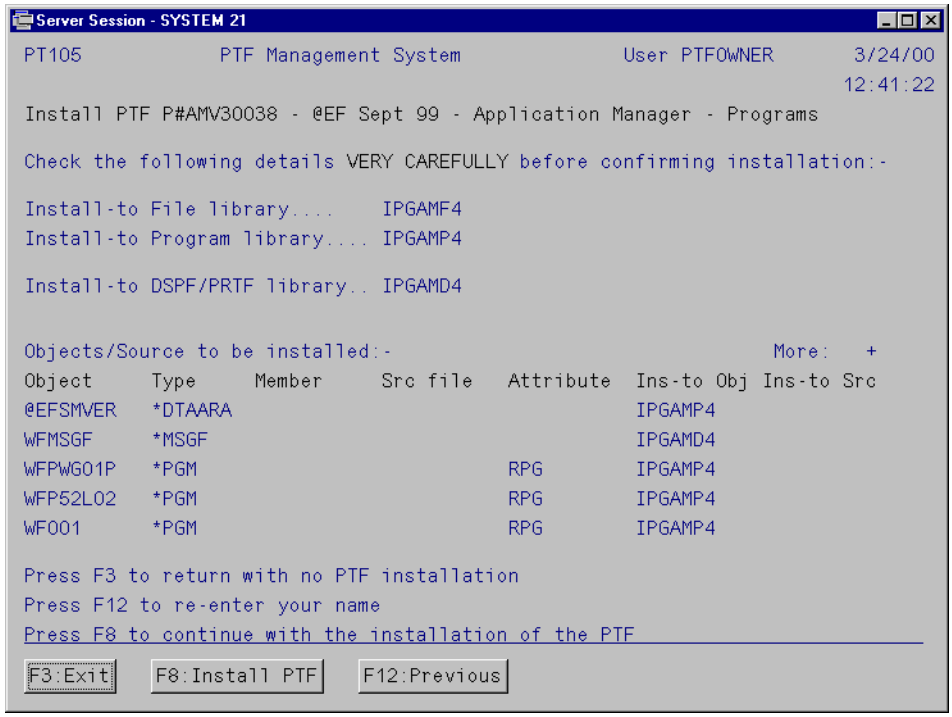

Figure 108. PTF installation details

9. Click **Install PTF** or press F8 to continue the installation. Click **Previous** or press F12 to return to the previous screen.
10. When the installation has completed successfully and the system parameters are set to automatically delete the backup library, you return to the list of PTFs screen (Figure 106 on page 202). Otherwise, you are asked to confirm the deleting of the backup library. Press Enter to delete the backup library, or click **Exit** or press F3 to leave the installation without deleting the backup library.

> **Note**
>
> If you decide not to delete the backup library, remember to delete it once you fully test the installation.

6.7.11.3 Audit report

If you specified in the system parameters that you want to create an audit report, the installation procedure creates a report for each installed PTF. This report lists the details of the Install-to libraries before and after the installation. You can use this report to help verify that the PTF is installed correctly.

Since this report also produces a hard copy of the objects that have changed, Geac advises that you print this report and file it for future reference.

6.7.11.4 Installation failure

If the PTF is not installed correctly for any reason, you are notified with an error message. You may be able to diagnose the problem by analyzing the AS/400 job log.

If you specified that you want to create a backup library in the system parameters, a message appears that details the name of the backup library. This name is normally in the format:

```
T#<PTF Number>
```

Consider this example:

```
T#ACV30012
```

To resolve the problem, you must manually return the objects from the backup library to the production library. Follow these steps to return the objects to the production library:

1. Delete the matching objects in the production library.
2. Copy the objects and data back to the production library using the Create Duplicate Object (CRTDUPOBJ) command.

Once you have resolved the problem, reinstall the PTF. If you cannot resolve the problem, contact your support organization.

6.7.12 Checking the installation

Before you install the next PTF, you must verify that the PTF is installed correctly. If you continue with another installation when a PTF was not installed correctly, the application software could become unusable and you have to perform a complete restore.

You can verify whether the PTF was installed correctly by using the PTF audit report and the PTF log.

The audit report lists all the objects before and after applying the PTF. The details include the object name, type, library, creation date, for objects before and after applying the PTF, and the description of the object after applying the PTF. See 6.7.4, “Maintaining system parameters” on page 191.

The PTF log shows all PTFs installed on the system, in a specified application library, since the last major upgrade. See 6.7.6, “Checking the current PTF levels” on page 195.

In either the PTF log or the audit file, make sure that the date has changed for all the objects in the PTF library.

6.7.13 Manually installing the PTF

Attention

Before installing the PTF, make sure that you have:

- Maintained the system parameters
- Completed the pre-installation checks

If you cannot automatically install a PTF or the automatic installation has failed, you can manually install the PTF. To do this, you must use standard AS/400 commands, or tools, to copy the objects in the fixed objects list to the standard System 21 libraries.

Follow these steps:

1. Identify the objects you want to copy.
2. Delete the identified objects from the standard System 21 libraries.
3. Copy the objects from the PTF library into the standard library.
4. Update the PTF log.

6.7.13.1 Installing the PTF using Product Development Manager

Follow these steps to install the PTF using Product Development Manager (PDM):

1. Sign on as `PTFOWNER`, unless instructed by the PTF installation documentation to sign on as `QSECOF`.
2. Click **Command** or press F10 to access an AS/400 command line.
3. Access PDM by entering the following command:

   ```
   STRPDM
   ```

4. Select option **2** (Work with Objects).
5. Change the library name to the PTF library, and press Enter.

   This displays the contents of the PTF library.
6. Select option **3** (Copy) to copy the objects into the target library.
7. When prompted, type `Y` to indicate that the object already exists in the target library it is replaced.
8. Manually update the PTF log by selecting option **32** from the PTF Management System Main Menu.

6.7.13.2 Updating the PTF log

You must update the PTF log with a record of each PTF that you manually installed. For each PTF, record the following items:

- Date and time of installation
- The user who installed the PTF
- A brief description of the fix

If you manually install an automatic install PTF, you must update the PTF log using Data File Utility (DFU). Follow these steps to update the PTF log:

1. Log on as `PTFOWNER`.
2. From the PTF Management System main menu, select option **32** (Maintain PTF Log).
3. Enter the application library name of the PTF for which you want to maintain the text. This displays a list of the manual PTFs currently loaded on your system.
4. Type option `1` (Maintain PTF Log) next to the PTF you want to maintain.

6.7.14 Removing PTF libraries

After you load, install, and check a PTF, you can remove the PTF libraries from your system.

6.7.14.1 Removing a single PTF library

Follow these steps to remove a single PTF library:

1. Log on as `PTFOWNER`.
2. From the PTF Management System Main Menu, select **Remove A PTF From The System**.
3. Enter the PTF you want to delete, and press Enter.

You can also use the following AS/400 command to delete a single PTF library:

```
DLTLIB P#xxxxxx
```

Here, *P#xxxxxxxxx* is the PTF library you want to delete.

6.7.14.2 Removing multiple PTF libraries

If you want to delete more than one library at once, you can use the AS/400 commands:

```
WRKLIB P#*
WRKLIBPDM P#*
```

These two commands display a list of all the PTFs currently on your system. You can then select the PTFs you want to delete by typing `4` (Delete) in the Opt field. Press Enter to delete the PTFs.

6.7.15 Hints and tips

This section lists some hints and tips for working with the PTF Management System and restoring and installing PTFs.

6.7.15.1 Authorities

When supplied, PTF libraries have the following authority:

- PTFOWNER All authority (*ALL)
- PUBLIC No authority (*EXCLUDE)

Therefore, only PTFOWNER or QSECOFR can work with PTF libraries.

6.7.15.2 File destinations

Make sure that all objects are installed into their proper libraries. If you consolidated any of the standard System 21 libraries, be sure to review your installation prior to installing any PTFs.

6.7.15.3 Fixed asset PTFs

There are two versions of fixed assets: advanced and basic. They each have their own PTFs. You must check the Install-To libraries on the PTF documentation to see to which version this PTF applies.

The advanced fixed asset libraries are: OSLFAF3, OSLFBP3, and OSLFBD3.

6.7.15.4 Physical and logical files

When a new logical file is included in the PTF, the related physical file is also included. You do not need to install the physical file.

You can check that the logical file has, in its scope, the correct physical file, using the Display Database Relations (DSPDBR) command.

6.7.16 Electronic PTF distribution

All GA PTFs are made available to authorized distributors of Geac System 21 through a GA PTF Repository. The repository is accessed via an intranet and Internet connection to the Geac Web site: `http://websrv1.jba.co.uk`

Note

This Web site is protected with a user ID and password. To learn how to obtain a password for your Lotus Notes ID, read the Geac Product Support Information Sheet number 438.

This site allows you to download PTF files from the intranet or Internet onto a PC and then either transfer them back onto an AS/400 system as a PTF library or distribute the files directly to customers. Each PTF has a utility built into the download file that runs on the client PC and automatically transfers the PTF file back to a connected AS/400 system. You can do this by using either IBM Client Access Express or FTP. The utility submits a job on the AS/400 system to restore the PTF library from the file. The PTF is now ready for installation by the PTF Management System.

Note

Automatic submission of a restore job only functions correctly with the PTF Management System at PTF level PT/V1/15. Otherwise, you have to use the Restore from Media option within the PTF Management System.

Follow these steps to access the GA PTF Repository site:

1. Access the Geac Web site at: `http://websrv1.jba.co.uk`
2. Click **Product Division** from the home page.
3. Click **Global Source Repository** from the Product Division page.
4. Click **GA PTF Repository** from the GSR Home page.

Chapter 7. Security

This chapter describes the basic AS/400 security concepts. It also offers some recommendations on how to set up security in the System 21 environment.

7.1 AS/400 security architecture

System security is an integrated function of the AS/400 system and controls all AS/400 software functions. Users are identified and authenticated by a single security mechanism. All objects on an AS/400 system are under security control, including libraries and files, display stations, operator console functions, programs, menus, and so on.

Security on the AS/400 system is flexible enough to meet the requirements of a wide range of users and situations. It has three important objectives:

- **Confidentiality**:
  - Protecting against disclosing information to unauthorized people
  - Restricting access to confidential information
  - Protecting against curious system users and outsiders
- **Integrity**:
  - Protecting against unauthorized changes to data
  - Restricting manipulation of data to authorized programs
  - Providing assurance that data is trustworthy
- **Availability**:
  - Preventing accidental changes or destruction of data
  - Protecting against attempts by outsiders to abuse or destroy system resources

System security is often associated with external threats, such as hackers or business rivals. However, protection against system accidents by authorized system users is often the greatest benefit of a well-designed security system. In a system without good security features, pressing the wrong key might result in deleting important information. System security can prevent this type of accident.

The best security system functions cannot produce good results without good planning. Security that is set up in small pieces, without planning, can be confusing. It is difficult to maintain and to audit this type of system. Planning does not imply designing the security for every file, program, and device in advance. It implies establishing an overall approach to security on the system and communicating that approach to application designers, programmers, and system users.

As you plan security on your system and decide how much security you need, consider these questions:

- Is there a company policy or standard that requires a certain level of security?
- Do the company auditors require some level of security?
- How important is our system and the data on it to our business?
- How important is the error protection provided by the security features?
- What are our company security requirements for the future?

To facilitate installation, many of the security capabilities on your system are not activated when your system is shipped. Recommendations are provided in *OS/400 Security - Reference,* SC41-5302, to bring your system to a reasonable level of security. Consider the security requirements of your own installation as you evaluate the recommendations.

7.1.1 Physical security

Physical security includes protecting the system unit, system devices, and backup media from accidental or deliberate damage. Most measures you take to ensure the physical security of your system are external to the system. However, the system is equipped with a keylock that prevents unauthorized functions at the system unit. Physical security of the AS/400 system itself is a high priority. This chapter doesn't discuss physical security, but the topic is covered in *OS/400 Security - Reference,* SC41-5302.

7.1.2 Security levels

The AS/400 system has five levels of security controlled by the entry in the QSECURITY system value. An IPL is required to change the security level. IBM recommends that you run the system at level 40. The security levels are:

- **Level 10**: Level 10 is no longer supported by OS/400.
- **Level 20** (Password): The system requires a user ID and password for signon. All users are given access to all objects.
- **Level 30** (Password and Resource): The system requires a user ID and password for signon. The security of resources is enforced.
- **Level 40** (Password, Resource, and Operating System Integrity): The system requires a user ID and password for signon. The security of resources is enforced. Additional integrity protection features are also enforced.
- **Level 50** (Password, Resource, and enhanced Operating System Integrity): The system requires a user ID and password for signon. The security of resources is enforced. Level 40 integrity protection and enhanced integrity are enforced. Security level 50 is intended for AS/400 systems with high security requirements. It is designed to meet C2 security requirements.

To display the security level for your system, type the following command:

```
DSPSYSVAL SYSVAL(QSECURITY)
```

See Figure 109.

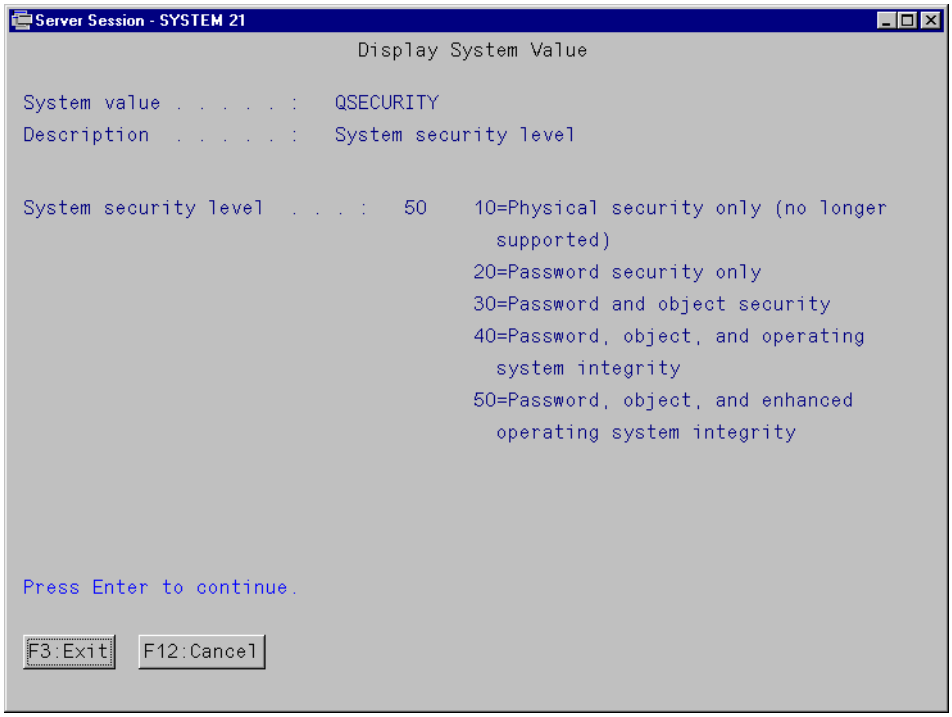

Figure 109. DSPSYSVAL QSECURITY

7.1.3 System integrity

The integrity of the operating system is an important prerequisite for the implementation of security controls. The AS/400 system has good integrity for several reasons:

- Precisely controlled storage that addresses limits for a user.
- Security implementation at the instruction level.
- A physical keylock that controls the operating system security environment.
- A precisely defined method that provides limited capabilities for users.
- A security system that is an integral part of the operating and database systems.
- A communications environment with security features built in at the lowest level.
- Special hardware to validate software pointers.
- Complete auditing capabilities of system and user functions.
- Because AS/400 objects can be accessed only by name, security cannot be bypassed to access an object.

7.1.4 Security system values

The AS/400 system has over 100 variables that control system-wide functions. These are called *system values*. Some of the system values are security-related. These security-related system values fall into four main categories:

- General security defaults
- Audit control

- Password rules
- Other system values related to security

To examine or change your system security values, type `WRKSYSVAL` on the command line as shown in Figure 110.

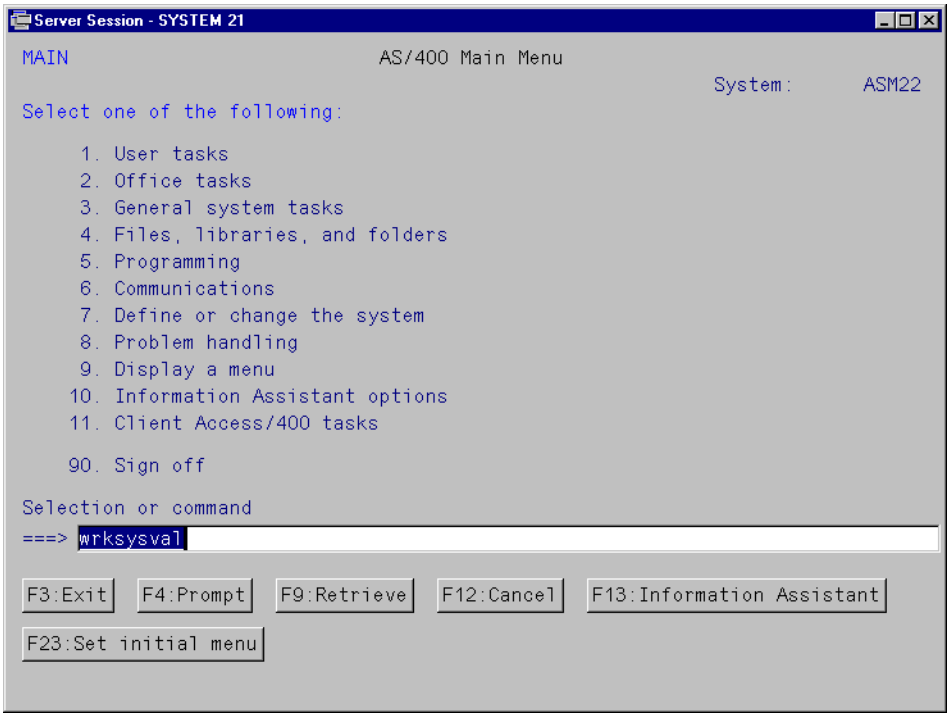

Figure 110. WRKSYSVAL (Part 1 of 4)

Figure 111 shows the opening panel of the WRKSYSVAL command. This panel shows all the system values to which you are authorized.

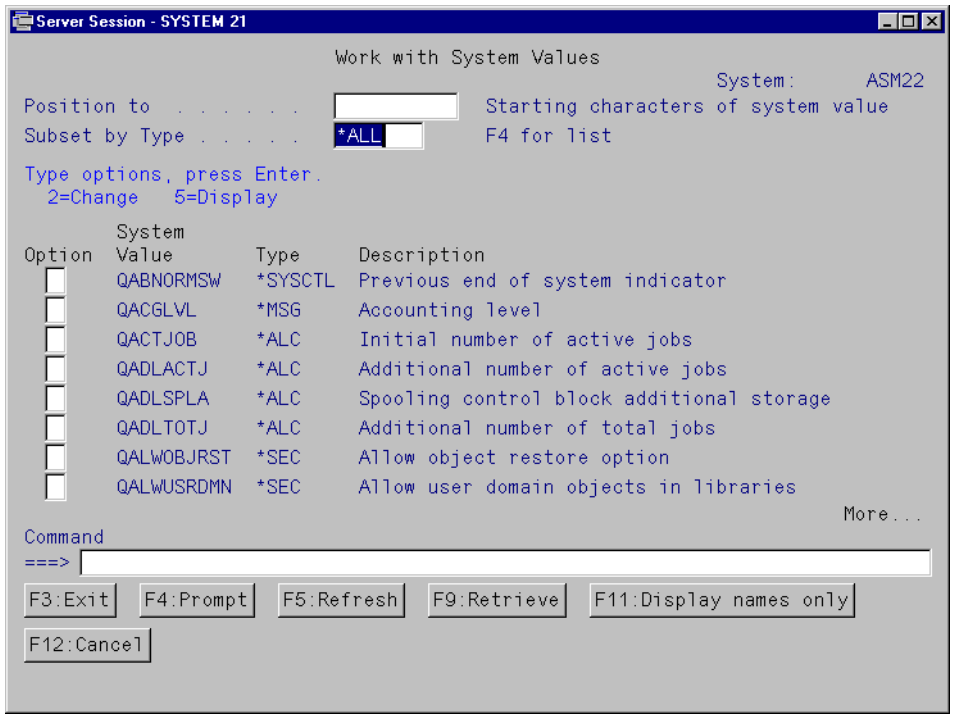

Figure 111. WRKSYSVAL (Part 2 of 4)

To select only the security related system values, put your cursor in the *Subset by Type* box, and click **Prompt** to display the possible values, as shown in Figure 112.

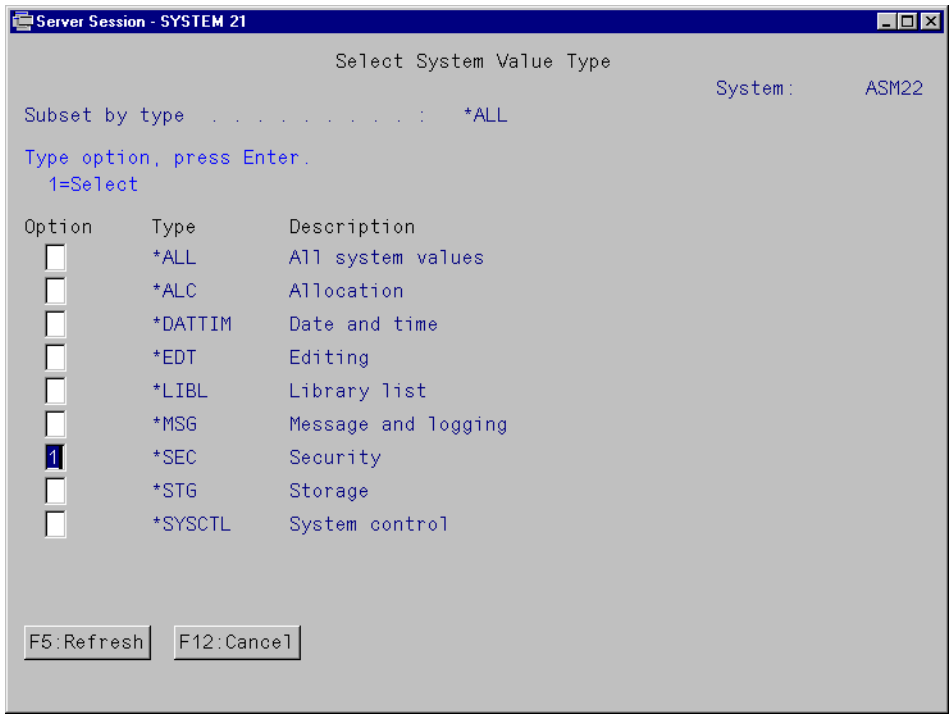

Figure 112. WRKSYSVAL (Part 3 of 4)

Type a 1 in the option field, and press Enter to select the *SEC type system values. In Figure 113, the list now shows only the security system values.

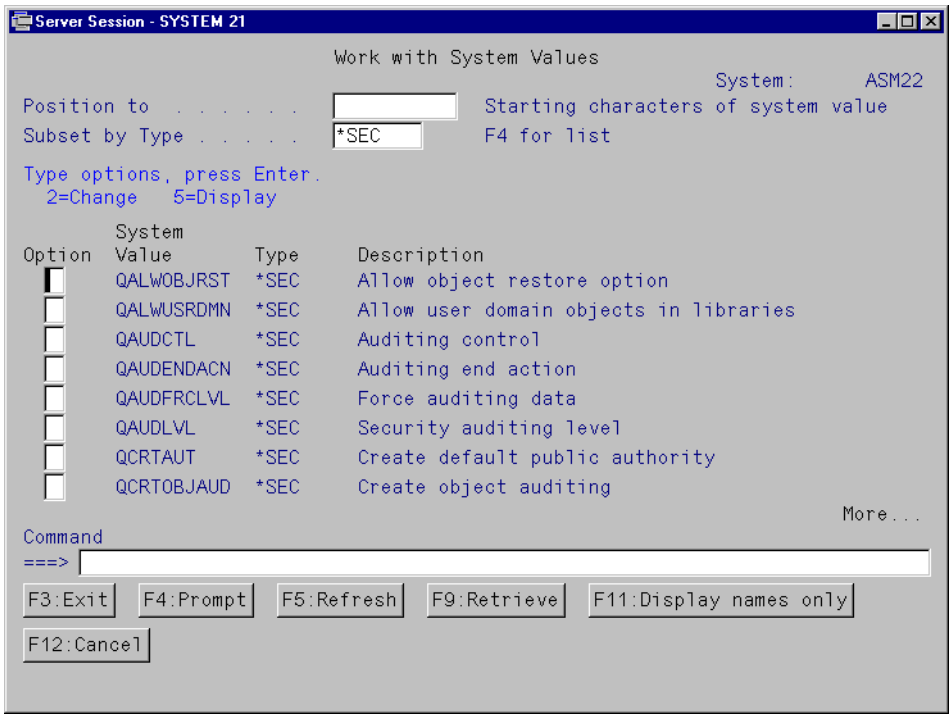

Figure 113. WRKSYSVAL (Part 4 of 4)

7.1.5 User and group profiles

The following terms and concepts are involved in defining users and their authorities to the AS/400 system. Users are defined with profiles and can:

- Be organized into groups
- Have special capabilities
- Have special limitations

7.1.5.1 User profiles

User profiles contain information that describes a system user and that user's privileges and limitations when using the system. The profiles also control the objects that the user owns or is authorized to use.

Note

If your users will launch System 21 upon sign on, it is vital that you enter the correct initial program in the INLPGM field of the OS/400 user profile. The three initial programs and their differences are:

- **XAINITIAL**: Used for “Green on Black” (GOB) or “Classic” terminal sessions.
- **AMINITIAL**: Supports either GOB or Explorer sessions, at a very slight cost in performance, and with one additional window on initial entry.
- **CWSINITIAL**: Supports only Explorer sessions, with maximized performance.

7.1.5.2 Special authorities

All security systems have special user privileges for certain security and system administration functions. Special authorities allow certain users to administer AS/400 security and system tasks. There are eight special authorities that are not hierarchical:

- ***ALLOBJ**: All object authority is granted for accessing any system resource.
- ***AUDIT**: Allows the user to perform auditing functions.
- ***JOBCTL**: Allows the manipulation of job and output.
- ***SAVSYS**: Used for saving and restoring the system and data without having explicit authority to object queues and subsystems.
- ***SECADM**: Allows the administration of User Profiles and Office.
- ***SERVICE**: Allows access to special service functions for problem diagnosis.
- ***SPLCTL**: Allows the control of spool functions.
- ***IOSYSCFG**: Allows the change of system configuration.

7.1.5.3 User classes

There are five user classes that are hierarchical in authority. The classes represent different roles in the user and IT environments. These classes are a convenient ways to assign special authorities. The five user classes with their default special authorities include:

- ***SECOFR**: Security Officer (all levels—*SAVSYS, *ALLOBJ*, *JOBCTL, *SERVICE, *SPLCTL, *SECADM, *AUDIT, *IOSYSCFG)
- ***SECADM**: Security Administrator (at security level 20—*ALLOBJ, *SAVSYS, *SECADM, *JOBCTL; at security level 30 or higher—*SECADM)
- ***PGMR**: Programmer (at security level 20—*ALLOBJ, *SAVSYS, *JOBCTL; at security level 30 or higher—no special authorities)
- ***SYSOPR**: System Operator (at security level 20—*ALLOBJ, *SAVSYS, *JOBCTL; at security level 30 or higher—*SAVSYS, *JOBCTL)
- ***USER**: End User (at security level 20—*ALLOBJ, *SAVSYS; at security level 30 or higher—no special authorities)

A user class also affects which options are shown on the system menus. A user with higher authorities sees more of the system menu options. A user with fewer authorities only sees the menu choices allowed by the user class. A user may be given any of the previously mentioned special authorities regardless of user class. A convenient way to start is to let the special authorities be assigned automatically to match the user class.

7.1.5.4 Group profiles

A user profile may be linked to a group profile. This allows all the members of the group to share common attributes, common access to selected objects, and common ownership of objects. A user is not required to be a member of a group. A user may be a member of up to 16 different groups. Group profiles are used to organize users along lines of common functions. The profiles also simplify the assignment and administration of object authorities by enabling a smaller number of profiles to administer. When designing groups, it is important that you understand the group ownership concepts. It is also important that you use good naming conventions.

A group profile is implemented as a user profile. It is created like a user profile. In fact, a user profile becomes a group profile when the first user profile specifies it as its group profile. When granting authority, the AS/400 system does not treat groups any differently than user profiles. For easy management, it is better that user and group profiles be used as separate entities. One way to enforce this is to set the group profile password to *NONE. This prevents signon using a group profile.

7.1.5.5 Limited capability

A user may be assigned limited capability. This is done when creating or changing a user profile. Limited capability restricts a user to a desired subset of the system's functions. This option, coupled with the security system within System 21, restricts users to authorized functions.

On a user's OS/400 user profile, the limited capability keyword may be set to *no*, *partial*, or *full*. The selected value affects the initial program, initial menu, current library, current attention program (associated with the attention key on the terminal), and access to general system commands.

7.1.6 Object protection

Since all AS/400 data structures (system and user) are objects, the security system is primarily concerned with protecting objects. All objects have some common structures in their control blocks (invisible to the normal user). This allows a unified approach to security, since all objects interface the same way to the security routines.

7.1.6.1 Authorities

In AS/400 terminology, *authority* is the permission to access an object. The object owner and the security officer (or other users having all-object security levels) can grant or revoke authority to an object. It is important that you understand the difference between authority to an object and authority to the data in the object. Such operations as moving, renaming, saving, and deleting apply to the object as such. It is possible to have authority for these operations without having access to the data stored in the object. Likewise, you can have full access (read, write, update, delete, execute) to the data in an object without having full authority to manipulate the whole object.

Figure 114 shows the relationship between the object rights and the data rights.

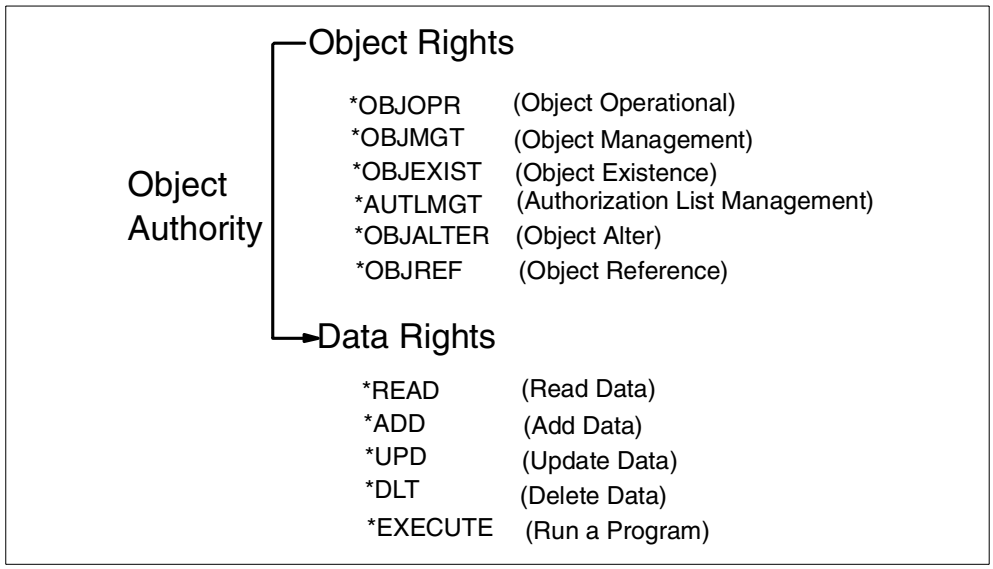

Figure 114. Object authority elements

The following authorities are independent (not hierarchical). For some operations, a combination of authorities is required:

- ***OBJOPR**: The object operational authority controls the use of an object and the ability to look at the description of the object. It is needed to open a file and, therefore, is usually assigned in combination with the desired data rights.
- ***OBJMGT**: The object management authority controls the move, rename, and change attribute functions for the object, and the grant and revoke authority functions for other users or groups.
- ***OBJEXIST**: The object existence authority controls the delete, save, restore, or transfer ownership operations of an object.
- ***AUTLMGT**: This authority is needed to manage the contents of an authorization list associated with the object. This is a specialized security authorization that is not usually grouped with the other seven object authorities.
- ***OBJALTER**: This authority is needed to alter the attributes of database files and change the attributes of SQL packages.
- ***OBJREF**: This authority is needed to specify a database file as the first level in a referential constraint.
- ***READ**: Controls the ability to read data from the object.
- ***ADD**: Controls the ability to insert a new entry (such as a new record in a file) into the object.
- ***UPDATE**: Controls the ability to modify existing entries in the object.
- ***DELETE**: Controls the ability to remove existing entries (for example, records) in the object. Deleting the entire object requires *OBJEXIST authority.
- ***EXECUTE**: Controls the ability to run a program, service program, or SQL package, and to locate an object in a library or a directory.

Some common combinations of authorities were given special names as an abbreviated form. For example, *USE is the combination of *OBJOPR, *READ, and *EXECUTE. Some of the common combinations include:

- ***ALL**: Allows unlimited access to the object and its data.
- ***CHANGE**: Allows unlimited access to the data in the object.
- ***USE**: Allows data in the object to be read.
- ***EXCLUDE**: Allows no access to the object or its data.
- ***USER DEF**: User-defined authorities that do not match any of the standard ones.

7.1.6.2 *PUBLIC authority

Public authority is the default authority for an object. It is used if users do not have any specific (private) authority to an object, are not on the authorization list (if one is specified) for the object, or their groups have no specific authority to the object.

7.1.6.3 Authorization lists

An authorization list is a security structure that is used to authorize a user or a group of users to different types of objects (such as files or programs) secured by the authorization list.

An object may have only one authorization list associated to it. An authorization list may secure more than one object. A user can appear on many different authorization lists.

7.1.6.4 Adopted authority

Certain programs or commands called by a user may require a higher level of authority (for the duration of the command) than is normally available to that user. Adopted authority provides a means for handling this situation. Adopted authority allows a user to temporarily gain the authority of the owner of a program (in addition to the user's own authorities) while that program is running. This provides a method to give a user additional access to objects, without requiring direct authority to objects. System 21 applications use adopted authority within the security functions.

7.1.6.5 Audit journal

The Security Audit Journal is a facility that allows security-related events to be logged in a controlled way that cannot be bypassed. The security auditing function is managed by the system values QAUDCTL and QAUDLVL. If you want to turn on auditing for the first time, it may be helpful to use the Change Security Audit (CHGSECAUD) command. Some of the events that may be logged are:

- Authorization failures
- Object creations
- Object deletions
- Changes to jobs
- Moved or renamed objects
- Changes to system distribution directory or office mail actions
- Obtaining authority from programs that adopt
- System security violations
- Printing actions, both spooled and direct print
- Actions on spooled file data

- Restore operations
- Changes to user profiles, system values, or network attributes
- Use of service tools
- System management functions
- Users' access to audited objects
- CL command strings

Information from the audit journal can be printed using the Display Audit Journal (DSPAUDJRNE) command. Another method is to enter `GO SECTOOLS` on the command line to go to the Security menu, page down, and select option 22.

Figure 115 illustrates the overall security flow for OS/400.

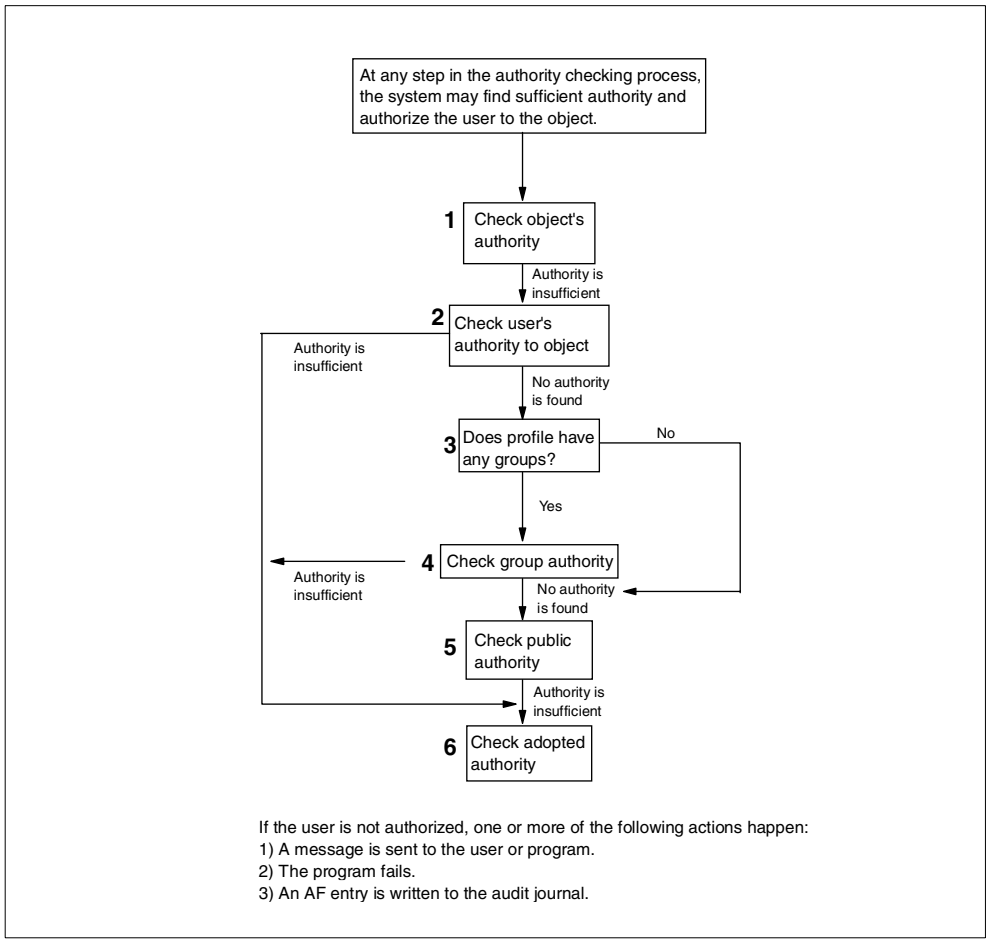

Figure 115. OS/400 security flow

7.2 System 21 security

System 21 starts with AS/400 system security and builds upon it by adding additional layers of functionality.

All System 21 users must have a System 21 user profile. We recommend that you create a model user profile to use for copying into new user's profiles.

System 21 uses both user profiles and group profiles to define user environments, user overrides, and application security. Any of the definable values that are associated directly with a user profile are used first. The absence of these values for a user profile causes System 21 to defer to the values defined by a user's group profile. With the exception of a couple of options, setting up a group profile is identical to setting up a user profile.

User profiles define:

- The list of companies that a user can select when using System 21
- The language preference of the user
- The environment in which the user will work
- The functions that are available to the user
- Which certain "look and feel" features are enabled for the user

Figure 116 illustrates the framework of System 21 security.

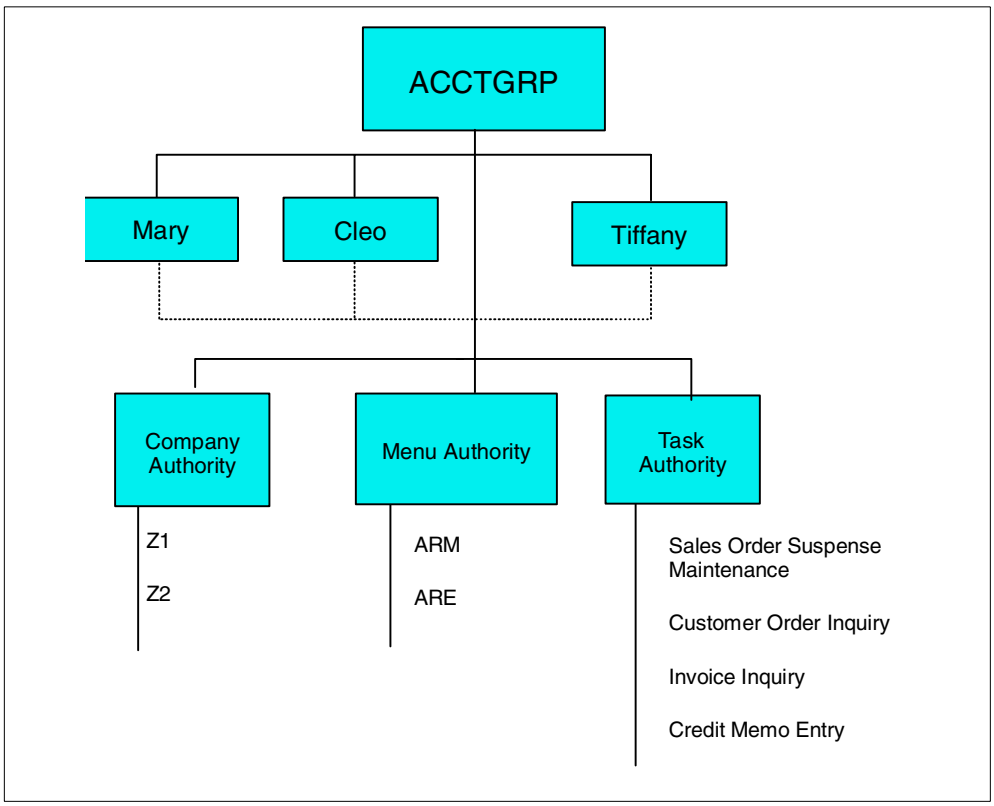

Figure 116. System 21 security framework example

7.2.1 User profile basics

A user profile is either associated with an active OS/400 user profile, or it is a System 21 group profile. Group profiles in System 21 do not need to have a corresponding OS/400 user profile.

After the initial installation, you should begin planning how you want to organize your group profiles and your individual user profiles. A user inherits the rights of the group profile to which they are assigned. Therefore, the system administrator needs to create the group profiles first, and then add individual users to the groups. Here are the basic steps to complete this task:

1. Create all of the group profiles for the enterprise.
2. Create a user profile for every user and assign that user to a group profile.
3. Assign to each group or user the following preferences:
   - **Environment**: The environments you want available to each group or user.
   - **Companies**: The company codes to be available to each group or user.

Important

Security mapping is an important step in setting up your system and making it easier to maintain security. Generally, security mapping is the offline process of defining and documenting the functional groups in your security plan. The easiest way to perform your mapping is to do it as you go through the process of setting up and assigning your user and group profiles.

To create user and group profiles, use the Administration Functions menu. You can access this menu by typing the Start IPG Functions (STRIPGCF) command on a command line and pressing Enter. The Administration Functions menu should appear as shown in Figure 117.

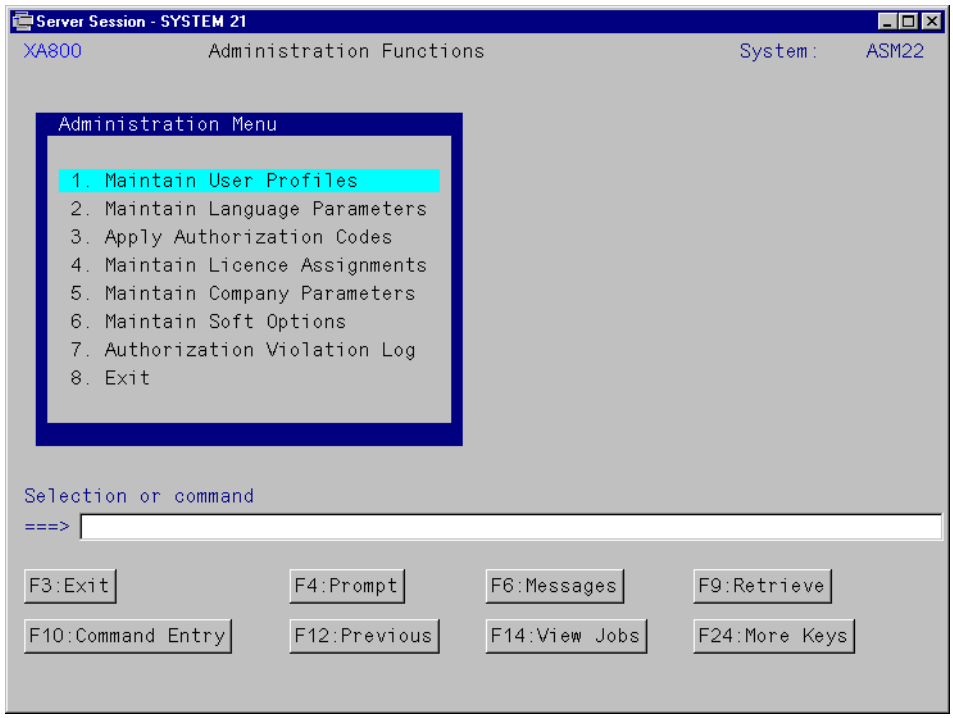

Figure 117. Administration Functions main menu

Type option `1` (Maintain User Profiles) from the Administration Functions main menu to perform the following actions:

- Add or modify group profiles
- Add or modify individual profiles
- Assign environments
- Assign companies
- Assign user preferences

7.2.1.1 User profiles

You can assign each user profile to a group profile. A user profile that belongs to a group cannot be maintained individually. Any changes made to the group user profile are automatically made to each user profile within the user group list.

After you decide on the profiles, the setup begins. From the Administrator Menu, type option `1` (Maintain User Profiles). You see a display similar to the example in Figure 118.

Note

For additional information regarding user profile setup, refer to Chapter 1 in the Geac System 21 *Administration Functions Active Enterprise Framework Manual*.

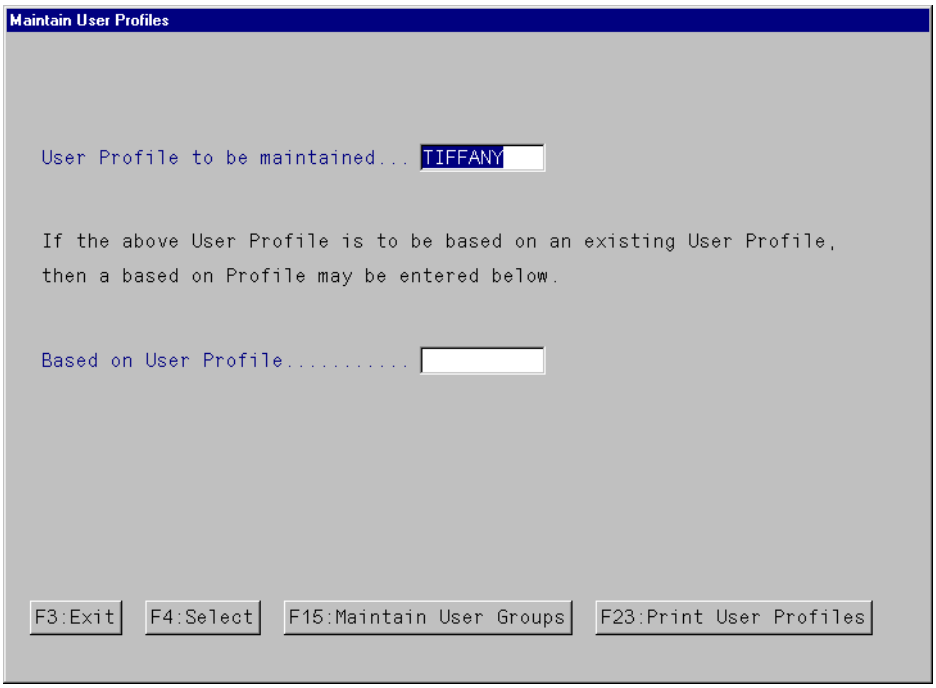

Figure 118. Create User Profile - Entry

In this example, we set up a user profile for someone in the Accounting department. Enter a new user name and press Enter to display the User Profile panel (Figure 119).

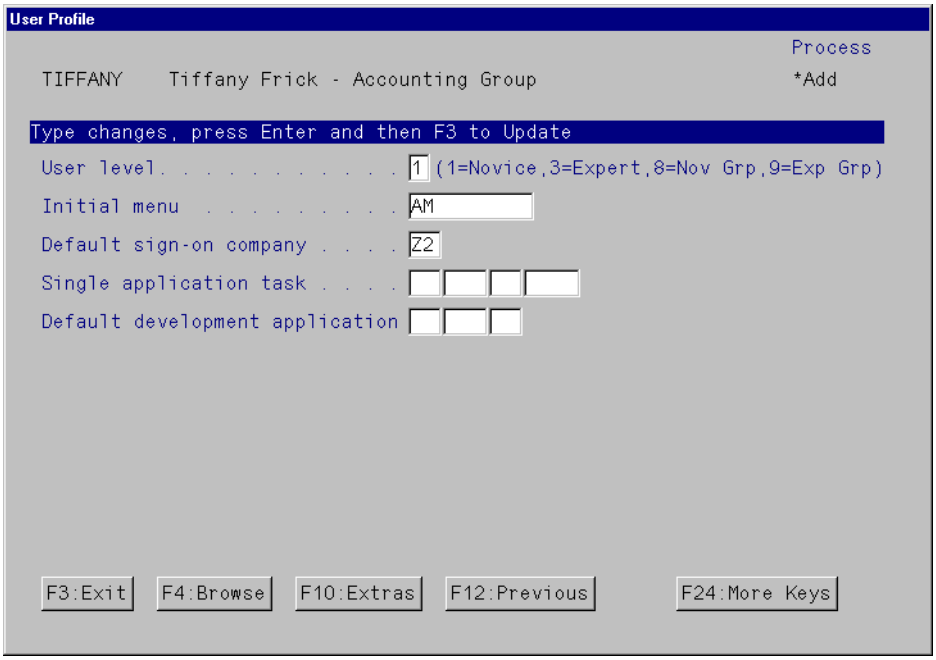

Figure 119. Create User Profile - Basic

To set up the rest of the user's options, click **Extras** to display all of the user profile attributes, as shown in Figure 120.

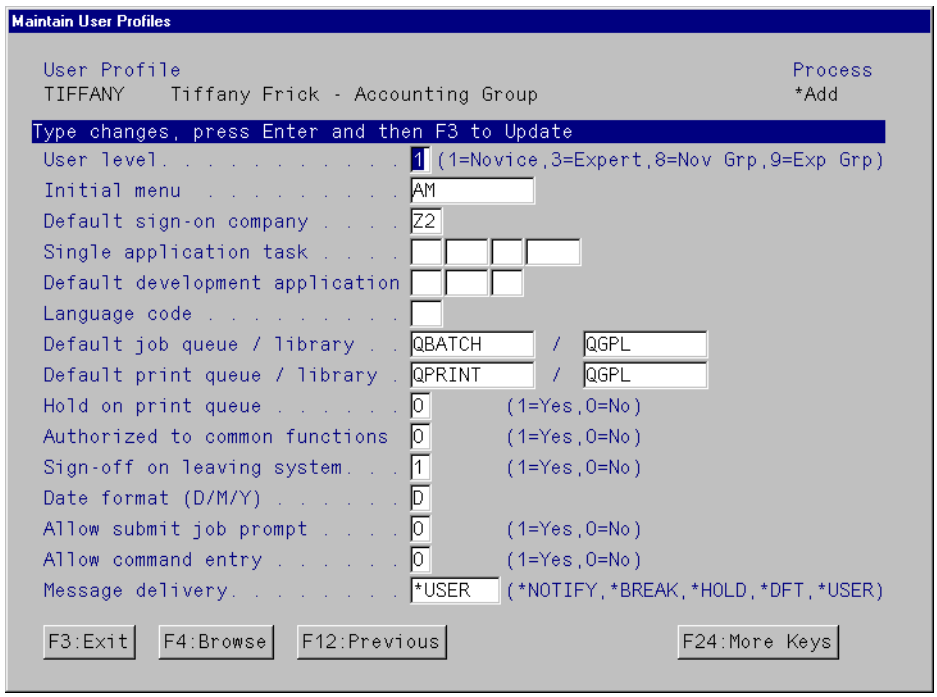

Figure 120. Create User Profile - Extras

When setting up profiles, the "extra" fields are very important. Even though they have default values that are perfectly acceptable, you should review and change them where necessary. We set the following values:

- **Initial Menu**: AM is the very top level menu from which all applications are accessed. This field only applies to traditional, “green-screen” sessions.
- **Default Signon Company**: Set to Z2, which represent a single company.
- **Date Format**: Set to M, because we want our users to see all dates in the MMDDYY format.

There are special considerations you need to make regarding some of these “extra” options:

- Common Functions authorization should only be authorized to the person responsible for administering the system. Any user that is granted access to Common Functions can create System 21 users in Common Functions. System 21 is initialized with the profile of QSECOFR and QPGMR having this right. Therefore, the first user must be created by either QSECOFR or QPGMR profiles.
- The profile QSECOFR has the additional ability to create new OS/400 user profiles during the process of setting up System 21 users.
- Access to the Submit Job Prompt should be severely restricted, because of the detrimental effect on performance if users can shuffle their jobs around.
- We do not recommend Command Entry for users. This option governs which users may enter commands (System 21 or OS/400) on the command line. If a user has access to Command Entry, they may be able to circumvent security measures and damage data or programs.
- Signing off upon leaving the system is a very important security measure. By signing off a user when they exit the System 21 application, they cannot break out of the security system’s control, or access the OS/400 operating system menus.

After setting the values in this panel, click **More Keys**. The display shown in Figure 121 appears.

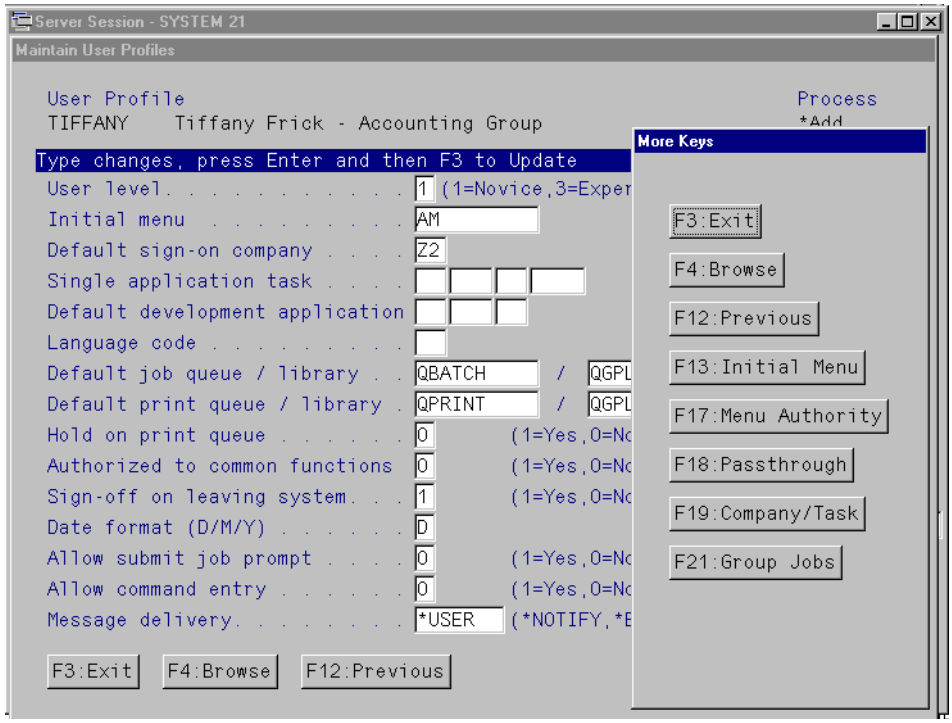

Figure 121. Create User Profile - More Keys

This panel displays the additional areas for defining user authority. When setting up a user profile, the main areas of concern are the *Menu Authority* and *Company/Task* buttons.

The Menu Authority button displays a panel where you can select the menus and options that are available to the user. In our example, we set up an Accounting Clerk profile. Figure 122 shows the Menu Authority panel.

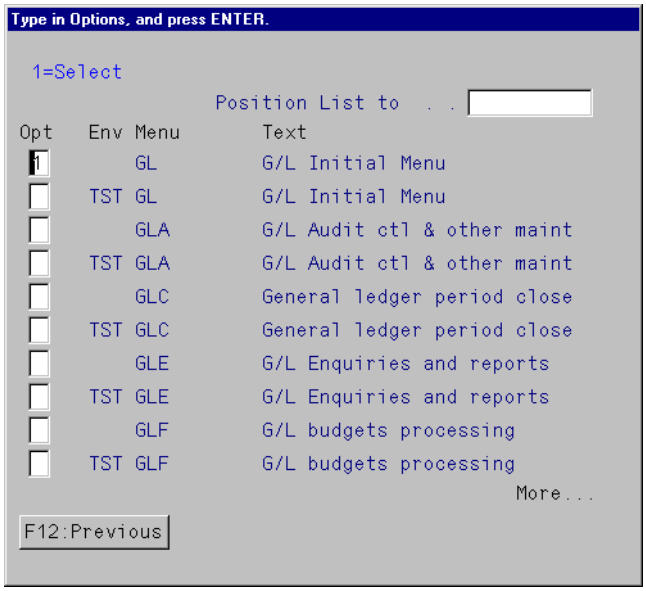

Figure 122. Menu authorization panel

When you select a menu to which to authorize the user, the Menu Activity Selection panel appears, and you can authorize the user to individual options on the menu. See Figure 123 for an example.

Note

At the Menu Authorization panel, it is helpful to select all of the menus to authorize the user to first. Then, when you press Enter, the Menu Activity Selection panel appears for each menu, in turn, saving you the step of selecting a menu each time.

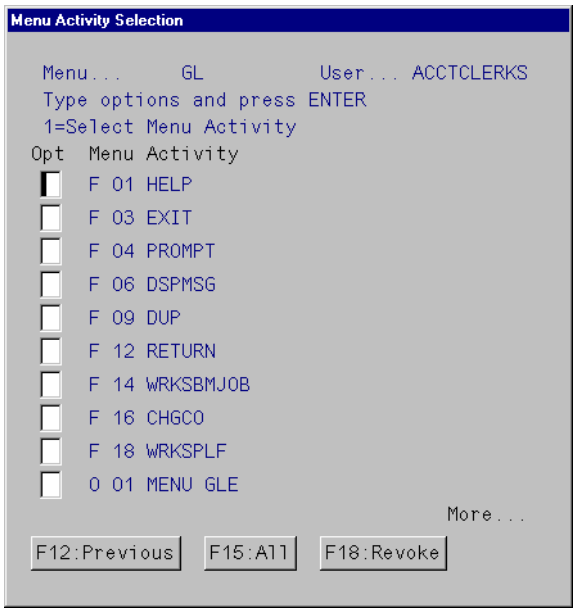

Figure 123. Menu Activity Selection panel

After you have authorized the user to all of the menus, click **Previous** to take you back to the Maintain User Profiles panel. From there, click **More Keys** again, and click **Company/Task**. Then, use the Position list field to move down to the GL entries, as shown in Figure 124. When you authorize a user to a menu option, the user is automatically authorized to the task number.

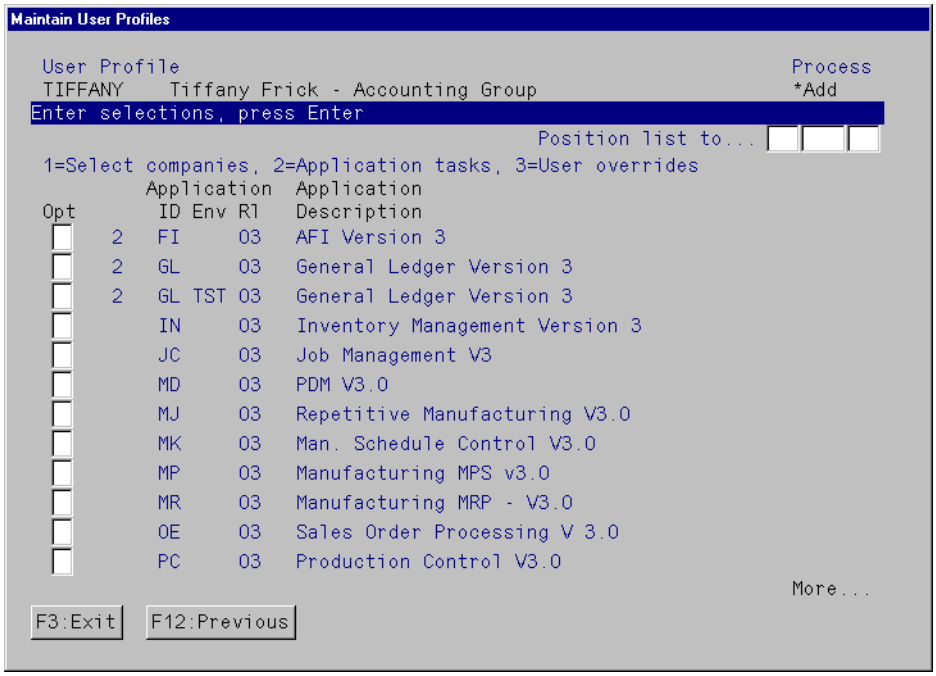

Figure 124. Company tasks

Note

Notice that in Figure 124, there is a “2” to the right of the option field for some entries. That indicates that the user has already been authorized to application tasks within that application. This occurred when we made the entries on the Menu Activities panels.

Select the GL 03 application using option 1 (Select Companies). The company authorization panel is displayed, and you can authorize the user to the desired companies. See Figure 125 on page 228 for an example.

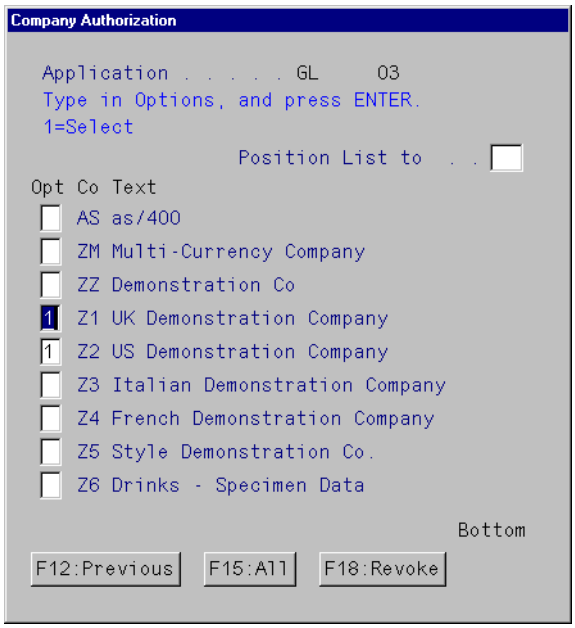

Figure 125. Company Authorization panel

Type a `1` in the option field to authorize the user to the desired companies. When finished, your first basic user profile is complete!

7.2.1.2 Group profiles

A group profile is a user profile whose attributes and authorities are linked to other user profiles. A group profile must be defined to Administration Functions, but does not have to be defined to OS/400.

Each user profile can be assigned to a user group's list. A user profile that is defined as belonging to a group cannot be maintained individually. Any changes made to the group user profile automatically apply to each user profile within the user group list.

Note

A group profile is maintained the same way as a user profile. The difference being that the user level (in the Maintain User Profile Details) must be 8 or 9.

To add users to a group profile, click **Maintain User Groups** on the Maintain User Profiles panel. A display similar to the example in Figure 126 appears.

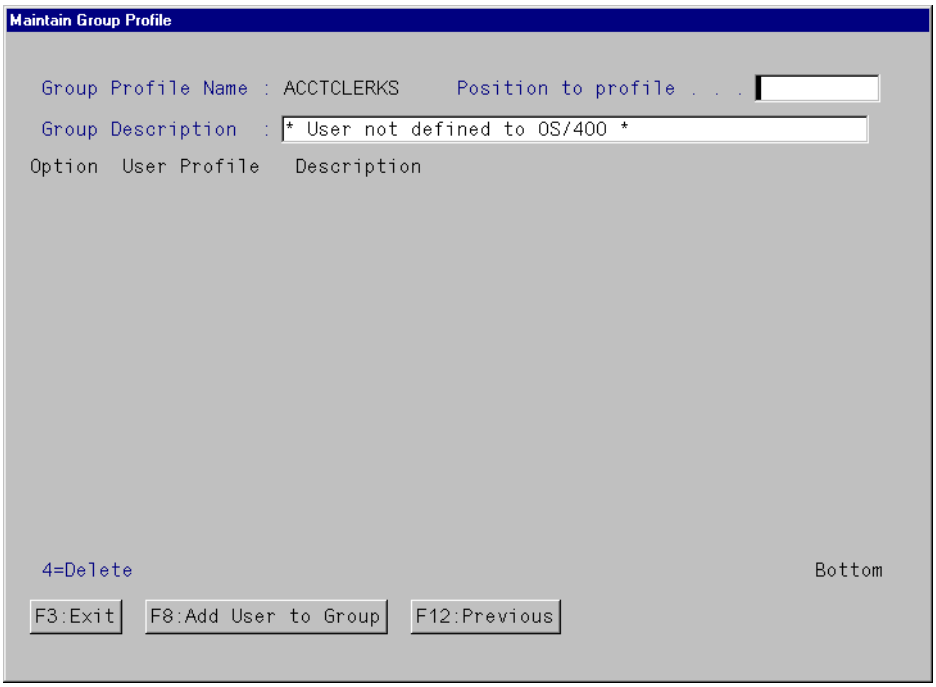

Figure 126. Maintain Group Profile panel

On the panel shown in Figure 126, you see that there are no users attached to this group profile. To add a user, click **Add User to Group**. A panel asking for the user profile to be added appears. That is all that's necessary to make a user part of the group.

When the occasion arises where you need to remove a user from a group profile, simply return to this option and select option 4 to delete the user from the group.

7.2.2 System 21 Explorer user roles

Explorer adds several additional levels of functionality to System 21. The user roles are perhaps the most useful. The roles allow you to present any number of tasks to the user, from just the ones necessary to function, to all the tasks in System 21 and beyond. The main uses for user roles are:

- You can limit the functional areas and tasks that the user sees on their desktop.
- Roles can be assigned to non-System 21 tasks and functions, such as documents, and other PC software products.
- Roles are used in an @ctive Enterprise environment to manage workload assignments.

For an example of how to set up and configure role processing, see Chapter 5, "Installation and set up" on page 87.

7.3 Object security considerations

There are a couple of other considerations to remember about System 21:

- **Adopted authority**: The software is designed to use adopted authority. This means that when the program is run, the job has the authority of the program's owner, not the user.
- **Object ownership**: The software is shipped with all objects being owned by user QPGMR, with the exception of a few commands that are owned by QSECOFR. This condition makes it very important to check object ownership whenever performing any customization or maintenance work to the software.

Chapter 8. Printing

This chapter provides a general overview of AS/400 printing, printing setup, and issues specific to System 21.

8.1 AS/400 printing

The following items are the major components of AS/400 print management:

- Printer device description
- Output queue
- Printer file definition
- Printer writer
- Spooled file

These comments are described later to give you an understanding of the capabilities of using AS/400 spool management. Figure 127 shows a flow of to-be-printed data from an AS/400 application to the printer.

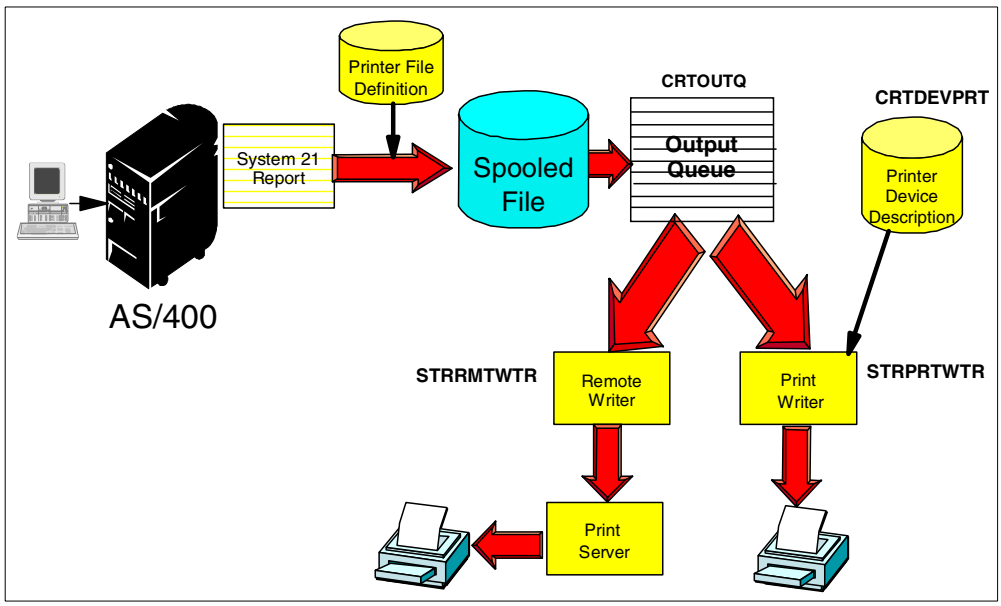

Figure 127. AS/400 print management

System 21 creates a *report*, which is stored in a *spooled file*. The spooled file contains the to-be-printed data. Spooled file attributes (such as page size, number of copies, default font, and so on) are defined in the *printer file* associated with the application. The spooled file is placed into an *output queue*, where it waits until it is printed. A *printer writer* program then processes the spooled file to generate the report on the printer. During this process, the printer writer takes information about the printer from the *printer device description*.

8.1.1 AS/400 printer attachment

This section shows the different printer attachment methods on the AS/400 system depending on the type of printer. The following attachment methods are a few of the possible alternatives:

- Printers attached to a workstation controller or to an IBM 5x94 (Remote Control Unit)
- (Intelligent Printer Data Stream) IPDS printers LAN attached
- ASCII printers attached to PCs
- ASCII printers LAN attached

Note that these are printers directly attached and controlled by an AS/400 system. In other words, these are printers for which there is a device description. All printers attached to remote systems or connected using a TCP/IP LPR/LPD attachment are discussed in 8.1.7.2, “TCP/IP LPR and LPD printing” on page 238.

For information on printing SCS, IPDS, AFPDS, or USERASCII spooled files on the different attachment methods and for information on IBM printers, refer to *AS/400 Printer Device Programming*, SC41-5713, and *AS/400 Printing V*, SG24-2160. Figure 128 shows some possibilities of attaching printers to the AS/400 system.

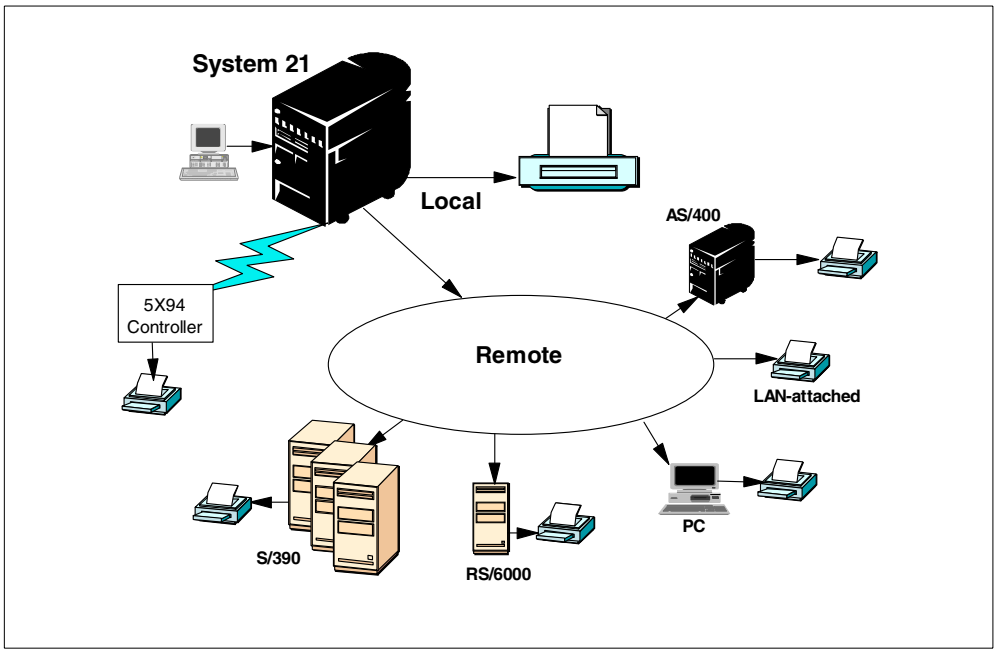

Figure 128. AS/400 printer attachment

8.1.1.1 Printers attached to WSC or 5x94

Several IBM printers (including SCS or IPDS) can be attached directly to AS/400 workstation controllers by a twinaxial cable. The same printers can also be attached by twinaxial cable to a Remote Control Unit IBM 5x94.

8.1.1.2 LAN attached IPDS printers

IPDS LAN capability is provided in a number of ways in IBM AS/400 printers. Any IPDS printer with an IBM AFCCU (Advanced Function Common Control Unit) can be LAN attached to an AS/400 system (for example, IBM InfoPrint 60, InfoPrint62, InfoPrint 3000, InfoPrint 4000). These printers support one or more of the following attachment methods:

- TCP/IP Token Ring
- TCP/IP Ethernet
- SNA Token Ring
- SDLC

IBM workgroup printers, such as the Network Printer 12 (4312), Network Printer 17 (4317), InfoPrint 20 (4320), InfoPrint 21 (4322), or InfoPrint 32/40 (4332), are LAN attached with the appropriate network interface card (NIC)—either TCP/IP Token Ring or TCP/IP Ethernet. The IPDS feature is also required.

The IBM 6400 line printer has an integrated Ethernet IPDS feature that provides Ethernet TCP/IP connection.

Older IBM IPDS printers (for example, IBM 3812, 3816, 3912, 3916, 3112, 3116, 4028, 4230) can be LAN attached using the IBM 7913 LAN attachment unit (this is a hardware Request for Price Quotation (RPQ)).

For details on LAN attachment of IPDS printers, refer to the *IBM Ethernet and Token Ring Configuration Guide,* G544-5240.

8.1.1.3 ASCII printers attached to PCs

All ASCII printers can be connected to a PC using the standard parallel or serial port. PC5250 sessions are used to print AS/400 spooled files on the PC. When a spooled file is sent to a PC5250 printer session, it needs to be converted to an ASCII data stream supported by the target printer. There are three ways that this conversion occurs:

- PC5250 transform based on a Printer Definition Table (PDT)
- PC5250 transform based on the Windows 95/NT printer driver
- Host print transform

8.1.1.4 ASCII printers attached to a LAN

ASCII printers may be attached directly on the LAN using Token-Ring or Ethernet connections. Three system drivers (*IBMPJLDRV, *HPPJLDRV, and *IBMSNMPDRV) allow you to attach ASCII printers on the LAN:

- The *IBMPJLDRV driver supports all of the IBM network printers. This includes the IBM Network Printer 12 (4312), Network Printer 17 (4317), InfoPrint 20 (4320), and InfoPrint 32/40 (4332) attached with a TCP/IP NIC.
- The *HPPJLDRV driver supports all of the HP and HP compatible printers (for example, HP4 and HP5) attached using an HP JetDirect card (TCP/IP address).
- The *IBMSNMPDRV driver can be used with printers that support the industry standard Host Resource MIB. If the printer is connected to a network adapter, the adapter must also support the Host Resource MIB.

8.1.2 AS/400 controllers and devices

The AS/400 system can automatically configure any controller or device (printer or display) attached to twinaxial or ASCII controllers. The same is done for devices attached to an IBM 5494-EXT attached using LAN or WAN (Token-Ring or Ethernet). This is accomplished by selecting automatic configuration through the system value QAUTOCFG and using the Work with System Value (WRKSYSVAL) command:

```
WRKSYSVAL QAUTOCFG
```

Automatic configuration also occurs for any Client Access or Telnet devices. The system value that controls this is called QAUTOVRT. The WRKSYSVAL command allows the configuration change as in QAUTOCFG.

Automatic configuration for remote controllers can be achieved using the system value QAUTORMT. For additional information on local device and automatic configuration, refer to *AS/400 Local Device Configuration*, SC41-5121. For additional information on remote workstation support, refer to *Remote Work Station Support*, SC41-5402.

8.1.3 AS/400 output queue

An output queue is a list of spooled files waiting to be printed. A single output queue may have spooled files from many different jobs and many different users. In some cases, a single job may place spooled files on more than one output queue. Spooled files from a single output queue can be directed to multiple printers.

8.1.4 Printer files

A printer file can be thought of as a template for a spooled file object. A printer file determines how the system handles output from application programs. We can define printer files in two groups:

- **Program-described printer files**: These printer files do not have any field or record-level formatting. The attributes of the printer file are used to define how all of the data in the spooled file is printed. Any positioning of information within the file has to be determined by the application program. Most of the printer files use these simple files.
- **Externally-described printer files**: These printer files have formatting defined using Data Description Specification (DDS) external to the application program. Some of the attributes of the printer file apply to all of the data. The DDS can override or enhance these options for individual records or fields (for example, a single field can be printed as a barcode). For detailed information on DDS output keywords, refer to *Data Description Specification Guide,* SC41-5712. An example of a system-supplied printer file is QSYSPRT in the QSYS library.

8.1.5 Spooled files

A spooled file contains the to-be-printed data. The spooled files stored in output queues can have different origins and different formats (data streams):

- Spooled files can be created on the AS/400 system by an application or by pressing the Print Screen key.
- Windows clients can send a PC output to an AS/400 output queue.
- You may also receive spooled files from host systems (IBM S/390), UNIX systems (IBM RS/6000), OEM systems, or other AS/400 systems.

8.1.5.1 Data stream types

The AS/400 system supports different data streams and can automatically create the majority of them. The Printer device type parameter in the printer file determines the type of data stream to be created (Figure 129).

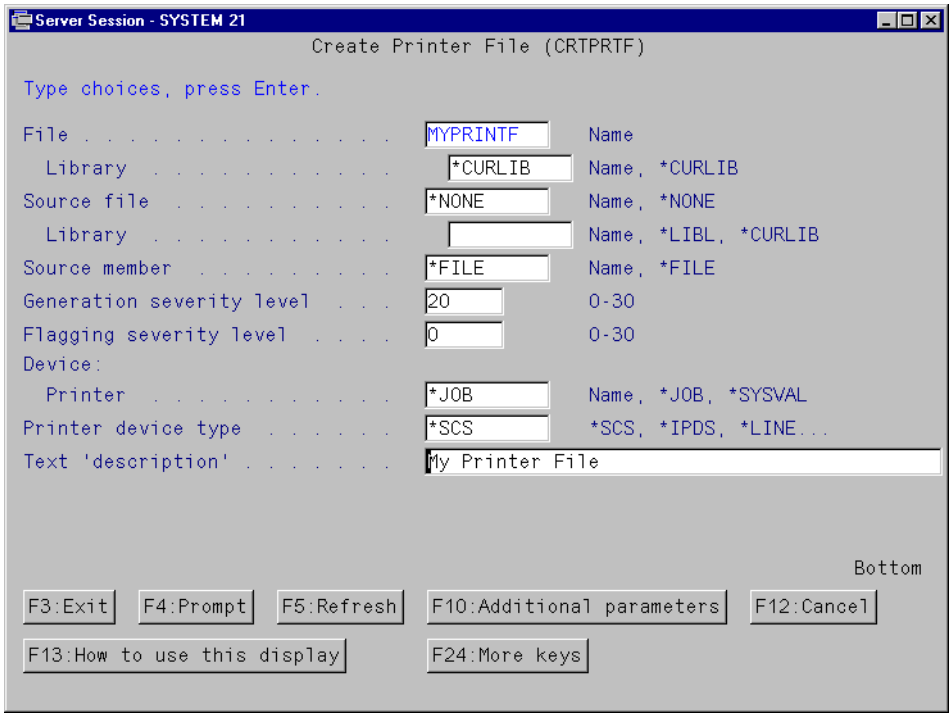

Figure 129. Create Printer File - Printer device type parameter

The Printer device type parameter can be set to one of the following values:

- ***SCS (SNA Character String)**: SCS is used to control line mode printers and has a relatively simple structure.
- ***IPDS (Intelligent Printer Data Stream)**: A server-to-printer data stream used for Advanced Function Presentation (AFP) applications and reliable TCP/IP printing across the network. It provides an attachment-independent interface for managing IPDS printers. The IPDS connection provides an interactive, two-way dialog between the printer writer (PSF/400) and the printer that controls printer information, status, error recovery, and resource management.

  Note that the AS/400-generated IPDS is a subset of the full IPDS.
- ***AFPDS (Advanced Function Printing Data Stream)**: A data stream for advanced function printers (independent of operating systems, independent of page printers, and portable across environments). AFPDS is a structured data stream divided into components called “objects”. AFPDS includes text, images, graphics, and barcodes, and references AFP resources (for example, overlays, page segments, and fonts).
- ***LINE (Line data stream)**: A LINE data stream that uses a page definition and form definition (standard AS/400 formatting objects) to format the spooled file.
- ***AFPDSLINE (AFPDS line data stream)**: AFPDSLINE data stream is a mixture of AFP structured fields and LINE data. Only certain AFP structured fields can be mixed with the line data.
- ***USERASCII (ASCII data stream)**: There is no formal structure that controls the use of the ASCII data stream to control printers attached to systems providing ASCII support. There is no architectural data stream standard to which ASCII printers can conform in the interest of uniformity.

A *USERASCII spooled file can contain any form of an ASCII printer data stream (for example, PCL5 or PostScript).

You should designate a printer that supports the data stream created in the spooled file.

By default, AS/400 printer files use SNA character string (SCS) as the data stream type. This type of data stream can be sent to any printer, including ASCII printers using SCS-to-ASCII Host Print Transform. SCS spooled files can also be sent to printers configured as *IPDS, AFP=NO, and *IPDS, AFP=*YES. The printer writer handles this automatically. It looks at the printer's device description and transforms the SCS spooled file into the appropriate data stream. For IPDS printers configured AFP=*YES, the standard process includes the steps illustrated in Figure 130.

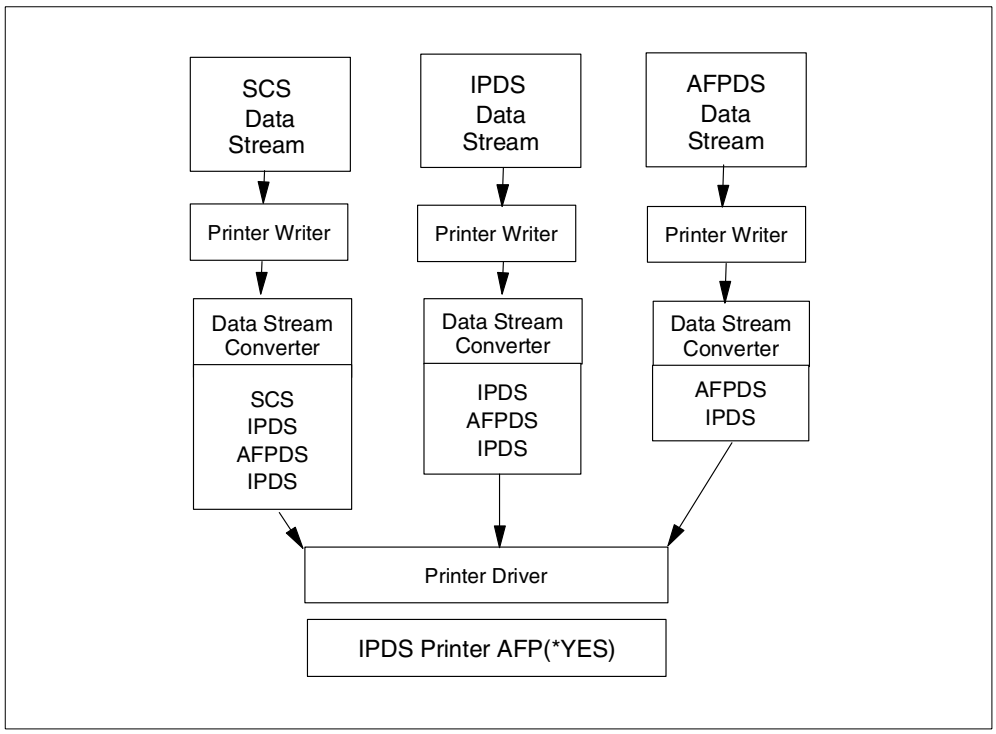

*Figure 130. Data stream transforms when printing to an IPDS AFP (*YES) printer*

8.1.5.2 AS/400 host print transform

The host print transform function allows SCS-to-ASCII and AFPDS-to-ASCII conversion to take place on the AS/400 system instead of by 5250 emulators. Having the conversion take place on the AS/400 system provides the following advantages:

- **Consistent output for most ASCII printers**: The host print transform function is capable of supporting many different types of ASCII printer data streams (for example, the Hewlett-Packard Printer Control Language (PCL), the IBM Personal Printer Data Stream (PPDS), and the Epson FX and LQ data streams). Having the conversion done on the AS/400 system ensures that the resultant ASCII printer data stream provides the same printed output regardless of the emulator or device to which the printer is physically attached.

- **Support for many different ASCII printers**: Currently, each emulator supports a limited number of ASCII printers. With the host print transform function, most IBM printers and a large number of OEM printers are supported.
- **Customized printer support**: Workstation customizing objects that come with the host print transform function can be updated by the user to change or add characteristics to a particular printer. Also, if the host print transform function does not have a workstation customizing object for a printer you want to use, you can create your own.

Figure 131 shows an overview of some of the ways in which ASCII printers can be attached. Host print transform can be used to print to all of these printers.

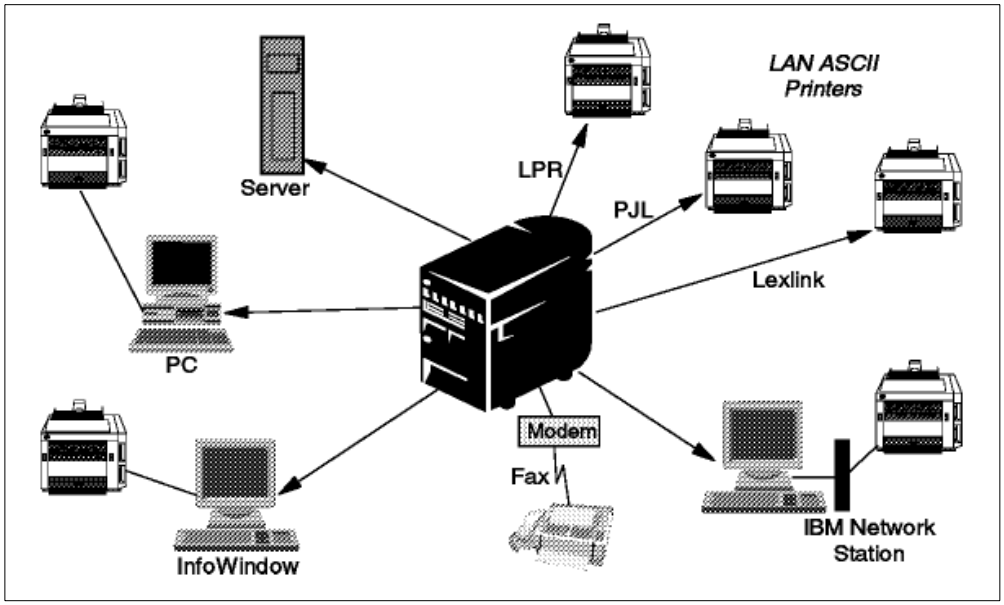

Figure 131. Host print transform

8.1.6 Printer writer

A printer writer is an OS/400 program that takes spooled files from an output queue and sends them to a printer defined on the AS/400 system. More than one printer writer can be started to the same output queue (10 is the limit). However, each writer name must be unique, and printer writers cannot be mixed with remote writers on the same output queue.

The printer writer program takes spooled files, one at a time, from the output queue based on their priority. The printer writer program prints a spooled file only if its entry on the output queue indicates that it has a ready (RDY) status. You can display the status of a particular spooled file by using the Work with Output Queue (WRKOUTQ) command.

8.1.7 Remote system printing

Remote system printing is particularly useful for customers who have networked systems for automatically routing spooled files to printers connected to other systems. Output queue parameters define the target system. Depending on the

target system or printer, host print transform can be called to convert the spooled file into an ASCII printer data stream.

8.1.7.1 Remote writer program

A remote writer is an OS/400 program that takes spooled output files from a remote output queue and sends them to the specified remote system. The remote writer, which is a system job, sends the spooled output files using Systems network architecture distribution services (SNADS), TCP/IP, or Internetwork Packet Exchange (IPX). This function is known as remote system printing on the AS/400 system. The Start Remote Writer (STRRMTWTR) command is used to initiate remote system printing.

After the spooled output file is successfully sent to a remote system, it is deleted or saved as determined by the SAVE spooled file attribute value. Figure 132 shows several remote system printing possibilities.

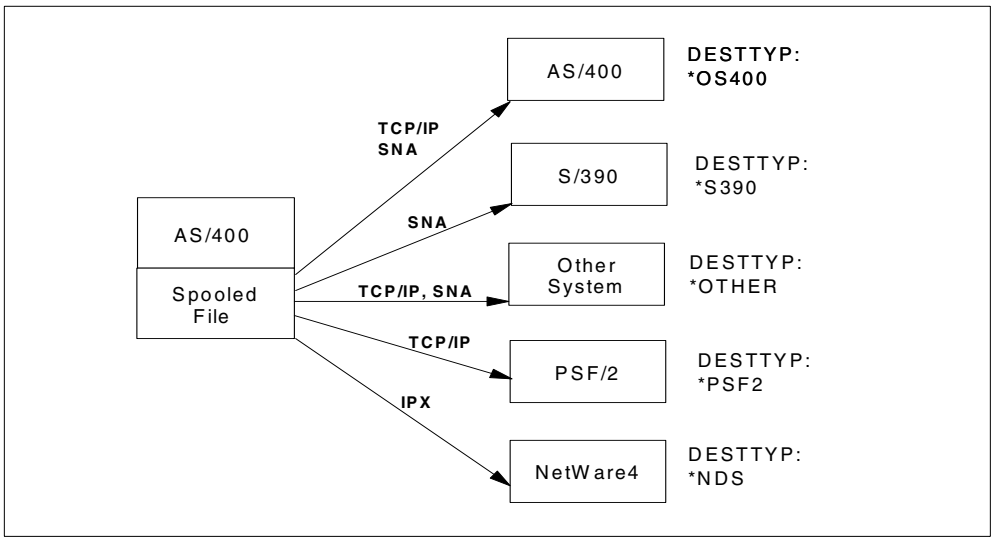

Figure 132. Remote system printing

8.1.7.2 TCP/IP LPR and LPD printing

You can request to have your spooled file sent and printed on any system in your TCP/IP network. The line printer requester (LPR) is the sending, or client portion, of a spooled file transfer. On the AS/400 system, the Send TCP/IP Spool File (SNDTCPSPLF) command, the TCP/IP LPR command, or remote system printing provide this function by allowing you to specify the system on which you want the spooled file printed and how you want it printed. When sending a spooled file, the host print transform function can also be used to transform SCS or AFPDS spooled files into ASCII.

Printing the file is done by the printing facilities of the destination system. The destination system must be running TCP/IP. The line printer daemon (LPD) is the process on the destination system that receives the file sent by the LPR function. Figure 133 shows the process flow of remote printing with LPR and LPD.

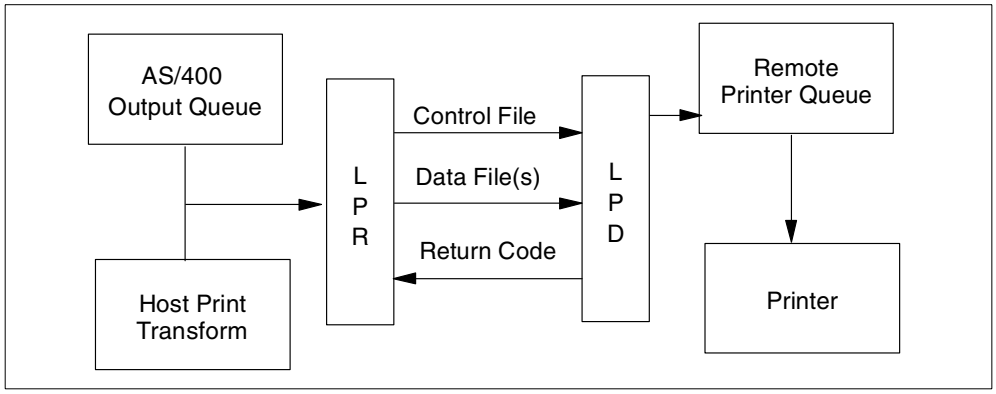

Figure 133. TCP/IP LPR and LPD

8.1.8 AS/400 NetServer

With AS/400 NetServer, you can make AS/400 output queues available as network printers to PC clients. AS/400 NetServer has been available since Version 4 Release 2 of OS/400. It is integrated into the base of OS/400 and is not a separately installable option or product.

8.1.8.1 What AS/400 NetServer is

NetServer enables an AS/400 system to provide file and print serving in a Windows network without the need to install additional hardware or software on the AS/400 system. AS/400 NetServer uses the Server Message Block (SMB) protocol to communicate with the network. PCs access the AS/400 NetServer with Windows networking functions without having additional software installed.

NetServer officially supports Windows for Workgroups (Windows 3.11), Windows 95, Windows 98, Windows NT 3.51, and Windows NT 4.0 clients. OS/2 Warp Connect, although it is an SMB client, is not supported with NetServer.

8.1.8.2 Sharing printers

Sharing an output queue with NetServer works almost the same as sharing a directory. There are three methods to do this. The first two methods involve Operations Navigator, and the third method is a direct call to an AS/400 NetServer API on the AS/400 system.

For more information on NetServer, refer to *AS/400 Client Access Express for Windows: Implementing V4R4M0,* SG24-5191.

8.1.9 Client Access Express printing

In the Client Access Express environment, it is possible to print PC application output on an AS/400 printer and AS/400 application output on a PC printer. Or, by using a combination of these functions, you can print PC application output on another PC printer. For more information, refer to *Client Access Express for Windows – Setup V4R4M0*, SC41-5507, or *AS/400 Printing V*, SG24-2160.

When using Client Access Express for your printing needs, two different types of printing capabilities are provided:

- Sharing AS/400 printers using AS/400 NetServer
- Printer emulation

Windows drivers have to be used if the target printer is an ASCII printer. In this case, the spooled file in the AS/400 output queue is shown with a *USERASCII Device Type (DEVTYPE) attribute.

8.1.9.1 Sharing AS/400 printers using NetServer

Client Access Express for Windows, unlike the other Client Access clients, does not provide by itself the functionality of Network Drives and Network Printing. It relies on AS/400 NetServer for these functions. While Client Access for Windows 95/NT Network Printers use background jobs on the PC to make their functions available to the Windows desktop, NetServer does not need background jobs on the PC. This results in less overhead and less memory used on the PC.

For more information on NetServer, refer to 8.1.8, “AS/400 NetServer” on page 239.

8.1.9.2 Printer emulation

Printing AS/400 application output on PC-attached printers using such facilities as Client Access Express is referred to as *printer emulation*. In this case, AS/400 spooled files in an SCS or an AFP data stream must be converted into an ASCII printer data stream depending on the target PC printer. This conversion can be done by one of the following methods:

- PC5250 emulation based on a Windows printer driver: The transformation takes place on the PC, and only SCS spooled files can be converted. No customization is possible.
- PC5250 emulation using Printer Definition Tables (PDT): The transformation takes place on the PC, and only SCS spooled files can be converted. Printer functions can be adapted by modifying the Printer Definition Table (PDT). The modified PDT must be the Printer Definition Table (PDT). The modified PDT must be available on all PCs using the printer.
- OS/400 host print transform: The transformation takes place on the AS/400 system. SCS and AFPDS spooled files can be converted. Customization is possible by modifying the Work Station Customizing (WSCST) object. The same WSCST object is used for all printers of a similar type. For detailed information on host print transform, see 8.1.5.2, “AS/400 host print transform” on page 236.

Redirecting PC application output using the AS/400 system to another PC printer in the network is a combination of the previous two capabilities. PC-generated output is sent to an AS/400 output queue in an ASCII printer data stream and then printed on a Client Access-attached ASCII printer. This brings the AS/400 spooling capabilities to PC application output.

8.2 Spool management

This section describes the AS/400 commands used to manage printed output directed to the AS/400 spooling system. It includes:

- Creating remote output queues for printing to a LAN-attached printer
- Creating virtual printer devices
- Starting printer writers
- Working with output queues

8.2.1 Setting up a remote output queue

This section describes the steps to create an AS/400 remote output queue to support server printing.

You can create an AS/400 output queue for a LAN attached network printer after your initial software installation. Type the Create Output Queue (CRTOUTQ) command. Then, enter the parameter values shown in Figure 134 and Figure 135 on page 242.

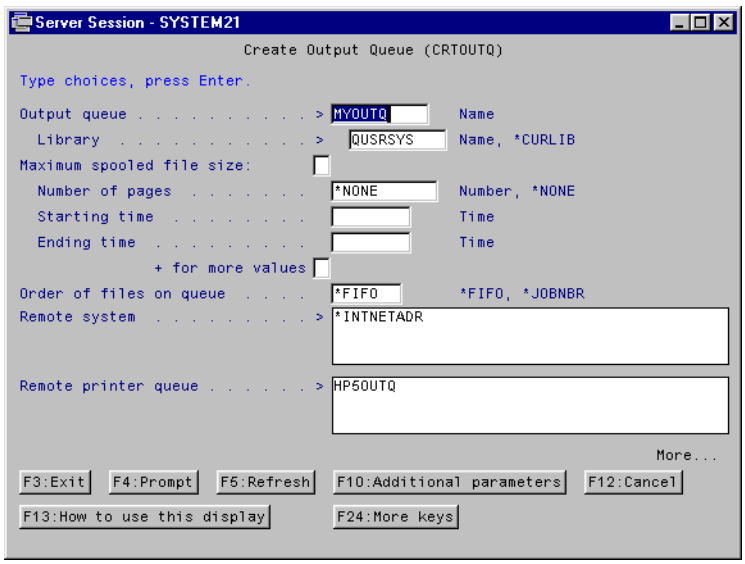

Figure 134. Create Output Queue (Part 1 of 2)

The parameters are explained here:

- **Output queue**: The name for your new output queue. Substitute your printer name instead of MYOUTQ. It should be something meaningful. For example, it can be the model and type of the printer (HP5SI), the physical location (FLR3RM202), or department (ACCOUNTING).
- **Remote system**: The value *INTNETADR allows you to specify the TCP/IP address of your printer. If you have already set up TCP/IP to find your Domain Name Server (DNS), you can use the IP Host name instead.
- **Remote printer queue**: Assign a name to the remote printer queue. The default value of *USER is not valid when configuring a network printer.

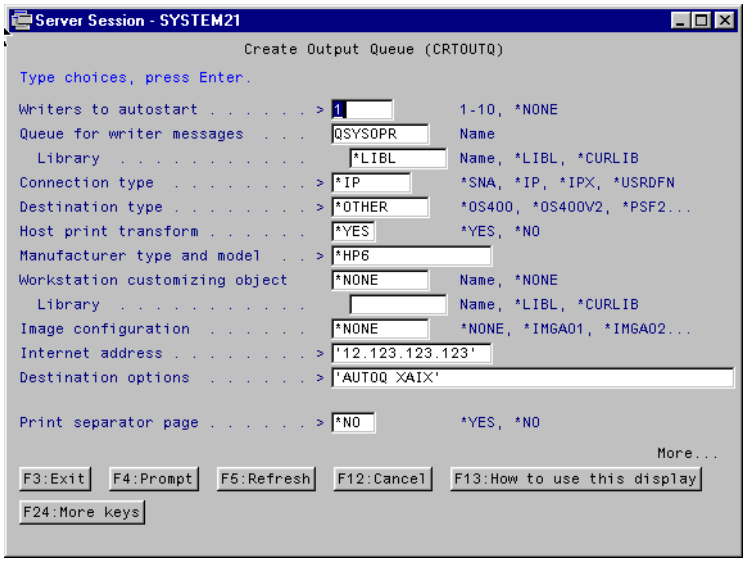

Figure 135. Create Output Queue (Part 2 of 2)

- **Writers to autostart**: Specify `1` if you want the remote writer to autostart when a print job is sent to the queue. If `*NONE` is used, you must use the Start Remote writer (STRRMTWTR) command to start the writer.
- **Connection type**: You must enter the value `*IP` to use Internet Protocol (IP) addressing for the printer.
- **Destination type**: When configuring a network printer, you should specify *OTHER for the destination type.
- **Host print transform**: Defines whether the transformation from EBCDIC to ASCII happens on the AS/400 system or on the printer. If you are creating a remote output queue to another AS/400 system, type `*NO`.
- **Manufacturer type and model**: Select the manufacturer or model of your printer. If your printer is not listed, consult your printer manual for emulation information.
- **Printer IP Address**: The IP address of the network card in the printer. If you do not know this information, check the configuration on the printer using the manual supplied with it or ask your local network administrator.
- **Destination options**: Specify `AUTOQ` and `XAIX`. AUTOQ is required. XAIX gives the output queue multiple copies support for the spooled files.

After you complete out the required fields, press Enter to create your output queue.

The remote writer runs in the AS/400 subsystem QSPL. When a spooled file is in a ready state and the remote writer is started or active, the AS/400 system sends the output to the LAN-attached print server with this IP address.

Once a writer is started, you must end it before you can make changes to the output queue. Type the End Writer (ENDWTR) command:

```
ENDWTR outq-name *IMMED
```

Here, *outq-name* is the name of the output queue.

After you complete making any changes, the writer should start up automatically. If it doesn't, you can manually start it by entering the Start Remote Writer (STRRMTWTR) command:

```
STRRMTWTR outq-library/outq-name
```

Output queues can have a physical printer associated with them, or you can create an output queue to be used just as a report repository. The printouts or spooled files reside there until printed, deleted, or moved to another output queue.

With special authority granted to this output queue, other LAN or WAN users can share this printer from their desktop.

For additional information on output queues, refer to Chapter 5, "Spool Support" in *Data Management*, SC41-5710.

8.2.2 Creating a virtual IPDS printer device

When printing using remote writer support, you do not have any direct communication with the printer itself. The spooled file is simply sent to an IP address. Problem determination and error recovery are limited. There is no feedback on printer status, no management of print resources (for example, fonts, overlays, and images), and a very incomplete implementation of AS/400 printer file options.

Using an IPDS LAN-attached printer and defining an IPDS printer device description addresses of all of these shortcomings of remote writer support. An IPDS printer device description provides, in essence, the functionality of a direct-attached AS/400 printer (read Twinax) in a network-connected TCP/IP environment.

You can create a printer device description by typing:

```
CRTDEVPRT
```

Press F4 (Prompt).

8.2.3 Starting AS/400 printer writers

Before a printer can print the spooled files, a printer writer program must be started using either the autostart writer option or one of the following commands:

- `STRPRTWTR`: Start Printer Writer
- `STRRMTWTR`: Start Remote Writer

Normally, all writers are started when the system starts after an Initial Program Load (IPL). This is done using the system value QSTRPRTWTR (Start printer writers at IPL). The shipped value of QSTRPRTWTR is one (1), which starts all printer writers. A change to this value becomes effective only at the next IPL. The writer commands can be accessed using the Writer menu (`GO CMDWTR`).

Remote writers are started automatically with an autostart job entry when the subsystem QSPL is started.

If a writer ends the request of a user or operator, it must be started before it can print, unless requesting direct printing and bypassing the output queue. To end a

print writer (either a local or a remote), enter the following command on the command line:

```
ENDWTR <Writername> *IMMED
```

8.2.3.1 Local printer writer

Figure 136 and Figure 137 show the values you need to enter to start a printer writer for a locally attached printer.

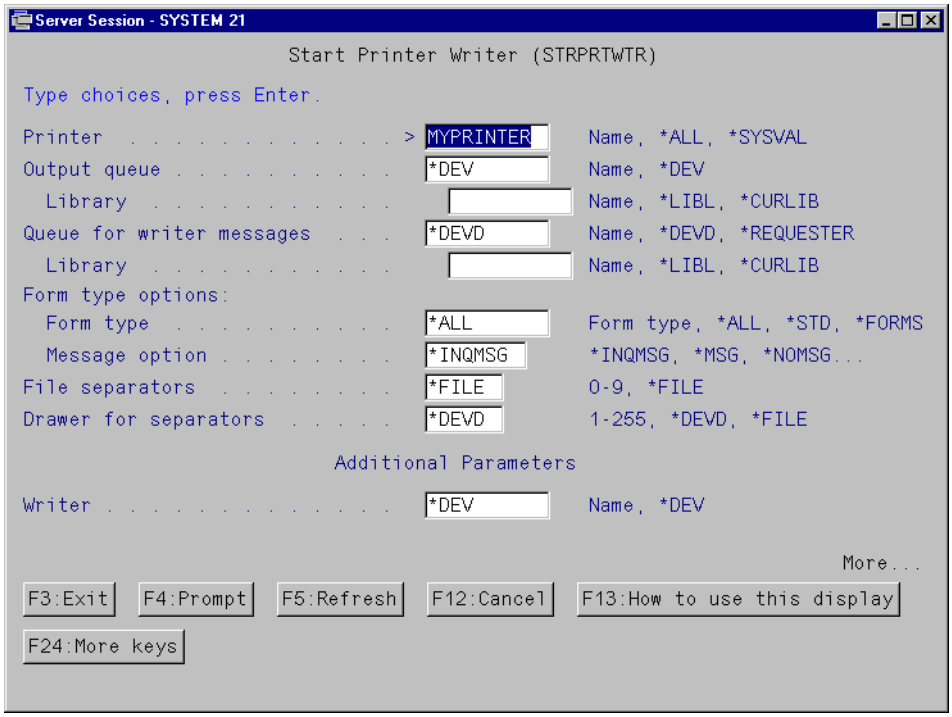

Figure 136. STRPRTWTR Prompt command (Part 1 of 2)

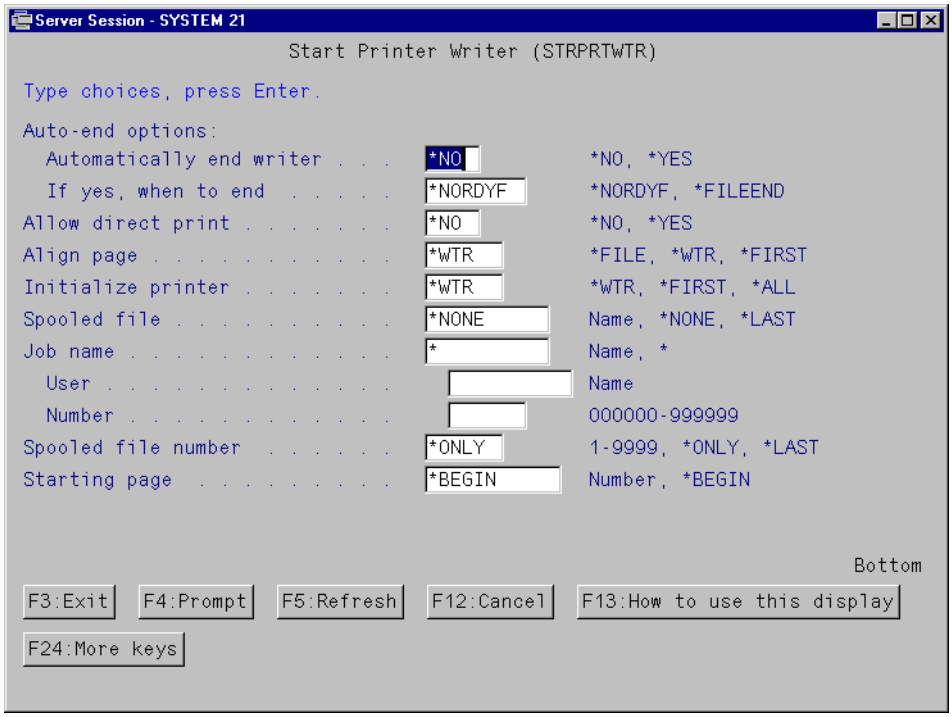

Figure 137. Additional information for the STRPRTWTR command (Part 2 of 2)

Most of the parameters needed for a user or operator to start a printer writer are on the first display (Figure 136). The necessary information includes the name of the writer, the name of the output queue (can be the writer name or a different name), and where the printer attention messages are sent (for our example, the user or operator that started the writer). There are other parameters that control which form types to print, separator pages to be printed, and a name for the writer (if the device name is not used).

The second display (Figure 137) lets you specify whether the printer should end when no ready files are available, allow direct print (used to allow a program to direct print to the device bypassing the queue; this can be used in a barcode scenario), check page alignment, and initialize the writer. The other parameters include:

- Spooled file
- Job name
- User
- Number
- Spooled file number
- Starting page

These parameters are used to print or reprint a specific spooled file. The information for these parameters is retrieved by using the Work Output Queue (WRKOUTQ) command and finding the spooled file to print or reprint. The starting page parameter is used to start at a specific page in the spooled file for printing or reprinting.

8.2.3.2 Remote printer writer

Figure 138 on page 246 shows the parameters and values you need to complete to start a printer writer for a remotely attached printer.

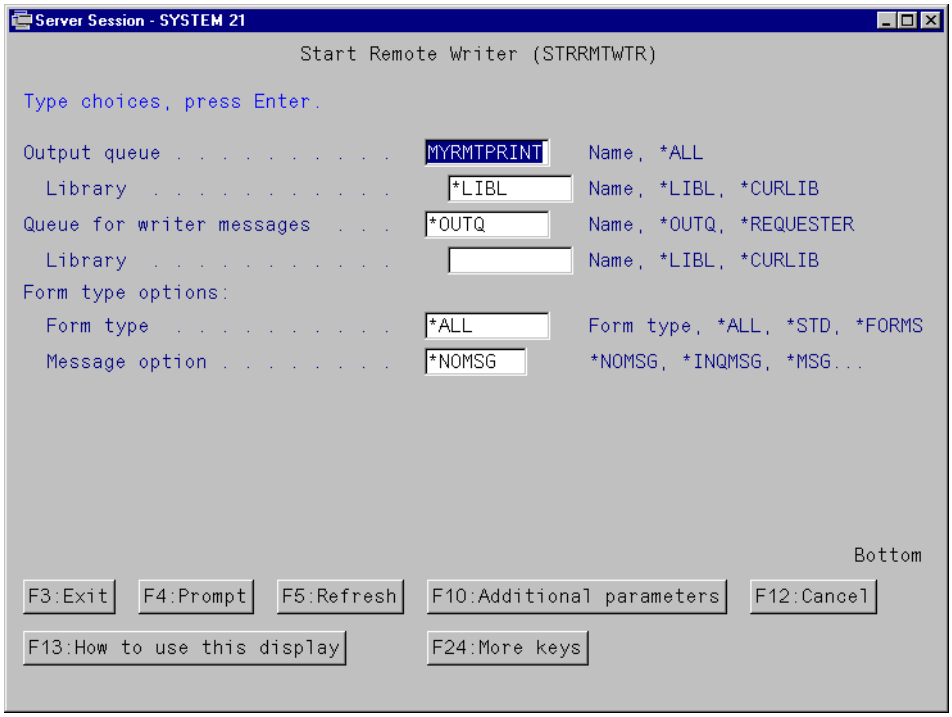

Figure 138. Start Remote Writer (STRRMTWTR)

The STRRMTWTR command is different. It starts the writer using an output queue name that was created as a remote queue. Some of the parameters are the same as the STRPRTWTR command. The command specifies the queue for messages, form type, writer name, and auto-end options.

Once the remote writer is started, all files in ready status are sent or printed to the remote printer or remote system.

8.2.4 Working with output queues

Once you create the output queue, you need to know how to display or view its contents using the Work with Output Queues (WRKOUTQ) command. The WRKOUTQ command shows the contents of:

- A specific queue by indicating the queue name
- All output queues by specifying the special value *ALL
- A generic list of output queues by specifying the first few letters of the queue names, followed by an asterisk (*)

For example, specifying NEW*, in the output queue name field, would display all of the output queues that have names starting with the letters NEW. You can access all output queues from the display shown in Figure 139.

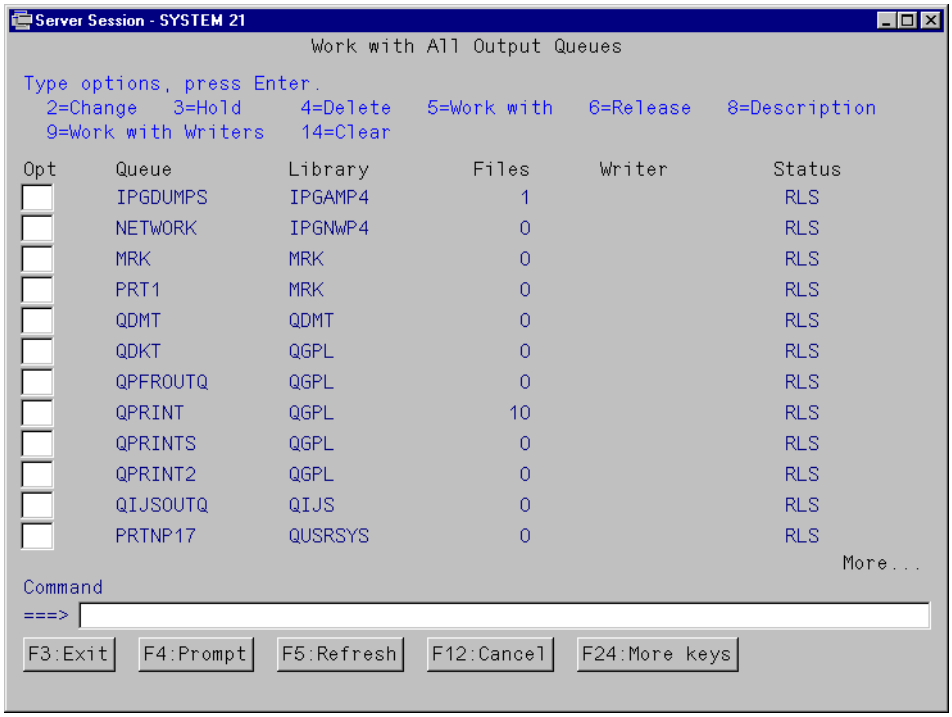

Figure 139. Example of Work with All Output Queues

Using the options shown in Figure 139, you can change output queue attributes; hold an entire output queue; delete, work with (and display stored spooled files), and release the queue; change the description of the queue; or clear all spooled files stored in the queue.

Figure 140 on page 248 shows the Work with Output Queue display.

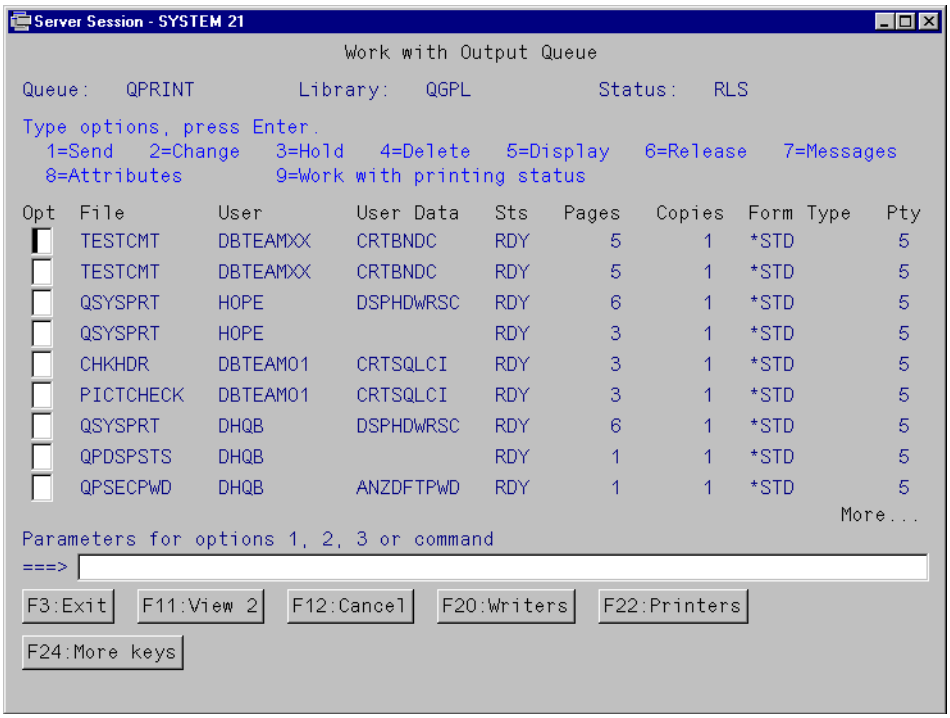

Figure 140. Example of option 5 on the QPRINT output queue

This display allows you to work with individual or groups of spooled files. In the top right-hand corner, the Status field refers to the status of the output queue (RLS - Released) and the status of the printer writer (WTR - Writing) in this example. The following list shows all of the output queue status possibilities:

- **HLD (Held)**: The queue is held.
- **HLD/WTR (Held/Writer)**: The queue is attached to a writer and is held.
- **RLS/WTR (Release/Writer)**: The queue is attached to a writer and is released.
- **RLS (Released)**: The queue is released, and no writer is attached.

8.2.5 AS/400 Printer menu

The AS/400 Printer menu (Figure 141) can be helpful if you are not familiar with the system. To access the menu, type `GO PRINTER` on a command line. This menu has options to work with spooled files, output queues, printers, and writers. Remember, a user always has access to spooled files that they created. However, if you want to manipulate other printing features, you need *SPLCTL special authority.

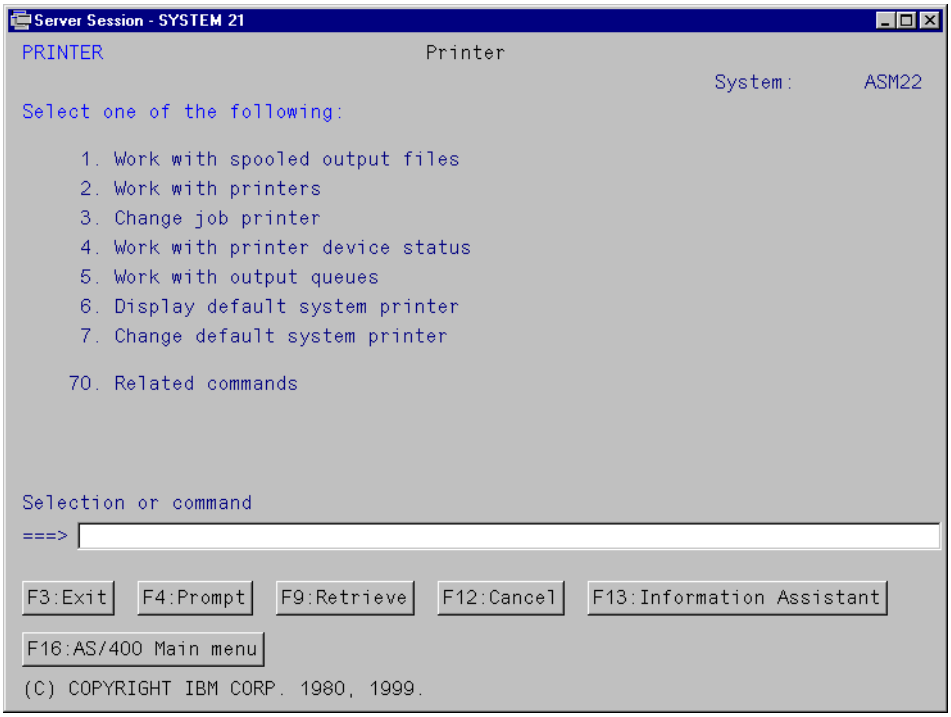

Figure 141. AS/400 Printer menu

8.3 System 21 specifics

System 21 allows flexibility in configuring the printing topography. The application supports a hierarchy for directing spooled output to specific output queues. For example, you may want to direct a particular user (or group of users) to a certain output queue, or direct a report to a certain output queue. System 21 uses a specific hierarchy when determining overrides to output queues. This hierarchy is illustrated in Figure 142.

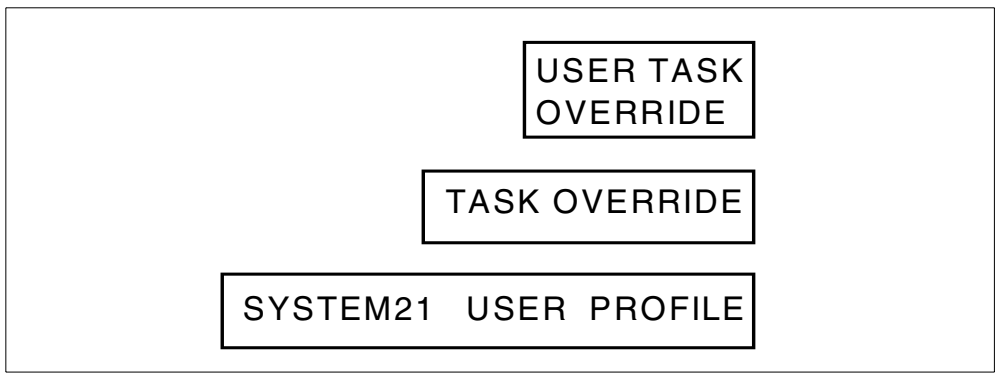

Figure 142. Override hierarchy

In Figure 142, at the lowest level, a default output queue is specified for the user profile. The output queue for particular functions can be overridden at the task level. Finally, functions for a particular user can be overridden at the user/task level.

Chapter 9. Backup and recovery

Today, computer systems and the applications and information that they provide are at the heart of most businesses. Without the critical functions they support—customer service, sales, order processing, distribution, manufacturing—business quickly comes to a halt. You need to plan backup, recovery, and system availability to protect your ability to maintain crucial business functions no matter what happens. Planning can mean the difference between business success and business failure.

The backup and recovery requirements for a business vary from business to business, but the goals are the same:

- Protect and secure your investment.
- Keep your system available for your users.
- Be prepared for a system failure of any magnitude.

You should consider the following questions when determining a strategy for backup and recovery:

- How much down time can I afford after a system failure?
- What are the costs to my business resulting from a failure?
- What is the probability of a system failure occurring?
- How much down time can I afford to perform a proper save?
- What are the costs associated with each strategy, such as, operator time, media cost, storage costs, hardware, and software?
- How much data do I need to save and what is my growth projection?

The answers to these questions will help to form your strategy. The costs and benefits of any backup and recovery strategy should be weighed against your company's goals in determining the right approach.

Your strategy should include a plan for recovering from a disaster resulting in the loss of your our AS/400 system. In such a case, you need to restore to a different AS/400 system.

IBM Business Recovery Services (BRS) offers an extensive portfolio of services to help you design, set up, and manage a comprehensive, enterprise-wide AS/400 business recovery strategy. BRS can help you minimize the effects of network and system outages and plan for their efficient recovery. BRS consultants can help you:

- Evaluate critical business functions and applications
- Assess your system environment.
- Design a recovery plan to keep your business running in the event of an extended outage.

BRS recovery centers are equipped with the latest AS/400 business computing system technologies. They are staffed with technical experts to assist you in testing your recovery plan and performing a recovery in the event of a disaster.

A backup strategy must protect against the loss of your database, as well as system objects and application programs. The three main components of a backup strategy are:

- **System**: Including the operating system (OS/400), user profiles, authorities, configurations, system, and network values.
- **Application software**: Required for normal operations of the business, including compilers, utility libraries, application and general purpose libraries (QGPL), IBM licensed program libraries, job descriptions, output queues, data areas, message queues, and other application dependent objects.
- **Databases**: The libraries and files that contain the organization's data.

9.1 AS/400 backup and recovery overview

While we do not develop a full backup and recovery strategy in this section, we discuss some considerations and include some example commands for reference. For in-depth information on backup and recovery strategies, see *Backup and Recovery*, SC41-5304, for more information.

There are three main ways to back up data on the AS/400 system:

- **Manual**: Using the SAVE and RESTORE menus or user written programs
- **Operational Assistant**: Basic automated backup and tape management
- **Backup and Recovery Media Services/400 (BRMS/400)**: Provides automated backup and archival operations, and tape management services. For additional information on BRMS/400, refer to *AS/400 Backup Recovery and Media Services*, SC41-4345. BRMS/400 provides many facilities to save and restore information on the AS/400 system. Depending on backup requirements and the operational environment, you can select them from menu options or run them from a command line, or in user-written programs.

9.1.1 Manual save and restore

If you choose to perform your saves and restores manually, the first step is to become familiar with the way the AS/400 system saves and restores objects.

9.1.1.1 AS/400 save and restore functions overview

Figure 143 and Figure 144 on page 254 illustrate the functions performed by the standard AS/400 save and restore menu options and OS/400 commands and DB2/400 systems.

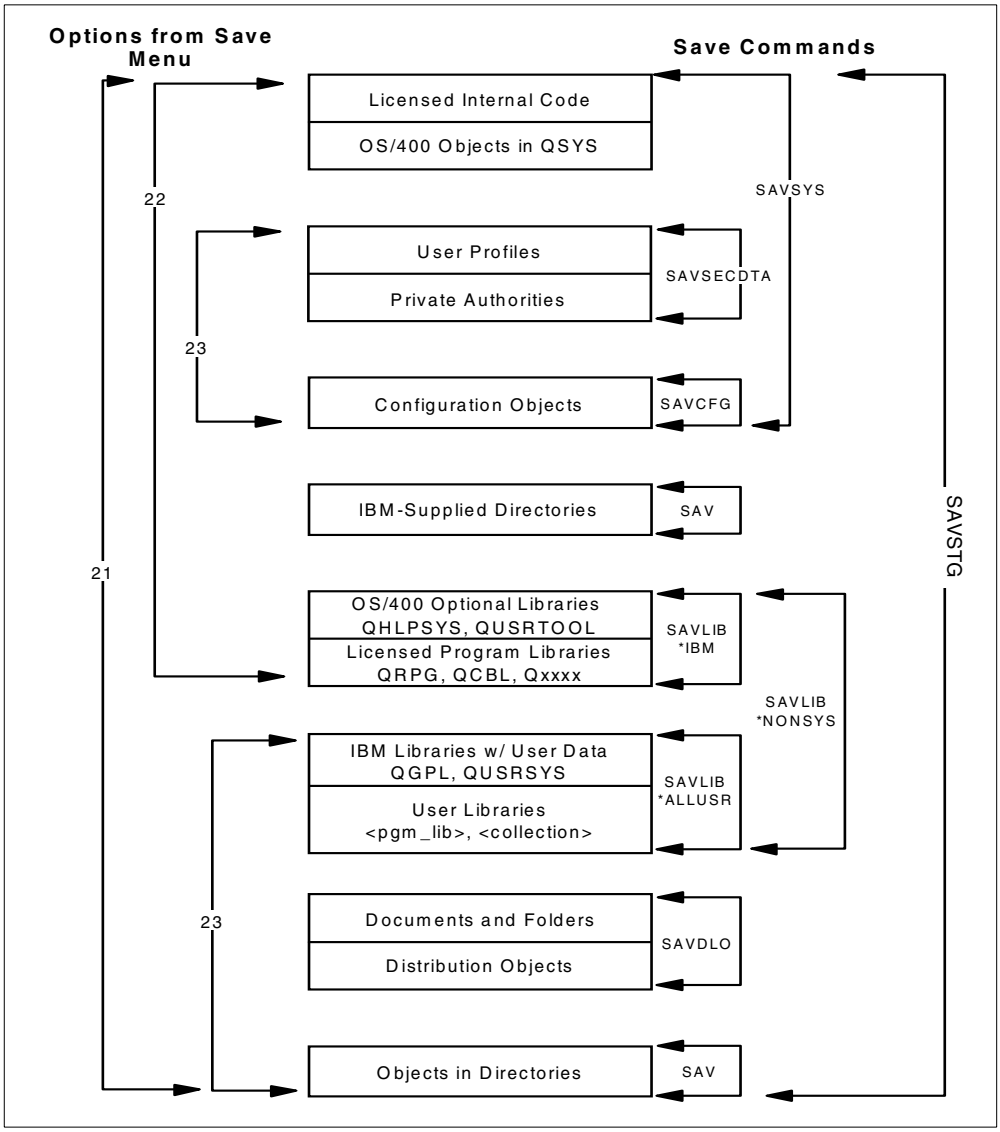

Figure 143. Library save commands and Save menu options

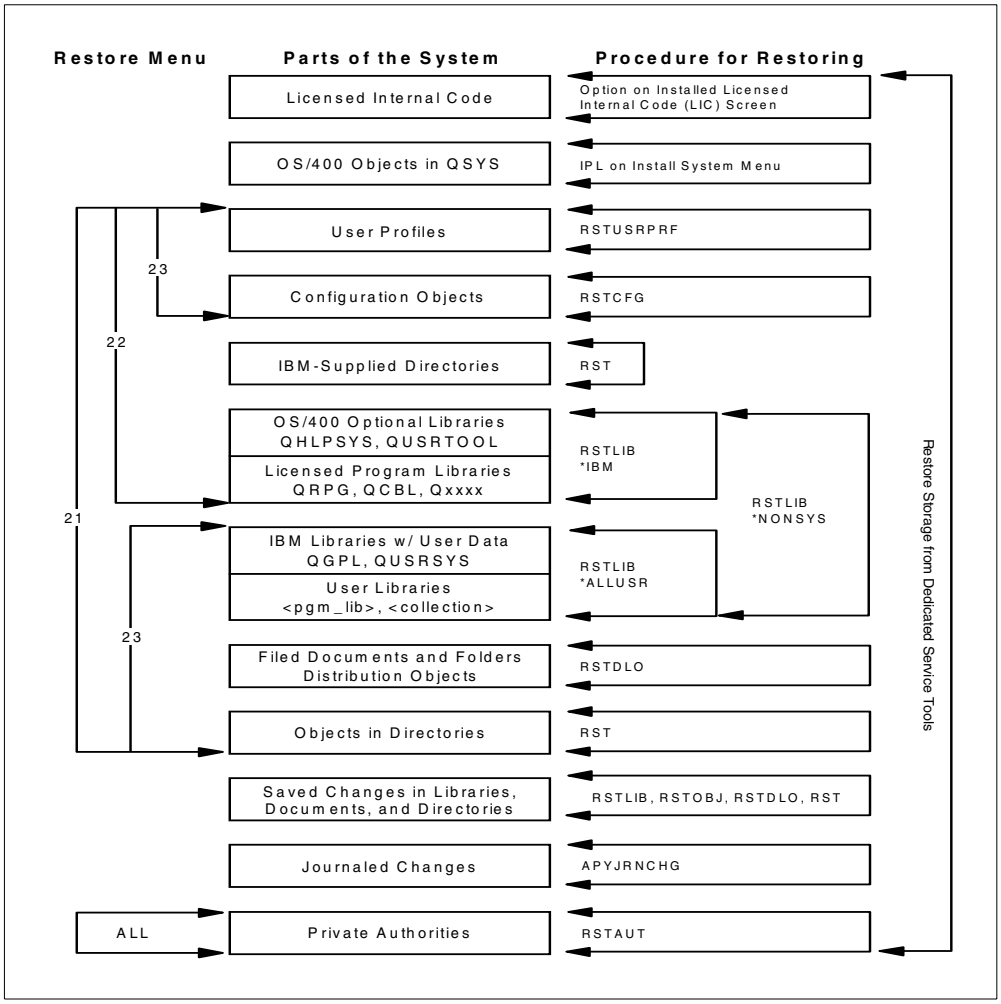

Figure 144. Library restore commands and Restore menu options

Figure 145 and Figure 146 on page 256 illustrate the functions performed by the standard AS/400 save and restore menu options and commands for the integrated file system (IFS).

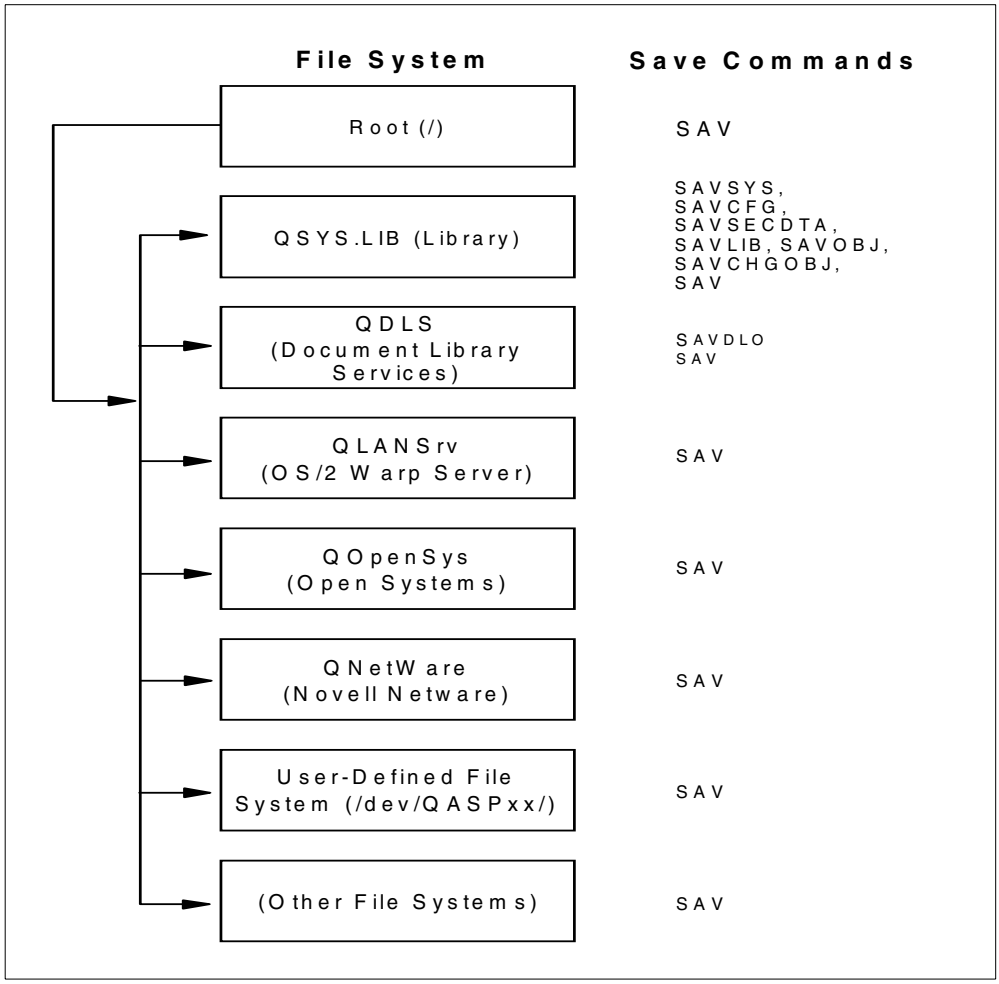

Figure 145. Save commands for the integrated file system (IFS)

Note

The following file systems cannot be saved:

- NFS
- QFileSvr.400
- QOPT
- QNTC

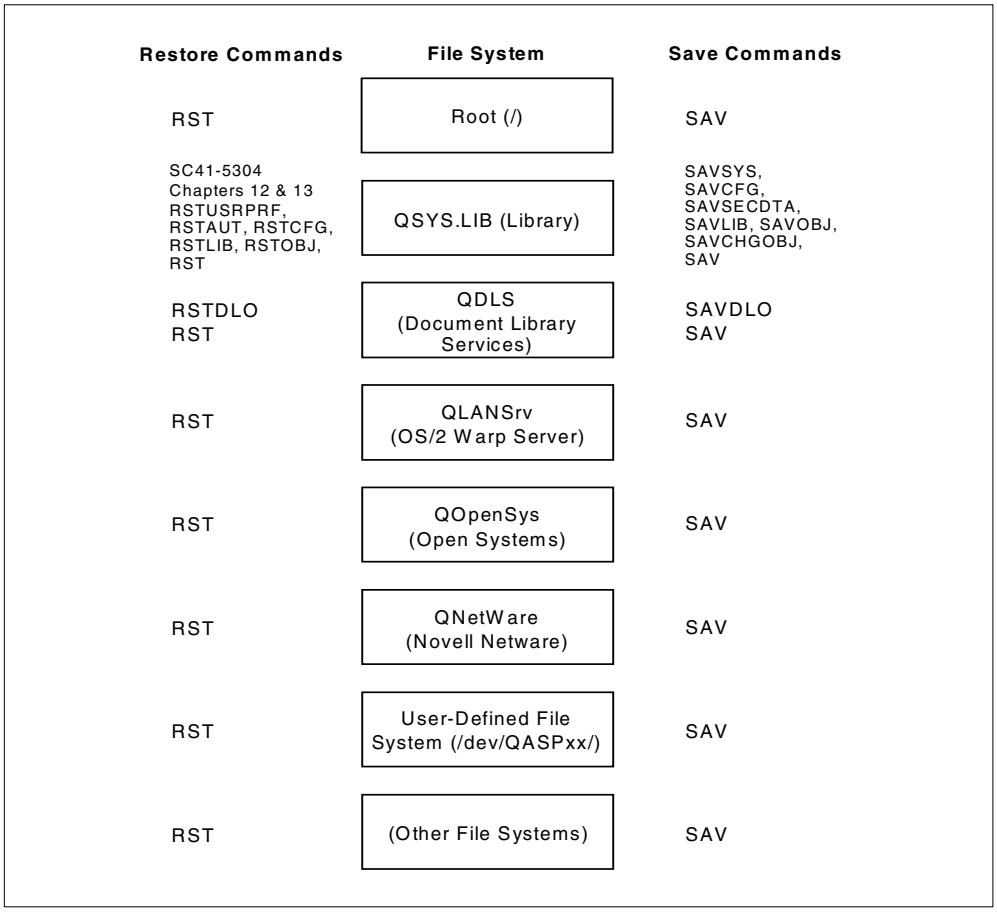

Figure 146. Save and restore commands for the integrated file system (IFS)

9.1.1.2 OS/400 save and restore commands

All AS/400 save and restore commands are provided in the base OS/400 operating system. Save and restore functions can be accessed in several different ways:

- From menus via the GO command
- Indirectly through other commands
- Directly by the commands themselves

The common save commands found on the CMDSAV and SAVE menus are listed in Table 51.

Table 51. Common save commands

Save command	Description
SAVDLO	Save Document Library Objects
SAVLIB	Save Library
SAVOBJ	Save Object
SAVSECDTA	Save Security Data
SAVSTG	Save Storage
SAVCFG	Save System Configuration

Save command	Description
SAVSYS	Save System
SAVCHGOBJ	Save Changed Objects
SAV	Save Integrated File System Objects

The common restore commands found on the CMDRST and RESTORE menu are listed in Table 52.

Table 52. Common restore commands

Restore command	Description
RSTDLO	Restore Document Library Objects
RSTLIB	Restore Library
RSTOBJ	Restore Object(s)
RSTAUT	Restore User Authorities to Objects
RSTCFG	Restore System Configuration
RSTUSRPRF	Restore User Profiles and Authority Tables
RST	Restore Integrated File System Object(s)

Note that there is no Restore System command since this is done as a dedicated service tools function. Nor is there a Restore Changed Object command. There are additional commands, but they are not listed or described here.

This chapter does not intend to explain each command in detail. If you want detailed information on the save and restore commands, please refer to *Backup and Recovery,* SC41-5304*,* or *CL Reference,* SC41-5722.

9.1.1.3 Save commands requiring a dedicated system

Some save commands require that the system be in a “restricted state”. This means that all but the controlling subsystem are shut down, and no jobs are running. The only interactive session available is the system console.

If you wrote your own save or backup programs using save-while-active and the system is in a dedicated mode, the save-while-active processing is ignored.

The save commands requiring a dedicated system are:

- SAVSYS
- SAVSTG
- SAVLIB LIB(*NONSYS)

9.1.1.4 Save commands not requiring a dedicated system

The following list of commands does not require a dedicated system, but require extra attention. Both the save operation and application jobs issue locks over objects. To this end, use caution to prevent an interruption to production users and to prevent an object from being missed by the backup because of object locks. These save commands are:

- SAV
- SAVCFG

- SAVCHGOBJ OBJ(*ALL) LIB(library-name)
- SAVCHGOBJ OBJ(*ALL) LIB(*ALLUSR)
- SAVDLO
- SAVLIB LIB(*IBM)
- SAVLIB LIB(*ALLUSR)
- SAVOBJ OBJ(object-name/library-name)
- SAVSECDTA

9.1.1.5 Save-while-active

OS/400 has the capability of saving information, while objects are still in use by users and applications. This capability is called *save-while-active*.
Save-while-active is an option on many save commands.

The system performs the save-while-active function by maintaining an image of the object being saved as it existed at a single point in time. This point in time is called the *checkpoint* for an object, and the image of the object is called the *checkpoint image*. It can be viewed as if the system is maintaining two images of an object as it is being saved: one image that contains the updates to the object that normal system activity works with, and the checkpoint image that only the save-while-active job is using to save the object to the media. The system does not maintain two complete images of the object being saved. It only maintains two images of the data being changed as the save is being performed.

When more than one object is being saved, you can choose whether the checkpoint images for the objects should be synchronized. With full synchronization, the checkpoints for all of the objects occur at the same time (actually, during a time period in which no changes can occur to the objects). With library synchronization, the checkpoints for all of the objects in a library occur at the same time. With system-defined synchronization, the checkpoints for the objects may occur at different times.

The term “save-while-active” may imply that objects can be changed at any time during the save operation, but this is not true. The system allocates (locks) objects as it obtains checkpoint images. Objects cannot be changed during the checkpoint processing. After the system obtains the checkpoint images, the objects may be changed.

The amount of time that the system is unavailable to users during the backup process is referred to as the *save outage*. The easiest and recommended way to use the save-while-active function is to reduce your save outage by ending your applications that change objects until after the checkpoint images have been obtained. You can choose to have the save-while-active function send a notification when the checkpoint processing is complete and it is safe to start your applications again. When the save-while-active function is used this way, the save outage can be much less than with normal save operations.

You can also use the save-while-active function to eliminate your save outage, but the performance and response time of your applications will be affected. Your recovery procedures will also be affected. You will need to use journaling and commitment control to simplify your recovery procedures.

If you have a window of opportunity to perform a dedicated backup, we recommend that you use this strategy. For detailed information on this capability, please refer to *Backup and Recovery,* SC41-5304.

9.1.1.6 Initial and periodic entire system saves

An initial save of the System 21 environment is done after the initial installation is complete. Periodic entire system saves are recommended on a monthly basis, as well as before or after major system changes, such as:

- Hardware addition/removals
- Extensive system configuration changes
- Operating system patches (PTFs)
- Application software additions, removals, upgrades

Option 21 on the Save menu saves the entire system to tape, including the AS/400 system library, user profiles, system configuration, IBM licensed program product libraries, all user libraries, document libraries, and the integrated file system (IFS).

Option 21 requires a “dedicated system”, which means that no subsystems, except the controlling subsystem (for example QCTL), are available and only to support the console. Upon completion, the controlling subsystem is restarted, and the system is made ready for production.

The Save menu is shown in Figure 147. Type the command `GO SAVE`.

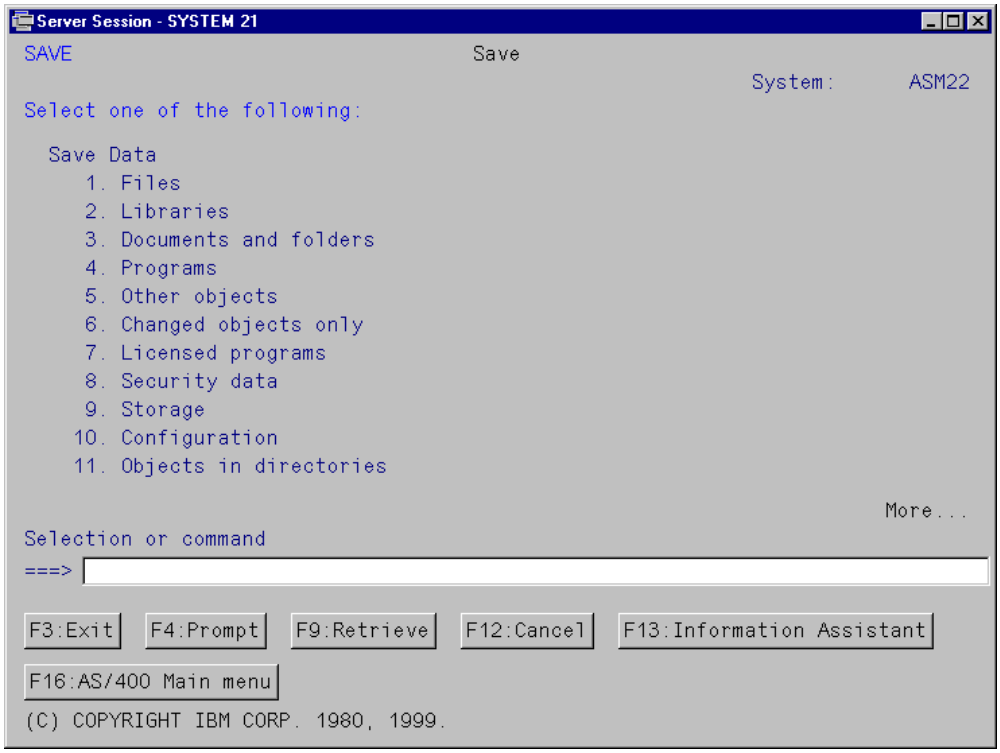

Figure 147. AS/400 Save menu display (Part 1 of 2)

Use the Page Down key to move down the list of options. You will see option 21 on the window, as shown in Figure 148 on page 260.

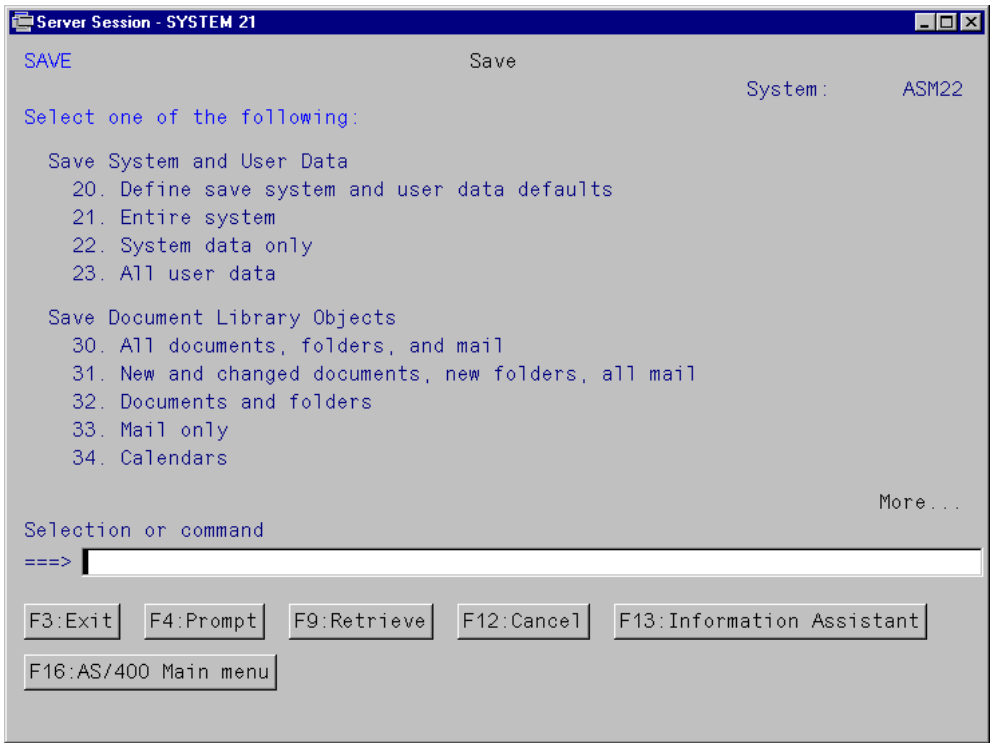

Figure 148. AS/400 Save menu display (Part 2 of 2)

Type option `21` (Entire system), and press Enter to view the information shown in Figure 149. If you are not on the console, or if the system is not in a restricted state, you will see a display advising you of this section.

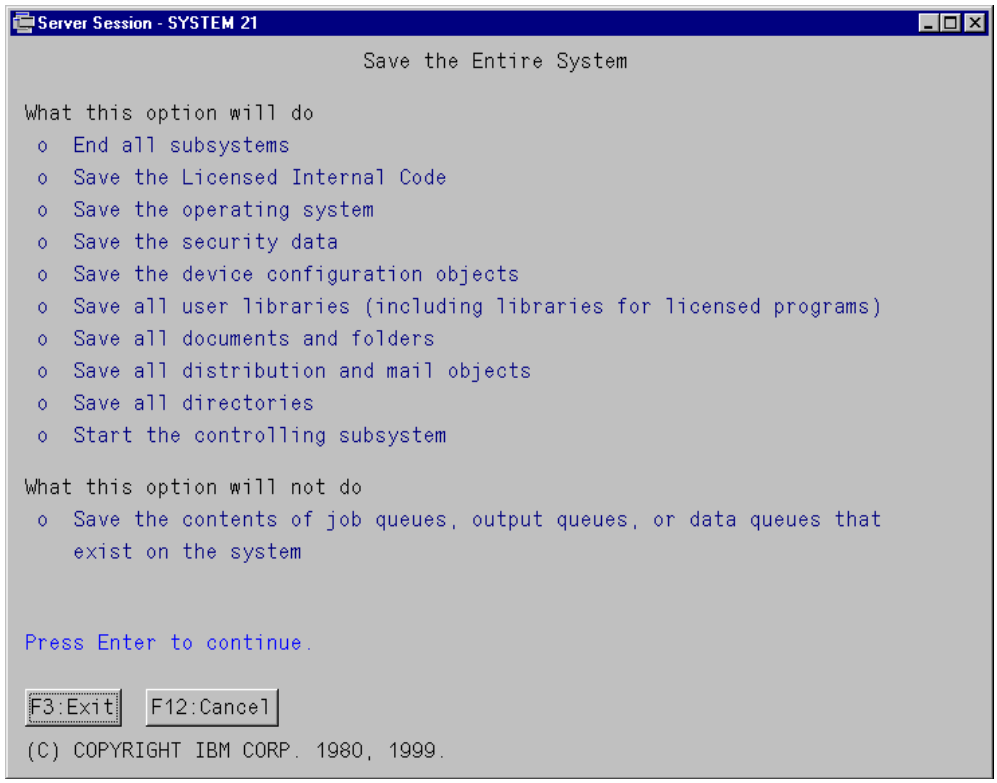

Figure 149. Selecting option 21 (Part 1 of 2)

When you press Enter to continue, the display shown in Figure 150 on page 262 appears.

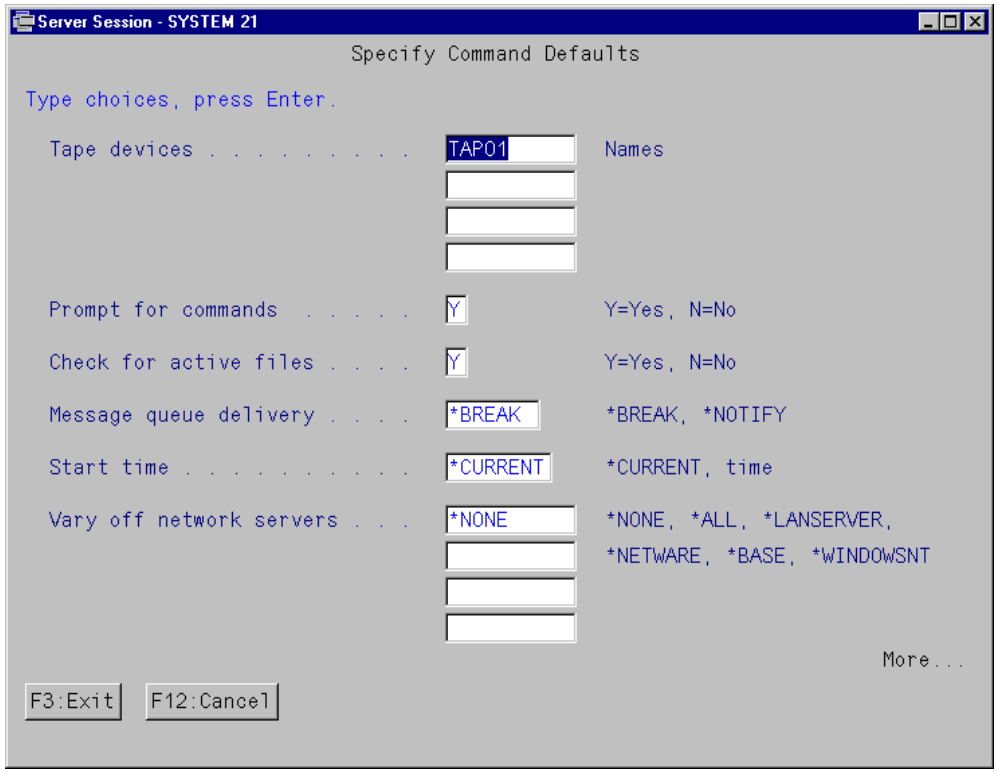

Figure 150. Selecting option 21 (Part 2 of 2)

Fill in the tape device name and decide if you want the system to prompt you for additional responses, or run without any intervention. Leaving the “Y” in the *Prompt for commands* field takes you through each command. It also allows you to specify the overrides for each save command to be executed. However, the save does not run unattended, so you must press the Enter key. When you select the default “Y” for *Check for active files*, the tape media is checked to ensure that data is expired before it is written over. If the data is not expired, a message is sent to change the tape, or to write over the existing data. Specify *NOTIFY for the *Message queue delivery* field. If left at the default, messages interrupt the job and affect the completion of the save. Leave the default of *CURRENT for the Start time field to start the immediately, unless a start time is specified. The start time must be entered in a 24-hour format.

Pay close attention to the start time parameter if the save is not going to be performed immediately. If you have an Integrated Netfinity Server, enter `*ALL` for *Vary off network servers*. When you page down, will see the rest of the options. If you are using a User Defined File System (UDFS), specify `Y` to unmount the file systems, so that the UDFS may be saved also. Specify `Y` for print system information for a report to be used in case of system recovery. Once you press the Enter key, the backup starts.

This save, when completed, produces an offline copy of the entire system to tape. These tapes can be used for recovery purposes of the entire system or individual objects.

9.1.1.7 Weekly saves

A weekly System 21 backup or save is the same as the initial save, except you do not have to save the OS/400 system library. This type of backup is referred to as a *NONSYS. This weekly save can be set up in Machine Manager for automatic execution.

Insert a blank tape into the tape drive. Use the `INZTAP` command to initialize the tape. Your display should appear as shown in Figure 151.

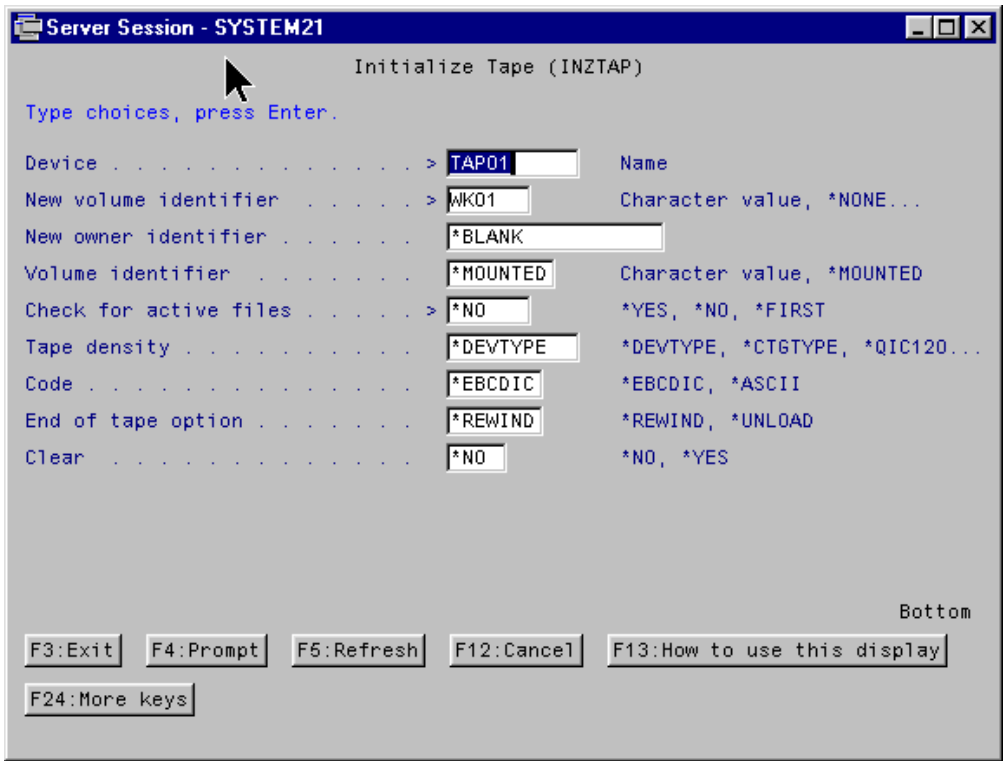

Figure 151. Initialize Tape (INZTAP) display

The *New volume identifier* parameter should be set to a value up to six characters, such as WK01. Otherwise, the INZTAP command will complete with message CPC6776:

```
Nonlabeled tape volume initalized
```

If a new volume identifier is not specified, then a subsequent SAVLIB command will fail with message CPA4058:

```
Volume *N on device device name wrong type (C INZ R).
```

Note

Depending on the device type being used, checking for active files may add a substantial amount of time to the initialization function. We recommend that you label all tapes properly with an expiration date to avoid re-using current backup tapes.

The weekly save should consist of a *NONSYS save, which includes all non-system related libraries, using the `SAVLIB LIB(*NONSYS)` command. This command must be run while the system is in a restricted state.

9.1.1.8 Daily saves

A daily backup or save can be exactly like the weekly backup. However, with most commercial installations, system availability must be kept to a maximum. There are two distinct functions that can assist. One is to use the SAVCHGOBJ command on the Geac System 21 libraries. This saves all objects that changed since the last full save (Reference Date = *SAVLIB). This can save time, since this backup does not save information that did not change since the last weekly backup. Figure 152 shows an example.

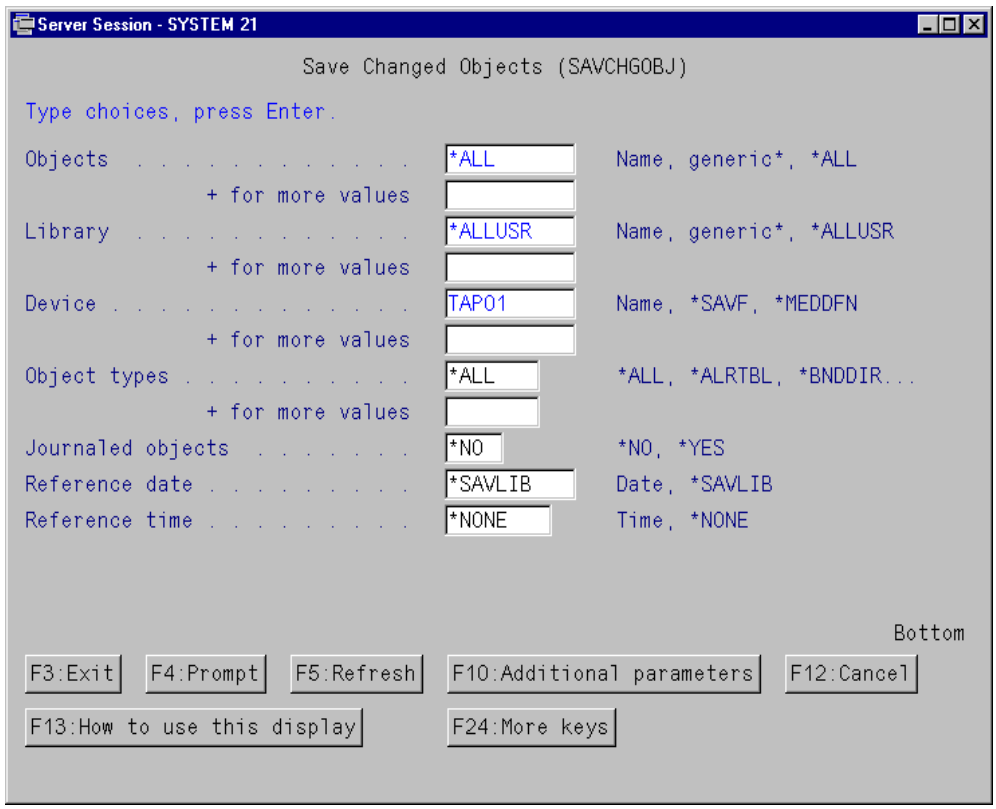

Figure 152. Save Changed Objects display

While it is possible to select individual libraries on the *Library* field to save additional time, you risk missing a library and rendering your backup useless. Another option is to specify a reference date instead of *SAVLIB. Using this strategy, you can perform incremental backups daily, instead of a cumulative backup from the last full save. However, this complicates the restore process.

The System 21 Housekeeping module can handle your backup and recovery tasks for you, reducing the chance of error and saving operator time.

Note

Some installations require extremely high availability or 24 x 7 systems and, therefore, have special backup/restore requirements. For information on handling these situations, refer to *AS/400 Backup and Recovery,* SC41-5304.

9.1.1.9 Creating your own save and restore programs

If you purchase the Application Development Toolset Licensed Program Product (LPP), you can use the AS/400 Programming Development Manager (PDM) and Source Entry Utility (SEU) to develop your own program by entering CL commands to run your save routines. You should be familiar with the SEU, CL commands, and how to create a CL program object.

9.1.2 Using OS/400 Operational Assistant

The OS/400 Operational Assistant has a very good system for basic backup scheduling and tape management. To access the Assistant, simply type the command `GO BACKUP` at the command line, and press Enter. The Backup Tasks menu shown in Figure 153 appears.

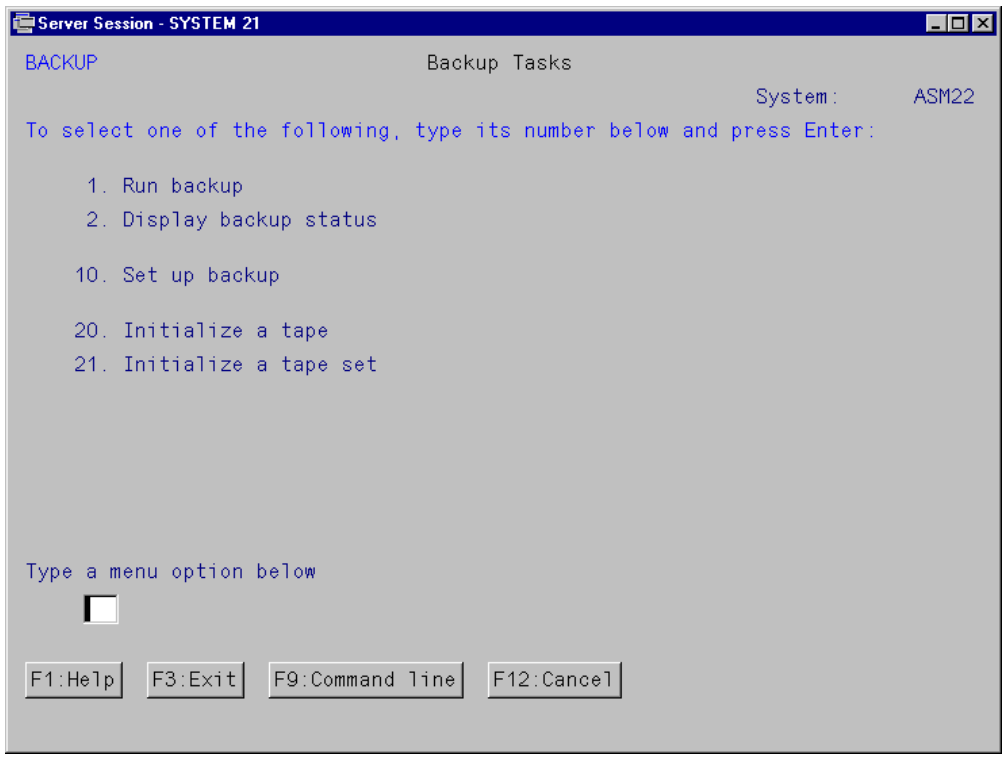

Figure 153. Backup Tasks menu

9.1.2.1 Initial and periodic entire system saves

An initial save of the System 21 environment is required after the initial installation is complete. Periodic entire system saves are recommended on a monthly basis, as well as before and after major system changes, such as:

- Hardware addition/removals
- Extensive system configuration changes
- Operating system patches (PTFs)
- Application software additions, removals, upgrades

To perform the initial save, type option `1` (Run Backup). The RUNBCKUP menu appears as shown in Figure 154.

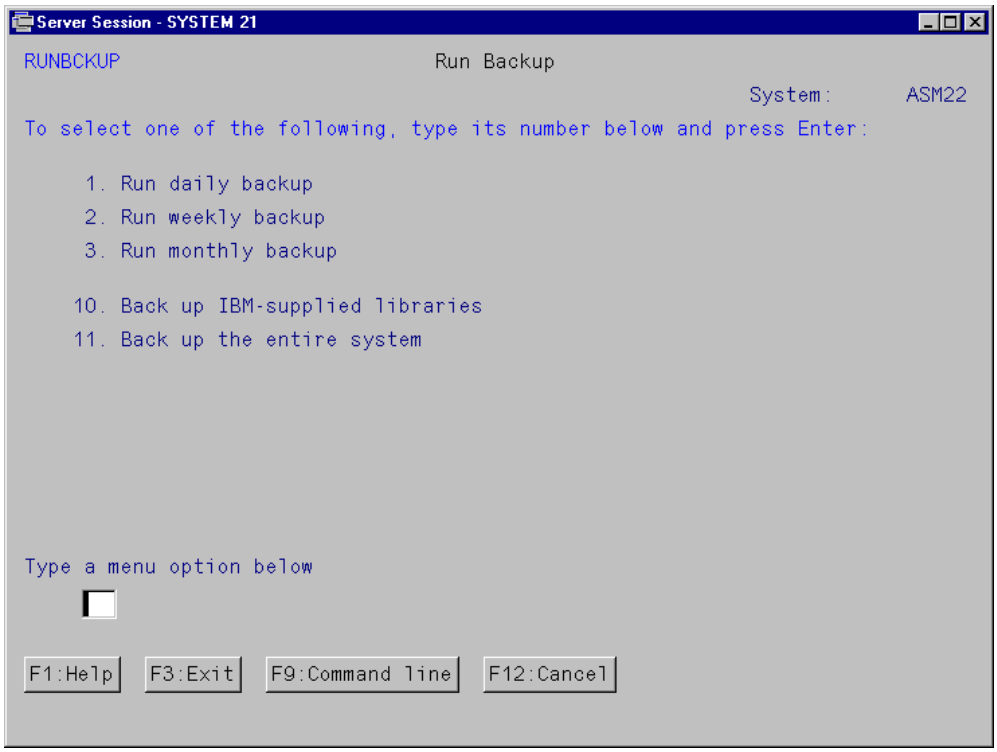

Figure 154. RUNBCKUP menu

From the RUNBCKUP menu, type option `11` (Back up the entire system). This option saves the entire system to tape, including the AS/400 system library, user profiles, system configuration, IBM licensed program product libraries, all user libraries, document libraries, and the integrated file system (IFS). It also requires a “dedicated system”, which means that no subsystems, except the controlling subsystem (QCTL), are available and only to support the console. If your display session is not running in the QCTL subsystem, a panel will be displayed that gives you instructions on transferring your job into the QCTL subsystem (see Figure 155).

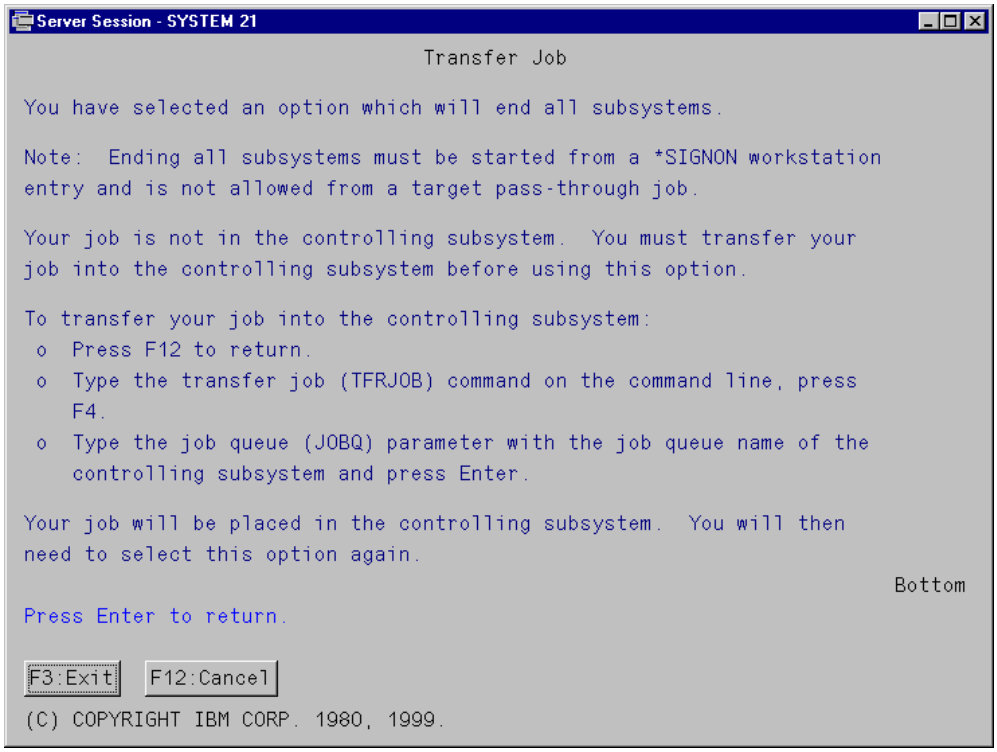

Figure 155. Transfer Job panel

After you transfer your job to QCTL (or if you are using the system console), type option `11` (Back up your entire system). Then, you see the confirmation panel as shown in Figure 156 on page 268.

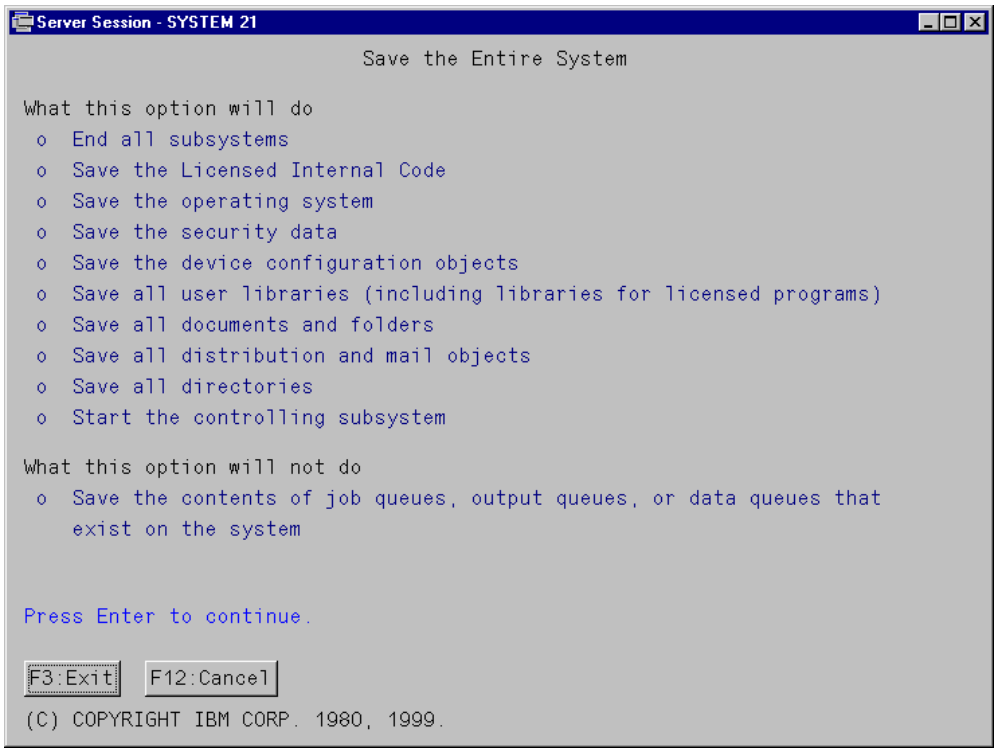

Figure 156. Save the Entire System confirmation panel

At this point, make sure that an initialized tape is in the tape drive, and press Enter to start saving the system and all data.

9.1.2.2 Setting up backup

Setting up the Operational Assistant Backup is initiated by typing option `10` (Set up backup) on the Backup Tasks panel. Figure 157 shows the SETUPBCKUP menu.

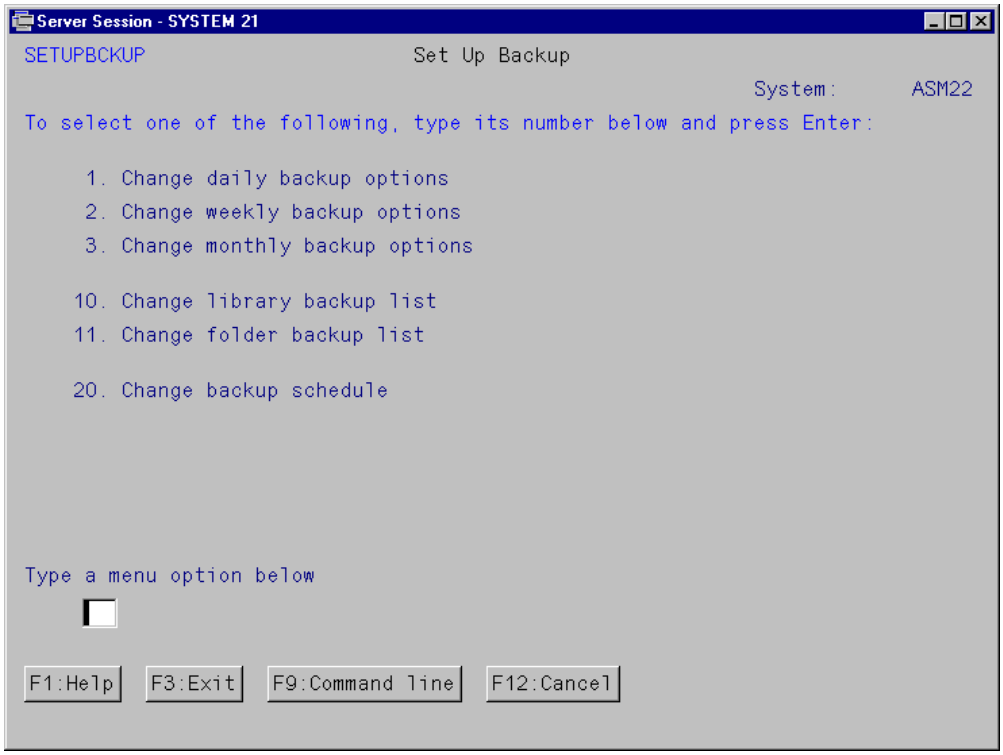

Figure 157. SETUPBCKUP menu

Setting up the backup is accomplished by working through the entries on the SETUPBCKUP menu. The following example explains how to use it.

First, type option `1` to change daily backup options. A display appears as shown in Figure 158 on page 270.

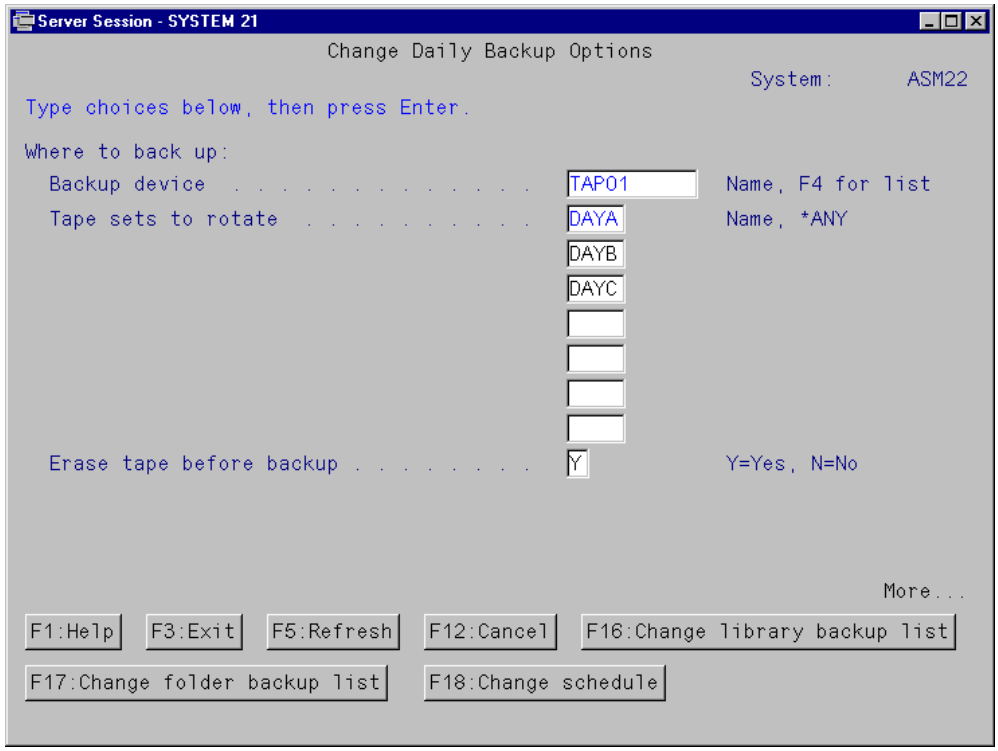

Figure 158. Change Daily Backup Options (Part 1 of 2)

This panel is where you specify the options you want for the backups. You can accept the defaults or specify the way you want your daily backups to run. The fields to specify are:

- **Backup device**: This is the name of your tape device for backups. The default is TAP01.
- **Tape sets to rotate**: This is where you specify the names and number of tape sets you want in your rotation. The default is three sets, but you may enter up to seven. The greater the number of tape sets, the less likely that a single tape failure will put your data at risk.
- **Erase tape before backup**: Specify if you want the tapes erased before writing. This will keep the tapes from filling up with old backup data.

After making your selections for these fields, press Page Down to see the rest of the fields, as shown in Figure 159.

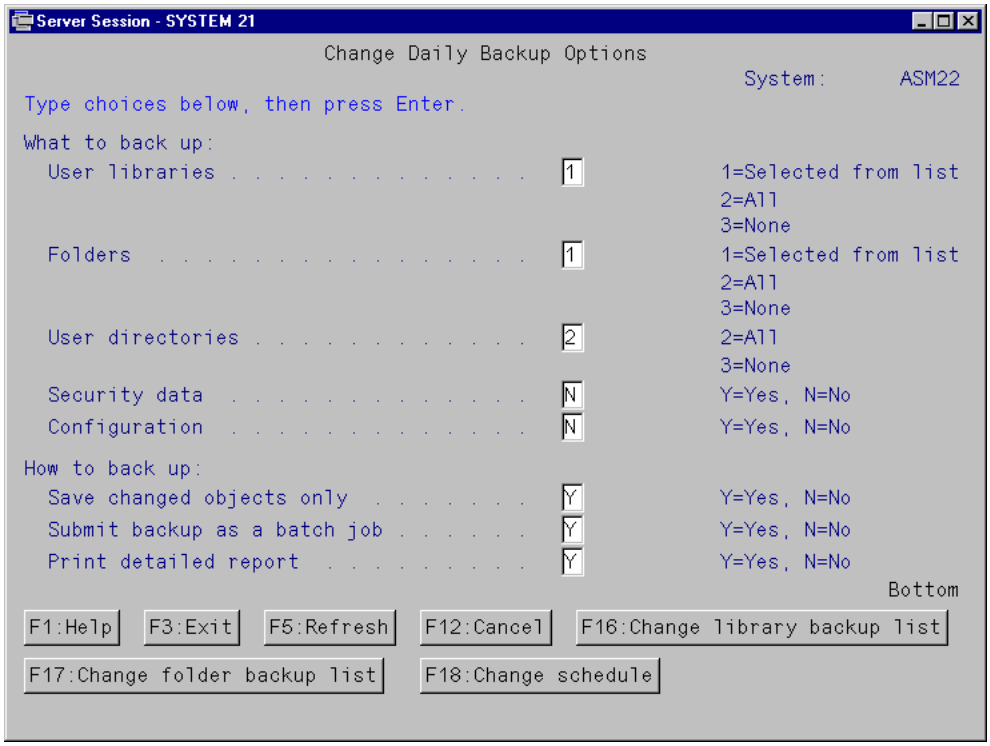

Figure 159. Change Daily Backup Options (Part 2 of 2)

The options on this panel dictate what is to be backed up and how to back it up. On this panel, you set the options to dictate:

- What to back up:
  - **User libraries**: The User libraries option can be set to save all, none, or a selected list of libraries daily.
  - **Folders**: The Folders option can be set to save all, none, or a selected list of folders daily.
  - **User directories**: Specify whether you want the user directories saved daily.
  - **Security data**: You can specify whether you want the system security backed up daily.
  - **Configurations**: You can specify whether you want the system configuration information backed up daily.
- How to back up:
  - **Save changed objects only**: Specify whether you want to save only the changed objects or all the objects.
  - **Submit backup as a batch job**: Specify whether you want the backup to run as an interactive or batch job.
  - **Print detailed reports**: Specify whether you want a report generated that lists the objects that were saved.

In the example shown in Figure 158 and Figure 159, we selected the default values.

When you press Enter, your changes are saved, and the SETUPBCKUP menu is displayed again.

Now, we repeat the process by typing option `2` (Change weekly backup options) and option `3` (Change monthly backup options), which have the same parameters as option 1.

After this is complete, we work on the library backup lists by typing option `10` (Change library backup list), which produces the screen shown in Figure 160.

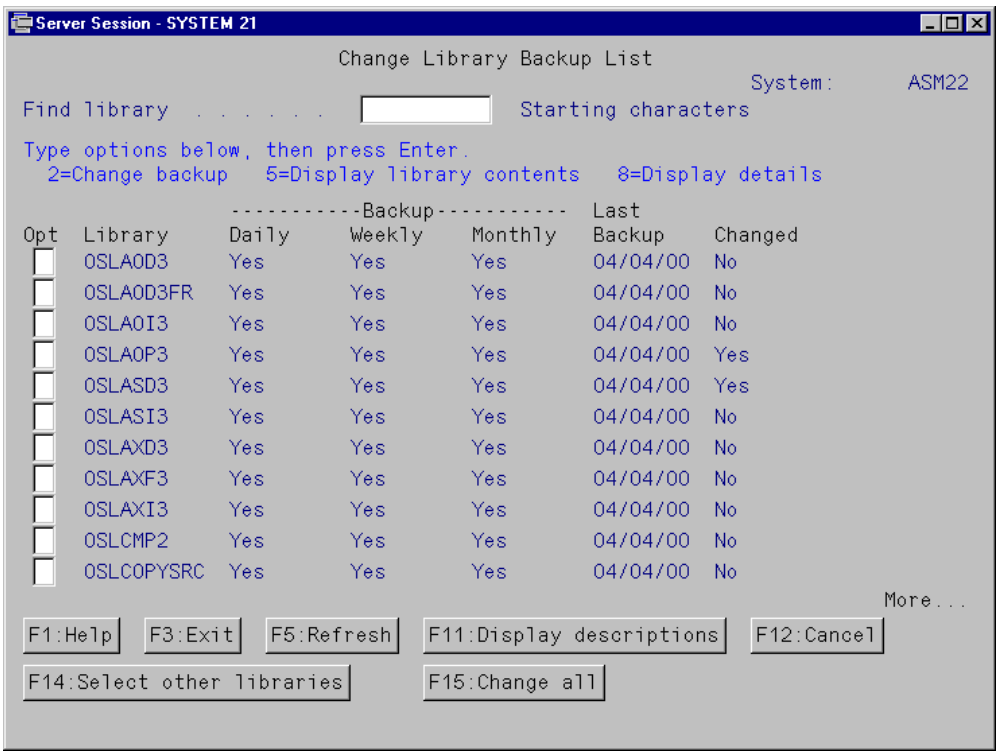

Figure 160. Change Library Backup List

This panel shows a listing of all libraries on the system and important details about each one. The panel shows what backup lists (daily, weekly, or monthly) the library is included in, the date last backed up, and if the library has changed since the last backup. You can select from the following options:

- **Change backup**: Allows you to specify when to back up this library when using the select list for backups (shown in Figure 161).
- **Display library contents**: Displays a list of the objects in the library and allows you to display various details on each object (shown in Figure 162 on page 274).
- **Display details**: Displays the description details of the library.

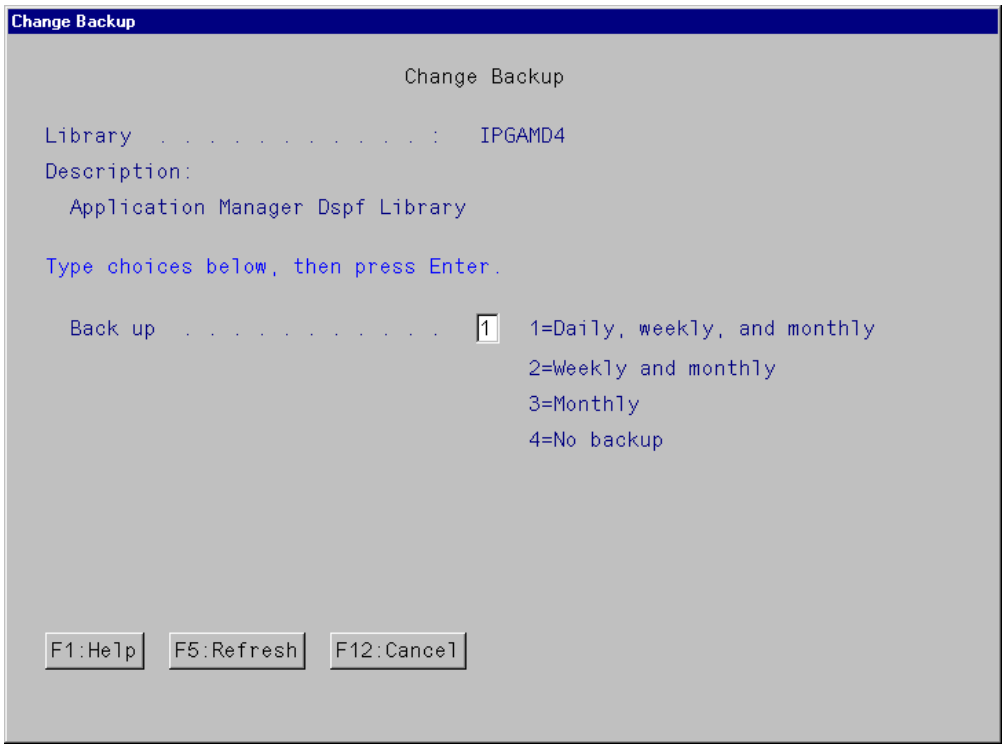

Figure 161. Change Backup panel

This panel is where you specify which lists you want this library to join:

- The daily, weekly, and monthly lists
- The weekly and monthly lists
- The monthly list
- No backup lists

You may also use option 5 (Display Library) to examine the information about the libraries in greater detail as shown in Figure 162 on page 274.

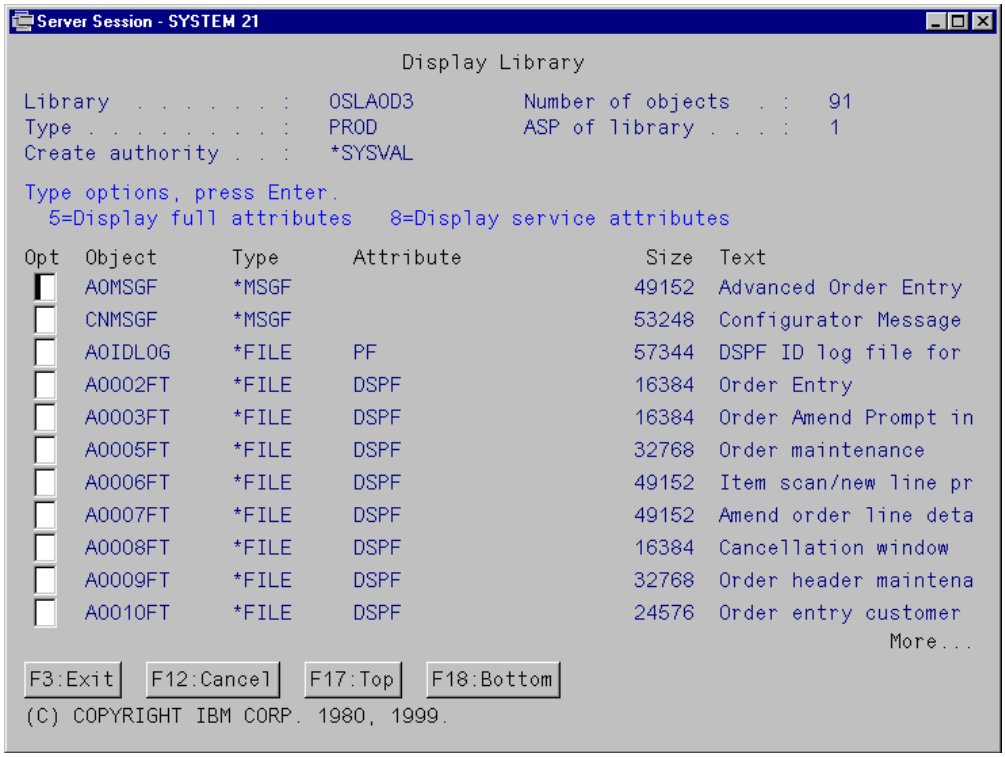

Figure 162. Display Library panel

On the Display Library panel, you can view either the full attributes or the service attributes for each of the objects held within the library.

When you press Enter, your changes are saved and the SETUPBCKUP menu is displayed again. Now, we repeat the process by selecting option 11 (Change folder backup list) as shown in Figure 163.

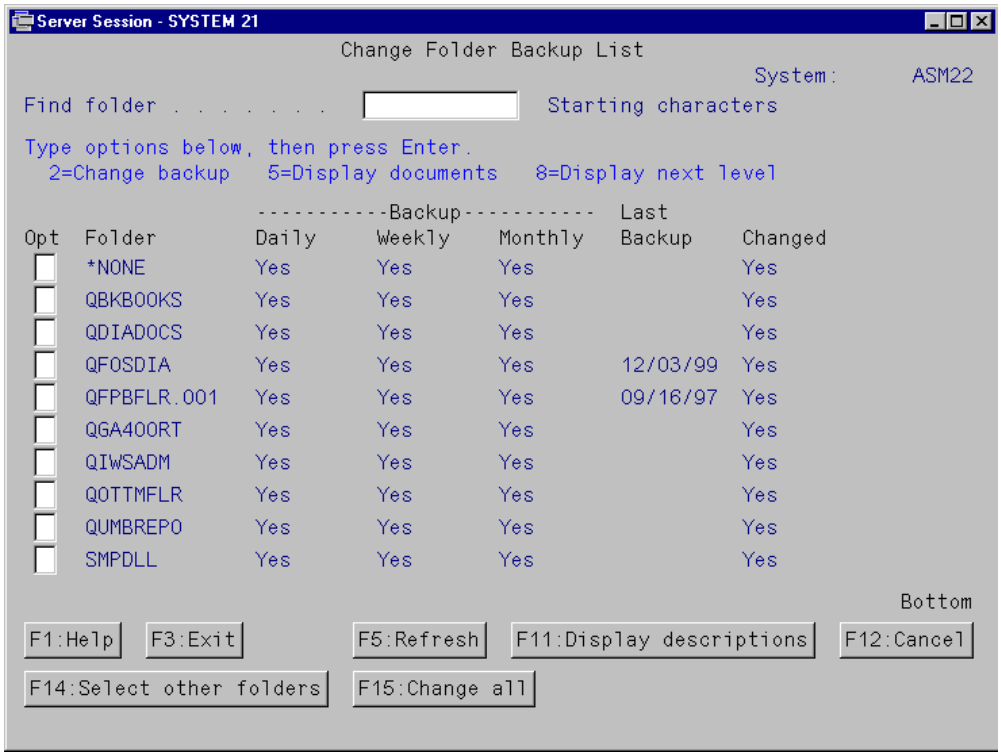

Figure 163. Change Backup - Folders

This panel is where you specify which lists you want this folder to join. You may also use option 5 (Display Documents) to examine the documents within the folders, as shown in Figure 164 on page 276.

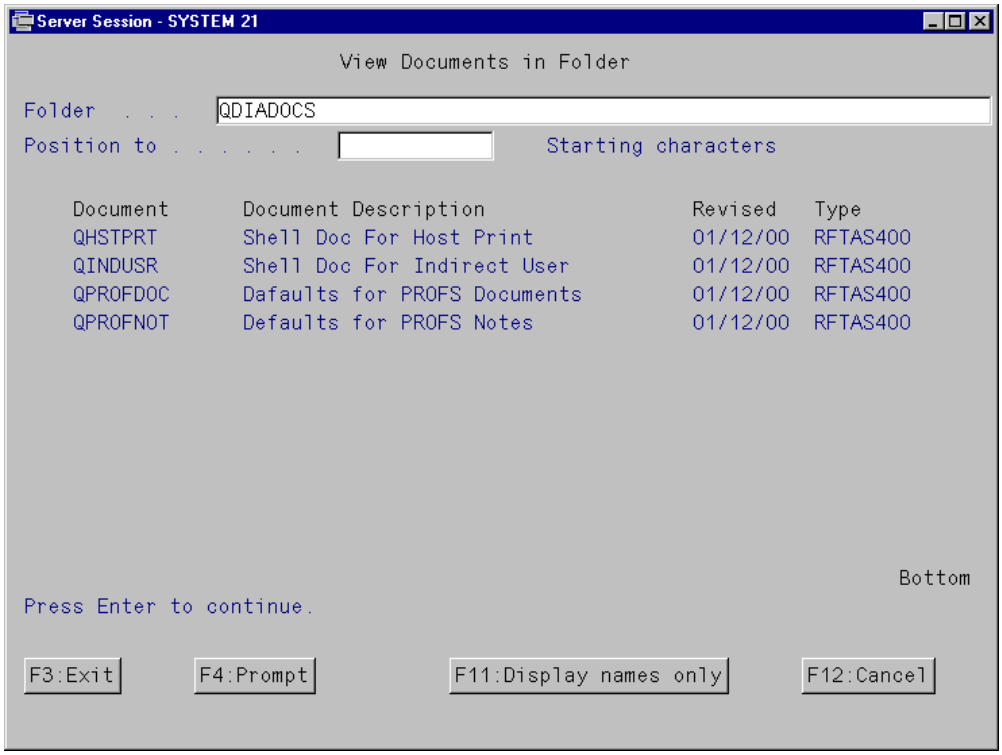

Figure 164. View Documents in Folder panel

Option 8 (Display next level) shows the next level within the folder, as shown in Figure 165.

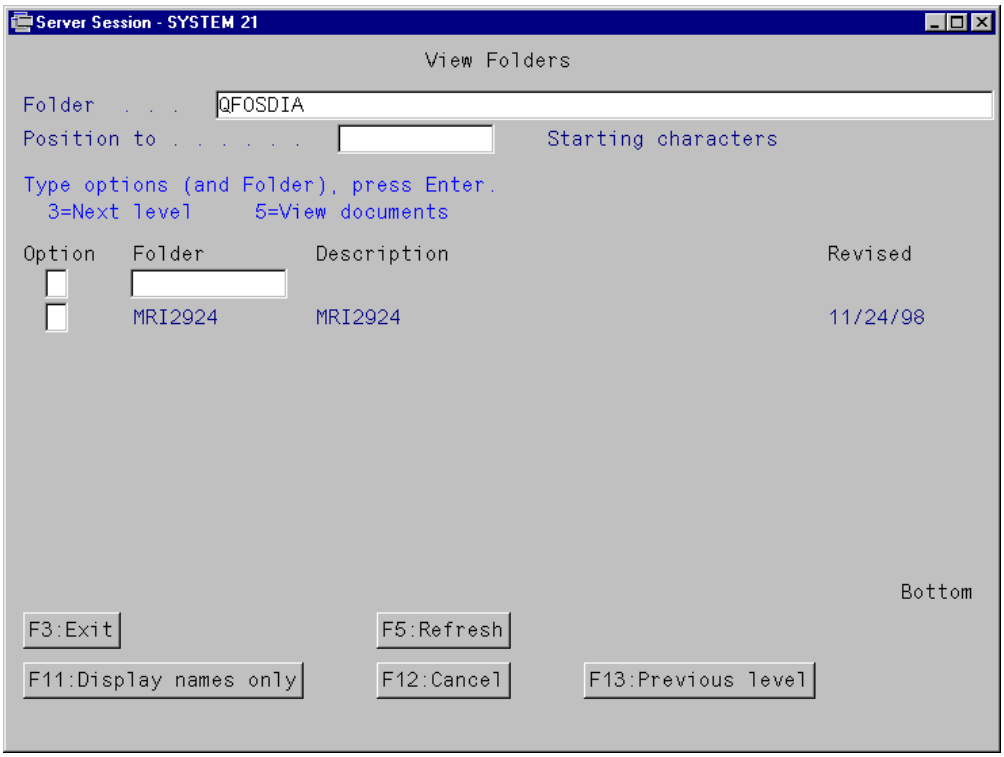

Figure 165. View Folders panel

When you press Enter, your changes are saved, and the SETUPBCKUP menu is displayed again. Now, we finish the process by selecting option 20 (Change backup schedule), as shown in Figure 166.

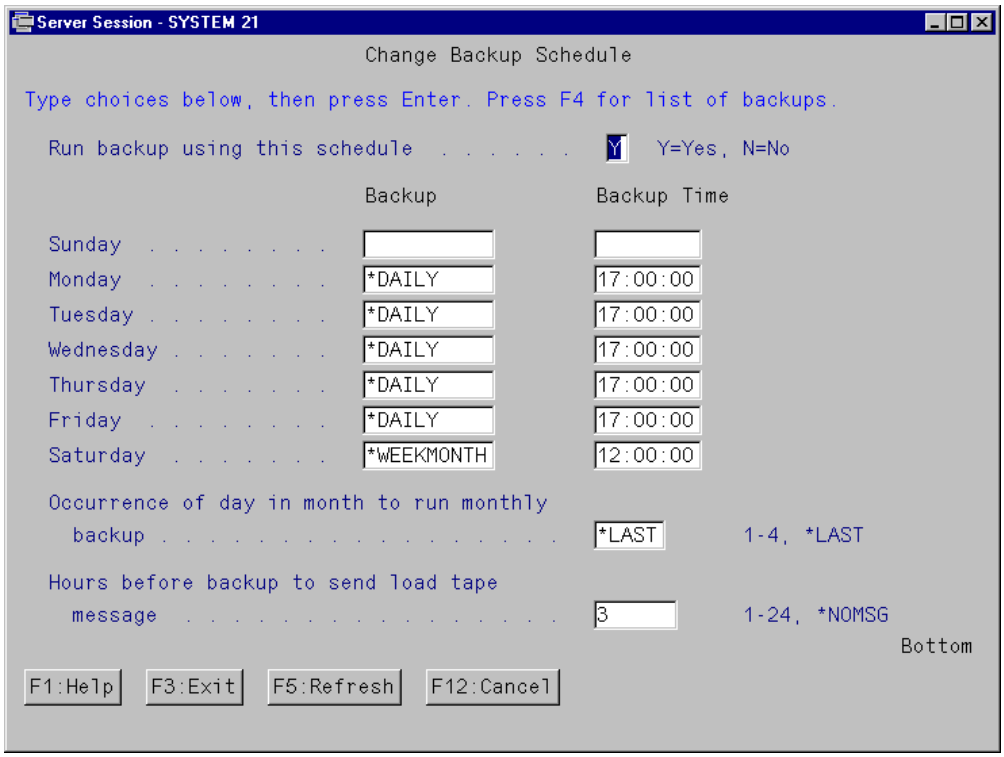

Figure 166. Change Backup Schedule panel

On this panel, you can specify the days and times at which to run the backups, if at all, as well as the day of the month to run the monthly backups, and when to send a message to the operator to load the tape for the backup.

After this panel is complete and you press Enter, your changes are saved, and the SETUPBCKUP menu is displayed. You now have a basic, functional backup routine set up.

Now, use option 21 (Initialize a tape set) to prepare your backup tapes for use with the backup schedule you created, as shown in Figure 167 on page 278.

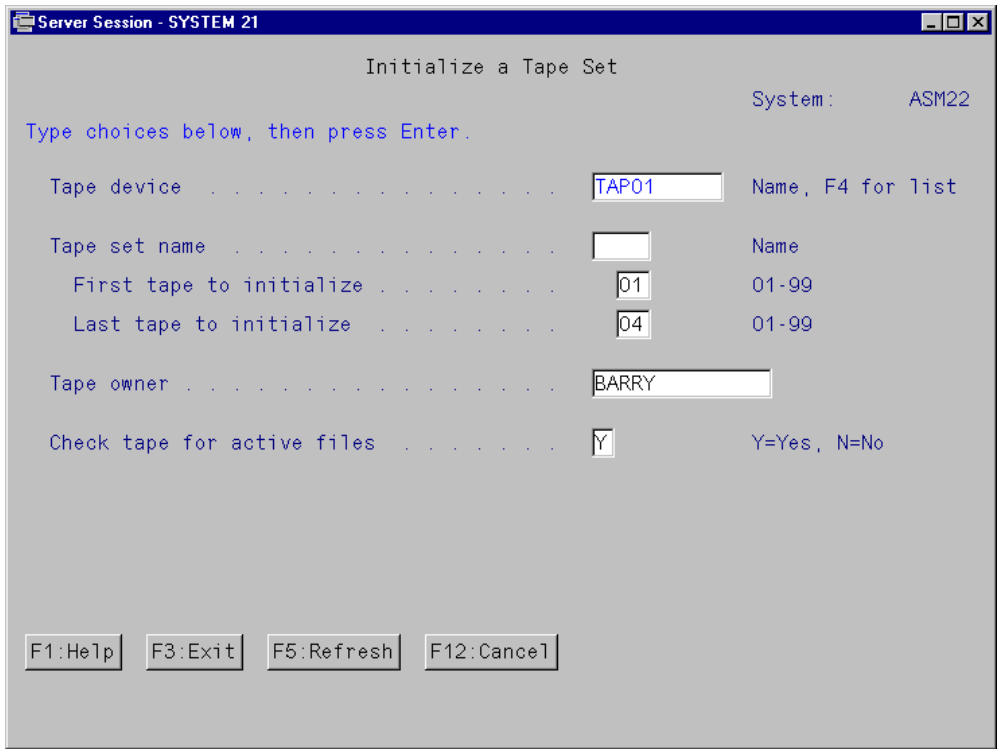

Figure 167. Initialize a Tape Set panel

On this panel, you enter the name of the tape set, the number of tapes in the set, the owner of the tapes, and that you want the tapes checked for active files. When you press Enter, the initialization begins, and the tapes will be named xx01, xx, and so on, where *xx* represents your name of the tape set. After each tape is initialized, be sure to label it with its name. When the process is complete for this daily set, you need to repeat it for each daily, weekly, and monthly set. After all tape sets are complete, the process is finished, and normal backup operations will begin.

9.2 Backup Recovery and Media Services (BRMS)

The IBM Backup Recovery and Media Services (BRMS) Licensed Program Product (5769-BR1) provides an AS/400 solution for policy-driven backup, recovery, hierarchical storage, and media management. BRMS can be used for running and tracking routine operations involving tape media, ADSM Server storage, and related devices. It can run on a single AS/400 system or within a network of AS/400 systems supporting a shared media inventory. Media content information can be replicated on one or more systems in a network, enabling them to serve as data recovery centers. BRMS can be used in conjunction with the IBM AS/400 Job Scheduler (5769-JS1) to provide a very robust and flexible unattended automated backup strategy. A save strategy using multiple tape drives operating concurrently is recommended when performing unattended backups on systems with large amounts of disk. A 3494 Tape Library can further automate this approach if 3590 or 3490 tape drives are used.

For more information, refer to *Backup Recovery and Media Services for AS/400*, SC41-5345.

Tape media is not always reliable. Therefore, you may want to rotate your tape media and make additional copies of valuable data and keep those tapes off site. You may want to create multiple tape sets to protect your operation and create a unique and meaningful naming scheme for them. BRMS/400 can handle this job automatically for you.

9.3 System 21 Housekeeping module

The System 21 Housekeeping module is used to specify, maintain, and perform backup and recovery services for your libraries. The Housekeeping tools and utilities can be used to perform and manage the following activities:

- Create, maintain, and archive libraries.
- Specify where to save library files. You can then backup the files created, to external media, disk, or tape.
- Protect library files from deletion.
- Restore library and housekeeping files from the backup.
- Specify default print queue settings.

Housekeeping also provides bar charts of library size information. These bar charts display how the size of a library has changed over a period of six months. You can use this information to plan future disk requirements.

You can use Housekeeping to keep a record of:

- How often a library is used
- The size of a library
- Who owns the library
- The date of the last change and save

Housekeeping keeps a register of libraries, which is maintained by the user. Housekeeping functions include carrying out cyclic saves, monitoring library sizes, deleting libraries that are not registered, and reorganizing data files within libraries.

9.3.1 Housekeeping setup overview

For Housekeeping to be fully functional, the following areas need to be set up:

- **The default print queue and save details**: You must specify the libraries to hold the save files. The backup method and devices used must also be specified to save to offline storage. This information is covered in 9.3.4, “Control Details menu” on page 282.
- **Library usage codes**: Each library can be given a code to describe its usage. For example, a library can be part of a standard application, a programmers development library, or a test library. This is covered in 9.3.4.2, “Library types” on page 285.
- **Library object codes**: Each library can be given a code to describe the objects that it contains. For example, a library can contain source or program objects or data files. This is covered in 9.3.4.2, “Library types” on page 285.
- **Save groups**: Each library can belong to a pre-defined group to save as a set so you can store it at an off-site location for system security. This information is covered in 9.3.4.4, “Offsite Save Groups” on page 285.

- **Unknown libraries**: Protect libraries not defined to Housekeeping from the Delete Unknown Libraries command. This information is covered in 9.3.4.5, “Protected libraries” on page 285.

9.3.2 Housekeeping data areas

Housekeeping has several data areas that are used with specific tasks. These data areas are:

- **HKDISKLMT** (System Auxiliary Storage Usage Limit For Backups): This holds the auxiliary storage usage level, as a limit for auto-backup saves to save files. HKDISKLMT is a two-character data area in library IPGHKP4 that holds the disk utilization threshold at which saves to save files are to be terminated. This is initially set at 97%. This limit may be changed by using the CHGDTAARA command. We recommend that you lower the level to a point below 90%. For example, if you set the value to 85% and the save to a save file of a library takes the system auxiliary storage usage beyond this level, then the save will not take place and an appropriate message will be sent to the message queue HKSAVERR. The following command is used to change the limit to the desired level (in this example, it is being changed to 85%):

  ```
  CHGDTAARA DTAARA(IPGHKP4/HKDISKLMT (1 2)) VALUE(85)
  ```

- **HKFSAVDTA** (Last Run Details): This data area holds details about the last execution of the Save Housekeeping Files function, that is, of the offline storage media volume used.
- **HKINTFLR** (Last Used Internal Folder Name): This data area holds the latest internal folder name generated by Housekeeping. It is incremented each time there is a new folder registration.
- **HKOFFGRP** (Library Save Group Designated To Be Saved): This data area holds the code of the library save group to be saved by the Library Save Groups Auto-backups Routine as selected via the select Library Save Group To Be Saved function.
- **HKSIZDATIM** (Size All Libraries Last Run Datetime (Cyymmddhhmmss)): This data area holds the date and time that the last run of the Re-size All Libraries routine was completed.

9.3.3 Housekeeping data files

One of the principal functions of Housekeeping is to produce an accurate history of library saves. This log is important if you need to restore a library. It is of even greater importance if you need to restore a system. In this case, the Housekeeping files need to be restored initially to tell the Installation Manager where to find the latest save of each library for restoring. The most accurate picture of the saves performed is immediately after all the backups have been completed. If you rely on the save of the Housekeeping files library by the Housekeeping overnight routine, details of the day’s backups are not reflected in the current save of the Housekeeping files. We recommend, therefore, that you perform the Housekeeping file save routine as a separate activity, after the backups have been completed. The option to restore Housekeeping files, as one of the first steps in the recovery process, is also available.

The failure of the Libraries Auto-backups routine to save a library to a save file may occur for any of the reasons that may cause the SAVLIB command to fail. Most commonly, this is due to the user of the routine not having sufficient

authority to the library or due to locks held on the library. When saves are not made because the given system auxiliary storage usage limit would be exceeded, a message is sent to the message queue HKSAVERR.

The following section discusses how to save and restore the Housekeeping data files.

9.3.3.1 Save Housekeeping Files

The Save Housekeeping Files operation should be routinely carried out after all of the other save operations have been completed, so that the data saved fully records the current state of all of the saves known to Housekeeping.

When Housekeeping runs, it makes copies of the the key files that are stored in IPGHKF4, and stores the copies in QTEMP. If the execution of a Save Housekeeping Files operation is interrupted before it completes, these copies of the Housekeeping files may still be left in the library QTEMP. You should delete these files before you carry out any further Housekeeping operations to prevent updating the bad copies. When the execution of a Save Housekeeping Files operation completes normally, these files are deleted.

The key files within Housekeeping are defined in Table 53.

Table 53. Housekeeping key files

File Name	Library	Description
AHK01PHY	IPGHKF4	Library Definition file (MNGLIB)
AHK03PHY	IPGHKF4	Library Media file (which tape(s) a library is loaded on.)
AHK15PHY	IPGHKF4	Last Library Size Data file
AHK40PHY	IPGHKF4	Library Size History file

The key commands for Housekeeping are listed in Table 54.

Table 54. Housekeeping commands

Command	Description
COMPALLPGM	Compress all programs
DLTUNKLIBS	Delete unknown libraries
DSPDLTAUD	Display Library Deletion Audit
DSPDLTRQS	Display Library Delete Request
DSPMED	Display Media
DSPMYFLR USER(*USER, User ID)	Display User Folders
DSPMYLIBS USER(*USER, *SELECT, User ID) CURLIB(0, 1) SLTUSR(0, 1)	Display User Libraries
FREFLRMED	Free Folder Save Media
FREMED	Free Library Save Media
MNGARC	Manage Library Archiving Saves
MNGCON	Manage Control Information
MNGDET TYPE(T, C)	Manage Housekeeping Details

Command	Description
MNGFLR FLR(*SELECT, Folder Path/Name)	Manage Folders
MNGLIB LIB(*SELECT, Library Name)	Manage Libraries
MNGMED	Manage Library Save Media
MNGOFF	Manage Library Save Groups
MNGOFFGRP	Manage Save Group To Save
MNGPROLIBS	Manage Protected Libraries
MNGRST	Manage Library Restores
MNGSAV	Manage Library Saves
MNGSAVFLR	Manage Folder Saves
MNGSAVOFF	Manage Library Group Saves
RGZALLPFMS	Reorganize All Physical Files
RGZLIBPFM LIB(Library Name)	Reorganize Library Files
RSTHKF	Restore Housekeeping Files
SAVHKF	Save Housekeeping Files

These commands are found in the library IPGHKP4. But, when Housekeeping is installed, they are copied to the library OSLSYS.

9.3.4 Control Details menu

From the Control Details menu, you can set up or maintain your Housekeeping files. The selections you make here will affect how Housekeeping saves your data.

9.3.4.1 Control Information option

The Control Information area is where you define how you want Housekeeping to handle your backups. It allows you to define:

- Default print queue
- Save details
- Libraries to hold the save files
- Backup method
- Devices to save to offline storage

To set up the control information, type option `1` (Maintain Control Information) on the Manage Control Information panel shown in Figure 168.

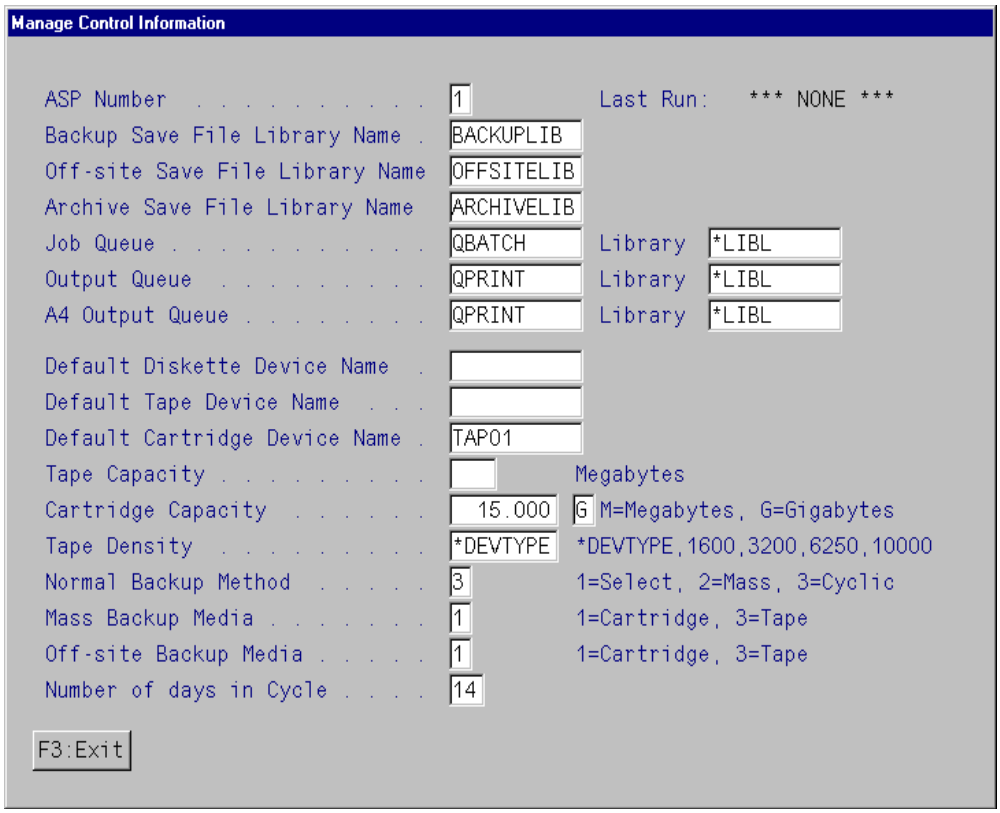

Figure 168. Manage Control Information

On the Manage Control Information panel, you see the following fields:

- **ASP Number**: Enter the auxiliary storage pool (ASP) from which the system allocates storage for the save files created. The default is to ASP(1), the system auxiliary storage pool. If you choose ASP(1), you can leave the field blank, or type `1` as shown in Figure 168.
- **Backup Save File Library Name**: Enter the name of the library that has been specifically created as the location for save files of libraries and folders. In the example shown in Figure 168, we entered the name “BACKUPLIB” as the library name.
- **Off-Site Save File Library Name**: Enter the name of the library that was specifically created as the location for save files of libraries requested for off-site saving. In the example shown in Figure 168, we entered the name “OFFSITELIB” as the library name.
- **Archive Save File Library Name**: Enter the name of the library that has been specifically created as the location for save files of libraries to be archived. In the example shown in Figure 168, we entered the name “ARCHIVELIB” as the library name.

Note

You must create the libraries used for Backup, Off-Site, and Archive save files before entering the names in the fields shown in Figure 168.

- **Job Queue/Library**: Enter the job queue and library name of the library to which this job queue belongs to which all batch jobs will be submitted. In the example shown in Figure 168 on page 283, we kept the default entry.
- **Output Queue/Library**: Enter the print queue and library name of the library to which this print queue belongs to be used for standard reports. In the example shown in Figure 168 on page 283, we kept the default entry.
- **A4 Output Queue/Library**: Enter the print queue and library name of the library to which this print queue belongs to be used for A4 type reports. In the example shown in Figure 168 on page 283, we kept the default entry.
- **Default Diskette Device Name**: If media saves are to be to diskette, enter the diskette device description. The diskette option is rarely, if ever, used anymore, due to advances in storage technology. Our example uses a 3570 Magstar tape drive, so we leave the field blank.
- **Default Tape Device Name**: If media saves are to be to tape, enter the tape device description. The tape option was originally developed for the 9-track tape, and is rarely, if ever, used anymore, due to advances in storage technology. Our example uses a 3570 Magstar tape drive, so we leave the field blank.
- **Default Cartridge Device Name**: If media saves are to be to a cartridge tape, enter the device name here. Our example uses a 3570 Magstar tape drive, so we enter the value “TAP01” in the field.

Note

Even though Housekeeping supports the use of high capacity cartridge tapes, it cannot control volumes spanning multiple tapes. Housekeeping will save libraries to the capacity of the tape and ask for another volume.

- **Tape Capacity**: If tapes are to be used in the saves to media, enter the storage capacity of a tape in megabytes. If you are using tapes with different capacities, then enter the capacity of the smallest tape.
- **Cartridge Capacity**: If cartridges are to be used in the saves to media, enter the storage capacity of a cartridge. You can express the capacity in either (M) megabytes or (G) gigabytes. We recommend that you use the compressed capacity of your tape for greater efficiency in using tapes.
- **Tape Density**: If tapes or cartridges are to be used for the saves to media, enter the tape density to be used.
- **Normal Backup Method**: Enter one of the following options as your default backup method:
  - **Select**: To backup a single library per volume. The user selects the library to be saved and prompted to load the media volume for that library, once it is specified.
  - **Mass**: To backup multiple libraries per volume. Libraries are divided into groups that will save to a single volume. The user then selects a group and nominates the volume ID to be used. This option cannot be used if you are choosing to backup to diskettes. This option is always used for saving folders and off-site libraries.

– **Cycle**: To backup multiple libraries per volume, with storage media used on a day-cycle basis. See 9.3.6, “The Save to Media menu” on page 293, for full details about saving to media.

Attention

The save medium is freed automatically when cyclic saves are made. Therefore, Housekeeping does not check if the medium contains the latest saves of any libraries. We recommend that you set the libraries to Force Save=1 and Save frequency less than or equal to the number of days in the cycle, or on a daily basis. Otherwise, you could lose your last save of a library.

After selecting your options, press Enter to save your changes.

9.3.4.2 Library types

This option is used to set up type codes to describe library usage. You can set up library types to classify the different types of library used. For example, you could use type A for applications, S for source libraries, and so on. Library types and codes are applied to libraries in the Manage Libraries option.

Note

Library type W (work) has a specific use within Housekeeping. Use this code for temporary or work libraries, which are cleared out by the next overnight routine. Once the overnight routine has cleared the library, it creates the following source files within the work library: QDDSSRC, QRPGSRC, QCLSRC, and QCMDSRC.

9.3.4.3 Library contents

You can set up library content codes to classify the different contents of your libraries. For example, you could use type D for data, or P for programs.

Note: You can further categorize libraries by Library Type. Library content codes and types are applied to libraries in the Manage Libraries option.

9.3.4.4 Offsite Save Groups

Use this panel to set up the codes for Library Save Groups. Refer to 9.3.9, “Execute Day-End Functions” on page 297, for further information about off-site saves.

9.3.4.5 Protected libraries

This menu option lets you define what libraries are to be protected from the Delete Unknown Libraries (DLTUNKLIBS) command. Select option 5 from the Control Details menu as shown in Figure 169 on page 286.

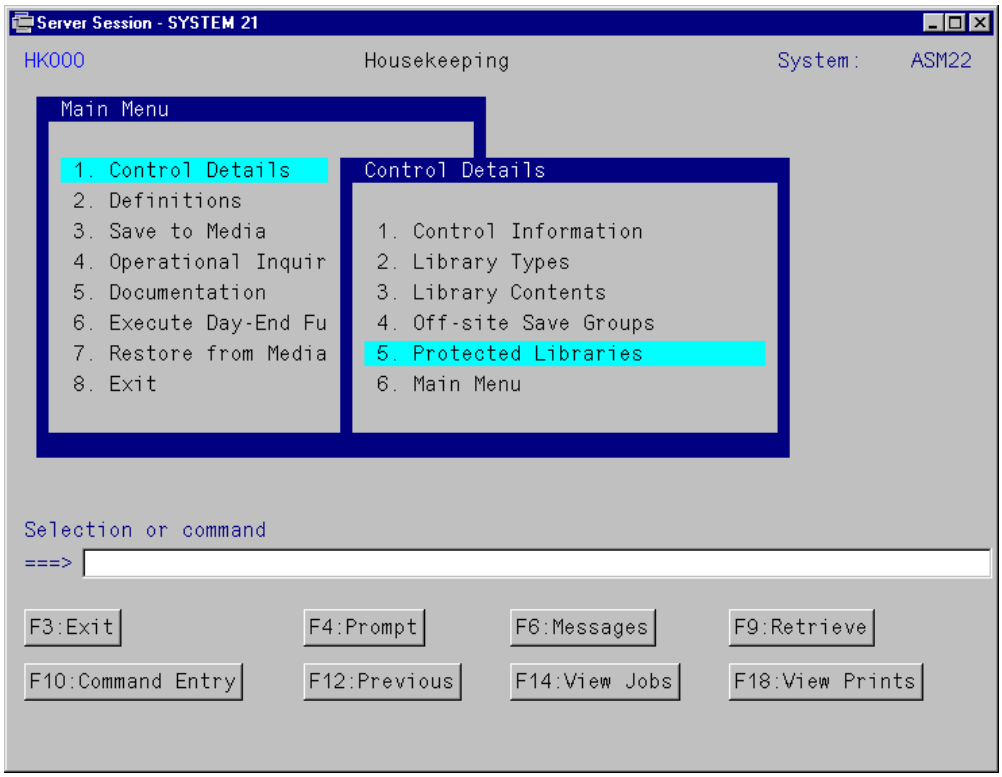

Figure 169. Selecting the Protected Libraries option

This option prevents selected libraries from being deleted by the Delete Unknown Libraries function. Enter the names of those libraries, which are not defined to Housekeeping, that you want to protect from the Delete Unknown Libraries function. Use the * (asterisk) for generic libraries. Housekeeping is pre-configured to protect the following generic library names: IPG*, OSL*, and Q*. Verify that these libraries are still defined in the protected libraries list, as shown Figure 170.

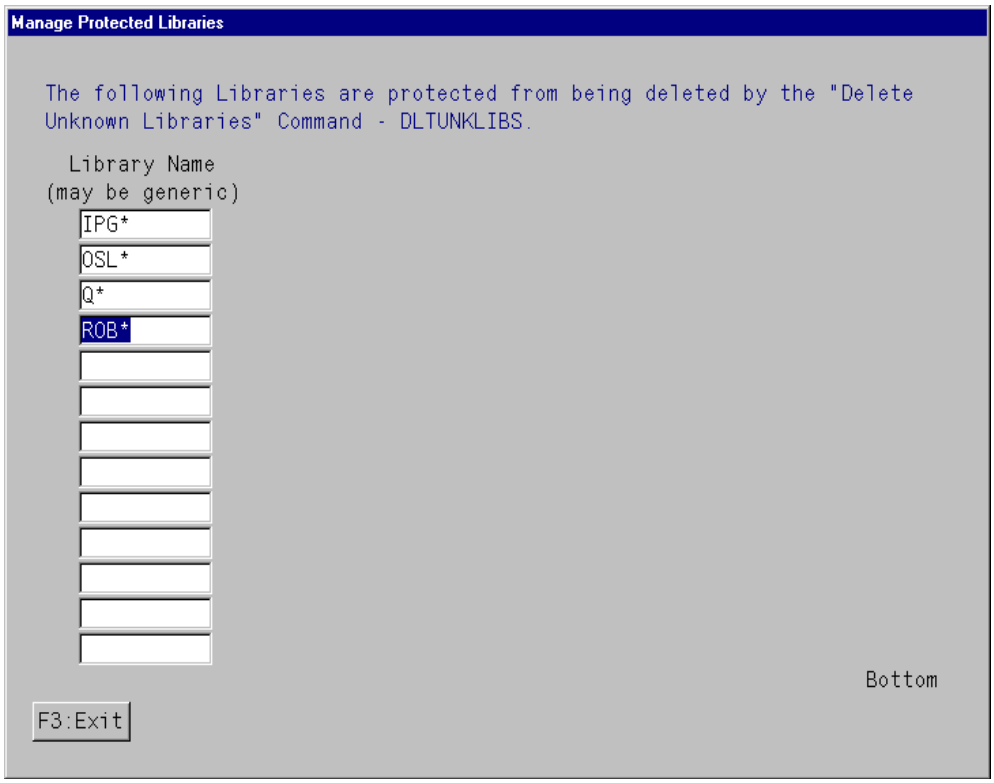

Figure 170. Protecting unknown libraries

Enter the names of the libraries to be protected from the Delete Unknown Libraries command. In the example shown Figure 170, we added the generic name of ROB*. All libraries that begin with the letters ROB will be protected.

Note

You need the codes defined in the preceding steps when you define libraries and folders to Housekeeping (see the following section).

9.3.5 The Definitions menus

The Definitions menus are for setting up the various parameters for saving libraries, folders, and media. The information within these definitions is used to control Housekeeping's backup processes. The following sections describe these parameters.

9.3.5.1 Libraries

Use the libraries facility to create and amend details of a library including its description, extended text, ownership, and security profile.

Note

Since libraries can be both created and deleted via Housekeeping functions, if you want to use Housekeeping most effectively for object and machine (storage) management, we recommend that you revoke public authority to the CRTLIB and DLTLIB commands.

To do this, sign on as QSECOFR. To remove the authority to create and delete libraries, enter the following commands:

```
GRTOBJAUT OBJ(CRTLIB) OBJTYPE(*CMD) USER(*PUBLIC) AUT(*EXCLUDE)
GRTOBJAUT OBJ(DLTLIB) OBJTYPE(*CMD) USER(*PUBLIC) AUT(*EXCLUDE)
```

We begin setting up the library information by selecting the Libraries option from the Definitions menu. See Figure 171 for an example.

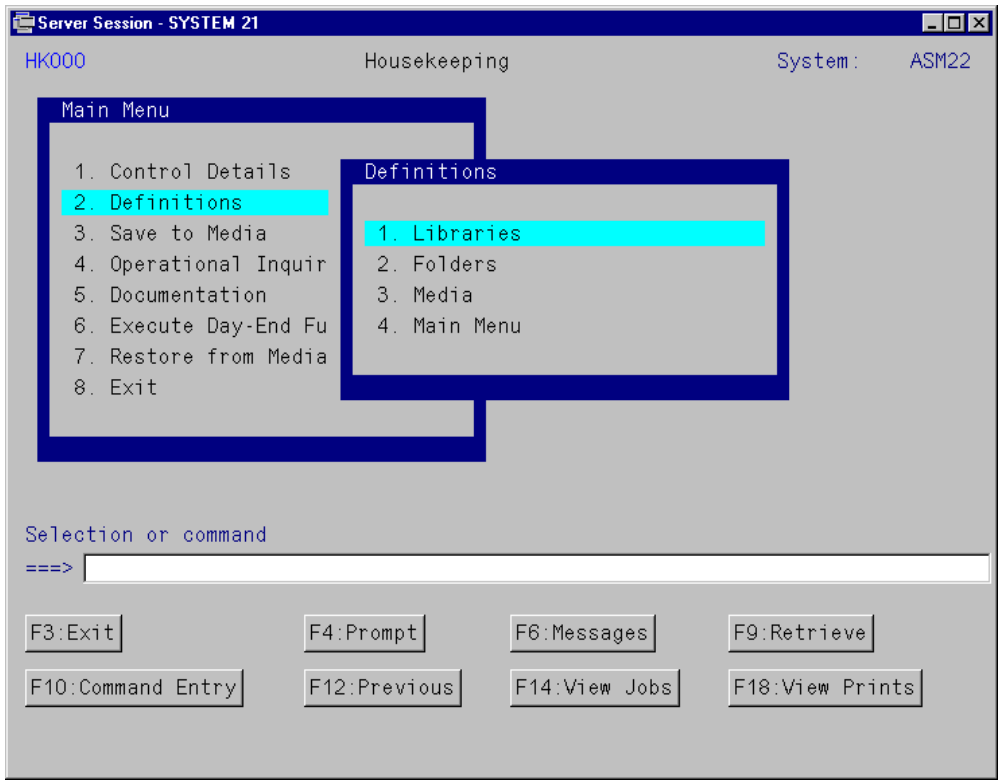

Figure 171. Selecting the Libraries option from the Definitions menu

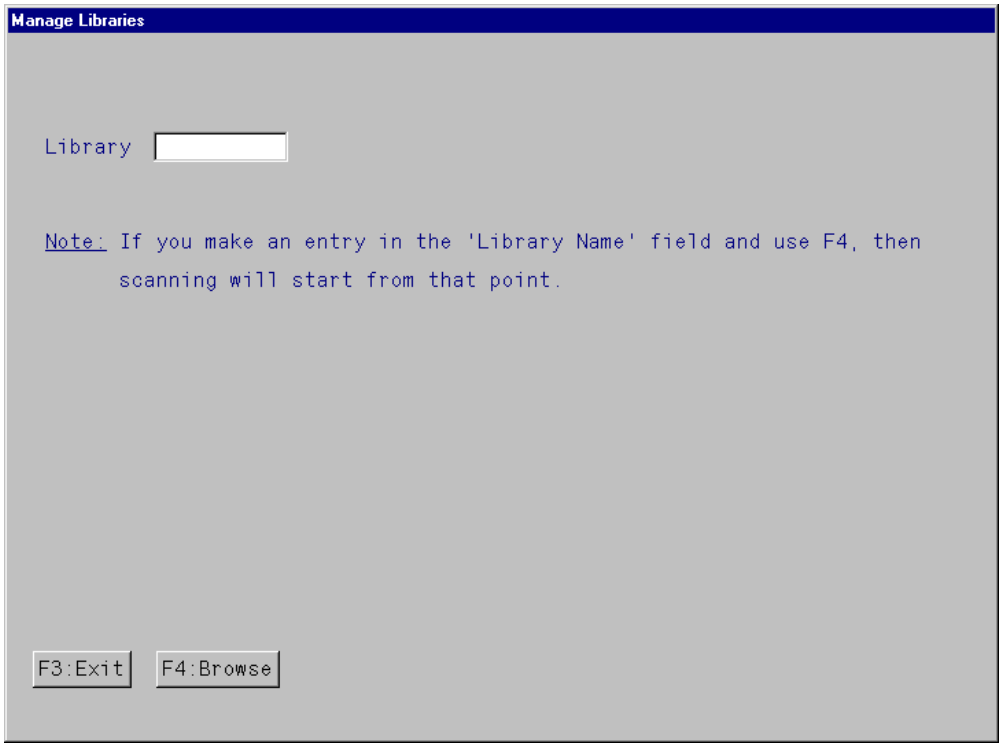

Figure 172. Manage Libraries panel

On the Manage Libraries panel, shown in Figure 172, you can enter a library name at which to start the list, or click **Browse** to see the list from the beginning. Clicking Browse displays the Select Library panel (see Figure 173).

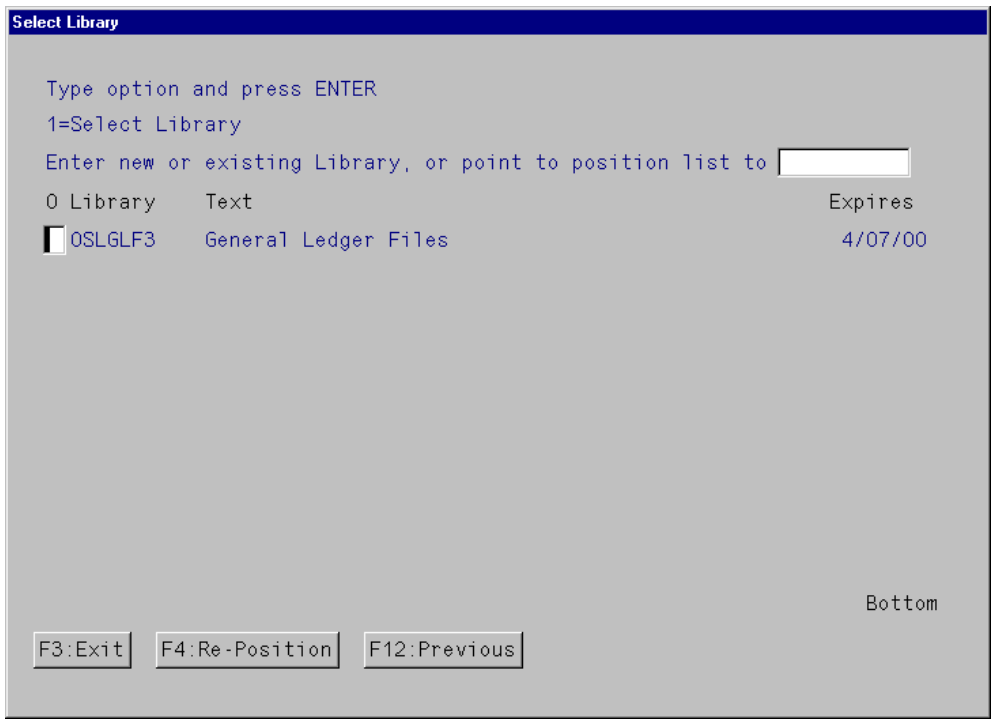

Figure 173. Select Library panel

When you first start using Housekeeping, you will not have any entries. In this example, we created a description for the library OSLGLF3. To create one of your own, simply type the name in the position to box in the upper right of the panel. Figure 174 shows the warning display that appears when you add a new library to the Manage Libraries panel.

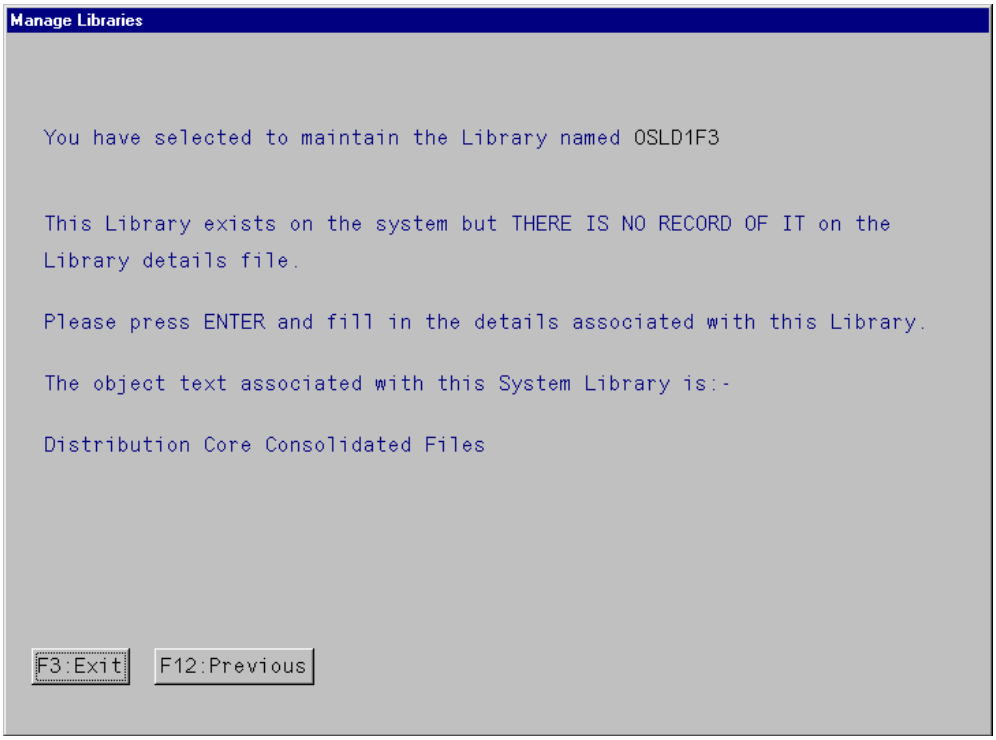

Figure 174. Manage Libraries warning display

9.3.5.2 Manage libraries

Use this window to select the library that you want to enter or of which you want to amend the details. To create a new library, simply enter a new library name. If the name of the library entered was previously deleted or archived, and the system can access the library, a warning is displayed. You will be warned that the new version of the library can overwrite the existing library, and you will be given the option to proceed if required.

Note

Machine Manager includes a standard job to reorganize files and can be included as an Auto Day-End job. This facility is also provided from Execute Day-End Functions (see 9.3.9, “Execute Day-End Functions” on page 297, for further information).

9.3.5.3 Save frequency (days)

This parameter specifies how often a library is to be saved by entering the number of days between saves. The overnight routine will calculate whether a library is due for a save, based on its last save date and this save frequency. If a library is due for a save, the system then checks if it has changed. If it has

changed, the system will recommend a save. If the save frequency is set to a value other than 0 or 999, the system recommends a save if:

- The library is due for saving according to the frequency and has changed.
- The library is due for saving according to the frequency, and no changes have been made, but Force Save is set to 1.
- If save frequency is set to 0 or 999, the system will not recommend a save.

9.3.5.4 Daily operations

You need to do a regular backup to offline storage for security reasons. You can use the offline storage to restore your data in case of any major fault on your system. Offline storage can be another system elsewhere on your site, tapes, or disks. However you should keep at least one copy a week at an offsite location or in a fire-proof safe.

You can specify, for each library or folder, how often you want to save the information to offline storage. It is usual to back up your data files every night and your program files once a week.

Three kinds of library saves to media can be performed. The method used is determined by Housekeeping's Control Information, where you entered 1, 2, or 3 for the Normal Backup Method field. The methods are: Select, Mass, and Cycle.

There are two steps in the saving to offline storage process:

1. **Selecting the libraries to save**: You must complete this step for all three types of library saves. In this type of save, libraries are selected manually. To perform this save, follow these steps:
   a. Choose the **Save To Media** option from the Housekeeping Main Menu.
   b. From the list displayed, identify the libraries that need to be saved. You will be informed if there are no libraries to be saved.
   c. Compare the date the library was last saved with today's date to calculate the number of elapsed days since the last save was made. The elapsed days are then compared with the save frequency specified. If a library qualifies for saving on the due date basis, and changes have taken place since it was last saved, then it is saved in this processing run.
2. **Saving to offline storage**: You must specify this step for the Mass and Cyclic types of library save only.

9.3.5.5 Notes about the mass backup

There are several key points to keep in mind regarding the mass backup operation:

- **Save function**: To set up the Housekeeping Save function, to run automatically, add an entry in the Auto Day-End schedule of Machine Manager. Click **Standard Jobs Function**, and select **Housekeeping Save Libraries**.
- **Tape name**: Each day the user must set up the name of the tape to be used for the backup. To do this, use the Execute Day-End Functions menu, and select option **9** (Set Direct To Media tape Volume ID).

- **Volume ID**: You must initialize each new tape that you use with the correct Volume name. This facility is provided by pressing F21 from the Set Direct To Tape Media Volume menu option.
- **Volume name and location**: This information is held in the data area HKLADBUDTA. You may enter a command in your Auto Day-End schedule to change positions 16 to 23, which hold the volume name and location, as entered via option 9, to automate this step. This can be seen in the following example.
- **Free media**: For Mass backups, you must manually free media that was previously used. This can be done from the Save to Media menu. The system monitors which tapes have active libraries on them, that is, tapes with the latest copy of a library on them. Use the Free Media (FREMED) command.

9.3.5.6 Further Housekeeping facilities

The standard jobs HK_RG2FILE and HK_SIZELIB are run to provide the following information:

- **Reorganize libraries (HK_RG2FILE)**: We recommend that you run this job regularly. This job is available as a standard Machine Manager Day-End Job. Reorganization performs housekeeping on your files to help control file size and maintain access speed.
- **Size libraries (HK_SIZELIB)**: We recommend that you run this job regularly. This job is available as a standard Machine Manager Day-End Jobs. This job collects information on the size of your libraries. This information is useful for performance evaluation. You can view or report library size information in the following ways:
  - You can see the size history of a library using the Manage Library function. Access this using the Manage Library (MNGLIB) command or the Library Definitions option within the Housekeeping menu system.
  - You can access the current size information from IPGHKF4/AHK15PHY.
  - You can access all historical details from IPGHKF4/AHK40PHY.
- **Restore from media**: If you need to restore files from the backup media, you should follow these steps:
  a. Restore the Housekeeping libraries from the last known save. This is listed on the Save Audit reports.
  b. Run the Restore Housekeeping Files routine.
  c. Consult Housekeeping as to the last save of all other libraries, and restore them.
- **Archiving**: If you want to remove a library that is likely to be used in the future, it should be archived. If you archive a library, it is saved to two offline storage devices. This reduces the dependence on a single storage media in the unlikely event that it is faulty. You can flag a library for archiving via the Display User Libraries facility or use the Manage Libraries Archiving function (MNGARC) command.
- **Libraries not saved**: Use the Housekeeping Libraries Archiving Routine to view libraries not saved overnight and to save those not saved.

- **Archive report**: When an archive is performed, an audit report is produced automatically. This lists the libraries saved to each media volume and the sequence in which they were saved.
- **Deleting**: You can run a function to delete all unknown libraries. This function physically deletes all of the libraries that are not known to Housekeeping. You can use the operational enquiries to display a list of all the libraries marked for deletion.

> **Attention**
>
> Before running the Delete Unknown Libraries function, make sure that you have all of the libraries you want to keep defined to Housekeeping or protected by the Protected Libraries function.

9.3.6 The Save to Media menu

This menu has the media-related tasks you can choose. An example of the Save to Media menu is shown in Figure 175.

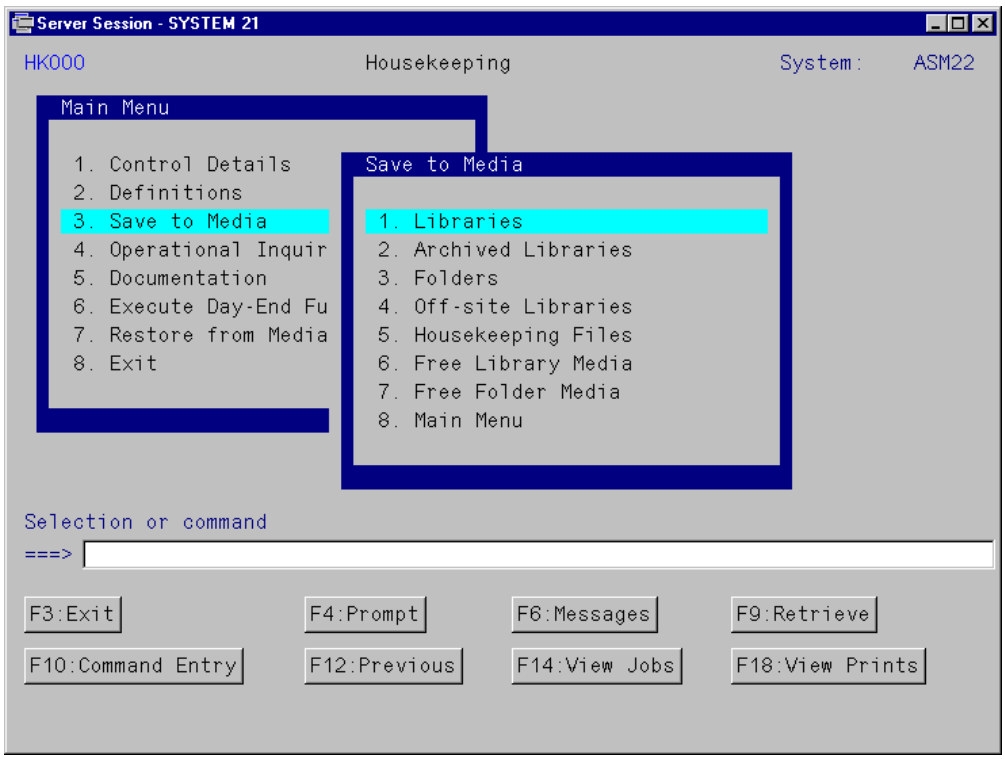

Figure 175. Save to Media menu

The available choices are:

- **Libraries**: Move the library save files created by Housekeeping to offline media.
- **Archived Libraries**: Save the archived libraries to offline media.
- **Folders**: Move the folder save files created by Housekeeping to offline media.
- **Off-site Libraries**: Save the off-site library groups to offline media.

- **Housekeeping Files**: Save the Housekeeping files to offline media
- **Free Library Media**: Free the offline media containing saved libraries.
- **Free Folder Media**: Free the offline media containing saved folders.

In addition, reports detailing the following information are automatically produced:

- Media available to be made free
- Media that contains active backups and must be kept
- Media you selected to be freed

9.3.7 The Operational Inquiries menu

This menu has some informative inquiries from which you can choose. An example of the Operational Inquiries menu is shown in Figure 176.

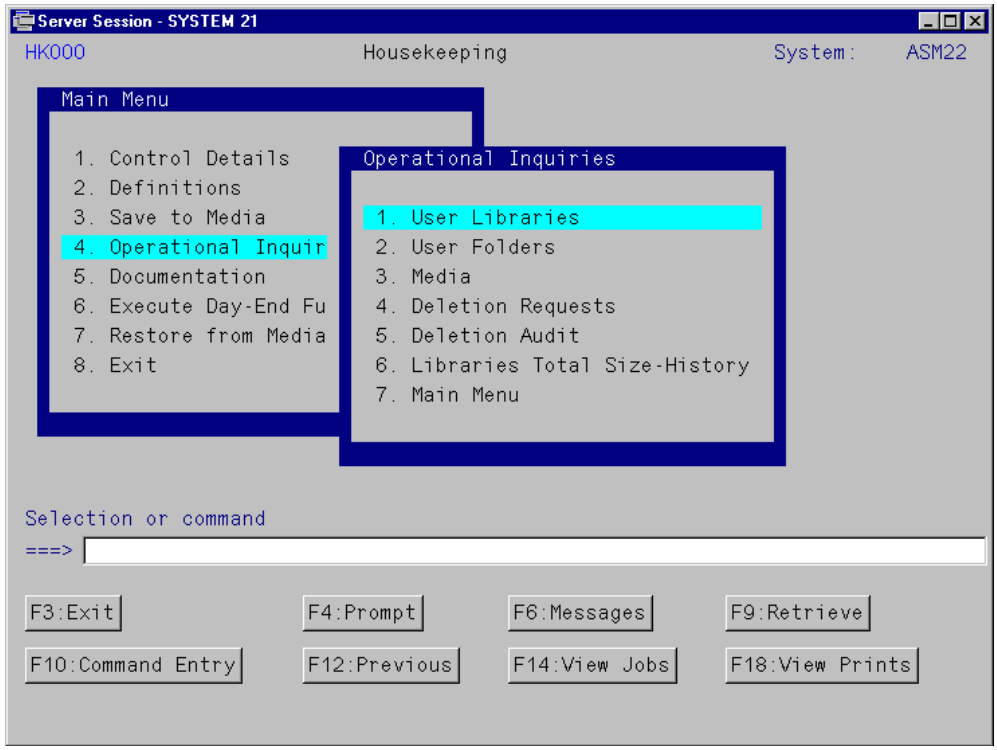

Figure 176. Operational Inquiries menu

On the Operational Inquiries menu, you can display information on:

- **Libraries**: This shows when the library was last used, saved, and the library size. A flashing asterisk (*) indicates that this library is overdue for a save.
- **Folders**: This shows the folder name and reference, as well as the latest save details. The flashing asterisk (*) indicates those folders that are overdue for a save.
- **Media**: This displays the active offline storage media.
- **Deletion requests**: This displays the library to be deleted, who requested the deletion, from which terminal, the date and time of the request, and whether a security save was made. All libraries shown are deleted by the next overnight routine.

- **Deletion audit**: This is an alphabetical sequence of library names, showing successful deletions and unsuccessful deletion attempts.
- **Libraries total size history**: This is a bar chart showing, chronologically, the size of all libraries defined to Housekeeping. To rebuild the bar chart, select the Resize Libraries function. See 9.3.9.5, “Reorganize Libraries” on page 300.

You can also use these enquiries to initiate various functions elsewhere in the system. For example, you may want to initiate the archiving of a library from the User Libraries inquiry.

9.3.8 The Documentation menu

This menu has useful reports for you to choose. An example of the Documentation menu is shown in Figure 177.

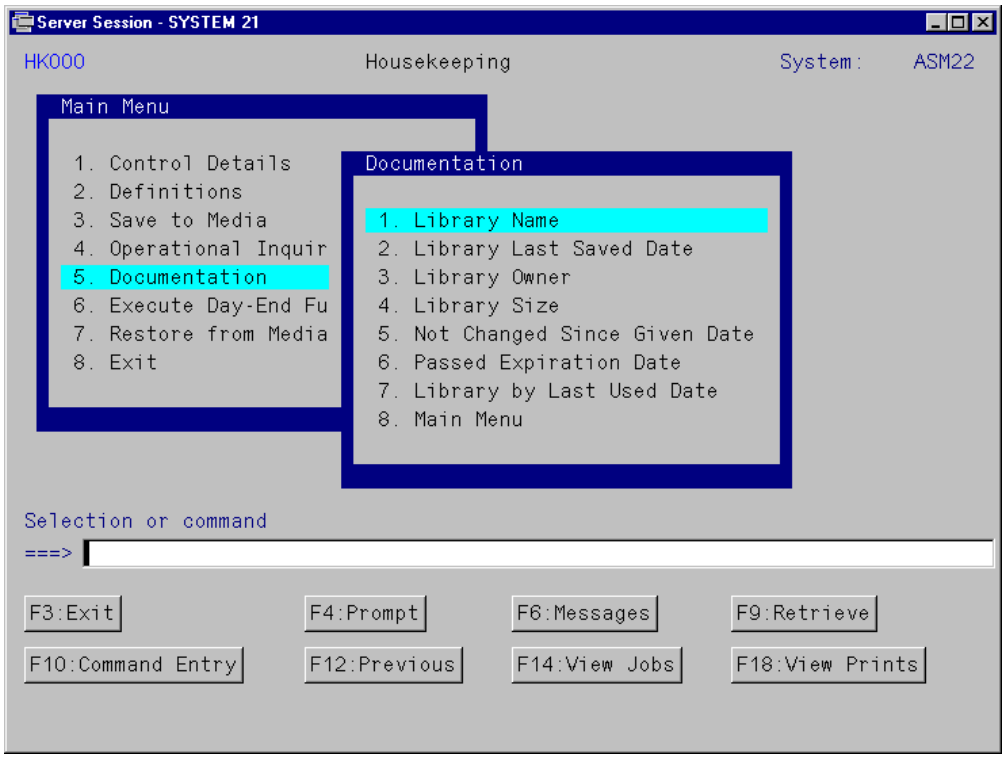

Figure 177. Documentation main menu

Batch jobs can be submitted to produce various reports including:

- **Library name report**: This report details all of the libraries on your system, regardless of whether they have been defined to Housekeeping. The report information includes:
  - Library name and text
  - Date and time last saved
  - Last save media type and location
  - Messages (for example, Not defined to Housekeeping, Never saved)
- **Library last saved date**: Details of libraries in the sequence of the date they were last saved. This report sequences libraries by the date they were last saved. The following details are included in the report:

  - Library name and text
  - Date and time last saved
  - Last save media type and location
  - Messages (for example: Not defined to Housekeeping, Never saved)

- **Library owner report**: Details of library saves in the sequence of the library owner. This report provides the following information, sequencing by the library owner:
  - Library name and text
  - Date and time last saved
  - Last save media type and location
  - Messages (for example, Not defined to Housekeeping, Never saved)
- **Library size report**: Details of library saves in the sequence of the library owner and then by library size. This report is sequenced by library owner and then library size. It provides the following information:
  - Library owner
  - Library name and text
  - Library size

> **Note**
>
> The library size details shown are from the last time the library sizing routines that were run. The details remain static until the next time the sizing routines are run.

- **Library not changed since given date report**: A report of libraries not changed since the date entered. Select **Not Changed Since Given Date** from the Documentation menu. The report contains the following information:
  - Library name and text
  - Library owner
  - Last saved date and time
  - Last saved media type and location
  - Last changed date
  - Date last checked by Housekeeping
- **Passed expiration date report**: A report of those libraries that have passed their expiration date. The library expiration date is contained within the library definition. The report contains the following information:
  - Library name and text
  - Date and time last saved
  - Last save media type and location
  - Messages (for example, Not defined to Housekeeping, Never saved)
- **Library by last used date**: This report provides a list of libraries sorted by the date they were last used. The report provides the following information:
  - Library name and text
  - Last changed date
  - Library size
  - Library creator
  - Library owner

- **Libraries last changed date report**: This report provides a list of libraries sorted by the last changed date. However, you can specify if you want to use the OS/400 system last changed date or Housekeeping's last changed date.

9.3.9 Execute Day-End Functions

Housekeeping's Day-End Functions perform two major activities:

- Saving libraries and folders to save files for subsequent saving to media. See 9.3.6, "The Save to Media menu" on page 293, for further information.
- Activities to keep your AS/400 performance optimized: Deleting libraries not defined to Housekeeping, compressing libraries, and re-organizing the physical files contained within libraries.

You should perform the above activities as part of an overnight routine. To perform them on a regular basis, we recommend that you set them up and run them as standard jobs within Machine Manager's Auto Day-End. This ensures that they are run regularly without the need for manual intervention. Before you initiate any of the Day-End Functions, you should first make sure that you have set up Housekeeping's control details and definitions.

Note

Error messages from Housekeeping's Day-End functions are sent to a message queue called HKSAVERR. It is important to monitor the message queue diligently.

Figure 178 on page 298 shows the Execute Day-End Functions menu. The following sections discuss the Day-End Functions.

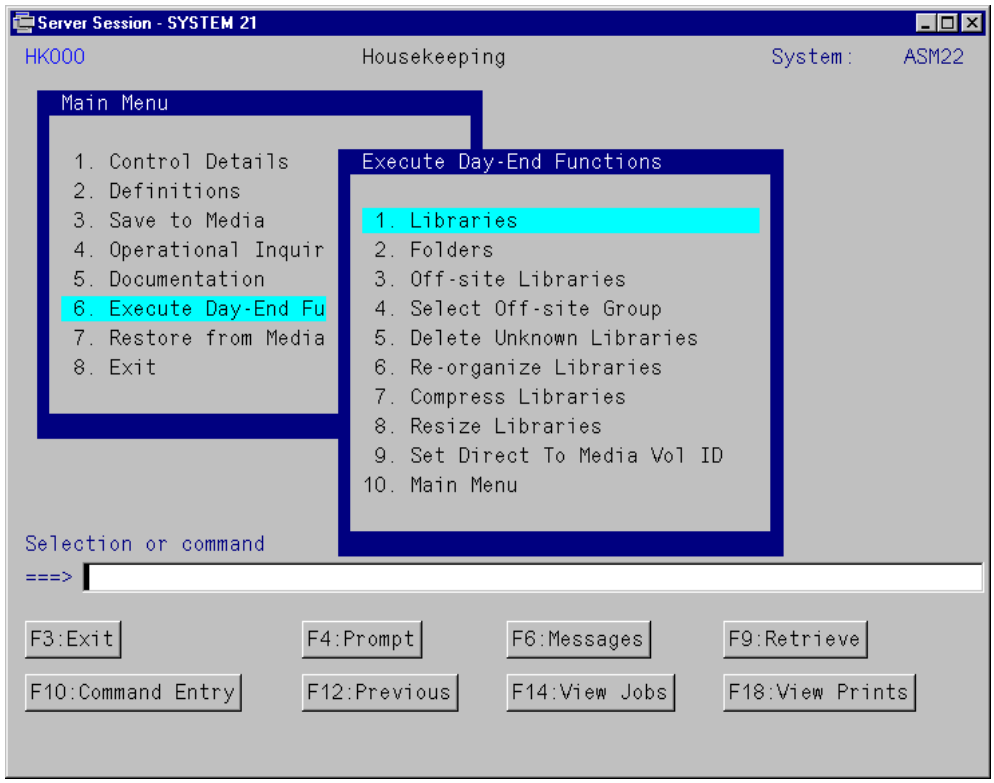

Figure 178. Execute Day-End Functions menu

9.3.9.1 Libraries

This function performs the following activities:

- Saving libraries to save files.
- Deleting libraries tagged for deletion.
- Saving archives to save files, which after saving off-line are tagged for deletion. The deletion is not performed if a security copy was requested and has not yet been performed.
- Deleting libraries tagged for archiving.
- Clearing out work libraries.
- Re-sizing libraries and analyses when they last changed, if the library save frequency indicates they should be saved.

A library will be saved to a save file specified in Housekeeping's control if any one of the following points applies:

- The library is due for saving. This refers to the number of days since the last save to media equals or exceeds the library's save frequency, and the library has changed since the last save to media. A library's save frequency is maintained via Library Definitions.
- The library is due for saving and the Force Save flag is set to 1 (Yes). The Force Save flag is maintained via Library Definitions.
- The library has been flagged for deletion, and a security save to media has been requested.

- The library has been flagged to be archived.
- The library has been flagged to force a save tonight. A library can be flagged to force a save tonight by either the User Libraries function or the Free Library Media function.

Once the save to save file has been completed, then the library can be saved to media.

There are a number of situations where even though Housekeeping calculates that a library is due to be saved to a save file, the save is not performed:

- If the library is in use, Housekeeping will not attempt to save it to the save file.
- If the user who initiates the Day-End function has insufficient authority to perform the save.
- The disk overhead in auxiliary storage used by the save file generated can cause critical storage to be reached, or even passed. Before Housekeeping performs the saves to a save file, it calculates the potential storage needed for each library. If the total potential storage needed exceeds Housekeeping's critical storage threshold, the save to a save file will not occur.

9.3.9.2 Folders

This function saves those folders due to be saved to the save file specified in Housekeeping's control information. A folder will be saved to the save file for one of the following reasons:

- The folder is due for saving. This refers to the number of days since the last save to media equals or exceeds the folder's save frequency, and the folder has changed since the last save to media.
- The folder is due for saving and the Force Save flag is set to 1 (Yes).
- The folder has been flagged to force a save tonight.

There are situations where even though Housekeeping calculates that a folder is due to be saved, the save is not performed:

- If the folder is in use, Housekeeping will not attempt to save it to the save file.
- If the user who initiates the Day-End function has insufficient authority to perform the save.
- The disk overhead in auxiliary storage used by the save file generated can cause critical storage to be reached or even passed. Before Housekeeping performs the saves to save file, it calculates the potential storage needed for each folder. If the total potential storage needed exceeds Housekeeping's critical storage threshold, the save to save file will not occur.

9.3.9.3 Off-site Libraries

Each library can belong to a pre-defined group for the purpose of saving a number of libraries as a set to store them at an off-site location. This group of libraries is known as an *off-site save group*.

Only one off-site save group can be saved at any one time. The selection of a group of libraries to be saved is performed by the Select Off-Site Group function. A list of the saved library volume groups is displayed. Housekeeping organizes saved libraries into these volume groups so that a group of saved libraries can be

saved onto a single media volume. A library will not be saved across two volumes.

Before you run this Day-End function to save off-site libraries, you must select an off-site group to be saved. The libraries are saved to a save file, which can subsequently be saved directly to media.

Note

Archived libraries are backed up twice and then flagged for deletion from the system. Libraries assigned to an off-site save group are not flagged for deletion. Instead, additional backups are made, as a set, which are beyond the normal or regular backups as individuals by the Libraries Auto-Management.

There are a number of situations where even though Housekeeping calculates that a library is due to be saved to a save file, the save is not performed:

- If the library is in use, Housekeeping will not attempt to save it to the save file.
- If the user who initiates the Day-End function has insufficient authority to perform the save.
- The disk overhead in auxiliary storage used by the save file generated can cause critical storage to be reached or even passed. Before Housekeeping performs the saves to a save file, it calculates the potential storage needed for each library. If the total potential storage needed exceeds Housekeeping's critical storage threshold, the save to a save file will not occur.

9.3.9.4 Delete Unknown Libraries

Use this option to physically delete from your IBM AS/400 all of the libraries that are not known to Housekeeping.

Attention

You must verify that the libraries you want to keep are defined to Housekeeping or protected by the Protected Libraries Function. *Failure to do so may cause severe loss of data.*

9.3.9.5 Reorganize Libraries

This option examines each library defined to Housekeeping and determines if that library is flagged to have its files reorganized.

If it is, the physical files in each of the selected libraries will be reorganized. The re-organization of physical files frees up the space occupied by deleted records to make significant savings in disk space.

9.3.9.6 Compress Libraries

Use this option to examine each library defined to Housekeeping and determine if that library is flagged to be compressed.

The programs in each selected library will have their observability information removed. Removing the observability of program objects can lead to significant savings in disk space without affecting the performance of the program.

Note

Removing the observability information from program objects restricts the information provided by program dumps. Therefore, we advise that you do not remove the observability information from programs until they are stable.

All System 21 products are shipped with the observability information removed.

9.3.9.7 Resize Libraries

This function examines each library defined to Housekeeping and determines its size. The library size information produced is used in a number of areas within Housekeeping:

- A library's size history can be viewed in bar-chart form.
- Housekeeping's documentation provides reports that are based on information provided by the library re-sizing routines.

9.3.9.8 Set Direct To Media Vol ID

Use this option to direct the next run of the Libraries Auto-Management routine (the overnight routine) to attempt to save libraries directly to offline backups rather than saving to the save file.

9.4 Restoring from backups

There are three main AS/400 restore scenarios:

- **Restoring the entire system**: Includes restoring the system library due to an entire system or site failure.
- **Restoring individual objects**: Includes only restoring the affected objects from the backups.
- **Systems Managed Access Paths (SMAP)**: SMAP is a methodology for reducing the recovery time of a restore.

This section also discusses restoring objects using System 21 Housekeeping.

9.4.1 Restoring the entire system

This section does not explain the entire system restore scenario. It is documented in the manual *Backup and Recovery,* SC41-5304. However, the major steps that need to be accomplished are:

1. Restore or install System Licensed Internal Code from CD-ROM or tape
2. Install the operating system from the Alternate IPL device
3. Restore User Profiles (RSTUSRPRF)
4. Restore Configuration (RSTCFG)
5. Restore All Libraries (RSTLIB)
6. Restore Document Library Objects (RSTDLO)
7. Restore Integrated File System (RST)
8. Restore public and private authorization (RSTAUT)
9. Validate the Geac System 21 environment (testing)
10. Start the System 21 environment and make the system available to users

9.4.2 Restoring an object in the System 21 environment

If the entire system is not lost, you may need to restore an individual library or file that was inadvertently deleted or has become damaged or corrupted in some way. This can be accomplished by using the RSTLIB, RSTOBJ, or the RST command for IFS objects. Sometimes it is easier to delete the object that you want to replace before you overlay it. Here is an example of the command you can use to restore the security workbench table:

```
RSTOBJ OBJ(OEP35) DEV(TAP01) SAVLIB(OSLD1F3) OBJTYPE(*FILE) MBROPT(*ALL)
```

Since it is impossible to predict the different scenarios, we recommend that you refer to the IBM manual *AS/400 Backup and Recovery,* SC41-5304.

9.4.3 Restore from Media menu

This menu is where you restore the objects you saved using Housekeeping. An example of the Restore from Media menu is shown in Figure 179.

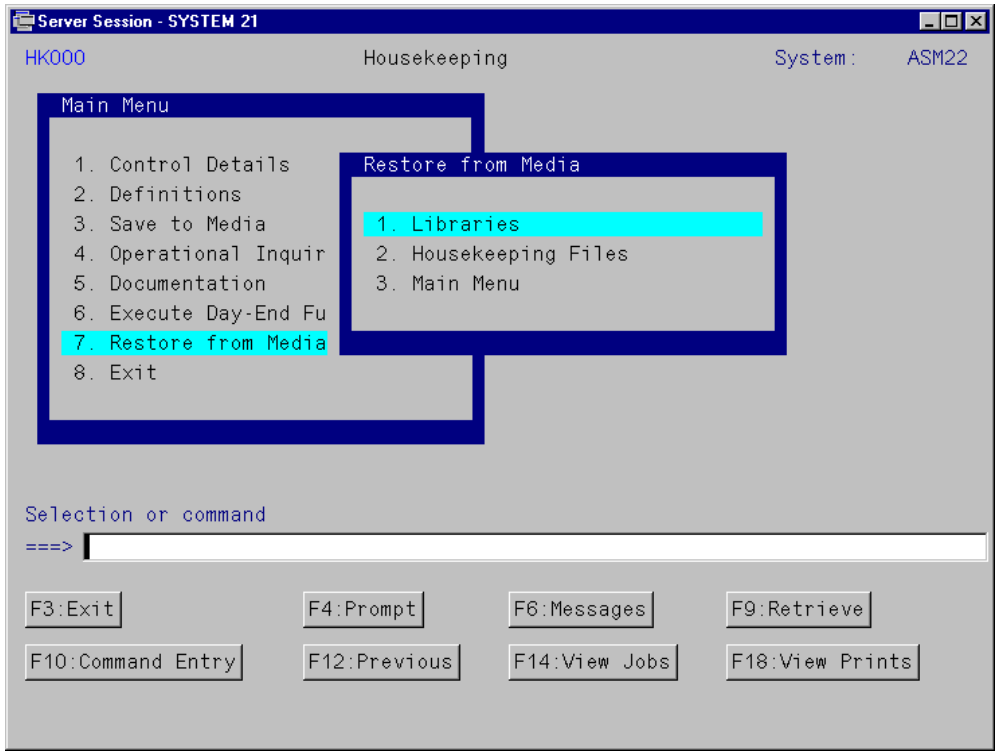

Figure 179. Restore from Media menu

On this menu, you have the following options for restoring objects:

- **Libraries**: You use this option to restore an entire library and its contents from the backup media. When you select this option, you are shown all of the saves of the library, with the most recent at the top of the list.
- **Housekeeping Files**: You use this option to restore the Housekeeping files from the backup media.

Note

To help ensure data integrity, Housekeeping does not allow you to restore a single object. The entire library must be restored. This is especially important to keep in mind when planning data files library consolidation. The restore time may be greatly increased when data files libraries are consolidated.

9.5 System Managed Access Path Protection (SMAPP)

System Managed Access Path Protection (SMAPP) can greatly reduce the amount of time it takes to perform an IPL after an abnormal end. It is an automatic AS/400 system function that runs without attention. SMAPP determines which access paths to protect without any intervention by the user. It automatically adjusts or makes changes in the environment such as when adding new applications or new hardware.

SMAPP does not require any setup, and you do not have to change your applications. You do not have to journal any physical files or even use journaling at all. You simply need to determine your policy for access path recovery:

- How long you can afford to spend rebuilding access paths during an IPL after a failure
- How to balance access path protection with other demands on system resources
- Whether to have different target times for recovering access paths for different ASPs

You may need to experiment with different target recovery times for access paths to achieve the correct balance for your system. If you configure additional user ASPs, you should also evaluate your access path recovery times.

SMAPP creates and manages its own internal journals and journal receivers. You cannot use these journals and journal receivers for any other journaling functions. They do not appear on the Work with Journals display. You do not need to, nor can you, save them to tape.

SMAPP requires additional auxiliary storage for journal receivers. However, SMAPP is designed to keep the additional disk usage to a minimum. SMAPP manages journal receivers and removes them from the system as soon as they are no longer needed.

Under SMAPP, the system looks at all access paths to determine how it can meet the specified target times for recovering access paths. It may not choose to protect an access path that you consider critical. When the system determines how to meet the target times for recovering access paths, it considers only access paths that are not explicitly journaled.

You can allow the system to determine which access paths to protect. Specify target recovery times for access paths for the entire system or for ASPs. Your system has a default recovery time for access paths for the entire system of 150 minutes when it is shipped. You can use the Edit Recovery for Access Paths (EDTRCYAP) command to see and change the target recovery times for access

paths. This command also allows you to see how much space the system is using for System Managed Access Path Protection (SMAPP).

SMAPP provides a simple method to reduce your recovery time after an abnormal system end. SMAPP manages the required environment for you. You do not need to use any type of journal management to use SMAPP.

Refer to *Backup and Recovery,* SC41-5304, for additional information on SMAPP.

Part 3. Advanced topics

This part covers some advanced topics that will be of interest to those of you who want to optimize your System 21 AS/400 system to run smoother, faster, easier, better, etc. This part includes these chapters:

- Chapter 10, “Performance management” on page 307, introduces you to a performance management methodology for running the System 21 application on the AS/400 system. It describes performance tuning concepts, tuning techniques, and tuning recommendations, as well as performance analysis tools that can be used to measure and analyze various components of system performance.
- Chapter 11, “Customization” on page 389, gives you the background information necessary to enable you to customize System 21 to your needs.
- Chapter 12, “Work management” on page 435, provides an understanding of the basic concepts of AS/400 work management. This is an important prerequisite if a standard System 21 implementation is to be modified.
- Chapter 13, “Geac Work Management” on page 483, covers Geac Work Management, which allows a business to actively model the process and workflow within the business.
- Chapter 14, “National language support” on page 495, aims to provide introductory information on the national language support topics you need to understand when implementing Geac System 21 on the AS/400 system.

Chapter 10. Performance management

The key to good system performance is to provide the system resources with sufficient capacity in a balanced configuration. The processor, memory, disk I/O, and network communications components need to be sufficient to handle the application workload and, in balance with one another, to prevent performance bottlenecks. Performance management is a continual, iterative process used to achieve this goal. It consists of four key steps:

1. Measure
2. Analyze
3. Adjust
4. Re-measure

To maintain good system performance, you should repeat these steps on a regular basis. The results are used to predict and schedule system upgrades, as well as to resolve specific performance problems.

This chapter introduces you to a performance management methodology for running the System 21 application on the AS/400 system. The recommended approach is based on ongoing measurement and analysis of system performance. Performance tuning concepts, tuning techniques, and tuning recommendations are described, as well as AS/400 and third-party performance analysis tools that can be used to measure and analyze various components of system performance.

10.1 Performance concepts

This section presents an overview of some key factors that the affect system, the application, and network performance.

10.1.1 Queuing concepts

The work of a single job or the transactions within that job are comprised of several tasks. The invitation to perform the work required by a task is called a *request*. The requested work is performed by a server. The time taken to complete the requested work of the task is called the *service time*.

Queuing is a concept that applies equally to requests waiting for computer resources or to people waiting in line at the supermarket or bank. In general, the length of time it takes to complete a work request—whether it be a request to complete a purchase at the supermarket counter, complete a transaction at the bank, perform a disk I/O operation, or use the CPU—depends on three primary factors:

- The number of “waiters” in the line ahead of a new request
- The number of servers responding to the requests
- The service time to complete a request given to the server, which is a function of the speed of the server and the amount of work to do

Consider a service point where certain tasks are performed for requestors of a service. Generally, requests for service are responded to in the order in which they arrive. Therefore, those arriving first are responded to first and leave the service point first.

If the rate of arrival of requests is greater than the rate at which they leave after being serviced, a queue is built at the server. The total response time to have a request serviced is the sum of:

- The time spent in the queue waiting to be serviced
- The time it takes the server to perform the requested work

When the queue grows longer, more time is spent waiting in the queue, and the total time taken for a request becomes longer.

The following basic principles govern queuing:

- A single server can service only one request at a time.
- Multiple concurrent requests are queued for service.
- The higher the server utilization is, the longer the queue is, and the longer queue waiting time and total response time are.

In the AS/400 environment, examples of service requestors are:

- Applications
- System tasks

Examples of service providers are:

- CPU
- I/O processors
- Disk arms

The equivalent functions of requestors and servers are also present within the client system and the communications network.

When requests arrive randomly at a single server with a single queue, there is an equation that predicts the expected service time as a function of server utilization. This equation expresses the expected service times as a multiple of the time it takes to process a request once it has finished waiting in the queue. The equation is:

```
QM = 1 / (1 - U), where U = utilization and QM is the queuing multiplier
```

For example, if server utilization is at 50%, QM=1 / (1 -.5) = 2. This indicates that a new request arriving in the queue is expected to take twice as long to be completed as it would if the server were not being utilized at all.

Response time is directly proportional to queue length, and the queuing multiplier expresses the effect of queuing on response times. A graph of the queuing multiplier against the utilization of the server is shown in Figure 180.

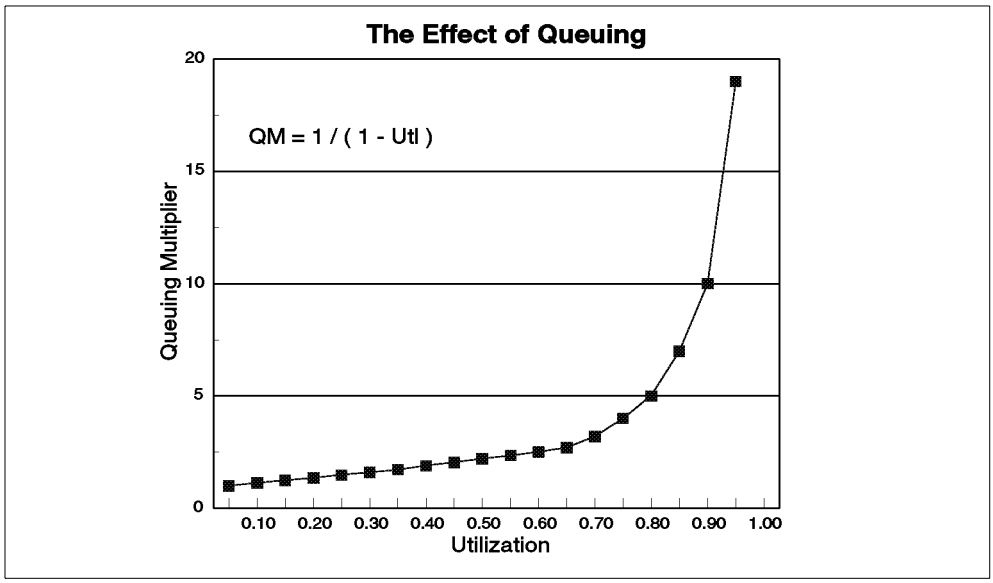

Figure 180. Effect of utilization on the queuing multiplier

As the utilization of a server increases (more work for the server), queuing can account for a much longer elapsed time for work (or request) to complete.

The queuing multiplier is an important factor when projecting the impact of adding work or hardware on current system performance. Systems with performance problems often exhibit resources with high queuing factors.

The simplified queuing theory discussed here assumes a single queue of requestors and a single server. In high-end AS/400 models, multiprocessor (N-way) systems have more than one central processor executing instructions, even though there is only a single queue of requestors (Task Dispatching Queue). In this situation, the increased number of servers reduces the queuing multiplier and the average queue length. However, the affect of queuing on response times is still a significant factor.

10.1.2 Response time curve

Response time is the elapsed time between the request for a service and the completion of that service. For a System 21 user, the interactive response time is the time between sending a request to the server and displaying a response screen.

The queuing multiplier is a measure of the affect of queue length on response time, based on the utilization of the resource providing the service.

Another important concept is highlighted by Figure 180. The curve shows the utilization at various rates and the significance of the *knee* of the curve. The knee of the curve is the point where a change in utilization produces a correspondingly greater change in the queuing multiplier. That is, the change along the Y-axis (queuing multiplier) is significantly greater than the change along the X-axis (utilization). The knee of the curve reflects the maximum utilization to which a resource should be driven. Beyond the knee, service time becomes less stable and may increase dramatically for small increases in utilization.

Not all resources react the same. There are different recommended maximum values for different resources, such as CPU, disk, memory, controller, remote line, IOPs, and so on.

The *AS/400 Performance Tools,* SC41-5340, provides additional information on queuing.

10.1.3 Client/server response time

In a client/server environment, the response time perceived by the user is the combined response time of the following service providers:

- **Client system**: When a user at a client system, such as a PC, requests information, that request is first processed by the PC and translated to a request to the server system.
- **Communication network** (to server system): The request is sent through the line to the server (such as a database or application or file server).
- **Server system**: The server system accepts the request and performs the requested functions.
- **Communication Network** (from server system): The server response is sent back to the client.
- **Client system**: The client receives the information, performs further processing (if necessary), and presents the final response to the user's request.

Therefore, the total response time experienced by a client/server application user is the sum of the service times of the:

- Client
- Server
- Network

Typically, a server system functions in an environment with multiple requestors. The response time experienced by a requestor is affected by the function of the particular task and by the workload introduced by other concurrent requestors and the relative servicing priority assigned to them.

Client PCs, on the other hand, are single-user systems where the contention for resources is minimal. However, with the introduction of multi-tasking operating systems, and more concurrent activity on the PCs, resource contention is becoming a significant contributor to overall client/server performance.

10.2 AS/400 server tuning

The AS/400e server plays a crucial role in the overall performance of System 21 applications. Server performance can be impacted by:

- Hardware configuration and component usage
- System tuning and workload management

This section discusses performance requirements and recommendations for each of these areas. It also includes a detailed review of commonly used performance analysis tools.

10.2.1 AS/400 server hardware

Hardware is an essential component of performance. If your hardware is overutilized, you can expect performance degradation. Some of the server hardware components that affect performance are:

- CPU:
  - Utilization
  - CPU speed
  - Number of processors
- Disk:
  - Number of disk accesses
  - Disk performance
  - Disk storage capacity
  - Total number of disks
- Main storage:
  - Amount of paging
  - Cache
- Input/output processor (IOP):
  - Utilization
  - IOP capacity
  - Efficiency of frame size
  - Amount of error recovery necessary

The server CPU handles requests from a client. If the CPU utilization is exceptionally high, incoming requests are queued until there are sufficient CPU cycles free to process the next request. This means that a large proportion of the response time is spent in waiting for the CPU.

Server main storage determines the amount of pages that can be processed. The more memory you have, the more pages can be brought into memory for processing, and the better the CPU is utilized. If you do not have enough memory, the CPU may only do a fraction of the workload of which it is capable.

Memory also provides the facility to support *caching*. Caching is the process of bringing data into memory before it is needed, therefore reducing the time required to process the data.

Access to data on the disk is crucial to response time. DASD (disk) performance is controlled by the disk subsystem, the actuator arms, and the capacity of the disks. For optimum performance, the disk actuator arms should never exceed 40% utilization. The more actuator arms there are in the disk array, the better the performance potential is.

For high availability, disks should be protected with RAID-5 or mirrored protection. Mirrored protection offers the best performance. It is usually the more expensive option because it requires hardware duplication. RAID-5 is lower in cost, but may incur a performance overhead for heavy write-intensive environments. In a RAID-5 environment, a single write request requires a read to another drive in the stripe set and two writes. Therefore, writes to RAID-5 make disk drives slightly slower than writes to unprotected drives. In the case of mirroring, writes may be slightly slower than writes to unprotected drives.

However, reads are generally faster. For more details on RAID-5 and mirroring, refer to OS/400 *Backup and Recovery,* SC41-5304.

10.2.1.1 AS/400 server model behavior

Traditional AS/400 models (non-server) have a single Commercial Processing Workload rating (CPW). CPW is an AS/400 relative performance measurement unit that represents the maximum workload that can be supported by that model. On traditional AS/400 models, the CPW value applies to an interactive workload, a client/server workload, or a combination of the two.

On the server, custom server, and advanced server models, there are two CPW values. The larger value represents the maximum workload the system can support if the workload is entirely client/server. The smaller CPW value represents the maximum workload that the model can support if the workload is entirely interactive.

Server models were designed to support a client/server workload, but with the ability to accommodate an interactive workload. Depending on the individual AS/400 server model, the coexistence of interactive and client/server workload components is handled differently.

- **Advanced servers and first generation 170s**: When the interactive workload exceeds approximately one-third of the maximum interactive CPW, the client/server processing performance of the system becomes increasingly impacted. Once the interactive workload reaches the maximum interactive CPW rating, no capacity is available to support client/server workloads.
- **Custom servers**: When the interactive workload exceeds approximately six-sevenths of the maximum interactive CPW, the client/server processing performance of the system becomes increasingly impacted. Once the interactive workload reaches the maximum interactive CPW rating, no capacity is available to support client/server workloads.
- **7xx servers and second generation 170s**: The interactive workload is allowed to achieve the capacity of the interactive feature without impacting client/server throughput. However, the capacity allocated to the interactive workload, is not available for client/server processing.

  Each interactive feature will support a CPW rating in excess of the published figure. The maximum value is obtained by multiplying the published number by seven-sixths. If this level of interactive throughput is achieved, no capacity is available to support client/server workloads.
- **8xx servers and 270s**: The interactive workload is allowed to achieve the capacity of the interactive feature without impacting client/server throughput. However, the capacity allocated to the interactive workload is not available for client/server processing.

  Each interactive feature will support a CPW rating in excess of the published number. The maximum value is obtained by multiplying the published number by seven-sixths. At V4R5, a change in the performance algorithm means there is no impact on client/server processing, if this level of interactive throughput is achieved.

Microcode task CFINTnn, for all AS/400 models, is an indication of the time used to handle interrupts and task switching. For server models, it is also an indication of how much overall system performance is impacted by the interactive

processing. On servers other than 8xx and 270 (with V4R5), once the interactive workload reaches the *maximum* interactive CPW value, all of the CPU cycles are used. There is no capacity available for handling a client/server workload.

10.2.2 Basic AS/400 tuning commands

This section explains the level of system performance tuning you can do with the AS/400 system commands.

10.2.2.1 Work with System Values (WRKSYSVAL)

There is a set of AS/400 system values that affect the overall system performance. You should review and set them up appropriately. Table 55 lists these system values.

Table 55. Performance related system values

System value	Description
QACTJOB	Initial number of active jobs
QADLACTJ	Additional number of active jobs
QADLTOTJ	Additional number of total jobs
QBASACTLVL	Base storage pool activity level
QBASPOOL	Base storage pool minimum size
QDYNPTYSCD	Dynamic priority scheduler
QJOBMSGQFL	Job message queue full action
QJOBMSGQMX	Maximum size of job message queue
QMCHPOOL	Machine storage pool size
QPFRADJ	Performance adjustment
QTOTJOB	Initial total number of jobs
QTSEPOOL	Time slice end pool
QQRYDEGREE	Parallel processing degree

Refer to *OS/400 Work Management,* SC41-5306, for information on how to set these system values.

10.2.2.2 Work with System Status (WRKSYSSTS)

This function provides information on AS/400 system resource utilization for a particular time interval, including:

- Disk capacity and usage of the system auxiliary storage pool (ASP1)
- Faulting rate per second in each memory pool
- Queuing jobs running in each memory pool

To review the system status, enter the following command:

```
WRKSYSSTS
```

This displays the screen shown in Figure 181 on page 314 (the command assistance level has been set to “Intermediate”).

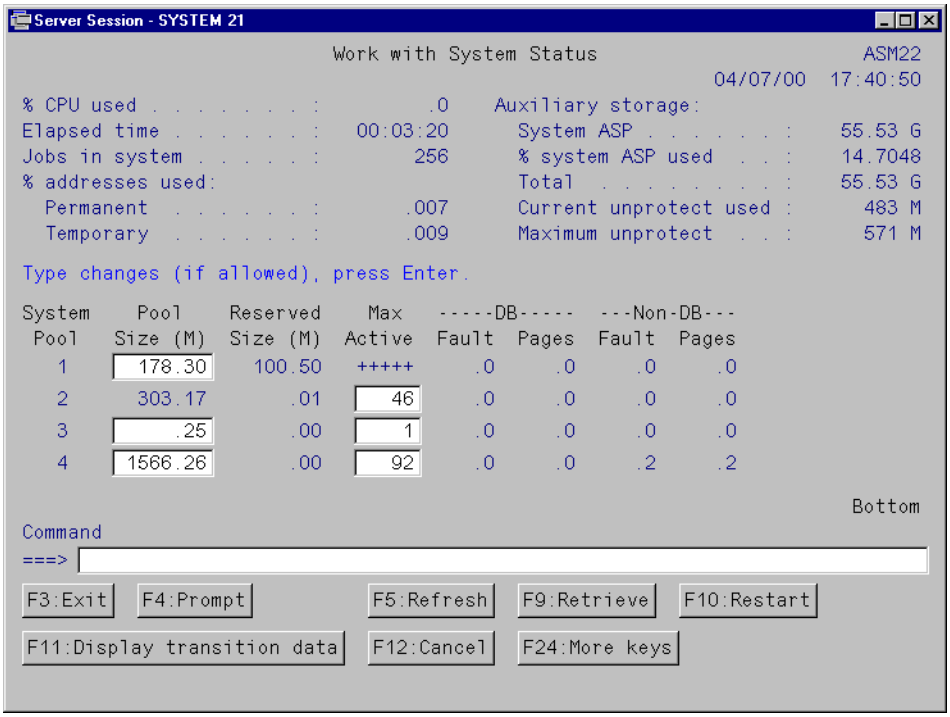

Figure 181. Work with System Status (Part 1 of 2)

When reviewing the output from the command, select an elapsed time of at least five minutes for an analysis of AS/400 resource utilization (F10 restarts the elapsed time, F5 refreshes the elapsed time measurement). Run this command during periods of typical and peak system activity.

Note the following parameters:

- **% CPU Used**: This indicates the amount of CPU used during the elapsed time. If any batch processes were running at the time, this value can be high. If CPU usage is sustained at a high level (100%), you may have a saturated CPU.
- **% System ASP Used**: This indicates the amount of disk space used out of the total available space in the system ASP. This value includes the amount of disk space occupied by the temporary objects created during normal AS/400 operations.
- **Total**: This refers to the total disk space in the entire system and excludes any disk space that was used in disk protection such as RAID-5 or mirroring.
- **Current unprotected used**: This indicates the amount of disk currently used by temporary objects.
- **Maximum unprotected used**: This indicates the maximum amount of disk used by temporary objects since the last IPL.
- **DB and Non-DB faulting**: This is measured in faults per second, and is the only measure to determine how the AS/400 system uses the available memory in each pool. Make sure you review the total number of faults per second in each pool and not the number of pages.

To view information on the AS/400 job transitions occurring in each memory pool, press F11. This displays the screen shown in the example in Figure 182.

Note

If the assistance level for the WRKSYSSTS command is set to “3”, a consolidated screen is displayed. This screen contains all of the information displayed in Figure 181 and Figure 182.

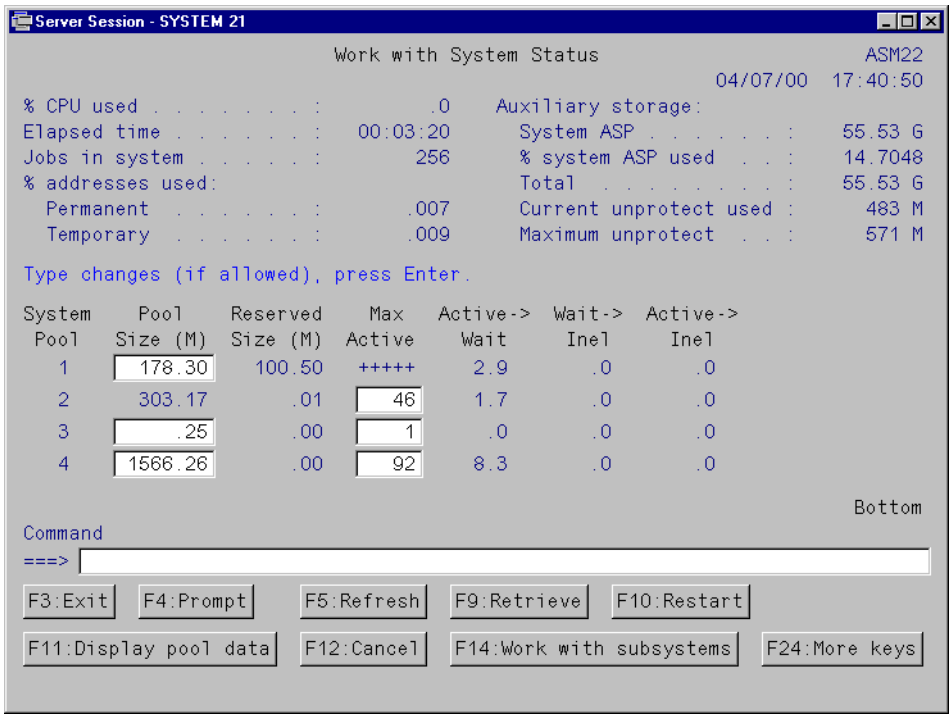

Figure 182. Work with System Status (Part 2 of 2)

The Wait->Inel and Act->Inel columns are explained here:

- **Wait->Inel**: This measures the transition of jobs from the wait state to the ineligible state where a job is ready to run but cannot secure an activity level. This indicates that the value set for *maximum active* jobs in the memory pool may be too low.
- **Act->Inel**: This measures the transition of jobs from the active state to the ineligible state. In this case, a job has reached time slice end but has not finished processing. It is ready to run but cannot secure an activity level. This indicates that the value set for *maximum active* jobs in the memory pool may be too low.

10.2.2.3 Work with Disk Status (WRKDSKSTS)

The Work with Disk Status (WRKDSKSTS) command shows the AS/400 system’s disk activity and helps to identify any performance problems related to disk utilization.

To review disk status, enter the following command:

```
WRKDSKSTS
```

Then, the Work with Disk Status screen appears (Figure 183 on page 316).

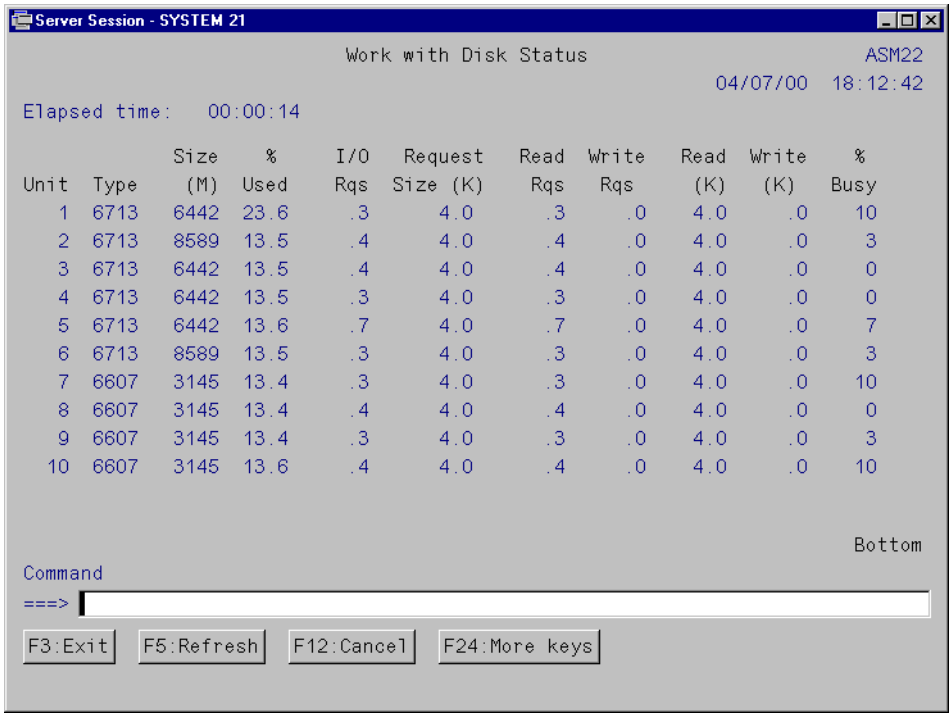

Figure 183. Work with Disk Status display

The following parameters are particularly significant:

- **% Used**: This indicates the amount of space used on each disk unit. The amount should not exceed 80% on any disk except the first disk (or the first two or four disks if the internal disks are mirrored). Ensure you have adequate disk space to allow for growth in the database.
- **% Busy**: This is a key factor in disk performance and should remain under 30% during a measured interval.

10.2.2.4 Work with Active Job (WRKACTJOB)

This command displays all of the jobs running on the AS/400 system within each active subsystem. It shows detailed information including:

- Subsystem
- User identifier
- Job type
- Memory pool
- Job priority
- CPU usage (%)
- CPU usage (seconds)
- Disk I/O count

To review active jobs, enter the following command:

```
WRKACTJOB
```

The Work with Active Jobs screen appears (Figure 184).

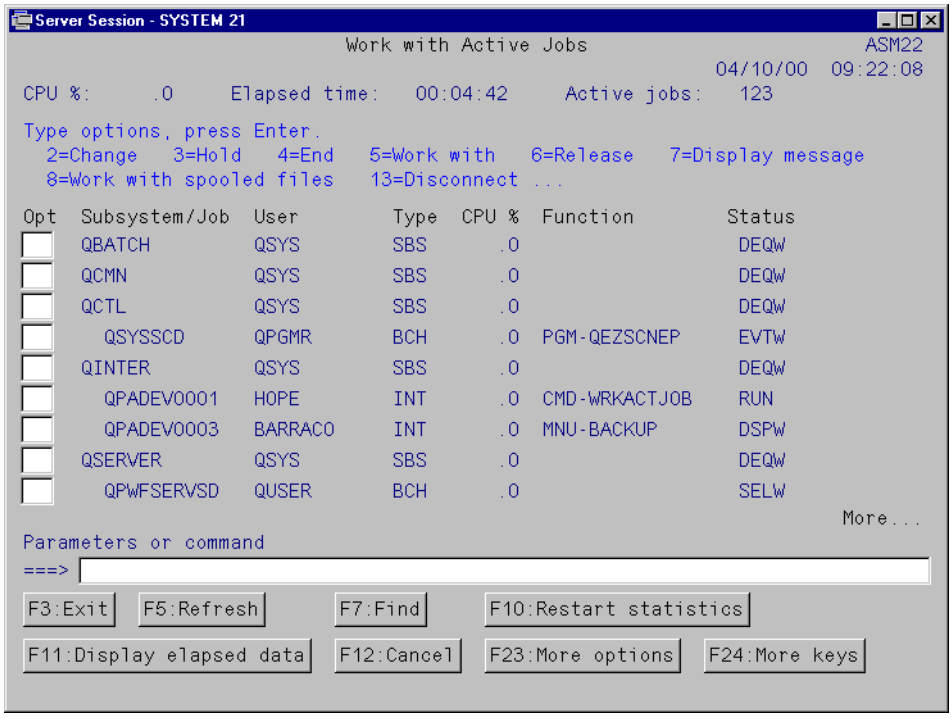

Figure 184. Work with Active Jobs display

Press F11 to view additional information on the jobs running on the AS/400 system. This includes such details as the associated storage pool and the job run priority. Figure 185 shows the alternative view obtained by pressing F11.

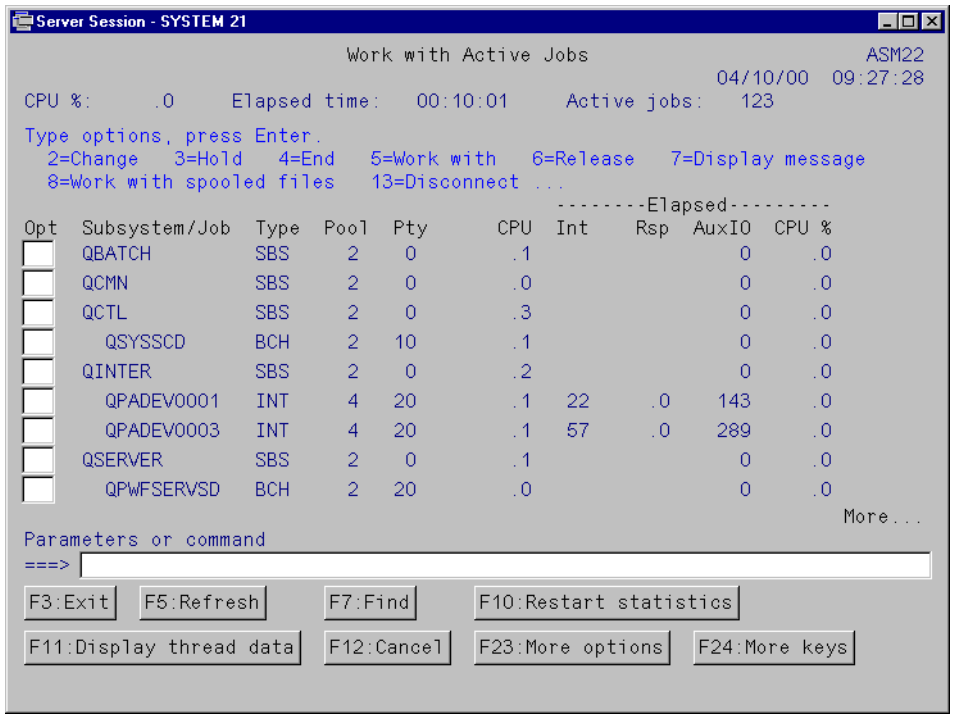

Figure 185. Work with Active Jobs display - F11 alternative view

10.2.2.5 Work with System Activity (WRKSYSACT)

The Work with System Activity (WRKSYSACT) function allows you to view and collect performance data in real-time fashion. This data is reported for any selected job or task that is currently active on the system.

The performance statistics reported by this function represent activity that has occurred since a previous collection.

The WRKSYSACT function is particularly useful for identifying jobs that use sustained amounts of system resource, causing workload throughput constraints.

Important

The WRKSYSACT command can only be invoked by one job at a time. Once invoked, the priority of the job using the command is raised to “1”. Do not use this command for sustained periods of time because it may introduce an additional performance overhead.

To review system activity, enter the following command:

```
WRKSYSACT
```

Figure 186 shows the output from the WRKSYSACT command.

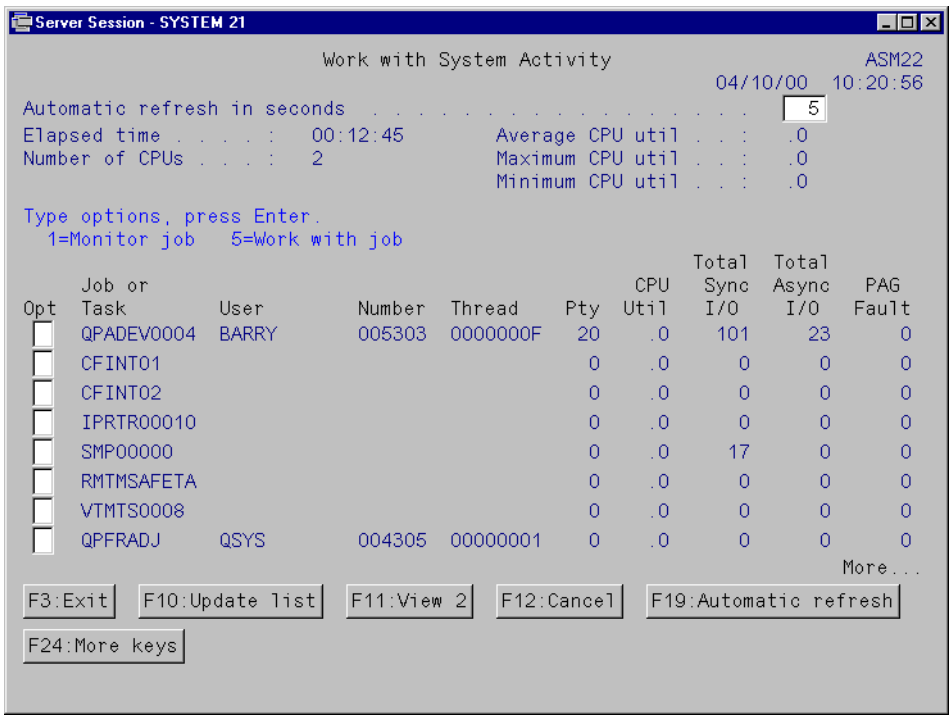

Figure 186. Work with System Activity display

The following parameters are shown on the WRKSYSACT screen:

- **Elapsed time**: The length of time over which the current performance statistics were collected.
- **Average CPU utility**: The average CPU utilization for all active processors.
- **Number of CPUs**: The number of processors that are configured.

- **Maximum CPU utility**: The CPU utilization of the processor that reported the maximum amount of CPU utilization.
- **Minimum CPU utility**: The CPU utilization of the processor that reported the minimum amount of CPU utilization.
- **Thread**: A thread is a unique flow of control within a process. A thread runs a procedure asynchronously to other threads running the same or different procedures within the process.

  Every job has an initial thread associated with it. An initial thread is started automatically when a job is started. Each job can start one or more secondary threads. The initial and secondary threads share the same qualifying attributes for a job: job name, job number, and user name. An attribute that uniquely distinguishes one thread from another is known as the *thread identifier*, which is an 8-byte identifier.

  A task does not have any threads associated with it. In the situation where a task is displayed, the thread field will not have any information.
- **Priority**: The priority at which the job or task was running when performance statistics were collected.

  You may notice a low-priority job having its priority temporarily raised to a higher priority. This occurs when the low priority job has a seize or lock on an object to which a higher priority job needs access. The lower job priority is temporarily increased to release the seize or lock for the other job sooner. The original priority is automatically restored when the seize or lock is released or when a lock wait time-out occurs.
- **CPU utilization**: The percentage of the elapsed time during which the processing unit was utilized by jobs or tasks.

The WRKSYSACT command can also be submitted in batch mode to collect performance data into an output file. This provides an alternative method of performance data collection. The data is collected, as a default, in the QPFRDATA/QAITMON file.

The contents of this file can be analyzed with data reporting tools like Query/400 to determine resource-intensive jobs or tasks. Figure 187 on page 320 shows the parameters for batch submission.

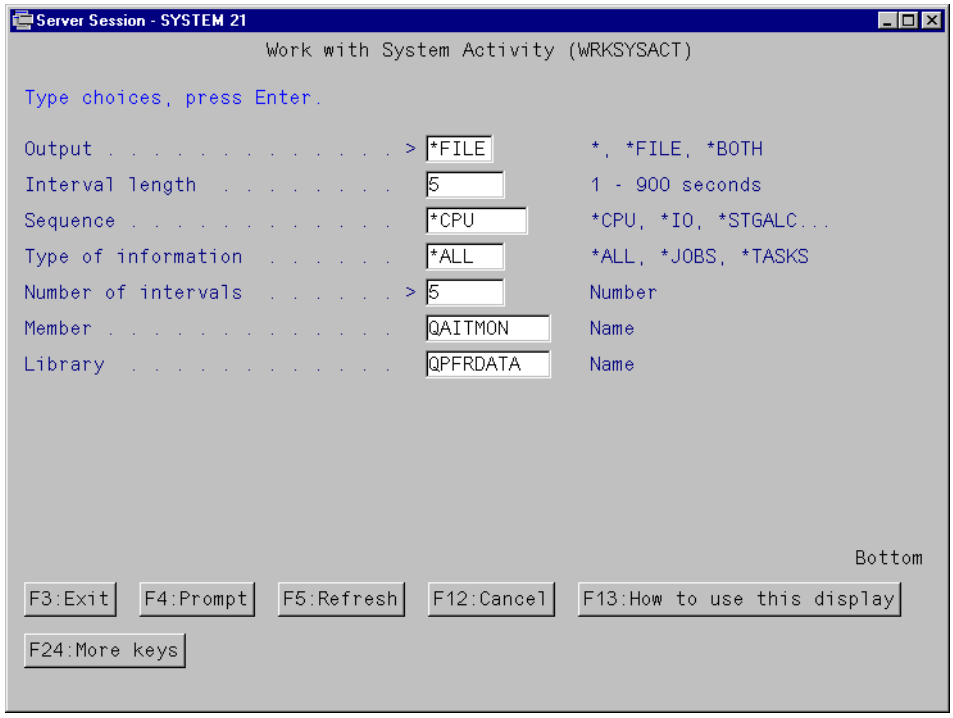

Figure 187. Collecting data from WRKSYSACT to an output file

10.2.3 Performance data collection and analysis

The AS/400 system supports a number of tools for data collection and analysis. Some of these tools are part of the operating system, while others are supported through Licensed Program Products (LPPs). This section identifies the principle tools available for data collection and analysis.

10.2.3.1 AS/400 Performance Monitor

To carry out in-depth performance analysis on the AS/400 system, you need to collect performance data. The Performance Tools LPP, 5769-PT1 is not required for this process. Within the operating system, IBM provides the data collection command Start Performance Monitor (STRPFRMON). Figure 188 shows the STPFRMON parameters.

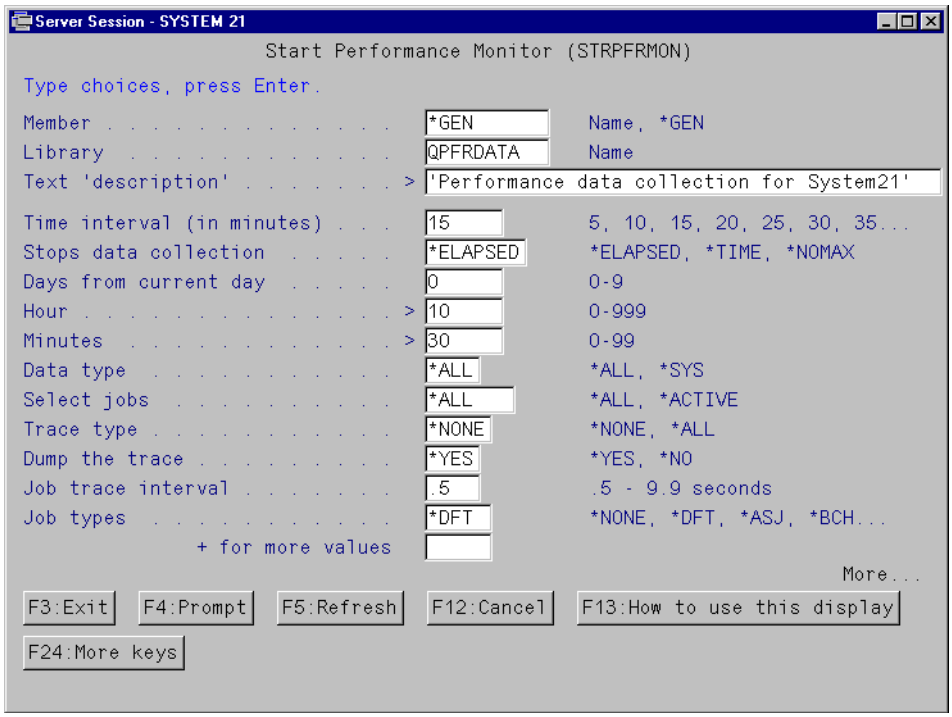

Figure 188. Start Performance Monitor display

The following parameters are usually completed:

- **Member**: This can either be set to system generated or a specific member name. You will find it useful to assign a meaningful member name.
- **Library**: QPFRDATA is the default collection library. You may want to change this to a specific library for a collection. This will assist in restoring the performance data to alternative systems.
- **Time interval**: This defaults to 15 minutes. Use this value for long collection periods to initially identify a problem. Use smaller intervals, possibly with trace, to drill down on a performance issue.
- **Stops data collection**: This parameter defines when data collection will end. You can use a particular time of day or you can specify an elapsed time. The later option is more frequently used.
- **Trace type**: If you want to collect trace data, set this parameter to *YES.

> **Important**
>
> Trace data collection usually generates extensive database files. Only use this option for short, concentrated intervals to generate low level performance detail.

- **Job queue**: The default job queue is QCTL. This routes the job into the QCTL subsystem where it will be assigned a run priority of 10. This should not have an excessive impact on overall system performance.

Performance data collection can be scheduled using the WRKJOBSCDE command provided in the operating system. If the *GEN parameter is used for the

Member Name, a single collection entry can be added to the schedule. If you use specific member names, you must define individual entries to the schedule.

Important

- Performance data will be overwritten if you use a specific member name to collect data for more than one day.
- You should set the system value for automatic performance adjustment (QPFRADJ) should be set to zero while collecting performance data. Data must be collected from a static system, from a system that is being continually reviewed and revised.

If Performance Tools - Manager is installed, you can collect performance data through a menu driven interface. You can also schedule data collection instead of using the WRKJOBSCDE command. To access this feature, complete the following steps:

1. Type `Go Perform` on the command line, and press Enter.
2. Type option `2` (Collect Performance Data).
3. Type option `3` (Work with Performance Collection).
4. Type option `1` to specify a data collection definition.
5. Enter the parameters for the data collection, and press Enter.

Note that Collection days and Collection start time fields have been added to the standard STRPFRMON command.

Note

You can define multiple performance collection definitions, but the definitions cannot overlap. Each definition must be unique in terms of the days and times over which the data will be collected. Definitions that are not unique will not be created.

The collection definitions will not be invoked unless the performance collection job is active. To start performance collection, enter the following command:

```
STRPFRCOL
```

Similarly, to end performance collection, enter the following command:

```
ENDPFRCOL
```

Use the IBM Job Scheduler (or the System 21 Job Scheduler) to submit these jobs. Submit the jobs to the QCTL job queue approximately 15 minutes before the performance data collection is scheduled to start.

Performance data analysis can only be undertaken with the Performance Tools Manager feature. However, data can be exported from systems that do not possess this feature to systems that possess it. Performance data files are upwardly compatible from a release perspective. You can convert performance data files to the latest OS/400 release with the Convert Performance Data (CVTPFRDTA) command. This command converts the data from the existing file formats to the new file formats.

10.2.3.2 AS/400 Advisor

If you have Performance Tools - Manager LPP installed, you can use the Performance Advisor function. The Advisor uses collected performance data to recommend performance tuning changes. It can also point out other problems affecting system performance.

To access the Advisor function, complete the following steps.

1. Enter `Go Perform` and press Enter.
2. Type option `10` (Advisor).
3. Enter the name of the performance data library, or accept the default.
4. Locate the data member you want to view or analyze.
5. Type `1` to analyze or `5` to view. Press Enter.
6. Select the interval or intervals that you want to review by typing `1` in the adjacent option field. Press Enter.

Figure 189 illustrates the main Advisor interval selection screen. In this example, an interval of just under one hour has been selected, from 09:42 to 10:27.

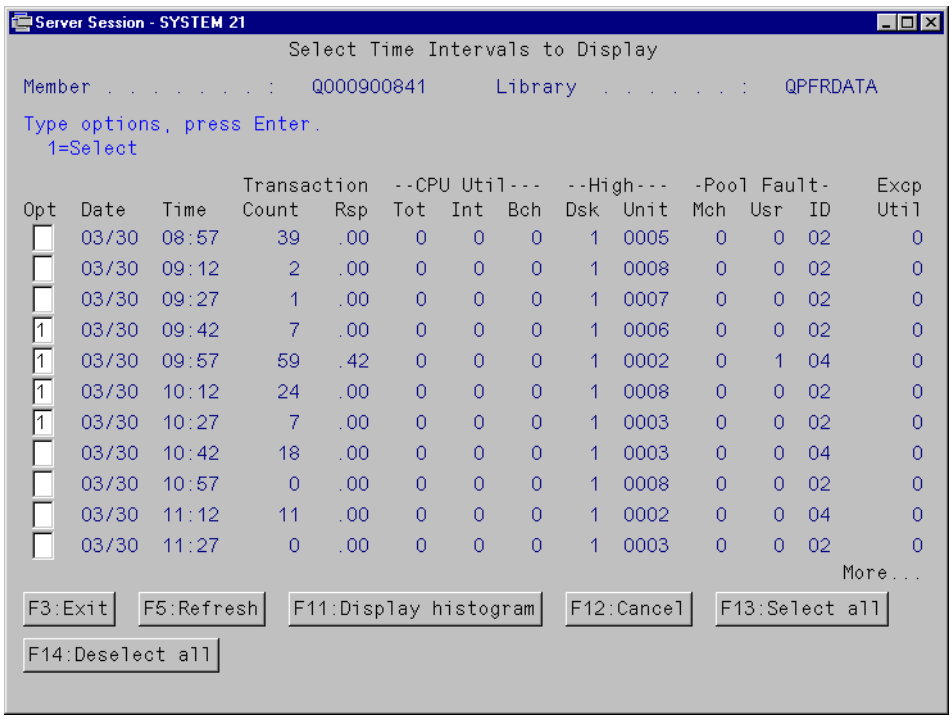

Figure 189. Advisor interval selection display

When you enter a 5 on the initial performance member selection panel, the display shown in Figure 190 on page 324 appears.

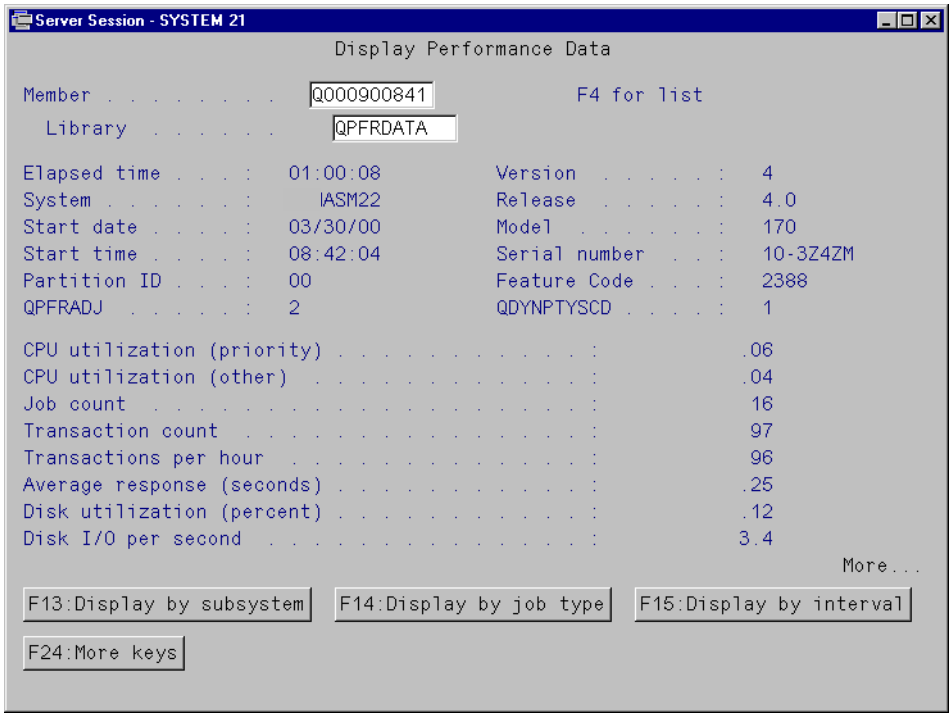

Figure 190. Advisor Display Performance Data

The Display Performance Data screen presents details about the configuration of the system from which the data was collected. It provides summary figures for the key performance components over the selected interval. It also provides the opportunity to “drill down” into the data by using the function keys at the bottom of the screen. When you enter a 1 on the initial performance member selection panel, the display shown in Figure 191 appears.

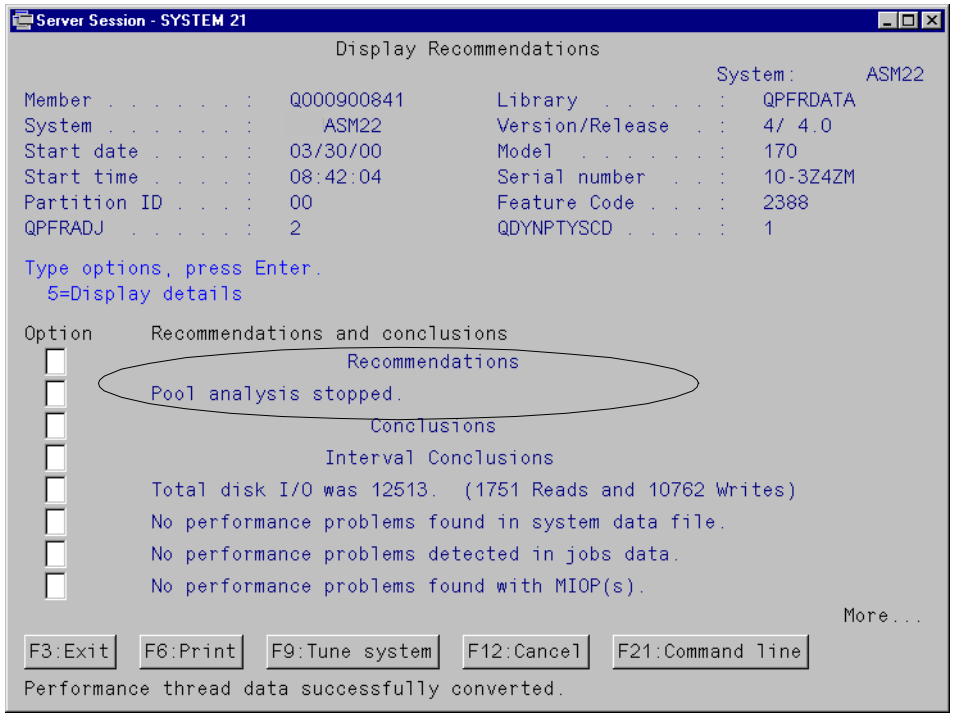

Figure 191. Advisor Display Recommendations analysis

This display provides a review of the key hardware components over the measured interval.

Note

In the example in Figure 191, under the heading of *Recommendations,* note the message “Pool analysis stopped”. You receive this message if QPFRADJ has not been set to zero, and the main storage pools have been adjusted in the measured interval. In Figure 190, the value of QPFRADJ is clearly set to 2.

You can display additional details for each hardware component listed. Type a `5` to display additional details. Figure 192 on page 326 illustrates the interval conclusion details for the disk arms. In this example, no problems were recorded for the disk units during the selection interval.

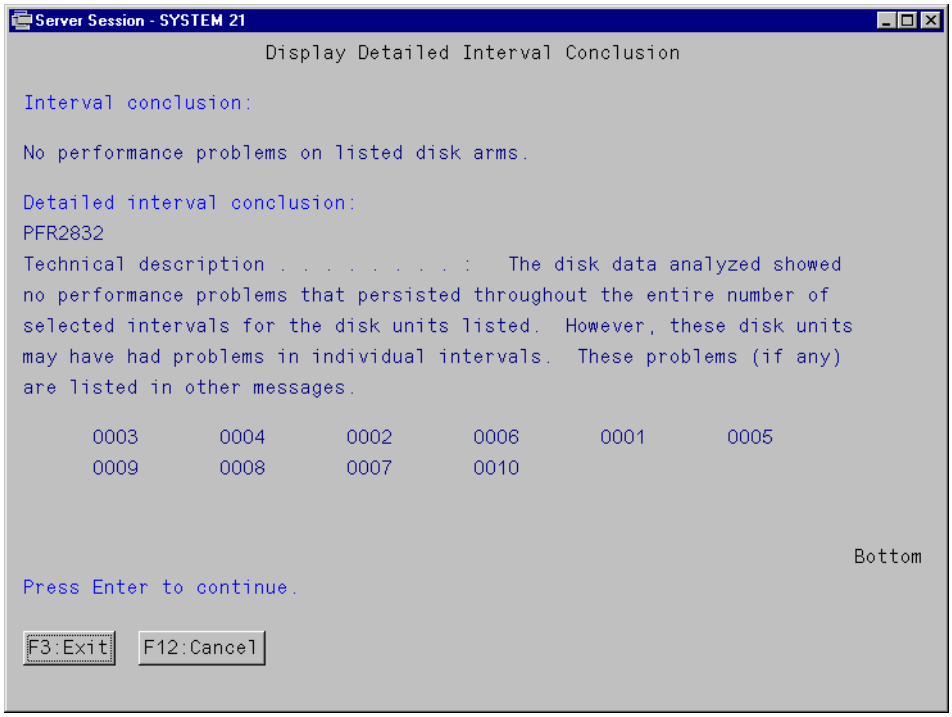

Figure 192. Advisor Display Detailed Interval Conclusion for hardware component

The Advisor is a useful data review tool that can quickly highlight areas of poor performance. It uses the same data source as the performance tools and reports, but provides an interface that is easier to review and interpret. After you identify an area of concern, you can use the performance tools reports to enhance the level of analysis.

10.2.3.3 Performance tools reports

Performance reports provide a way for you to effectively research areas of the system that are causing performance problems. After you have collected performance data over time, you can use different reports to see how and where system resources are used. Performance reports can direct you to specific application programs, users, or inefficient workloads that are causing lower overall response times.

Several types of performance reports show data focusing on different aspects of the system. For example, one report identifies CPU usage and another identifies communications use. These reports help identify various performance problems.

- **System Report**: Supplies you with an overview of how the system is operating. It contains summary information on the workload, resource use, storage pool utilization, disk utilization, and communications. This is a good report to run and print often, giving you a general idea of system use. You can print selected sections of this report.
- **Component Report**: Provides information about the same components of system performance as a System Report, but at a greater level of detail. This report helps you find out which jobs are consuming high amounts of system resources, such as CPU and disk.

- **Job Interval Report/Pool Interval Report/Resource Interval Report**: Provides the same information as the System Report and Component Report, but on an interval-by-interval basis.
- **Lock Report**: Provides information about lock and seize conflicts during system operation.
- **Batch Job Trace Report**: Shows the progression of different job types (for example, batch jobs) traced through time.
- **Transaction Report**: Provides detailed information about the transactions that occurred during the performance data collection.

The performance reports are available with the Performance Tools Manager feature. To access the reports, follow these steps:

1. Type `Go Perform` on the command line, and press Enter.
2. Type option `3` (Print performance report), and press Enter.
3. Type the name of the desired performance data library, or accept the default by pressing Enter.
4. Locate the data member to be analyzed.
5. Type the option number for the required report type in the Option field, and press Enter.

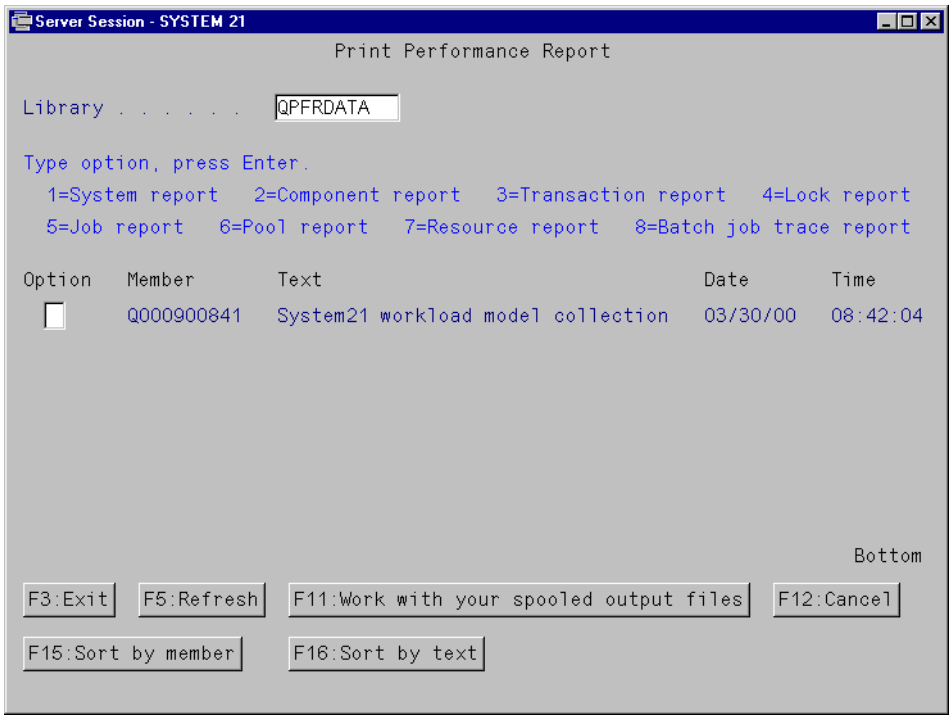

Figure 193. Print Performance Report display

Figure 193 illustrates the main Print Performance Report screen. The available report types are represented by option 1 through option 8 at the top of the screen. For additional details on the performance reports and their contents, refer to *Performance Tools V4R2,* SC41-5340.

10.2.3.4 AS/400 Performance Explorer (PEX)

PEX is a set of performance collection and reporting functions and commands available on AS/400 RISC systems with the AS/400 Performance Tools/400, (LPP) 5716-PT1. PEX provides three types of performance data analysis capabilities:

- **PEX STATS**: PEX STATS collects CPU utilization and physical disk (DASD) I/O counts of programs or modules that run during the collection period. These programs or modules may be IBM operating system modules and tasks or application programs or modules.

  You use STATS to find the high resource-consuming programs and modules that run during the performance collection. The objective is to determine whether there are specific programs or modules doing most of the resource consumption. If you suspect that an application implementation problem is the reason for poor performance, STATS collection enables you to determine which programs should be examined, based upon the CPU and disk statistics and the number of times the program has been called.

- **PEX PROFILE**: Once you identify a high resource-consuming program or module and want to do further performance analysis, you can use PROFILE to find the hot spots (high CPU usage sections of instructions) within the program according to the High Level Language (HLL) source statement numbers.

  PROFILE output analysis may also identify a program that is constantly branching between the start of the program and subroutines at the end of the program. If the program is large enough, this constant jumping back and forth could cause excessive page fault rates on a system with limited main storage.

- **PEX TRACE**: PEX TRACE is a new function that collects detailed program, Licensed Internal Code (LIC) task, OS/400 job, and object reference information.

  You can use PEX TRACE functions to do additional job and program performance analysis. In cases where other performance tools usage cannot identify an application, set of jobs, or programs, you can use the TRACE functions system-wide to assist in identifying applications or programs that need further analysis.

  Further information on the PEX tool and its usage can be found in *AS/400 Performance Explorer Tips and Techniques*, SG24-4781.

You can access the PEX commands by typing:

```
Go CMDPEX
```

Alternatively, you can access the PEX main menu in the following manner:

1. Type `Go Perform` at the command line, and press Enter.
2. Type option `5` (Performance utilities), and press Enter.
3. Type option `3` (Work with Performance Explorer), and press Enter.

Figure 194 shows the Work with Performance Explorer menu.

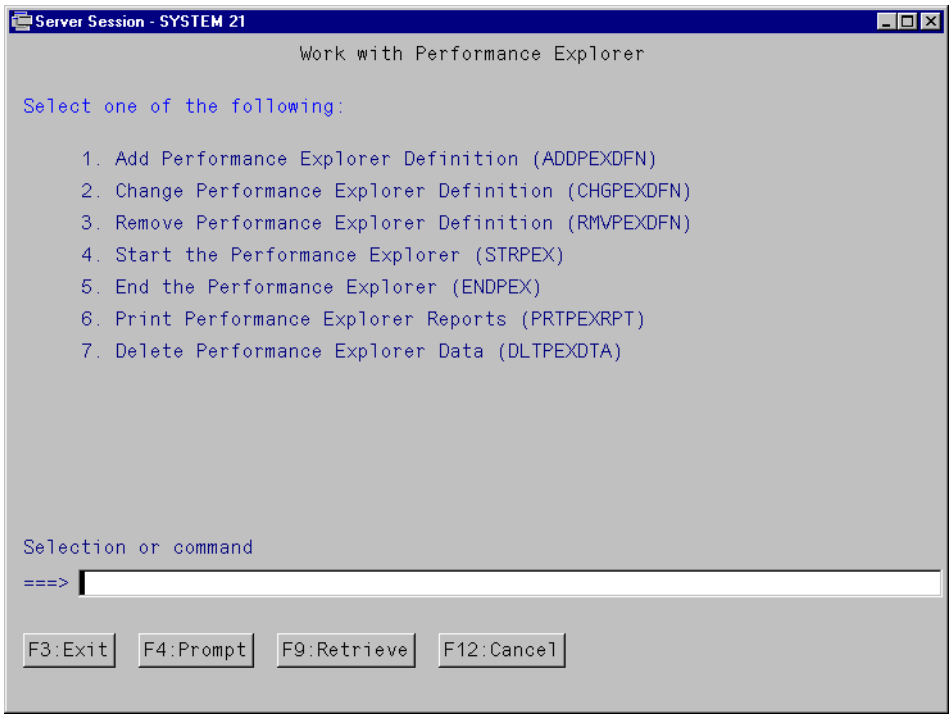

Figure 194. Work with Performance Explorer

When using the PEX tool, you follow this sequence of events:

1. Add a PEX definition (Stats, Profile, or Trace).
2. Start the Performance Explorer.
3. End the Performance Explorer. This writes the PEX data into files.
4. Print the PEX report to analyze the data.
5. Delete the PEX definition after it's not needed anymore.
6. Delete the PEX data.

Steps 5 and 6 are optional depending on the need to re-run the trace or retain the collected data.

10.2.3.5 Job trace

The job trace provides information on the program modules called during the running of a job. It collects performance statistics for the specified job. A trace record is generated for every external program call and return, exception, message, and workstation wait in the job. At least two and usually more trace records are generated for every I/O statement (open, close, read, and write) in a high-level language program.

Tracing has a significant affect on the performance of the current job. Time stamps shown may indicate longer processing within a program than actually occurred. However, you can use the time stamp (system clock) for the relative execution time compared to other programs or modules listed in the trace.

The job trace function can be used to trace either interactive or batch jobs. In addition, Debug can be incorporated into the process to collect details, such as SQL optimizer messages.

The steps used to collect job trace information for a batch job are outlined:

1. Start the Service Job (STRSRVJOB) by using the following command:

   ```
   STRSRVJOB JOB(number/user/name)
   ```

2. Start Debug:

   ```
   STRDBG UPDPROD(*YES)
   ```

3. Start Trace:

   ```
   TRCJOB MAXSTG(16000) TRCFULL(*STOPTRC)
   ```

4. Change the job to produce a job log:

   ```
   CHGJOB JOB(number/user/name) LOG(4 00 *SECLVL)
   ```

5. To end the job trace, debug, and service job, use the following commands listed here:

   - `TRCJOB SET(*OFF)` to end the trace and print a report
   - `ENDDBG` to exit the debug mode
   - `ENDSRVJOB` to end the service job

The steps used to collect job trace information for an interactive job are:

1. Start Debug:

   ```
   STRDBG UPDPROD(*YES)
   ```

2. Start Trace:

   ```
   TRCJOB MAXSTG(16000) TRCFULL(*STOPTRC)
   ```

3. Change the job to produce a job log:

   ```
   CHGJOB JOB(number/user/name) LOG(4 00 *SECLVL)
   ```

4. To end the job trace, debug, and service job, use the following commands:

   - `TRCJOB SET(*OFF)` to end the trace and print a report
   - `ENDDBG` to exit debug mode

Data collected through the job trace can be used in conjunction with performance trace data to build a complete picture of transaction activity. Time stamping is used in both methods of data collection so they can be easily compared.

10.2.3.6 Process Access Group (PAG) analysis

Process Access Group (PAG) analysis is undertaken using two commands:

- **DSPACCGRP**: The Display Access Group (DSPACCGRP) command shows, for each selected job, the PAG size, the names and I/O counts for open files, and the program data storage used. It also optionally writes this information to a database file for further analysis by the Analyze Access Group (ANZACCGRP) command.
- **ANZACCGRP**: The Analyze Access Group (ANZACCGRP) command produces a report that summarizes the PAG data collected with the Display Access Group (DSPACCGRP) command. The report is useful in examining the process-access group data from a large number of jobs.

  The environment section of the report shows a summary of all job types, the average number of files, duplicate files, display files, I/O counts, and process-access group size for the different job types. The job section shows information for each selected job.

The file section shows, for each open file, the file name and type, the number of jobs using the file, the number of opens, the I/O count, and the average ODP (Open Data Path) size.

These commands are very useful for analyzing jobs that are considered to be performing poorly.

10.2.3.7 AS/400 communications trace

The AS/400 communications trace facility is an important tool for isolating both performance problems and error conditions. It traces and formats any communications type that has a line description (for example, Token-Ring, Ethernet, or SDLC).

AS/400 communications traces assist in diagnosing where a performance delay is occurring. Use the time stamp and the eye-catcher fields to measure how long the AS/400 system takes to process a request.

Communications traces also capture the data stream being passed between a client device and the AS/400 system, or another host system and the AS/400 system. This data stream can then be diagnosed for errors in the sent and received transmissions.

Starting a communications trace

To set up a communications trace, you need to perform the following steps:

1. On the command line, enter the Start System Service Tools (`STRSST`) command. Your user profile should have all object authority.
2. Type option `1` (Start a Service Tool), and press Enter.
3. Type option `3` (Work with Communications Trace), and press Enter. You see the Work with Communications Traces screen, which is shown in Figure 195 on page 332.

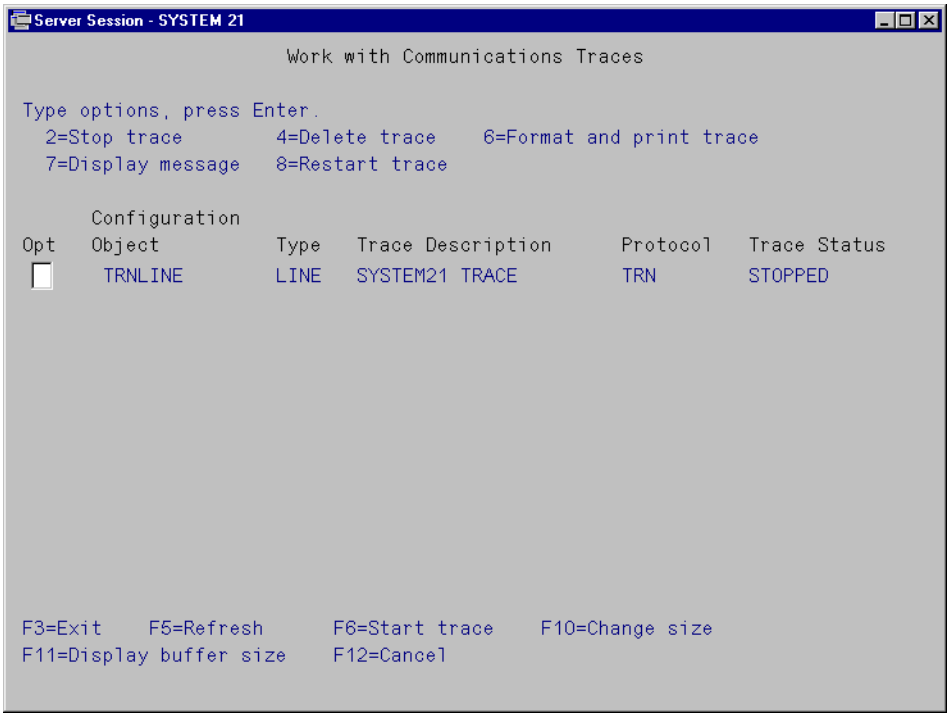

Figure 195. Work with Communications Traces

4. If the name of the line you want to trace is under the Configuration Object field, type an `8` in the Option field. Press Enter to access the Start Trace display (Figure 196). If the line name is not already defined, press F6 to access the Start Trace field.

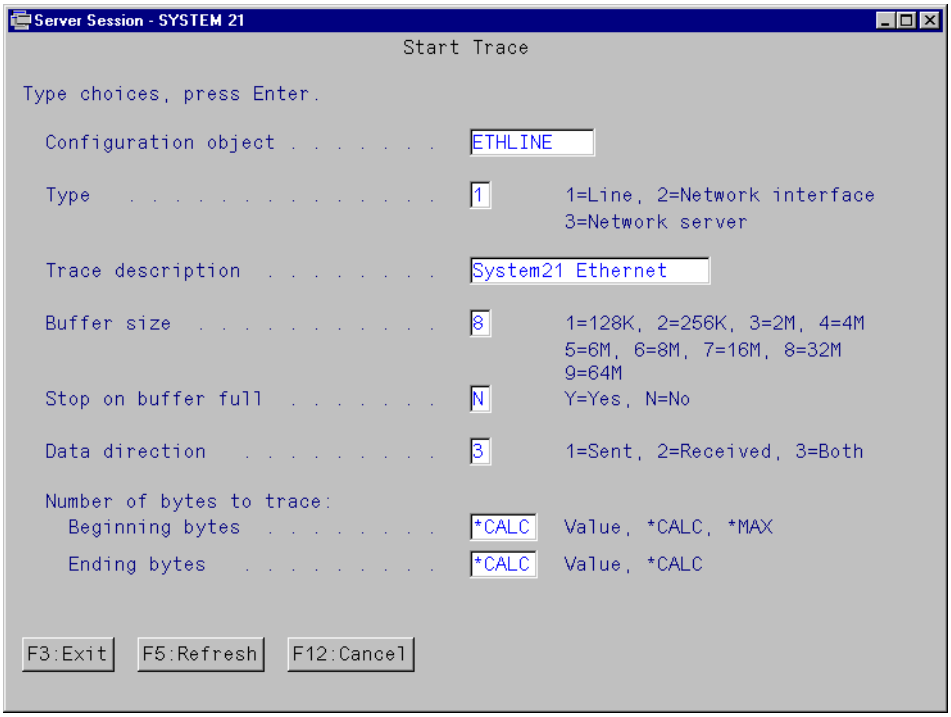

Figure 196. Start Trace - Defining a communications trace

To create a line trace, enter the following parameters:

- **Configuration object**: The name of the line description object you want to trace.
- **Trace description**: Type a description of what you are tracing.
- **Buffer size**: Select one of the largest sizes available.

Leave the other fields with the default values, and press Enter.

5. You are prompted for Trace Options as shown in Figure 197.

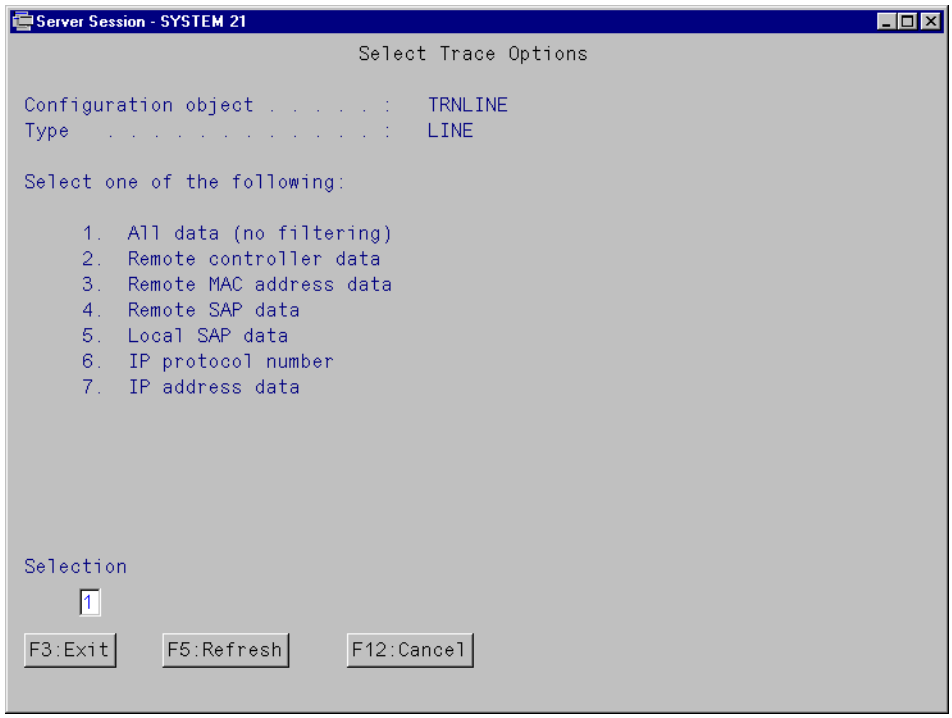

Figure 197. Select Trace Options (V4R1 or higher releases)

When running the trace for an extended period of time, you should select the appropriate filtering option to reduce the amount of data collected. Use option 2 for SNA connections or option 7 for TCP/IP. For SNA, enter the controller name and, for TCP/IP, enter the IP address. Press Enter to return to the Work with Communications Traces display.

The trace is now active and recording data.

6. Re-create the problem to be traced. Then, end the trace and review the collected data.

Ending a communications trace

To end the communications trace, type option `2` (Stop trace) on the Work with Communication Traces display. Press Enter.

Formatting and printing a communications trace report

From the Work with Communication Traces display, perform the following steps:

1. Type a `6` in the option field next to the trace to be formatted. Press Enter.

2. Format the trace as required depending on the protocol. Figure 198 shows the Format Trace Data screen. In this example, the trace is being formatted for TCP/IP data.

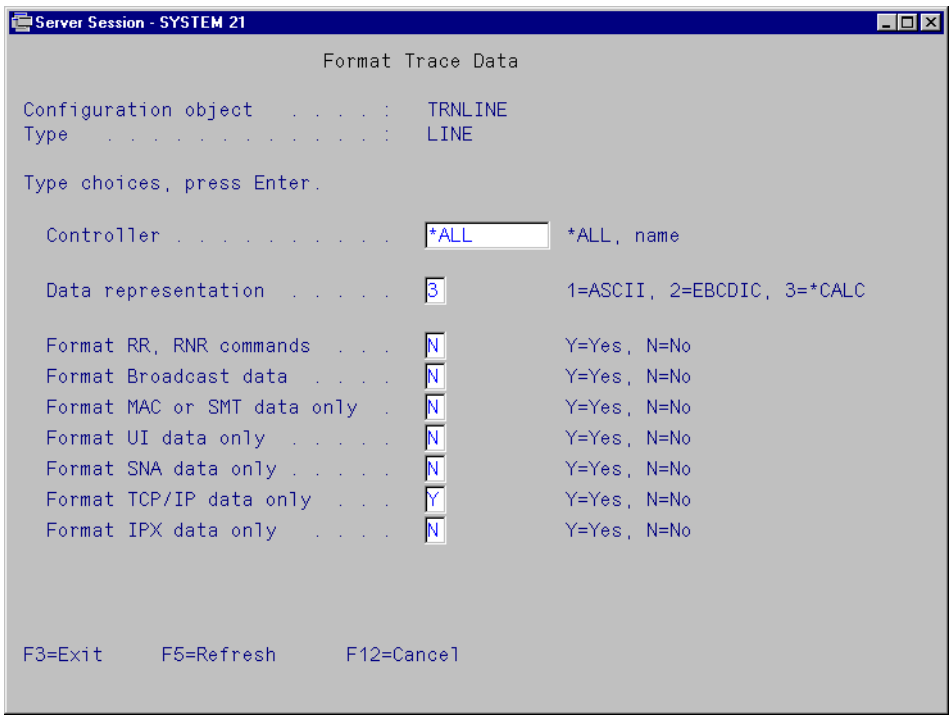

Figure 198. Format Trace Data

3. Press Enter to format the trace. Wait for the message `Format of trace data complete`, at which point a spooled file is produced.
4. Press F3 three times to reach the Exit System Service Tools display.
5. Press Enter to end the STRSST command.
6. Type the `WRKSPLF` command, and press Enter to access the formatted trace.

Note

Interpreting the information on the communications trace requires a specialist's knowledge. The formatted trace will normally be forwarded to Geac or IBM for analysis and review by specially trained personnel.

10.2.4 AS/400 database query optimization tools

The AS/400 database has a sophisticated methodology for query optimization. Usage of certain tools are essential for analyzing the optimizer behavior. These tools are required to determine what user-written queries or SQL statements are doing, and how the optimizer is processing them.

Use the following tools to analyze your queries and the optimizer:

- Database monitor statistics
- Print SQL information command
- Query optimizer debug messages
- Change query attributes

10.2.4.1 Database monitor statistics

Database monitor logs all information and statistics about queries being run by a particular job or at a system level. The Start Database Monitor (STRDBMON) command is used to start the monitor, and the End Database Monitor (ENDDBMON) command is used to end it. The database monitor can also be started with the STRPFRMON command by using the DBMON parameter.

Figure 199 shows an example of the STRDBMON command.

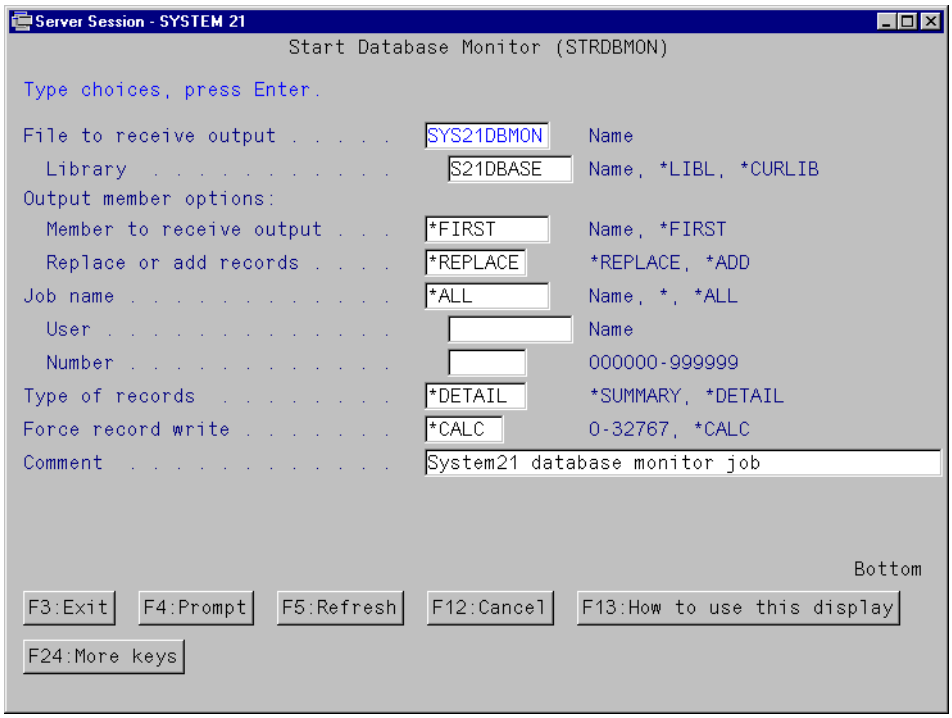

Figure 199. Start Database Monitor

The monitor can be specified for a specific job or all the jobs on the system, with statistics placed in the output database file specified on the command. Records in the output database files are uniquely identified by their record identification number.

Each job in the system can be monitored concurrently by two monitors: one monitor for the specific job and one for all jobs on the system.

Some of the database information collected includes:

- System and job name
- SQL statement and sub-select number
- Start and end time stamp
- Estimated processing time
- Total rows in file queried
- Number of rows selected
- Estimated number of rows selected
- Estimated number of joined rows
- Key fields for advised index
- Total optimization time

- Join type and method
- ODP implementation

Running the database monitor allows you to answer key questions relative to your database, including:

- How many queries perform dynamic replans?
- How many temporary indexes were created over a particular file?
- Which queries are the most time consuming?
- Which user is running those queries?
- Which queries were implemented using reusable open data paths (ODPs)?
- Does a particular PTF apply the users?
- Has the implementation of a particular query changed with the application of a PTF or a new release?

The answers to these questions are found by querying the information collected by the database monitor.

The database monitor data is collected in 14 different records (13 records if *SUMMARY data was collected). Section 1.4.7 in *DB2 for AS/400 Database Programming*, SC41-5701, gives you a detailed description of each record type. Before you start analyzing these records, you may have to create individual logical files for each record type.

Source DDS for each database monitor logical file is given in Section 1.4.7.7 of *DB2 for AS/400 Database Programming*, SC41-5701. Create these source file members in a library of your choice. Then, create logical files for the collected database monitor data using the source file members.

After you create the logical files, you can start the database access analysis. A number of database monitor examples are provided in Section 1.4.7.5 of *DB2 for AS/400 Database Programming*, SC41-5701. You can use these examples to build your own queries and reports.

10.2.4.2 Useful tips for database monitor analysis

The database monitor collects an extensive amount of data. To simplify the analysis, this section provides information on the most often used record types and fields, as well as example analysis queries.

The most commonly used DB Monitor records types are:

- **1000**: SQL summary record
- **3000**: Arrival sequence
- **3001**: Using existing index
- **3002**: Index created
- **3003**: Query sort
- **3006**: Access path rebuilt
- **3007**: Index optimization data
- **3010**: Host variable and ODP implementation

The fields QQJOB (Job name), QQUSER (Job user name), QQJNUM (Job number), and QQTIME (Time that the record was created) are common to all these record types. The commonly used fields in these record types are explained in the following list, with some performance analysis examples:

- **Record Type 1000**: SQL statement summary.

  This record type contains basic SQL query information for each SQL query operation (open, update, close, commit, and so on). The commonly used fields are:

  – **QQ1000**: Prepared text for SQL statement
  – **QQC21**: Type of SQL operation (OP, FE, CL, UP, IN, DL...)
  – **QQI2**: Number of rows fetched (only on FE records)
  – **QQI3**: Number of rows updated, inserted, or deleted
  – **QQI5**: Refresh counter
  – **QQI4**: Elapsed time for this operation in milliseconds
  – **QQSTIM**: Time stamp for start SQL operation
  – **QQETIM**: Time stamp for end of SQL operation

  If you need to identify jobs that need further analysis, you can run the following query on this record type:

```
SELECT SUM(QQI4), COUNT(*), QQJOB, QQUSER, QQJNUM
FROM QAPMDBMON
WHERE QQRID = 1000
GROUP BY QQJOB, QQUSER, QQJNUM ORDER BY 1 DESC
```

  To find which SQL operations account for the most run time for selected jobs, you may run this query:

```
SELECT SUM(QQI4), COUNT(*), QQC21
FROM QAPMDBMON
WHERE QQRID = 1000 AND QQJNUM ='job_number'
GROUP BY QQC21 ORDER BY 1 DESC
```

- **Record Type 3000**: Arrival Sequence (Table Scan)

  This record type identifies queries where an entire table is scanned without using an index. This is generally OK in cases where a large portion of the file is selected or if the file contains a small number of records.

  – **QQPTFN**: File name.
  – **QQPTLN**: File library name.
  – **QQTOTR**: Number of rows in a table (use to determine if a table scan is for a significant number of rows).
  – **QQRCOD**: Reason code (why the arrival sequence was chosen).
  – **QQIDXA**: Index advised (Y or N). If “N”, QQI2 and QQIDXD do not contain data. Index is not be advised if an index for these keys already exists.
  – **QQI2**: Number of primary keys in QQIDXD field.
  – **QQIDXD**: Suggested keys for index (selection only).

  For example, if you run the following query, you can list the advised indexes for all those SQL queries that performed a table scan (selection only):

```
SELECT QQTLN, QQTFN, QQIDXD
FROM QAPMDBMON WHERE QQRID = 3000
AND QQIDXA = 'Y'
```

  To determine which queries involve an arrival sequence, you can use the following code:

```
SELECT SUM(QQI4), COUNT(*), QQUCNT,QQ1000
FROM QAPMDBMON WHERE QQJNUM ='job_number'
AND QQRID = 1000
```

```
AND QQUCNT IN (SELECT DISTINCT QQUCNT FROM QAPMDBMON WHERE QQRID = 3000 AND
QQJNUM ='job_number')
GROUP BY QQUCNT, QQ1000 ORDER BY 1 DESC
```

- **Record Type 3001**: Using Existing Index

  This record type shows the file and index that are used to access a file, and why it was chosen. If the index was chosen for join, additional information is given to help determine how the file "fits" in the join. The order of 3001 records indicates the join order chosen by the optimizer:

  – **QQPTFN**: File name (*N indicates a temporary results table)
  – **QQPTLN**: File library name (blank if the file name is *N)
  – **QQIFNM**: Name of the selected index (may be *TEMP)
  – **QQILNM**: Index library name (blank if the index name is *TEMP)
  – **QQRCOD**: Reason the index was selected
  – **QQC21**: Join method (NL, MF, HJ)
  – **QQC22**: Join type (IN, PO, EX)
  – **QQC23**: Join operator (EQ, LT, GT, CP, and so on)
  – **QQTOTR**: Number of rows in the table
  – **QQAJN**: Estimated number of joined rows from this table
  – **QQIDXA**: Index advised (Y or N)
  – **QQI2**: Number of suggested primary keys in the QQIDXD field
  – **QQIDXD**: Recommended primary and secondary keys for index on this table

- **Record Type 3002**: Index Create

  This record type contains data on the temporary indexes created for running a query. The reason for temporary index creation is placed in the record type 3007:

  – **QQPTFN**: Table name for which the index is built. Name of *N indicates temporary results table (3004 record). Index build is unavoidable.

  – **QQPTLN**: Table library name (blank if file name is *N).

  – **QQIFNM**: Name of index. Will be blank if index is built over the entire table. Will contain the index name if an index from the index build occurred.

  – **QQILNM**: Index library name (blank if built on entire table).

  – **QQRCOD**: Reason the index build was done.

  – **QQTOTR**: Number of rows in a table.

  – **QQRIDX**: Number of entries in a temporary index.

  – **QQ1000**: Contains join, order by, or group by keys used in the index build.

  – **QQSTIM**: Time stamp for start of index build.

  – **QQETIM**: Time stamp for end of index build.

  – **QQETIM**: QQSTIM shows the elapsed time for the index build.

  – **QQI2**: Number of primary selection keys in QQIDXD.

  – **QQIDXD**: Suggested primary and secondary keys for index.

For example, you may use the following query to determine which indexes are built most often:

```
SELECT QQUCNT, QQETIM-QQSTIM, QQPTFN, QQTOTR, QQRIDX, QQRCOD,
QQIDXA, SUBSTR(QQ1000, 1, 100), SUBSTR(QQIDXD, 1, 200)
FROM QAPMDBMON
WHERE QQRID = 3002 AND QQIDXA = 'Y'
ORDER BY 2 DESC
```

- **Record Type 3003**: Query Sort
  - **QQSTIM**: Time stamp for start of refill and sort.
  - **QQETIM**: Time stamp for end of refill and sort.
  - **QQRCOD**: Reason for choosing query sort.
  - **QQRSS**: Number of rows in sort space.
- **Record Type 3006**: Access Plan Rebuild

  QQRCOD field lists the reason the replan is occurring.
- **Record Type 3007**: Index Optimization and Selection

  This record type shows all indexes that are evaluated for a given file, including which one (if any) was selected for use in this query and which were not (and why).
  - **QQPTFN**: File name
  - **QQPTLN**: File library name
  - **QQC11**: Optimizer timed out (Y or N)
  - **QQ1000**: Contains library qualified index names, each with a reason code
- **Record Type 3010**: Host Variable and ODP Implementation

  This record type shows the substitution values for the host variables or parameter markers in the query text:
  - **QQ1000**: Host variable or parameter marker values.
  - **QQI5**: Refresh count (use to link to specific query instance).

Note

The Query Optimizer analyzes the record selection in the query and determines, based on the default estimate, if the creation of a permanent index can improve performance. If a permanent index can be beneficial, it returns the key fields necessary to create this index. The index advisor information can be found in debug message CPI432F or in the Database Monitor records QQQ3000, QQQ3001, and QQQ3002.

10.2.4.3 Print SQL Information command

Print SQL Information (PRTSQLINF) command allows you to print the SQL information contained within a program, SQL package, or service program. A spooled file is created that contains SQL statements, the type of access plan used by each statement, and such commands as CRTSQLxxx used to invoke the SQL precompiler. The output information is similar to the debug messages.

Use the `PRTSQLINF` command with object type `*PGM` to print the SQL information associated with the program. Figure 200 on page 340 shows an example of the PRTSQLINF command.

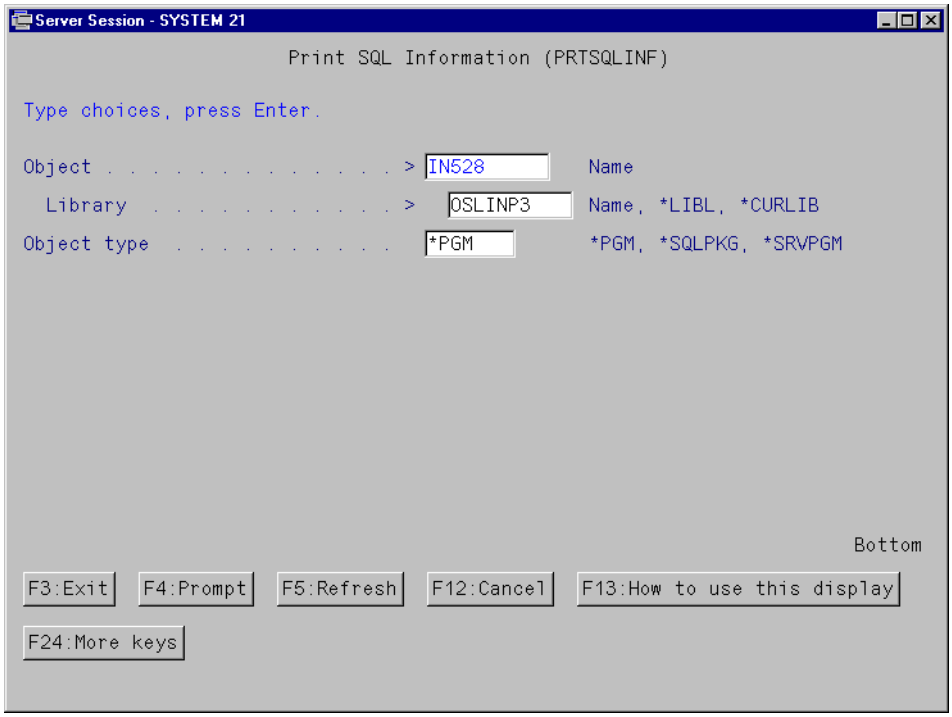

Figure 200. Print SQL Information display

Figure 201 shows an example of a PRTSQLINF report.

```
5769SS1 V4R4M0 990521     Print SQL information          Program OSLINP3/IN528
Object name................OSLINP3/IN528
Object type................*PGM
  CRTSQLRPG
      PGM(OSLINP3/IN528)
      SRCFILE(OSLINX3/QRPGSRC)
      SRCMBR(IN528)
      COMMIT(*NONE)
      OPTION(*SYS *PERIOD)
      TEXT('Purge Routine                                    ')
DECLARE C_INP19_W CURSOR FOR SELECT A . APID19 , B . AUFL19 , B . NDAY19 , B .
    AFDF19 , A . INCL19 FROM INP19W A , INP19 B WHERE A . CONO19 = : L#CONO AND A .
    CONO19 = B . CONO19 AND A . APID19 = B . APID19 AND B . INCL19 = '1' AND B .
    RCTP19 = '2' AND B . AUFL19 <> : BLANKA AND B . AFDF19 <> : BLANKA ORDER BY A .
    APID19
  SQL4021  Access plan last saved on 11/14/97 at 10:31:26.
  SQL4020  Estimated query run time is 1 seconds.
  SQL4017  Host variables implemented as reusable ODP.
  SQL4007  Query implementation for join position 1 file 1.
  SQL4008  Access path INP19WL1 used for file 1.
  SQL4011  Key row positioning used on file 1.
  SQL4007  Query implementation for join position 2 file 2.
  SQL4006  All access paths considered for file 2.
  SQL4008  Access path INP19L02 used for file 2.
  SQL4014  2 join field pair(s) are used for this join position.
  SQL4015  From-field 1.CONO19, to-field 2.CONO19, join operator EQ, join predicate 1.
  SQL4015  From-field 1.APID19, to-field 2.APID19, join operator EQ, join predicate 2.
DECLARE C_INP19_ALL CURSOR FOR SELECT APID19 , AUFL19 , NDAY19 , AFDF19 , '0'
    FROM INP19 WHERE CONO19 = : L#CONO AND INCL19 = '1' AND RCTP19 = '2' AND AUFL19
    <> : BLANKA AND AFDF19 <> : BLANKA
  SQL4021  Access plan last saved on 11/14/97 at 10:54:57.
```

Figure 201. Print SQL Information example

The time stamp on the access plan represents when the plan was last updated. In a stable environment, this should correspond to the time the application was first run. In an environment where a significant number of records or rows are added or deleted, or index fields are updated, the Query Optimizer may determine that

the access plan is no longer efficient and change the time stamp when the file is opened next.

The access method identified in the access plan may help to identify the need to create new logical views, for example, to improve performance. If the access method chosen at program creation time is already known to not be appropriate, you can create the appropriate index or logical view before you go into production mode.

Remember, when using AS/400 Extended Dynamic SQL, the order of the SQL statements within the package are the order in which they were received by the AS/400 Query Optimizer. The time stamps represent the last time the access plan for the same statement was updated. This update occurs during file or table open processing.

10.2.4.4 Debug messages

Debug messages issue informational messages to the job log about the implementation of a query. The messages describe query implementation methods such as indexes, file join orders, temporary results, access plans, and Open Data Paths (ODPs).

The messages explain what happened during the query optimization. They also explain details, such as why an index was used, or why a temporary result was required. It shows the join order of the files and the index suggested by the optimizer.

To run a selected SQL statement (or query) in debug mode, use the following command:

```
STRDBG UPDPROD(*YES)
```

When you run this command, most of the SQL optimizer messages are displayed in the job log. The Query Optimizer provides you with information messages on the current query processing. Display the job log by using `DSPJOBLOG` command to see the optimizer messages. Figure 202 on page 342 shows the resulting display.

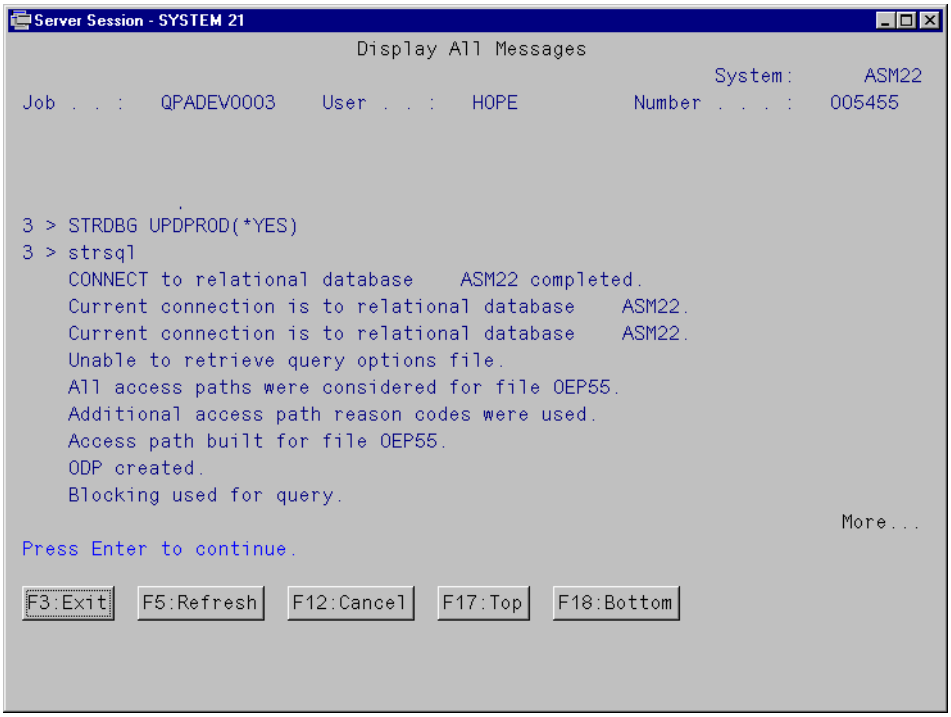

Figure 202. First level text of job log messages

If you need additional information on what the optimizer did, for example, why the access path was built, analyze the messages by pressing using the Help key (F1) for the second level text. When you position the cursor on the “Access path built for file OEP55” message in Figure 202 and press F1, the display shown in Figure 203 appears.

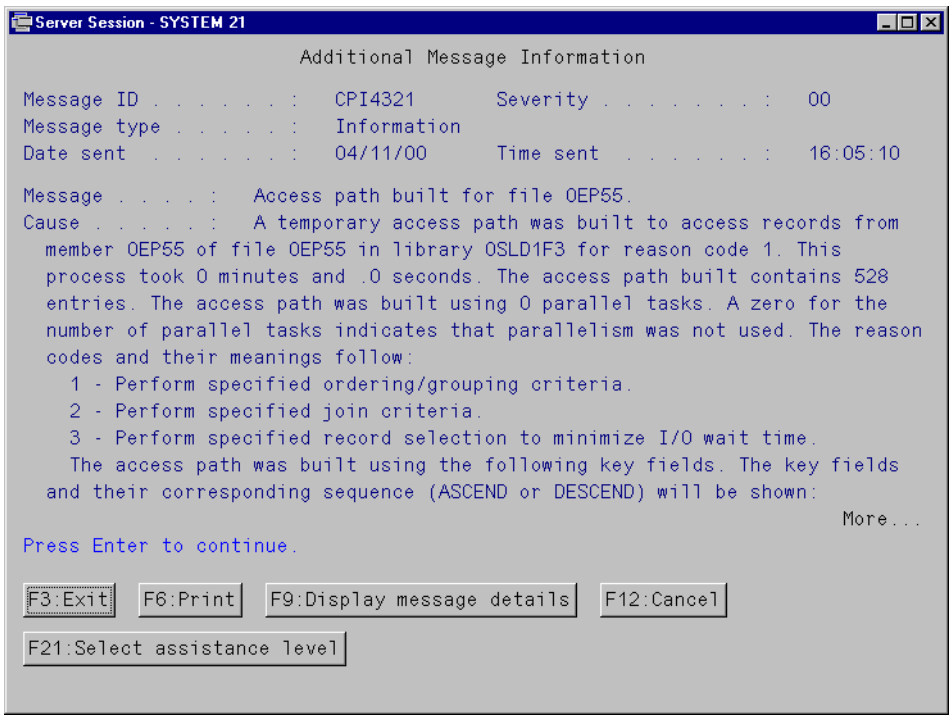

Figure 203. Second level text of job log messages

You can evaluate the structure and performance of the given SQL statement in your programs using the informational messages entered in the job log. For a complete list of optimizer messages and their interpretation, refer to Section 1.4.4 in *DB2 for AS/400 Database Programming*, SC41-5701.

Note

Before running an SQL statement, you can set the time limit of ZERO for the QRYTIMLMT parameter in the CHGQRYA command. The Query Optimizer messages are written to the job log prior to the actual execution of the query. You get all of the optimizer messages without actually running the query.

10.2.4.5 Query attributes

A user can change the attributes of a query during the execution of a job. Some of the attributes that can be modified include:

- Query processing time limit
- Parallel processing degree
- Number of tasks
- Asynchronous job
- Apply CHGQRYA to remote

It is important to remember that the query time limit is checked against the estimated elapsed query time before initiating a query. The inquiry message CPA4259 is displayed showing the predicted runtime and the operations that the query will perform. A time limit of zero is used to see the optimization messages without actually running the queries. Debug messages are written to the job log if the query is canceled.

To change query attributes for the current job, enter the following command:

```
CHGQRYA
```

Figure 204 on page 344 shows the CHGQRYA screen.

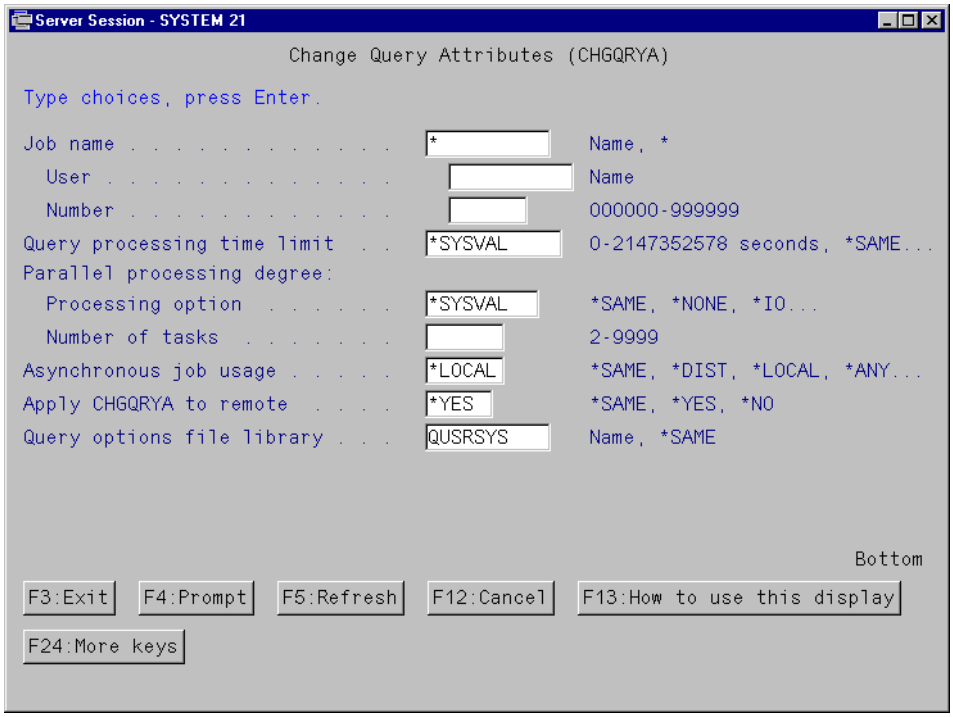

Figure 204. Change Query Attributes (for the current job)

10.2.4.6 Comparison of optimization analysis methods

Table 56 compares the features and optimization tools discussed in the previous sections.

Table 56. Comparison of optimization analysis methods

PRTSQLINF	STRDBG/CHGQRYA	STRDBMON
Available without running query (after an access plan is created).	Only available when the query is run.	Only available when the query is run.
Displayed for all queries in the SQL program, regardless of whether it is executed.	Displayed only for those queries that are executed.	Displayed only for those queries that are executed.
Information on the host variable implementation.	Limited information on the implementation of host variables.	All information on host variables, implementation, and values
Available only to SQL users with programs, packages, or service programs.	Available to all query users (OPNQRYF, QUERY/400, SQL).	Available to all query users (OPNQRYF, QUERY/400, and SQL).
Messages printed to spooled file.	Messages displayed in the job log.	Performance records are written to a database file.
Easier to tie messages to query with subqueries or unions.	Difficult to tie messages to query with subqueries or unions.	Uniquely identifies every query.

10.2.4.7 Database performance analysis with Operations Navigator

The *Database* component of Operations Navigator provides a graphical interface for many DB2 Universal Database (UDB) for AS/400 database operations, including:

- Creating and managing tables and views
- Creating and managing OS/400 journals (record changes to database and other functions supporting journals)
- Entering new or modifying already created SQL statements
- Running and debugging previously created SQL statements (referred to as *scripts*)
- Saving SQL statements for later use
- Performance analysis of your SQL statements

The Database component of AS/400 Operations Navigator is not installed by default when choosing the *Typical* installation option of IBM AS/400 Client Access Express. If it is not installed, you can run Selective Setup to install it.

With proper authorization to the database objects, the user of the database graphical interface has easy access to OS/400 server administration tools, has a clear overview of the entire database system, can perform remote database management, and receives assistance for complex tasks.

Figure 205 illustrates the main Operations Navigator access display. The available database management options are displayed in the right-hand panel.

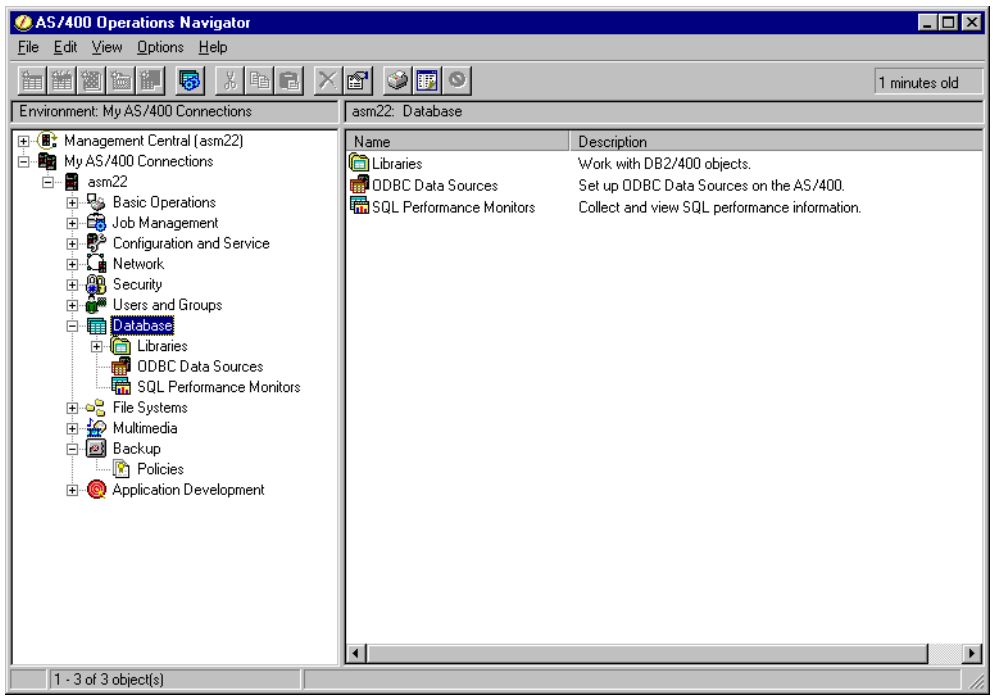

Figure 205. Operations Navigator Database functions

Operations Navigator, which was released with V4R4, is a very powerful SQL performance analysis tool. This support provides a graphical interface to IBM-supplied SQL queries for analyzing data collected by the Memory Resident

Database Monitor that was introduced in V4R3. In addition, the monitor can output optimizer messages equivalent to those displayed in debug mode. It can also monitor multiple jobs and show the executed SQL statements. This interface is referred to as the *SQL Performance Monitors*.

Further information on Operations Navigator can be found in *AS/400 Client Access Express for Windows: Implementing V4R4M0,* SG24-5191.

10.3 System 21 performance concepts

This section describes the basic performance concepts that apply to the implementation of System 21 on the AS/400 server.

10.3.1 Components affecting performance

The first step is to define the term *performance*. What is good performance? For a System 21 customer, the two main goals are:

- Acceptable response time
- Acceptable throughput

Acceptable response time refers to the interactive response time perceived by each user. *Acceptable throughput* refers to the system's overall performance. Examples of throughput include:

- Order lines processed per hour
- Time to complete a large batch job
- Time to complete a backup

Response time can be defined as the elapsed time (t_1-t_0) from the moment a user presses a key on the keyboard (the user interface goes into a lock state), until the moment the user interface is ready to receive the next input (Figure 206).

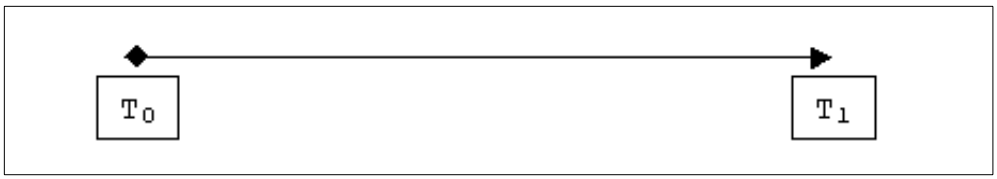

Figure 206. Response time

The response time can be divided into the components shown in Figure 207.

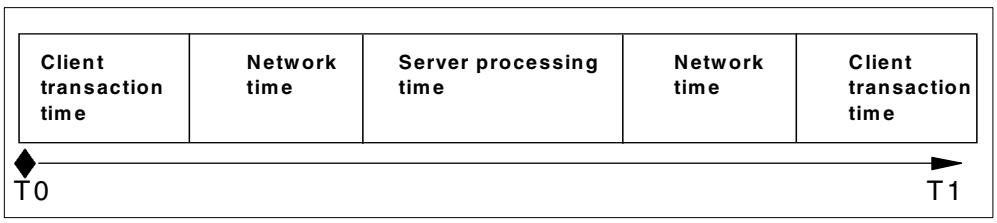

Figure 207. Response time components

By dividing the response time in this manner, these key components are identified:

- **Client**: A PC, network computer, a 5250 terminal, or a data collection device
- **Network**: LAN or WAN
- **Server**: AS/400 system

10.3.2 The client

In a System 21 installation, you run either the graphical user interface System 21 Explorer or a standard 5250 character-based interface. System 21 Explorer may run on clients using either Microsoft Windows NT 4.0 , Microsoft Windows 95/98 or Microsoft Windows 2000.

10.3.3 Network

Network design, setup, and tuning are key to achieving good performance. The network can often be the slowest link in the system. You need to consider this as part of the original design and implementation to achieve the performance objectives. Typically, you can achieve this by reducing the amount of WAN network traffic and optimizing the LAN network traffic.

For TCP/IP communications, the main performance parameters that you can change on the AS/400 system are the maximum transmission unit size, and the send and receive buffer size. These are described as follows:

- **Maximum Transmission Unit (MTU) Size**: Specifies the maximum size (in bytes) of IP datagrams that can be transmitted through this route.

  Use the Change TCP/IP Route (CHGTCPRTE) command to set the MTU value to *IFC. This means that the MTU is the MTU of the interface that is associated with this route (Figure 208).

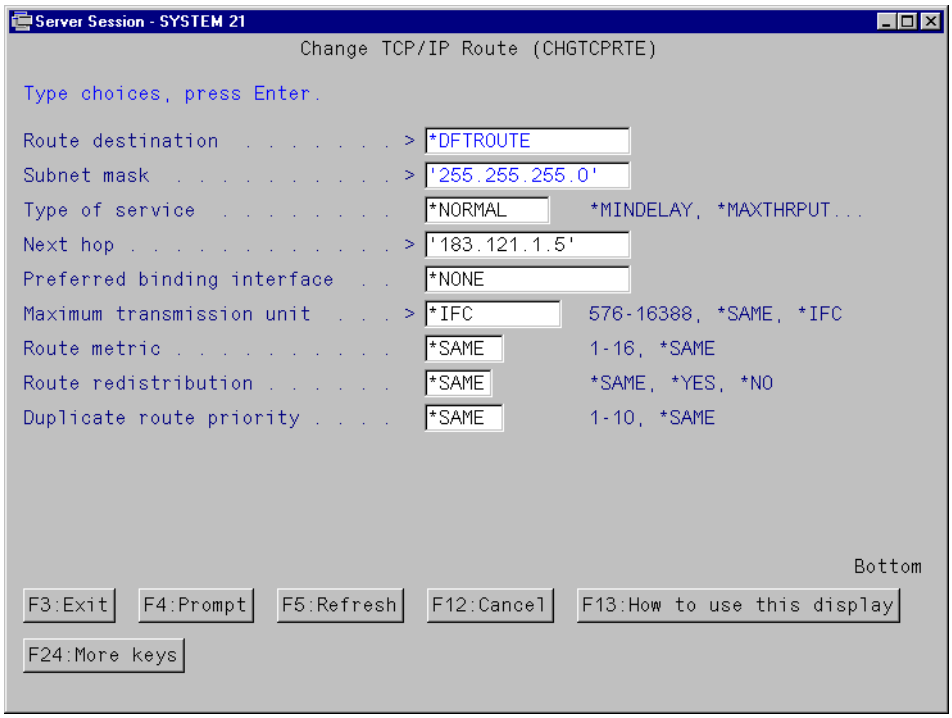

Figure 208. Change TCP/IP Route display

- **Buffer Size**: Use the Change TIP/IP Attributes (CHGTCPA) command to set the TCP/IP buffer size to 64K (Figure 209).

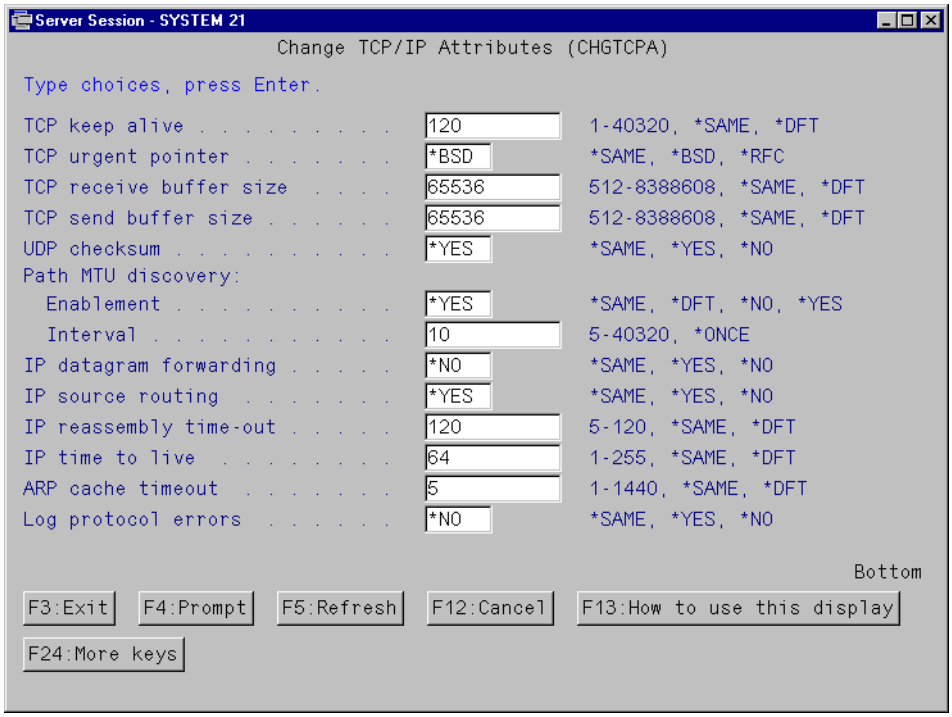

Figure 209. Change TCP/IP Attributes display

For a more comprehensive review of AS/400 communications performance, refer to *AS/400 Communication Performance Investigation,* SG24-4895.

10.3.4 Server

The server for a System 21 customer is an AS/400e server. The following four components affect the performance of the server:

- Communication interface
- CPU
- Auxiliary storage (disk)
- Main storage (memory)

10.3.4.1 CPU and CPW metric

Selecting the right AS/400 server for a customer is based on:

- The anticipated daily workload throughput requirements
- The workload composition

With the nature of the current server architecture, it is essential to determine the extent of both the interactive and client/server workload components.

While new customers buy AS/400 RISC systems, there are still some customers who use the older CISC systems. The relative performance metric used to rate all of the systems is called the Commercial Processing Workload (CPW). This metric replaces the older RAMP-C metric. The CPW workload is a modified implementation of the TPC-C workload. It is not representative of either IBM or other vendor optimized implementations. However, it is more representative of a

sophisticated commercial processing workload than the earlier RAMP-C workload.

10.3.4.2 Server response time

Server response time is generally considered as the time taken from the receipt of a request at the AS/400 communications interface, to the exit of that request from the communication interface back to the user. In this context, response time is internal to the system, not end to end.

Once in the system, the internal transaction response time consists of the following key components:

- CPU service time
- Synchronous disk access time
- Wait time

When you use the Performance Tools System Report, you can determine the CPU seconds per transaction and the synchronous disk I/Os per transaction. The disk service time is known, so you can calculate the total time spent doing disk I/O. Use the following equation to determine the transaction *wait* time:

```
WtTm = AvRt- (CpuTran + DskWt)
```

The variable definitions are:

- **WtTm**: Total transaction wait time
- **AvRt**: Average response time per transaction
- **CpuTran**: Average CPU seconds per transaction
- **DskWt**: Total disk wait time

In the context of this equation, wait time represents the consolidation of a number of components including:

- Queuing time
- Lock waits
- Seize conflicts
- Short wait
- Short wait extended (long wait)

Transactions that display a long wait time component as part of the overall response time are candidates for performance investigation.

10.3.4.3 CPW metric and the System 21 workload

Results of extensive tests, where various AS/400 servers were running the same and different application workloads, have suggested a strong correlation between the CPW metric and the System 21 application workload. Figure 210 on page 350 shows a correlation of CPW throughput and CPU utilization in these tests.

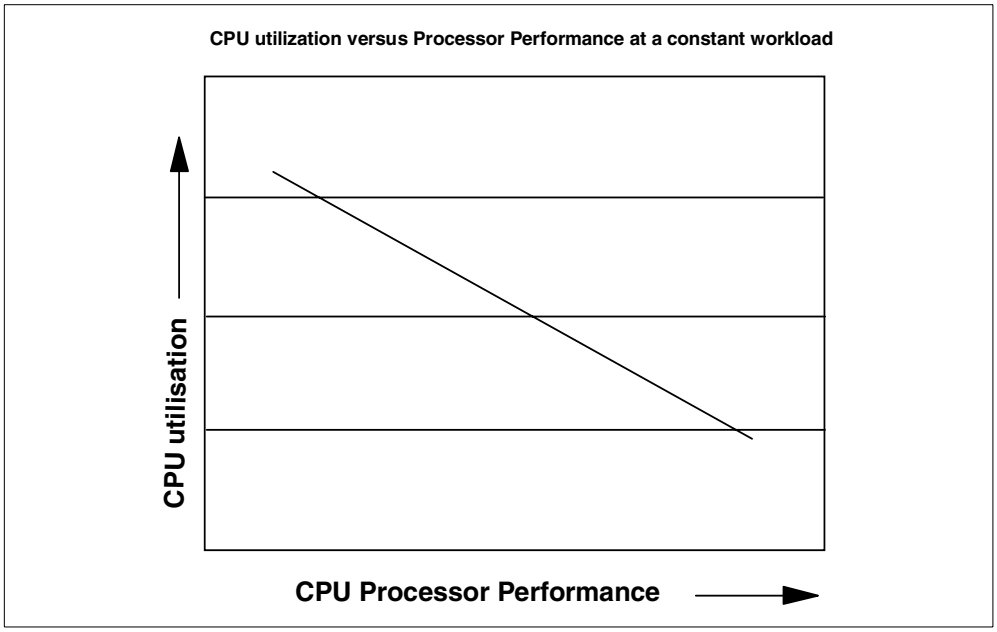

Figure 210. CPU utilization versus CPW value at a constant System 21 workload

This means that you can use the CPW value to estimate System 21 workload throughput. This also implies that the System 21 BEST/1 workload models are reasonably accurate for predicting system throughput.

10.3.4.4 N-way processor system

As technology continues to advance, it will be more increasingly common for System 21 customers to buy an AS/400 server with more than one CPU. These are referred to as *N-way* systems. N-way systems have a number of servers serving a single queue (OS/400 has only one task dispatching queue irrespective of the number of processors). Processor utilization may be a function of all of the processors in the system, or a subset of these if Logical Partitioning (LPAR) has been implemented.

In most cases, changing to an N-way system reduces the queuing multiplier, which increases workload throughput and *elapsed* response time. For example, transporting 500 people on a bus with a capacity of 50 will require ten trips. The same operation with two buses will require five trips. The time for each journey will not change, but the elapsed time for the entire process will reduce by fifty percent. This concept is particularly important to understand in cases where adding an extra CPU will *not* improve performance:

- **Long response time and low processor utilization**: In this case, adding more processors will not enhance performance. Look for other bottlenecks in the system, such as high disk utilization, record locking, and memory availability.
- **A single-threaded job**: The current System 21 application does not provide native support for multi-threaded jobs. Multi-threading allows a single job to execute simultaneously on multiple CPUs. If a job is running for a long period of time with low processor contention, adding an extra CPU will not improve throughput or run time. This applies to large batch jobs such as MRP, MPS, and call list generation.

- **Interactive response times**: Upgrading a single CPU server to a single CPU server with a higher CPW rating may improve response time (although it may not be visible to the naked eye). Upgrading a single CPU server to an N-way server, where the average CPW rating for each N-way processor is less than or equal to the CPW rating for the single CPU processor, will not improve response times.
- **Jobs with a high degree of disk I/O**: Jobs undertaking a high degree of disk I/O may not be processor constrained. Disk service time and arm contention may be responsible for a considerable performance overhead.

10.3.4.5 CPU utilization

On traditional AS/400 systems (systems with single CPW rating), interactive response times became unacceptable beyond a total interactive utilization of 70%. This limitation was not system imposed. It was related to the queuing theory that is outlined in 10.1.1, “Queuing concepts” on page 307.

With the introduction of the AS/400e server, the concept of a *processor* and an *interactive* feature was introduced. In general, the maximum interactive feature supported by a particular server model does not represent a utilization in excess of 70% for the overall processor feature. However, in certain situations, it is possible to order an interactive feature with the same capacity as the processor feature. In this case, the queuing theory will still apply to interactive response times.

The impact of the queuing theory is modified on N-way systems. Table 56 illustrates the affect of multiple processors on the CPU utilization guideline.

Table 57. Affect of N-way systems on the queuing multiplier and CPU utilization

Number of processors	CPU utilization at guideline (‘knee’)
1 - way	70%
2 - way	76%
4 - way	81%
8 - way	89%
12 - way	92%

It is clear that for a server with a single processor, interactive utilization should not exceed 70% of the capacity of the overall processor feature. However, on larger systems supporting multiple processors, this number can be extended up to 92% (for 12-way). This increase in capacity is attributed to the affect of multiple servers in the queuing theory.

The ability to support an interactive capability up to 92% on N-way machines introduces a potential throughput constraint. Within System 21, a business workload profile will contain an essential component of both interactive and batch processing. For example, there is little point in accepting Sales Orders if you cannot produce the pick notes. Each element is essential to the operation of the business. If you use 92% of the total system capacity for interactive processing, you will invariably introduce a batch workload constraint. The batch processing component required to support an interactive throughput of this order of magnitude will invariably be greater than 8%.

Workload balancing is an essential part of every System 21 implementation. You must make sure that for a known level of interactive workload, your system has sufficient capacity to support the associated batch throughput. This is particularly important as the use of Business Intelligence tools increases.

10.3.4.6 The Dynamic Priority Scheduler

On an AS/400 CISC-model, all ready-to-run OS/400 jobs and Licensed Internal Code (LIC) tasks are sequenced on the Task Dispatching Queue (TDQ) based on priority assigned at creation time. In addition, for N-way models, there is a cache affinity field used by Horizontal Licensed Internal Code (HLIC) to keep track of the processor on which the job was most recently active. A job is assigned to the processor for which it has cache affinity, unless that would result in a processor remaining idle or an excessive number of higher-priority jobs being skipped. The priority of jobs varies very little such that the resequencing for execution only affects jobs of the same initially assigned priority. This is referred to as Fixed Priority Scheduling.

With the introduction of the AS/400 RISC-based model came a new algorithm called *Dynamic Priority Scheduling*. This new scheduler schedules jobs according to “delay costs” dynamically computed based on their time waiting in the TDQ as well as priority. The job priority may be adjusted if it exceeded its resource usage limit. The cache affinity field is no longer used in an N-way multiprocessor machine. Thus, on an N-way multiprocessor machine, a job will have equal affinity for all processors, based only on delay cost.

A new system value, QDYNPTYSCD, has been implemented to select the type of job dispatching. The Job Scheduler uses this system value to determine the algorithm for scheduling jobs running on the system. The default for this system value is to use Dynamic Priority Scheduling (set to “1”). This scheduling scheme allows the CPU resource to be spread to all jobs in the system.

The benefits of Dynamic Priority Scheduling are:

- No job or set of jobs will monopolize the CPU.
- Low priority jobs, like batch, will have a chance to process.
- Jobs that use too much resource will be penalized by having their priority reduced.
- Job response time/throughput will still behave much like fixed priority scheduling.

By providing this type of scheduling, long running, batch-type interactive transactions, such as a query, will not run at priority 20 all the time. In addition, batch jobs will acquire some CPU resources rather than interactive jobs running at high CPU utilization and delivering response times that may be faster than required.

To use Fixed Priority Scheduling, the system value (QDYNPTYSCD) has to be set to “0”.

Delay cost uses these terms:

- **Delay cost**: Delay cost refers to how expensive it is to keep a job in the system. The longer a job spends in the system waiting for resources, the larger its delay cost is. The higher the delay cost is, the higher the priority is.

Just like the priority value, jobs of higher delay cost will be dispatched ahead of other jobs of relatively lower delay cost.

- **Waiting time**: The waiting time is used to determine the delay cost of a job at a particular time. The waiting time of a job that affects the cost is the time that the job has been waiting on the TDQ for execution.
- **Delay cost curves**: The end-user interface for setting job priorities has not changed. However, internally the priority of a job is mapped to a set of delay cost curves (see the “Priority mapping to Delay cost curves” section below). The delay cost curve is used to determine a job's delay cost based on how long it has been waiting on the TDQ. This delay cost is then used to dynamically adjust the job's priority, and as a result, possibly the position of the job in the TDQ.

  On a lightly loaded system, the jobs' cost will basically stay at their initial point. The jobs will not climb the curve. As the workload is increased, the jobs will start to climb their curves, but will have little, if any, effect on dispatching. When the workload reaches around 80 to 90% CPU utilization, some of the jobs on lower slope curves (lower priority), begin to overtake jobs on higher slope curves which have only been on the dispatcher for a short time. This is when the Dynamic Priority Scheduler begins to benefit as it prevents starvation of the lower priority jobs. When the CPU utilization is at a point of saturation, the lower priority jobs are climbing quite a way up the curve and interacting with other curves all the time. This is when the Dynamic Priority Scheduler works the best.

  Note that when a job begins to execute, its cost is constant at the value it had when it began executing.

  This allows other jobs on the same curve to eventually catch-up and benefit from part of the CPU. Once the job has executed, it “slides” down the curve it is on, to the start of the curve.

Priority mapping to delay cost curves

The mapping scheme divides the 99 “user” job priorities into two categories:

- **User priorities 0-9**: This range of priorities is meant for critical jobs such as system jobs. Jobs in this range will *not* be overtaken by user jobs of lower priorities. You should not assign long-running, resource-intensive jobs within this range of priorities.
- **User priorities 10-99**: This range of priorities is meant for jobs that will execute in the system with dynamic priorities. The dispatching priorities of jobs in this range will change depending on waiting time in the TDQ if the QDYNPTYSCD system value is set to “1”.

  The priorities in this range are divided into groups:

  – Priority 10-16
  – Priority 17-22
  – Priority 23-35
  – Priority 36-46
  – Priority 47-51
  – Priority 52-89
  – Priority 90-99

  Jobs in the same group will have the same resource (CPU seconds and Disk I/O requests) usage limits. Internally, each group will be associated with one

set of delay cost curves. This would give some preferential treatment to jobs of higher user priorities at low system utilization.

With this mapping scheme, and using the default priorities of 20 for interactive jobs and 50 for batch jobs, users will see that the relative performance for interactive jobs will be better than that of batch jobs, without CPU starvation.

Benefits of Dynamic Priority Scheduling
Some of the main benefits of using Dynamic Priority Scheduling are:

- No single CPU-intensive interactive job will “take over” the system resources.
- Batch jobs will obtain CPU resources with less of an impact to your interactive jobs. The batch job gets more CPU utilization and consequently a shorter run time.
- Overall system performance is increased.

For additional information on the Dynamic Priority Scheduler, refer to the *Work Management Guid*e, SC41-5306.

10.3.5 Main storage tuning

As part of AS/400 tuning, you have the ability to tune the main storage by:

- Assigning storage pools to subsystems
- Separating different job types from running in the same storage pool
- Adjusting the size of allocated storage, manually or automatically
- Adjusting the activity level, manually or automatically

All of these tasks assist in achieving a good job environment and help to reduce the impact of page faulting, which introduces these terms:

Page fault	A notification that occurs when an address that is not in main storage (memory) is referenced by an active program.
Database (DB)	Occurs when referencing database data or access paths.
Non-database (NDB)	Refers to objects other than database objects. NDB pages include programs, data queues, configuration objects, and internal space objects.

When either fault occurs, the job must wait for the necessary information to be transferred from disk to main storage.

The Work with System Status (WRKSYSSTS) command provides details of page faulting and job transitions for each main storage pool. To view these details, the assistance level should be set to intermediate (2) or advanced (3). Use the following guidelines to determine acceptable levels of faulting and Wait to Ineligible (W->I) transitions:

- The machine pool (pool 1) should have fewer than 10 faults per second (sum of DB and NDB faults). Increase the pool by 10% until the faults per second are satisfactory.
- If your machine pool is experiencing low page fault rates (less than 0.4), decrease the size of the machine pool. If the page fault rate is this low, you may benefit from allocating the memory to other storage pools.

- If only system jobs and subsystem programs are running in *BASE pool, the fault rate for that pool should be less than 30 faults per second. To increase *BASE storage pool, you need to decrease the size of another storage pool.
- For interactive pools, the W->I should be less than 10% of A->W (Active to Wait) job transitions. If you see an increase in W->Is, increase the MAXACT parameter by increments of 5 until the W->I is 0. After each increase in the MAXACT value, press F10 to reset the statistics. You should wait at least one minute between refreshes (F5).
- For user pools, the fault rate alone is not necessarily a measure of good or poor performance. Response time and throughput are the actual measures of performance. Therefore, you should tune your pools by moving storage from pools with better performance to pools with poor performance. Continue to move the storage to the pool with poor performance until performance improves. Do not decrease a pool by more than 10% at one time.

10.3.5.1 Page faulting formula

Traditionally, the guidelines published in *OS/400 Work Management*, SC41-5306, have been used to determine the acceptable rate of page faulting in user pools. Starting with V4R1M0, use the faulting percent formula instead of these guidelines. This method calculates the overhead on response time as a result of page faulting.

To achieve a reasonable level of page faulting in user pools, determine how much paging is affecting the interactive response time or batch throughput. The following calculations illustrate the percentage of time spent making page faults.

> **Note**
>
> The following guidelines assume that interactive jobs are running in their own pool, and batch jobs are running in their own pool. All data can be gathered with the STRPFRMON command and printed with the PRTSYSRPT command.

- **Interactive jobs**:

```
FltRtTran = DiskRt * Flts / Tp (Average page faulting time per transaction)
Flt% = FltRtTran / Rt * 100 (Percentage of response time due to fault)
```

  The variables used in the formula are explained as follows:

  – **Flts**: Sum of database and non-database faults per second during a representative sample interval for the interactive pool.

  – **Rt**: Interactive response time for the interval.

  – **DiskRt**: Average disk response time for the interval.

  – **Tp**: Interactive throughput for the interval in transactions per second (transactions per hour/3600 seconds per hour).

  If Flt% is less than 10% of the total response time, there is not much potential benefit of adding storage to this interactive pool. However, if Flt% is 25% or more of the total response time, adding storage to the interactive pool may be beneficial.

- **Batch jobs**:

  ```
  Flt% = Flts * DiskRt * 100
  ```

  Flt% is the percentage of time spent page faulting in the batch pool. *Flts* is a sum of database and non-database faults per second during a representative sample interval for the batch pool. If multiple batch jobs are running concurrently, you need to divide Flt% by the number of concurrently running batch jobs:

  ```
  NewFlt% = Flt% / (Flt% + BatchCPU%)
  ```

  NewFlt% is the percentage of time the job is spent page faulting compared to the time it spends at the processor. *BatchCPU%* is batch CPU utilization for the sample interval. If higher priority jobs (other than the batch jobs in the pool you are analyzing) consume a high percentage of the processor time, *Flt%* is always low. This means adding storage may have a low impact, because most of the batch time is spent waiting for the processor. To eliminate this factor, divide Flt% by the sum of Flt% and BatchCPU% as shown in the previous example.

  Once again, if Flt% is less than 10%, the potential gain is low. If Flt% is greater than 25%, the gain is high enough to warrant moving main storage into this batch pool.

Examples 1 and 2 illustrate the impact of increasing main storage in a pool being utilized by interactive jobs:

- **Example 1**

  DiskRt = 0.020 seconds

  Flts = 50 faults per second

  Tp = 48,000/3600 = 13.33 transactions per second

  Rt = 0.80 seconds

  FltRtTran = 0.020 * 50 / 13.33 = 0.075

  Flt% = 0.075 / 0.80 * 100 = **9.3**% (no real benefit in adding storage)

- **Example 2**

  DiskRt = 0.040 seconds

  Flts = 100 faults per second

  Tp = 48,000/3600 = 13.33 transactions per second

  Rt = 0.80 seconds

  FltRtTran = 0.040 * 100 / 13.33 = 0.300

  Flt% = 0.30 / 0.80 * 100 = **37.5**% (considering adding more storage)

It is difficult to predict the improvement of adding storage to a pool, even if the calculated gain is thought to be high. In addition, these calculations are of limited value for pools that have Expert Cache turned on. Expert Cache can reduce I/Os with the addition of more main storage, although the I/Os may or may not be page faults.

10.3.5.2 Pool tuning

There are two main approaches to tuning user pools:

- **Automatic tuning**:

  Set the system value QPFRADJ to 2 or 3 to allow the system to automatically tune the page faulting and activity levels of the shared pools using an internal AS/400 algorithm. This algorithm determines which pool or pools are page faulting, and attempts to redistribute resources accordingly. When the system value is set to either 2 or 3, customers do not tend to intervene in pool tuning. However, they may still need to determine whether there is a need to increase total main storage.

- **Manual tuning**:

  Modify storage pool configurations until the response times and throughputs are acceptable.

> **Important**
>
> Main storage tuning using the QPFRADJ system value only occurs on shared pools. Private pools are not affected by automatic performance adjustment. You need to manually tune them.

The most common approach to pool tuning is to use automatic tuning. This sets up the pool size and activity levels of the main shared storage pools. Once the pools have stabilized, you may turn the auto tuner off by changing the system value QPFRADJ to 1. Monitor the pools for excessive faults and make the appropriate adjustments.

Note: The storage pool configurations during periods of low workload throughput will be substantially different from those required to support periods of peak workload throughput.

10.3.5.3 Expert Cache

Expert Cache works by minimizing the effect of synchronous disk I/O on one or more jobs in a storage pool. Expert Cache is enabled at the individual pool level; it is not a system wide setting. When you switch on Expert Cache, the system automatically adjusts storage pool paging and determines the best approach for handling data in the pool.

To start Expert Cache for a specific shared storage pool, enter the following command:

```
WRKSHRPOOL
```

The Work with Shared Pools screen (Figure 211 on page 358) appears.

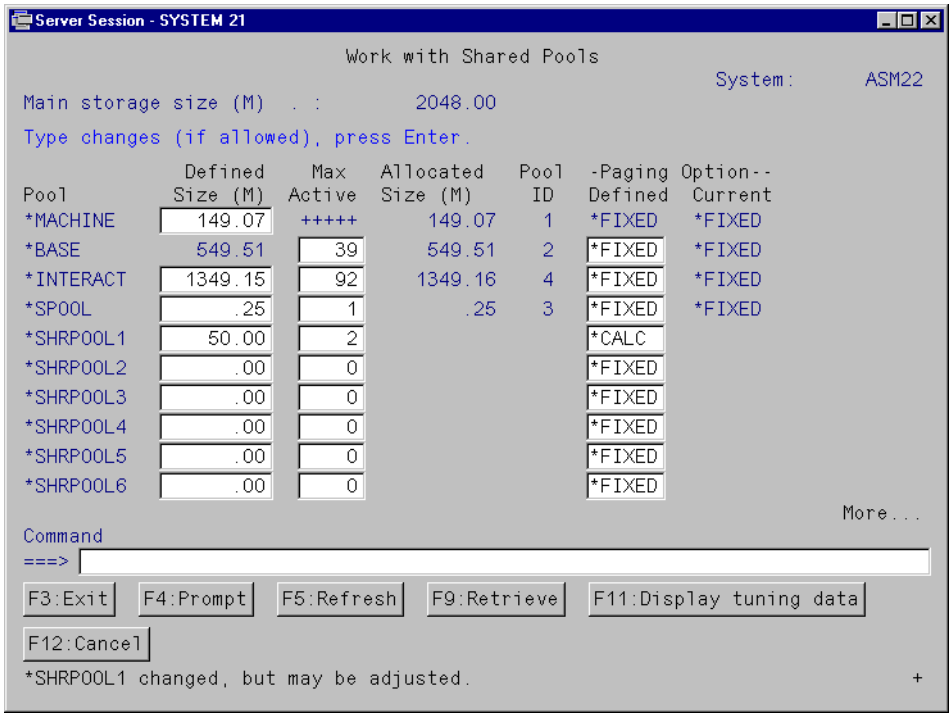

Figure 211. Work With Shared Pools

In this example, Expert Cache has been configured for SHRPOOL1. This can be identified by the *CALC entry in the Paging Option field. Entering a value of *CALC against a Shared Pool enables Expert Cache for that pool.

Once started, Expert Cache monitors the Direct Access Storage Device (DASD) input/output (I/O) activity and logical reference pattern for each database file that is accessed within the shared pool. Then, it dynamically adjusts the size and type of I/Os for these files to maximize the use of main storage and minimize the number of disk I/Os. An advantage of using Expert Cache is that the system dynamically determines which objects should have larger blocks of data brought into main storage.

Reducing the number of synchronous disk I/Os can enhance processing times. For interactive jobs, this generally means better response time. For batch jobs, it can mean completing your current batch work in a shorter elapsed time, depending on overall system workload.

The WRKSHRPOOL command also provides the ability to configure tuning parameters for each of the shared pools.

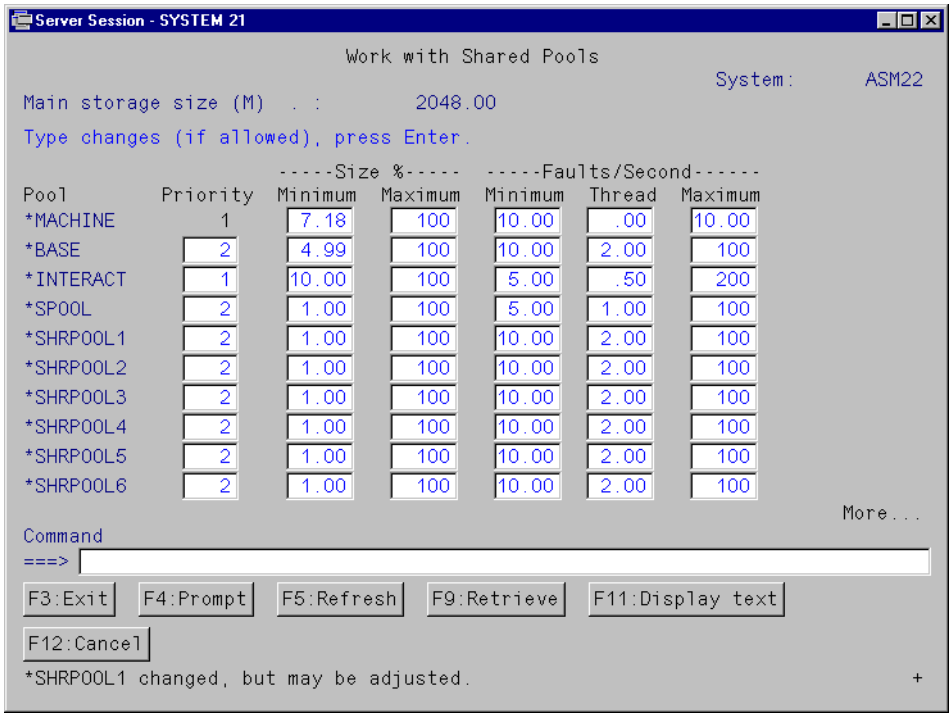

Figure 212. Work with Shared Pools - Tuning data

Figure 212 illustrates the pool configuration data. The displayed values are only considered if the QPFRADJ system value is set to 2 or 3.

10.3.6 Disk storage

Secondary (or auxiliary) storage on the AS/400 system consists of Direct Access Storage Devices (DASD) attached to one or more controllers and input/output processor (IOP) cards. The ratio of disk access time to main storage access time is about one thousand to one. Therefore, it is critical to ensure that disk performance problems do not exist on a system.

Certain System 21 components may be I/O intensive, depending on how the application has been configured. The I/O requests are mainly database reads. The measure of activity against a database for both reads and writes can be expressed in logical database I/Os. This number represents the amount of accesses a program makes to database objects. This number should be the same for two identical transaction environments. If logical I/Os are not satisfied by access to main storage, a physical disk I/O is required.

A physical disk I/O can be either synchronous or asynchronous. *Synchronous I/Os* require that the job (program) waits until the disk request is satisfied. An *asynchronous I/O* can be done while the job (program) is running. Synchronous I/Os have a direct impact on performance. However, asynchronous and synchronous I/Os are influenced by application definition and are difficult to address with tuning and configuration.

When looking at DASD performance, consider the following components:

- Overall disk configuration
- Disk response time, disk utilization, and disk usage
- IOP utilization

These components are discussed in the following sections.

10.3.6.1 Overall disk configuration

On an installed system, the disk configuration can be reviewed with the command:

```
WRKHDWRSC TYPE (*STG)
```

This command displays the type, model, and status of all IOPs and each attached storage controller. An example of the display is shown in Figure 213.

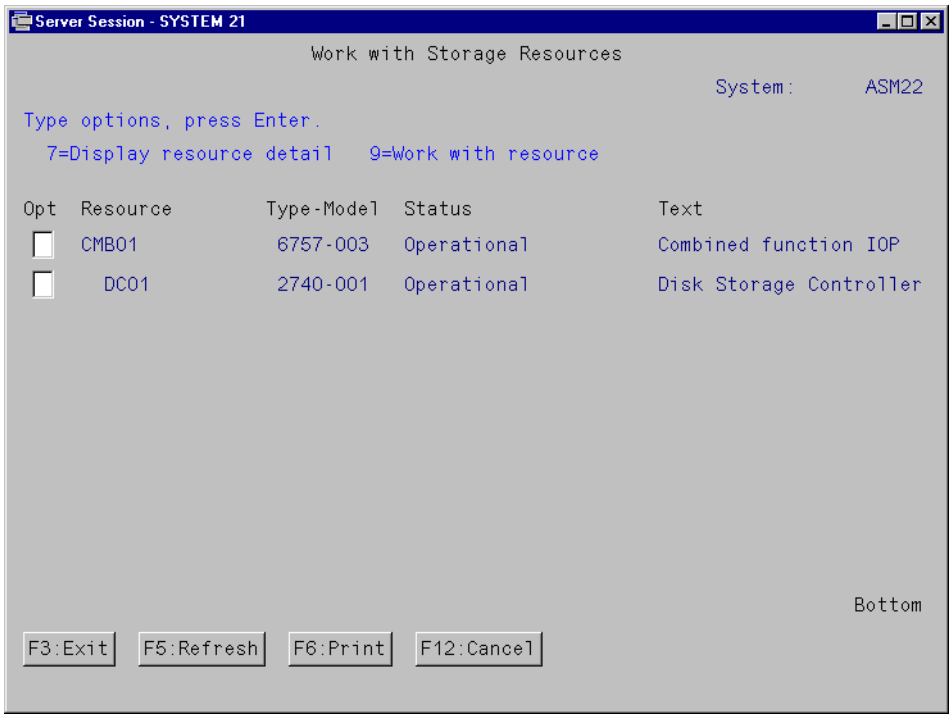

Figure 213. Work with Storage Resources

Option 9 (Work with Resources) allows you to view the disk resources connected to each controller. Figure 214 shows an example of the disk units connected to the DC01 Disk Storage Controller.

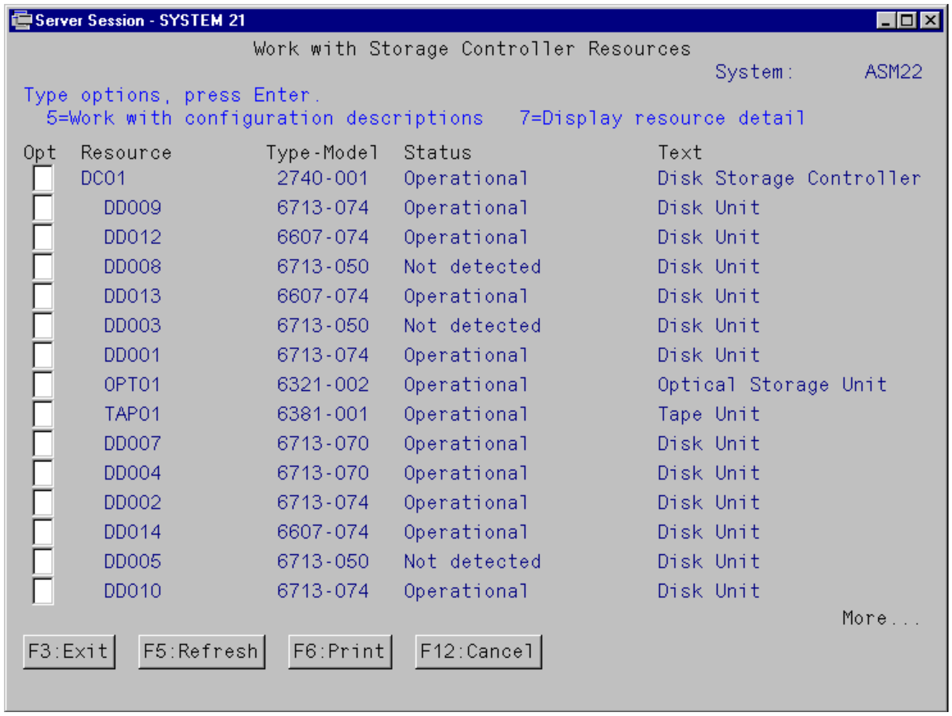

Figure 214. Work with Storage Controller Resources

This information is important when deciding if and where new disks are to be added, or if some controllers or IOPs are unbalanced (have too many resources attached to them). When configuring a new system, information about IOPs, controllers and disks can be found in *OS/400 Work Management* V4R4, SC41-5306.

10.3.6.2 Disk response time, disk utilization, and disk usage

As a result of the difference between a logical I/O (main storage) and a physical I/O (disk), disk response time is a key performance issue. To review disk response time, a performance collection must be made. Figure 215 shows the System Report - Disk Utilization output from the Performance Tools reports. All of the relevant details, including response times, are presented on this report.

```
                              System Report                                      11/11/98  8:20:08
                                          Disk Utilization                                           Page 0006
                                    STD I, B, then java/threads
Q983150757 Model/Serial  . : 510-2144/10-16CAD   Main storage . . :  512.0 M   Started  . . . . : 11/11/98 07:58:01
PFRRES42   System name . . :          ABSYSTEM   Version/Release  :   4/ 2.0   Stopped  . . . . : 11/11/98 08:18:43
          Size    IOP    IOP             Dsk CPU  ASP   --Percent--    Op Per    K Per     - Average Time Per I/O --
   Type   (M)     Util                   Util
                         Name                     ID    Full   Util    Second     I/O      Service   Wait    Response
--- ---- -------  ----   ------------    -------  ---   ----   ----  ---------  ---------  -------  ------
                                                                                                             --------
   6606   1,967   1.8    CMB01              .0     01   77.2    1.8       1.43        5.6   .0125    .0014      .0139
   6606   1,967   1.8    CMB01              .0     01   77.2    1.5       1.64        5.4   .0091    .0006      .0097
   6606   1,475   6.5    SI03               .0     01   74.6     .4       1.86        6.5   .0021    .0000      .0021
   6606   1,475   6.5    SI03               .0     01   74.3     .9       2.27        5.8   .0039    .0004      .0043
   6606   1,475   6.5    SI03               .0     01   74.6     .8       1.65        6.0   .0048    .0000      .0048
   6606   1,475   6.5    SI03               .0     01   74.1     .8       2.45        6.0   .0032    .0000      .0032
   6607   3,145   6.5    SI03               .0     01   74.0    2.0       7.90        6.1   .0025    .0001      .0026
   6607   3,145   6.5    SI03               .0     01   74.4     .6       2.11        6.0   .0028    .0005      .0033
   6607   3,145   6.5    SI03               .0     01   74.0    5.0      20.88        6.2   .0023    .0004      .0027
   6607   3,145   6.5    SI03               .0     01   74.2     .5       1.72        6.7   .0028    .0000      .0028
         22,414
                                                        74.8    1.4       4.39        6.1   .0031    .0005      .0036
```

Figure 215. System Report - Disk Utilization

You can also use the Work with Disk Status (WRKDSKSTS) command to view disk utilization. The WRKDSKSTS command is reviewed in 10.2.2, “Basic AS/400 tuning commands” on page 313.

There is a distinct difference between disk utilization and disk usage. These variables are displayed in the System Report or on the WRKDSKSTS display. *Disk utilization* refers to the estimated percentage of time the disk unit is being used over the measured interval. For example, a value of 20% indicates that the disk arm is busy for 20% of the time over the measured interval. The guidelines vary. However, a disk utilization in excess of 30% may result in performance degradation.

The *disk usage* refers to the percentage of the available disk space used. As a rule of thumb, consider an upper usage limit of 80% for a disk configuration. However, the performance impact of this variable depends on the total available disk space. Larger amounts of disk space will support a higher degree of usage before incurring a performance overhead.

10.3.6.3 IOP utilization

It is possible to study the IOP utilization on the system report, but the component report provides more information about the IOP utilization. An IOP can be used for communication, local workstation, or disk operations. The Component Report displays the utilization for each usage type (Comm, LWSC, DASD), and also presents the total utilization for each IOP. Figure 216 shows an example of the Component Report for IOP Utilization.

```
                                                Component Report
                                                    IOP Utilizations
                                                 Sample Component Report
Member  . . . : ONE        Model/Serial  . : 436-2106/10-10BDA   Main storage . . :  256.0  M  Started . . . . :
  Library . . : DFLBUGDL1  System name . . :          ABSYSTEM   Version/Release  :    4/ 2.0  Stopped . . . . :
                        --- IOP Processor Util ---     DASD      -- KBytes Transmitted --    Available
IOP                    Total   Comm   LWSC   DASD    Ops/Sec       IOP          System       Storage     Util 2
--------------------   -----   -----  -----  -----  -----------  -----------  -----------   -----------  ------
CC01          (2623)      .2     .0                                      94            0     1,772,096      .0
CC02          (2623)      .2     .0                                      94            0     1,772,096      .0
CC03          (2626)    28.4   28.4                                 488,619      316,044       287,972      .0
CC04          (2626)      .1     .0                                      94            0     1,772,216      .0
CC05          (2619)     3.5    3.5     .0     .0                   191,623        1,191     1,864,336      .0
CMB01         (918B)     3.6     .0     .0    3.5                     1,506    7,890,496     2,122,560      .0
SI02          (6533)     2.7     .0     .0    1.7                     3,645       29,324     6,485,936      .0
WS01          (2661)      .6                                          63           39
IOP                        --  Resource name and model number for each communications, DASD,
                               multifunction, and local work station IOP
IOP Processor Util Total   --  Total utilization for IOP
IOP Processor Util Comm    --  Utilization of IOP due to communications activity
IOP Processor Util LWSC    --  Utilization of IOP due to local work station activity
IOP Processor Util DASD    --  Utilization of IOP due to DASD activity
DASD Ops/Sec               --  Disk operations per second
KBytes Transmitted IOP     --  Total Kbytes transmitted from an IOP to the system across the bus
KBytes Transmitted System  --  Total Kbytes transmitted to the IOP from the system across the bus
Available Storage          --  The average number of bytes of free local storage in the IOP
Util 2                     --  Utilization of co-processor
```

Figure 216. Component Report - IOP Utilizations

The guideline suggests that IOP utilization should not exceed 35%. You can add additional IOPs and move resources between IOPs to help resolve high utilization issues.

10.4 Preventative maintenance for performance

Once System 21 has been implemented, maintenance should be an ongoing and straightforward requirement. While the AS/00 system is a low maintenance system, it should not be considered as a “no maintenance” system. System management and housekeeping activities are required on a regular basis to sustain an acceptable level of performance. As an analogy, you would not expect

to purchase a new car and change the oil every 50,000 miles. While the car may still function, its performance would be impaired.

The following sections identify preventative maintenance activities that will enhance the day-to-day operation of your AS/400 system.

10.4.1 Workload management

It is important to manage the jobs running on your system to sustain workload throughput. The concept of a daily workload profile is discussed in Chapter 4, “Sizing System 21 on the AS/400 system” on page 67. A workload profile should be designed, implemented, and maintained to achieve acceptable system performance.

The following points may have a considerable positive impact on workload throughput:

- Jobs are scheduled at appropriate run priorities.
- Key interactive users have:
  - A higher run priority than normal users
  - Their job Purge parameter set to *No
  - Their jobs routed to a separate private storage pool within the subsystem
- Revise IBM-supplied classes to reduce the impact of client/server tasks executing at interactive priority.
- Schedule low priority and high impact batch jobs to run during periods of low system activity.
- Restrict the impact of ad-hoc workloads like interactive query.
- Limit the use of Business Intelligence tools to periods of low system activity.
- Restrict the use of the system console for interactive tasks or revise the job run priority from 10 to 20.
- Do not support a development environment on a production machine.
- Ensure high priority work (priority 20 or less) does not exceed 65%.
- Ensure that the batch workload is not constrained by the interactive workload component.
- Tune the system to support *output*, rather than *input*. Allow jobs to complete before releasing additional jobs on to the system.
- If using a multi-processor AS/400 system, consider using multiple batch streams to take advantage of the available capacity.
- Restrict the use of resource intensive system functions, such as WRKACTJOB, to key users.
- Prevent users from changing job attributes (like run priority) and job submission attributes (submitted job queue).

The key to successful workload management is managing the known workload and minimizing the impact of the unexpected workload.

10.4.2 Storage management

Storage management is an area of AS/400 maintenance that is frequently overlooked. Over time, the cost per gigabyte of auxiliary storage has been

reduced considerably. This has encouraged users to purchase additional disk drives, rather than implement storage management policies. While this approach is easy to implement, it does not address the underlying issues. Eventually the buildup of transaction history will have an adverse affect on transaction performance. The following sections discuss areas you need to consider as part of storage management.

10.4.2.1 Storage review

A storage review policy is essential for monitoring database growth trends and predicting upgrade requirements. There are two OS/400 commands that produce an entire catalog of the information on the disk units:

- The Retrieve Disk Information (RTVDSKINF) command retrieves the disk information to an output file.
- The Print Disk Information (PRTDSKINF) command formats and prints the details.

The output from the RTVDSKINF command is stored in the file QUSRSYS/QAEZDISK. Each time the command is executed, the data from the previous collection is overwritten.

Disk information should be collected on a monthly basis as part of month end processing. Database growth can be determined on a net change basis, by comparing the data to that recorded for the previous month. Database growth can also be related to a key business factor, such as sales order line throughput. This enables the forecasting of database requirements based on projected business volumes.

The report also provides an effective tool for policing the storage. Identification of unwanted or miscellaneous objects can be easily achieved as object owner information is included.

10.4.2.2 File reorganization

When the AS/400 system deletes a record, it normally flags the record as deleted, but it does not reuse the space. This allows the file to maintain the relative record numbers intact. However, it slows down disk access if many records need to be read at the synchronous I/O level, that do not get passed to the logical I/O level, simply because they are deleted. Deleted records can be removed by reorganizing the physical file or copying the file with the `COMPRESS(*YES)` command.

Within the System 21 database, a number of the key transaction and work files will incur deleted records. You need to reorganize these files on a regular basis. You can identify of files with deleted records by using the Display File Description (DSPFD) command. An example of the command is shown in Figure 217. In this example, the file details are generated to an output file for analysis using Query/400. Note that the Type of Information field must be set to `*MBRLIST` to obtain the required information.

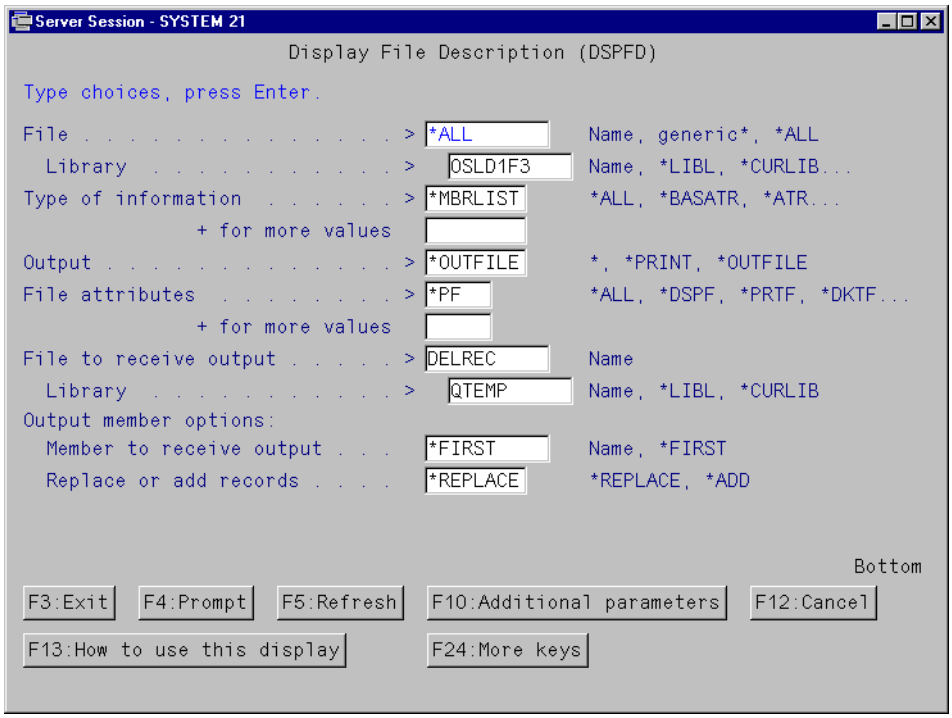

Figure 217. Display File Description

An alternative approach is to use the Max.% deleted records allowed field on the physical file description. This field can be set to a value between 1 and 100. When the ratio of deleted records to actual records in a member exceeds this value, a message is sent to the QHST history log. The history log can be monitored, and the files issuing the messages are reorganized.

System 21 also provides a command called Reorganize Data Base Files in Library (RGZDTALIB). This command reorganizes all of the physical files in a specific library, by access path or relative record number.

The reorganization process can also arrange physical file data in the order of the keys specified within a logical file. This can reduce the number of physical IOs required when a file is processed sequentially by key, since the next requested physical record may already be in the memory. Figure 218 on page 366 illustrates the reorganization of the OEP40 file using the access path OEP40L01 to sequence the data.

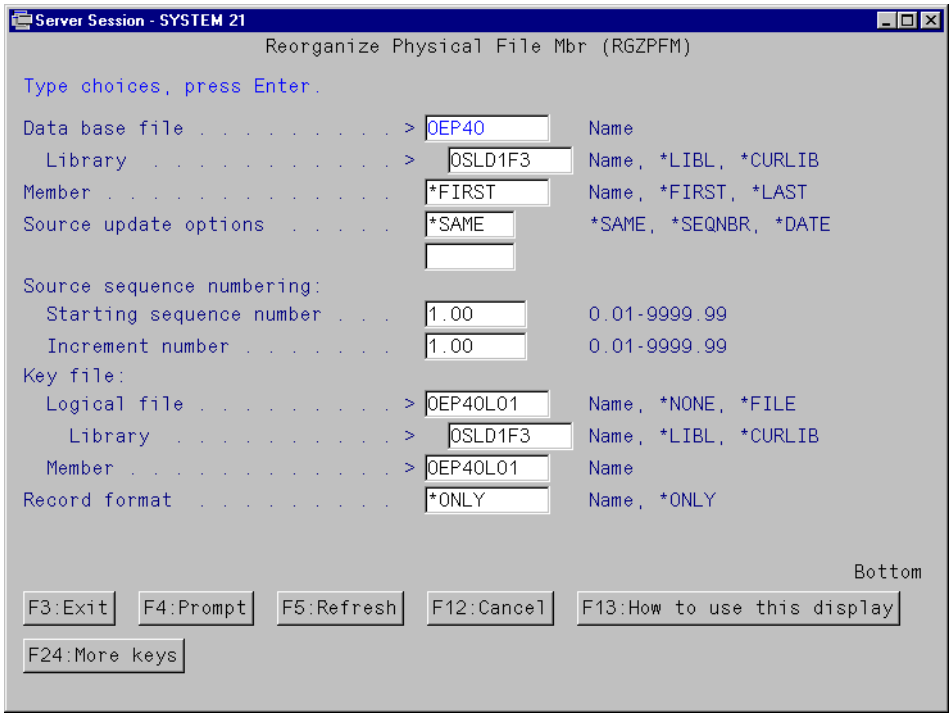

Figure 218. Reorganize Physical File Member

Attention

Reorganizing a physical file member may force the rebuilding of access paths. This may cause a performance overhead and should be done in an off-peak period.

10.4.2.3 Reusing deleted records

An alternative to file reorganization is to use the Reuse Deleted Records (REUSEDLT) function. This is a file attribute on the physical file. As a default, System 21 physical files are shipped with the REUSEDLT flag set to *NO. You can change this file attribute to *YES if required. This is possible since System 21 does not use relative record number (RRN) processing. The impact on performance from implementing this function varies depending on the type of operation being performed.

Important

Changing and maintaining System 21 file attributes remains the responsibility of the customer. Unless Geac adopts REUSEDLT(*YES) as a standard, subsequent implementations of System 21 files need to be maintained by the customer to reflect this attribute.

10.4.2.4 Access path size

AS/400 indexes are defined as either a maximum 4 GB index or a maximum 1 TB index. The 1 TB index is relatively new, and it is not currently used as the default when indexes are created in System 21. In general, the 4 GB index is faster for

smaller non-dynamic tables, and the 1 TB is better for large dynamic tables. Another consideration is that the entire table is seized for the insertion of an entry into a 4 GB index, while only the appropriate page is seized while inserting an entry into a 1 TB index. A 1 TB index also has an advantage in that it can be built in parallel if the system is a multi-processor system.

Beginning at OS/400 V4R1, the file creation default is to use 1 TB indexes. System 21 will function with either index type. However, customers may want to consider converting their database files from 4 GB to 1 TB to obtain the benefits previously identified.

To determine whether an index is 4 GB or 1 TB index, enter either of the following commands:

```
DSPFD library name/Iogical file name
DSPFD library/*all (to list all the files in the library)
```

The following entry shows a 4 GB index:

```
Access path size.................: ACCPTHSIZ *MAX4GB
```

This can be changed to MAX1TB by entering the command:

```
CHGLF logical_file_name ACCPTHSIZ *MAX1TB
```

Note: When an index type is changed, it will be rebuilt. This process can take a considerable period of time and should be scheduled during a period of low system activity.

10.4.2.5 System 21 audit files

System 21 supports transaction audit files within the application file libraries. Audit files effectively provide before and after image journaling, but with no facility for application recovery. Their primary use is to provide a transaction audit trail.

Audit files associated with key transaction files can increase in size at a substantial rate. A data retention policy needs to be established for these files to ensure that the data is purged at regular intervals.

For a description of the principle audit files and their associated purge routines, refer to 6.6, “Archive and purging” on page 175.

10.4.2.6 Data archiving

Large System 21 installations process a substantial number of business transactions. Over a period of time, these transactions consume a considerable amount of disk space and invariably impact system performance.

A data retention policy must be established for each principle business transaction file. The retention interval is normally based on business-specific requirements, or country-specific legal and fiscal requirements. Once the retention intervals have been established, the archiving policy must be strictly maintained.

System 21 provides a number of archiving and purging routines. The routines either:

- Purge transaction data to a history file
- Delete the transaction data completely

In each instance, data is removed from the primary application file, therefore reducing the overhead on access path maintenance and data access.

For a description of the archiving and purging routines, refer to 6.6, “Archive and purging” on page 175.

10.4.2.7 Test environments

System 21 supports the concept of environments to provide logical business partitions. In general, customers take advantage of this facility and create at least one other environment in addition to their production environment. The creation of a test environment is the most common.

Populating test environments with data can be a tedious job. Many customers find the easiest way is to copy their live database into the test environment database. While this approach will achieve the desired objective, it will not be the most effective. Test environment databases invariably contain:

- Large amounts of unnecessary transaction history
- Audit file data
- Deleted records
- Excessive amounts of static data (for example, items in the Item Master)

The recommended approach is to construct a separate database for the test environment. This should include a subset of both the static data and the transaction history. Audit files should be purged and files containing deleted records should be reorganized. The clean database should be saved to tape so that it can be re-installed at any point in the future.

While this approach requires an initial investment of time, it provides considerable benefits in the future.

10.4.2.8 Spooled files and job logs

The maintenance of spooled files in a production environment can be particularly difficult. Users generate spooled files and retain them for considerable periods of time.

A spooled file retention policy should be agreed and established with each key user group in an organization. This should include the principal spooled files generated by each business area. The approach may need to be subdivided if a central system is supporting multiple geographic locations. Once implemented, it must be strictly enforced.

Job details associated with a spooled file are maintained with the AS/400 Work Control Block Table (WCBT). Only once all of the spooled files for a job are printed or deleted, the entry is removed from the WCBT. This has a maintenance overhead for AS/400 work management.

10.4.2.9 Setting the job logging level

To reduce the overhead associated with the production of job logs, standard System 21 user profiles should have their log Level set to `4`, Severity set to `0`, and Text set to `*NOLIST`. The only exception is if a profile is being used for debugging or testing purposes.

Message logging details are held on the job description. To amend the details, you can either:

- Change the job description associated with the user profiles
- Create a new job description and amend the user profiles
- Issue a Change Job command as part of a user logon script

Figure 219 illustrates the Create Job Description command. The Message logging parameters in this example have been set to `4`, `0`, and `*NOLIST`.

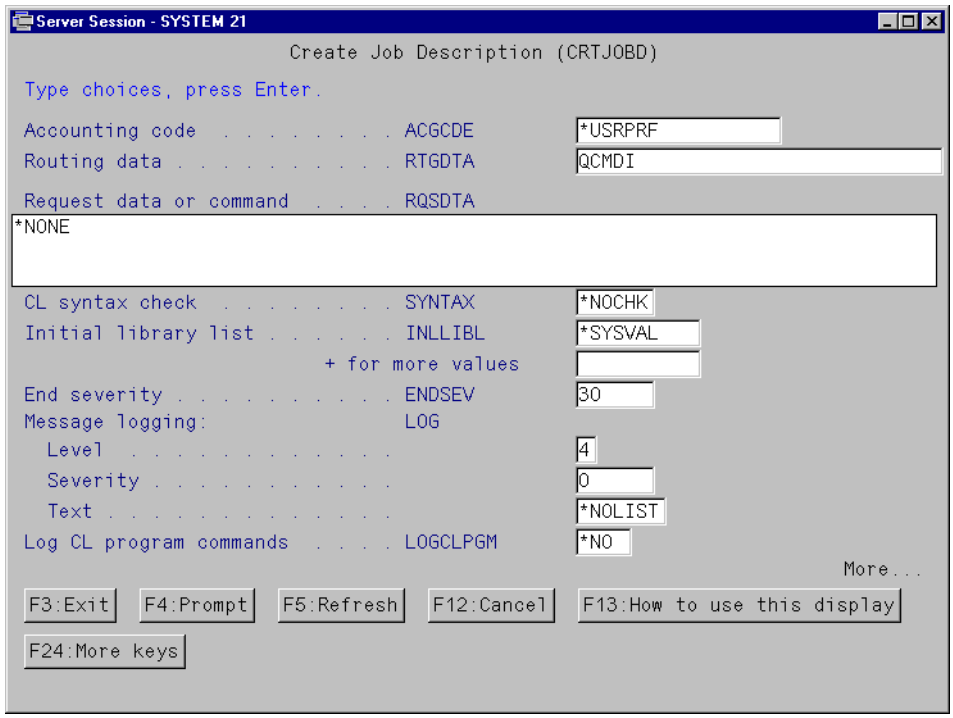

Figure 219. Create Job Description

Changing the message level for the user profile should minimize the production of unnecessary system output.

10.4.3 Advanced performance facilities

The AS/400 system supports a number of advanced utilities for improving workload throughput. Some of the utilities are inherent within the operating system, while others are supported in software LPPs.

Hardware configuration also plays an important part in the use of the facilities. The availability of multiple processors and main storage are essential for the support of such functions as SMP and SETOBJACC.

System 21 does not require the use of these facilities as part of normal operation. However, their use in a large commercial installation may considerably improve workload throughput.

10.4.3.1 Symmetric Multiprocessing (SMP) feature

This feature enables a single database operation to be split into multiple tasks and run on one or multiple processors at the same time. Typically, this would be used for queries run through Query, DB2 Query Manager, or a PC-based query or report writing tool. Both SQL and native database interfaces are supported. The SMP function takes advantage of the N-way processor capability of the AS/400

system, which currently supports up to 24 N-way processors on the high-end models. The query sees performance improvements by being run in parallel across these multiple processors.

The degree of parallel processing can be configured system wide by setting the system value QQRYDEGREE to one of the following options:

- ***MAX**: Initiate sufficient tasks to use most or all CPU resources
- ***OPTIMIZE**: Initiate tasks to use a good share of CPU resources
- ***NBRTASKS**: Number of tasks not to exceed a specified number
- ***IO**: I/O parallelism only (available without SMP installed)
- ***NONE**: No parallelism

The SMP feature can be used only if the DB2 Symmetric Multiprocessing for OS/400 feature (#2698) is installed on your AS/400 server. This feature provides the following query optimization algorithms:

- **Parallel table scan**: Provides parallel operations for queries requiring a sequential scan of the entire table. Multiple tasks are used to scan the same table concurrently. Each task performs selection and column processing on a table partition and returns selected records to the requester.
- **Index only access**: Provides performance improvement by extracting a query result from an index rather than performing random I/Os against a physical table.
- **Parallel key selection**: Provides parallel index operations for key selection. Multiple tasks are used to scan the same index concurrently.
- **Parallel key positioning**: Multiple tasks are used to perform key positioning on a partitioned subset of the key ranges. Only those index entries that are within a selected range are processed.
- **Hashing algorithms**: Provides an optimization alternative for *group by* and some *join queries*. This method avoids having to use an index and, therefore, having to perform random I/Os to retrieve the results.
- **Parallel index build**: This can speed up the process of building a temporary index when the query optimizer cannot locate an appropriate index. It determines how to build a temporary index to execute a particular query. It also speeds up the process of building permanent indexes, particularly when built over large database files.
- **Parallel index maintenance**: This is effective only when blocked inserts are performed on the base database table and there are at least eight indexes over the table.
- **Parallel data loader**: This is a new function in V4R3 (also available via a PTF on V4R2 and V4R1) that makes loading AS/400 database tables from external data simpler and faster. The data loader can import fixed format, delimited, and byte stream files.

  The following PTFs are required for V4R1 and V4R2 releases of OS/400:

  - V4R1M0: SF47138 and SF47177 for OS/400
  - V4R2M0: SF46911 and SF46976 for OS/400

If AS/400 resources are available (memory and CPU are not a constraint), changing the system value QQRYDEGREE to *OPTIMIZE may provide a better performance for query-based applications.

Optionally, you may set the multiprocessing degree for a specific job by using the command:

```
CHGQRYA DEGREE (*OPTIMIZE/*MAX...)
```

For more information on the SMP feature, see Section 1.4.6, “Controlling Parallel Processing”, in *DB2 for AS/400 Database Programming*, SC41-5701.

10.4.3.2 Parallel pre-fetch

Parallel pre-fetching of data can be invoked by using the CHGQRYA command or the system value QQRYDEGREE *IO. This does not require the DB2/400 SMP feature to be installed on the AS/400 server. Pre-fetching involves the reading of data from multiple disk arms in parallel and reduces the possibility of a performance overhead resulting from disk arm contention. There is, however, a memory overhead of approximately 1 MB per actuator. Selecting Expert Cache for the storage pool in which the job is executing is also a prerequisite. In addition, the increased availability of data decreases the query elapsed time and increases the percentage of CPU utilized during execution.

Figure 220 illustrates the CHGQRYA command. The Processing option has been set to *IO.

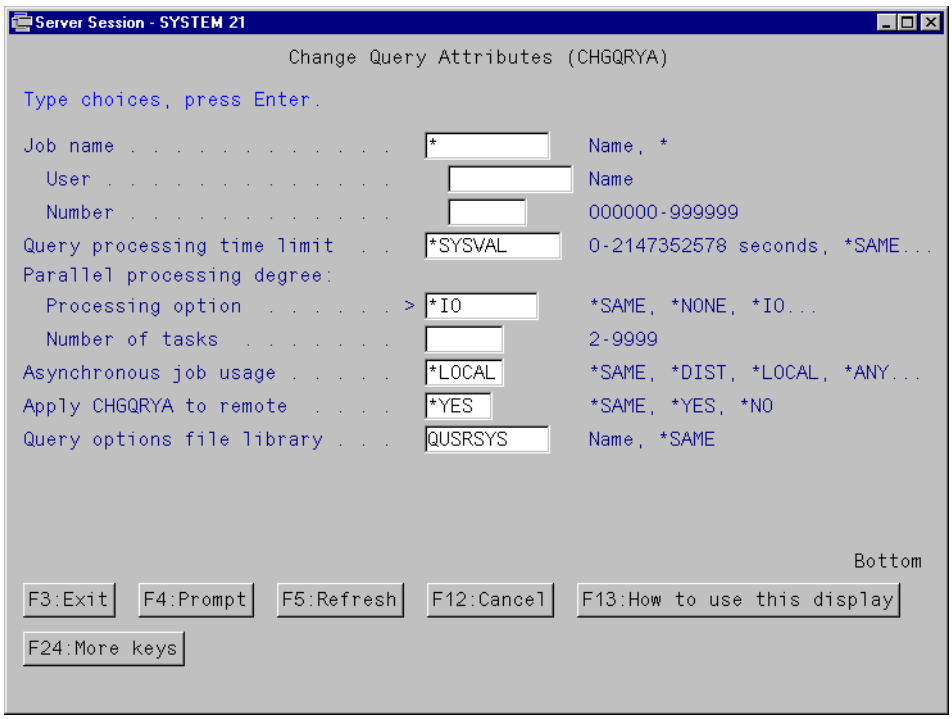

Figure 220. Change Query Attributes

10.4.3.3 Pin frequently accessed objects in memory

Selected database and program objects can be pinned in main storage by using the SETOBJACC command. This can:

- Reduce the amount of physical disk accesses
- Reduce overall disk arm and IOP utilization
- Improve disk response time
- Improve transaction response time or elapsed time

You can identify files that are candidates for SETOBJACC by using:

- The Display Job (DSPJOB) command
- The Display Access Group (DSPACCGRP) and Analyze Access Group (ANZACCGRP) commands
- The PEX Trace. For details on how to identify SETOBJACC candidates through the use of PEX Trace, see Chapter 9 of *AS/400 Performance Explorer Tips and Techniques*, SG24-4781. You can download the V4R3 and V4R4 versions of the SMTRACE and QYPINT libraries from the Web site:
  `http://www.as400service.ibm.com/p_dir/pexgui.nsf`

Once you identify the database files to be placed in main storage, you need to perform the following steps:

1. Create a subsystem description and allocate a private memory pool to it. You must allocate an area of main storage in which to load the selected database objects. This can be done by either creating a new subsystem description and allocating a storage pool, or by modifying an existing subsystem description to allocate a new private memory pool. Section 12.3.4, “Creating subsystems” on page 469, explains how to create a subsystem description.

   The following CL command creates a new subsystem called OBJACCSBS, and allocates a 20 Mb private storage pool:

   ```
   CRTSBSD SBSD(QSYS/OBJACCSBS) POOLS((1 *BASE) (2 20000 1)) TEXT ('Subsystem
   to pin selected files in main storage')
   ```

2. Use the Clear Pool (`CLRPOOL`) command to clear the storage pool.

   Before loading the database files, you must ensure that the allocated storage pool is clear. It should be cleared when the pool is initially allocated, but you need to ensure that it is cleared whenever you reload it. Type the following command:

   ```
   CLRPOOL
   ```

   The CLRPOOL command ensures that all pages that are in the pool are written out to disk. An example of the CLRPOOL command is shown in Figure 221.

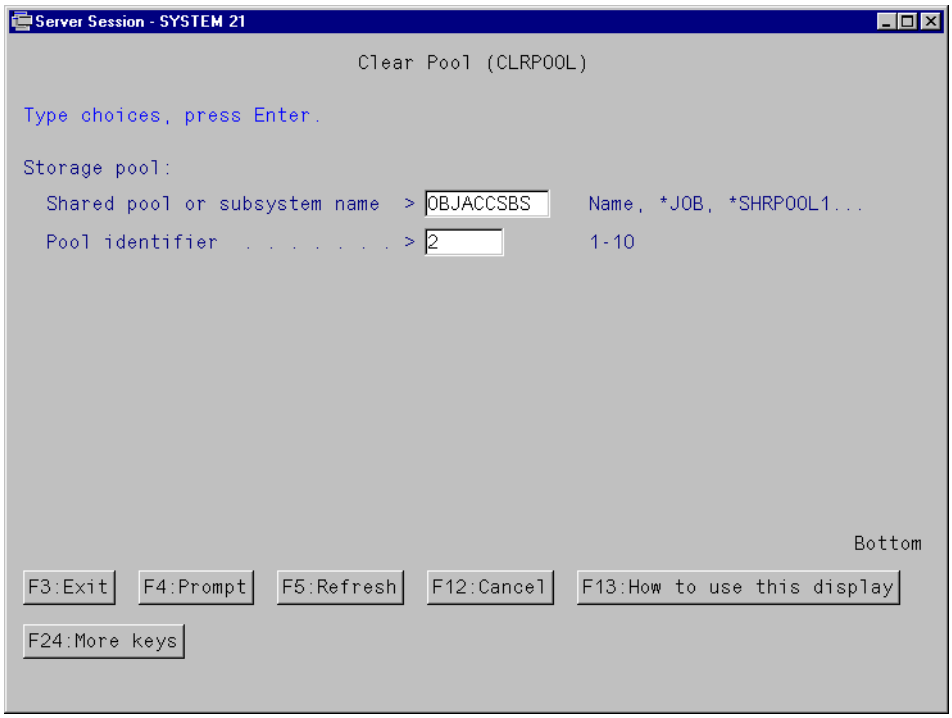

Figure 221. Clear Pool

3. Use the SETOBJACC command to load each object into the required subsystem pool. Using the SETOBJACC command, load each file in turn. Figure 222 illustrates the use of the SETOBJACC command to load the OEP40 file in to storage pool 2 in the OBJACCSBS subsystem.

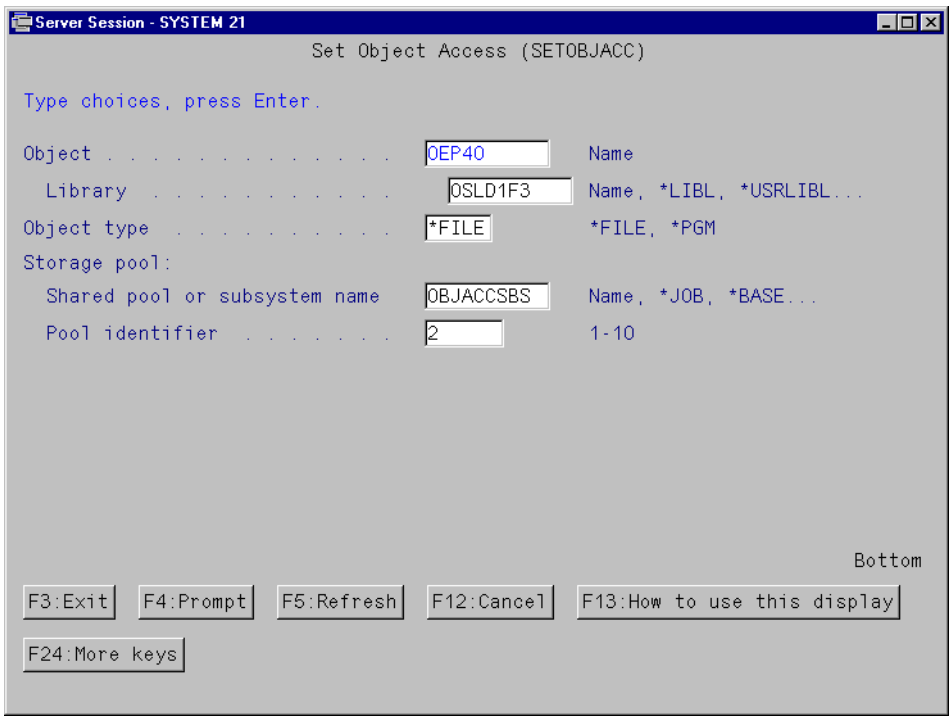

Figure 222. Set Object Access

If you display the job log of the job loading the files, you will see detailed messages relating to the SETOBJACC operation. Figure 223 illustrates the following job log information:

- Using the CLRPOOL operation to clear pool 2 in the subsystem
- Loading the OEP40 file with the SETOBJACC command
- The size of OEP40 loaded into the pool and the total remaining space. This point is of particular importance because this provides information on the size of the objects loaded and how much space is remaining in the pool. It is important to ensure that all of the selected objects fit in to the pool. Failure to do so may introduce a performance overhead.

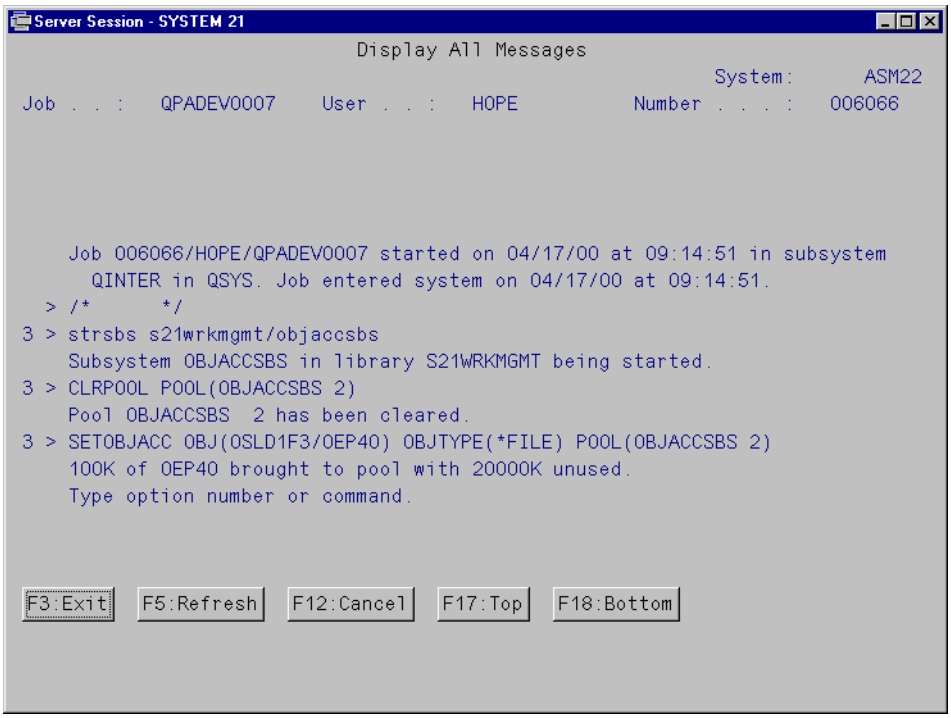

Figure 223. Display job log - All messages

Some additional factors to consider when using the SETOBJACC command are:

- Deleted record space is loaded into main storage. Reorganize the files (use the `RGZPFM` command) or set the file to re-use deleted record space before "pinning" a file into the memory.
- SETOBJACC is pool specific. Once you issue the command for an object, the object stays in the pool until you clear the pool, issue another SETOBJACC command, or specify `POOL(*PURGE)` for the object.
- If you load the same object into the same pool again, the previous copy of the object is purged, and the object is reloaded.
- Consider using the SETOBJACC approach for database objects from which data is read, rather than updated.

10.5 Performance review

This section covers two key areas:

- Identifying a methodology with which to review a poorly performing system
- Reviewing the common components that may impact performance

10.5.1 Reviewing performance problems: An approach

Understanding a performance problem in customer terms is key to minimizing the unnecessary analysis of low priority problems.

While some customers may desire transaction response times of less than 1 millisecond, this may not be a fundamental business requirement. Furthermore, purchasing hardware with the ability to deliver this requirement, may not be commercially viable.

To carry out a performance investigation, it is important to understand the critical success factors of the business. The solution must be capable of achieving these factors, or the implementation will never be considered adequate.

The investigation methodology involves understanding the perceived problem, which may include:

- Application function
- Application design
- Expected response or throughput
- Perceived response or throughput

It is important to understand the problem from a user perspective. The required response time goals and transaction throughput rates need to be established. They can then be validated against the application architecture to ensure that they are achievable. If performance issues exist, you should establish factors such as:

- Is the problem system-wide or application specific?
- If it is application specific, does the problem relate only to certain transactions?
- Is the problem related to specific times during the working day?

The user's locality to the server is also a performance consideration. The communications infrastructure is a key component of user response times. This may be particularly significant when connecting LAN-based users over a WAN network to a remote server.

Initially, examine the system configuration to ensure that the system parameters affecting performance are acceptable. Review storage pool allocation and activity levels to determine if they are suitable to sustain the required workload throughput. This preliminary review should be done interactively or by a review of representative system performance data analyzed with the AS/400 Advisor function. Do not embark on an application review at this stage of the investigation.

If an initial review does not identify the problem, carry out a detailed system performance or capacity study. This may require using:

- OS/400 performance data
- System commands like Work with System Status and Work with System Activity
- OS/400 Performance Explorer to collect statistical information
- The Retrieve Disk Information command to catalogue the system contents
- The database monitor to collect details of the database activity

Once you complete the review of summary level information, you may determine that tuning system resources will address the performance problem. This may require the addition of system resources like:

- A CPU configuration with the ability to support an enhanced workload throughput
- Additional main storage
- Additional disk units or a faster disk subsystem
- Enhanced communications capacity

If you exceed utilization guidelines for the various resources, you need to resolve these issues. You need to ensure that the entire system configuration is performing optimally, before looking for alternative solutions. If performance issues remain, and all resource measurements are significantly below the guidelines, individual application performance data must be collected and analyzed by a performance specialist.

Note

Performance management is an iterative process. You must establish the performance characteristics of a particular configuration before modifying it. Once the configuration has been modified, you must review the throughput of the new configuration and compare it to the original workload throughput. This enables you to accurately determine the extent of the performance improvement.

10.5.2 A performance checklist

This section provides an outline for a performance review approach. It is by no means conclusive. However, it identifies some of the key areas to consider when encountering System 21 performance problems:

- **System**:
  - Review the CPU utilization for high priority CPU tasks (less than or equal to priority 20). Check that utilization falls within the guidelines. Review CPU utilization required to support the batch workload, and determine if it is constrained.
  - Review page faulting associated with the main storage configuration. Determine if sufficient storage is available to support the workload. Adjust the activity levels to support job output, and review any increase in job ineligibility associated with this change.
  - If the system resources appear to be overutilized, review the nature and composition of the workload profile. If the profile is consistent with

anticipated daily workload throughput, you need to review the suitability of the hardware configuration.

- **Disk hardware**:
  - Review the disk subsystem configuration. Ensure that there are sufficient disk arms to support the workload throughput. Check that disk arm utilization does not exceed 30% for a sustained interval
  - Do not implement storage configurations that utilize 17 GB disk units. Configurations of this nature seldom have sufficient arms to accommodate System 21 disk I/O requirements. Using the 4 GB, 8 GB, and high-speed 8 GB drives normally provides an acceptable solution.
  - Ensure that there are sufficient disk IOPs to support the disk subsystem and that the IOP utilization is within the guidelines. Check that the distribution of disk units is evenly spread across the IOPs.
  - If new disk units have been added to the disk subsystem, ensure that the data has been evenly distributed. If there appears to be an imbalance, use the following commands:
    - Trace ASP Balance (TRCASPBAL) to collect disk usage statistics
    - Start ASP Balance (STRASPBAL) to move data between disk units

    Note

    Disk balancing was introduced in V4R1 with the Disk Balance (DSKBAL) command. Support was provided by PTFs, up to and including V4R3. At V4R4, the command was changed to Start ASP Balance (STRASPBAL). When using the STRASPBAL command, the system attempts to move data to achieve even disk arm utilization, rather than even disk space usage.

  - Make sure that the drives remain less than 80% full. When space usage exceeds this threshold, disk activity associated with extent allocation may increase and impact performance.
- **Software versions**:

  Make sure that you are running on the latest available versions and Service Packs for OS/400, Client Access Express, and System 21.

  When upgrading to new releases of OS/400, ensure that any HIPER PTFs for performance are applied to your system. In particular, apply any PTFs relating to SQL Optimizer performance as they may have a substantial impact on workload throughput.
- **System tuning**:

  Make sure that the system is using its existing resources efficiently:
  - Is the Machine Pool fault rate within recommended guidelines (see *OS/400 Work Management Guide*, SC41-5306). Excessive faulting in the Machine Pool affects all jobs on the system.
  - Are the fault rates in other memory pools within recommended guidelines? Again, excessive faulting in user pools may have an adverse effect on application performance.

- Are you mixing workloads (for example, batch and interactive) in the same pool? Consider the segregation of different workload types into separate storage pools, so that their different execution characteristics do not interfere with each another.
- Is interactive utilization at an acceptable level on the older server systems? On these systems, interactive activity can adversely affect batch performance beyond a predefined level. Check the job CFINTxx, for a high CPU utilization. This is normally an indication that the interactive throughput guideline for the processor configuration may have been exceeded.

- **DB2 UDB for AS/400 tuning**:

  Make sure that DB2 is working efficiently:

  - Are there any relatively small, high-I/O files that could be made memory-resident using SETOBJACC?
  - Are the indexes over large, heavily updated files terabyte indexes rather than the older 4 GB indexes? These newer indexes have less contention because they are locked during index update operations at the page level rather than at the table level.
  - Are there files with a large percentage of deleted records, especially work files? Deleted records still have to be handled by the operating system. It will improve performance if files with a high percentage of deleted records are periodically reorganized, or have their Reuse Deleted Records attribute set to *Yes.
  - Has historic data been archived from the live transaction files? Ensure that only business-critical transaction data is maintained in the production files.
  - Are System 21 audit files sustaining high transaction levels? Make sure a data retention policy is implemented for each of the key files.
  - Are redundant libraries being maintained on the system? This includes development work libraries, user-specific libraries, query-output file libraries, and PTF-installation libraries.

- **Workload support**:
  - Are you asking the system to perform unscheduled work that is not business critical?
  - Is the workload profile consistent with the one defined in the operations workload profile?
  - Are batch jobs being scheduled during periods of low system activity?
  - Are data extraction requests for Business Intelligence tools being scheduled appropriately?
  - Are users using interactive query during periods of peak workload activity?
  - Are users changing the job execution environment for both interactive and batch jobs?
  - Do users have access to system commands, such as WRKACTJOB and WRKSYSSTS, which introduce a system overhead when invoked?
  - Is the production machine supporting a development environment? If so, are the developers compiling programs in the production batch subsystems?

- Are IT staff responsible for generating extraneous workloads during periods of peak transaction processing? This normally involves using tools like Query/400 and SQL.
- Could batch workloads, such as EDI order processing, be handled as a number of frequently executed tasks, rather than one large task?
- Are the transaction throughput rates consistent with those determined for the daily, weekly, and monthly workload profiles?

- **Additional system tuning**:

  Additional tuning parameters that may be considered include:

  - How many concurrent batch jobs are executing system wide?

    This should be limited by the number of jobs that can simultaneously processed from each job queue. It should also be limited by the number of jobs that can concurrently execute within the subsystem. Configure the system for output rather than input, and allow batch jobs to finish before starting new jobs. This will help to reduce batch job elapsed processing time.
  - Review class settings. Check the value of QPWFSERVER and reduce, if appropriate (uses run priority 20 for file server tasks).
  - Change the job attribute to Purge (*NO). This may benefit interactive users who require minimal delay during data input (for example Telesales users).
  - Review the activity level settings for the storage pools. Ensure that the W - I value for each pool does not exceed the guidelines.
  - Do not activate System 21 subsystem descriptions that are not required. This specifically applies to subsystems required by test environments.
  - Automatic performance adjust turned off. If the system is in a stable condition, performance may improve if the Performance Adjuster is turned off. However, on systems with main storage constraints, using the Adjuster may enhance performance.
  - Use shared storage pools. Shared storage pools offer a facility to combine jobs with a similar characteristics in a common pool. Use the Work with Shared Pool (WRKSHRPOOL) command to set the size and activity level and to set the Paging Option to *CALC.
  - Over-managed subsystems, pools, etc. It is common to see AS/400 systems that are over managed. At one point, the tuning was correct, but frequently the tuning is not changed as usage of the system changes.

- **Network configuration**:

  Is the communications network setup effectively?

  - Are the ping times reasonable? Ping times on the local network should be less than 10ms to the AS/400 system.
  - Is the duplex setting on-line description properly set? Is half duplex being used for data transmission rather than full duplex?
  - Is the DNS name resolution efficient?
  - Has the max transmission unit (MTU) on the AS/400 TCP/IP configuration been set to *IFC?

- Has the TCP/IP buffer size on the interface been set to 64K?
- Is communications line utilization under 20%?

- **Job management**:

  The number of jobs being managed by the system must be maintained at a reasonable level, and the job-related system values must reflect this level of activity.

  - How many jobs are maintained by the system? If jobs are not maintained, the AS/400 Work Control Block Table will be forced to extend which may impact system performance. On the AS/400 system, a table entry is created when the job is submitted to the job queue, and it is removed when all components of the job have been removed (such as spooled files). Spooled files to review include:
    - User requested application spooled files
    - Job logs
    - Program dumps
    - DFU audit trails
  - Is there excessive sign on and sign off activity? If so, consider using the Discontinue Job (DSCJOB) command to temporarily suspend sessions.
  - Are users closing System 21 Explorer sessions prematurely (by using the "X" to close the window)? This will leave detached sessions on the AS/400 system, which may need to be ended. Users should be educated to close an Explorer session using the **File->Exit** route.
  - Do system values accurately reflect the number of jobs? QACTJOB and QTOTJOB establish the initial WCBT values. QADLACTJ and QADLTOTJ define the extent increments for expansion for the QACTJOB and QTOTJOB parameters, respectively.

    QACTJOB should normally be 10% greater than the Active Jobs value shown on the WRKACTJOB display.

    QTOTJOB should normally be 10% greater than the Jobs in System value shown on the WRKSYSSTS display.

10.6 Capacity planning with BEST/1

The objective of any capacity planning exercise is to determine the most cost-effective configuration required to support a specified workload (typically based on current, measured levels of activity) so that acceptable response times are delivered to the user.

This section presents an overview of the factors that you need to consider prior to embarking upon a capacity planning project. These considerations are valid for most capacity planning exercises. They are not confined to an AS/400 server environment.

While it is not within the scope of this section to discuss performance tuning and performance optimization, we strongly recommend that you make every effort to make the application, its implementation, and its use as efficient as possible in the business environment. If this is not done as a prerequisite, any inefficiencies are carried through with the increased workload, causing increased resource utilization.

10.6.1 Introduction

Capacity planning is a predictive process to determine future computing hardware resources required to support the estimated increases in computing workload. The increased workload can be a result of such factors as:

- Growth in business volumes
- The introduction of new applications and functions to enhance the current suite of applications
- Acquisition of additional operating companies
- A change in the companies market emphasis
- A change in seasonal business trends

Due to its predictive nature, capacity planning can only be considered at best an approximation. The implementation of the same application in different environments can result in significantly different system requirements. There are many factors that can influence the degree of success in achieving the predicted results. These include changes in application design, the way users interact with the application, and the number of users who may use the applications. It is also difficult to determine external factors that may affect the distribution of the workload over a given period of time, such as phone-in customer orders during a working day.

The objective of this section is to provide an overview of the approach required to predict future AS/400 system requirements in a traditional interactive workload environment.

The functions of the AS/400e capacity planning facility (BEST/1), available as part of the AS/400e Performance Tools Licensed Program (5769-PT1) Manager Feature, are used to predict AS/400 requirements. Detailed information on the use of this function is available in *BEST/1 Capacity Planning Tool*, SC41-3341.

This section introduces the key aspects of the capacity planning process. It does not cover the use of the BEST/1 tool, because it is already documented in the publication mentioned above. The capacity planning approach assumes that performance data has been collected with the Performance Monitor and is available to build a workload model.

Note

This section expects you to have at least a moderate level of understanding and experience with BEST/1. We recommend that you read *BEST/1 Capacity Planning Tool*, SC41-3341, to understand the concepts in this section.

10.6.2 AS/400 server modelling

In the context of the capacity planning methodology, we assume that AS/400 workload modelling starts from a known, measured workload. An extrapolation technique is then used to determine resource utilization and response times, associated with a specific growth rate.

The basic prerequisites for the measured workload profile are:

- The application is running optimally at expected levels of performance.
- There are no application-dependent constraints that invalidate BEST/1 extrapolations.
- No changes are expected in patterns of application usage or user behavior.
- A particular period of measured activity on the AS/400 system can be established as being representative of a sustained high peak workload.
- The proposed increase in workload can be related to the activity measured.
- An acceptable average response time estimate is established.
- A suitable capacity planning unit of measure has been determined based on application knowledge and measurability.

This process is fundamental to any capacity planning process, which is based on an existing measured workload. It is essential that you fully understand:

- What you have measured
- What it represents
- How it relates to what you are trying to model

If you don't fully understand the above points at this point in the process, it is unlikely that the end result will accurately reflect the actual business environment.

10.6.3 Assumptions

The capacity planning process makes the following assumptions:

- The applications under consideration have been optimized for the environment in which they are running with regard to:
  - Functions
  - Business requirements
  - User behavior
- The performance profile used in the capacity planning exercise is a good representation of a typical business workload. The profile should include a representative application transaction mix and workload volume.
- There are no application dependent bottlenecks that prevent growth in throughput or improved response times.
- The performance data is collected on a system that is not constrained by any of the key hardware components such as processor, memory, and disk. When system resources are saturated, they introduce overheads, such as queuing, that are difficult to isolate and eliminate in the modelling process.
- The nature of the applications and their complexity do not change significantly as a part of the capacity projection. For example, a version upgrade of an application suite often results in significant changes in resource requirements.
- There is no change in the overall use of any functions of the application that result in increased utilization of system resources.

If any of these assumptions are not valid, plan to make the appropriate allowances in the workload projections.

10.6.4 Understanding the application environment

Consider the interaction of the suite of applications to be extrapolated with other associated applications. Increased workload in one application may cause a cascading effect on related applications and increase their workload as well. For example, an increase in the number of sales order entry transactions can result in increased business volume in related systems such as inventory control, picking and dispatch, production planning, accounting, and so on. This may also extend batch run times for associated transactions such as customer invoicing.

A good understanding of the application can also assist in taking measurements that enable you to create a reasonably accurate workload model for extrapolation. An understanding of the key business components that the profile represents will simplify the correlation with the associated data volumes.

10.6.5 Selecting a capacity planning unit of measure (CPUM)

Identifying a measurable capacity planning unit of measure is critical to the success of a capacity planning project. The selected unit of measure must be clearly understood and have boundaries that can be defined and identified.

Business transactions, such as sales order lines, pick lines, and invoice lines, are frequently used as the capacity planning unit of measure. The volume of transactions can be easily calculated for a period of time. Each business transaction is the product of multiple interactions with the computer system, with some amount of keythink time between each interaction. In this situation, the capacity planning unit of measure is invariably represented as a number of AS/400 transactions per business unit.

10.6.6 Determining growth objectives

An effective capacity planning project requires an estimate of the proposed increase in workload with which the system must cope. Often business managers predict increases in terms of sales revenue, profit projections, or other business measurements. These business objectives have to be translated into the impact on the system workload.

You must have a very clear perspective of the impact of the business growth on the workload model. It is important to have a clear understanding of the key model components and how each one will be affected by the proposed business growth. An increase in volume at one business level can have a substantial impact on the overall system throughput. Ensure that you document the assumptions regarding the basis on which the increases in computing workload were determined. This will be beneficial when reconciling any differences that may occur between the *predicted* and the *actual* workloads.

Business growth objectives can be specified over varying time scales. However, in today's rapidly changing commercial environment, customers rarely maintain a static business profile for a prolonged period of time. For this reason, business growth projections are generally more accurate over short periods of time. Building workload models that represent business projections in excess of 12 months do not normally produce accurate results.

10.6.7 Setting expectations

The deliverables from the capacity planning project must be agreed upon and understood. It is important to emphasize the nature of the capacity planning process, in particular, that there are many factors that can influence the degree of success in achieving the predicted results.

There are margins for error at every stage of the predictive process including:

- Estimation of workload at the business level
- Existence of application dependant bottlenecks
- Translation of the business workload into CPUMs
- Prediction of user behavior
- Determination of periods of peak activity
- Seasonal workload fluctuations
- Changes in business market emphasis
- Impact of acquisitions and mergers

For these reasons, the conclusions and recommendation of a capacity planning project cannot be considered as finite. They are only an approximation.

Response time expectations are generally expressed as an *average per transaction*. With regard to the capacity planning process, response time is not end to end. It is within the AS/400 system only. Estimations of network propagation delays are beyond the scope of BEST/1 and the capacity planning process. Response time requirements are normally specified below a particular value (for example, an average of less than 1.5 seconds) for a specified percentage of the transactions (for example, 90% of the interactive transactions).

Note

The BEST/1 modelling tool is based on the use of average values, which include predictions of utilization and response times.

10.6.8 Measuring workload and system resource utilization

This is a fundamental aspect of the capacity planning project. The measured workload information collected at this point is used in the extrapolation of the growth estimates provided by the customer. Consider the following points:

- The interval over which performance data is collected, should provide representative information for a period of high workload activity. If possible, data should be collected during a period of peak business workload throughput. Additional data collections should be made during periods of normal business activity to provide workload verification.
- Determine a suitable capacity planning unit of measure (CPUM) that can be used as a basis for modelling the growth. The selected CPUM must be measurable in terms of the quantity and average response time (per transaction) over the measured interval.

Building a workload model for BEST/1 requires the following basic information:

- AS/400 resource utilization information
- Application workload measurements:

– Number of CPUMs
– Number of AS/400 transactions per CPUM
– Average response time per transaction for the CPUM

To construct a measured workload profile, you need to collect AS/400 performance data and application workload data for the selected period of system activity. You can then begin to develop a correlation between AS/400 system activity and business transaction rates. This forms the basis of the CPUM.

10.6.9 Collecting AS/400 performance data

Use the standard OS/400 Start Performance Monitor (STRPFRMON) command for performance data collection. This provides information on the AS/400 resource usage and associated transaction rates during the measured interval. Select the data collection time interval to provide sufficient granularity to identify a representative data set for modelling.

Make sure that the measured interval includes any associated batch workload activity required to support the interactive transactions.

In a 24x7 business scenario, you may want to capture data sets from the entire operations window. This is to ensure that processing requirements do not vary substantially for each operation.

Ensure that data collection is undertaken for a number of working days, but not less than five. Where possible, set up data collections for subsequent periods to confirm the validity of the data being used in the workload model. Under no circumstances should you use a single data collection interval as a basis for a workload model. This approach may introduce anomalies into the model that are not representative of daily peak workload processing.

10.6.10 Collecting business data

Business transaction data needs to be collected for the periods that correspond to the performance data collection. The nature of the business information will depend on the CPUM and the principle business components of the workload profile.

For example, for a Finance and Logistics model, you may want to consider the following business transactions:

- Order headers
- Order lines
- Pick lines
- Invoice headers
- Invoice lines
- Cash allocation
- Journal posting
- Invoice posting

This list is by no means definitive and will vary depending individual customer requirements. A customer may place far more emphasis on the importance of one transaction, rather than another customer in the same business sector.

10.6.11 Creating a model using measured data

BEST/1 provides the facility to use measured AS/400 performance data in the construction of a model for capacity planning. The objective is to create individual or consolidated *workloads* within the model. These represent the various business application workloads that are supported in the capacity planning project.

Once you create the workloads, you can analyzed them for the effect of independent growth rates on resource utilization and response time. You can also save and use them in other BEST/1 models.

The main steps used to create a BEST/1 model with one or more distinct workloads based on the workload definitions are:

1. Use the Start BEST/1 (STRBEST) command to activate the “advanced user level” of BEST/1.
2. Select the performance data set to be used in modelling.
3. Identify the time period for analysis.
4. Classify the jobs into appropriate workload groups.
5. Define the number of Capacity Planning Units of Measure (CPUMs) per hour for each workload.
6. Create the model.

10.6.12 Summary

Capacity planning involves a detailed analysis of the server and network resource load. Using this information, in conjunction with application transaction data, you can determine the necessary resources to meet a specific service level.

Using the AS/400 Performance Monitor data to understand key server resource usage, in conjunction with business transaction detail, you can construct a business workload model. Then, you can use the BEST/1 tool to model any one of a number of future workload scenarios.

Capacity planning for network resources is a complex area. BEST/1 provides an indication of network interface utilization, but this is not comprehensive. BEST/1 will only consider interface utilization based on network traffic associated with the measured profiles. It will not provide an estimate of LAN and WAN utilization for components such as:

- E-mail
- Internet access
- File sharing

You may need to enlist the services of a network specialist to undertake detailed network capacity planning.

Capacity planning is an ongoing scenario. There is no definite answer, nor right or wrong. Capacity planning should form part of an ongoing business review process, because you are attempting to forecast the system components required to support the business objectives. Figure 224 illustrates the capacity planning cycle. It is clear from this illustration that the process is continual and subject to constant review and revision.

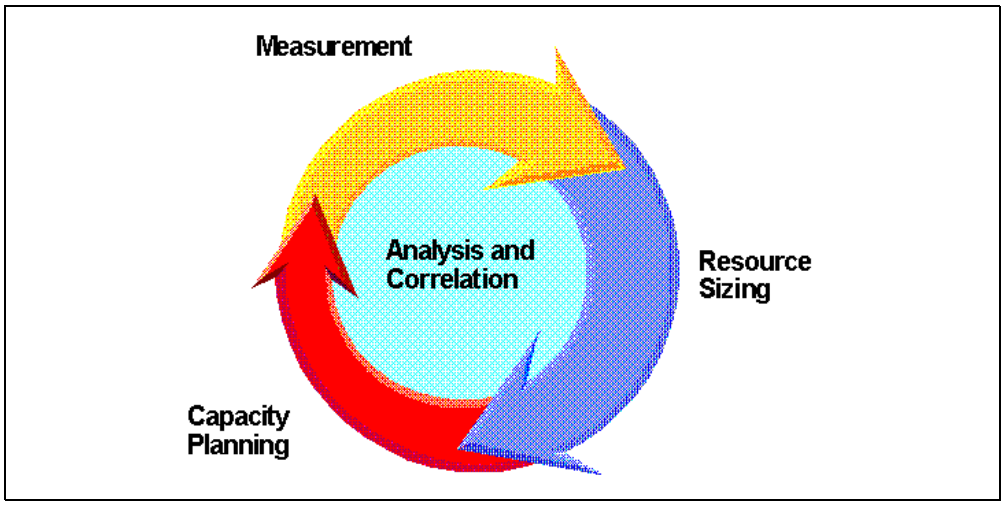

Figure 224. Measurement, analysis, correlation, sizing, and capacity planning

Your application environment will be subject to constant revision, as a result of many external factors. Analyzing the impact of these factors on a continual basis is generally an impractical solution. Capacity planning reviews should be scheduled at regular intervals, especially prior to major business environment changes.

Capacity planning can be considered as an art rather than a science. There are no absolute answers, only approximations based on interpretations and assumptions. It is an iterative process, because the environment is continually changing. However, it is essential for establishing an IT environment that is functionality complete, and achieves critical performance requirements while remaining commercially viable.

Chapter 11. Customization

Generally, very little modification is required for System 21 programs. However, more advanced users, or those with specialized requirements, find that they may want to make changes to the software. This chapter gives you the background information necessary to enable you to customize the System 21 to your needs.

Note

Any modifications that you make to System 21 are not supported by Geac, unless you purchase their modification support services. Any time that a Geac Service Pack is released, it has to be checked for any impact to your modified programs. Sometimes, the modifications have to be implemented on the new programs, as well.

11.1 Where and what the objects are

When looking for objects in the system, it is helpful to know where certain types of objects are located. This section takes a look at the various types of objects that are used by System 21 applications and where they can be found.

11.1.1 Naming conventions

System 21 objects follow this basic naming convention:

- **Libraries**: The library name is broken into four areas:
  - The software code
  - The application code
  - The library type
  - The version number

Figure 225 on page 390 illustrates the naming convention for library objects.

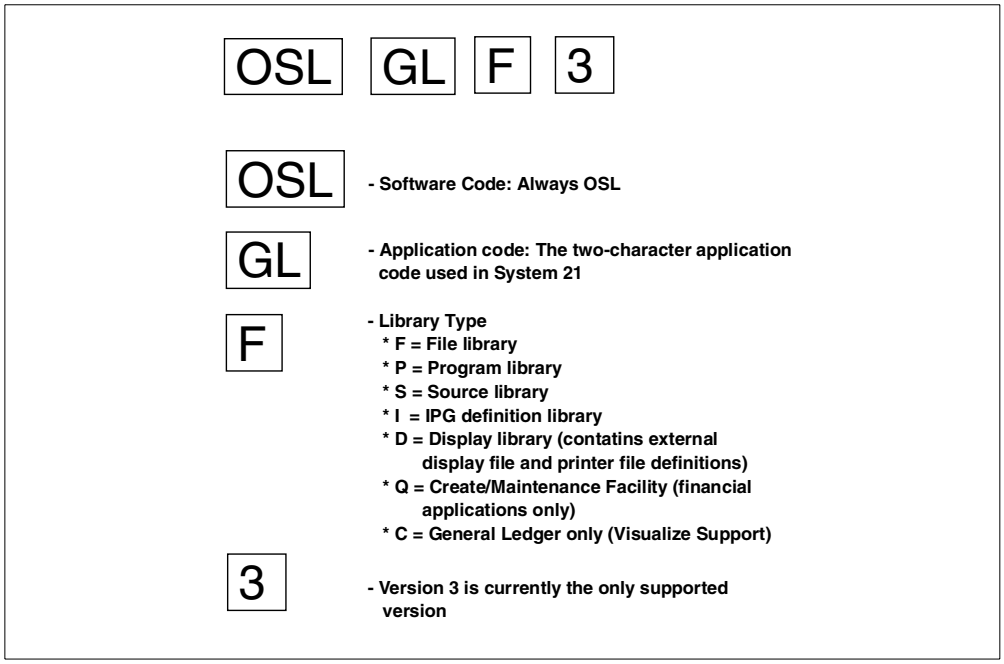

Figure 225. Library naming convention

Note

If you build custom logical files over System 21 files, remember the following point: When restoring libraries from backups, you must ensure that the System 21 files library is restored before the library containing the custom logical files. If the System 21 files do not exist when the custom logical files are restored, the restore will fail.

- **Programs**: Figure 226 illustrates the naming convention for program objects.

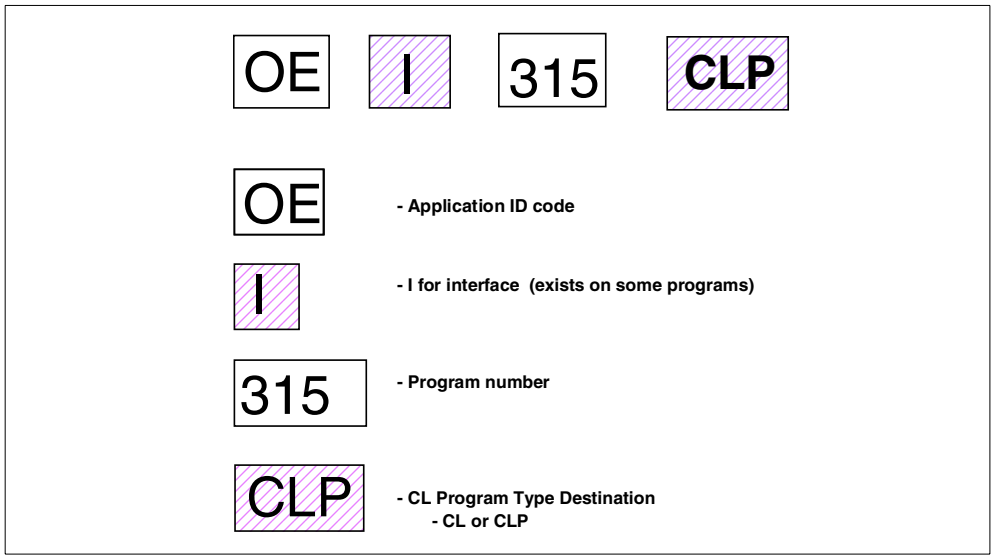

Figure 226. Program naming convention

- **Data Files**: Figure 227 illustrates the naming convention for data files.

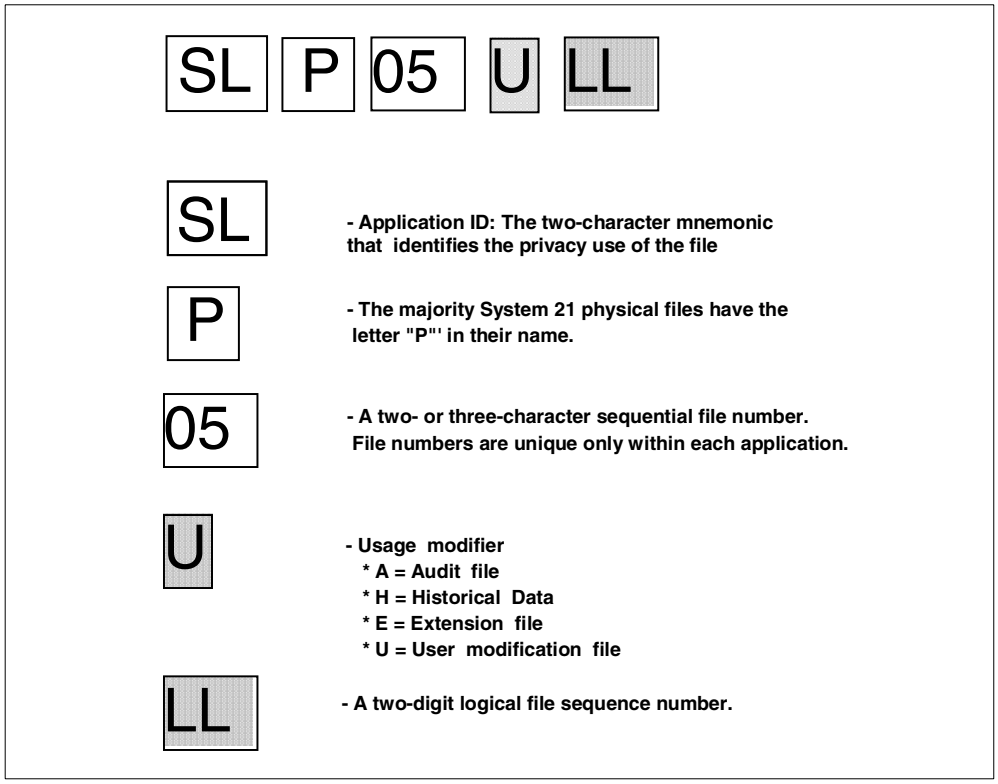

Figure 227. Data file naming convention

- **Print file**: Figure 228 illustrates the naming convention for print files.

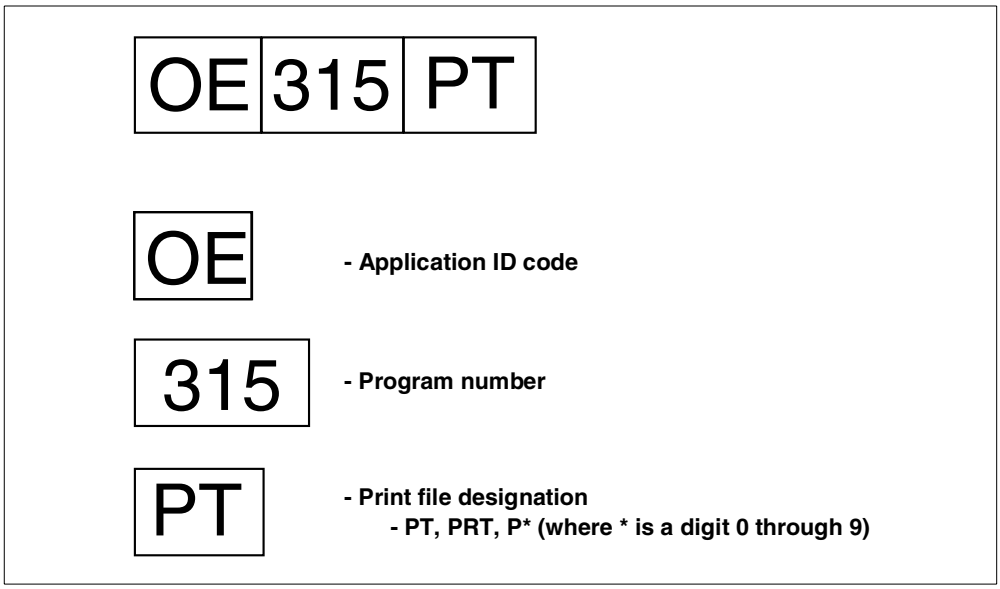

Figure 228. Print file naming convention

- **Display file**: Figure 229 on page 392 illustrates the naming convention for display files.

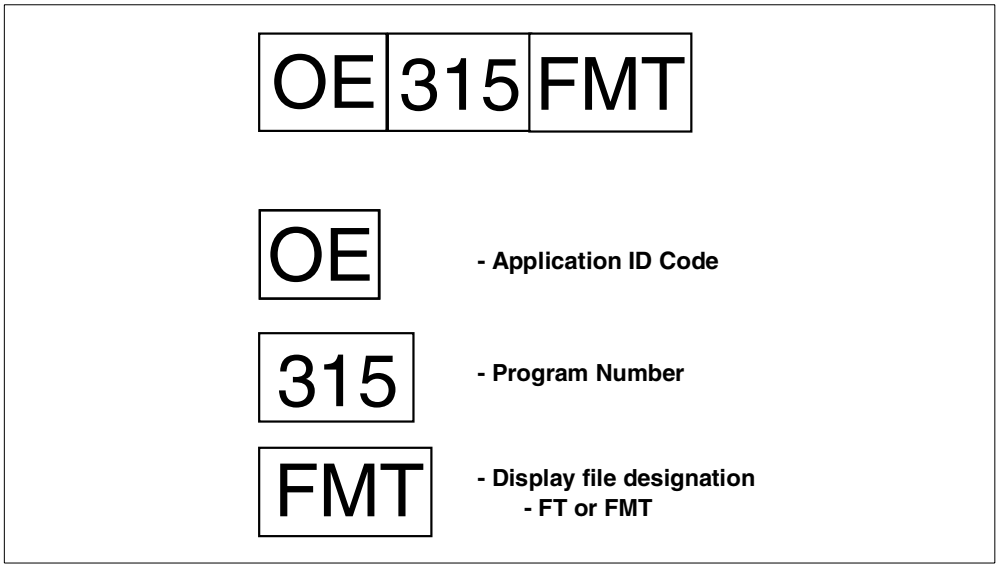

Figure 229. Display file naming convention for data files

- **Message files**: The message file name consists of the application code followed by the suffix “MSGF”.

11.1.2 Object types and locations

In the System 21 environment, the objects are stored in different areas, divided by object type. This section describes the different object types and where they are stored in a default environment:

- **Program objects**: Standard program type objects (RPG, RPG/SQL, CLP, and CLP(CRT)) are found in the OSLxxPv libraries, where *xx* is the application and *v* is the version. If the program libraries and display libraries are combined, the programs will be found in the OSLxxDv libraries. User-defined programs, such as Financial Manager Report and Sales Analysis Reports, are found in the files library.
- **Data files**: Standard files are found in the OSLxxFv libraries, where *xx* is the application and *v* is the version. If multiple files libraries were combined, the files will be found in the combined libraries (usually named OSLDxFv, where *x* is a sequential number of the combined files library (currently some System 21 modules use 1 and 2) and *v* is the version. The files libraries hold all the physical and logical files used by applications. Because these databases change during the normal working day, as a process of running the applications, they must be saved on a daily basis.
- **Message files**: Message files store error messages used by the applications. They store constant information, such as text used for displays and reports and tables used for validation. Message files are found in the displays libraries.
- **Source files**: The source files are found in the source libraries. These libraries contain the source code that is compiled into executable instruction sets. The following source member files are used to store the source code:

– QCLSRC: CLP program source members
– QRPGSRC: RPG program source members
– QDDSSRC: DDS file definitions

The sources for all display files and printer files are found in the display libraries. These libraries contain all display files and printer files for the applications. The following source member files are used to store the source code:

- **DISPLAYS**: DDS file definitions for display files.
- **PRINTFILES**: DDS file definitions for report files.
- **Copy source member files**: Copy source member files contain often used utilities and code. See 11.4, “Copy Source members” on page 395, for more details.
- **Data areas**: There are several data areas used by the applications to store various control data. Data areas that store static information about the application are found in every application library. Data areas that interact with the applications are typically found in the data file libraries.
- **Data queues**: Data queues are used to trigger automatic update functions. Data queues are found in the program object libraries.

11.2 The local data area (LDA)

A local data area (LDA) is a character data area that is 1024 bytes in length and is automatically associated with an interactive job. The LDA remains for the entire time your interactive session is open and is used for communications between programs and processes.

The LDA is used extensively in System 21 software. You need to consider the LDA when designing and coding any modifications.

The LDA is defined to be used consistently across all System 21 applications. The LDA record is divided into separate zones. The zones are defined in Table 58.

Table 58. Local Data Area (LDA) Zones

Zone	Usage
1 to 256	Reserved for Application Manager fields. Refer to 11.3, “Record layout for zone 1” on page 394.
257 to 768	Ad hoc area used for work fields used for passing information from one program to another as needed.
769 to 960	Contains application standard fields when used with a common function such as item searches and parameter prompt windows.
961 to 1024	Originally intended for customer modifications only. Now also used by System 21 for standard application uses.

Customers need to perform careful analysis prior to changing or introducing new programs that alter the definition of the LDA. If it becomes necessary to integrate new functionality with System 21, we recommend that you write the program so that the contents of the LDA are saved in the program prior to calling the new function, and then restore the original values after the new function completes.

11.3 Record layout for zone 1

To simplify the use of the LDA, a record layout has been defined as a dummy physical file, held in library IPGAMP4. All the fields are prefixed with the characters L#, as shown in Table 59. The record layouts for individual application standards are found in copy source members in the individual application libraries.

Table 59. LDA layout for zone 1

Name	Positions	Length	Description
L#CONO	1-2	2	Company code
L#CONM	3-37	35	Company name
L#PRQU	38-47	10	Print Queue for Output
L#PLIB	48 - 57	10	Print Queue Library
L#JOBQ	58 - 67	10	Job Queue for Submitted Jobs
L#JOBL	68 - 77	10	Job Queue Library
L#DFNM	78 - 87	10	Display File Name
L#FMTN	88 - 97	10	Display File Record Format Name
L#PGID	97 - 107	10	Program name for submitted Jobs
L#JOBN	108 - 117	10	Job name for submitted Jobs
L#RTCD	118 - 119	2	General purpose return code
L#USER	120 - 129	10	Application user ID
L#APPN	130 - 131	2	Application code
L#FUNC	132 - 135	4	Function (Task) code
L#HOLD	136 - 136	1	Output queue hold status
L#LIBL	137 - 140	4	Library list code
L#CUSC	141 - 143	3	Customer code
L#JOBN	144 - 152	9	System 21 job number
L#SOFF	153 - 153	1	Sign off after request (Y/N)
L#MNCO	154 - 154	1	Authorized to maintain company (Y/N)
L#RSTA	155 - 155	1	Current user has restricted access (Y/N)
L#EXCL	156 - 156	1	Exclusivity requirement
L#TERM	157 - 166	10	Submitting terminal
L#RLSL	167 - 168	2	Release level
L#APSR	169 - 169	1	System 21 or user source application
L#GLCO	170 - 171	2	General Ledger company (if interfaced)
L#PRCO	172 - 173	2	Private Ledger company
L#XXCO	174 - 175	2	Company code for other interfaces

Name	Positions	Length	Description
L#CPFN	176 - 181	6	CPF job number
L#HPCD	182 - 183	2	Help window code
L#NAPS	184 - 184	1	Number of applications authorized to user
L#SBMX	185 - 185	1	Extra submission details requested
L#DTFM	186 - 186	1	Date format (D=DMY, M=MDY, Y=YMD)
L#LANG	187 - 188	2	Language code
L#AACD	189 - 197	9	Application authority code
L#IDAT	198 - 204	7,0	Internal current date (CYYMMDD) (Signed Decimal)
L#EDAT	205 - 210	6,0	External date (format specified in L#DTFM) (Signed Decimal)
L#LGLB	211 - 220	10	Language library
L#MENU	221 - 230	10	User menu
L#INAM	231 - 240	10	Instruction name
L#CROW	241 - 241	1	Cursor row
L#CCOL	242 - 242	1	Cursor column
L#MCUR	243 - 243	1	Multi-currency
L#USAF	244 - 244	1	United States flag
L#VATF	245 - 245	1	Value Added Tax flag
L#RSVD	246 - 256	11	Reserved for future development

11.4 Copy Source members

Many standard routines or calculations used in application programs are defined and stored in “Copy Source” members. These standard instruction sets are then copied into the RPG source code by using the /COPY statement.

The OSLCOPYSRC library contains a number of standard routines that are used throughout the applications. Special calculation routines for applications are found in source files. You can use them by calling the program *xx*COPYSRC, where *xx* is the application code (for example, INCOPYSRC).

OSLCOPYSRC contains the QRPGSRC and QTXTSRC files, which contain the RPG copy member and associated documentation respectively. A sample of routines found in OSLCOPYSRC is shown in Table 60.

Table 60. Samples of OSLCOPYSRC routines

Routine name	Description
@DIV@C	Validate a date in internal format
@DTD@C	Convert date form elapsed days to internal form
@DTE@C	Convert date from internal form to elapsed days

Routine name	Description
@DTI@C	Convert date from external to internal format
@DTO@C	Convert date from internal to external format
@DTV@C	Validate date in external format
@GDT@C	Get latest internal and external dates
@WKI@C	Convert week - external / internal
@WKO@C	Convert week from CYYWW to WWYY
PSSR	Standard PSSR error handling routine
@LINDS	Printer file overflow data structure
@LINDS1-9	Printer file overflow data structure for program with more then one printer file

For details on the exact use of the routines that are provided in the OSLCOPYSRC library, refer to the associated member in the QTXTSRC file contained within.

11.5 Consolidating libraries

If you run out of space on your user library list, library consolidation is currently the best solution to overcome this problem.

System 21 is shipped with a set of standard libraries. These contain database files, programs, display files, printer files, IPG definitions, source objects or translation objects.

Library lists are used by the AS/400 system to locate objects used by applications. Library lists are defined within System 21 Application Manager and are defined automatically when you install an application using the Install AM Application (AMINSAPP) command.

Consolidation is a process of merging libraries together to decrease the number of libraries in the user portion of the library list. Reasons for consolidating libraries are:

- Adding libraries (for example, when designing custom software or national language support) can easily drive your library lists to the 25-entry limit. If you consolidate your libraries, you can avoid reaching that boundary. For example, the Order Entry has separate libraries for program objects and display or printer files. You can consolidate them into one library.
- Backup purposes. You can consolidate all the database libraries into one library. By backing up that one library, instead of several libraries, you can be assured that the state of the database is preserved.

Some libraries have already been consolidated in the standard product:

- The program object and display or printer files in Financials and a number of other applications have been consolidated. The program objects have been moved to the display and printer files library.

- The Customer Service and Logistics database has been consolidated into two libraries, OSLD1F3 and OSLD2F3.

11.5.1 Libraries consolidation guidelines

The recommended areas for consolidating libraries are:

- **Program and displays or printer files**: Consolidating these libraries for each application module helps to reduce the number of entries per library list. However, where translation libraries are being used, this may not provide sufficient space for these additional libraries.
- **Translation objects**: Consolidating all translation objects into one library can help substantially in a multi-language installation.
- **Financials database libraries**: Consolidate these libraries into one library, for example, OSLF1F3. Background subsystems need to have their library lists updated.

> **Note**
>
> When consolidating libraries, do not forget to merge the PTFLOG files from the old libraries into the new consolidated library.

11.6 Brewing your own tasks

Tasks are designed to execute application functions. They form a part of the core of System 21. The attributes you assign to a task determine how it will function. This section gives you the background information necessary for setting up your own tasks within the System 21 environment.

11.6.1 Tasks and environments

Tasks may be defined within a specific environment if required. If environment specific task definitions do not exist, System Manager checks the default environment (the one referred to in the data area AMCUSCODE) for task definitions. If nothing is found, it defaults to the task definitions in the base environment.

11.6.2 Task forms

A task can take one of three forms:

- An interactive call from a menu such as Whole Order Enquiry. Enter only an interactive program name.
- A batch task that simply asks the user to confirm that they want to submit the job. Enter only a batch program name and job name.
- A batch task with a prompt panel for runtime parameters or selection criteria. Enter an interactive program, batch program, and job name.

Figure 230 on page 398 shows the fields to consider when creating a new task.

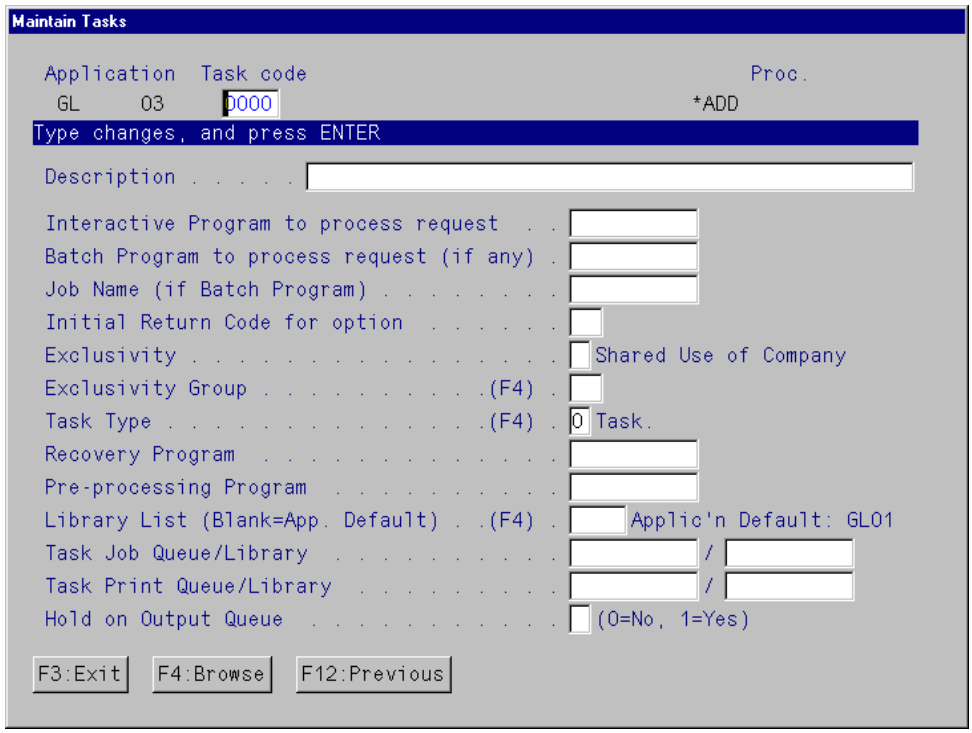

Figure 230. Creating a new task

Some of the parameters are explained here:

- **Exclusivity and Exclusivity Groups**: Exclusivity codes and groups are used to set up scenarios where a task cannot be run unless all other tasks of the same group are not running. Exclusivity codes with groups allow you to set up exclusivity dependencies that are outside a single application. This allows you to set up basic exclusivity of a company or application or to set up very complex scenarios.
- **Task Type**: Task Type enables Application Manager to handle different sets of tasks you may want to write. System 21 uses “O” as the task type.
- **Recovery Program**: Recovery programs can be specified to be called if a task ends abnormally.
- **Pre-processing Program**: Pre-processing programs are always called before the first program of a process. Some applications use these routines to set up LDA values before a task is called.
- **Overrides**: Library lists, job queues, and print queues can be overridden at the task level.

Note

When maintaining tasks, press F19 to see where a task is used.

11.6.3 Task code set up

If you are adding a new application task code, the following numbering convention is required:

- Numbers below 0099 are reserved for functions that do not require company validation at initialization, for example company maintenance. When these task codes are used, Application Manager initializes the LDA field L#CONO with “&&”.
- Numbers 0100 to 8999 are for standard application tasks. Do not use this range.
- Numbers 9000 to 9899 are used for customer task codes, but may also be used by System 21.
- Numbers 9900 to 9999 are reserved for System 21 tasks.

11.7 Print file modifications

Most companies find that they want to do some modifying or reformatting to a report or a form. The most commonly modified print files are shown in Table 61. You may have to make arrangements with Geac if you do not have the source code for the print file you want to modify.

When forms are modified, place them in the modification library that you have specified to appear at the top of every library list. Table 61 shows the file name and source libraries for each of the reports.

Table 61. Print file locations and names

Report	Print file name	Source file	Source library
A/P Checks (U.S.)	UPLCHECK	PRINTFILES	OSLPLD3
A/P Cheques (U.K.)	PLCHEQUE	PRINTFILES	OSLPLD3
A/P Check Remittance Note (U.S)	UPLCHKRM	PRINTFILES	OSLPLD3
A/P Cheque Remittance Note (U.K.)	PLCHQREM	PRINTFILES	OSLPLD3
A/P Remittance Advice (U.S.)	UPLREMT	PRINTFILES	OSLPLD3
A/P Statement (U.S.)	UPLSTATM	PRINTFILES	OSLPLD3
S/L Statement (U.S.)	USLSTATM	PRINTFILES	OSLSLD3
S/L Statement (U.K.)	SLSTATMT	PRINTFILES	OSLSLD3
Invoice (U.S.)	OE345PU1	PRINTFILES	OSLOED3
Invoice (U.K.)	OE345PT1	PRINTFILES	OSLOED3
Credit Memo (U.S.)	OE345PU2	PRINTFILES	OSLOED3
Credit Memo (U.K.)	OE345PT2	PRINTFILES	OSLOED3
Pick Note	OE341PR	PRINTFILES	OSLOED3
Purchase Order (U.S.)	PM084PU	PRINTFILES	OSLPMD3
Purchase Order (U.K.)	PM084PT	PRINTFILES	OSLPMD3

11.8 Operating environments

Different operating environments allow you to train users, test modifications, and develop custom applications, all without risking any of your valuable production data. Even though these are not the only uses of different operating environments in System 21, they are the most common reasons for creating different environments.

Creating operating environments gives you a substantial amount of flexibility in choosing the libraries and applications to build in your new environment. For example, you may want to create a training environment, which uses the exact same non-database libraries (programs and displays libraries) as the live environment, but uses separate database libraries to isolate the training data.

An acceptance testing library is commonly used to hold new objects while they are tested. It is placed at the top of the library lists so that the objects within it are used instead of any other objects of the same name. The most common use for an acceptance testing library is to test application PTFs. The PTF is applied to the acceptance testing library and tested before application to the production environment.

Table 62 shows the relationship between production and non-production libraries and some of the different types of environments.

Table 62. Library options for different environment types

Environment type	Production database libraries	Production non-database libraries	Non - production database libraries	Non - production non-database libraries
Production	YES	YES	NO	NO
Training	NO	YES	YES	NO
Acceptance Testing	NO	YES	YES	NO
Development	NO	NO	YES	YES

Note

Acceptance testing and development environments may also be used for training. The number and type of environments on your system are determined by your particular business needs, as well as your AS/400 configuration.

The common standard naming convention used when creating a new environment is to replace the first three characters of the library name (usually “OSL”) with three characters selected as the new environment code. For example, OSLGLF3 becomes TSTGLF3. When consolidating multiple applications into a single library, we suggest that you change the application code in the library name to “@@”.

11.8.1 Terminology

Different entities within System 21 include:

- **Version**: This is used to describe the setup within Application Manager for an environment.
- **Environment**: This is used to describe the complete set of System 21 libraries.
- **Production environment**: This is used to describe the set of System 21 libraries that are used in the daily operation of the business.
- **Non-production environment**: This is used to describe the set of libraries that are used for development, testing, training, or any other non-critical application.

11.8.2 Types of environments

This section provides a brief explanation of the different types of environments that you can create for testing and training purposes.

- **Standard environment**: The standard environment, or *blank environment*, as it is often called, is the one that comes standard with System 21. It uses the standard OSL libraries, which are shipped along with the previously defined menus, tasks, and library lists. The reason it is known as the blank environment is that the Version Code, as seen between the Application Code and release, is blank, for example, OE/ /03.

  Users must be authorized to use the standard environment within Common Functions.

  Attention

  Never modify any tasks, menus, library lists, or other settings in the blank environment except by a PTF or Issued Support Alert, both of which are supplied by Geac.

- **Default customer environment**: This is a special environment that should be used for customization, such as menus and library lists for a specific customer. It is defined by the value that is held in the AMCUSCODE data area, known as the Customer Code. Users use this version when they use the command AM3 or enter System 21 through one of the startup programs (AMINITIAL, XAINITIAL, or CWSINITIAL).

  This environment is special because not all library lists need to exist in Application Manager in this version. If a task needs library list code 0001 in OE/ / 03, it first looks in version OE/xxx/03, where *xxx* is the Customer Code. If a library list is found here, it is used. Otherwise, the library list in the blank version OE/ /03 is used instead. This is useful where a customer has a modification library that contains custom programs or print files. An example is an invoice print, which then can be used by setting up a library list in version OE/xxx/03 for the task without having to set up library lists for every application.

- **Independent machine environment**: The simplest setup is to have a completely separate machine that has an exact duplicate of the setup on the live machine. This is the simplest to support and set up because the libraries from the live machine can be saved and restored directly onto the separate

machine. Then, all that is left is to set up the user profiles and apply authorization codes.

Because System 21 licences are processor and model dependent, this setup would require additional authorization codes and licenses.

- **Training environment**: A training environment can be set up on the live machine. This environment should have a complete duplicate set of the database files libraries (for example, OSLGLF3, OSLD1F3, OSLPDF3), but it uses exactly the same programs and company numbers as the live version. A common standard is to use the naming convention *yyy*GLF3, where *yyy* is the name of the version. Or, combine all file type libraries to a consolidated library called *yyy*@@F3.

  In the training environment, library lists need to be set up for all applications. This can be done by using the option in Application Manager to copy library lists, or by using Library Mapping in Application Manager and the AMINSAPP command with the parameter options *LIBL & *AUTOMAP. This function is discussed in greater detail in 11.8.5, “Installing the software” on page 404.

  If you have any library lists in your production version, you need to update the training version to reflect this.

- **Acceptance or development environment**: This type of environment is used for applying Application Product Updates (PTFs) or custom programming so that it may be tested prior to loading into your customer environment, and without affecting the production environment. This type of environment keeps the production data and programs safe from unstable or development programs and data loss.

  There are two methods for achieving this. The first method uses the same programs as the production environment, with a modification library riding at the top of the library lists. The second method uses a completely separate set of program libraries. Each method has common features, including:

  - Separate database libraries.
  - They are set up the same was as the training environment.
  - Complete set up within the Application Manager, which uses the AMINSAPP command and specifies the TOVRSN parameter and library mapping as *AUTOMAP. The copy option must be specified as *ALL and not *LIBL, as it is when creating the training environment.

11.8.3 Checking prerequisites

Before you start creating your test environments, make sure that you have a full and working system with a standard default environment.

Check the following areas before you create a test environment:

- Application Manager is common to all environments and, as such, must support the highest version level of the software present on the machine. For example, a machine with V3.5.1 live and a V3.5.2 test environment would require V3.5.2 Application Manager to support all environments.
- There is sufficient disk space to enable a copy to be made of all relevant programs and files to facilitate the new environment.

- A full system save is completed and verified before commencing any setup to safeguard the integrity of the data in the event of a problem.
- You created a listing of all of the libraries you intend to duplicate in your new environment.

11.8.4 Loading the software

The software should be loaded from the shipped distribution media or a recent backup. This should be done using the Restore Library (RSTLIB) command since the default library names to which the software loads needs to be overridden.

To start the process, make sure the media is loaded in the appropriate device, and sign on to the AS/400 system using the QSECOFR user ID.

If you are restoring from distribution media, go to a command line and type the following command for each library to be copied into your new environment:

```
RSTLIB LIB(OSLlibraryname)DEV(opt01) OPTFILE(/OSLlibraryname)
STLIB(Newlibraryname)
```

The following list explains the variables used in the command line:

- `OSLlibraryname` is the name given to the library when it is installed into a default environment.
- `Opt01` is the default name of the AS/400 CD drive. This should be changed to reflect the name of the device that contains your installation or backup media. If you are using a device other than `Opt01` for your restore, you will not use the OPTFILE keyword and entry.
- `Newlibraryname` is the name overridden to allow the library to be loaded alongside the default library. Generally, the three-character environment code of the new environment is used by replacing the first three characters of the library name with the new environment code. For example, if your test environment is named TST, you would restore the library OSLGLF3 as TSTGLF3.

Attention

It is important to follow this step closely! Failure to do so may cause your production libraries to be overwritten, resulting in data loss and possible business interruption.

You must repeat this step for every library needed in the new environment, with the only exception being System Manager. There must not be two occurrences of System Manager in the machine.

11.8.4.1 Company number consideration

Some people change the company numbers in the non-production environments. Consider these key areas when making your decision on changing company numbers are:

- **Company exclusivity locks**: A user in a non-production environment will hold a lock on the company with which the user is working. If that company happens to be the same as in the production environment, certain processes

cannot be performed until the lock is released by the user in the non-production environment.

- **Database occurrences**: The company code field exists in most files in the System 21 database. All non-production database libraries need an extensive process to migrate to the new company numbers.

After checking to make sure all of the libraries have been loaded correctly and changing the company numbers (if you choose), you are ready to proceed with the process explained in the following section.

11.8.5 Installing the software

Once you load the libraries for your test environment on the system, you can set up the Application Manager files to recognize them. To make the necessary associations, you need to sign on to the AS/400 system as QSECOFR and follow these steps:

1. Library list mapping.

   To map the library lists, start Application Manager using the Start IPG Application Manager (`STRIPGAM`) command, and type option `2` (Maintain Library Lists).

   You see a panel similar to the example in Figure 231.

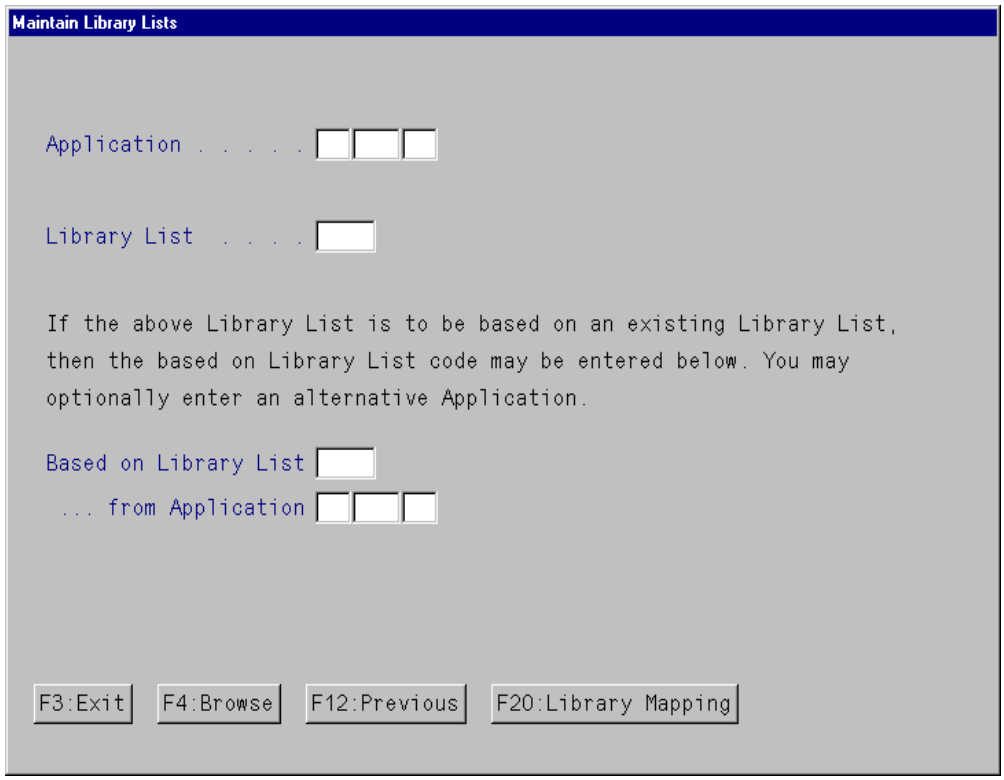

Figure 231. Maintain Library List display

   Click **Library Mapping** to access the Library Mapping panel shown in Figure 232.

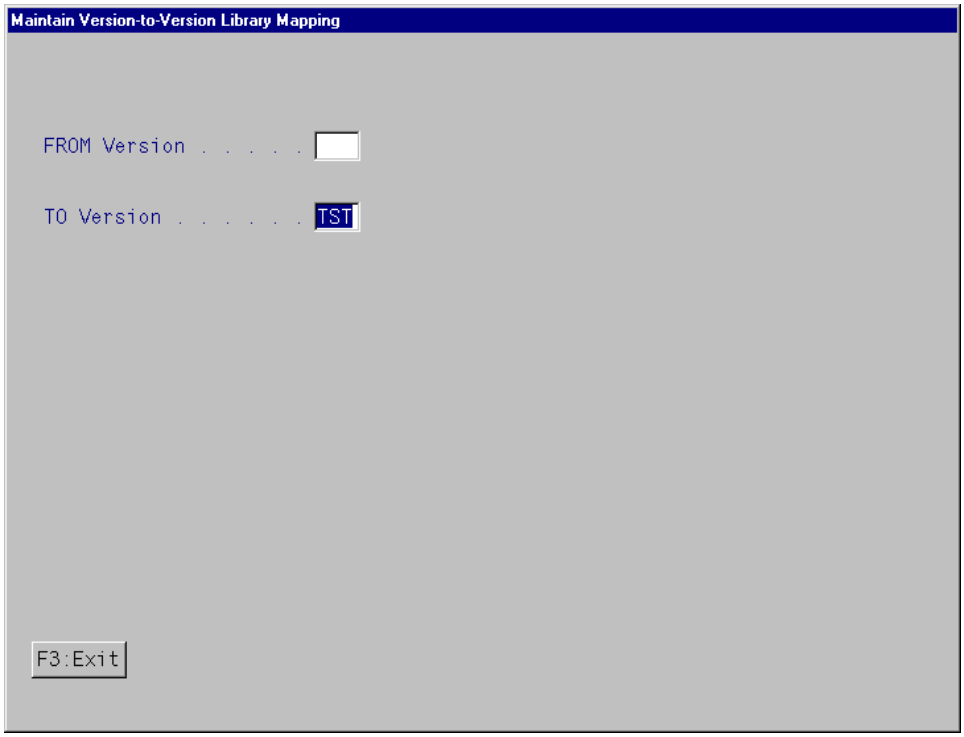

Figure 232. Library Mapping display

We leave the “FROM Version” field blank in this example, but you may have an environment you want to copy as the base for another. To accomplish that, enter the environment code to be copied in the “FROM Version” field.

Now, enter the 3 character code of the environment you are creating in the “TO Version” field. In Figure 232, we entered “TST” for illustration purposes. When you press Enter, the Library Mapping program reads all of the libraries used in all library lists for the blank environment and displays them (Figure 233 on page 406).

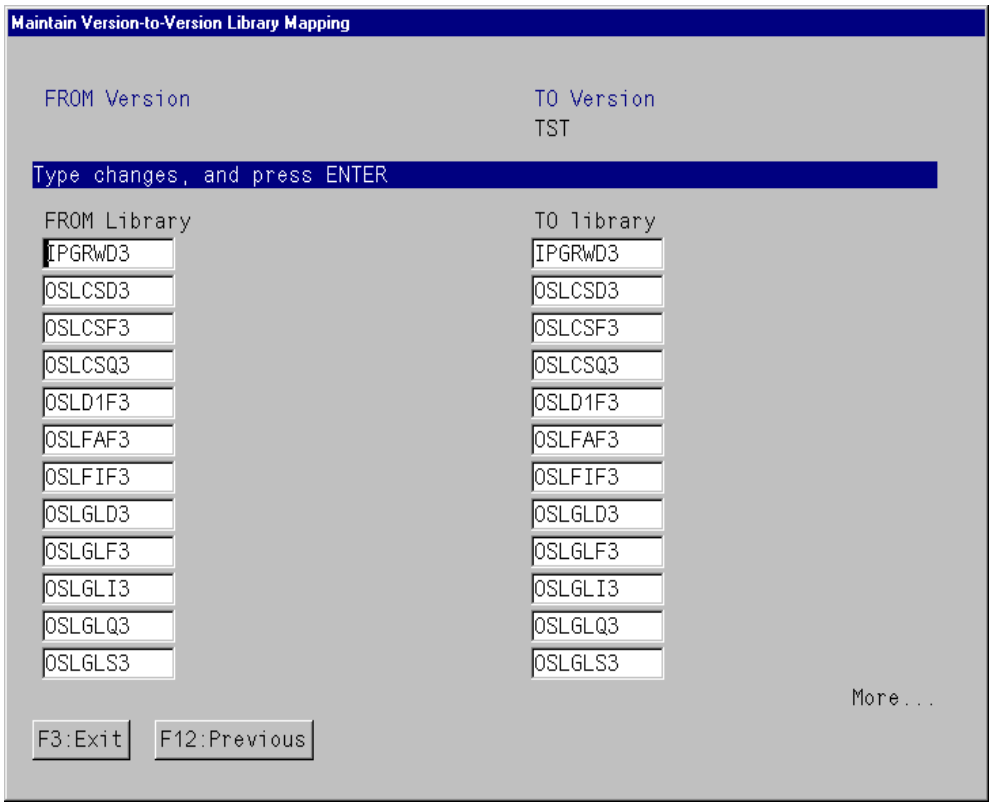

Figure 233. Maintain Version-to-Version Library Mapping (before editing)

Now, you need to edit the entries in the “To Library” list to match up with the libraries you restored to the system. The normal convention is to replace the first three characters of the library list with the three character code for your new environment, but you may use your own naming convention. See Figure 234 for an example of the editing.

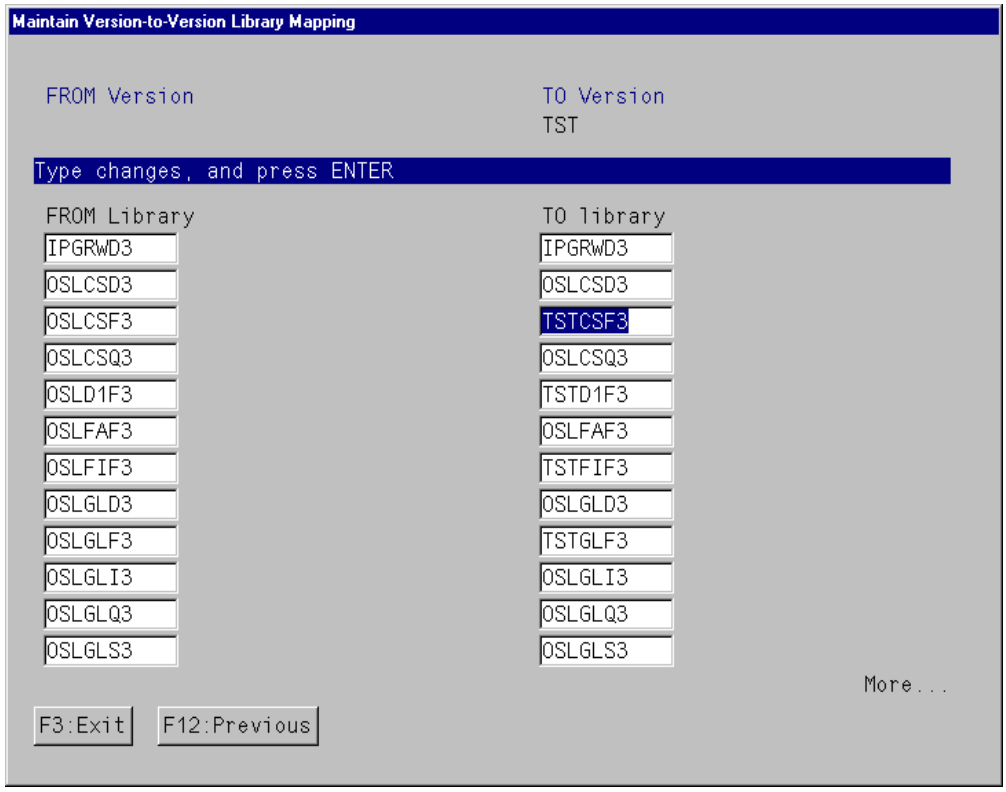

Figure 234. Maintain Version-to-Version Library Mapping (after editing)

Press the Page Down key to navigate down the list and make your changes. When you are finished editing the “To Library” list, press Enter to save the library mapping specifications.

Note

The “To Library” entries must exist on the system prior to naming them in Version-to-Version Library Mapping.

2. Install the applications using the Install AM Application (AMINSAPP) command.

   After signing on as QSECOFR, type `AMINSAPP` on the command line. Press F4 (Prompt) to see the parameters. Figure 235 on page 408 shows the AMINSAPP panel.

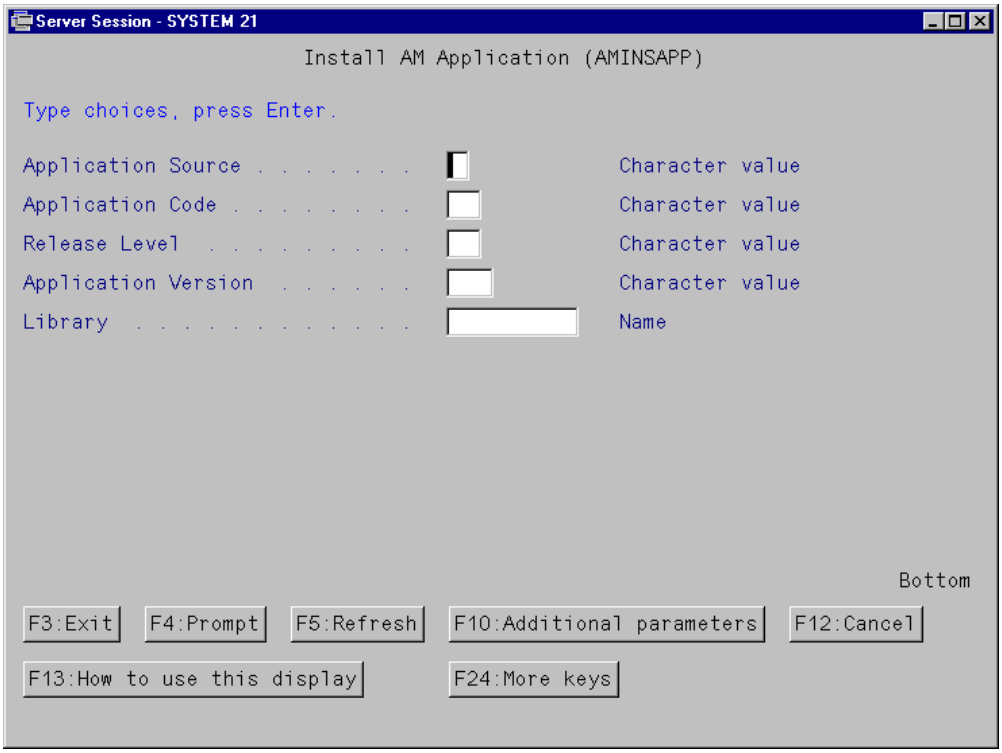

Figure 235. AMINSAPP parameters (Part 1 of 2)

At this panel, click **Additional Parameters** to see the rest of the fields we will use. The complete window is shown in Figure 236.

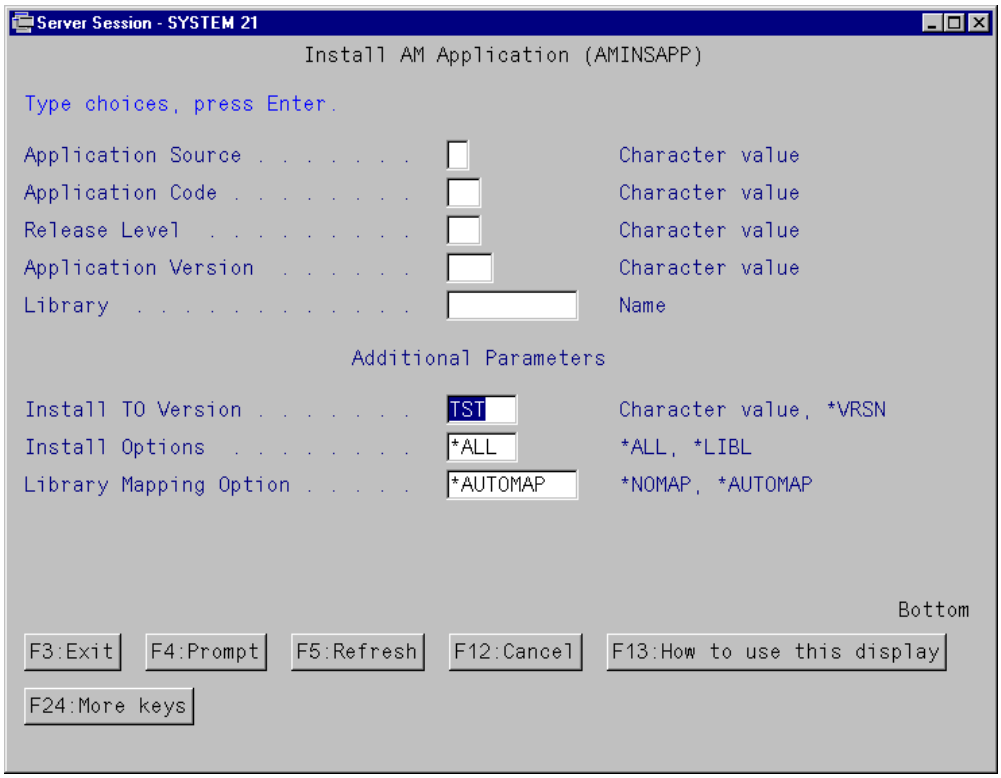

Figure 236. AMINSAPP parameters (Part 2 of 2)

The definitions and values for the fields are as follows:

- **Application Source**: This field has two possible values:
  - **O**: Indicates System 21 standard software and is the most commonly used value.
  - **U**: Indicates user-developed applications and is rarely used. For more information on this, see 11.10, “Coexistence with other applications” on page 429.
- **Application Code**: Refer to Table 63 on page 410 for the correct two-character code to use for each application
- **Release Level**: Currently, all System 21 software is at Release Level 03. This is the value you will use here.
- **Application Version**: This field is used during the initial software installation to associate the tasks, library lists, and menus within Application Manager. Leave it blank.
- **Library**: This is the library name that contains the installation files that Application Manager will use to set up your new tasks, library lists, and menus for your new environment. Refer to Table 63 on page 410 for the correct library name for your application.
- **Install To Version**: This is where you will enter the three character code you selected for your new environment.
- **Install Options**:
  - ***ALL**: This value is normally used in acceptance testing-type environments. It instructs AMINSAPP to install:
    - An Application Header defining the default library list for the application and the text description assigned to each application.
    - The library lists for each application, which facilitate using the new libraries defined for the new environment.
    - Task definitions, that contain reference to the Library List and Program called.
    - Menu definitions for each application and the associated options and task lookups.
  - ***LIBL**: This is the value used in most environments. AMINSAPP installs an Application Header defining the default library list for the application and the text description assigned to each application.
- **Library Mapping Option**: This parameter has two values:
  - ***NOMAP**: This option tells AMINSAPP not to map the library names automatically, leaving it for you to do manually.
  - ***AUTOMAP**: This option tells AMINSAPP to automatically map the library names. We will use this option, because we set up mapping in the previous step.

The values in Table 63 are used in the installation of System 21 V3.5.2 core applications. Refer to the *System 21 Installation and Setup Guide* for subsequent versions.

Table 63. Values for AMINSAPP fields

Application name	Application code	Library
Financials		
Accounts Payable	PL	OSLPLD3
Accounts Receivables	SL	OSLSLD3
Advanced Financial Integrator (AFI)	FI	OSLFID3
Bacstel	BP	OSLBPP2
Cash Management	CS	OSLCSD3
Financial Manager	RW	OSLRWD3
Fixed Assets	FA	OSLFAD3
General Ledger	GL	OSLGLD3
German Banking	DX	OSLDX3
Italian Function	IX	OSLIXD3
Customer Service & Logistics		
Application Interface	AI	OSLAIP3
Advanced Order Entry	AO	OSLAOP3
Customer Returns	CR	OSLCRP3
Distribution Requirements Planning	DR	OSLDRP3
Document Processing	DY	OSLDYD3
Forecasting	FC	OSLFCP3
Inventory Management	IN	OSLINP3
Sales Order Processing	OE	OSLOEP3
Job Management	JC	OSLJCD3
Purchase Order Management	PM	OSLPMP3
Requisitioning	RQ	OSLRQP3
Sales Analysis	SA	OSLSAP3
Service Management	SS	OSLS2P3
Transport Planning	TP	OSLTPP3
Telesales	TS	OSLTSP3
US Sales Tax	US	OSLUSP3
Warehousing	WH	OSLWHP3
World Trade	WT	OSLWTP3

Application name	Application code	Library
Manufacturing		
Capacity Planning	CP	OSLCPP3
Master Production Scheduling	MP	OSLMPP3
Material Requirements Planning	MR	OSLMRP3
Product Data Management	PD	OSLPDP3
Production Control & Costing	PC	OSLPCP3
Production PDM	MD	OSLMDP3
Production Schedule Control	MK	OSLMKP3
Production Support	MJ	OSLMJP3

11.8.6 Setting up specific applications

Until this point, all instructions have referred largely to the product as a whole. There are additional changes that are needed at application level before you can use the new environment. The changes will ensure the smooth running of the system.

To set up each application as explained in the following sections, you must be signed on as QSECOFR.

11.8.6.1 Financials (includes GL, CS, PL, SL, FI)

General Ledger, Accounts Receivable, Cash Management, and Accounts Payable all have their own background jobs, running in individual subsystems, that process all of the transaction data entering the system. These subsystems run over the standard set of application file libraries in the standard environment. It is necessary to define new background jobs for the new environment.

You should delete the objects in Table 64 from the new environment libraries. They will be recreated with the correct parameters, when you duplicate them from the standard environment.

Table 64. Objects to be deleted from new environment libraries

Object	Type	Description
GLBACK3	*SBSD	Subsystem description
GLBACK3	*JOBD	Job description
GLBACK3	*JOBQ	Job queue
GLBACK3	*CLS	Class description
GLSBSDTA	*DTAARA	Subsystem data area
CSBACK3	*SBSD	Subsystem description
CSBACK3	*JOBD	Job description
CSBACK3	*JOBQ	Job queue
CSBACK3	*CLS	Class description

Object	Type	Description
CSSBSDTA	*DTAARA	Subsystem data area
PLBACK3	*SBSD	Subsystem description
PLBACK3	*JOBD	Job description
PLBACK3	*JOBQ	Job queue
PLBACK3	*CLS	Class description
PLSBSDTA	*DTAARA	Subsystem data area
SLBACK3	*SBSD	Subsystem description
SLBACK3	*JOBD	Job description
SLBACK3	*JOBQ	Job queue
SLBACK3	*CLS	Class description
SLSBSDTA	*DTAARA	Subsystem data area

Issue the following commands to recreate the objects in the new environment libraries.

1. Create the new job descriptions for the new environment:

```
CRTDUPOBJ OBJ(GLBACK3) FROMLIB(OSLGLD3) OBJTYPE(*JOBD)
TOLIB(Newlibraryname)NEWOBJ(GLBACK3xxx)
CRTDUPOBJ OBJ(CSBACK3) FROMLIB(OSLCSD3) OBJTYPE(*JOBD)
TOLIB(Newlibraryname)NEWOBJ(CSBACK3xxx)
CRTDUPOBJ OBJ(SLBACK3) FROMLIB(OSLSLD3) OBJTYPE(*JOBD)
TOLIB(Newlibraryname)NEWOBJ(SLBACK3xxx)
CRTDUPOBJ OBJ(PLBACK3) FROMLIB(OSLPLD3) OBJTYPE(*JOBD)
TOLIB(Newlibraryname) NEWOBJ(PLBACK3xxx)
```

   If you are running Advanced Financial Integrator, run the following command:

```
CRTDUPOBJ OBJ(OSLFIP) FROMLIB(OSLFID3) OBJTYPE(*JOBD) TOLIB(Newlibraryname)
NEWOBJ(OSLFIPxxx)
```

   Newlibraryname is the name overridden to allow the library to be loaded alongside the default library. We suggest that you use the code of the new environment in place of *xxx*.

2. You must now update the initial library list within the job descriptions to reflect the libraries for your environment. Use the following commands, changing the library names in the INLLIBL keyword to reflect your new library names. If you do not have a new name for a library on the list, simply leave it as it is. The commands are:

```
CHGJOBD JOBD(Newlibraryname/GLBACK3xxx) INLLIBL(QTEMP xxxSLF3 OSLSLD3
xxxGLF3 OSLGLD3 xxxPLF3 OSLPLD3 xxxCSF3 OSLCSD3 IPGAMF4 IPGAMD4 IPGAMP4
IPGCFF4 IPGCFP4 IPGCFD4 QGPL)
CHGJOBD JOBD(Newlibraryname/CSBACK3xxx) INLLIBL(QTEMP xxxSLF3 OSLSLD3
xxxGLF3 OSLGLD3 xxxPLF3 OSLPLD3 xxxCSF3 OSLCSD3 IPGAMF4 IPGAMD4 IPGAMP4
IPGCFP4 IPGCFF4 IPGCFD4 QGPL)
CHGJOBD JOBD(Newlibraryname/PLBACK3xxx) INLLIBL(QTEMP xxxPLF3 OSLPLD3
xxxGLF3 OSLGLD3 xxxSLF3 OSLSLD3 xxxCSF3 OSLCSD3 IPGAMF4 IPGAMD4 IPGAMP4
IPGCFF4 IPGCFP4 IPGCFD4 QGPL)
```

```
CHGJOBD JOBD(Newlibraryname/SLBACK3xxx) INLLIBL(QTEMP xxxSLF3 OSLSLD3
xxxGLF3 OSLGLD3 xxxPLF3 OSLPLD3 xxxCSF3 OSLCSD3 IPGAMF4 IPGAMD4 IPGAMP4
IPGCFP4 IPGCFF4 IPGCFD4 QGPL)
```

If your are running Advanced Financial Integrator, enter the following command, and remember to update the INLLIBL keyword values:

```
CHGJOBD JOBD(Newlibraryname/OSLFIPxxx) INLLIBL(xxxFIF3 xxxD1F3 xxxLF3
xxxGLF3 OSLFID3 OSLFIP3 IPGAMF4 IPGAMP4 IPGAMD4 IPGCFF4)
```

3. Create the new job queues for the new environment by using the following commands:

```
CRTDUPOBJ OBJ(GLBACK3) FROMLIB(OSLGLD3) OBJTYPE(*JOBQ)
TOLIB(Newlibraryname) NEWOBJ(GLBACK3xxx)
CRTDUPOBJ OBJ(CSBACK3) FROMLIB(OSLCSD3) OBJTYPE(*JOBQ)
TOLIB(Newlibraryname) NEWOBJ(CSBACK3xxx)
CRTDUPOBJ OBJ(PLBACK3) FROMLIB(OSLPLD3) OBJTYPE(*JOBQ)
TOLIB(Newlibraryname) NEWOBJ(PLBACK3xxx)
CRTDUPOBJ OBJ(SLBACK3) FROMLIB(OSLSLD3) OBJTYPE(*JOBQ)
TOLIB(Newlibraryname) NEWOBJ(SLBACK3xxx)
```

4. Change the new job description for the new environment by using the following commands:

```
CHGJOBD JOBD(Newlibraryname/GLBACK3xxx) JOBQ(Newlibraryname/GLBACK3xxx)
CHGJOBD JOBD(Newlibraryname/CSBACK3xxx) JOBQ(Newlibraryname/CSBACK3xxx)
CHGJOBD JOBD(Newlibraryname/PLBACK3xxx) JOBQ(Newlibraryname/PLBACK3xxx)
CHGJOBD JOBD(Newlibraryname/SLBACK3xxx) JOBQ(Newlibraryname/SLBACK3xxx)
```

5. Create the subsystem descriptions for the new environment:

```
CRTDUPOBJ OBJ(GLBACK3) FROMLIB(OSLGLD3) OBJTYPE(*SBSD)
TOLIB(Newlibraryname) NEWOBJ(GLBACK3xxx)
CRTDUPOBJ OBJ(CSBACK3) FROMLIB(OSLCSD3) OBJTYPE(*SBSD)
TOLIB(Newlibraryname) NEWOBJ(CSBACK3xxx)
CRTDUPOBJ OBJ(PLBACK3) FROMLIB(OSLPLD3) OBJTYPE(*SBSD)
TOLIB(Newlibraryname) NEWOBJ(PLBACK3xxx)
CRTDUPOBJ OBJ(SLBACK3) FROMLIB(OSLSLD3) OBJTYPE(*SBSD)
TOLIB(Newlibraryname) NEWOBJ(SLBACK3xxx)
```

6. Amend the subsystems to refer to the non-standard environment setup by issuing the following commands *in order*:

```
CHGAJE SBSD(Newlibraryname/GLBACK3xxx) JOB(GLUPDATE)
JOBD(Newlibraryname/GLBACK3xxx)
RMVJOBQE SBSD(Newlibraryname/GLBACK3xxx) JOBQ(OSLGLD3/GLBACK3)
ADDJOBQE SBSD(Newlibraryname/GLBACK3xxx) JOBQ(Newlibraryname/GLBACK3xxx)
CHGAJE SBSD(Newlibraryname/CSBACK3xxx) JOB(CSUPDATE)
JOBD(Newlibraryname/CSBACK3xxx)
RMVJOBQE SBSD(Newlibraryname/CSBACK3xxx)JOBQ(OSLCSD3/CSBACK3)
ADDJOBQE SBSD(Newlibraryname/CSBACK3xxx)JOBQ(Newlibraryname/CSBACK3xxx)
CHGAJE SBSD(Newlibraryname/PLBACK3xxx) JOB(PLUPDATE)
JOBD(Newlibraryname/PLBACK3xxx)
RMVJOBQE SBSD(Newlibraryname/PLBACK3xxx) JOBQ(OSLPLD3/PLBACK3)
ADDJOBQE SBSD(Newlibraryname/PLBACK3xxx) JOBQ(Newlibraryname/PLBACK3xxx)
CHGAJE SBSD(Newlibraryname/SLBACK3xxx) JOB(SLUPDATE)
JOBD(Newlibraryname/SLBACK3xxx)
RMVJOBQE SBSD(Newlibraryname/SLBACK3xxx) JOBQ(OSLSLD3/SLBACK3)
ADDJOBQE SBSD(Newlibraryname/SLBACK3xxx) JOBQ(Newlibraryname/SLBACK3xxx)
```

7. Create the data areas referencing the new subsystem environment set up by issuing the following commands *in order*:

```
CRTDUPOBJ OBJ(GLSBSDTA) FROMLIB(OSLGLD3) OBJTYPE(*DTAARA)
TOLIB(Newlibraryname)
CHGDTAARA DTAARA(Newlibraryname/GLSBSDTA(1 10))VALUE(GLBACK3xxx)
CHGDTAARA DTAARA(Newlibraryname/GLSBSDTA(11 1))VALUE(0)
CRTDUPOBJ OBJ(CSSBSDTA) FROMLIB(OSLCSD3) OBJTYPE(*DTAARA)
TOLIB(Newlibraryname)
CHGDTAARA DTAARA(Newlibraryname/CSSBSDTA(1 10))VALUE(CSBACK3xxx)
CRTDUPOBJ OBJ(PLSBSDTA) FROMLIB(OSLPLD3) OBJTYPE(*DTAARA)
TOLIB(Newlibraryname)
CHGDTAARA DTAARA(Newlibraryname/PLSBSDTA(1 10))VALUE(PLBACK3xxx)
CRTDUPOBJ OBJ(SLSBSDTA) FROMLIB(OSLSLD3) OBJTYPE(*DTAARA)
TOLIB(Newlibraryname)
CHGDTAARA DTAARA(Newlibraryname/SLSBSDTA(1 10))VALUE(SLBACK3xxx)
```

8. Create new class descriptions for the new environment by using the following commands:

```
CRTDUPOBJ OBJ (GLBACK3) FROMLIB (OSLGLD3) OBJTYPE (*CLS)
TOLIB(Newlibraryname) NEWOBJ(GLBACK3xxx)
CRTDUPOBJ OBJ (CSBACK3) FROMLIB (OSLCSD3) OBJTYPE (*CLS)
TOLIB(Newlibraryname) NEWOBJ(CSBACK3xxx)
CRTDUPOBJ OBJ (PLBACK3) FROMLIB (OSLPLD3) OBJTYPE (*CLS)
TOLIB(Newlibraryname) NEWOBJ(PLBACK3xxx)
CRTDUPOBJ OBJ (SLBACK3) FROMLIB (OSLSLD3) OBJTYPE (*CLS)
TOLIB(Newlibraryname) NEWOBJ(SLBACK3xxx)
```

9. Attach the new class descriptions for the new environment to the new subsystems by using the following commands:

```
CHGRTGE SBSD(Newlibraryname/GLBACK3xxx) SEQNBR(9999)
CLS(Newlibraryname/GLBACK3xxx)
CHGRTGE SBSD(Newlibraryname/CSBACK3xxx) SEQNBR(9999)
CLS(Newlibraryname/CSBACK3xxx)
CHGRTGE SBSD(Newlibraryname/PLBACK3xxx) SEQNBR(9999)
CLS(Newlibraryname/PLBACK3xxx)
CHGRTGE SBSD(Newlibraryname/SLBACK3xxx) SEQNBR(9999)
CLS(Newlibraryname/SLBACK3xxx)
```

10. Create the data queues for the subsystems in the new environment by using the following commands:

```
CRTDTAQ DTAQ(Newlibraryname/SL_BALUPDS) MAXLEN(9)
CRTDTAQ DTAQ(Newlibraryname/PL_BALUPDS) MAXLEN(9)
```

11.8.6.2 Distribution (includes IN, TP, TS, WH, WT)

A utility exists that allows the user to create a duplicate of the standard subsystem in a new environment. It is used to set up the new environment with a separate set of data files from those in the live environment. That is, it creates duplicates of all relevant file libraries and ensures that the new environment library lists reference these libraries. Perform the following steps:

1. At the System 21 command line, type `/INB` and press Enter to go to the Inventory Background Processing menu.
2. Select option **11** to create a test subsystem. The utility prompts you for the following fields:

- **Application**: Enter the application code for which the new subsystem is required. These are the codes:
  - IN (Inventory)
  - TP (Transport Planning)
  - TS (Telesales)
  - WH (Warehousing)
  - WT (World Trade)
- **Subsystem name**: Enter a name for the subsystem to be created.

  Make sure that you do not use any of the standard subsystems, such as INBACK3, TPBACK3, TSBACK3, WHBACK3 or WTBACK3.
- **New library**: Enter the name of the library that is to contain the test subsystem. This must be a valid library and should ideally be the library containing the duplicated set of files. The utility will then create all objects required for running a new subsystem.

3. The utility creates all required objects for the test subsystems except for data queues. The data queues must be manually created. Use these commands to complete the setup:

   Inventory

```
CRTDTAQ DTAQ(NewLibraryName/INPQ001) MAXLEN(9) TEXT('Reserved sales order
data queue')
CRTDTAQ DTAQ(NewLibraryName/INPQ002) MAXLEN(60) TEXT('Stock status monitor
data queue')
CRTDTAQ DTAQ(NewLibraryName/INPQ003) MAXLEN(17) TEXT('Item deletion data
queue')
CRTDTAQ DTAQ(NewLibraryName/INPQ004) MAXLEN(15) TEXT('Advanced shipping
monitor data queue')
CRTDTAQ DTAQ(NewLibraryName/INPQ005) MAXLEN(32) TEXT('Customer restrictions
generator data queue')
Transport Planning
CRTDTAQ DTAQ(NewLibraryName/TPQ001) MAXLEN(60) TEXT('Data queue TPQ001')
CRTDTAQ DTAQ(NewLibraryName/TPQ002) MAXLEN(30) TEXT('Data queue TPQ002')
CRTDTAQ DTAQ(NewLibraryName/TPQ003) MAXLEN(30) TEXT('Data queue TPQ003')
CRTDTAQ DTAQ(NewLibraryName/TPQ004) MAXLEN(30) TEXT('Data queue TPQ004')
CRTDTAQ DTAQ(NewLibraryName/TPQ005) MAXLEN(30) TEXT('Data queue TPQ005')
CRTDTAQ DTAQ(NewLibraryName/TPQ007) MAXLEN(73) TEXT('Data queue TPQ001')
```

   Telesales

```
CRTDTAQ DTAQ(NewLibraryName/TSCALREQS) MAXLEN(256) TEXT('Telephone call
request data queue')
CRTDTAQ DTAQ(NewLibraryName/TSORDERB) MAXLEN(256) TEXT('Order bank update
data queue')
CRTDTAQ DTAQ(NewLibraryName/TSRESCHD) MAXLEN(256) TEXT('Reschedule control
data queue')
CRTDTAQ DTAQ(NewLibraryName/TSSBSCTL) MAXLEN(256) TEXT('Subsystem control
data queue')
```

   Warehousing

```
CRTDTAQ DTAQ(NewLibraryName/WHQ001) MAXLEN(141) TEXT('Confirm put-away data
queue')
CRTDTAQ DTAQ(NewLibraryName/WHQ002) MAXLEN(31) TEXT('Replenishment data
queue')
CRTDTAQ DTAQ(NewLibraryName/WHQ003) MAXLEN(18) TEXT('Confirm dispatch data
queue')
```

```
CRTDTAQ DTAQ(NewLibraryName/WHQ004) MAXLEN(18) TEXT('Production issues data
queue')
```

World Trade

```
CRTDTAQ DTAQ(NewLibraryName/WTQ001) MAXLEN(47) TEXT('World Trade data
queue')
```

4. Ensure that both the production subsystem and the newly created subsystem are started.
5. Set up the Auto Day Start and End routines for the new subsystems.

   Within the standard subsystems, INBACK3, TPBACK3, TSBACK3, WHBACK3, and WTBACK3, tasks have been set up to start and end the various background jobs. These tasks can be used to set up these jobs within the Day Start and Day End routines.

   Table 65 gives you the task codes and descriptions to enter for each application. For example, for Inventory application (IN 03), you use the task code 0065 for Start stock status monitor.

Table 65. Task codes for Auto Day Start and End subsystems control

Application code	Version	Task number	Description
IN	03	0065	Start stock status monitor
IN	03	0070	End stock status monitor
IN	03	0075	Start reservations monitor
IN	03	0080	End reservations monitor
TP	03	0088	Start all background jobs
TP	03	0089	End all background jobs
TS	03	0020	Start all background jobs
TS	03	0025	End all background jobs
WH	03	0010	Start putaway processor
WH	03	0012	End putaway process
WH	03	0014	Start confirmation updates
WH	03	0016	End confirmation updates
WH	03	0018	Start replenishment monitor
WH	03	0020	End replenishment monitor
WH	03	0022	Start serious error monitor
WH	03	0024	End serious error monitor
WH	03	0026	Start confirm dispatches update
WH	03	0028	End confirm dispatches update
WH	03	0030	Start Confirm material issue
WH	03	0032	End confirm material issue
WT	03	0020	Start invoice transfer

Application code	Version	Task number	Description
WT	03	0025	End invoice transfer

Within Machine Manager, an Auto Day Start job must be added to execute the command to start a background subsystem, for example, INBACK3xxx.

You can add other background jobs by using F24 and ensuring that the new environment Code is included, for example, task IN/xxx /03 0065 (Start stock status monitor). This ensures that the job is submitted to the correct subsystem and that it is processing the correct library list.

Within Machine Manager, you can add an Auto Day End job to end a background job using the relevant task details, for example, Task IN/xxx/03 (End Stock Status monitor). An Auto Day End job must be added to execute the command to stop a background subsystem, for example, INBACK3xxx.

Each task sends a status message to QSYSOPR message queue. Therefore, it is possible for the user to monitor whether the jobs were started and the reasons why they were not started if applicable.

11.8.6.3 Fixed Assets

This section details the steps you need to set up Fixed Assets in the new environment. Issue the following commands to set up the objects required for the new environment:

1. Delete the job description, job queue, subsystem description, data areas, and class entries that were copied from the production libraries by using the following commands:

   ```
   DLTOBJ OBJ(Newlibraryname/OSLFBP) OBJTYPE(*JOBD)
   DLTOBJ OBJ(Newlibraryname/FABACK) OBJTYPE(*JOBQ)
   DLTOBJ OBJ(Newlibraryname/FABACK3) OBJTYPE(*SBSD)
   DLTOBJ OBJ(Newlibraryname/FALIBS) OBJTYPE(*DTAARA)
   DLTOBJ OBJ(Newlibraryname/FACLS) OBJTYPE(*CLS)
   ```

2. Create a new job description for the new environment:

   ```
   CRTDUPOBJ OBJ(OSLFBP) FROMLIB(OSLFBD3) OBJTYPE(*JOBD) TOLIB(Newlibraryname)
   NEWOBJ(OSLFBPxxx)
   ```

   Newlibraryname is the name overridden to allow the library to be loaded alongside the default library. We suggest that you use the code of the new environment in place of *xxx*.

3. You must now update the initial library list within the job descriptions to reflect the libraries for your environment. Use the following commands and change the library names in the INLLIBL keyword to reflect your new library names. If you do not have a new name for a library on the list, simply leave it as it is. The command is:

   ```
   CHGJOBD JOBD(Newlibraryname/OSLFBPxxx) INLLIBL(xxxFAF3 OSLFBD3 OSLFBP3
   OSLFBS3 xxxGLF3 OSLGLD3 OSLGLP3 xxxPLF3 OSLPLD3 OSLPLP3 xxxSLF3 OSLSLD3
   OSLSLP3 IPGCFF4 IPGAMD4 IPGAMP4 QIDU QRPG QGPL QTEMP)
   ```

4. Create a new job queue for the new environment by using the following command:

   ```
   CRTDUPOBJ OBJ(FABACK) FROMLIB(OSLFBD3) OBJTYPE(*JOBQ) TOLIB(Newlibraryname)
   NEWOBJ(FABACKxxx)
   ```

5. Create a subsystem description for the new environment:

   ```
   CRTDUPOBJ OBJ(FABACK3) FROMLIB(OSLFBD3) OBJTYPE(*SBSD)
   TOLIB(Newlibraryname) NEWOBJ(FABACK3xxx)
   ```

6. Amend the subsystem to refer to the non-standard environment setup by issuing the following commands in order:

   ```
   RMVJOBQE SBSD(Newlibraryname/FABACKxxx) JOBQ(OSLFBD3/FABACK)
   ADDJOBQE SBSD(Newlibraryname/FABACKxxx) JOBQ(Newlibraryname/FABACKxxx)
   ```

7. Copy the existing data areas and change them to reflect any new libraries for your new environment by issuing the following commands *in order*:

   ```
   CRTDUPOBJ OBJ(FALIBS) FROMLIB(OSLFAD3) OBJTYPE(*DTAARA)
   TOLIB(Newlibraryname)
   ```

   All positions in the FALIBS data area may not need to be updated. It depends on the libraries that you included in your new environment. Use the Display Data Area (`DSPDTAARA`) command to view the contents of the data area before making any changes. Use the `d-i` commands to change only the library names needing updating.

   ```
   CHGDTAARA DTAARA(Newlibraryname/FALIBS(1 10))VALUE(Newlibraryname)
   CHGDTAARA DTAARA(Newlibraryname/FALIBS(11 10))VALUE(Newlibraryname)
   CHGDTAARA DTAARA(Newlibraryname/FALIBS(21 10))VALUE(Newlibraryname)
   CHGDTAARA DTAARA(Newlibraryname/FALIBS(31 10))VALUE(Newlibraryname)
   CHGDTAARA DTAARA(Newlibraryname/FALIBS(41 10))VALUE(Newlibraryname)
   CHGDTAARA DTAARA(Newlibraryname/FALIBS(51 10))VALUE(Newlibraryname)
   ```

8. Create a new class description for the new environment by using the command:

   ```
   CRTDUPOBJ OBJ(FACLS) FROMLIB(OSLFBD3) OBJTYPE(*CLS) TOLIB(Newlibraryname)
   NEWOBJ(FACLSxxx)
   ```

9. Attach the new class description for the new environment to the new subsystem:

   ```
   CHGRTGE SBSD(Newlibraryname/FABACK3xxx) SEQNBR(9999)
   CLS(Newlibraryname/FACLSxxx)
   ```

11.8.6.4 Advanced Fixed Assets

This section provides the steps you need to set up Advanced Fixed Assets in the new environment. Issue the following commands to set up the objects required for the new environment:

1. Delete the job description and data areas that were copied from the production libraries by using the following commands:

   ```
   DLTOBJ OBJ(Newlibraryname/OSLFAP) OBJTYPE(*JOBD)
   DLTOBJ OBJ(Newlibraryname/FALIBS) OBJTYPE(*DTAARA)
   ```

2. Create the new job description for the new environment:

   ```
   CRTDUPOBJ OBJ(OSLFAP) FROMLIB(OSLFAD3) OBJTYPE(*JOBD) TOLIB(Newlibraryname)
   NEWOBJ(OSLFAPxxx)
   ```

Newlibraryname is the name overridden to allow the library to be loaded alongside the default library. We suggest that you use the code of the new environment in place of *xxx*.

3. The initial library list within the job descriptions must now be updated to reflect the libraries for your environment. Use the following commands and change the library names in the INLLIBL keyword to reflect your new library names. If you do not have a new name for a library on the list, simply leave it as it is. The command is:

```
CHGJOBD JOBD(Newlibraryname/OSLFAPxxx) INLLIBL(xxxFAF3 OSLFAD3 OSLFAP3
OSLFAS3 OSLFBD3 OSLFBP3 OSLFBS3 xxxGLF3 OSLGLD3 OSLGLP3 xxxPLF3 OSLPLD3
OSLPLP3 xxxSLF3 OSLSLD3 OSLSLP3 IPGCFF4 IPGAMD4 IPGAMP4 QGPL QTEMP)
```

4. Copy the existing data areas, and change them to reflect the new libraries for your new environment by issuing the following commands *in order*:

```
CRTDUPOBJ OBJ(FALIBS) FROMLIB(OSLFAD3) OBJTYPE(*DTAARA)
TOLIB(Newlibraryname)
```

   All positions in the FALIBS data area may not need to be updated. It depends on the libraries that you have included in your new environment. Use the Display Data Area (DSPDTAARA) command to view the contents of the data area before making any changes. Use the d-i commands to change only the library names needing updating.

```
CHGDTAARA DTAARA(Newlibraryname/FALIBS(1 10))VALUE(Newlibraryname)
CHGDTAARA DTAARA(Newlibraryname/FALIBS(11 10))VALUE(Newlibraryname)
CHGDTAARA DTAARA(Newlibraryname/FALIBS(21 10))VALUE(Newlibraryname)
CHGDTAARA DTAARA(Newlibraryname/FALIBS(31 10))VALUE(Newlibraryname)
CHGDTAARA DTAARA(Newlibraryname/FALIBS(41 10))VALUE(Newlibraryname)
CHGDTAARA DTAARA(Newlibraryname/FALIBS(51 10))VALUE(Newlibraryname)
```

11.8.6.5 Service Management

This section explains how to set up Service Management in the new environment. Issue the following commands to set up the objects required for the new environment:

1. Delete the job description, job queue, subsystem description, data area, and class entries that were copied from the production libraries by using the following commands:

```
DLTOBJ OBJ(Newlibraryname/OSLSSP) OBJTYPE(*JOBD)
DLTOBJ OBJ(Newlibraryname/OSLSSP) OBJTYPE(*JOBQ)
DLTOBJ OBJ(Newlibraryname/S2BACK3) OBJTYPE(*SBSD)
DLTOBJ OBJ(Newlibraryname/OSLSSP) OBJTYPE(*CLS)
```

2. Create the new job description for the new environment:

```
CRTDUPOBJ OBJ(OSLSSP) FROMLIB(OSLS2P3) OBJTYPE(*JOBD) TOLIB(Newlibraryname)
NEWOBJ(OSLSSPxxx)
```

   Newlibraryname is the name overridden to allow the library to be loaded alongside the default library. We suggest that you use the code of the new environment in place of *xxx*.

3. You must now update the initial library list within the job descriptions to reflect the libraries for your environment. Use the following commands, and change the library names in the INLLIBL keyword to reflect your new library names. If you do not have a new name for a library on the list, simply leave it as it is. The command is:

```
CHGJOBD JOBD(Newlibraryname/OSLSSPxxx) INLLIBL(QTEMP OSLS2X3 xxxS2F3
OSLS2D3 OSLS2P3 xxxSLF3 OSLSLD3 xxxGLF3 OSLGLD3 xxxD1F3 OSLOEP3 OSLINP3
IPGAMF4 IPGAMP4 IPGCFF4 IPGCFP4 QGPL QRPG)
```

4. Create the new job queues for the new environment by using the following commands:

```
CRTDUPOBJ OBJ(OSLSSP) FROMLIB(OSLS2P3) OBJTYPE(*JOBQ) TOLIB(Newlibraryname)
NEWOBJ(OSLSSPxxx)
```

5. Change the new job description for the new environment to use the new job queue:

```
CHGJOBD JOBD(Newlibraryname/OSLSSPxxx) JOBQ(Newlibraryname/OSLSSPxxx)
```

6. Create the subsystem descriptions for the new environment:

```
CRTDUPOBJ OBJ(S2BACK3) FROMLIB(OSLS2P3) OBJTYPE(*SBSD)
TOLIB(Newlibraryname) NEWOBJ(S2BACK3xxx)
```

7. Amend the subsystems to refer to the non-standard environment setup by issuing the following commands in order:

```
RMVJOBQE SBSD(Newlibraryname/S2BACK3xxx) JOBQ(OSLS2P3/OSLSSP)
ADDJOBQE SBSD(Newlibraryname/S2BACK3xxx) JOBQ(Newlibraryname/OSLSSPxxx)
```

8. Create new class descriptions for the new environment by using the command:

```
CRTDUPOBJ OBJ(OSLSSP) FROMLIB(OSLS2P3) OBJTYPE(*CLS) TOLIB(Newlibraryname)
NEWOBJ(OSLSSPxxx)
```

9. Attach the new class description for the new environment to the new subsystem.

```
CHGRTGE SBSD(Newlibraryname/S2BACK3xxx) SEQNBR(9999)
CLS(Newlibraryname/OSLSSPxxx)
```

11.8.6.6 Distribution Requirements Planning (DRP)

This section explains how to set up Distribution Requirements Planning in the new environment. Issue the following commands to set up the objects required for the new environment:

1. Delete the job description and data areas that were copied from the production libraries using the following commands:

```
DLTOBJ OBJ(Newlibraryname/DRJOBD) OBJTYPE(*JOBD)
```

2. Create the new job description for the new environment:

```
CRTDUPOBJ OBJ(DRJOBD) FROMLIB(OSLDRP3) OBJTYPE(*JOBD) TOLIB(Newlibraryname)
NEWOBJ(DRJOBDxxx)
```

   Newlibraryname is the name overridden to allow the library to be loaded alongside the default library. We suggest that you use the code of the new environment in place of *xxx*.

3. The initial library list within the job descriptions must now be updated to reflect the libraries for your environment. Use the following commands, and change the library names in the INLLIBL keyword to reflect your new library names. If you do not have a new name for a library on the list, simply leave it as it is. The command is:

```
CHGJOBD JOBD(Newlibraryname/DRJOBDxxx) INLLIBL(xxxD1F3 xxxD2F3 OSLDRP3
OSLDRS3 OSLIND3 OSLINP3 OSLPMD3 OSLPMP3 OSLRQD3 OSLRQP3 OSLOED3 OSLOEP3
IPGAMP4 IPGAMF4 IPGCFF4 OSLCOPYSRC QRPG QGPL)
```

11.8.6.7 U.S. Tax

This section explains the steps to set up U.S. Tax in the new environment. Issue the following commands to set up the objects required for the new environment:

1. Delete the job description that was copied from the production libraries by using the following command:

   ```
   DLTOBJ OBJ(Newlibraryname/OSLUSP) OBJTYPE(*JOBD)
   ```

2. Create the new job description for the new environment:

   ```
   CRTDUPOBJ OBJ(OSLUSP) FROMLIB(OSLUSP3) OBJTYPE(*JOBD) TOLIB(Newlibraryname)
   NEWOBJ(OSLUSPxxx)
   ```

   Newlibraryname is the name overridden to allow the library to be loaded alongside the default library. Use the code of the new environment in place of *xxx*.

3. Update the initial library list within the job descriptions to reflect the libraries for your environment. Use the following commands, and change the library names in the INLLIBL keyword to reflect your new library names. If you do not have a new name for a library on the list, simply leave it as it is. The command is:

   ```
   CHGJOBD JOBD(Newlibraryname/OSLUSPxxx) INLLIBL(QTEMP xxxD1F3 xxxUSF3
   xxxSLF3 IPGAMF4 OSLUSP3 OSLOEP3 OSLINP3 OSLSLP3 IPGCFF4 QRPG QGPL OSLUSD3
   OSLOED3 OSLIND3 OSLSLD3 IPGAMP4)
   ```

11.8.6.8 Workshop Management

This section details the steps to set up Workshop Management in the new environment. Issue the following commands to set up the objects required for the new environment:

1. Delete the job description, job queues, subsystem description, data area, and classes that were copied from the production libraries by using the following commands:

   ```
   DLTOBJ OBJ(Newlibraryname/OSLWOP) OBJTYPE(*JOBD)
   DLTOBJ OBJ(Newlibraryname/OSLWOUPD) OBJTYPE(*JOBQ)
   DLTOBJ OBJ(Newlibraryname/WOBACK3) OBJTYPE(*SBSD)
   DLTOBJ OBJ(Newlibraryname/OSLWOP) OBJTYPE(*CLS)
   DLTOBJ OBJ(Newlibraryname/OSLWOUPD) OBJTYPE(*CLS)
   ```

2. Create the new job description for the new environment:

   ```
   CRTDUPOBJ OBJ(OSLWOP3) FROMLIB(OSLWPP3) OBJTYPE(*JOBD)
   TOLIB(Newlibraryname) NEWOBJ(OSLWOPxxx)
   ```

   Newlibraryname is the name overridden to allow the library to be loaded alongside the default library. Use the code of the new environment in place of *xxx*.

3. Create the new job queues for the new environment by using the following commands *in order*:

   ```
   CRTDUPOBJ OBJ(OSLWOP) FROMLIB(OSLWOP3) OBJTYPE(*JOBQ) TOLIB(Newlibraryname)
   NEWOBJ(OSLWOPxxx)
   CRTDUPOBJ OBJ(OSLWOUPD) FROMLIB(OSLWOP3) OBJTYPE(*JOBQ)
   TOLIB(Newlibraryname) NEWOBJ(OSLWOUxxx)
   ```

4. Create the subsystem descriptions for the new environment:

   ```
   CRTDUPOBJ OBJ(WOBACK3) FROMLIB(OSLWOP3) OBJTYPE(*SBSD)
   TOLIB(Newlibraryname) NEWOBJ(WOBACK3xxx)
   ```

5. Amend the subsystems to refer to the non-standard environment setup by issuing the following commands *in order*:

```
RMVJOBQE SBSD(Newlibraryname/WOBACK3xxx) JOBQ(OSLFBD3/OSLWOP)
ADDJOBQE SBSD(Newlibraryname/WOBACK3xxx) JOBQ(Newlibraryname/OSLWOPxxx)
RMVJOBQE SBSD(Newlibraryname/WOBACK3xxx) JOBQ(OSLFBD3/OSLWOUPD)
ADDJOBQE SBSD(Newlibraryname/WOBACK3xxx) JOBQ(Newlibraryname/OSLWOUPDxxx)
```

6. Create new class descriptions for the new environment by using the command:

```
CRTDUPOBJ OBJ(OSLWOP) FROMLIB(OSLWOP3) OBJTYPE(*CLS) TOLIB(Newlibraryname)
NEWOBJ(OSLWOPxxx)
CRTDUPOBJ OBJ(OSLWOUPD) FROMLIB(OSLWOP3) OBJTYPE(*CLS)
TOLIB(Newlibraryname) NEWOBJ(OSLWOUxxx)
```

11.8.6.9 Advanced Customer Scheduling

This section explains the process to set up Advanced Customer Scheduling in the new environment. Issue the following commands to set up the objects required for the new environment:

1. Delete the job queue, subsystem description, data area, and class entries that were copied from the production libraries by using the following commands:

```
DLTOBJ OBJ(Newlibraryname/ACBACK3) OBJTYPE(*JOBQ)
DLTOBJ OBJ(Newlibraryname/ACBACK3) OBJTYPE(*SBSD)
DLTOBJ OBJ(Newlibraryname/ACBACK3) OBJTYPE(*CLS)
```

2. Create the new job queues for the new environment by using the following command:

```
CRTDUPOBJ OBJ(ACBACK3) FROMLIB(OSLACD3) OBJTYPE(*JOBQ)
TOLIB(Newlibraryname) NEWOBJ(ACBACK3xxx)
```

3. Create the subsystem description for the new environment:

```
CRTDUPOBJ OBJ(ACBACK3) FROMLIB(OSLACD3) OBJTYPE(*SBSD)
TOLIB(Newlibraryname) NEWOBJ(ACBACK3xxx)
```

4. Amend the subsystem to refer to the non-standard environment setup by issuing the following commands *in order*:

```
RMVJOBQE SBSD(Newlibraryname/ACBACK3xxx) JOBQ(OSLACD3/ACBACK3)
ADDJOBQE SBSD(Newlibraryname/ACBACK3xxx) JOBQ(Newlibraryname/ACBACK3xxx)
```

5. Create new class descriptions for the new environment by using the command:

```
CRTDUPOBJ OBJ(ACBACK3) FROMLIB(OSLACD3) OBJTYPE(*CLS) TOLIB(Newlibraryname)
NEWOBJ(ACBACK3xxx)
```

6. Attach the new class description for the new environment to the new subsystem:

```
CHGRTGE SBSD(Newlibraryname/ACBACK3xxx) SEQNBR(1)
CLS(Newlibraryname/ACBACK3xxx)
```

11.8.6.10 Production Control

This section provides the steps needed to help you set up Production Control in the new environment. Issue the following commands to set up the objects required for the new environment:

1. Delete the job description, job queue, subsystem description, and data area that were copied from the production libraries by using the following commands:

```
DLTOBJ OBJ(Newlibraryname/PCBACK3) OBJTYPE(*SBSD)
DLTOBJ OBJ(Newlibraryname/PCBACK3) OBJTYPE(*JOBQ)
DLTOBJ OBJ(Newlibraryname/PCBACK3) OBJTYPE(*CLS)
```

2. Create the new job class for the new environment:

```
CRTDUPOBJ OBJ(PCBACK3) FROMLIB(OSLAOP3) OBJTYPE(*CLS) TOLIB(Newlibraryname)
NEWOBJ(PCBACK3xxx)
```

   Newlibraryname is the name overridden to allow the library to be loaded alongside the default library. Use the code of the new environment in place of *xxx*.

3. Create the new job queues for the new environment by using the following command:

```
CRTDUPOBJ OBJ(PCBACK3) FROMLIB(OSLAOP3) OBJTYPE(*JOBQ)
TOLIB(Newlibraryname) NEWOBJ(PCBACK3xxx)
```

4. Create the subsystem description for the new environment:

```
CRTDUPOBJ OBJ(PCBACK3) FROMLIB(OSLAOP3) OBJTYPE(*SBSD)
TOLIB(Newlibraryname) NEWOBJ(PCBACK3xxx)
```

5. Amend the subsystem to refer to the non-standard environment setup by issuing the following commands *in order*:

```
RMVJOBQE SBSD(Newlibraryname/PCBACK3xxx) JOBQ(OSLAOP3/PCBACK3)
ADDJOBQE SBSD(Newlibraryname/PCBACK3xxx) JOBQ(Newlibraryname/PCBACK3xxx)
```

6. Attach the new class description for the new environment to the new subsystem:

```
CHGRTGE SBSD(Newlibraryname/PCBACK3xxx) SEQNBR(9999)
CLS(Newlibraryname/PCBACK3xxx)
```

11.8.6.11 Document Processing

To set up Document Processing in the new environment, follow the steps provided here. Issue the following commands to set up the objects required for the new environment:

1. Delete the job description, job queue, subsystem description, data area, and class entries that were copied from the production libraries by using the following commands:

```
DLTOBJ OBJ(Newlibraryname/DYBACK3) OBJTYPE(*JOBQ)
DLTOBJ OBJ(Newlibraryname/DYBACK3) OBJTYPE(*SBSD)
DLTOBJ OBJ(Newlibraryname/DYBACK3) OBJTYPE(*CLS)
```

   Newlibraryname is the name overridden to allow the library to be loaded alongside the default library. Use the code of the new environment in place of *xxx*.

2. Create the new job queue for the new environment by using the following command:

```
CRTDUPOBJ OBJ(DYBACK3) FROMLIB(OSLDYD3) OBJTYPE(*JOBQ)
TOLIB(Newlibraryname) NEWOBJ(DYBACK3xxx)
```

3. Create the subsystem description for the new environment:

```
CRTDUPOBJ OBJ(DYBACK3) FROMLIB(OSLDYD3) OBJTYPE(*SBSD)
TOLIB(Newlibraryname) NEWOBJ(DYBACK3xxx)
```

4. Amend the subsystem to refer to the non-standard environment setup by issuing the following commands *in order*:

```
RMVJOBQE SBSD(Newlibraryname/DYBACK3xxx) JOBQ(OSLDYD3/DYBACK3)
ADDJOBQE SBSD(Newlibraryname/DYABACK3xxx) JOBQ(Newlibraryname/DYBACK3xxx)
```

5. Create new class descriptions for the new environment by using the command:

```
CRTDUPOBJ OBJ(DYBACK3) FROMLIB(OSLDYD3) OBJTYPE(*CLS) TOLIB(Newlibraryname)
NEWOBJ(DYBACK3xxx)
```

6. Attach the new class description for the new environment to the new subsystem:

```
CHGRTGE SBSD(Newlibraryname/DYBACK3xxx) SEQNBR(9999)
CLS(Newlibraryname/DYBACK3xxx)
```

11.8.6.12 Advanced Shipping

Set up Advanced Shipping in the new environment by following the process explained here. Issue the following commands to set up the objects required for the new environment:

1. Delete the job queue, subsystem description, data area, and class entries that were copied from the production libraries by using the following commands:

```
DLTOBJ OBJ(Newlibraryname/ASBACK3) OBJTYPE(*JOBQ)
DLTOBJ OBJ(Newlibraryname/ASBACK3) OBJTYPE(*SBSD)
DLTOBJ OBJ(Newlibraryname/ASBACK3) OBJTYPE(*CLS)
```

2. Create the new job queues for the new environment by using the following command:

```
CRTDUPOBJ OBJ(ASBACK3) FROMLIB(OSLASD3) OBJTYPE(*JOBQ)
TOLIB(Newlibraryname) NEWOBJ(ASBACK3xxx)
```

3. Create the subsystem description for the new environment:

```
CRTDUPOBJ OBJ(ASBACK3) FROMLIB(OSLASD3) OBJTYPE(*SBSD)
TOLIB(Newlibraryname) NEWOBJ(ASBACK3xxx)
```

4. Amend the subsystem to refer to the non-standard environment setup by issuing the following commands *in order*:

```
RMVJOBQE SBSD(Newlibraryname/ASBACK3xxx) JOBQ(OSLASD3/ASBACK3)
ADDJOBQE SBSD(Newlibraryname/ASBACK3xxx) JOBQ(Newlibraryname/ASBACK3xxx)
```

5. Create a new class description for the new environment by using the command:

```
CRTDUPOBJ OBJ(ASBACK3) FROMLIB(OSLASD3) OBJTYPE(*CLS) TOLIB(Newlibraryname)
NEWOBJ(ASBACK3xxx)
```

6. Attach the new class description for the new environment to the new subsystem:

```
CHGRTGE SBSD(Newlibraryname/ASBACK3xxx) SEQNBR(9999)
CLS(Newlibraryname/ASBACK3xxx)
```

11.8.6.13 Job Management

You can set up Job Management in the new environment by completing the process explained here. Issue the following commands to set up the objects required for the new environment:

1. Delete the job queue, subsystem description, data area, and class entries that were copied from the production libraries by using the following commands:

   ```
   DLTOBJ OBJ(Newlibraryname/JMBACK) OBJTYPE(*JOBQ)
   DLTOBJ OBJ(Newlibraryname/JMBACK3) OBJTYPE(*SBSD)
   DLTOBJ OBJ(Newlibraryname/JMCLS) OBJTYPE(*CLS)
   ```

2. Create the new job queues for the new environment by using the following commands:

   ```
   CRTDUPOBJ OBJ(JMBACK) FROMLIB(OSLJCD3) OBJTYPE(*JOBQ) TOLIB(Newlibraryname)
   NEWOBJ(JMBACKxxx)
   ```

3. Create the subsystem description for the new environment:

   ```
   CRTDUPOBJ OBJ(JMBACK3) FROMLIB(OSLJCD3) OBJTYPE(*SBSD)
   TOLIB(Newlibraryname) NEWOBJ(JMBACK3xxx)
   ```

4. Amend the subsystem to refer to the non-standard environment setup by issuing the following commands *in order*:

   ```
   RMVJOBQE SBSD(Newlibraryname/JMBACK3xxx) JOBQ(OSLJCD3/JMBACK)
   ADDJOBQE SBSD(Newlibraryname/JMBACK3xxx) JOBQ(Newlibraryname/JMBACKxxx)
   ```

5. Create a new class description for the new environment by using the command:

   ```
   CRTDUPOBJ OBJ(JMCLS) FROMLIB(OSLJCD3) OBJTYPE(*CLS) TOLIB(Newlibraryname)
   NEWOBJ(JMCLSxxx)
   ```

6. Attach the new class description for the new environment to the new subsystem:

   ```
   CHGRTGE SBSD(Newlibraryname/JMBACK3xxx) SEQNBR(9999)
   CLS(Newlibraryname/JMCLSxxx)
   ```

11.8.6.14 Production Support

This section presents two methods for you to choose from to set up Production Support in the new environment. The first method allows each environment (up to 10) to share the same subsystem and job queue from which to execute. The second method creates an entirely new subsystem. The second method involves changing three CL programs.

Method 1

Create a new data queue for the new environment by using the command:

```
CRTDTAQ DTAQ(NewLibraryName/MJDTAQ) MAXLEN(1) TEXT('Production control data
queue')
```

Method 2

Issue the following commands to set up the objects required for the new environment:

1. Delete the job queue, subsystem description, data area, and class entries that were copied from the production libraries by using the following commands:

   ```
   DLTOBJ OBJ(Newlibraryname/OSLMJ) OBJTYPE(*JOBQ)
   DLTOBJ OBJ(Newlibraryname/OSLMJ) OBJTYPE(*SBSD)
   DLTOBJ OBJ(Newlibraryname/OSLMJ) OBJTYPE(*CLS)
   ```

2. Create the new job queues for the new environment by using the following command:

```
CRTDUPOBJ OBJ(OSLMJ) FROMLIB(OSLPDP3) OBJTYPE(*JOBQ) TOLIB(Newlibraryname)
NEWOBJ(OSLMJxxx)
```

3. Create the subsystem description for the new environment:

```
CRTDUPOBJ OBJ(OSLMJ) FROMLIB(OSLPDP3) OBJTYPE(*SBSD) TOLIB(Newlibraryname)
NEWOBJ(OSLMJxxx)
```

4. Amend the subsystem to refer to the non-standard environment setup by issuing the following commands *in order*:

```
RMVJOBQE SBSD(Newlibraryname/OSLMJxxx) JOBQ(OSLPDD3/OSLMJ)
ADDJOBQE SBSD(Newlibraryname/OSLMJxxx) JOBQ(Newlibraryname/OSLMJxxx)
```

5. Create a new class description for the new environment by using the command:

```
CRTDUPOBJ OBJ(OSLMJ) FROMLIB(OSLPDP3) OBJTYPE(*CLS) TOLIB(Newlibraryname)
NEWOBJ(OSLMJxxx)
```

6. Create new data queue for the new environment by using the command:

```
CRTDTAQ DTAQ(NewLibraryName/MJDTAQ) MAXLEN(1) TEXT('Production control data
queue')
```

7. Attach the new class description for the new environment to the new subsystem:

```
CHGRTGE SBSD(Newlibraryname/OSLMJxxx) SEQNBR(10)
CLS(Newlibraryname/OSLMJxxx)
```

8. Modify the following CL programs to use the new subsystem name OSLMJxxx in place of OSLMJ:
   - MJ001CLP
   - MJ100AUTO
   - MJ599AUTO

11.8.7 Completing the process

The following Data Areas reference library names and need to be changed using the Change Data Area (CHGDTAARA) command. To make sure none are missed, we recommend that you use the Work with Data Area (WRKDTAARA) command to look within all new environment libraries for the listed data areas:

- SAUSRLIB
- FALIBS
- OEUSRLIB
- RWFILLIB
- PDLIB
- COMPILES
- DSMONITOR
- DTSBSSETUP
- WHSBSSETUP
- INTSTSBS

For each of the data areas found to exist in your new environment libraries, select option 5 to display the data area (Figure 237).

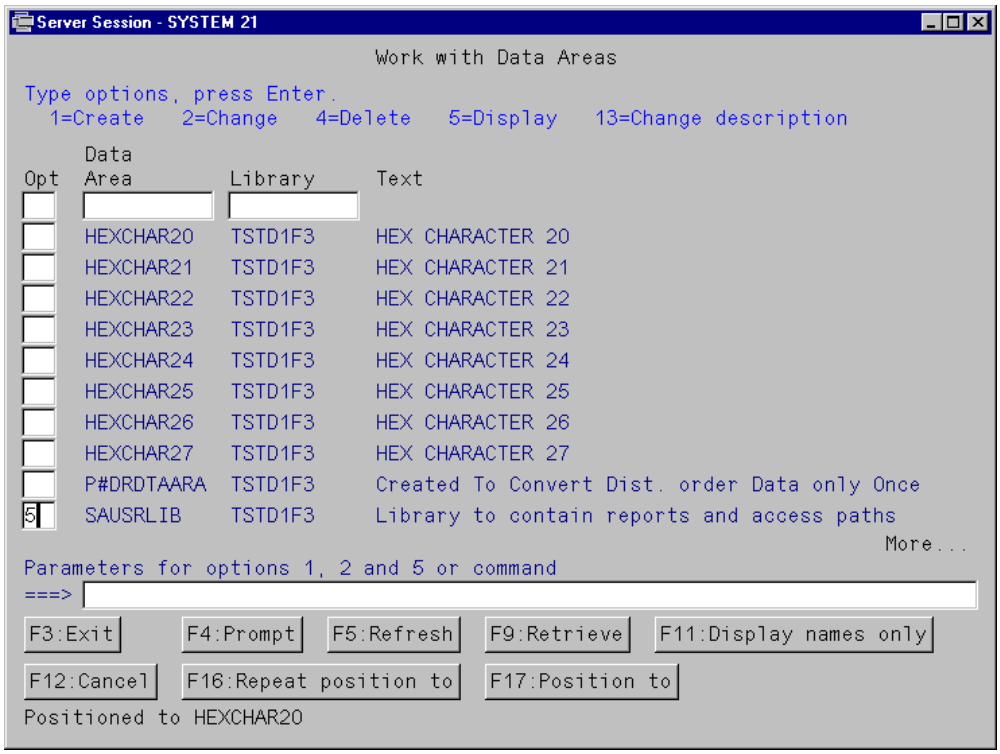

Figure 237. Work with Data Areas

When you look at the data area, any library names that occur in the data area need to be updated to reflect the new environment library names. See Figure 238 on page 428 for an example.

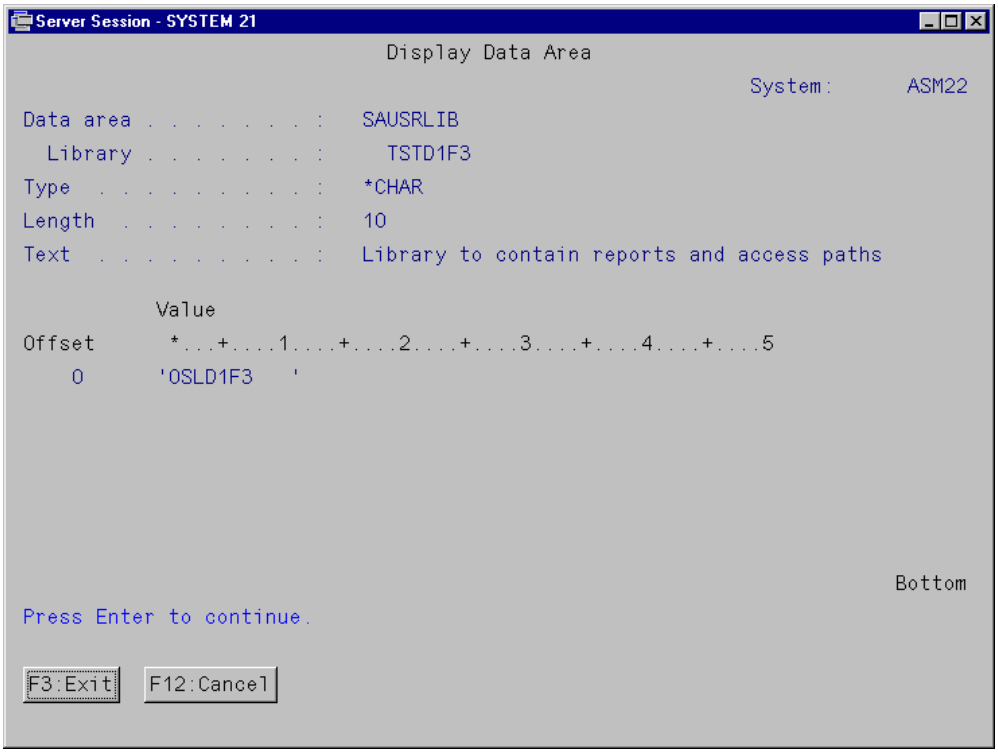

Figure 238. Display Data Area

To update the data area with the correct information, select option **2** (Change) from the Work with Data Area display (Figure 239).

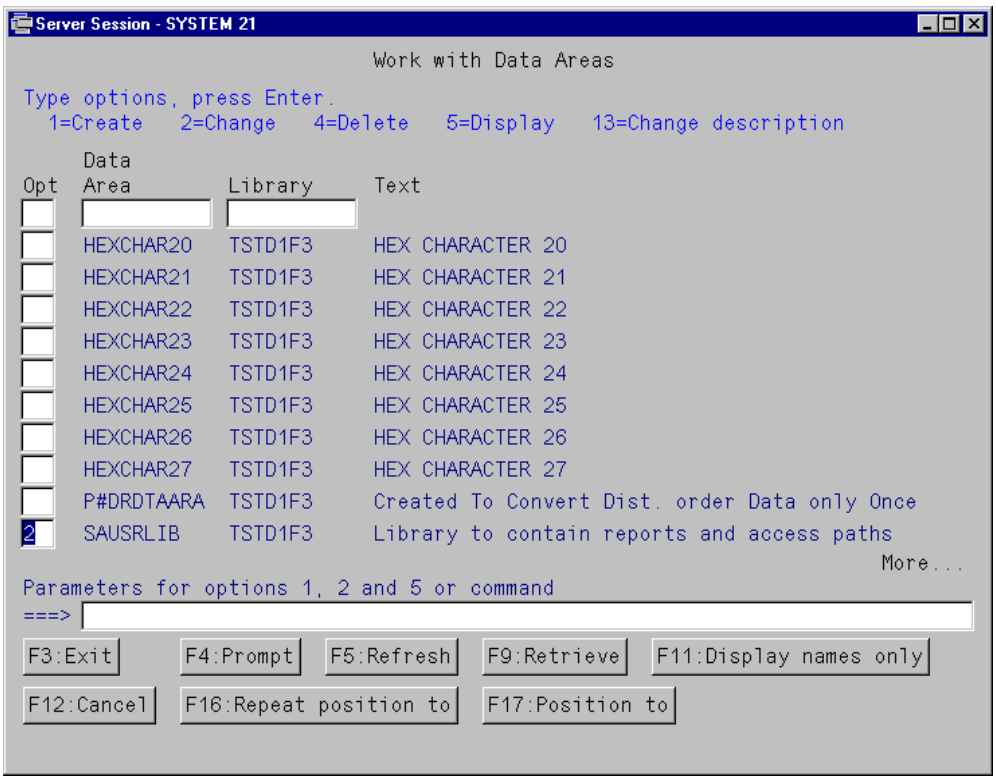

Figure 239. Change a Data Area (Part 1 of 2)

Press Enter. Enter the new library name into the data area as shown in Figure 240.

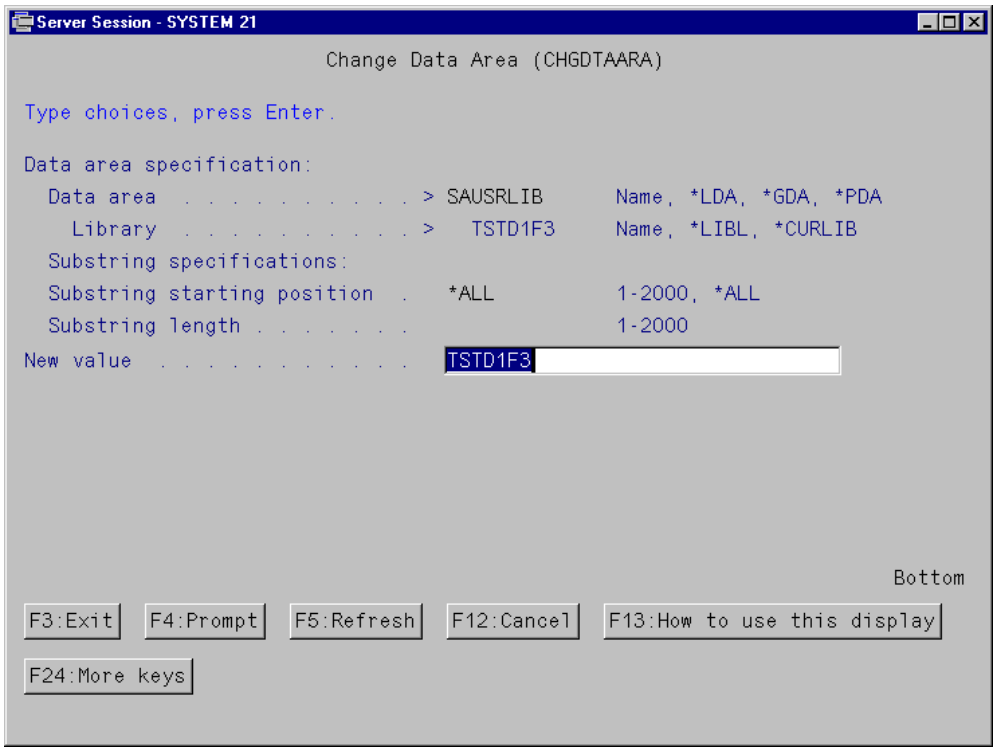

Figure 240. Change a Data Area (Part 2 of 2)

For information on setting up the application security, see Chapter 7, “Security” on page 209.

11.9 Automatic subsystem control in environments

Within Machine Manager, an Auto Day Start job must be added to execute the command to start a background subsystem in your non-production environments, for example, GLBACK3*xxx*. Do the same for Auto Day End jobs to execute the command to end a background subsystem in your non-production environments.

Refer to 6.1, “Using System 21 Machine Manager” on page 143, for further information about setting up Auto Day Start or Auto Day End jobs in Machine Manager. You can simply replace the environment codes and library names with your non-production environment entries.

11.10 Coexistence with other applications

If you have created your own application, it is possible to incorporate it as another application under your System 21 Application Manager. There are several areas to address to make this possible:

- **Licensing**: Depending on the type of System 21 installation you have, accessing your application through Application Manager may take licenses that the System 21 users may need.

- **Library lists**: The library lists for the application need to be set up in Application Manager.
- **Menus**: Any menus for the application need to be set up in Application Manager
- **Task Codes**: Task codes to initiate jobs or call functions in the application need to be set up within Application Manager.

11.11 Programming techniques

This section discusses the general utilities and practices employed in the standard software code. This discussion will allow you to follow the original developer's methods while customizing your code.

11.11.1 Documenting source changes

When making any changes to source code, it is wise practice to take the extra time to document the changes fully. Follow these tips when documenting your changes:

- Never change the original source. Instead, make a copy, and change the copy.
- Never make modifications in the live environment. Make them in a test environment, and copy the objects over when testing is complete.
- Never skip documentation within the program. There is a header block at the top to describe your changes. Use comments within the program code to break out your modifications.

11.11.2 Program Status Data Structure (PSDS)

The PSDS may be used within any RPG program to obtain information about the current program itself, such as the program name or current user. To simplify the definition of the PSDS, a dummy file is defined in IPGAMP4 for use by the RPG compiler. This may be used by defining a data structure and specifying it as externally defined.

11.11.3 Information Data Structure (INFDS)

Every file that exists within an RPG program contains an Information Data Structure. This data structure may be defined in a similar manner as the LDA and PSDS, and is used to obtain information about a file during the execution of a program. It is externally defined as a dummy physical file in IPGAMF4, called INFDS. For further information, see the field definition of the dummy physical file, or refer to *ILE RPG for AS/400 V4R4 Reference*, SC09-2508.

11.11.4 Error handling

The source code for the standard Program Exception and Error Handling Subroutine (PSSR) is contained within OSLCOPYSRC as a copy member. This subroutine is used to take control when a file exception or error occurs. A file exception occurs when an invalid file operation (read, write, update, delete, or output) is performed on a file in the program. Other errors occur for reasons, such as dividing a number by 0, attempting to execute a program that does not exist, or moving invalid characters into a program variable. When the PSSR routine is executed, it collects information about the job and logs the error in Application

Manager. The routine then generates a formatted RPG dump, which is a spooled file containing information about the program that failed. Sometimes the program explicitly executes the PSSR subroutine while processing because there is missing information.

The PSSR routine is specified in positions 60 through 65 of the file specification continuation line. The PSSR, when activated by an error, will return the value "**" in the L#RTCD field of the LDA and log the error information to Application Manager.

The PSSR may also be explicitly executed via the operation code `EXSR *PSSR`.

For interactive jobs, the routines allow the job to terminate gracefully so that a user response to an error message is not required. The user receives a message stating that the job terminated and to contact their data processing department.

For batch jobs, an unsuccessful job completion message is sent to the requesting user.

Note

You should never use halt indicators in any AS/400 RPG program. They were originally intended to handle exception or error conditions requiring a computer operator response. For AS/400 interactive systems, error handling should be carried out using the PSSR to enable the program to terminate gracefully and notify the problem to Application Manager.

11.11.5 Programs that will not compile

Here are some tips to help you ensure successful compiles:

- When using the AS/400 Programming Development Manager (PDM), invoke it from a System 21 command line. This ensures that you have the correct system library list set up.
- If you are attempting to recompile a program, you may find that the program will not compile because it cannot find all the file objects used by it. If runtime files are used, there should be a CL program that creates the temporary files and compiles the program. If the missing files are from applications not installed, the objects must be obtained from Geac.
- If attempting to recompile a program that contains SQL instructions a RPG/SQL compiler is required.
- Set the Application Library list.

  System 21 has a command, Set IPG Library List (SETIPGLIBL), which is very helpful for setting up the correct library list for compiling programs. When you use this command, you only need to remember the application code as opposed to all the libraries needed by your program.

  To use this command, type `SETIPGLIBL` on the command line, and press F4. Figure 241 on page 432 shows the fields needed for the command.

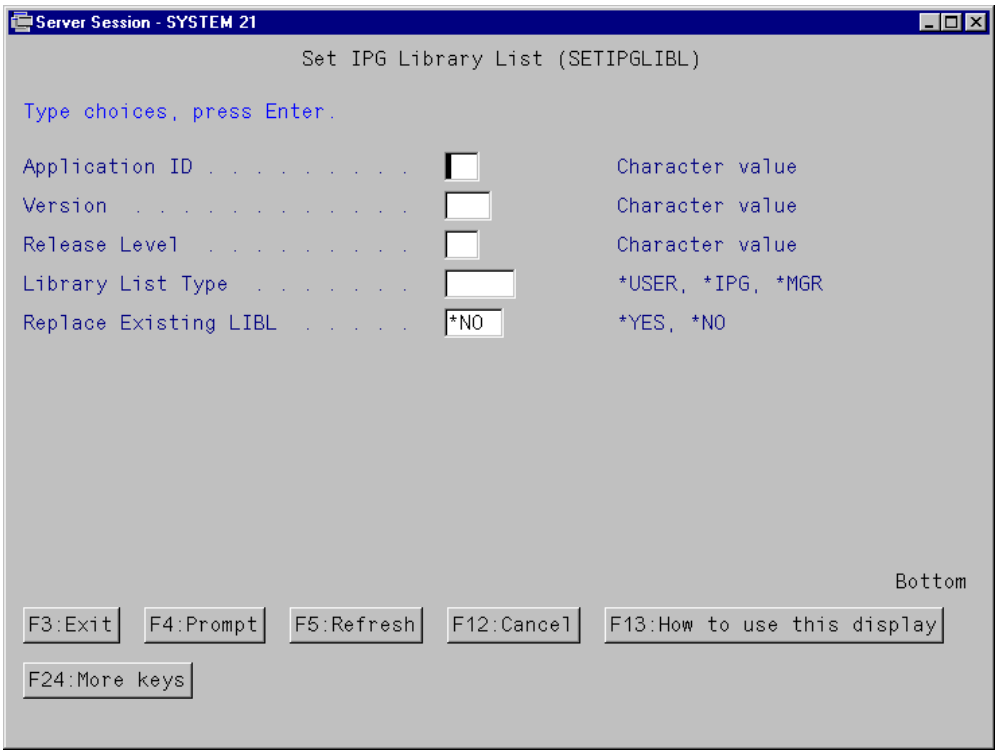

Figure 241. SETIPGLIBL command

The panel shown in Figure 241 can be somewhat confusing, because it doesn't follow the exact same terminology to which you are accustomed. The definitions of the fields are:

- **Application ID**: The two-character code describing the application to which the desired library list belongs.
- **Version**: This field is actually the three-character environment code.
- **Release Level**: This field is the version number. Currently the only value for this field is "03".
- **Library List Type**: This field always has a value of "O", unless you set up custom library list types.
- **Replace Existing Library List**:

  If *NO is specified, the command asks where to place the new entries in the current user library list. Then, it attempts to append the libraries to your library list.

  If *Yes is specified, the command replaces your library list with the one requested.

When the fields are completed to your specifications, press Enter to update the library list.

11.11.6 Menus

From a menu, you can set up a function key, execute a task, link to another menu, or execute an AS/400 command. You can create menus independently from an application.

If you set up a new custom menu, or change an existing standard menu, you should always create it in a specific environment so that it remains independent of any application installations and is preserved. You can access the Menu Design Aid software from the Application Manager menu. It gives you flexible control of the layout of a menu.

Attention

Menu Design Aid should not be used from System 21 Explorer. Use a Client Access Express terminal session instead.

When you create a new menu, you can base it on an existing menu or create a new one. We recommend that you base it on an existing menu. Be sure to link the menu to an application or else the Application Environment Gold (AMENVGOLD) command will not extract it. If you create a menu or screen from a copy, it is important to remember not to change the overall size of the window, or Explorer may lose part of the image.

Setting the Public Authority flag to 1 gives the user access to any tasks added to the menu simply by authorizing them to the menu. The facilities provided by menu design are similar to the AS/400 Screen Design Aid (SDA).

If you are not sure what function keys or commands to use, press F1 for help.

Press F10 to display a list of reserved words. The reserved words are basically fields available from Application Manager for display on your menu.

You can specify a task behind a menu, but you do not have to put any text on the menu to indicate that it is available. There is no correlation between text on the menu and the options set up for the menu. Tasks are executed, from a menu, for specific environments. This can be a difficult issue to manage in a multi-environment setup.

Chapter 12. Work management

Work management is a feature of the AS/400 system used to manage system resources to achieve optimum throughput. The AS/400 system contains many objects that interact with each other and applications to process information efficiently. When the Operating System/400 (OS/400) is installed, it includes a work management environment that supports interactive and batch work. Client/server support on the AS/400 system is enabled by the OS/400 Host Servers option. The host servers interact with Client Access Express on a personal computer to provide access to AS/400 resources.

An understanding of the basic concepts of work management is an important prerequisite if a standard System 21 implementation is to be modified.

12.1 AS/400 work management concepts

This section discusses AS/400 work management concepts affecting job flow through the system. It is not the intent of this section to cover all aspects of the subject. The *OS/400 Work Management Guide,* SC41-5306, provides a greater understanding of the subject. Chapter 10, “Performance management” on page 307, discusses some of these concepts as they relate to system performance.

12.1.1 System values

System values are elements of information that affect the operating environment of the entire system. A system value contains control information for the operation of certain parts of the system. A user can change the system value to define the working environment. The system date and library list are examples of system values.

12.1.1.1 Benefits

System values contain specifications that allow you to control or change the overall operation of your system. For example, you can use the QDATFMT system value to specify the date format, such as YMD, MDY, DMY, or JUL (Julian format).

12.1.1.2 Overview

All available system values are arranged by the types, or categories, that appear on the Work with System Values display:

- Allocation
- Date and Time
- Editing
- System Control
- Library List
- Message and Logging
- Security
- Storage

12.1.2 Network attributes

A network attribute specifies control information about the communications environment. Network attributes contain specifications that can be used for

networking and communications. Network attributes are not objects and cannot be passed as parameter values like CL variables.

The AS/400 system is shipped with default network attributes. Most of these attributes are important if your system is part of a communications network.

One important network attribute is the system name, which appears on many OS/400 displays, including the sign-on display. Other network attributes include the local network ID, default mode for the system, network server domain, and many others.

You can view the current values of the network attributes using the Display Network Attributes (DSPNETA) command. You can use the Change Network Attributes (CHGNETA) command to alter the values of any of the network attributes.

12.1.3 Subsystems

A subsystem is an object used to define an operating environment through which the system coordinates work flow and resource usage. Subsystems are used to allocate main storage and provide a degree of isolation for jobs with similar processing characteristics (such as batch, interactive, and so on) in which to run. The AS/400 system includes several concurrently active subsystems. The separation of jobs into subsystems minimizes the contention for system resources and increases efficiency.

A subsystem description defines how work can enter the subsystem (work entries), how much work the subsystem can handle concurrently (activity level), how main storage is allocated (pool specifications), and how jobs execute when they enter the subsystem and become active (routing entries). The important components of a subsystem description are:

- **Operational attributes**: This is information such as the number of jobs that can be active in the subsystem at the same time and the interactive 5250-type sign-on display.
- **Storage pool definitions**: On the AS/400 system, all main storage can be assigned logically into units called storage pools. There are two types of pools:
  - A *shared storage pool* is a pool in which multiple subsystems can run jobs. The system has two special shared pools and up to sixty-two general shared pools.

    The special shared pools are the machine pool and the base pool. The *machine pool* (*MACHINE) is used for jobs that the system must run. The *base pool* (*BASE) contains all unassigned main storage that is not required by the machine storage pool or any other pool.

    The general pools include the interactive pool, the spool pool, and shared pools 1 through 60. The *interactive pool* (*INTERACT) contains assigned main storage that is used for interactive jobs, by default, unless specifically assigned to other main storage pools. The *spool pool* (*SPOOL) contains assigned main storage that is used by jobs that perform spool file conversion, if necessary. For example, these jobs may perform SNA Character String (SCS) to Advanced Function Printing Data Stream (AFPDS) conversion. The spool pool is also used by jobs that print spool

file output to local and remote (including network) printers. You can optionally use the additional *shared pools* (*SHRPOOL1 through *SHRPOOL60) can be optionally used and assign main storage based on the anticipated number of subsystems and types of jobs that will run on the system.

– A *private storage pool* is an optionally assigned main storage pool that only supports jobs from a single subsystem. You can allocate as many as 62 private pools for use in active subsystems.

Storage pools also have an activity level and a paging option. The activity level is the maximum number of threads that can be active at the same time in that pool. The paging option characteristics, sometimes referred to as Expert Cache, determine whether the system should dynamically adjust the paging characteristics of the storage pool for optimum performance. The four main storage pool attributes defined are:

– Pool identification (within the subsystem)
– Pool size
– Maximum activity level
– Paging option

- **Work entries**: A work entry specifies the source from which jobs can be accepted for processing in the subsystem. The work-entry types are:

  – **Autostart job entries**: Each time the subsystem is started, the autostart jobs associated with it are started. This allows a one-time initialization of a job to perform a repetitive activity associated with the subsystem.

  – **Workstation entries**: A job is started when a workstation user signs on or when a workstation user transfers an interactive job from another subsystem. A workstation entry assigns a Non-Programmable Terminal (NPT) or workstation by type or by a specific device description name.

  – **Job queue entries**: Jobs are processed from the specified job queues. Job queue entries identify the job queues from which to take work and determine how much work to accept. Jobs are placed in a job queue using the AS/400 Submit Job (SBMJOB) command.

  – **Communications entries**: A communications job is a batch job that is started by a program start request from a remote system. For servers, the start request is initiated by a client or PC application. Communications work entries identify the sources from which the subsystem accepts start requests. A communications entry includes:

    - Device
    - Mode
    - Job description
    - Default user
    - Maximum active jobs

    For example, a program start request using a mode entry of QSERVER is routed to the QSERVER subsystem. Users of other modes, including QCASERVR and QPCSUPP, are routed to the QCMN subsystem.

  – **Prestart job entries**: A prestart job is a batch job that starts running before a program on a remote system sends a program start request. Prestart jobs are different from other jobs because they use prestart job entries to determine which program, class, and storage pool to use when they are

started. The objective of a prestart job is to perform as much “start-up” activity as possible before the remote request is received.

- **Routing entries**: Routing entries specify the controlling program to be called to manage a routing step for a job running in the subsystem (typically the system-supplied program QCMD), which subsystem memory pool the job uses, and from which class to get the run-time attributes. Routing data is the parameter used to select a routing entry for a job. Together, routing entries and routing data provide information on starting a job in a subsystem.

  The c*lass* associated with a subsystem is a very important object since it identifies aspects of the job execution or run-time environment such as:

  – **Run priority**: Run priority is a value, ranging from 1 (highest priority) through 99 (lowest priority.) It represents the importance of the job when it competes with other jobs for the machine resources. This value represents the relative, not absolute, importance of the job. For example, a job with a priority of 25 is not twice as important as one with a priority of 50. This value is the highest run priority allowed for any thread within the job. Individual threads within the job may have a lower priority.

  – **Time slice**: Specifies the maximum amount of processor time (in milliseconds) given to each thread in a job using this class before other threads in a job or other jobs are given the opportunity to run. The time slice establishes the amount of time allowed for the job to accomplish a meaningful amount of processing. If a thread exceeds its assigned time slice, it may be temporarily flagged as ineligible to run so that other threads can become active in the storage pool.

  – **Eligible for purge**: Specifies whether a job is eligible to be moved out of main storage and put into auxiliary storage at the end of a time slice or when there is a long wait (such as waiting for a workstation user's response). This attribute is ignored when more than one thread is active within the job. A job with multiple threads is never purged from main storage.

  – **Default wait time**: Specifies the default maximum wait time (in seconds) that a thread in the job waits for a system instruction, such as the LOCK machine interface (MI) instruction, to acquire a resource. This default wait time is used when a wait time is not otherwise specified for a given situation. Normally, this is the amount of time the system user is willing to wait for the system before the request is ended.

  – **Maximum CPU time**: Specifies the maximum processing unit time (in milliseconds) that a job can use. If the job consists of multiple routing steps, each routing step is allowed to use this amount of processing unit time. If the maximum time is exceeded, the job is ended.

  – **Maximum temporary storage**: Specifies the maximum amount of temporary (auxiliary) storage (in kilobytes) that a job can use for processing. If the job consists of multiple routing steps, this is the maximum temporary storage that the routing step can use. This temporary storage is used for storage required by the program itself and by implicitly created system objects used to support the routing step. If the maximum temporary storage is exceeded by a routing step, the routing step is ended. This parameter does not apply to the use of permanent storage, which is controlled through the user profile.

– **Maximum threads**: Specifies the maximum number of threads with which a job using this class can run, at any time. If multiple threads are initiated simultaneously, this value may be exceeded. If this maximum value is exceeded, the excess threads are allowed to run to their normal completion. Initiation of additional threads will be inhibited until the maximum number of threads in the job drops below this maximum value.

12.1.3.1 IBM-supplied subsystems

Several subsystems are provided by and used with OS/400. IBM licensed program applications may place jobs into one of these subsystems or supply their own subsystems. This section gives a brief overview of key subsystems. For applications, you must review application specific documentation to determine their unique subsystem requirements.

IBM-supplied subsystems may use shipped system values (such as QCTLSBSD) and subsystem description parameters to determine the work or functions assigned to a particular subsystem. Through manipulation of the subsystem description, a user may route IBM-provided applications to any subsystem or make adjustments to storage pools and job priorities. This section describes the typical assignments.

Some of the subsystems included here have IBM-supplied job names for IBM-supplied functions. A subset of the subsystems is listed. This does not include details of every job supported within each subsystem.

QBASE and QCTL subsystems

The AS/400 system has one subsystem called the *controlling subsystem*. The system value QCTLSBSD specifies which subsystem is the controlling subsystem. It is the first subsystem to start after an Initial Program Load (IPL) and has to be active while the system is running. It is also the only subsystem active when the system is operating in a *restricted state*. This is required when performing certain system functions such as complete system saves.

QBASE is the shipped default controlling subsystem (from the system value QCTLSBSD) and is typically used in simple, single application environments. Running non-interactive and interactive applications in QBASE simultaneously may result in poor page faulting rates.

Usually customers require a more sophisticated environment, which cannot be supported by performing all of the work in QBASE. Therefore, QCTL is usually configured as the controlling subsystem. The following subsystems are usually active instead of QBASE:

- QCTL (controlling subsystem)
- QBATCH (for batch-type work)
- QINTER (for interactive-type work)
- QCMN (for communications jobs)

Additional IBM subsystems, including QSPL, QSERVER, QSYSWRK and QUSRWRK, along with user-defined subsystems, may also be active.

The AS/400 system console runs in the controlling subsystem, which is normally QCTL. In some system environments, QCTL may also support interactive and batch user application work, although this is not generally recommended. Other jobs, such as the system cleanup job QSYSSCD, may also run in QCTL.

The system value for the Startup Program (QSTRUPPGM) specifies the start-up program that is called after the controlling subsystem has started at the end of an IPL. The start-up program can start the subsystems required by IBM and the customer after an IPL. As shipped from IBM, the start-up program starts subsystems QBATCH, QINTER, QSPL, QSNADS, QCMN, and QSERVER. Typically in a System 21 environment, the Start TCP/IP (STRTCP) and Start Host Server (STRHOSTSVR) commands are added to this program.

QBATCH and QINTER subsystems

Most OS/400 jobs that execute the Submit Job (SBMJOB) command defer the assignment of the job queue to the user profile's job description under which the job is running. The IBM-supplied default for this job queue, as defined in the job description, is QBATCH. The QBATCH job queue is assigned to subsystem QBATCH. This means, by default, typical non-interactive jobs run in the QBATCH subsystem.

The QINTER subsystem is set up so that interactive sessions default to run in QINTER. This includes local and remote dependent workstation displays (5250 and 3270 displays), 5250 display station pass-through sessions, 3270-based sessions (such as DHCF and SNA Primary Logical Unit (SPLS)), PC Support/400 or Client Access/400 Work Station Function (WSF) and 5250 emulator sessions, RUMBA/400 sessions, OS/2 Communication Manager 5250 emulation sessions, and ASCII Workstation Controller display devices.

QSPL subsystem

This subsystem is shipped to control all spooled output work. These tasks are usually initiated by the AS/400 commands Start Printer Writer (STRPRTWTR) and Start Remote Writer (STRRMTWTR).

QSNADS subsystem

This subsystem usually performs functions, such as document transmission and TCP/IP Simple Mail Transfer Protocol (SMTP) work, over an SNA network. There can be several routing jobs active and a job for each send distribution defined for a remote location. A few of the more common jobs are:

- **QSRVBAS/QESTP**: This job is activated as part of standard OS/400 support for receiving PTFs from IBM or a customer service provider.
- **QGATE/TCPIPLOC**: This job is activated when TCP/IP Simple Mail Transfer Protocol (SMTP) is activated for the local system.

QSERVER subsystem

The QSERVER subsystem is the file server subsystem. Subsystem QSERVER runs the host server jobs for Client Access Express *file serving* and *database serving* functions. The file server, the database server, and their associated daemon jobs *must* run in this subsystem. There is one autostart job and one file server job for each active client and one database server job for an active database serving session, as shown in the following list:

- **SNA jobs**:
  - QPGMR/QSERVER

    This autostart job sets up the file serving and database serving environment on the AS/400 system.

– User-id/QPWFSERV

File serving support includes storing programs and files as a network drive (virtual disk) for the attached client.

– QUSER/QZDAINIT

There is one of these database serving functions for each active client session. QZDAINIT is implemented as a prestarted job.

- **TCP/IP jobs**:

– User-id/QPWFSERVSO

File serving support includes storing programs and files as a network drive (virtual disk) for the attached client.

– User-id/QPWFSERVSD

This is the file server daemon.

– QUSER/QZDASOINIT

There is one of these database serving functions for each active client session. QZDASOINIT is implemented as a prestarted job.

– QUSER/QZDASRVSD

This is the database server daemon.

QSYSWRK subsystem

The QSYSWRK subsystem is a common subsystem for various system jobs. Because of the potentially large number of different jobs active within this subsystem, it is important to understand what is currently known about these job types. For a particular customer environment, changes to the default run priority or storage pool assignment may be necessary to improve the overall system performance. Additionally, all server jobs (except the file and database servers) run in this subsystem.

Subsystem description QSYSWRK is shipped to use only the base storage pool. It is not included in the system-supplied IPL start-up program QSTRUP. QSYSWRK is started by the SCPF job during an IPL unless the system performs an IPL to a restricted state. Some of the more common jobs include:

- **Integrated Netfinity Server (formerly Integrated PC Server) monitor job**: There is one job active for each active Integrated Netfinity Server or Integrated PC Server (IPCS). The monitor job has the name of the network server description started for the Integrated Netfinity Server or IPCS.
- **Mail Server Framework (QMSF/QMSF)**: There can be one or more mail server framework jobs (typically only one). You can use the AS/400 system Start Mail Server Framework Job (STRMSF) command to start up multiple QMSF jobs. This may improve performance during periods of excessive sending and receiving of mail or SNADS distributions.
- **TCP/IP support**: TCP/IP support is included in OS/400. When you issue the AS/400 system Start TCP/IP (STRTCP) command, several jobs are started in QSYSWRK. These include the File Transfer Protocol (FTP) server, Telnet server, and Line Printer Daemon (LPD) server.

Subsystem QSYSWRK is shipped with several autostart job entries, including QSYSWRKJOB and QFSIOPJOB. These jobs run when the subsystem is started

and perform functions such as QSYSWRK processing and restarting Integrated Netfinity Server (or Integrated PC Server) jobs.

> **Note**
>
> Starting at V4R4, some of the jobs previously supported in QSYSWRK are now supported in the QUSRWRK subsystem.

QCMN subsystem

Subsystem QCMN supports most communications jobs. User-written client/server application serving jobs (for example, using APPC or data queues) run in the QCMN subsystem. QCMN is active when the system value QCTLSBSD specifies the controlling subsystem as QCTL.

12.1.3.2 Subsystem starting

When a subsystem is started, the following sequence occurs:

1. The AS/400 Start Subsystem (STRSBS) command starts the subsystem.
2. The system interrogates the subsystem description for information.
3. Storage pools are allocated.
4. Display stations are allocated (sign-on displays are up) if appropriate.
5. Communications devices are allocated if appropriate.
6. Job queues are allocated.
7. Prestart jobs are started if appropriate.
8. Autostart jobs are started if appropriate.
9. The subsystem is up and running and ready for work.

12.1.4 Memory management

Memory management is a methodology to optimize the use of installed main memory and improve the efficiency of the system.

The installed memory on the AS/400 system is partitioned into memory pools to minimize contention for memory by jobs with different processing characteristics. For example, batch jobs are normally executed in different memory pools to those used by interactive jobs.

The maximum number of threads that may be active in the memory pool is determined by an activity level. An excessive value could result in increased page faulting due to many threads competing for memory. A low value could result in jobs having to wait for an activity level to be freed.

The Set Object Access (SETOBJACC) command allows programs or database files to be preloaded into a specified shared memory pool or private memory pool. This eliminates a need to access the data from the disk, since the objects are already in main memory. A good knowledge of the applications and database is a prerequisite for effective use of this facility.

Expert Cache is a selectable OS/400 option that enables the system's single-level storage support to use main memory as a cache for selected storage pools. Expert Cache is designed to reduce the number of physical disk I/Os and does not require a detailed understanding of the applications or database to be implemented. The operating system determines which objects (or portions of objects) are to remain in the shared storage pool where Expert Cache is enabled.

12.1.5 Jobs

A job is a unit of work on the AS/400 system, which is performed under a unique, fully-qualified name within the system. All jobs run within a subsystem.

12.1.5.1 Threads

A job is a collection of one or more *threads*. Each job has an *initial thread*. The initial thread is created when the job starts. The job may also have additional threads, identified as *secondary threads*, depending on the application.

A thread is an independent unit of dispatchable work. Each thread has its own execution environment, such as a call stack. The thread shares many of the resources that are assigned to the job. The identifier for the thread is unique in the job to which the thread belongs.

Controlling work in the system is performed mainly at the job level. Most commands and application programming interfaces (APIs) operate against the entire job.

Each thread is an independent unit of work. The activity level of a storage pool applies to threads rather than jobs. However, in the subsystem description, maximum active counts associated with a subsystem and the subsystem work entries apply to jobs. Therefore, a thread is used in information about storage pool activity levels. A job is used in information about subsystem maximum active counts.

12.1.5.2 Types of jobs

The AS/400 system supports many different types of jobs. They are categorized as shown here:

- **Interactive job**: Starts when a user signs on to the system from a display station and ends when they sign off. The user is interacting with the system by issuing commands, using function keys, and running programs and applications.
- **Group job**: One of up to 16 interactive jobs that are associated in a group with the same workstation device and user.
- **Batch job**: Has no interaction with the user and occurs when a user:
  - Submits a job to a job queue
  - Issues a communications program start request
  - Starts a subsystem and invokes an autostart job entry
  - Starts a subsystem and invokes a prestart job entry
- **Batch immediate job**: Is initiated (or spawned) directly by another job without going through any job queue. These jobs are similar to batch jobs in that they can exist without any direct communications with a user. Batch immediate jobs should always run in the same subsystem as the job that initiated them.
- **Autostart job**: Is automatically started each time the subsystem is started. It is a batch job that does repetitive work or one-time initialization work that is associated with a subsystem.
- **Communications job**: A batch job that is started by a program start request from a remote system.

- **Prestart job**: A batch job that is started before the remote program sends a program start request.
- **System job**: A batch job created by OS/400 to control system resources and schedule jobs.

12.1.5.3 Job names

To make it easier to control and identify jobs on the system, each job has a unique, qualified job name. The qualified job name consists of three parts:

- **Job name**: Also known as the *simple job name*. For interactive jobs, this is the same as the name of the workstation the user is signed on to. The job name for a batch job can be specified up to 10 characters long.
- **User name**: The name of the user profile under which the job is started. For interactive jobs, the user name is the name entered in the user field on the sign-on display. For batch jobs, it is the user profile under which the batch job was started. The user name can be up to 10 characters long.
- **Job number**: A unique number assigned by the system so users can identify jobs, even if more than one job has the same job name and user name. The job number always has six numeric digits.

The syntax for qualified job names is similar to qualified names for objects in libraries. For example, if the job name is DSP01, the user is QPGMR, and the job number is 000578, then the qualified job name is 000578/QPGMR/DSP01.

12.1.5.4 Job description

Job attributes determine how each job is executed on the system. A subsystem knows where and when to get job attributes from a job description, user profile, system value, or the currently active job, based on how each attribute is specified.

A job description contains a specific set of job attributes and can be used by multiple jobs. Therefore, when using a job description, a user does not need to specify the same parameters repeatedly for each job. Individual job descriptions can be created to describe batch jobs or interactive jobs. Alternatively a job description can be created for each system user. Here is a partial list of job attributes that make up a job description:

- Job queue
- Job priority (on JOBQ)
- Output priority (on OUTQ)
- Print device
- Output queue
- Initial library list
- Message logging

12.1.5.5 Job execution

The following basic elements control the selection of active jobs for processing by the AS/400 system:

- **Task dispatching and priority**: The AS/400 system manages the multiple tasks that need to be processed, through:
  - *Task Dispatch Queue*: Regardless of the number of CPUs in the AS/400 system, there is only one task dispatcher and Task Dispatch Queue (TDQ).

All active system and user jobs are represented in this queue as Task Dispatch Entries (TDE) and are ordered by job priority.

  - *Job priority*: Mainly determines the order of jobs in the TDQ. However, there are other considerations that affect the position of jobs of equal priority in the TDQ. Jobs with a lower numeric value have a higher priority in the TDQ and are processed ahead of those with a lower priority, such as batch jobs.

- **Activity levels**: Each thread in a job must occupy an activity level to be processed by the CPU or CPUs. An activity level is specified to control the maximum number of threads that may be run concurrently. It is specified at the system, subsystem, or memory pool level.
- **Time slice**: Is specified in the class and determines the amount of CPU time that each thread in a job is allowed to use to complete a task.
- **Job states**: A currently executing job is in one of the following states:
  - *Active*: Occupying an activity level
  - *Waiting*: Waiting for an event to occur
  - *Ineligible*: Not able to use the processor due to lack of an activity level
- **Job transitions**: As each thread in a job runs in the system, it is transferred between states. You can view the following transitions by using the AS/400 system Work with System Status (WRKSYSSTS) command and pressing the F11 key:
  - *Active-wait (A-W)*: Once a thread in a job has used the CPU and the required task is completed, the thread enters a *wait* state until an event (such as the user pressing the Enter key or a function key in an interactive job) occurs.
  - *Wait-ineligible (W-I)*: If the event, upon which the thread in a job was waiting, completes but an activity level is not available, the thread in the job enters an *ineligible* state.
  - *Active-ineligible (A-I)*: If the thread in the job does not complete the task in the assigned time slice, it has to release its activity level. It may become ineligible if there are other threads or jobs waiting for the activity level.

  Figure 242 on page 446 shows the thread transition states on the AS/400 system.

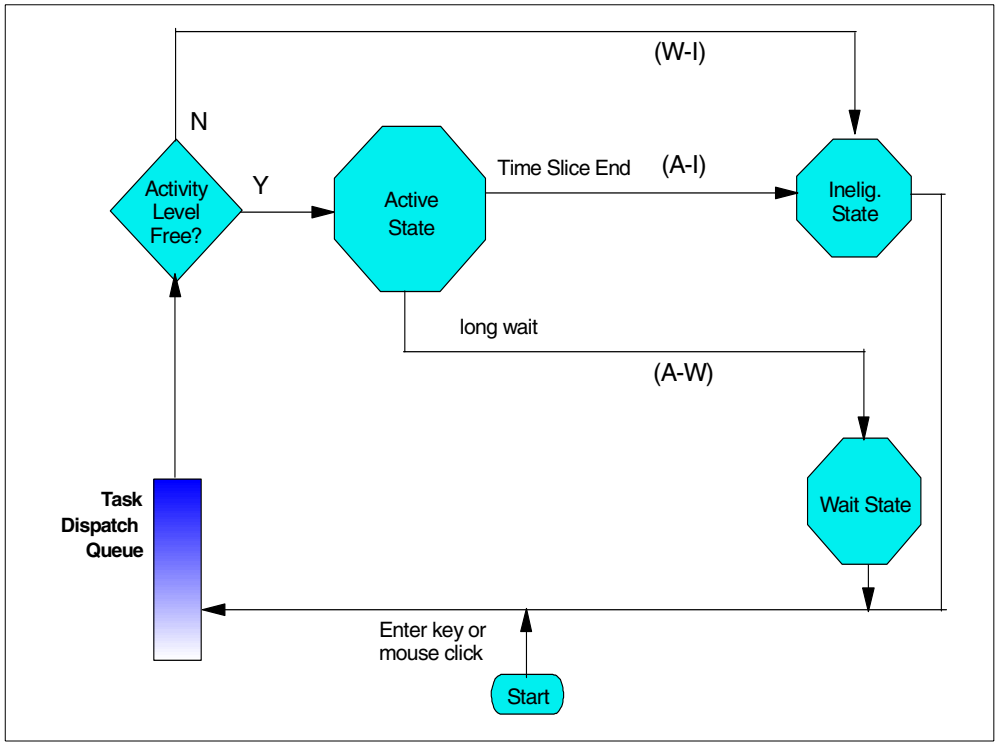

Figure 242. Thread transition states using the WRKSYSSTS command

12.1.6 Work Control Block Table

The Work Control Block Table (WCBT) is a system object that maintains information for all jobs from the time they enter the system until they are removed. Each job is represented by a single entry in the WCBT.

As of OS/400 V4R1, an index is maintained over the WCBT. This allows the system to locate entries much faster than on releases prior to V4R1, where a sequential search algorithm is used. The WCBT consists of a single space that contains the header information and one to ten spaces of entries for jobs.

There is a Work Control Block Table Entry (WCBTE) for every job tracked by OS/400. Jobs have a WCBTE if they are:

- On the job queue ready to run
- Actively in the system doing work
- Completed with output that remains on an output queue

When a job is no longer tracked by the system, a new job that is starting can reuse its Work Control Block Table Entry (WCBTE). However, there can be situations on heavily utilized systems where the number of jobs being tracked is quite large. This increases the total storage occupied by WCBT.

If a large number of entries (jobs) become “no longer tracked”, it can take a while to reuse the “available” entry space. During this time, accessing the Work Control Block Table Entries with commands, such as Work With Subsystem Jobs (WRKSBSJOB), can become time consuming. You need to compress these entries to remove the empty slots. This should return the count of the jobs in the system to the value specified in the QTOTJOB system value.

Compression is performed during IPL. Compression is supported through the Compress Job Tables (CPRJOBTBL) parameter on the Change IPL Attributes (CHGIPLA) command. Compression reduces the size of the WCBT by freeing up the unused WCBTEs.

12.2 Client/server work management

In an AS/400 client/server environment, OS/400 host servers provide server-side communications management. Client requests are provided by the Client Access products. The support provided to Client Access Express is called *optimized* support to distinguish it from the support provided to PC Support/400 clients (*original* support).

The optimized servers that are provided with the OS/400 host server option in V3R1 and later releases use OS/400 socket support to communicate with clients.

12.2.1 Optimized host servers

The optimized host servers include:

- A file server that integrates with the integrated file system (IFS) and allows clients to store and access information, such as files and programs, located on the AS/400 system
- A database server for data transfer, ODBC, Operations Navigator database, SQL APIs (DB APIs), and the Client Access Express OLE DB provider
- A network print server that allows enhanced client control over print resources on the AS/400 system
- A data queue server
- A remote command and program call server that allows PC applications to issue commands and call programs on the AS/400 system and return the results to the client
- A central server that provides services such as license management and other client management functions
- A signon server that provides password management functions for host servers with sockets support
- A server mapper that provides the current server port number to a client requesting a connection

12.2.2 Establishing client/server communications

Figure 243 on page 448 shows how client/server communications are established.

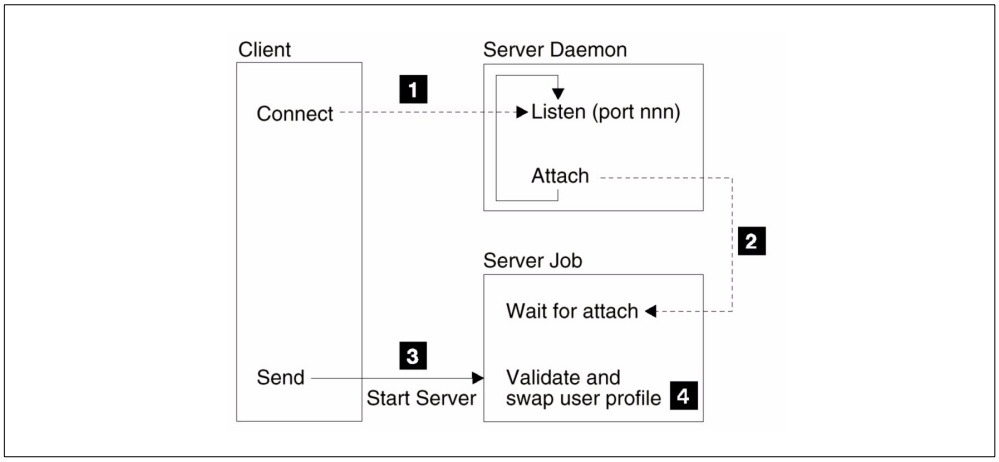

Figure 243. Establishing client/server communications

To initiate a server job that uses sockets communications support, the following process occurs (the numbers in parentheses correspond to the numbers in Figure 243):

1. The client system connects to a particular server's port number 1. A server daemon must be started (with the `STRHOSTSVR` command) to listen for and accept the client's connection request.
2. Upon accepting the connection request, the server daemon issues an internal request to attach the client's connection to a server job 2. This server job may be a prestarted job, or, if prestart jobs are not used, a batch job that is submitted when the client connection request is processed. The server job handles all further communications with the client.
3. The server connects to the client. The initial data exchange includes a request that identifies the user profile and password that are associated with the client user 3.
4. Once the user profile and password are validated, the server job switches to this user profile 4.

For additional information about optimized servers and managing AS/400 servers with sockets communications, refer to *AS/400 Client Access Express Host Servers,* SC41-5740.

12.2.2.1 Server mapper daemon

The server mapper daemon is a batch job that runs in the QSYSWRK subsystem. It provides a method for client applications to determine the port number that is associated with a particular server.

When the client sends the service name, the server mapper performs these actions in the order shown:

1. Obtains the port number for the specified service name from the service table.
2. Returns this port number to the client.
3. Ends the communication.
4. Returns to listen for another connection request.

The client uses the port number returned from the server mapper daemon to connect to the specified server daemon.

The server mapper daemon is started using the Start Host Server (STRHOSTSVR) command and ended using the End Host Server (ENDHOSTSVR) command.

12.2.2.2 Server daemons

The server daemon is a batch job that is associated with a particular server type. There is only one server daemon per server type. However, one server daemon can have many server jobs.

The server daemon allows client applications to start communications with a host server that is using sockets communications support. The server daemon does this by handling and routing incoming connection requests. Once the client establishes communications with the server job, there is no further association between the client and the server daemon for the duration of that server job.

Like the server mapper daemon, the Start Host Server (STRHOSTSVR) command starts server daemons. The End Host Server (ENDHOSTSVR) command ends them. The server daemons must be active for the client applications to establish a connection with a host server that is using sockets communications support.

All of the server daemons run in the QSYSWRK subsystem, except for the database and file server daemon, which run in the QSERVER subsystem. The server daemon jobs run in the same subsystem as their corresponding server jobs.

The TCP/IP protocol and the associated subsystem must be active when the server daemon job is started.

12.2.2.3 Service table

The service table contains the port number of the server mapper daemon, the port numbers of each server daemon, and the symbolic service names. The service table is updated with these entries when Host Server Option 12 is installed on the AS/400 system.

You can use the Work Service Table Entries (WRKSRVTBLE) command to see the service names and their associated port numbers. Table 66 shows the initial service table entries provided for the optimized servers and server mapper.

Table 66. Port numbers for host servers and server mapper using TCP (Part 1 of 2)

Service Name	Description	Port #
as-central	Central Server	8470
as-database	Database Server	8471
as-dtaq	Data queue server	8472
as-file	File server	8473
as-netprt	Network Print Server	8474
as-rmtcmd	Remote command/program call server	8475
as-signon	Signon server	8476
as-svrmap	Server mapper	449

Table 67 shows the initial service table entries provided for the servers and server mapper that use SSL (Secure Sockets Layer) support.

Table 67. Port numbers for host servers and server daemons using TCP (Part 2 of 2)

Service name	Description	Port #
as-central-s	Secure Central Server	9470
as-database-s	Secure Database Server	9471
as-dtaq-s	Secure Data queue server	9472
as-file-s	Secure File server	9473
as-netprt-s	Secure Network Print Server	9474
as-rmtcmd-s	Secure Remote command/program call server	9475
as-signon-s	Secure Signon server	9476

12.2.2.4 Starting and ending host servers

The Start Host Server (STRHOSTSVR) command starts the host server daemons and the server mapper daemon. In addition, the STRHOSTSVR command attempts to start the prestart job associated with the specified server types. There is no prestart job entry associated with the server mapper (*SVRMAP) type.

One server daemon exists for each of the host server types. In addition, one server mapper daemon is associated with all host servers that support client applications seeking to obtain a particular port number for a host server daemon. The client application then uses this port number to connect to the host server daemon. The server daemon accepts the incoming connection request and routes it to the server job for further processing.

The daemons are batch jobs that are submitted to either the QSYSWRK or the QSERVER subsystem. This depends on the value or values that are specified for the SERVER keyword. All daemon jobs are submitted to the QSYSWRK subsystem, with the exception of the *DATABASE and *FILE server daemons, which are submitted to the QSERVER subsystem. The server jobs run in the same subsystem as their corresponding server daemons. There are no server jobs that are associated with the server mapper daemon.

To have the host servers start automatically when TCP/IP is started, complete the following steps, using Client Access Express:

1. Double-click the **Operations Navigator** icon.
2. If necessary, expand **My AS/400 Connections**.
3. Expand your AS/400 server.
4. If necessary, sign on with `QSECOFR` for User ID, and enter the appropriate password.
5. Expand **Network**.
6. Expand **Servers**.
7. Click **Client Access**.
8. Right-click the host server (from Central, Database, Data queue, File, Net Print, Remote Command, Sign On, Server Mapper) that you want to start automatically, and select **Properties**.

9. If necessary, sign on with QSECOFR for User ID, and enter the appropriate password.
10. Select the **Start when TCP/IP is started** box on the General tab.
11. Click **OK**.
12. Now the jobs for that server will start when TCP/IP is started. Repeat steps 8 through 10 for each server to be started automatically.

The RQDPCL keyword is used to identify which communication protocols (TCP/IP or IPX) must be active at the time the STRHOSTSVR command is issued. If the required protocols are not active, the STRHOSTSVR command will fail. The server daemon can be started without any active protocols. When used in conjunction with the QZBSEVTM autostart job, the daemon job can dynamically identify when protocols become active.

Note

The host servers will not start if the QUSER password has expired. The password expiration interval should be set to *NOMAX for the QUSER profile.

The End Host Server (ENDHOSTSVR) command ends the host server daemons and the server mapper daemon. If either the server or server mapper daemon is ended, existing connections and jobs remain unaffected. However, subsequent requests from a client application will fail until the daemons are started again.

12.2.3 Client/server subsystems

Server jobs are configured to run in different subsystems depending on their function. The following subsystems are used by the server jobs:

- **QSYSWRK subsystem**

  All of the servers, with the exception of the database and file servers, the network drive server, the transfer function server, and their associated daemon jobs run in this subsystem. The file server and database server run in the QSERVER subsystem.

- **QUSRWRK subsystem**

  This subsystem supports the Network Print, Remote Command/Program Call, Central, Data Queue, and Signon servers.

- **QSERVER subsystem**

  Subsystem QSERVER runs the host server jobs for the Client Access/400 *file serving* and *database serving* functions. The file server, database server, and their associated daemon jobs *must* run in this subsystem. There is one autostart job and one file server job for each active client and one database server job for an active database serving session.

12.2.4 Using prestart jobs

Prestart jobs are particularly important in client/server communications. A prestart job is a batch job that is initiated before a program on a remote system sends a program start request. Prestart jobs differ from other jobs because they use prestart job entries in the subsystem description to determine which program, class, and storage pool to use when the jobs are started.

Prestart jobs increase performance when you initiate a connection to a server. Using prestart jobs allows us to reduce the amount of time required to handle a program start request. The initiation of a prestart job follows this procedure:

1. When a subsystem is started, or when the Start Prestart Job (STRPJ) command is entered, prestart jobs are started based on the information contained in the prestart job entries.
2. When a program start request is received on the target system, it goes to the subsystem that has the required communications device allocated.
3. The program start request attaches to a prestart job that is already running if the subsystem finds either of the following entries:
   - A prestart job entry with a program name that matches the program name of a program start request
   - A routing entry that matches the routing data of the program start request and the routing program on the found routing entry matches the program name on a prestart job entry
4. If the prestart job entry is not active, the program start request is rejected. If a match is not found, the program start request causes a communications batch job to start if the routing data matches the routing entry. Otherwise, the program start request is rejected.

Prestart jobs can be reused, but there is no automatic cleanup for the prestart job once it has been used and subsequently returned to the pool. The number of times the prestart job is reused is determined by the value specified for the maximum number of uses (MAXUSE) value of the Add Prestart Job Entry (ADDPJE) or Change Prestart Job Entry (CHGPJE) CL commands. This means that resources that are used by one user of the prestart job must be cleaned up before ending use of the prestart job. Otherwise, these resources will maintain the same status for the next user that uses the prestart job. For example, a file that is opened, but never closed by one user of a prestart job, remains open and available to the next user of the same prestart job.

By default, some of the server jobs run in QUSRWRK. QUSRWRK has prestart job entries added to it when the host servers option is installed. Table 68 and Table 69 summarize the prestart job default options shipped with OS/400 for TCP/IP connections.

Table 68. Default options for prestart jobs (Part 1 of 2)

Server	Network Print	Rmt Cmd Pgm Call	Central	Database
Subsystem	QUSRWRK	QUSRWRK	QUSRWRK	QSERVER
Library/ Program	QIWS/ QNPSERVS	QIWS/ QZRSRVS	QIWS/ QZSCRSVS	QIWS/ QZDASOINIT
User profile	QUSER	QUSER	QUSER	QUSER
Initial jobs	1	1	1	1
Threshold	1	1	1	1
Addl jobs	2	2	2	2
Max Jobs	*NOMAX	*NOMAX	*NOMAX	*NOMAX

Server	Network Print	Rmt Cmd Pgm Call	Central	Database
Max Users	200	1	200	1
Wait for job	*YES	*YES	*YES	*YES
Pool ID	1	1	1	1
Library/Class	QGPL/ QCASERVR	QGPL/ QCASERVR	QGPL/ QCASERVR	QSYS/ QPWFSERVER

Table 69. Default options for orestart jobs (Part 2 of 2)

Server	Secure database	File	Secure file	Data queue	Signon
Subsystem	QSERVER	QSERVER	QSERVER	QUSRWRK	QUSRWRK
Library/ Program	QIWS/ QZDASSINIT	QSYS/ QPWFSERVSO	QSYS/ QPWFSERSS	QIWS/ QZHQSSRV	QIWS/ QZSOSIGN
User profile	QUSER	QUSER	QUSER	QUSER	QUSER
Initial jobs	1	1	1	1	1
Threshold	1	1	1	1	1
Addl jobs	2	2	2	2	2
Max Jobs	*NOMAX	*NOMAX	*NOMAX	*NOMAX	*NOMAX
Max Users	200	*NOMAX	*NOMAX	200	200
Wait for job	*YES	*YES	*YES	*YES	*YES
Pool ID	1	1	1	1	1
Library/Class	QSYS/ QPWFSERVER	QSYS/ QPWFSERVER	QSYS/ QPWFSERVER	QGPL/ QCASERVR	QGPL/ QCASERVR

The following list explains some of the terms used in Table 68 and Table 69:

Subsystem description The subsystem that contains the prestart job entries.

Library/program The program initiated by the prestart job.

User profile The user profile under which the job runs.

Initial jobs The number of prestart jobs that are started when the subsystem is started.

Threshold The minimum number of currently unused prestart jobs that should remain active.

Additional jobs The number of additional jobs that are started when the number of jobs drops below the threshold value.

Maximum jobs The maximum number of jobs that may be active.

Maximum uses The maximum number of times each prestart job is *reused* before it is ended.

Wait for job	Causes a client connection request to wait for an available server job if the maximum number of jobs has been reached.
Pool ID	The memory pool number within the subsystem that the job uses.
Library/Class	The execution class that the job uses.

When the start jobs value for the prestart job entry is set to *YES and the remaining values are at their default settings, the following actions take place for each prestart job entry:

1. When the subsystem is started, one prestart job for each server is started.
2. When the first client connection request processes for a specific server, the initial job is used and the threshold is exceeded.
3. Two additional jobs are started for that server based on the number that is defined in the prestart job entry.
4. The number of available jobs is always at least one, as specified in the threshold value of the prestart job entry.
5. The subsystem periodically checks the number of prestart jobs that are ready to process requests, and ends excess jobs. The subsystem always leaves at least the number of prestart jobs specified in the threshold parameter.

12.2.4.1 Monitoring prestart jobs

Use the Display Active Prestart Jobs (DSPACTPJ) command to monitor the prestart jobs. To monitor prestart jobs, you must know in which subsystem (QUSRWRK, QSYSWRK or QSERVER) your prestart jobs are located and the program (for example, QZSOSIGN). Figure 244 and Figure 245 show the output from the Display Active Prestart Job command.

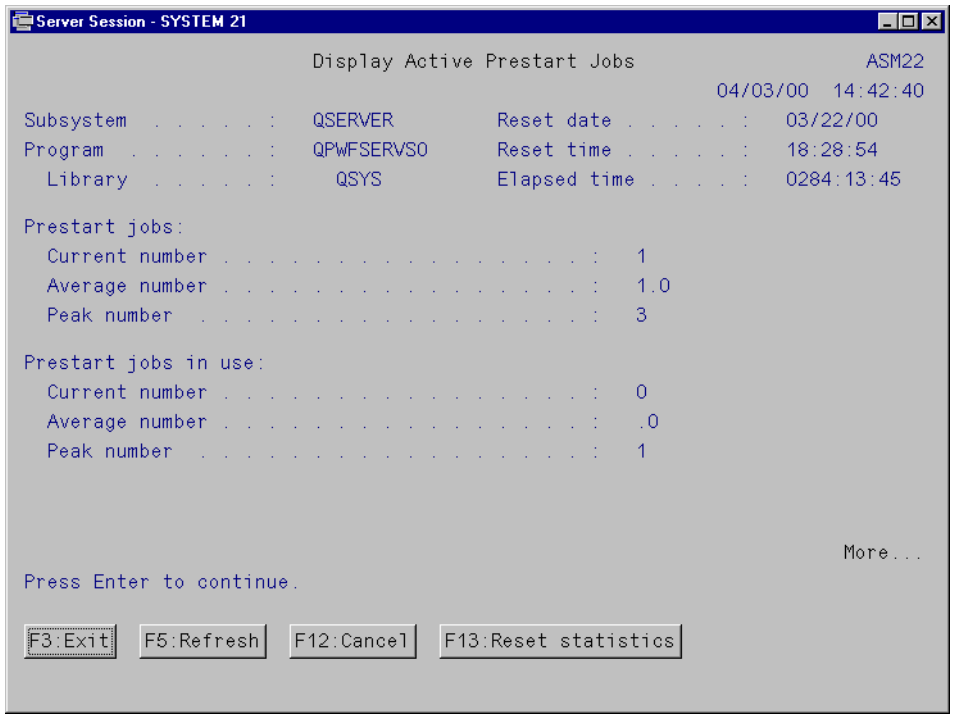

Figure 244. Monitoring Prestart Jobs with DSPACTPJ (Part 1 of 2)

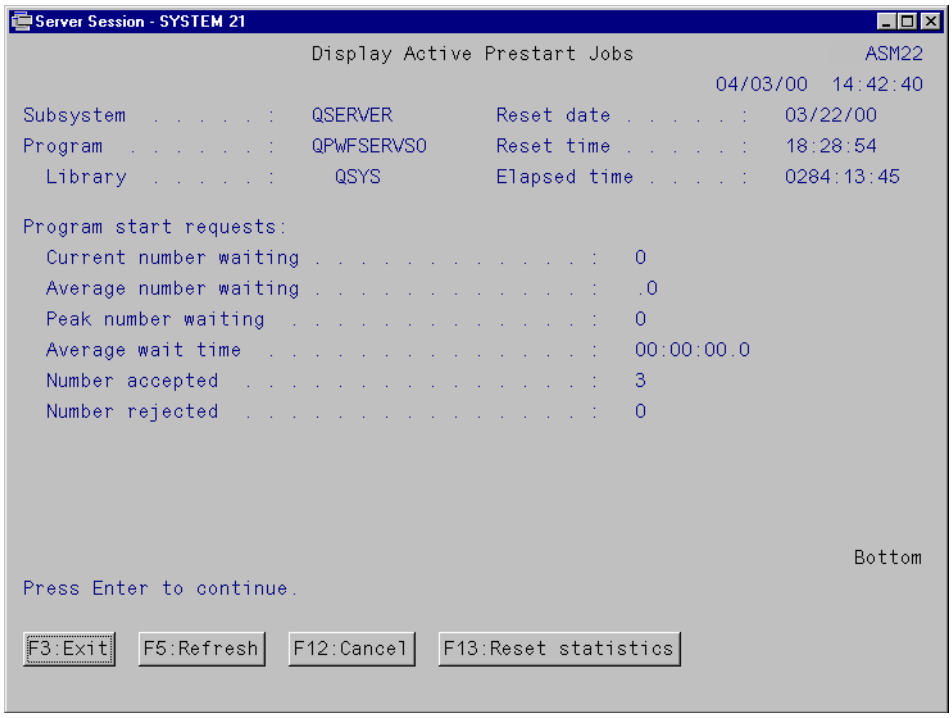

Figure 245. Monitoring Prestart Jobs with DSPACTPJ (Part 2 of 2)

Table 70 lists the programs used by the Client Access Express servers. More information is available in *Client Access Express Host Servers,* SC41-5740.

Table 70. Host servers for clients using sockets communications support

Server	Program name
File	QSYS/QPWFSERVSD - File server daemon QSYS/QPWFSERVSO - Main server for each user
Secure File	QSYS/QPWFSERVSS - Secure file server daemon
Database	QIWS/QZDASRVSD - Database server daemon QIWS/QZDASOINIT - All DB server requests
Secure Database	QIWS/QZDASSINIT - All secure DB server requests
Data Queue	QIWS/QZHQSRVD - Data queue server daemon QIWS/QZHQSSRV
Network Print	QIWS/QNPSERVD - Network printer server daemon QIWS/QNPSERVS
Central	QIWS/QZSCSRVSD - Central server daemon QIWS/QZSCSRVS
Rmt Cmd/Pgm Call	QIWS/QZRCSRVSD - Rmt cmd/Pgm call daemon QIWS/QZRCSRVS
Signon	QIWS/QZSOSGND - Signon server daemon QIWS/QZSOSIGN
Mapper Daemon	QIWS/QZSOSMAPD - Server mapper daemon

12.2.4.2 Managing prestart jobs

The information about program start requests can indicate whether you need to change the available number of prestart jobs. If the information indicates that program start requests are waiting for an available prestart job, you can change prestart jobs by using the Change Prestart Job Entry (CHGPJE) command.

If the program start requests are not being serviced quickly, you can perform any combination of the following options:

- Increase the threshold.
- Increase the parameter value for the initial number of jobs (INLJOBS).
- Increase the parameter value for the additional number of jobs (ADLJOBS).

The objective is to ensure that an available prestart job exists for every request.

12.2.5 Open Database Connectivity (ODBC) connections

Client applications can communicate with AS/400 server applications by using ODBC database driver. ODBC is a Microsoft architected database access interface that enables applications to access data using Structured Query Language (SQL) as a standard language.

ODBC requests are submitted to the QSERVER subsystem where QZDASOINIT pre-started jobs run. Each request to connect to a specific data source initiated by the Client Access ODBC driver uses one QZDASOINIT pre-started job, servicing the user profile specified in the connection string. The programs QZSCSRVS and QZSOSIGN are also used for making the connection.

12.2.6 Identifying client/server jobs

Being able to identify a particular job is a prerequisite to investigating problems and determining performance implications. In OS/400 V4R4, you can use Operations Navigator to identify your server jobs by performing the following steps:

1. Double-click **Operations Navigator** icon.
2. If necessary, expand **My AS/400 Connections**.
3. Expand your AS/400 server.
4. If required, sign on with QSECOFR for User ID, and enter a password.
5. Expand **Network**.
6. Expand **Servers**.
7. Click **TCP/IP** or **Client Access**, based on the type of servers for which you want to see jobs.
8. Right-click the host server for which you want to see jobs, and select **Server Jobs**.
9. If necessary, sign on with QSECOFR for User ID, and enter a password.

Another window opens that shows the server jobs with the user, job type, job status, time entered system, and date entered system for that server.

12.2.6.1 Server job names

The job name that is used on the AS/400 system consists of three parts:

- The simple job name
- The user ID
- The job number (ascending order)

The server jobs follow several conventions:

- Job name
  - For non-prestarted jobs, the server job name is the name of the server program.
  - Prestarted jobs use the name that is defined in the prestart job entry.
  - Jobs that are started by the servers use the job description name or an assigned name if they are batch jobs (the file server does this).
- The user ID
  - Is always QUSER, regardless of whether prestart jobs are used.
  - The job log shows which users have used the job.
- Work management creates the job number.

12.2.6.2 Identifying server jobs

There are two methods you can use to identify server jobs. The first method is to use the WRKACTJOB command. The second method is to display the history log to determine which job is being used by which client.

Displaying active jobs with WRKACTJOB

The WRKACTJOB command shows all active jobs, as well as the server daemons and the server mapper daemon. You must press F14 to see the

available prestart jobs. Figure 246 shows some of the active jobs in the QSYSWRK subsystem.

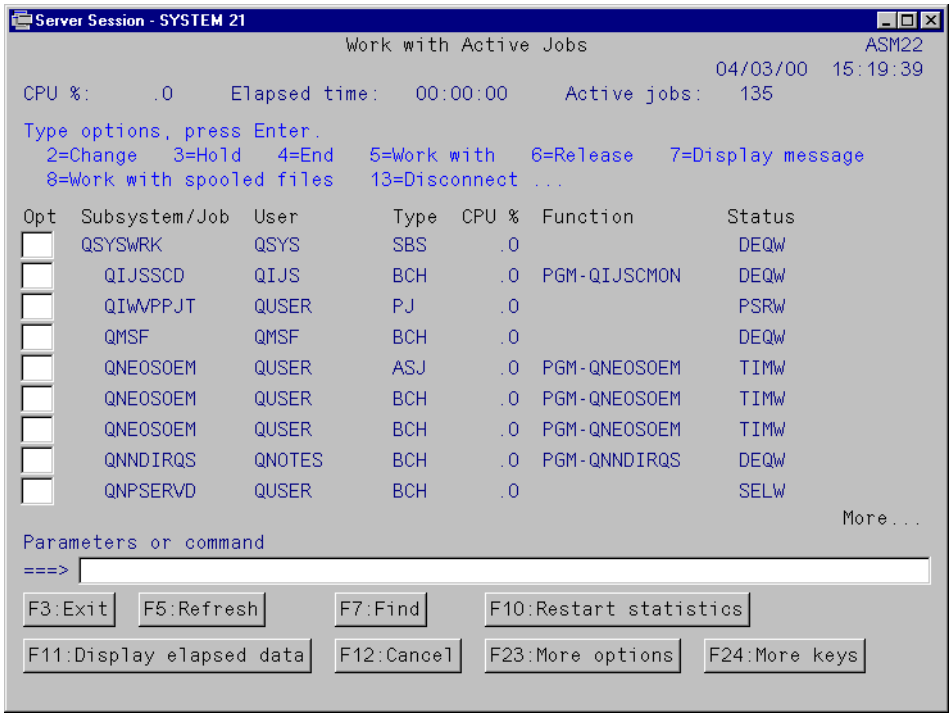

Figure 246. Displaying client/server jobs with WRKACTJOB SBS (QSYSWRK)

Figure 247 shows the active jobs in the QSERVER subsystem.

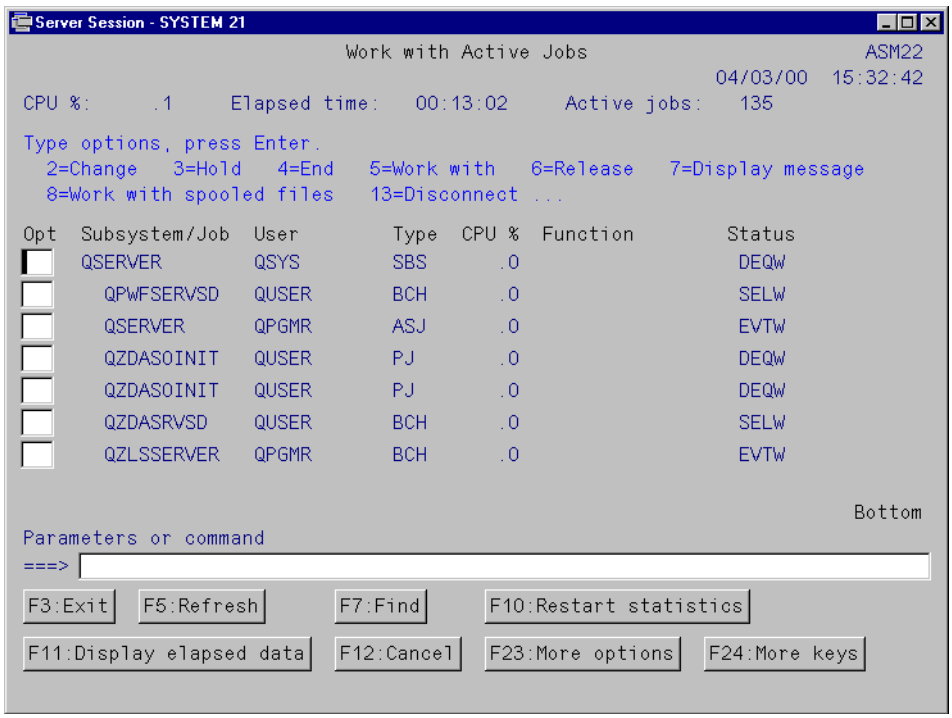

Figure 247. Displaying client/server jobs with WRKACTJOB SBS (QSERVER)

The following types of jobs are shown:

- **ASJ**: Autostart job for subsystem
- **SBS**: Subsystem monitor job
- **BCH**: Server daemon and server mapper daemon jobs
- **PJ**: Prestarted server job

Displaying the history log

Each time a client user successfully connects to a server job, the job is swapped to run under the profile of that client user. To determine which job is associated with a particular user, you can display the history log with the Display Log (DSPLOG) command as shown in Figure 248.

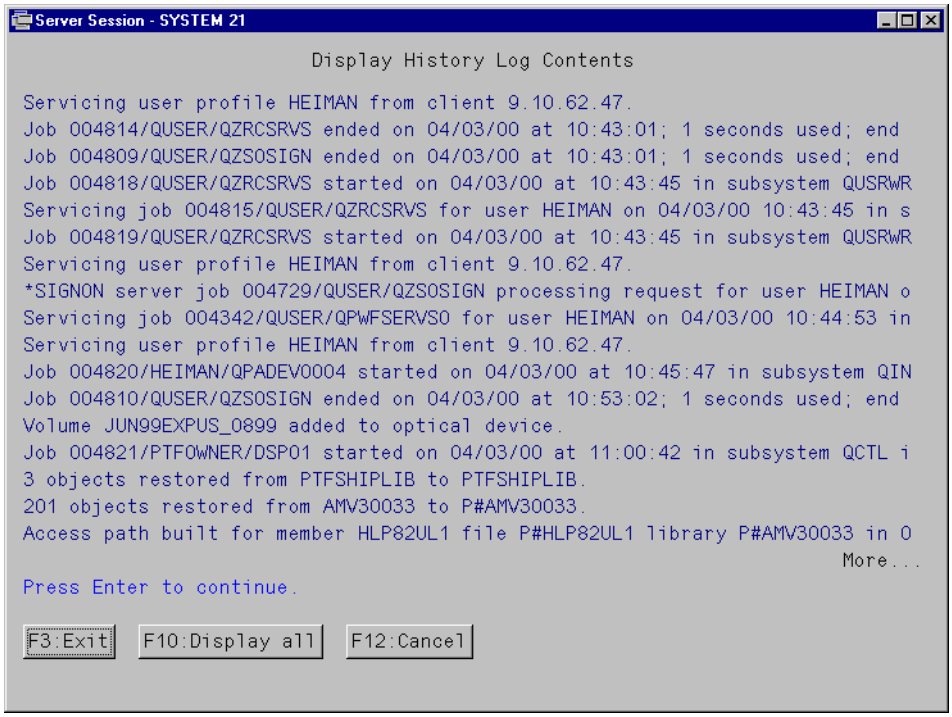

Figure 248. Displaying the history log contents

Identifying server jobs for a user

To display the server jobs for a particular user, perform the following steps:

1. Double-click the **Operations Navigator** icon.
2. If necessary, expand **My AS/400 Connections**.
3. Expand your AS/400 server.
4. If required, sign on with QSECOFR for User ID, and type a password.
5. Expand **Users and Groups**.
6. Click **All Users**.
7. Right-click on the user for whom you want to see server jobs.
8. Select **User Objects**.
9. Click **Jobs**.
10. If required, sign on with QSECOFR for User ID, and type a password.

    You see a window displaying all the server jobs for that user.

You can also use the Work Object Lock (WRKOBJLCK) command to identify and work with your database server jobs. In this case, you need to know the user ID (for example, QUSER) that was used to start Client/Access support. Perform the following steps:

1. Enter the following command:

   ```
   WRKOBJLCK QUSER *USRPF
   ```

2. You see a list of jobs holding locks. Select the **QZDASOINIT** job.

   There may be several QZDASOINIT jobs. You must try each one until you find the currently active job.

3. Select option **5** for the QZDASOINIT job.
4. Select option **10** from the Work with Job display to view the log.

12.3 Work management in the System 21 environment

The core System 21 product set does not require any specific work management considerations to be successfully implemented. Subsystem descriptions use available main storage pools (*BASE), and batch jobs are submitted to the QBATCH job queue in the QBATCH subsystem.

Using certain System 21 facilities, such as the Power Down System function, requires the creation of additional job queues (see Chapter 6, “Operations” on page 143, for further details). However, this function is optional and is not considered essential to an implementation.

The following sections review the System 21 approach to work management and how this can be tailored to specific installations.

12.3.1 System 21 subsystems

System 21 supports a simple approach to subsystems:

- Interactive sessions will be supported in the IBM-supplied QINTER subsystem.
- Batch jobs will be processed through the IBM-supplied QBATCH subsystem.
- System 21 specific background jobs will be supported in application-specific batch subsystems.
- All other workloads will be supported in standard IBM-supplied subsystems.

System 21 subsystems support both autostart and submitted job types. In general, the Finance subsystems have autostart job entries configured.

Table 71 lists the core subsystems for the standard System 21 application set. It does not include the subsystems required to support the Style and Drinks vertical products.

Table 71. Standard System 21 subsystems

Application area	Subsystem name	System 21 library
Enterprise Work Mgmt.	WFBACK3	IPGAMP4
Accounts Payable	PLBACK3	OSLPLD3

Application area	Subsystem name	System 21 library
Accounts Receivable	SLBACK3	OSLSLD3
Cash Management	CSBACK3	OSLCSD3
General Ledger	GLBACK3	OSLGLD3
World Trade	WTBACK3	OSLWTP3
Document Processing	DYBACK3	OSLDYD3
Inventory Management	INBACK3	OSLINP3
Telesales	TSBACK3	OSLTSP3
Transport Planning	TPBACK3	OSLTPP3
Warehousing	WHBACK3	OSLWHP3
Job Management	JMBACK3	OSLJCP3
Production Management	OSLMJ	OSLPDP3
Production Control	PCBACK3	OSLPCP3
Advanced Cust. Scheduling	ACBACK3	OSLACD3
Advanced Shipping	ACBACK3	OSLASD3
Service Management	S2BACK3	OSLS2P3
Workshop Management	WOBACK3	OSLWOP3

The subsystems support transaction activity specific to each application module. They can be started either manually, as part of a system startup program or through the Application Manager interface. The latter is the most common and is detailed in Chapter 6, “Operations” on page 143.

12.3.1.1 Memory requirements

Each subsystem is configured to use the *BASE storage pool as a default. You can amend this to reflect an alternative pool or pools (shared or private).

Note

You may want to save an amended subsystem description in a library other than the shipped library. This will prevent the description from being overwritten if a new version of the product is installed.

12.3.1.2 Subsystem attributes

The following attributes may be defined for a System 21 subsystem:

- Operational attributes (maximum jobs in subsystem)
- Autostart job entries
- Job description for autostart job
- Job queue entries
- Routing entries

In addition, a class of service description normally exists for each subsystem. The class of service and job queue names are usually the same as the subsystem name.

Where an autostart job is required, the job description used will have the same name as the subsystem description.

12.3.1.3 Environment-specific subsystems

Individual environment configurations require separate subsystem descriptions. This is an essential prerequisite and may lead to data corruption if they are configured incorrectly.

Chapter 11, “Customization” on page 389, details the process of creating an additional environment that includes the creation of subsystems. Please refer to this chapter for a structured approach on environment-specific subsystem creation.

The starting and ending of environment specific subsystems are normally ended by the Application Manager interface. From a performance perspective, subsystems that are not required should be rendered inactive. This reduces the number of jobs the OS/400 is required to support.

12.3.2 System 21 submitted batch jobs

System 21 jobs that are continually active are supported in application-specific subsystems. All other System 21 batch jobs are submitted to the QBATCH subsystem as a default. This is a generic approach that will work for any AS/400 system that is using QCTL as the controlling subsystem description. It relies on the assumption that the QBATCH subsystem is available as part of normal daily processing.

Certain organizations revise the job queue entries within QBATCH to support additional batch streams. This approach is both acceptable and encouraged. However, take care to preserve the amended subsystem description because it may be overwritten as part of an operating system upgrade.

12.3.2.1 System 21 task maintenance

To take advantage of additional AS/400 job queues, you need to update System 21 task definitions. To do this, enter the following command:

```
STRIPGAM
```

Type option `3` (Maintain Tasks), and press Enter. Enter the application code, environment code, and release level for the task or tasks you want to maintain. If task “drop through” is being used, leave the environment code as blank (empty).

Figure 249 illustrates some of the task definitions for the Order Entry (OE) application in the blank environment at release level 03.

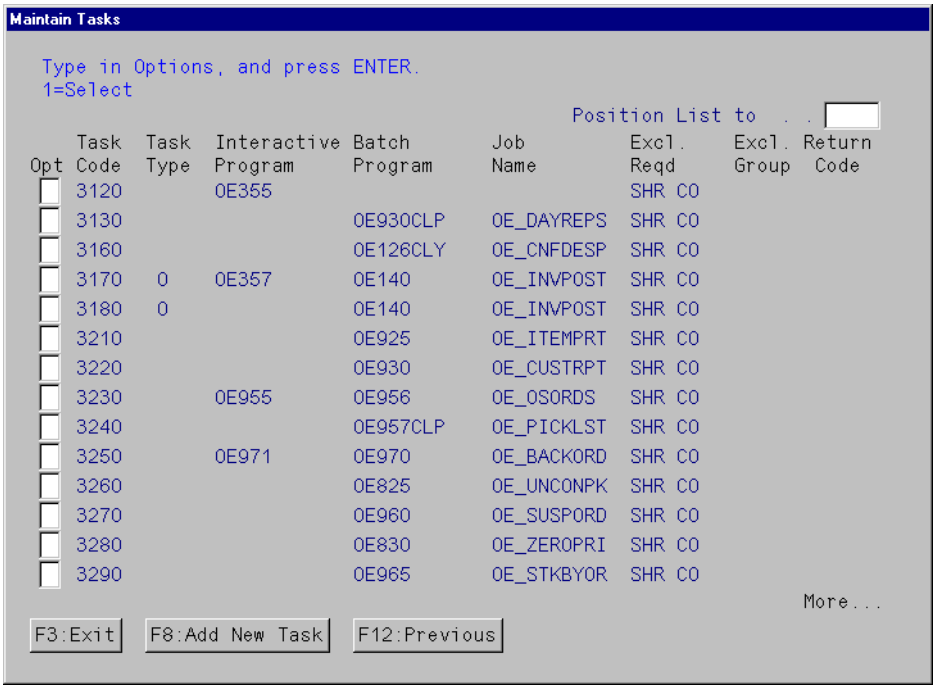

Figure 249. System 21 task definitions for the Order Entry application module

Tasks that have a Batch Program and a Job Name are normally batch tasks.

To revise a task definition, enter `1` in the input field adjacent to the task, and press Enter. This will display the base task definition details. Press F10 (Extras) to reveal all of the task details.

The task job queue and library can be overridden at this point. Figure 250 on page 464 illustrates the Picking List Reports task, which has been overridden to the job queue PICKNOTE in library QGPL.

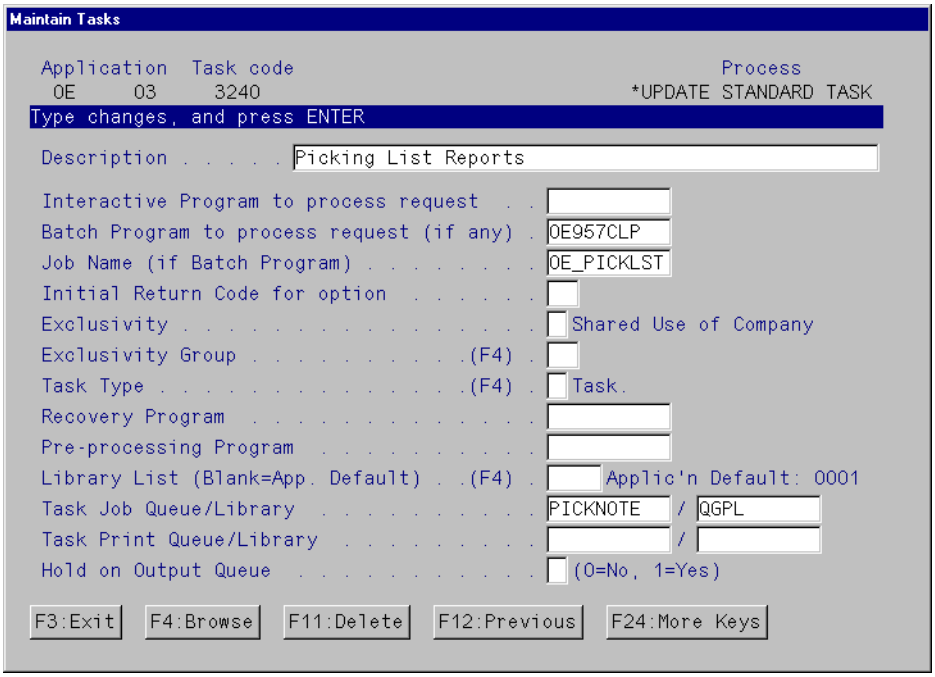

Figure 250. Overriding the job queue parameter on a System 21 task definition

Press Enter to update the task definition.

Note

You must create a job queue before you can be specify it on a System 21 task definition.

Important

Tasks maintained in the base environment may apply to all users in all environments. This may not be an acceptable approach.

Environment-specific task overrides are achieved by copying the task into each required environment and then amending the details.

12.3.2.2 System 21 user-level job queue overrides

Amendments to tasks in the base environment could have implications for all System 21 users in a single implementation. While this can be addressed in a multiple environment scenario, it is a severe limitation in a single environment implementation.

User-level job queue and output queue overrides are available to provide an additional level of flexibility in both single and multiple environment implementations. Overrides are applied for a single user, or a user group, at company level for one or more tasks in an application. This applies to tasks defined in the base environment or any additional environments.

You can gain access to user level overrides through System 21 user profile maintenance. To access this function, enter the following command:

```
STRIPGCF
```

Type option `1` (Maintain User Profiles), and press Enter. Enter the name of the user to be updated in the User Profile to be maintained field, and press Enter. On the detail screen, press F24 (More keys). Then, the display illustrated in Figure 251 appears.

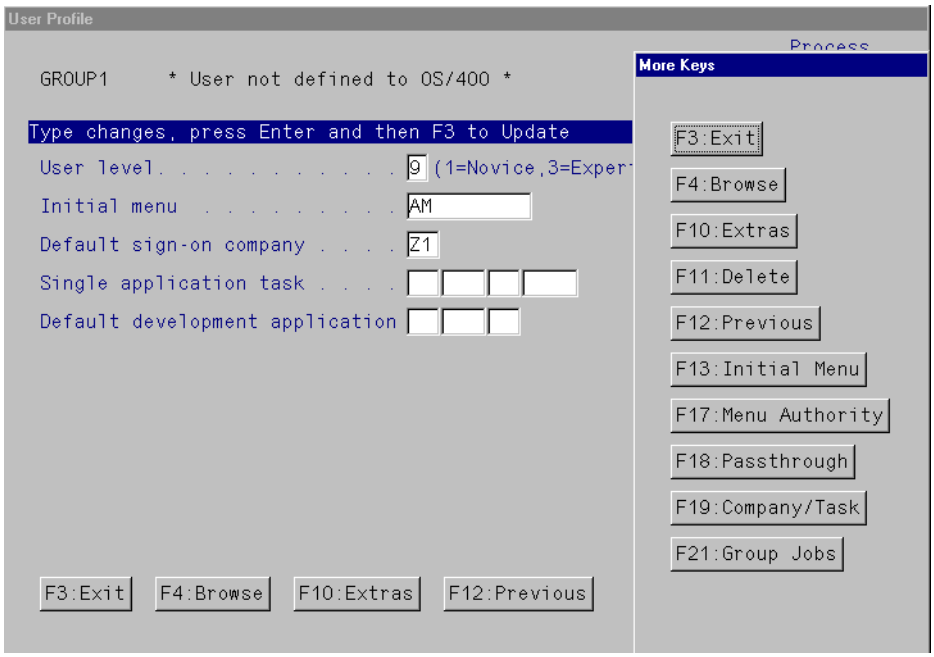

Figure 251. User profile maintenance

Press F19 (Company/Task). A list of installed applications are displayed. This includes applications installed in the base environment and all of the additional environments that have been created. Locate the application that requires user overrides, and enter a `3` in the box adjacent to it. Press Enter, and then see the Maintain User Overrides panel. Enter the Company Code to which the overrides are to be applied.

Figure 252 on page 466 shows the screen that is displayed.

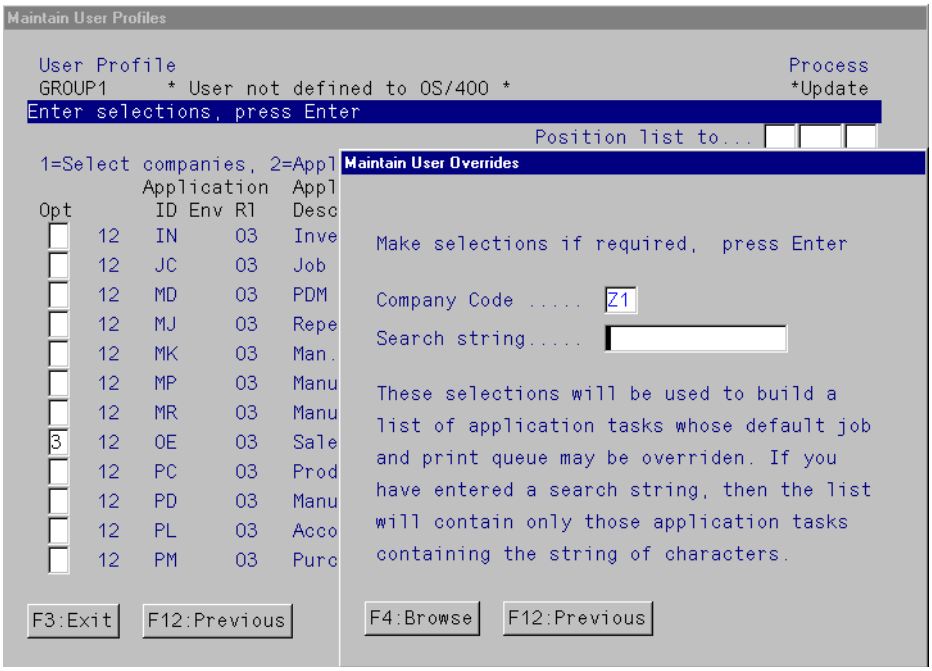

Figure 252. Selecting an application and the Maintain User Overrides display

Press Enter to confirm the Company Code. The Maintain User Overrides - Job Queues panel is displayed, on which authorized batch tasks for the selected application and company are displayed. This is shown in Figure 253.

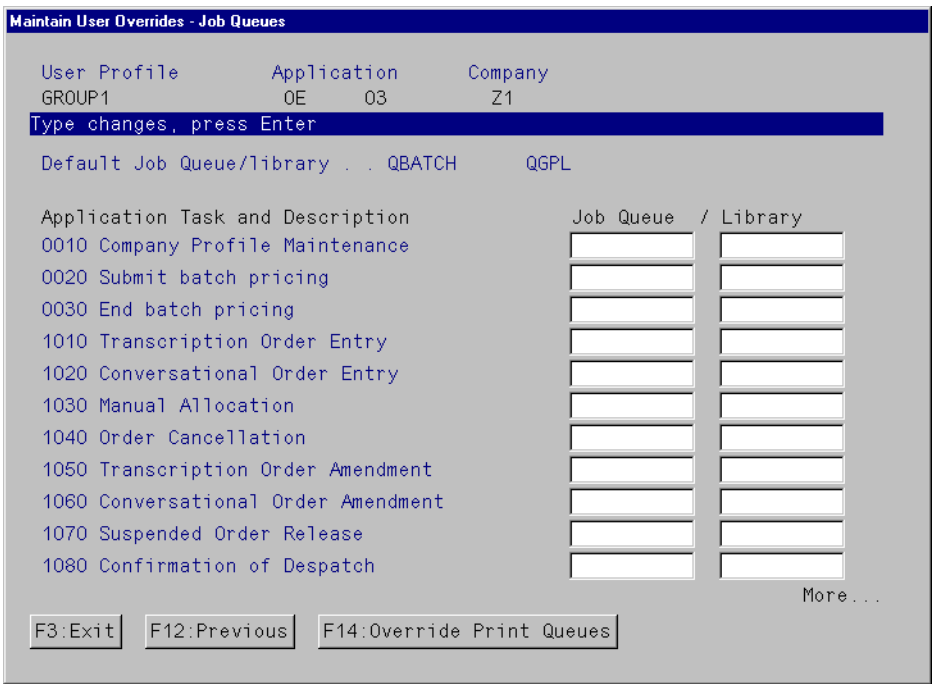

Figure 253. Maintain User Overrides - Job Queues

Job queue overrides can now be applied at the User, Application, Company, or Task level. Press F14 to access the print queue overrides for the tasks.

Using this approach, you can implement a work management strategy. However, the strategy is based on the assumption that all job queues are defined to QBATCH and that all System 21 tasks will execute at the same run priority (because they all use the same class description). This is a simplified approach and may not be suitable for large AS/400 installations.

12.3.3 Work management strategy

While the approach outlined in 12.3.1, “System 21 subsystems” on page 460, and 12.3.2, “System 21 submitted batch jobs” on page 462, provides a work management framework, it is generally too simplistic. Organizations want the ability to more closely control their job submission and execution parameters. They want to ensure that they achieved the required workload throughput. A clearly defined (and documented) work management strategy is needed to achieve the desired objectives.

12.3.3.1 Workload definition

Workload definition is the initial phase of any work management strategy. It is essential that the “key” business workloads are understood so that they can be configured in the workload hierarchy.

Workloads were traditionally split into interactive and batch components. However, a client/server component has since been introduced. This has become increasingly significant as a result of the AS/400 system becoming a database file server.

Each workload must be divided into key elements, with priorities assigned. Once priorities are assigned, they must agree with the business areas. Users must understand the strategy and how it relates to their business functions. Once the strategy has been accepted, it will form the basis of the work management framework.

The example in Table 72 illustrates key interactive business functions with an assigned execution priority.

Table 72. Interactive business functions with associated priority

Business function	Business priority
Telesales order processing	High
Pick processing	High
Dispatch processing	High
Purchase order receiving	Medium
Credit management	Medium
Ledger posting	Low

In this example, the receiving and dispatching of orders is considered the highest priority. Receiving stock and processing credit exceptions are considered to be medium priority, and ledger posting is the lowest priority.

In an interactive environment, business functions generally run at the same run priority. However, business functions that affect customer service may assume a

higher priority than those that do not. Using this approach in a large order-taking environment can result in response time degradation for other interactive users.

The same approach must be applied to batch business functions. Table 73 illustrates batch business functions with an assigned priority.

Table 73. Batch business functions with associated priority

Business function	Business priority
EDI order receipt	High
Print pick notes	High
Batch allocation	High
Invoice printing	Medium
New purchase orders audit report	Medium
Aged debtors report	Low

In some industry sectors, the execution of batch tasks may take precedence over interactive tasks. The receipt of EDI orders into Sales Order Processing is normally a good example.

12.3.3.2 Allocation of run priorities

After you assign priorities to all of the key business functions, your next step is to allocate run priorities. This determines the sequence in which the AS/400 system allocates resources to the work requests.

Run priorities for interactive processes will not vary dramatically. A standard interactive priority of 20 is assumed, unless there is a specific business requirement to be addressed.

Run priorities for batch tasks are more critical and also more difficult to allocate. The easiest way to address the requirement is with a run priority matrix. Table 74 shows an example of a run priority matrix. A priority range of 5 is used in this example, starting from run priority 25.

Table 74. Run priority matrix example

Run priority range	System 21 batch process
Priority Range 1 (25 - 29)	EDI order receive, batch allocation, pick note print, invoice print, confirm dispatch
Priority Range 2 (30 - 34)	Stock Monitor, Reservations Monitor, Transaction Manager
Priority Range 3 (35 - 39)	Print Purchase Orders,
Priority Range 4 (40 - 44)	GL Update, PL Update, SL Update, CS Update,
Priority Range 5 (45 - 49)	Session Audit Report, Trial Balance

All of the tasks in the range can be assigned a single priority or one of five different priorities. Initially use one priority for a group of tasks in a range. This allows a scope for expansion.

12.3.3.3 Definition of job queues

Interactive tasks are normally supported by the QINTER subsystem. They use the QINTER job queue to gain entry to the subsystem.

Batch tasks require a specific job queue structure to support their prioritization. You have to decide whether to use a single job queue to support multiple batch tasks or to have a dedicated queue per application task.

A common approach is to have dedicated job queues for the high priority batch tasks and shared queues for the lower priority tasks. This ensures that high priority tasks only queue behind tasks of the same type and do not incur unexpected delays. Lower priority tasks in consolidated queues may experience delays, but this should not impact business-critical processing.

An additional option is to allow multiple jobs to be active from a job queue at the same time. When using this approach, consider the following points:

- The average batch utilization of the system
- Batch job dependencies
- Impact on total batch throughput

12.3.3.4 Definition of subsystems

Submission of System 21 batch tasks is handled by System Manager. System 21 task definition does not support the facility to specify routing data. This means that all batch tasks submitted by a user are effectively assigned the same routing information.

The implication of this approach is the inability to control the routing of System 21 tasks within a subsystem. In general, an *ANY routing entry at sequence number 9999 is used to process all System 21 batch tasks.

Implementing a prioritized batch workload structure requires the creation of multiple subsystems. Each subsystem must have a single routing entry with an associated class. The class will reflect the run priority of all of the jobs in the subsystem.

This is not an optimal solution because the AS/400 system has to support more than one active subsystem. However, it allows the implementation of a structured workload management strategy.

12.3.4 Creating subsystems

Subsystems are required to support the work management framework. The components described in the following sections are required to produce a complete subsystem configuration.

12.3.4.1 Subsystem description

A *subsystem description* is a system object that contains information defining the characteristics of an operating environment controlled by the system. The system-recognized identifier for this object type is *SBSD.

A subsystem description defines how, where, and how much work enters a subsystem, and which resources the subsystem uses to perform the work. An active subsystem takes on the simple name of the subsystem description.

To create a subsystem description, enter the following command:

```
CRTSBSD
```

Then, press F4 to prompt for values.

In the example in Figure 254, a subsystem called S21BATCH is defined.

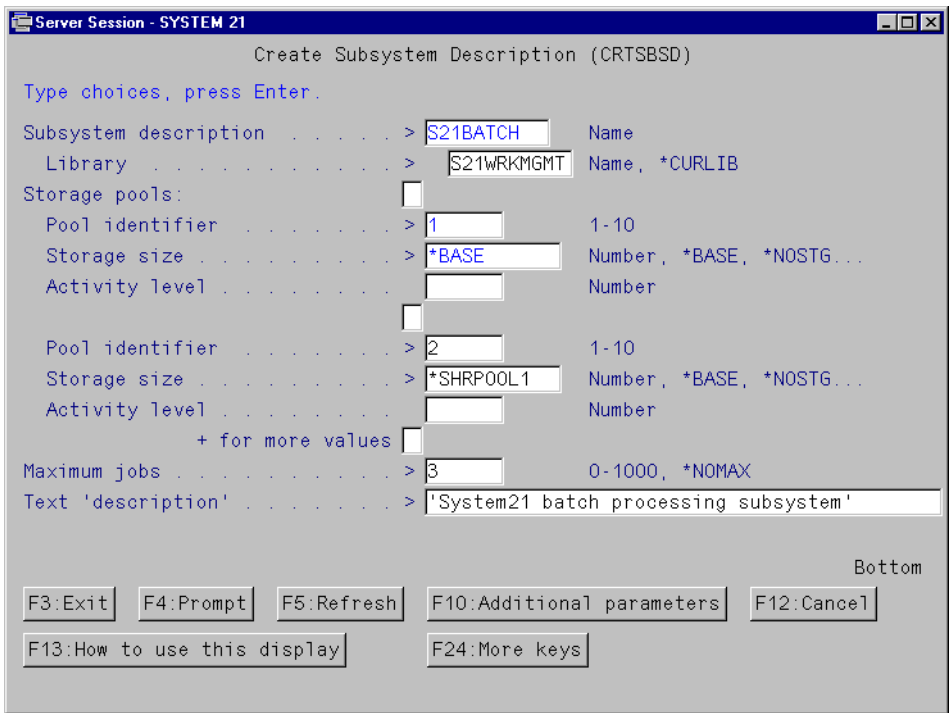

Figure 254. Create Subsystem Description display

S21BATCH has two storage pools allocated. Pool 1 is *BASE, and pool 2 is *SHRPOOL1. The subsystem will support up to three active jobs at any one time. This is the information required for a base definition.

12.3.4.2 Job queue definition

Jobs that are to be processed are submitted to a job queue. More than one subsystem description can refer to the same job queue, but only one active subsystem at a time can use the job queue as a source of batch jobs.

If a subsystem ends and jobs are still on the job queue, another subsystem referring to that job queue can be started to process the jobs. If another subsystem is already started and is waiting for the same job queue, the subsystem automatically allocates the job queue when it becomes available.

A job queue must be created before it can be defined to a subsystem. To create a job queue enter, the Create Job Queue command:

```
CRTJOBQ
```

Press F4 to prompt for values.

Figure 255 illustrates the definition of a job queue called S21PCKNTE.

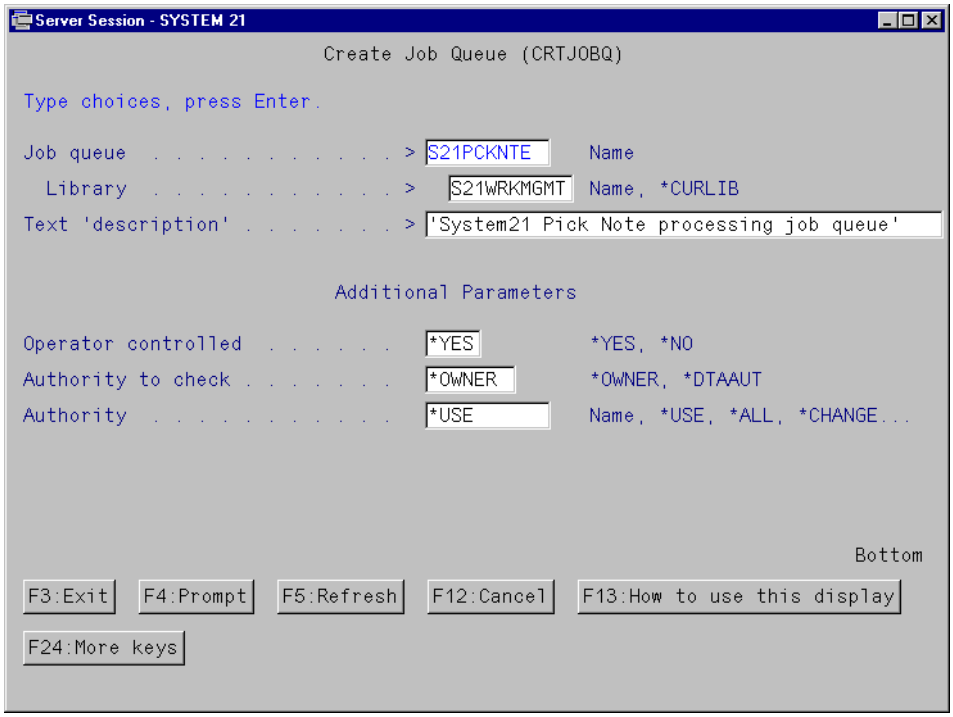

Figure 255. Create Job Queue display

The queue name is the only mandatory field. However, assigning a relevant text description may assist in future identification.

Once you create the job queue, you must assign it to the relevant subsystems. Enter the Add Job Queue Entry command to allocate the job queue to a subsystem:

```
ADDJOBQE
```

Press F4 to prompt for values.

Figure 256 on page 472 illustrates the addition of the S21PCKNTE job queue to the S21BATCH subsystem.

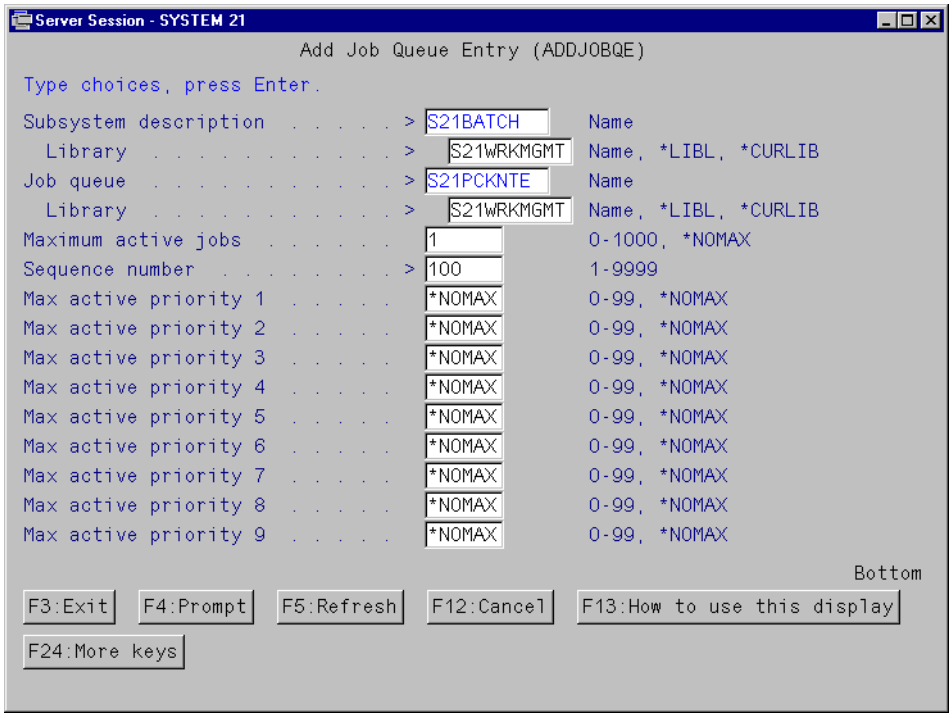

Figure 256. Add Job Queue Entry display

In this example, the job queue is assigned a sequence number of 100, and only one job is allowed to be active from the queue at a time.

Within a subsystem, each defined job queue must have a unique sequence number. Jobs from job queues with low sequence number are given priority over jobs from queues with high sequence numbers. This is particularly important when the number of active jobs in a subsystem has been restricted. It may take a considerable period of time before jobs on low priority queues (high sequence numbers) gain access to the subsystem.

12.3.4.3 Class definition

A class object contains the run attributes that control the runtime environment of a job. The key attributes of the class are run priority, time slice, and purge attribute.

A separate class can be created for each subsystem, or existing classes can be used if they have the appropriate runtime values. To display all of the available classes on the AS/400 system, enter the following command:

```
WRKCLS CLS(*ALL/*ALL)
```

Display the class description to review the runtime attributes assigned to it.

Important

If you use an existing IBM class, ensure that the definition attributes have not been revised when you install a new version of OS/400.

To create a new class, enter the following command:

```
CRTCLS
```

Press F4 to prompt for values.

Figure 257 illustrates the creation of a class called S21CLASS.

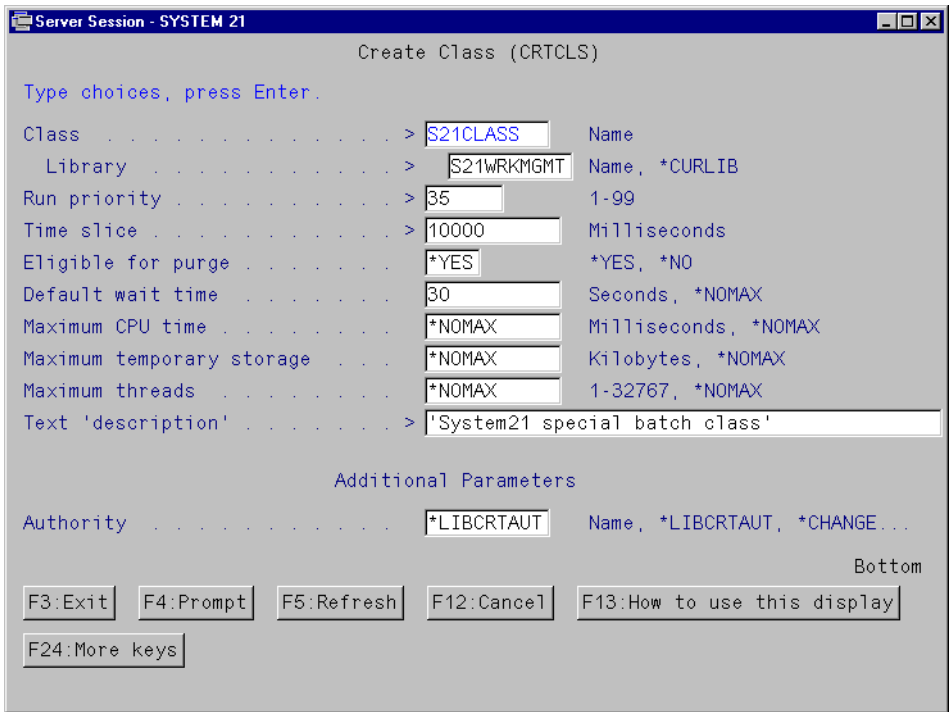

Figure 257. Create Class display

The run priority in this example is set to 35, the time slice is set to 10,000 milliseconds (10 seconds), and the purge parameter is left at the default of *YES. A description was added to explain the intended use of the class.

12.3.4.4 Routing entry definition

The routing entry identifies the main storage subsystem pool to use, the controlling program to run (typically the system-supplied program QCMD), and additional runtime information (stored in the class object).

To add a routing entry to the subsystem definition, enter the following command:

```
ADDRTGE
```

Press F4 to prompt for values.

Figure 258 on page 474 illustrates the addition of a routing entry to the S21BATCH subsystem.

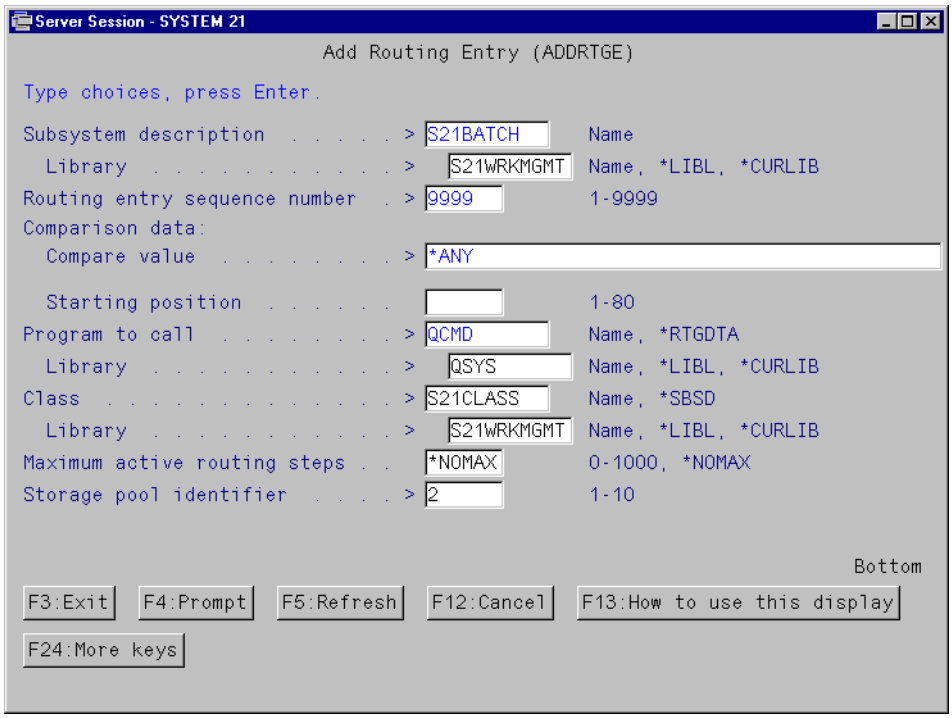

Figure 258. Add Routing Entry display

In this example, the default routing entry is configured with a sequence number of 9999. Compare data of *ANY has been specified, which applies to all routing data. Job run attributes will be obtained from S21CLASS, and the routed jobs will process in storage pool 2.

Note

Within a routing entry, the storage pool identifier relates to the pool number in the subsystem definition. In this example, pool 2 is *SHRPOOL1. The pool identifier does not relate to the one assigned on the WRKSYSSTS display or the WRKSHRPOOL display.

The selection of a routing entry for a submitted job is done on a “drop through” basis. The routing data for the submitted job is checked against each routing entry in sequence, in order to find a match. Once a match is found, the associated routing entry is used. Routing entry sequence 9999 with a compare value of *ANY is used to catch any jobs that have not been processed by routing entries with a lower sequence number. While it is not mandatory, most subsystem configurations have a default routing entry.

12.3.4.5 Job descriptions

A job description defines a specific set of job-related attributes. Multiple jobs can use the same job description. If you use a job description, you do not need to specify the same parameters repeatedly for each job. You can create job descriptions to support both batch and interactive jobs. They can be generic or unique to every job on the system.

Submitting batch tasks under the control of System Manager does not require the specification of a job description. Information is taken from the job attributes of the user submitting the request. Tasks can be overridden with specific job queues, which is explained in 12.3.2, “System 21 submitted batch jobs” on page 462.

Jobs submitted outside of System 21 require you to specify a job description. This can be one of the IBM-supplied job descriptions or one that has been user defined. To create a job description, enter the following command:

```
CRTJOBD
```

Press F4 to prompt for values.

Figure 259 illustrates the creation of the job description S21PCKJOBD, which will submit jobs to the S21PCKNTE job queue.

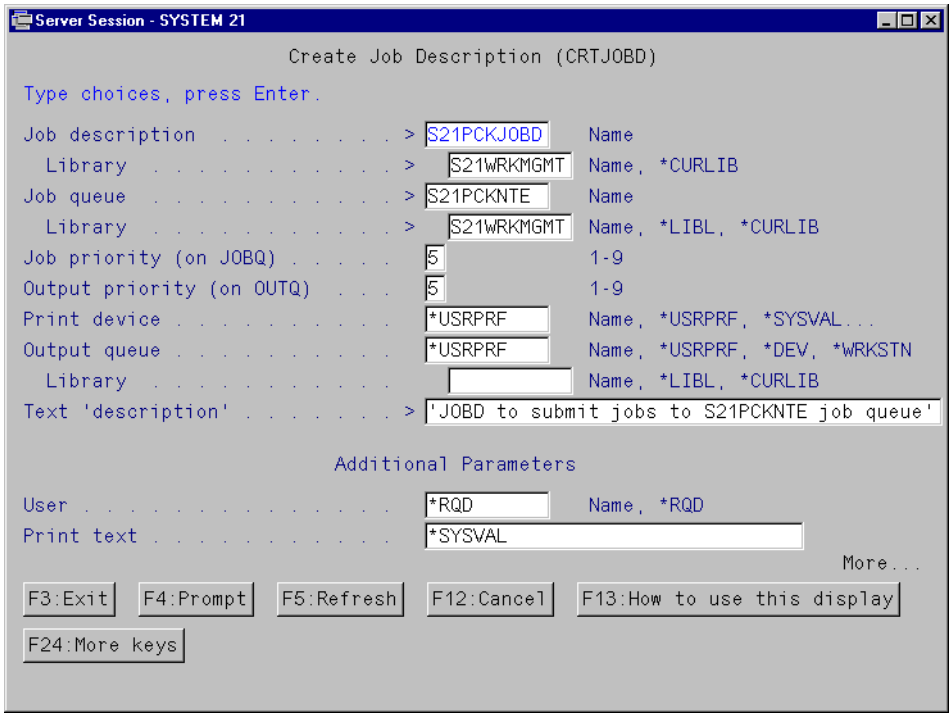

Figure 259. Create Job Description display

Other than the text description, no other parameters have been defined for this job description.

The job description can be used as part of a SBMJOB command, as illustrated in Figure 260 on page 476, or attached to a user profile as shown in Figure 261 on page 476.

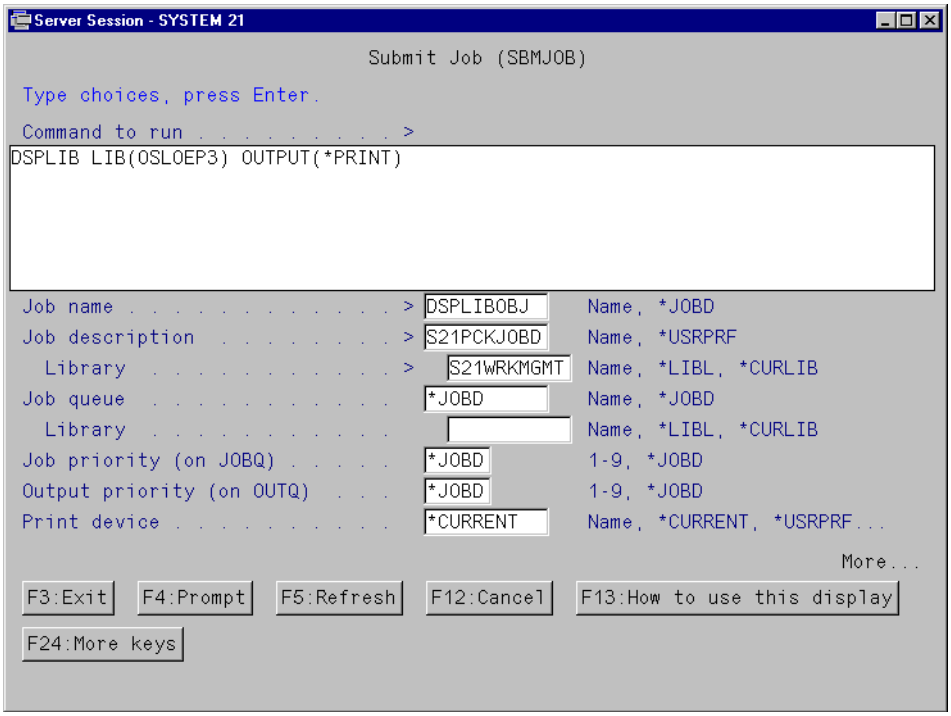

Figure 260. SBMJOB command using the S21PCKJOBD job description

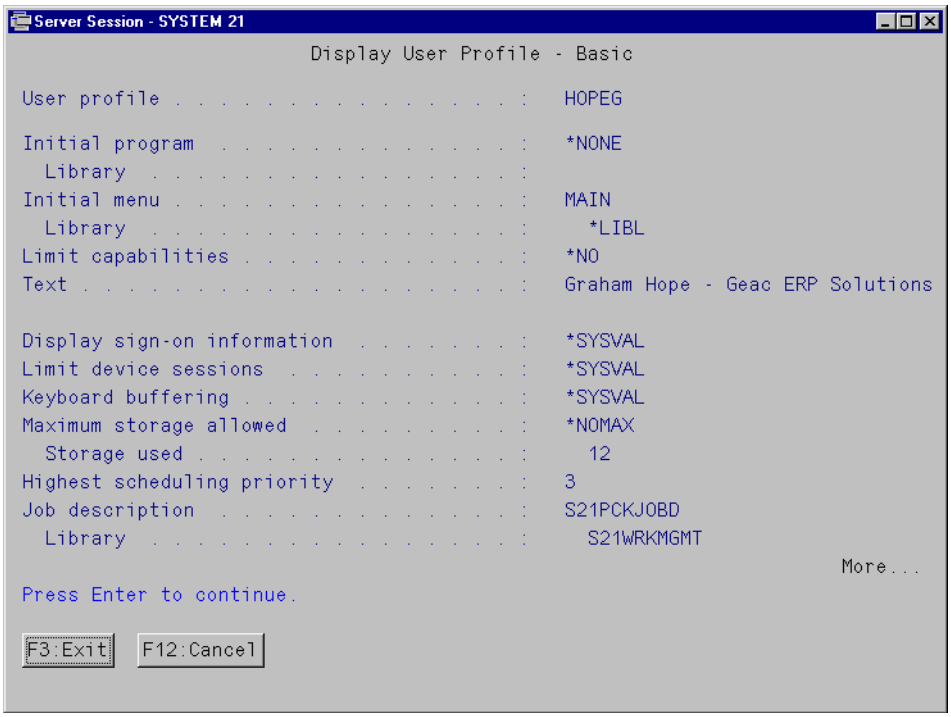

Figure 261. AS/400 user profile with S21PCKJOBD as the default job description

12.3.4.6 IBM-supplied classes

IBM supplies a number of classes to support the execution of system jobs. A full list can be found in Section C.1 of *OS/400 Work Management V4R4*, SC41-5306.

Each class has an associated run priority that you need to consider with respect to your management framework.

Some classes have a run priority that is less than or equal to the interactive priority (20). Jobs using these classes may have a considerable impact on interactive throughput. For example, jobs routed through the QSERVER subsystem use a class called QPWFSERVER, which has a run priority of 20. Jobs using this class will affect response times when they are executing. This may be particularly noticeable for jobs servicing ODBC data requests.

Jobs or tasks using a class with a run priority greater than 20 will affect batch throughput. The impact of the system-generated batch workload needs to be understood in the context of the entire batch workload strategy.

Important

You should only change run priorities for IBM-supplied classes if you fully understand the extent of the impact. Failure to do so may lead to severe system performance degradation.

12.3.5 Scheduling batch jobs

Batch job scheduling is a key component of work management. It is a means of ensuring that system resources are utilized when the system has available processing capacity. It also ensures that batch tasks can be scheduled in line with the requirements of the daily workload profile.

Scheduling of System 21 batch tasks can be achieved by using:

- System Manager Day Start and Day End processing
- IBM-supplied Job Scheduler
- Third-party job scheduling products

12.3.5.1 System Manager Day Start and Day End processing

System 21 provides an integrated job scheduling tool within the System Manager tool set. The tool is split into two distinct components referred to as Day Start and Day End processing.

A full description of the tool and its usage is provided in 6.1, “Using System 21 Machine Manager” on page 143. It includes how to schedule a batch job to execute at a particular time or as part of a batch job stream.

12.3.5.2 IBM Job Scheduler

IBM provides a job scheduling capability within the standard functionality of OS/400. The job schedule function allows for time-dependent scheduling of AS/400 batch jobs. You can schedule jobs to be released from the job queue at a particular time, or you can use a job schedule entry to submit your job to the job queue automatically at the time you specify.

To access the Job Scheduler, enter the following command, and press Enter:

```
WRKJOBSCDE
```

Figure 262 on page 478 shows the main Job Schedule Entry display.

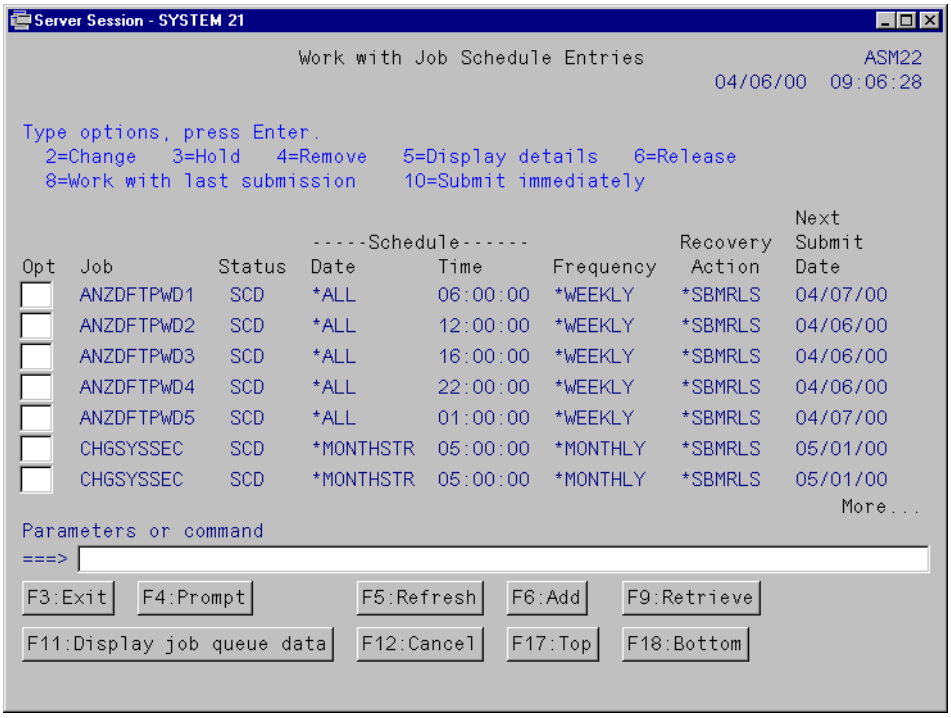

Figure 262. Work with Job Schedule Entries display

In this example, jobs are scheduled to run weekly and monthly on generic dates, but at a specific time.

You can use the IBM Job Scheduler to submit System 21 batch tasks. To configure the task submission parameters, you must use the following command:

```
EXCAMTASK
```

Figure 263 illustrates the use of EXCAMTASK to submit System 21 batch allocation.

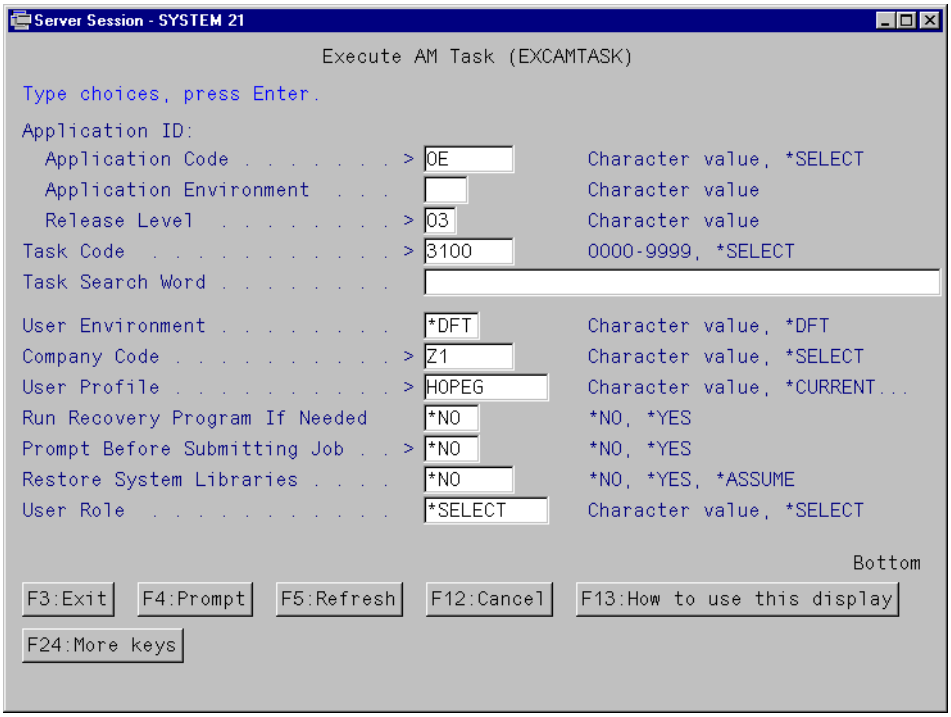

Figure 263. Execute AM Task configuration for batch allocation

Application ID and Task Code identify the task to be run. User Environment indicates the environment in which the task is to be executed. In this example, it is set as the default for the user. Company Code Z1 will be used in the default environment and the task is being requested by User Profile HOPEG.

Important

Do *not* use the Prompt Before Submitting Job parameter, within the EXCAMTASK command, for jobs submitted through Job Scheduler. This displays a screen that requires user interaction.

For batch tasks supported by a parameter entry screen, check the default submission parameters to ensure they are appropriate.

You need to incorporate the Execute AM Task (EXCAMTASK) command into the IBM Job Scheduler. On the Work with Job Schedule Entries display, press F6 to add a new entry.

Figure 264 on page 480 shows the first parameter entry display.

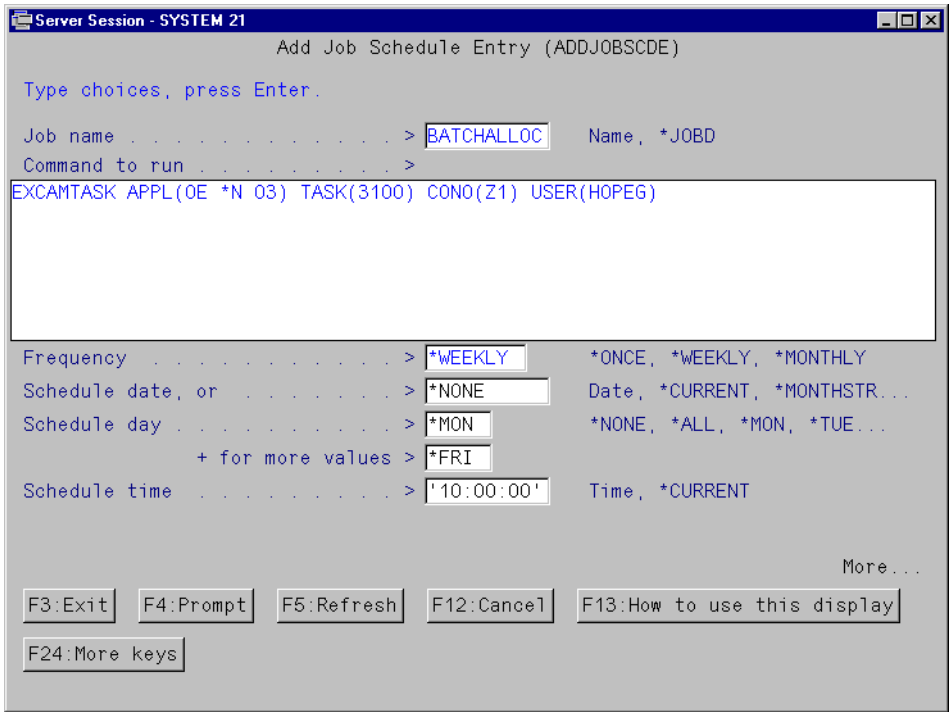

Figure 264. Add Job Schedule Entry (Part 1 of 2)

Enter the EXCAMTASK command in the Command to run field. You can prompt the EXCAMTASK command in the normal manner by pressing F4. In this example, the task has been scheduled to run weekly on Monday and Friday, at 10:00.

Press F10 (Additional Parameters), and page down to the second entry screen. Figure 265 illustrates the second panel.

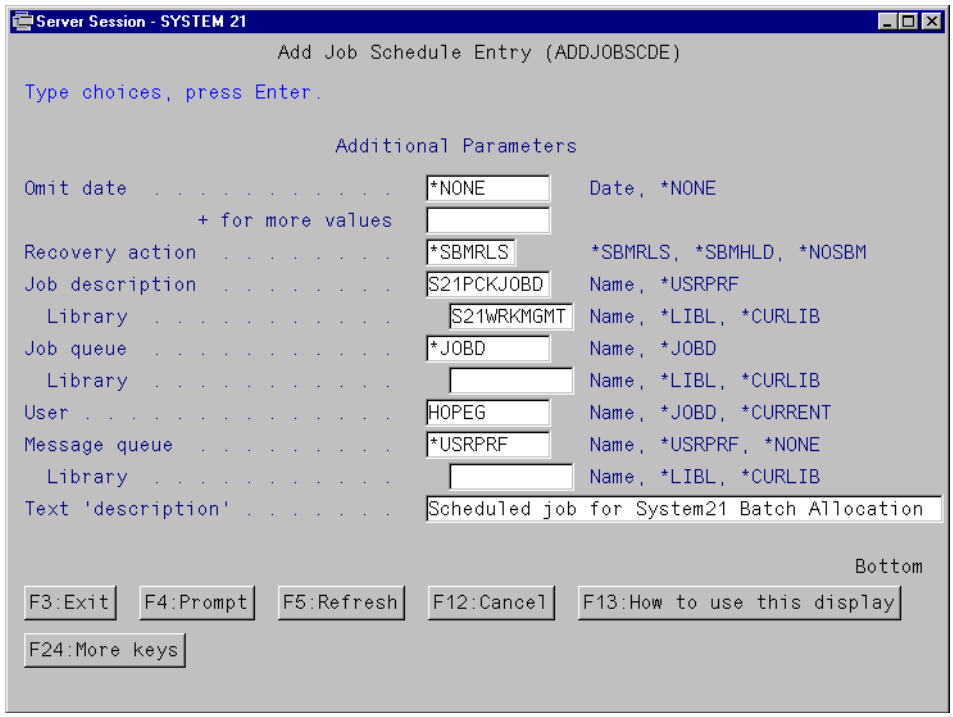

Figure 265. Add Job Schedule Entry (Part 2 of 2)

In this example, the Job description has been set to S21PCKJOBD, User has been set to HOPEG, and a description was added to Text ‘description’.

For a comprehensive review of the IBM Job Scheduler, refer to Chapter 12, “Job Scheduling”, in *OS/400 Work Management*, SC41-5306.

12.3.5.3 Third-party scheduling tools

A variety of third-party products are available for scheduling a workload on the AS/400 system. In general, they offer the same core functionality as the ones supported by System 21 and OS/400.

System 21 can co-exist with third-party scheduling tools using a similar approach to the one outlined in 12.3.5.2, “IBM Job Scheduler” on page 477. Tasks are scheduled in the same manner using the EXCAMTASK command.

The scheduling and coordination of tasks running on multiple AS/400 systems is not readily supported by either the System 21 or IBM Job Scheduler. For this scenario, using a third-party tool will provide a more viable solution.

Chapter 13. Geac Work Management

The benefits of Geac's Active Enterprise strategy are delivered through Geac Work Management. Not to be confused with AS/400 work management, Geac Work Management allows a business to actively model the process and workflow within the business.

Geac Work Management enables a business to become proactive, reacting to situations before they can disrupt the process and highlighting exceptions that can result in misuse of company personnel and company resources. Ultimately Work Management provides extraordinary potential to reduce business cycle times.

In a passive system, exceptions are only spotted when an inquiry is run or a report processed. All too often this results in a time lag between the exception that is occurring and the exception that is being handled by the relevant authority. A proactive system is designed to test for exceptions at every stage of the process. It aims to prevent problems from occurring rather than having to solve them when they occur.

A typical example of how credit checking of a customer's credit limit occurs is listed below. When the credit limit is exceeded, the following actions happen:

1. The order is placed on hold until the customer is informed.
2. The customer must then rectify the situation.
3. The order is then released manually.
4. The pick note is printed.

Where this type of system is in place for handling credit limit overruns, there is an inevitable delay between the order placing and the order being dispatched. Time has to be allowed for the supplier to inform the customer of the credit problem, for them to respond appropriately, and for the order clerk to release the suspended order.

Work Management aims to prevent this time lag and, therefore, reduce cycle time by highlighting orders by customers who are approaching their credit limit and informing them of the situation. However, because the credit limit is not exceeded, the order may still be processed.

This chapter introduces @ctive Modeler and takes you through the installation and basic configuration steps.

13.1 Components of a Work Management solution

There are three components to the Geac Work Management solution:

- @ctive Modeler
- Work Management Engine
- System 21 Explorer

This section describes these three components, which work together to deliver the @ctive Enterprise solution.

13.1.1 @ctive Modeler

@ctive Modeler is a powerful, yet simple-to-use, graphical process mapping product. It is designed and developed to enable business users to model the organizational elements, key processes, and systems within their enterprises. @ctive Modeler is a PC-based Geac product.

By modelling their business, a company can understand how their business works, the way the company is structured, identify key relationships, and highlight flaws in the processes.

Using the @ctive Modeler, business, software and execution models can be produced and deployed. It provides a clear and concise method to define what a business does, how it does it, what software is used to support its processes, and how activities are carried out and by whom.

@ctive Modeler supports four distinct stages in the successful application of a software solution to achieve business performance improvement. These stages are shown in Figure 266.

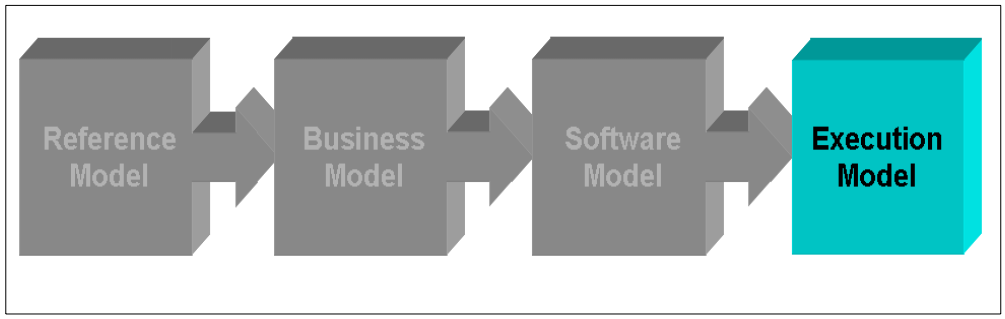

Figure 266. Stages of a performance improvement

The stages shown in Figure 266 are concerned with Execution Modelling. The Execution Model is the work management solution, designed to proactively drive the business. To review other stages, refer to the "@ctive Modeler in 24 Hours" course from Geac.

13.1.2 Work Management Engine

The Work Management Engine has the responsibility of moving business activities along a predetermined path known as Business Processes. It does not start the whole process. Events in the business are the triggering elements. These events can occur in a number of ways. One of the primary events is via System 21 Work Management-enabled activities.

The enabled activity starts the proceeding by calling an API that notifies the Work Management Engine of its status. The Engine constantly checks for events that have occurred, and if there any events, it reacts to it appropriately.

Information concerning the status of the transaction is written to a file and this status is updated as the transaction (job) passes through different activities and stages in the Business Process. This provides audit and status capability for Business Objects in the system.

The Engine handles any subsequent transactions that may be required. A completion status of one transaction can act as a trigger to process a new pending transaction if one exists. The Engine schedules new activities by putting them in a queue for Automatic Execution or adding them to an Action List in System 21 Explorer for user execution. The Engine supports parallel and serial execution of activities.

13.1.2.1 Work Management Scheduler

Transactions that need processing at particular times are posted to the Work Management Scheduler. These are established and configured in @ctive Modeler. The Work Management Scheduler checks the time stamp on an activity. If it corresponds with the current time, it places those tasks in a queue in its own subsystem.

The Work Management Scheduler may be started and stopped from the Work Management menu in Application Manager or scheduled in Machine Manager.

13.1.2.2 Work Management Escalation/Delegation Processor

Activities that are not completed by a user within a particular time range as set up through @ctive Modeler are escalated or delegated to another System 21 user. An existing activity is given a higher priority on an existing Action List or is moved automatically onto another User's Action List. This is handled by this utility.

You can start and stop the Work Management Escalation/Delegation Processor from the Work Management menu in Application Manager, or you can schedule it in Machine Manager.

13.1.3 System 21 Explorer

To the general user, Work Management is only visible through System 21 Explorer, the user interface for the Business Processes. While the user is completing a process, the Work Management Engine is tracking progress and scheduling and assigning activities, only if they are part of an activated process.

The Work Management Engine determines if an activity requires manual input and if so, to whom it should be directed. The relevant activity is then placed into the appropriate User's Action List. Depending on the Escalation and Delegation rules assigned to the process using @ctive Modeler, and how long an activity sits in the Action List without the appropriate attention, the Work Management Engine may assign the activity to another User or to another role.

System 21 Explorer provides an e-mail processing function that can transfer e-mail generated by the Work Management Engine to a mail server.

13.2 @ctive Modeler installation

The installation of @ctive Modeler is outlined in this section. The complete installation instructions are found in a Windows Help format on the CD-ROM in the wi.hlp file.

13.2.1 Preparation

To prepare for installation, read the installation instructions first.

Read the @Mreadme.html file on the CD-ROM by opening it with a Web browser. This file contains the latest information regarding changes to the product and installation instructions.

@ctive Modeler requires that you have previously installed System 21 Explorer, Active Enterprise Framework January 2000 Edition. Do not have System 21 Explorer active and running when installing the @ctive Modeler product.

@ctive Modeler requires a hard disk with at least 6 MB available for @ctive Modeler. We recommend that you do not install the product through a network installation.

Authorization Codes are required for licensing @active Modeler. These codes are not required during the installation, but are requested when the product is started the first time.

The *Work Management Product Guide* (WM.PDF file) covers a tutorial and review of the @ctive Modeler functions. We recommend that you start here to gain a good understanding of the product features.

13.2.2 Installation

Start the installation by clicking the **Setp.exe** file located in the \@MODJAN2000 directory on the CD-ROM to launch the standard Install Shield installer. Follow the installation prompts. When prompted for the installation directory, select the same directory to where the System 21 Explorer product was installed. The selection of the installation folder is shown in Figure 267.

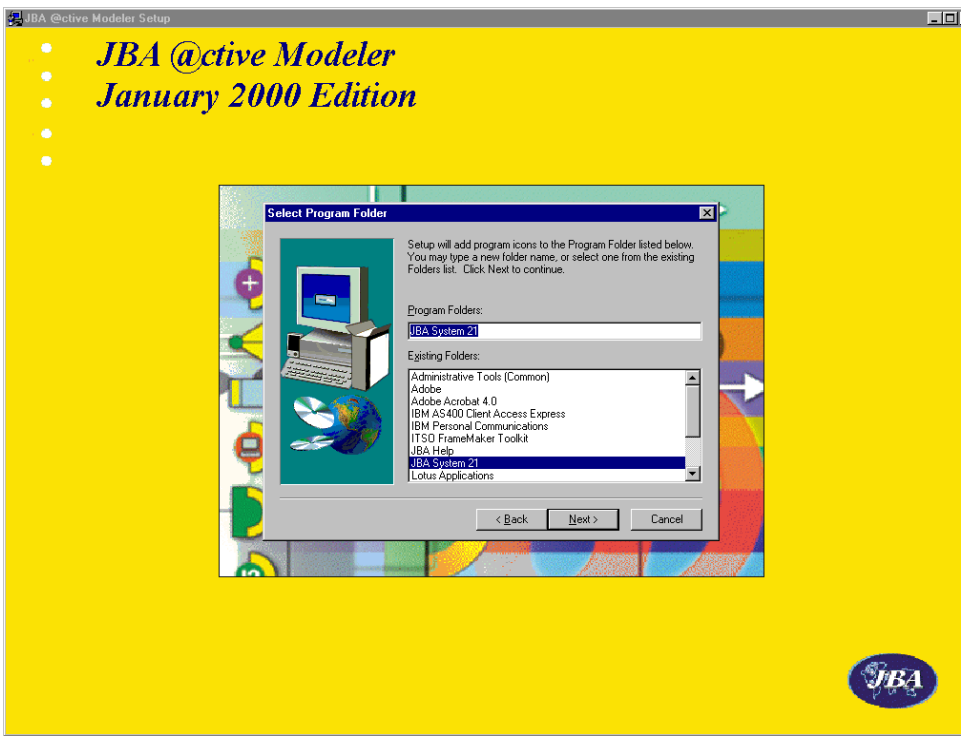

Figure 267. @ctive Modeler installation

After you complete the installation, you can start @ctive Modeler. The activation dialog appears as shown in Figure 268, where the license code is requested.

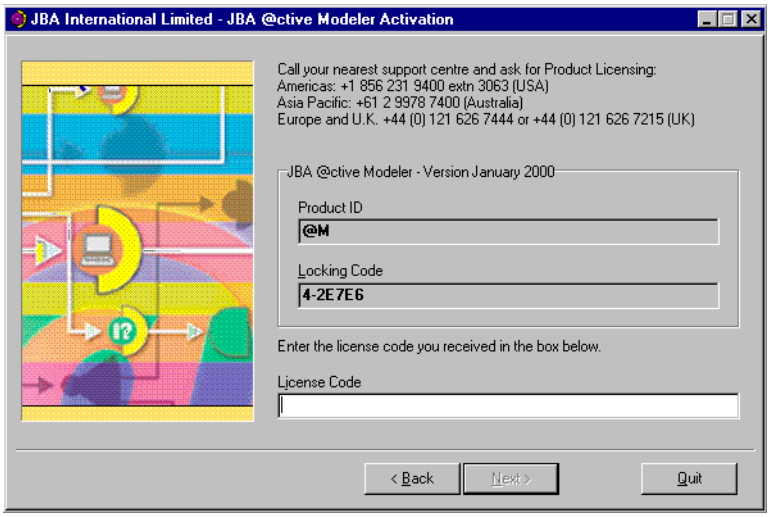

Figure 268. @ctive Modeler Activation dialog

This dialog cannot be passed until you have entered a proper code.

13.3 @ctive Modeler connection to the AS/400 system

For @ctive Modeler to access the server, a three-step process is involved. This process includes setting up a connection via Client Access ODBC and setting the server in the system configuration. This section assumes that IBM Client Access Express is the provider for the ODBC connection.

If you are not going to use @ctive Modeler for uploading and interaction with the server at this time, you may perform this step when you need to do so.

13.3.1 Client Access connection

You must create a connection to the server initially using IBM Client Access.

A connection wizard guides you through the relevant stages. The information that is required here includes the AS/400 system name and the relevant IP address, while the connection is made through a TCP/IP (Winsock) provider. You may also enter a default user ID.

13.3.2 ODBC connection

To deploy a Business Process, you must create an ODBC link to the server.

Note

While ODBC is available by default in Windows NT, it is an option that must be installed within Windows 95 or 98. ODBC is usually accessed through the Windows Control Panel.

From the Windows Control panel, ODBC Administration program, you may create a new connection. The icons in the control panel vary depending upon the version of Windows being used. Two of the typical icons are shown in Figure 269.

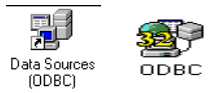

Figure 269. Windows ODBC icons

From the Data Source administrator dialog, select the **User DSN** (Data Source Name) tab, and click the **Add** button. Then select the IBM Client Access driver as shown in Figure 270.

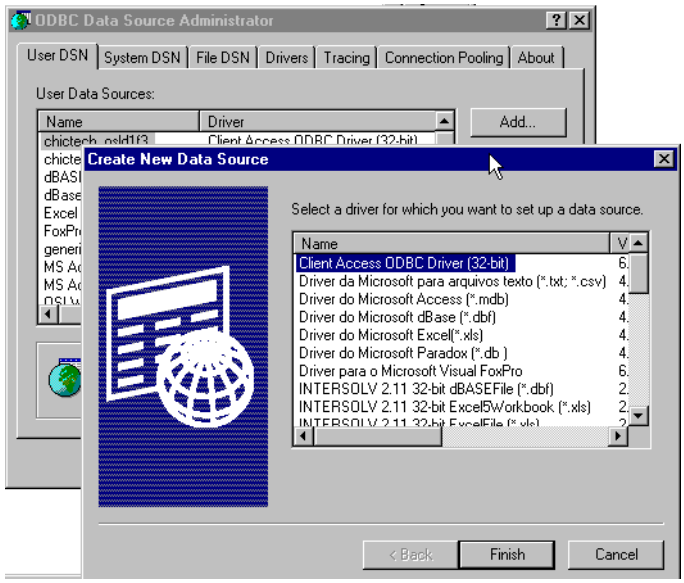

Figure 270. ODBC Data Source -select Driver

From the list of drivers, select **Client Access ODBC Driver (32-bit),** and click the **Finish** button.

At this point, the relevant server details are entered into the Data Source. You must assign a name to the data source. This is arbitrary but should indicate its function, while the optional description may be used to further clarify the Data Source's purpose. The system name must also be entered on the General tab as shown in Figure 271.

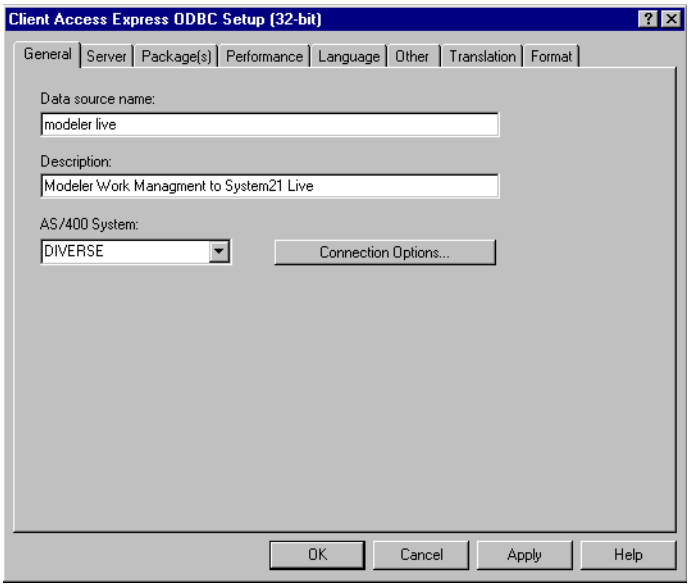

Figure 271. ODBC Setup - General tab

You should also enter the libraries that contain the Work Management elements on the Server tab. Obtain the default library from the system administrator.

The translation option on the Translation tab should be set to 65535. All other options should be left at the default values. This Data Source will be used later when, upon activation, a server must be selected. If there are multiple DSNs on the computer being used for different purposes, it is essential that the correct Data Source may be identified at the appropriate time.

13.3.3 System Configuration

@ctive Modeler must have a server set up before any business process can be activated. System Configuration allows a user to provide the relevant server information to @ctive Modeler. This is typically configured as a part of System 21 Explorer and is covered in Chapter 5, “Installation and set up” on page 87.

13.4 Starting and stopping Work Management on the server

The Work Management process is carried out by a group of jobs on the AS/400 server. These jobs need to be started and stopped as needed to perform daily functions. Typically this is done by the Machine Manager application.

There are three jobs that run in the Work Management subsystem:

- **Engine**: Evaluation and processing for the activities in the Business Processes
- **Scheduler**: Management of activities that are scheduled and awaiting a specific time
- **Processer**: Processing of the escalation and delegations occurring

13.4.1 Starting Work Management

There are two equally valid methods for users to start the Work Management Engine. Each option is presented in this section. To start the Engine, the user must be fully authorized to run any application activity that the Engine might run automatically.

13.4.1.1 Starting Work Management Engine via Application Manager

To start the Work Management Engine, enter option `1` (Start EWM) from the Work Management menu within Application Manager as shown in Figure 272.

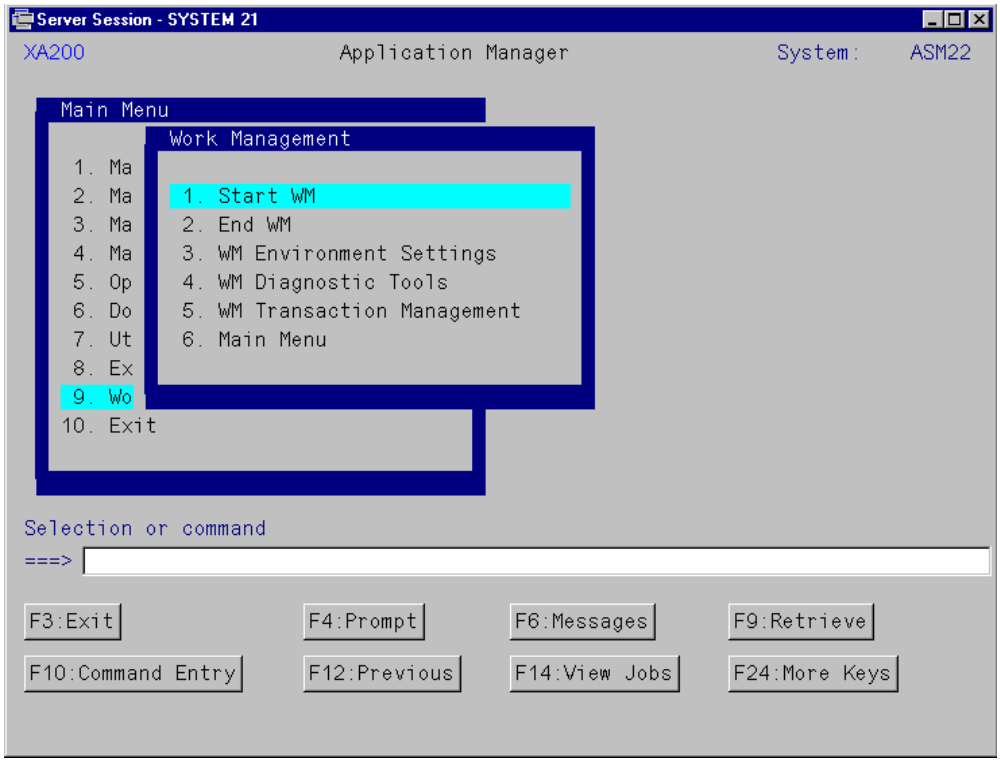

Figure 272. Starting Work Management via Application Manager

Enter the Work Management environment, and press Enter. The next panel provides options that allow variations in the start-up of the applications. The default starts the EWM Engine, EWM Scheduler, and Escalation/Delegation Processor. There is also the option to start the subsystem only as shown in Figure 273.

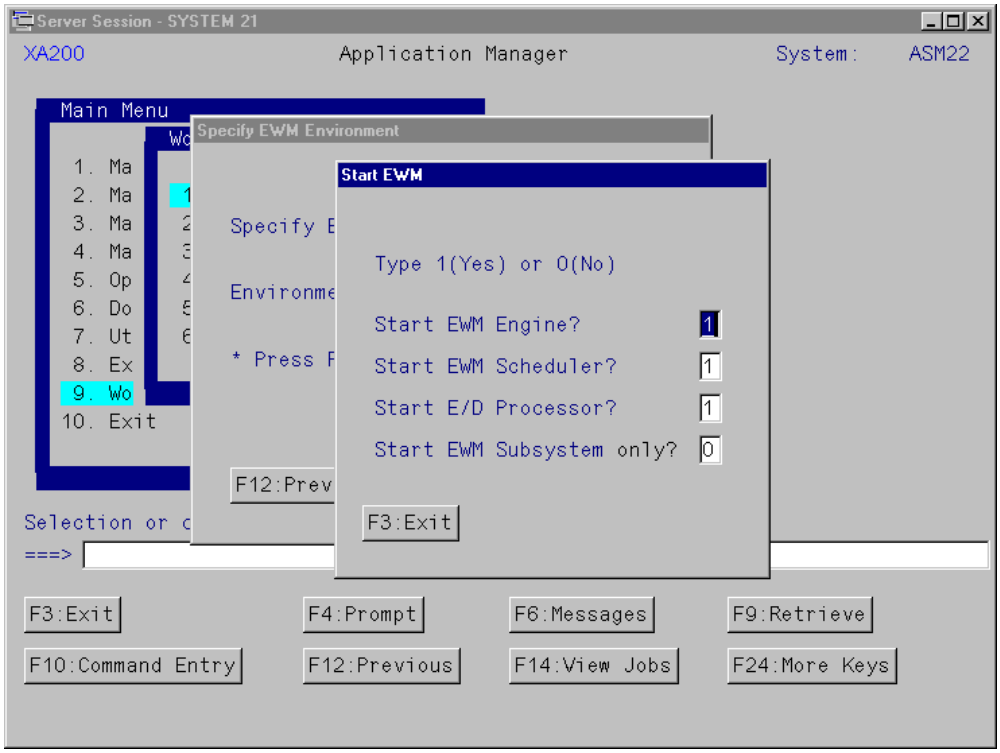

Figure 273. Start EWM choices

Press Enter to confirm the settings. A panel confirming these settings appears. Click the **Submit** button to start the requested server jobs.

When you click Submit, the subsystem WFBACK3 starts. If other options were chosen, these actions also begin. Each job will have the Work Management files library, as defined in the Environment Settings panel in Figure 273, added to the top of the system portion of the library list.

13.4.1.2 Starting Work Management Engine from a command line

The STRWM (Start Work Management) command carries out the same process as described in the previous section, but bypasses all interactive display processing. A valid environment must be passed as a parameter. The command is:

```
STRWM ENV(APS)
```

13.4.2 Ending Work Management

The Work Management server jobs can be ended as needed for daily functions. While these server jobs are not active, all Work Management requests from the software enter a queue and await processing.

13.4.2.1 Ending the Engine via System Manager

To end the Work Management Engine, type option `2` (End EWM) from the Work Management menu within Application Manager (Figure 272). Enter the environment name, and press Enter.

Type `1` next to the options to end. The default setup ends the EWM Engine, EWM Scheduler, and Escalation/Delegation Processor. There is also the option to end

the subsystem only. Any of the jobs may be bypassed and ended manually. Press Enter to confirm.

Confirm by pressing F8 (Terminate). The selected options end.

13.4.2.2 Ending Work Management Engine from a command line

The ENDWM (End Work Management) command carries out the same process as described in the previous section, but bypasses all interactive display processing. A valid environment must be passed as a parameter. The command is:

```
ENDWM ENV(APS)
```

13.5 Explorer impact

To the end user, Work Management is only visible through System 21 Explorer, the user interface for the Business Processes. While the user is completing a process, the Work Management Engine is tracking progress and scheduling and assigning activities, only if they are part of an activated process.

The Work Management Engine determines if an activity requires user input and if so, to whom it should be directed. The relevant activity is then placed into the appropriate User's Action List. Depending on the Escalation and Delegation rules assigned to the process using @ctive Modeler, and how long an activity sits in the Action List without the appropriate attention, the Work Management Engine may assign the activity to another user or to another role.

13.6 Document Viewer

Document Viewer enables you to maintain a database of documents that can then be accessed in a variety of ways. The Document Viewer database is a list of references to documents and does not hold the documents themselves. The actual documents may be held anywhere on your system.

Note

Although Document Viewer is classified as part of Sytem21 Explorer, it is also used within @ctive Modeler and can be used as a stand-alone facility or integrated into third-party links through an ActiveX interface.

The documents you can view may be:

- PC files of any type, including .EXE files. You need an appropriate viewing program on your machine. For example, if the document is a bitmap, you might want Microsoft Paint to be the viewing program.
- Web URL files. For this, you need a Web browser, such as Internet Explorer installed on your machine. Document Viewer will not work at all without this.

You can access Document Viewer by:

- Clicking the Document Viewer button on the System 21 Explorer.
- Selecting the Document Viewer option from the Tools Menu on the System 21 Explorer Main menu bar.

- Selecting the Documentation option from the pop-up menu when you right-click an activity in the System 21 Explorer Role Activity Area. In the same way, you can also right-click an Activity or Business Process in Constructor. For more information, refer to the Help in @ctive Modeler itself.

Note

If these options are disabled, contact your system administrator. Your system administrator can reset them using System Configuration.

Chapter 14. National language support

The implementation of ERP systems is no longer limited by geographical boundaries. Today a system located in Europe may be required to support implementations from the Americas to Asia Pacific. Businesses are expected to compete in a global market place that requires an extensive application toolset.

The AS/400 system has provided national language support (NLS) for a substantial period of time and has continued to enhance the supported languages. More latterly, the introduction of AS/400 Logical Partitioning has enabled the AS/400 system to readily address multi-lingual and time zone constraints.

This chapter aims to provide introductory information on the national language support topics you need to understand when implementing Geac System 21 on the AS/400 system.

14.1 AS/400 national language support overview

This section gives you an overview of the AS/400 system implementation of national language support.

14.1.1 Primary and secondary national language version

Each AS/400 system has one primary national language version (NLV). The primary national language version consists of the program code and textual data for each licensed program. The textual data (also referred to as machine readable information (MRI)) has been customized by IBM to meet the requirements of the language feature. Translation of a language may be full, partial, or none. Cultural system values are initialized for the primary language.

Each AS/400 system has a *primary language*. This is the first language installed on the system and is the language that is used for servicing purposes. For example, the system history log contains entries in the primary language.

Appendix E, “National language versions on AS/400 systems” on page 577, shows the available national language versions. If a national language version is not available for a specific language, one of the available national language versions must be used. In this case, customers have to set the culturally correct system values themselves.

Languages other than the primary language are, by definition, secondary languages. Installing a secondary language requires the MRI in the appropriate language. Software ordered from IBM as a secondary language cannot be used as a primary language. The program code is not contained within it. Secondary language support for a Licensed Program Product (LPP) consists only of textual data. The distribution media contains textual data for all licensed programs.

When installing a secondary language, new containers for the textual data are created as shown in Figure 274 on page 496.

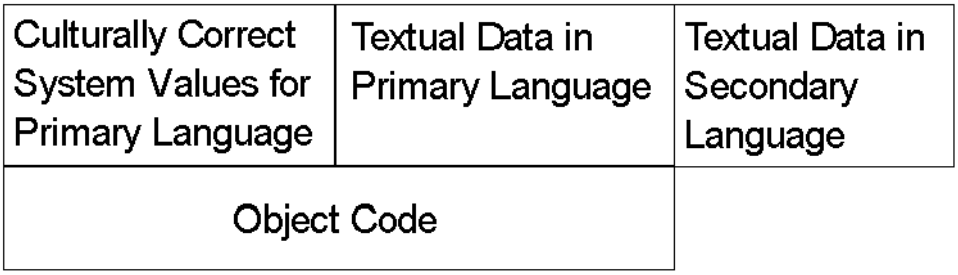

Figure 274. OS/400 secondary language NLV

For library objects, libraries are named QSYS29XX, where XX represents the last two digits of the secondary language feature code. See Appendix E, “National language versions on AS/400 systems” on page 577, for more information on language feature codes. For objects in directories, sub-directories named MRI29XX are created.

Note

Only the textual data for the licensed programs currently installed on the system is copied from the distribution media.

If new licensed programs are added after the initial installation of a secondary language, the secondary language must be re-installed to load the secondary language part for the new licensed programs.

Secondary languages require approximately 300 MB to 500 MB of disk space.

The AS/400 system can support the installation of multiple secondary languages on a single system. The ability to install secondary languages on an AS/400 system depends on the available disk space and:

- A specific secondary language from the regional software distribution center
- Available hardware (displays, keyboards, printers) for specific secondary languages

14.1.2 Language-sensitive settings

National language support may sometimes be viewed as the task of simply translating the textual data part of a product into other national languages. However, to achieve full national language support, facilities should be provided for the end user to obtain results that are culturally acceptable. The AS/400 system provides these facilities through cultural system values and job attributes.

14.1.2.1 Cultural system values

The AS/400 system provides default settings for the cultural information through system values. Table 75 shows the system values used to provide cultural defaults.

Table 75. AS/400 cultural system values

System value	Description
QCCSID	Coded character set identifier
QCHRID	Character set/code page
QCNTRYID	Country identifier
QCURSYM	Currency symbol
QDATFMT	Date format
QDATSEP	Date separator
QDECFMT	Decimal format
QKBDTYPE	Character set/code page for keyboard
QLANGID	Language identifier
QLEAPADJ	Leap year adjustment
QSRTSEQ	Sort sequence
QTIMSEP	Time separator

To access the system values, use the Display System Value (`DSPSYSVAL`) command to display a system value and the Work with System Value (`WRKSYSVAL`) command to display or change system values.

Important

Do not change the cultural system values on your AS/400 system, unless you are fully aware of the consequences. By changing some system values (especially QCCSID and QLANGID), you may impact your data.

14.1.2.2 Cultural job attribute values

Job attributes are assigned to a job when you sign on and the job initiates.

Job attributes can be set from the user profile associated with the job. The user profile often references the default system values. The user profile may specify its own attributes for the cultural values. This enables users with different requirements to operate on the same AS/400 system. Table 76 identifies the cultural job attribute values, some of which are referenced from the user profile.

Table 76. Cultural job attributes

Job attributes	Description
CCSID	Coded character set identifier
DFTCCSID	Default coded character set identifier
CNTRYID	Country ID
DATFMT	Date format
DATSEP	Date separator
LANGID	Language ID

Job attributes	Description
SRTSEQ	Sort sequence
TIMSEP	Time separator

Once initialized, the job attributes for that job can be changed.

The default CCSID cannot be changed directly because this value is set through a dependency of CCSID and LANGID, which is explained in 14.1.4.2, “The default CCSID” on page 500.

14.1.3 NLV setting for cultural values

Message ID CPX8416 in the QCPFMSG message file is used during the installation to set cultural system values for the primary language. For the primary language, message file QCPFMSG is located in library QSYS. The message description can be displayed by entering the following command:

```
DSPMSGD CPX8416
```

An example of the output is shown in Figure 275.

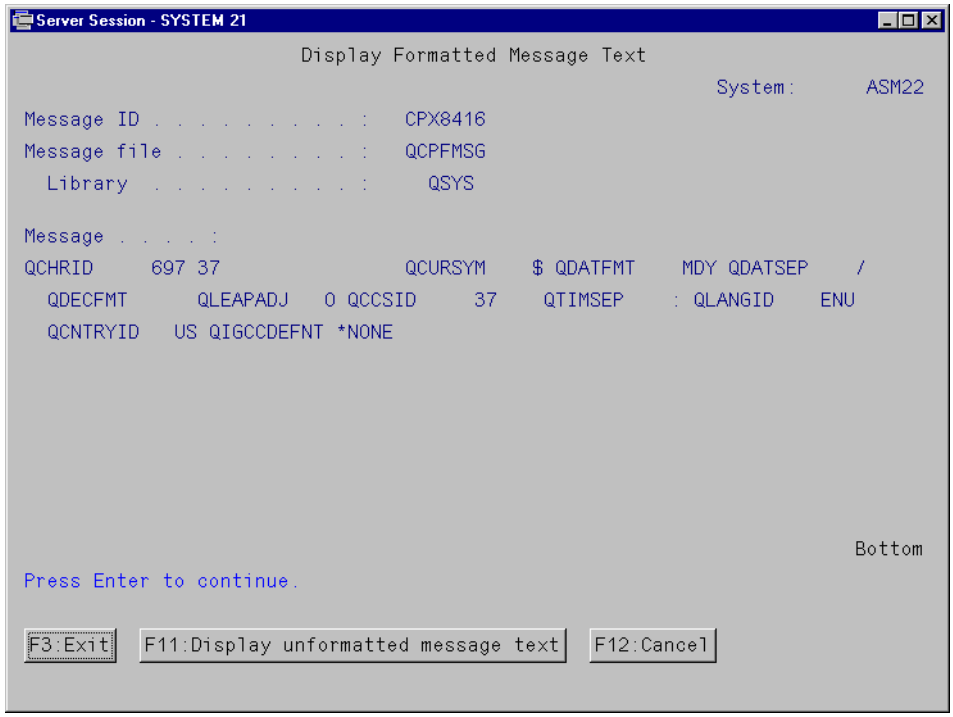

Figure 275. Primary language message description for US English

The output from CPX8416 is from the U.S. English national language version. It is explained in Table 77.

Table 77. Cultural system values for US English

Identifier	Value	Description
QCHRID	697 37	Character set/code
QCURSYM	$	Currency symbol

Identifier	Value	Description
QDATFMT	MDY	Date format
QDATSEP	/	Date separator
QDECFMT	(blank)	Decimal format
QLEAPADJ	0	Leap year adjustment
QCCSID	37	Preferred NLV CCSID
QTIMSEP	:	Time separator
QLANGID	ENU	Language ID
QCNTRYID	U.S.	Country ID

For a secondary language, the CPFMSG message file is located in the QSYS29XX library. The message description can be displayed by entering the following command:

```
DSPMSGD CPX8416 MSGF(QSYS29XX/QCPFMSG)
```

If there are different language users on a single system, it is possible to use message CPX8416 to set the cultural job values during signon for a user. An initial program specified in the user profile can add QSYS29XX to the system library list in front of QSYS, retrieve the values from message ID CPX8416, and use the CHGJOB command to revise the cultural values.

Changes made to the cultural system values do not change the contents of message CPX8416 in the QCPFMSG message file in QSYS. In addition, changes made to CPX8416 do not influence system values. For customers not using their intended national language version, or languages not having a national language version, the system values and content of CPX8416 should be kept synchronized except for system value QCCSID. You may not want to change system value QCCSID until you are sure that there is no impact to your data.

Licensed programs use messages to define their values for cultural processing in the same manner as CPX8416.

14.1.4 Multi-lingual and multi-system database support

With an integrated database, the AS/400 system is an excellent database server. It can support both single language, multilingual, and multi-platform environments. To perform the data conversions requested by applications and clients, the system needs to understand the content of the database files.

Just as the fields are described with column heading and text, the file description contains information about the actual encoding of the database records. This information is the coded character set identifier (CCSID).

14.1.4.1 The importance of CCSID

Whenever a new, externally described database file is created, the AS/400 system stores information about the encoding (the CCSID) in the file description. Generally, all character fields in one database file have the same CCSID although the AS/400 system allows the CCSID to be as granular as the field or column level.

All AS/400 systems are shipped with system value QCCSID 65535, which means no conversion. Selecting this value ensures release compatibility. It also minimizes impact on customer data if the value was set to the recommended setting for the national language version. Refer to Chapter 10 in the redbook *Speak the Right Language with Your AS/400 System*, SG24-2154, for more information.

Using a CCSID of 65535 may introduce problems when character data processing is performed and different code pages are involved. For example, Distributed Relational Database Architecture (DRDA) and Client Access Express use CCSIDs to determine how to represent character data to the client system. If the CCSID is 65535, no conversion is performed.

At V3R1, IBM introduced a job attribute called the default CCSID to address certain job-level data conversion issues.

14.1.4.2 The default CCSID

When a job is started on the AS/400 system, the job attributes are initialized. In this section, we discuss the issues relating to CCSID. Refer to Figure 276 for illustration purposes. For detailed information on all job attributes, see *Work Management Guide*, SC41-5306.

The job attributes for the language ID and CCSID are taken from the user profile associated with the job initiation. The user profile can define specific values or refer to the system values.

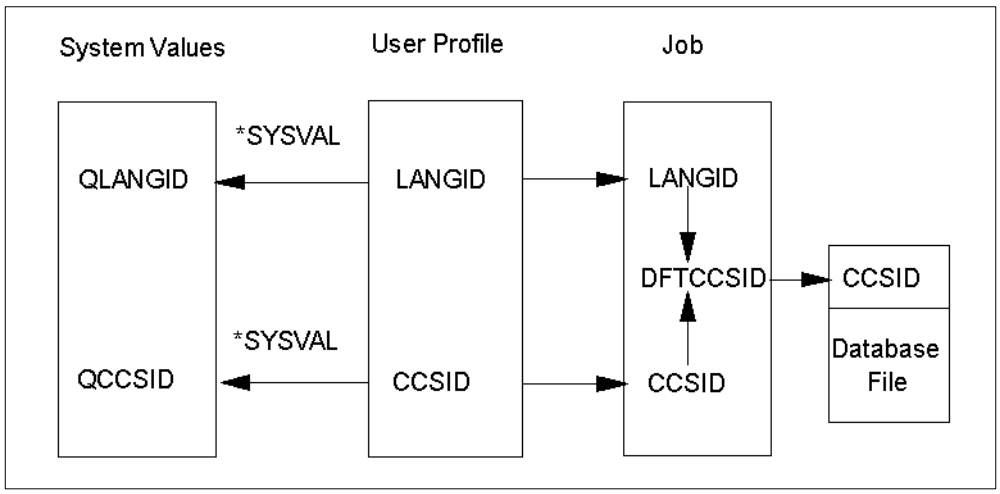

Figure 276. Cultural attributes assigned at job initialization

The default job level CCSID is determined as follows:

- If the job CCSID is 65535, the DFTCCSID is the CCSID corresponding to the language ID of the job.
- If the job CCSID is not 65535, the DFTCCSID is the same as the job CCSID.

Since the create default for all user profiles is to use the system values, customers using a primary language without defining the correct QLANGID, may find that their database files are not tagged correctly.

For example, a customer in Israel uses English uppercase and lowercase (feature code 2924) as their primary language, but the keyboard used is Hebrew. Looking at the Table 98 on page 577, the language ID (LANGID) for feature 2924 is ENU, and the associated CCSID is 37. Since the system value QCCSID is 65535, the default CCSID (DFTCCSID) on this Israeli system is 37.

Any new externally described file (including source files) that is not explicitly defined with a CCSID will be created with the default CCSID.

For the Israeli customer, this means that the files carry the CCSID tag of 37. However, the language ID for Hebrew is HEB, and the associated CCSID is 424. This would be the correct CCSID tag for database files created with Hebrew keyboards.

If the data is accessed only by interactive applications on the AS/400 system, it will appear correctly. However, if a user wants to access the data with Client Access Express, the Hebrew characters will not appear correctly.

Note

Conversions within an AS/400 job can only occur when the CCSID of the job is different from the CCSID of the file, and neither of them are set to 65535.

Important

Do not change system values or user profile attributes relating to language ID or CCSID on your system at this point in time. If your database files are incorrectly tagged, you need to plan a suitable migration schedule. This schedule should include the revision of the system values and user profile attributes.

14.1.4.3 Changing CCSIDs of physical files

You can change the CCSID of a physical file by using the Change Physical File (CHGPF) command. Changing the CCSID of a physical file automatically updates the associated logical files with the revised CCSID. There are several restrictions that may prevent you from changing the CCSID of a physical file:

- A logical file built over the physical file has a sort sequence table and the CCSID of the sort sequence table is incompatible with the new CCSID in the physical file.
- A select/omit file that performs select and omits on physical file fields that have different CCSIDs.
- A join logical file that performs joins between physical file fields that have different CCSIDs
- A join logical file with a sort sequence table where the CCSID of the logical file's secondary access path is different than the new CCSID for the physical file.
- CCSIDs are explicitly specified.

- A physical file has a physical file constraint. You must remove the physical file constraint before changing the CCSID of the physical file. When the CCSID is changed, the physical file constraint can be added again.

Changing the CCSID of a physical file does not change the content of the file, just the CCSID itself. The CCSID of the file should match the keyboard that entered the data into the file.

Note

When changing the CCSID of a source file, the last change date and time is updated. Refer to Chapter 10 in the redbook *Speak the Right Language with Your AS/400 System*, SG24-2154, for more information.

14.1.4.4 CCSID special values

The following CCSID values have a special meaning:

- **65535**: An object having this CCSID does not participate in any conversion. This is also known as *HEX.
- **65534**: Informs the user of an object to look at a lower level for the actual CCSID. For example, the DSPFD shows -1. This instructs you to look at the DSPFFD to find the CCSID tagging for each field.
- **0**: Informs the user of an object to look at a higher level in the hierarchy for the actual CCSID used. For example, the file field description internally specifies 0 in the CCSID when all fields within the file have the same CCSID, informing the system to look in the file description. Externally, the DSPFFD command propagates the CCSID of the file description to each field description.

14.1.5 System CCSID support

The AS/400 system includes CCSID support in object types other than database files and user profiles. For detailed information about CCSIDs for other object types, refer to *National Language Support*, SC41-5101, and *International Application Development*, SC41-5603.

Figure 277 shows all AS/400 objects that support CCSIDs and their relationship to each other.

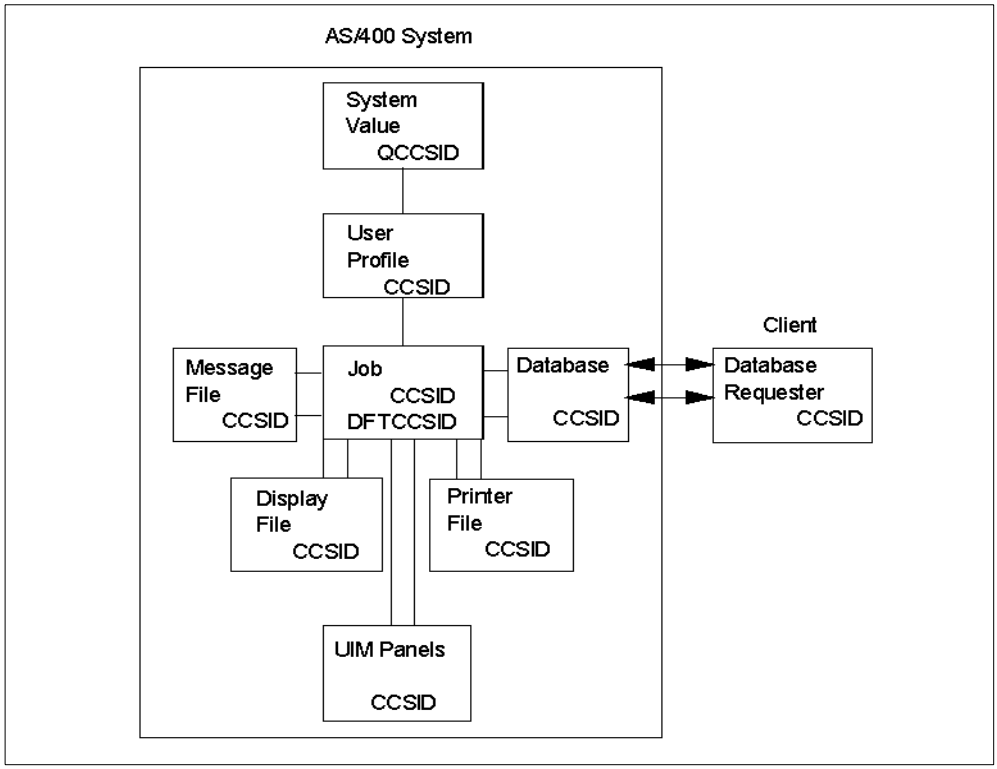

Figure 277. CCSID objects and relationships

Consider the following key points when reviewing the CCSID:

- The CCSID is an object tag, an identifier to the outside world about the encoding of character data.
- The job attributes for the CCSID and default CCSID are initiated by user profile values for CCSID and language ID, where the user profile may refer to system values QCCSID and QLANGID.
- Database files (including source files) are created with the default CCSID in the file description unless explicitly defined.
- Automatic conversion of character data is performed between two objects when the CCSIDs of the involved objects are different and none of them is 65535.

14.2 System 21 language considerations

Support for System 21 is currently available in a variety of national languages including French, German, Spanish, and Italian. Base language support is generally provided by UK English and US English. While base language support is supported in other national languages, availability and supported release levels should be confirmed locally.

Support for each national language version of System 21 resides with the Geac agent in the home country. The agent is are responsible for producing the language specific versions of core System 21 and any supporting country-specific software for example, Couche Francais in France.

14.2.1 Language installation process overview

The language installation process installs country-specific libraries onto the AS/400 system in the same manner as a standard System 21 product installation. You can choose to install one or more additional languages on the AS/400 stem after the initial System 21 installation and configuration process.

Either UK English or US English is installed as the base language for each System 21 implementation.

14.2.1.1 Language architecture

System 21's language architecture incorporates multinational language functionality for international customers. The software enables you to specify your language preference for screens, reports, help text, and message output. System 21 users are defined with a base language code but can access alternative languages when required.

Geac currently ships all software with a base language of English. The software installation process allows you to build support for multiple languages. Language objects are accessed by the language preference code settings in the System 21 user profile associated with the installed language.

14.2.1.2 Base language

System 21 language support works in conjunction with the English base language. The standard product is supplied in English and must be installed prior to installing the country specific objects. While it is preferable for your AS/400 primary language to be English, it is not a prerequisite.

14.2.1.3 Additional language

Country-specific language support for System 21 will be provided in one or more additional libraries. The names of these libraries will have the same initial construct as the base software libraries they replace. However, they will be appended with the appropriate country code suffix. In countries where additional software functionality is required, separate software libraries are provided.

In System 21, Geac currently provides support for over 20 languages. You can run single-byte languages on single-byte or double-byte operating systems. However, you must run double-byte languages only on double-byte operating systems.

14.2.1.4 Language codes

The language codes are the standard codes used throughout the software. The language code field located in the System 21 user profile specifies the base language for the user. All users are assigned a language code within the user profile.

A blank language code specifies a base language of English.

14.2.1.5 Database character set and code page considerations

Data representation within a database is defined by a set of parameters. A collection of characters within a defined database is called a *character set*. Hexadecimal representation of a character set is defined in a *code page*. A code page is a scheme for encoding character data. Every character in a code page is defined by a unique hexadecimal value.

All the characters of every national language supported on AS/400 system are represented in at least one character set. Some character sets may contain characters of multiple languages. For example, the Western European character set contains all characters common to the Western European languages (Aa to Zz) and all special characters unique to the specific languages, such as Á, á, Ü, and ü.

Within System 21, Geac uses code page conversions to control the consistent display of data.

14.2.1.6 Multinational code page settings

Before you install the translated software libraries from Geac, you must run the following command:

```
CHGJOB CCSID(65535)
```

The code page settings on PC clients, such as Microsoft Windows, are specified by Microsoft in Windows.

14.2.1.7 National language support

National language support (NLS) is a set of common standards that allow you to enter, display, store, retrieve, and print data in multiple languages, in different databases, and on different platforms.

For example, you can enter French data on a Microsoft Windows-based ASCII workstation, which will be converted to EBCDIC on the AS/400 system. The data is automatically converted by IBM Client Access. The text is stored in a specific character set that uniquely describes the data as French. The same database can store alternate language text along with French, relying on NLS standards to manage the text storage and retrieval. System 21 supports NLS on the AS/400 platform.

14.2.1.8 Single-byte and double-byte character set considerations

Many single-byte languages support either national code pages or multinational code pages. The double-byte languages support specific individual national code pages by language.

Single-byte character sets use a collection of phonetic characters that require one byte to create a single character. Conversely, the double-byte character sets use ideographic characters and require two bytes to create a single character.

Single-byte languages can generally be run on single- or double-byte systems. Double-byte languages, such as Japanese, Chinese, and Korean, must run on machines configured to support a double-byte system.

For AS/400 terminal emulation, System 21 requires a 32-bit ODBC driver if you are using a double-byte language. Geac recommends IBM Client Access Express (32-bit ODBC driver), which supports both single- and double-byte languages.

14.2.2 Language installation disk space requirements

Prior to performing your language installation, you must ensure that the target machines have sufficient disk space. You can confirm this by entering the following command:

```
WRKSYSSTS (or DSPSYSSTS)
```

Refer to the System ASP and% of system ASP used figures to confirm the available storage on your system. This assumes that System 21 is not being installed in a separately defined user ASP.

Confirmation of the disk space required for the translated software will be provided with the installation CD. In the absence of supporting documentation, seek confirmation from your local Geac support center.

14.3 Installing a System 21 additional language feature

This section provides instructions on the implementation of additional language support within the System 21 Application Manager framework.

14.3.1 System 21 language codes

For each translated language version that you intend to use, you must set up an Application Manager language code. To do this, enter the following command:

```
STRIPGCF
```

This displays the screen shown in Figure 278.

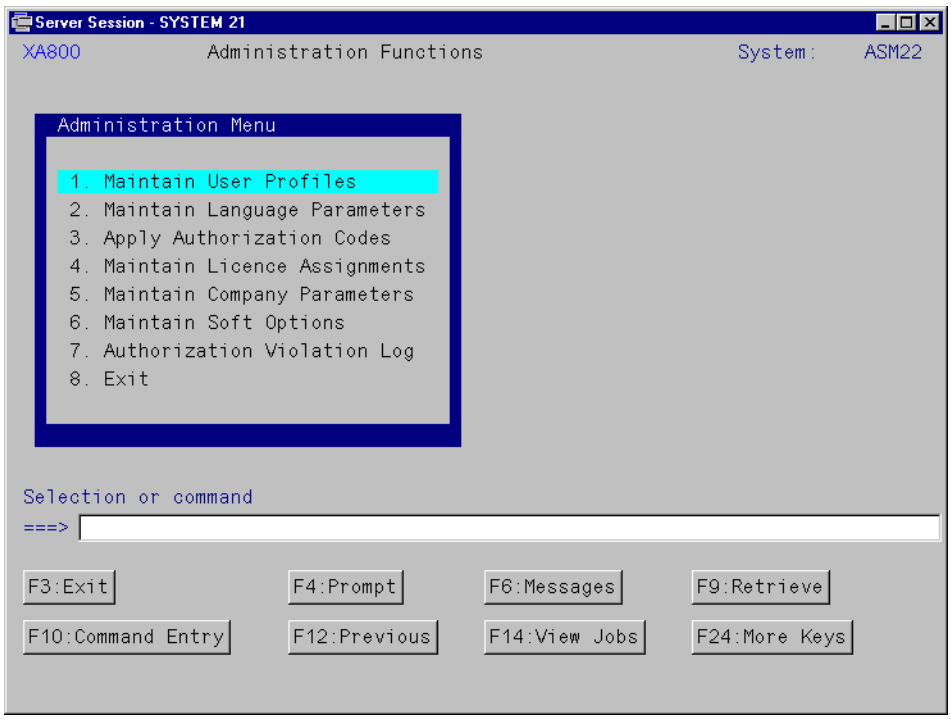

Figure 278. System 21 Administration Menu

Type option 2 (Maintain Language Parameters). Enter the new language code (FR for French, DE for German, IT for Italian, or SP for Spanish) that you want to create. You can enter a description next to the code if you choose, and then press Enter to update. The language addition screen is shown in Figure 279.

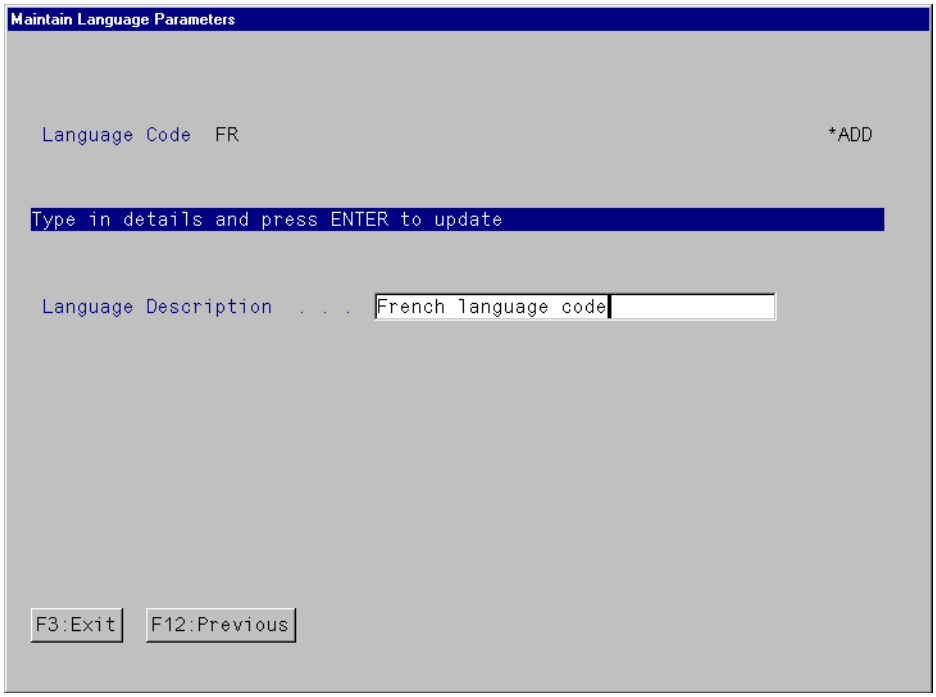

Figure 279. Maintain Language Parameters

Repeat this process for every additional language to be defined to System 21. Consult the installation documentation for the additional language to confirm the construct of the required language code.

14.3.2 System 21 System Manager requirements

System Manager is translated by creating new library lists to be used by the System Manager products. Each System Manager module on your AS/400 system should have a new library list created for it. Table 78 lists the principal System Manager components that requires a library list definition.

Table 78. System Manager components and module codes

System Manager module	Module code
Application Manager	AM
Common functions	CF
Housekeeping	HK
Machine Manager	MM
Network Manager	NW
System Manager	X@

Note

You do not need to create library list definitions for System Manager modules that you have not installed.

To create new library lists for the installed System Manager components, enter the following command:

```
MNTIPGLIBL
```

The entry screen is shown in Figure 280.

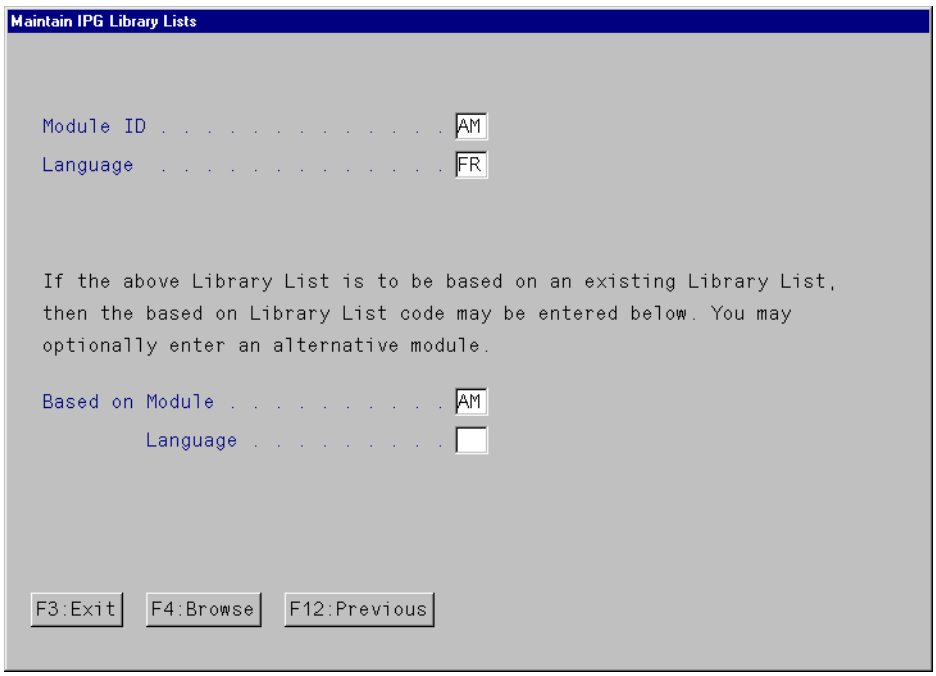

Figure 280. Maintain IPG Library Lists

Specify a Module ID of `AM` (for Application Manager) and your required language code (FR in this example). This new library list should be based on module AM with a blank language code. Press Enter to edit the library list for the French version of the AM module.

For each library ending with D4, add the appropriate language code. This specifies the library containing the translated language objects. In this example, for translating to French, all libraries ending in D4 would now end in D4FR.

Important

Do not apply a language code suffix to libraries, other than D4, unless you are specifically instructed to do so.

Figure 281 shows the library list maintenance screen prior to updating it.

You *must* install the translated libraries for the additional language support on the AS/400 system before updating the library lists.

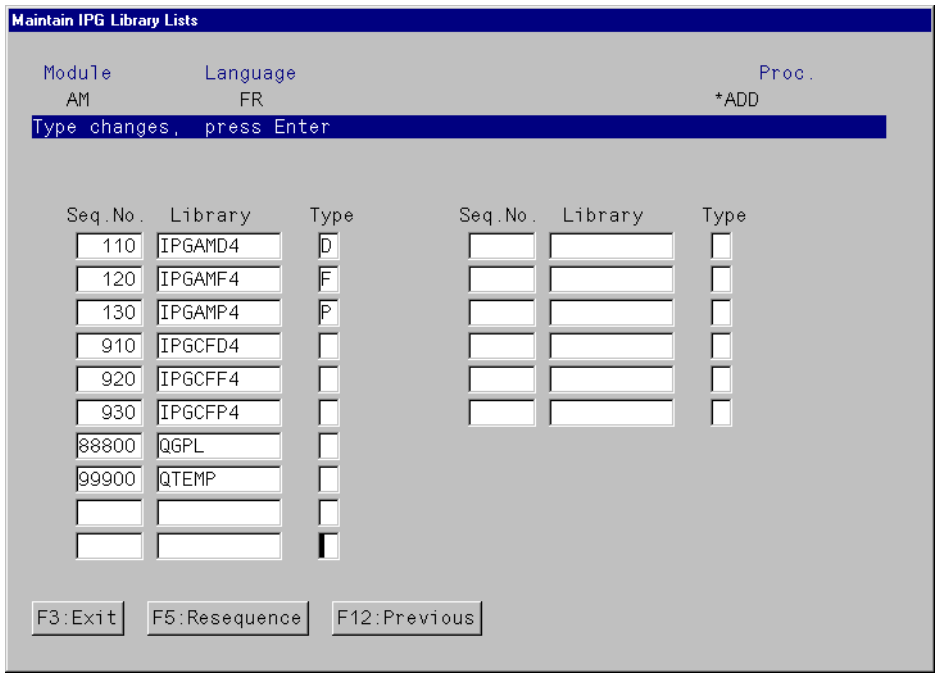

Figure 281. IPG library list maintenance - No update

Figure 282 shows the revised library list values. Press Enter to accept the revised values.

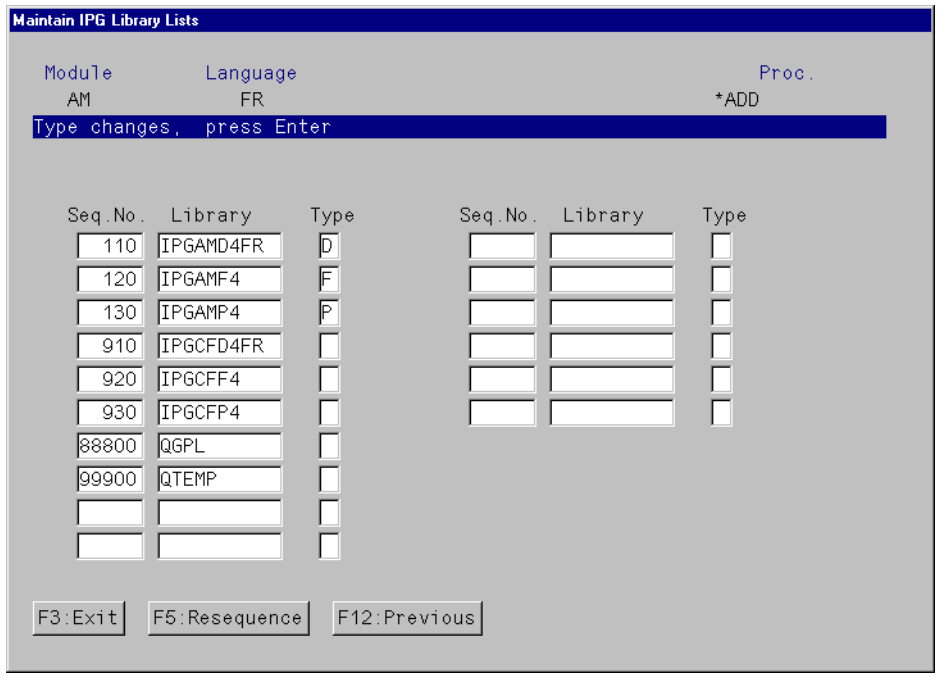

Figure 282. IPG library list maintenance - With update

Repeat the installation process for all of the installed System Manager components. Once this is complete, System Manager will be available with both base and secondary language support.

14.3.3 AMINSAPP of translated software

Once you load the translated object libraries, use the System 21 Install AM Application (AMINSAPP) command to install *each* of the translated applications. Using the AMINSAPP command to undertake standard application installation is explained in Chapter 5, “Installation and set up” on page 87.

Run the AMINSAPP command for each of the core System 21 applications required in a secondary language. The application version parameter (VRSN) identifies the language to which you are translating. The library parameter (LIB) refers to the translated object library you loaded.

You can find the AMINSAPP command in the OSLSYS library and the IPGAMP4 library.

Table 79 shows the value of the VRSN parameter for standard European language installations.

Table 79. VRSN parameter for standard European languages

National language	Value of VRSN parameter
French	FR
German	DE
Italian	IT
Spanish	SP

The application source (APSR) will be O for standard System 21 products. The release level (RLSL) refers to the System 21 release you are installing.

The AMINSAPP command for French language General Ledger is shown in Figure 283.

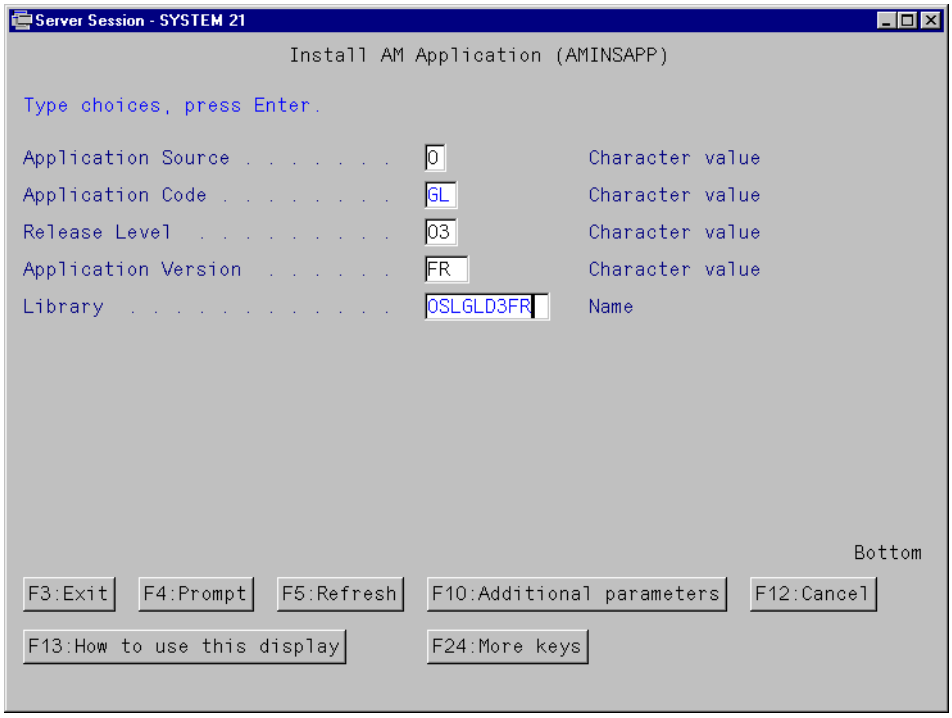

Figure 283. System 21 AMINSAPP command for module GL, language code FR

If you are using the System 21 Configuration module, the AMINSAPP command needs to be in the same format as the one in Figure 284.

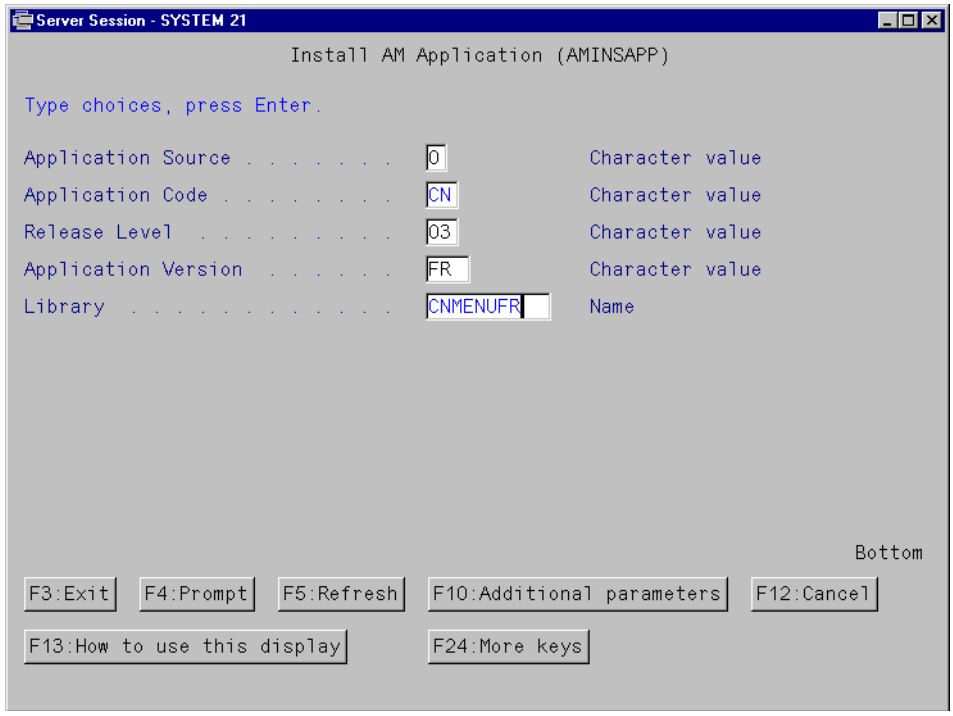

Figure 284. System 21 AMINSAPP command for module CN, language code FR

14.3.4 System 21 user profile requirements

Every user that wants to use a translated version of System 21 must have their System 21 user profile configured to use the translated objects. To edit the System 21 user profiles, enter the command:

```
STRIPGCF
```

Type option `1` (Maintain User Profiles). For each user, enter the user name, and press Enter. You are presented with the Maintain User Profile screen for the selected user. Press F10 (Extras). Enter the appropriate language code in the Language Code field. Press Enter and then F3 to apply the changes.

> **Note**
>
> The language code must be the one that you set up using the process detailed in 14.3.1, “System 21 language codes” on page 506.

Figure 285 shows the entry of the language code on the System 21 user profile.

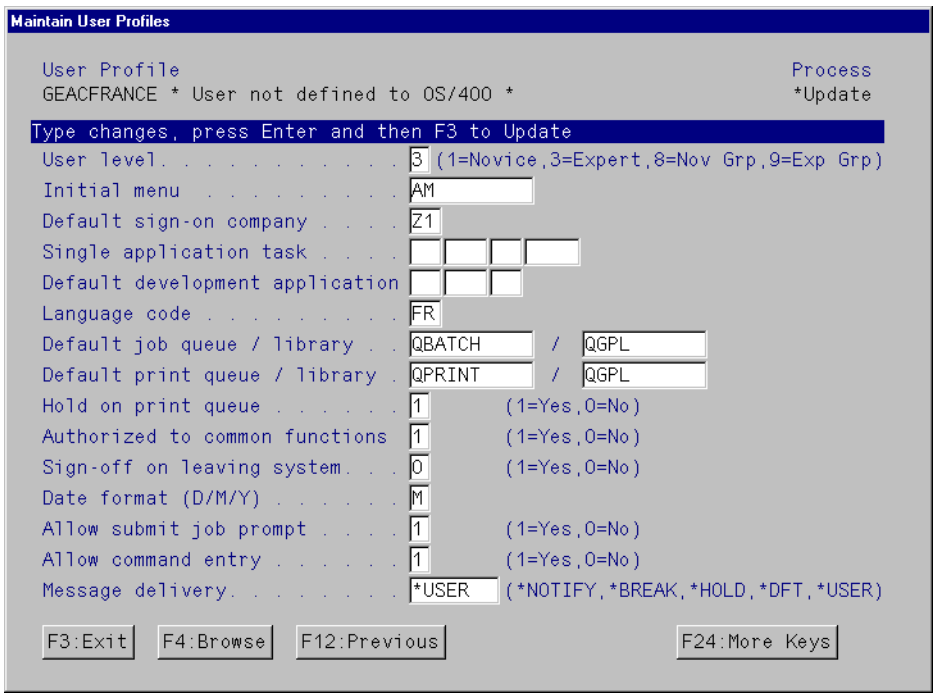

Figure 285. System 21 user profile maintenance

Once the user profile is updated, the user can access the translated objects associated with a System 21 application module.

14.3.5 System 21 environment requirements

Within System 21, secondary languages may be accessed through a separate environment. However, it is also possible to have multiple languages supported by a single environment. Depending on the complexity of installation and the requirement to support custom modifications, a single environment scenario may be preferable.

The creation of environments is covered in Chapter 11, “Customization” on page 389.

Your application administrator may create a System 21 environment to support each installed language, or one environment may support all secondary languages. The environment must have each of the required application modules defined to it. You may also need to create additional environments for support, testing, training, error reproduction, and development.

To confirm that the environments are created on your system, enter the command:

```
STRIPGAM
```

Type option `1` (Maintain Applications), and press Enter. You are presented with the Select Application panel as shown in Figure 286. In this example, a French live environment (FRL) has been defined for the AC and AG, application modules. In addition, a test environment (FRT) and an error reproduction environment (FRE) have been defined for the AC module. Note also the FR environment code for the AC and AG applications. This is created as part of the AMINSAPP command, which is explained in 14.3.3, “AMINSAPP of translated software” on page 510.

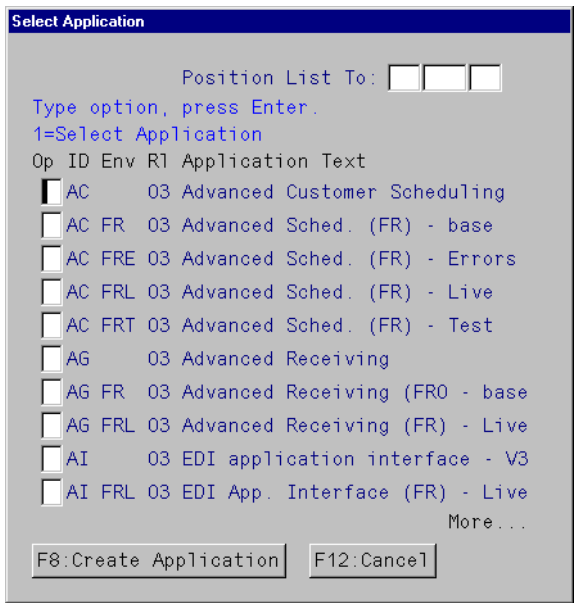

Figure 286. Application configuration selection

Select one of the applications by typing `1` next to it. You are presented with the Maintain Application panel shown in Figure 287 on page 514. Note that the default library list code for the AC application is 0001, the same as the base application. Library list codes are reviewed in 14.3.6, “System 21 library list support for additional languages” on page 515.

You should be in a position to gain access to the language specific application modules once the environment definition has been completed.

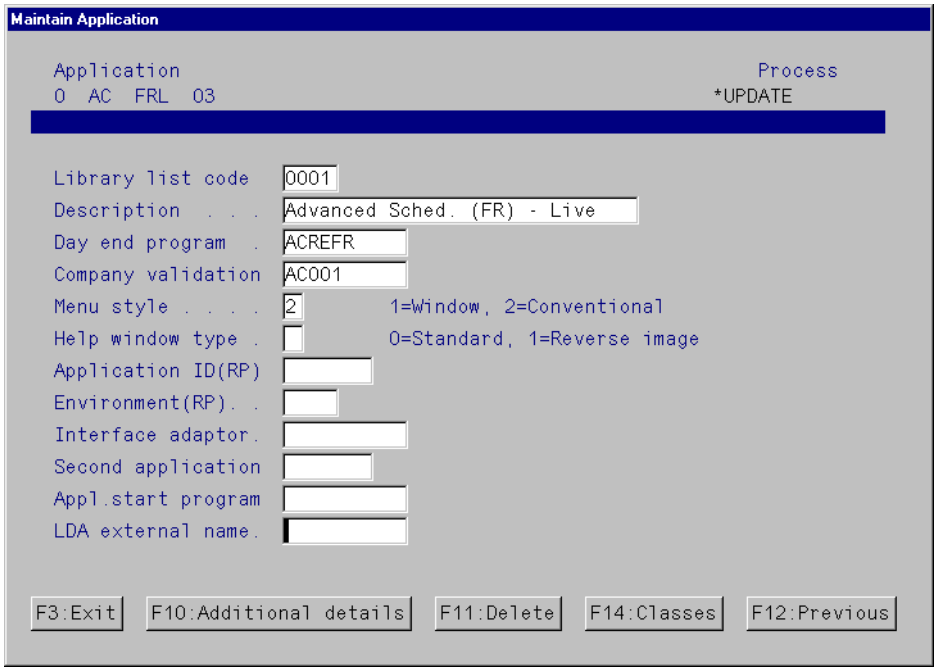

Figure 287. Application default parameter maintenance

14.3.5.1 Multilingual environment installations

In general, two approaches are adopted to setting up multilingual environments. They are both correct but have different benefits and drawbacks. They are described in the following sections.

Option 1

In the example in Table 80, the FRL environment will support both base language and French language users, assuming that the FRL environment is being created from the base environment.

Table 80. FRL environment definition using menus and tasks in base environment

Definition type	<blank> environment	FRL environment
Application library list	0001	0001
Library list	0001	0001 and FR01
Menus	Full defined set	None, use <blank>
Tasks	Full defined set	None, use <blank>

Menus and tasks exist in the base environment only. Application Manager will use “drop down” from the FRL environment to the base environment (after checking AMCUSCODE), to locate the menu and task definitions.

This is the simplest approach to maintain. However, tasks may need to be duplicated to the FRL environment if specific task overrides are required.

Option 2

In Table 81, assume that the FRL environment is being created from the base environment.

Table 81. FRL environment definition using menus and tasks in FRL environment

Definition type	<blank> environment	FRL environment
Application library list	0001	0001
Library list	0001	0001 and FR01
Menus	Full defined set	Fully defined set
Tasks	Full defined set	Fully defined set

In the example in Table 81, the FRL environment will again support base language and French language users. Menus and tasks exist in the base environment *and* the FRL environment. Application Manager will locate menu and task definitions in the FRL environment.

This is the simplest approach to customize. However, adopting this approach introduces a maintenance overhead that requires tighter control. Task amendments in the base environment must be reflected in the FRL environment. New task definitions introduced via PTFs to the base environment must also be replicated to the FRL environment.

You must decide which approach is most suitable for your System 21 implementation.

Note

If you use option 2, ensure that you have resolved all library list name conflicts in the <blank> environment before duplicating the tasks to the language environment. Refer to 14.3.6.1, “Conflicting library list names” on page 518, for a detailed explanation.

14.3.6 System 21 library list support for additional languages

Every task defined within System 21 has a library list assigned to it. The library list provides the runtime objects required for the task to successfully execute. The library list can be:

- Explicitly specified on the task definition
- Implicit from the default specified on the application definition

When implementing an additional language, it is important to ensure that the library lists for the System 21 application modules have been configured correctly. The creation of library lists for applications is covered in Chapter 11, “Customization” on page 389.

National language library lists are based on primary language library lists with the appropriate revisions. Within an environment, each application module must have a complete set of library lists defined. The library list codes for the additional language must begin with the appropriate language code. Table 82 on page 516

shows the library list mapping between the base primary environment and the French live environment for application module AC.

Table 82. Secondary language library list mapping

Environment code = <blank> (base)	Environment code = FRL (French live)
Application code = 'AC'	Application code = 'AC'
Language code = <blank>	Language code = 'FR'
Library list code = 0001	Library list code = FR01
Library list code = 0002	Library list code = FR02
Library list code = 0003	Library list code = FR03
Library list code = RLF1	Library list code = FRF1
Library list code = OEX1	Library list code = FRX1
Library list code = *DFT	Library list code = FRFT

System Manager provides a library list mapping utility. You can access the utility by entering the command:

```
STRIPGAM
```

Type option 2 (Maintain Library Lists), and press Enter. You are presented with the screen shown in Figure 288.

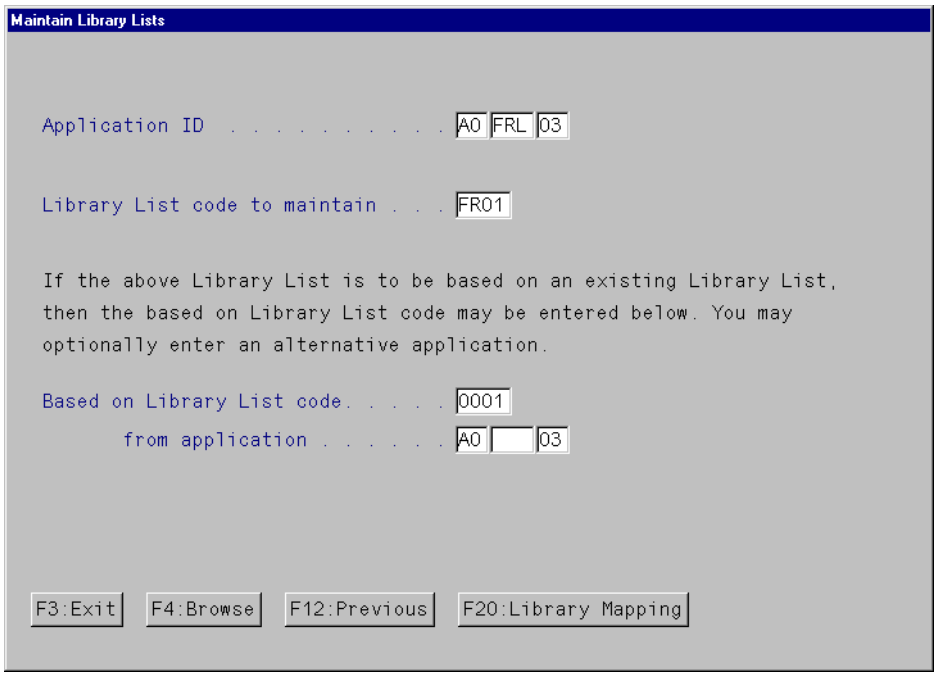

Figure 288. Library list configuration and maintenance

You must enter the target application details and the name of the library list you want to create. You must then enter the Based on Library List Code (the source library list code) and the base application details. Press Enter to display the library list maintenance screen shown in Figure 289.

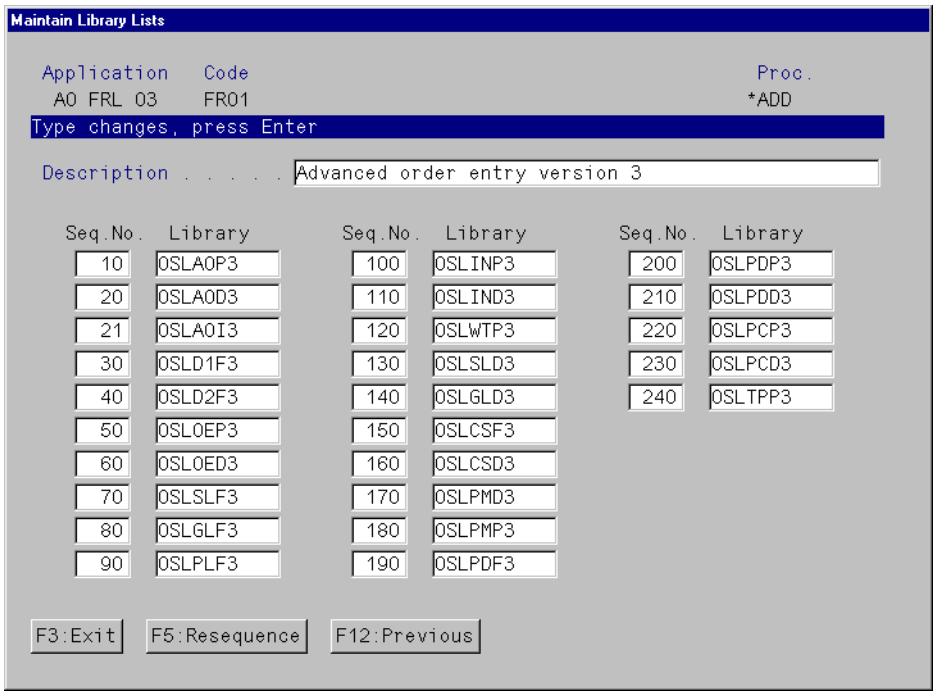

Figure 289. Library maintenance before amendment

The library names displayed are the same as the names in the base 0001 library list. You need to revise the appropriate library names to reflect the translated object libraries. You must add a suffix of FR to all of the libraries ending in D3. The revised screen is shown in Figure 290.

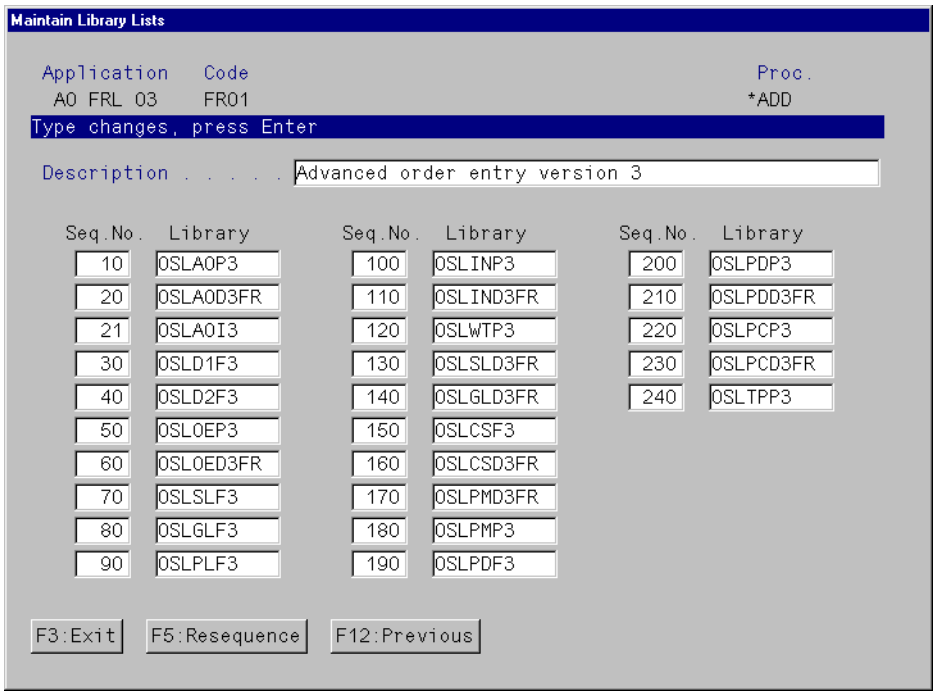

Figure 290. Library maintenance after it is revised

Once the library name revision is complete, press F3 to exit. This action displays the screen shown in Figure 291.

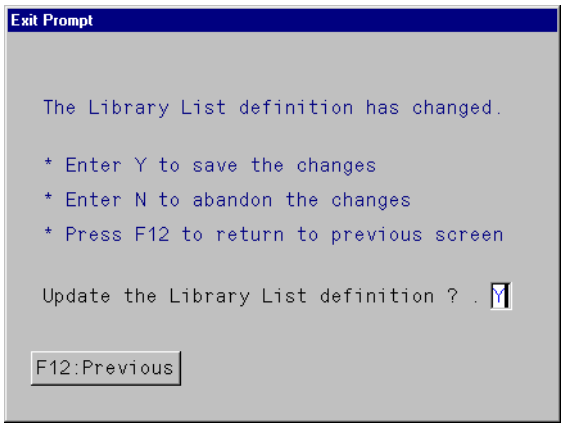

Figure 291. Library list update confirmation

Type `Y` to update the definition, and then press Enter to save the revised library list.

Important

You must complete the library mapping process for each library list in the base application. Failure to do so may result in application errors in the secondary language environment.

14.3.6.1 Conflicting library list names

Within a System 21 application, library list names must be unique. This will not present a problem in the base environment, but may cause issues in the secondary language environment.

Table 83 shows the conflict that may occur during the renaming of the secondary language library list.

Table 83. Duplicate library list codes example

Environment code = <blank> (base)	Environment code = FRL (French live)
Application code = 'AC'	Application code = 'AC'
Language code = <blank>	Language code = 'FR'
Library list code = 0001	Library list code = FR01
Library list code = 0002	Library list code = FR02
Library list code = RL01	Library list code = FR01
Library list code = RL02	Library list code = FR02

To resolve this conflict, you must perform the following steps:

1. To remove conflicting library lists in the base application, follow these steps:
   a. For each application that requires a secondary language, review the library list codes in the base application:

i. Enter the STRIPGAM command, and press Enter.
ii. Type option 2 (Maintain Library Lists), and press Enter.
iii. Enter the application ID, <blank> environment code, and release level.
iv. Position the cursor in the Library List code to maintain field, and press F4.

b. Make a note of the resulting library list codes if the language code prefix is applied.

c. Determine if any of the library list codes will be duplicated in the secondary language.

d. In the event of duplication, create a new library list code in the base application based on the original. Use a naming convention that removes the duplication.

e. Replicate the library lists from the base application to the application in the secondary language environment.

2. To revise the amended library list codes in the base application definitions, complete these tasks:

a. Access the application definitions for all applications in the <blank> environment.

i. Enter the STRIPGAM command, and press Enter.
ii. Type option 1 (Maintain Applications), and press Enter.

b. Select each application that has a <blank> environment code.

c. Review the library list code assigned to each application.

d. If the application uses a library list code that has been revised, update it with the new code.

e. Press F3 to exit the application.

f. Press Enter to confirm update of the application definition.

3. To revise amended library list codes in the base task definitions, follow this process:

a. Access the task definitions for all of the tasks in the base application.

i. Enter the STRIPGAM command, and press Enter.

ii. Type option 3 (Maintain Tasks), and press Enter.

iii. Enter the application ID, <blank> environment code, and release level. Then, press Enter.

b. Review the library list code defined for each task. If the code is <blank>, the default code is assumed from the application definition.

i. Type 1 next to the task to be reviewed, and press Enter.
ii. On the Maintain Tasks screen, press F10 (Extras).
iii. Review the contents of the Library List field.

c. Amend any task definition that has a library list code, which was revised in the base environment.

d. Update the task definition by pressing Enter.

4. To revise amended library list codes in the secondary language application definitions, perform these steps:

a. For application definitions that had the default library list code amended in the primary language, access the application definition in the secondary language.

   i. Enter the `STRIPGAM` command, and press Enter.
   ii. Type option `1` (Maintain Applications), and press Enter.

b. Select the required environment code or codes for each amended application.

c. Amend the default library list code for the application.

d. Press F3 to exit the application.

e. Press Enter to confirm update of the application definition.

Application Manager uses a “drop-through” approach for task execution. Tasks may be defined within a specific environment if required. If environment-specific task definitions do not exist, System Manager checks the default environment (the one referred to in the data area AMCUSCODE) for task definitions. If nothing is found, it defaults to the task definitions in the base environment. The library list code is overridden to the national language version when the task is executed.

Note

For detailed instructions on maintaining library lists and task definitions, refer to Chapter 11, “Customization” on page 389.

To assist the review process, you can access the System Manager data directly from the files detailed in Table 84. You can view the data using Query/400 or SQL if the LPPs are installed on your system.

Table 84. System 21 library list and task definition files

File name	Library	Description
APG25PHY	IPGCFF4	Library list detail
APG26PHY	IPGCFF4	Library list profile
APG35PHY	IPGAMF4	Application task definition

You must perform the library list review process for each application requiring secondary language support. Failing to ensure that library lists are unique and tasks are correctly updated may result in application issues.

14.4 Country-specific requirements

The core System 21 product set is developed and maintained primarily in the United Kingdom. Base language support is either UK English or US English. The following items *do not* form part of the standard System 21 product set:

- National language support
- Additional county specific software functionality

14.4.1 Country-specific requirements

Geac has regional offices or registered affiliates in many countries around the world. The provision of translated System 21 products remains their

responsibility. Once the core product is available, it is shipped to the appropriate regional organizations for translation. You should always confirm software shipment dates with your regional support center. They may vary depending on the translation schedule for the individual modules.

Regional support centers retain responsibility for the coordination of country-specific software requirements. This includes functionality like Couche Francaise, which is used in France. You must confirm the availability and release compatibility of this software with your regional support center.

14.4.2 Translated Service Packs

Within System 21, cumulative PTF packages are referred to as “Service Packs”. Service Packs are initially generated in UK or US English. After creation, they are available for translation.

Regional support centers retain responsibility for the translation of the Service Pack. You need to confirm availability of a national language version of the Service Pack with them.

Part 4. Appendices

This part contains appendices and complementary information to the chapters presented in this redbook. An overview of the appendices is listed here:

- Appendix A, “TCP/IP basic installation and configuration” on page 525, describes the process of configuring Transmission Control Protocol/Internet Protocol (TCP/IP) on the AS/400 system.
- Appendix B, “System 21 products and dependencies” on page 561, details System 21 application modules by business area including application prerequisites.
- Appendix C, “Suggested schedule for Machine Manager” on page 567, contains suggestions for setting up Machine Manager, to run for Distribution, Manufacturing, and Finance, both for Day Start and Day End.
- Appendix D, “Support” on page 573, outlines various System 21 support services.
- Appendix E, “National language versions on AS/400 systems” on page 577, provides a brief overview of some useful information related to national language versions on the AS/400 system, such as CCSID, character ID, keyboard ID, and so on.

Appendix A. TCP/IP basic installation and configuration

This appendix describes the process of configuring Transmission Control Protocol/Internet Protocol (TCP/IP) on the AS/400 system. If you want extensive knowledge about TCP/IP on the AS/400 platform, refer to *V4 TCP/IP for AS/400: More Cool Things Than Ever*, SG24-5190, *OS/400 TCP/IP Configuration and Reference*, SC41-5420, and *TCP/IP Fastpath Setup,* SC41-5430.

Note

You should configure TCP/IP prior to installing Geac System 21.

A.1 Configuring TCP/IP on the AS/400 system

You can configure and work with TCP/IP using Operations Navigator or the Command Line interface. For some functions, the entire configuration must be done through Operations Navigator, while other functions can only be configured through the command line interface.

A.1.1 TCP/IP configuration using a command line interface

This section shows you how to configure a basic TCP/IP connection using an AS/400 command line interface. You need one local workstation connected to the AS/400 system to do this.

The configuration process is complete once you perform a PING successfully on the AS/400 system. If you need more information, see *TCP/IP Fastpath Setup,* SC41-5430.

Here is a simple Ethernet network to show you how to configure TCP/IP. In Figure 292, you see an Ethernet network with one AS/400 system and one personal computer. The configuration is shown from the AS/400 system perspective.

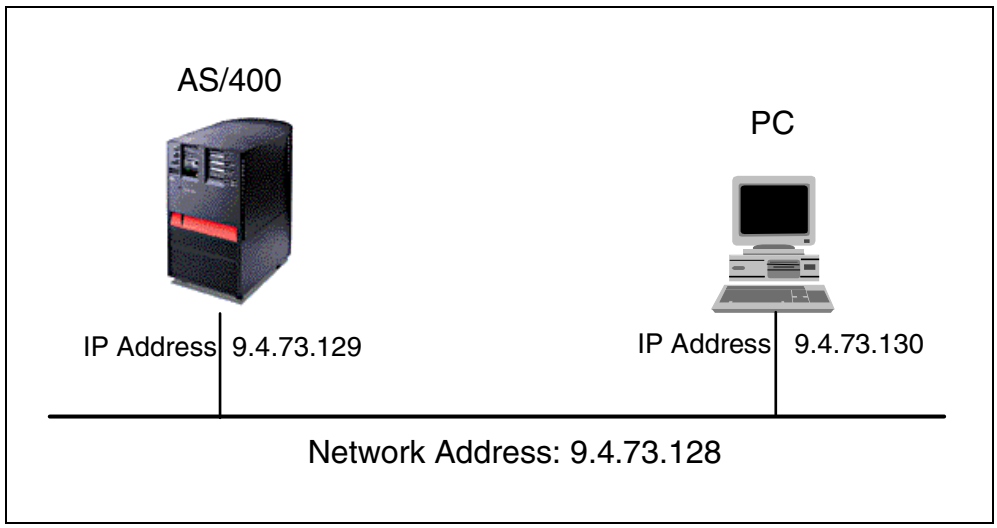

Figure 292. Ethernet network example

A.1.1.1 Collecting the network parameters

You need to know the addresses and subnet mask of your AS/400 system, router, and gateway. You also need your local domain name and the host name of your AS/400 system. In this scenario, we used the following information:

- **Network address**: 9.4.73.128
- **Subnet mask**: 255.255.255.128
- **Domain name**: SYSNAM123.IBM.COM
- **AS/400 host Internet address/name**: 9.4.73.129/SYSNAMA

If you are the network administrator and if you never plan to attach your network to the Internet, we suggest that you use an address such as 128.1, for your TCP/IP network, and 128.1.0.1, for your first TCP/IP host. The subnet mask would be 255.255.0.0.

A.1.1.2 Signing on to the AS/400 system

Sign on the AS/400 system as user `QSECOFR` (or another user with the special authority of `*IOSYSCFG`).

System configuration (*IOSYSCFG) special authority gives the user the ability to change how the system is configured. This may include, for example, adding or removing communications configuration information, working with TCP/IP servers, and configuring the Internet Connection Server (ICS).

A.1.1.3 Creating a line description

In this scenario, an Ethernet line is used. To see other types of lines, refer to Appendix A, “Configuring a Physical Line for TCP/IP communications” in *OS/400 TCP/IP Configuration and Reference*, SC41-5420.

You need to know the resource name and decide the line name. To do this, perform the following steps:

1. The resource name is the AS/400 system name for the adapter card. To obtain the resource name, enter the Work with Hardware Resources (`WRKHDWRSC`) command and specify the communications resources as shown here:

   ```
   WRKHDWRSC TYPE(*CMN)
   ```

   When you press Enter, the display shown in Figure 293 appears.

```
                    Work with Communication Resources

Type options, press Enter.
  5=Work with configuration descriptions   7=Display resource detail

Opt  Resource        Type  Status               Text

     CC13            2629  Operational          Comm Processor
       LIN20         6181  Operational          LAN Adapter
         CMN24       6181  Operational          Ethernet Port
       LIN22         6149  Operational          LAN Adapter
         CMN25       6149  Operational          Token-Ring Port
       LIN28         2699  Operational          Comm Adapter
         CMN29       2699  Operational          V.24 Port
         CMN30       2699  Operational          Comm Port
     CC14            6617  Operational          File Server IOP
       LIN30         2723  Operational          LAN Adapter
         CMN32       2723  Operational          Ethernet Port
       LIN33         2724  Operational          LAN Adapter
         CMN33       2724  Operational          Token-Ring Port
                                                                    More...
F3=Exit   F5=Refresh   F6=Print   F12=Cancel
```

*Figure 293. Work with Communication Resources (WRKHDWRSC TYPE(*CMN))*

2. Choose the proper resource name from the display, and decide the name of the line for the line description.
3. To create a line description, enter the Create Line Description (Ethernet) (CRTLINETH) command.

   Fill in the line name and resource name, and press Enter. The display shown in Figure 294 on page 528 appears. In this example, the resource name is CMN24, and the line name is LINETH01.

Note: Step 2 and step 3 can also be done in the following way:

Type option 5 (Work with configuration descriptions) in the Opt field as shown in Figure 294 on page 528. Then, the Work with Configuration Descriptions display appears. In this display, type option 1 (Create) in the Opt field. The display shown in Figure 294 on page 528 appears.

```
                  Create Line Desc (Ethernet) (CRTLINETH)

Type choices, press Enter.

Line description . . . . . > LINETH01      Name
Resource name  . . . . . > CMN24         Name, *NWID, *NWSD
Online at IPL  . . . . . .   *YES          *YES, *NO
Vary on wait . . . . . .   *NOWAIT       *NOWAIT, 15-180 seconds
Local adapter address  . . . . .   *ADPT         020000000000-7EFFFFFFFFFF...
Exchange identifier  . . . . . .   *SYSGEN       05600000-056FFFFF, *SYSGEN
Ethernet standard  . . . . . .   *ALL          *ETHV2, *IEEE8023, *ALL
Line speed . . . . . .  10M           Character value, 10M, 100M...
Duplex . . . . . .  *FULL         Character value, *HALF...
SSAP list:
  Source service access point  .   *SYSGEN       02-FE, *SYSGEN
  SSAP maximum frame . . . . . .                 *MAXFRAME, 265-1496, 265...
  SSAP type  . . . . . .                         *CALC, *NONSNA, *SNA, *HPR
             + for more values
Text 'description' . . . . . .   *BLANK

                                                                       More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 294. Create Line Description (Ethernet) (CRTLINETH) display

Ensure that the modes and line speed for the Ethernet line are matched correctly, for example, if a switch is set to full duplex, and the AS/400 system is set to full duplex.

A.1.1.4 Creating a TCP/IP interface

You need the IP and subnet mask addresses to create a TCP/IP interface. Perform the following steps:

1. Go to the CFGTCP menu, and select option **1** (Work with TCP/IP Interfaces). The display shown in Figure 295 appears.

```
                          Work with TCP/IP Interfaces

Type options, press Enter.
  1=Add   2=Change   4=Remove   5=Display   9=Start   10=End

     Internet         Subnet             Line      Line
Opt  Address          Mask            Description  Type

     127.0.0.1        255.0.0.0        *LOOPBACK    *NONE

                                                                       More...
F3=Exit   F5=Refresh   F6=Print list   F10=Work with IP over SNA interfaces
F11=Display interface status           F12=Cancel   F17=Top   F18=Bottom
```

Figure 295. CFGTCP menu display: Work with TCP/IP Interfaces

2. Select option **1** (Add) to add a TCP/IP interface to the table, and press Enter. The display shown in Figure 296 appears.

```
                        Add TCP/IP Interface (ADDTCPIFC)

Type choices, press Enter.

 Internet address . . . . . > '9.4.73.129'
 Line description . . . . . .   lineth01      Name, *LOOPBACK
 Subnet mask  . . . . . . . .   255.255.255.128
 Associated local interface . . .   *NONE
 Type of service  . . . . . .   *NORMAL       *MINDELAY, *MAXTHRPUT...
 Maximum transmission unit  . . .   *LIND         576-16388, *LIND
 Autostart  . . . . . . . . .   *YES          *YES, *NO
 PVC logical channel identifier                001-FFF
               + for more values
 X.25 idle circuit timeout  . . .   60           1-600
 X.25 maximum virtual circuits  .   64           0-64
 X.25 DDN interface . . . . . .   *NO           *YES, *NO
 TRLAN bit sequencing . . . . . .   *MSB          *MSB, *LSB

                                                                       Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 296. Add TCP/IP Interface (ADDTCPIFC) display

3. Enter the Internet address, line description, and subnet mask. After pressing Enter, the Work with TCP/IP Interface display appears as shown in Figure 297. Note the message at the bottom that states the TCP/IP interface was added successfully.

```
                          Work with TCP/IP Interfaces

 Type options, press Enter
   1=Add   2=Change   4=Remove   5=Display   9=Start   10=End

      Internet         Subnet             Line      Line
 Opt  Address          Mask             Description  Type

      9.47.73.129      255.255.255.128  LINETH01     *ELAN
      127.0.0.1        255.0.0.0        *LOOPBACK    *NONE

                                                                      More...
 F3=Exit   F5=Refresh   F6=Print list   F10=Work with IP over SNA interfaces
 F11=Display interface status           F12=Cancel   F17=Top   F18=Bottom
 TCP/IP interface added successfully.
```

Figure 297. CFGTCP menu display - Work with TCP/IP Interfaces

A.1.1.5 Creating a TCP/IP host table entry

A host table entry allows you to associate a host name (for example, SYSNAMA) to an Internet address (for example, 9.47.73.129). To do this, perform the following tasks:

1. Select option **10** (Work with TCP/IP host table entries) on the CFGTCP menu, and press Enter. The display shown in Figure 298 on page 530 appears.

```
                    Work with TCP/IP Host Table Entries

 Type options, press Enter.
   1=Add   2=Change   4=Remove   5=Display   7=Rename

      Internet         Host
 Opt  Address          Name

      127.0.0.1        LOOPBACK

                                                                        Bottom
 F3=Exit   F5=Refresh   F6=Print list   F12=Cancel   F17=Position to
```

Figure 298. CFGTCP menu display - Work with TCP/IP Host Table Entries

2. Select option **1** (Add) to add one entry to the table. The Add a TCP/IP Host table entry display should appear. This is shown in Figure 299.

```
                    Add TCP/IP Host Table Entry (ADDTCPHTE)

 Type choices, press Enter.

Internet address . . . . . . . . > 9.4.7.129
 Host names:
   Name . . . . . . . . . . . . . > SYSNAMA

   Name . . . . . . . . . . . . . > SYSNAMA.SYSNAM123.IBM.COM
Text 'description' . . . . . .   'Entry for AS/400 (SYSNAMA) '

                                                                        Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 299. Add TCP/IP Host Table Entry (ADDTCPHTE) display

3. This display provides fields for the Internet address, associated host name, and an optional text description. Type in the values. After pressing Enter, the Work with TCP/IP Host Table Entries appears as shown in Figure 300.

```
                    Work with TCP/IP Host Table Entries

 Type options, press Enter.
   1=Add   2=Change   4=Remove   5=Display   7=Rename

      Internet         Host
 Opt  Address          Name

      9.4.73.129     SYSNAMA
                     SYSNAMA.SYSNAM123.IBM.COM
      127.0.0.1      LOOPBACK

 F3=Exit   F5=Refresh   F6=Print list   F12=Cancel   F17=Position to
```

Figure 300. CFGTCP menu display - Work with TCP/IP Host Table Entries

For information on how to configure a TCP/IP route, refer to A.2.2, “Route configuration” on page 559.

A.1.1.6 Configuring a local domain and host name

The local host and domain name are used to identify the AS/400 system within the TCP/IP domain in which it is located. POP and SMTP mail servers require that the local host and domain name be configured.

To define the local host and domain name for AS/400 machine, select option **12** (Change TCP/IP domain information) from the CFGTCP menu. The display shown in Figure 301 appears.

```
                      Change TCP/IP Domain (CHGTCPDMN)

 Type choices, press Enter.

 Host name  . . . . . . . . . . .   'SYSNAMA'

 Domain name  . . . . . . . . . .   'SYSNAM123.IBM.COM'



 Host name search priority  . . .   *LOCAL        *REMOTE, *LOCAL, *SAME


   Internet address . . . . . .   '9.4.73.129'

Additional Parameters

 Port . . . . . . . . . . . . . .   53             1-65535, *SAME
 Protocol . . . . . . . . . . . .   *UDP           *UDP, *TCP, *SAME
                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display       F24=More keys
```

Figure 301. Change TCP/IP Domain (CHGTCPDMN) display

In this example, 9.4.73.129 is the IP address of the DNS server.

For more information about the local host name and domain name, see *OS/400 TCP/IP Configuration and Reference*, SC41-5420.

A.1.1.7 Starting TCP/IP

Before any TCP/IP services are available, TCP/IP processing must be initialized and activated. The steps for starting TCP/IP are:

1. Select option **3** (Start TCP/IP) from the TCP/IP Administration menu using the command:

   ```
   GO TCPADM
   ```

   You can also choose to enter the Start TCP (`STRTCP`) command. Both commands initialize and activate TCP/IP processing. They also start the TCP/IP interface control job, which starts all interfaces with an AUTOSTART value set to `*YES`. It starts the TCP/IP server jobs.

2. Allow a few moments for TCP/IP to start. Then, enter the command:

   ```
   WRKACTJOB SBS(QSYSWRK) JOB(QT*)
   ```

   The job QTCPIP should appear as shown in Figure 302 on page 532. After this job is started, you can proceed with TCP/IP connection verification.

```
                              Work with Active Jobs

CPU %:    2.2     Elapsed time:   00:01:21     Active jobs:   219

 Type options, press Enter.
   2=Change   3=Hold   4=End   5=Work with   6=Release   7=Display message
   8=Work with spooled files   13=Disconnect ...

 Opt  Subsystem/Job  User        Type  CPU %  Function        Status

        QTCPIP       QTCP        BCH      .0                  DEQW
        QTFTP01357   QTCP        BCH      .0  CMD-CHGJOB      ICFW
        QTGTELNETS   QTCP        BCH      .0                  DEQA
        QTLPD00266   QTCP        BCH      .0                  DEQW
        QTMSNMP      QTCP        BCH      .0  PGM-QTOSMAIN    DEQW
        QTSMTPSRVR   QTCP        BCH      .0  PGM-QTMSSRCP    SELW
        QTWSG02808   QTMTWSG     BCH      .0                  TIMW

                                                                      Bottom
 Parameters or command
 ===>
 F3=Exit   F4=Prompt        F5=Refresh   F10=Restart statistics
 F11=Display elapsed data   F12=Cancel   F14=Include   F24=More keys
```

Figure 302. Work with Active Jobs (WRKACTJOB) display - QTCPIP job

Messages indicating that TCP/IP has been started are also sent to the QTCP and QSYSOPR message queues. To check for the successful start of TCP/IP, enter either of these commands:

```
DSPMSG QSYSOPR
DSPMSG QTCP
```

If the QTCPIP job does not start, look for spooled job logs. Generally, the user for these job logs is QTCP. Use the Work with Spooled Files (`WRKSPLF`) command, and specify QTCP for the user to find the logs:

```
WRKSPLF QTCP
```

A.1.1.8 Stopping TCP/IP

Stopping TCP/IP ends all TCP/IP processing, all active TCP/IP interfaces, and all TCP/IP connections on the AS/400 system with which you are working. Unless you specified ENDSVR (*NO), all TCP/IP server jobs for agents that are currently active in the QSYSWRK subsystem are ended. There are two possible values when stopping TCP/IP: *controlled* and *immediately*. There are two ways to stop TCP/IP using the CL interface:

- Enter `ENDTCP`, and press F4.
- Type `GO TCPADM`, and select option **4** (End TCP/IP).

To stop TCP/IP from the TCP/IP Administration menu, perform the following steps:

1. Type `GO TCPADM` on the AS/400 Main Menu. The TCP/IP Administration Menu is displayed (Figure 303).

```
TCPADM                      TCP/IP Administration

Select one of the following:

     1. Configure TCP/IP
     2. Configure TCP/IP applications
     3. Start TCP/IP
     4. End TCP/IP
     5. Start TCP/IP servers
     6. End TCP/IP servers
     7. Work with TCP/IP network status
     8. Verify TCP/IP connection
     9. Start TCP/IP FTP session
    10. Start TCP/IP TELNET session
    11. Send TCP/IP spooled file

    20. Work with TCP/IP jobs in QSYSWRK subsystem


Selection or command
===> 4

F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel
(C) COPYRIGHT IBM CORP. 1980, 1998.
```

Figure 303. TCP/IP Administration menu

2. Select option **4** (End TCP/IP), and press Enter. The End TCP/IP display is shown (Figure 304).

```
                              End TCP/IP (ENDTCP)

Type choices, press Enter.

How to end . . . . . .   *IMMED        *IMMED, *CNTRLD

                           Additional Parameters

End application servers  . . . .   *YES          *YES, *NO
                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 304. End TCP/IP (ENDTCP)

Note: There is no confirmation display shown when ENDTCP is entered. The ENDTCP command must be used with caution. When it is used, it ends all TCP/IP processing on the AS/400 system on which you are working.

3. To individually stop a TCP/IP server, use the ENDTCPSVR command, and press F4. The End TCP/IP Server display is shown in Figure 305 on page 534.

```
                        End TCP/IP Server (ENDTCPSVR)

Type choices, press Enter.

Server application . . . . . .   *ALL          *ALL, *SNMP, *ROUTED...
              + for more values
                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 305. ENDTCPSVR

A.1.1.9 Verifying the TCP/IP connection

Use the PING command to verify the TCP/IP configuration. Perform the following steps:

1. To test the TCP/IP code without sending anything out of the Ethernet adapter, specify the special host name LOOPBACK:

   ```
   PING LOOPBACK
   ```

   The display shown in Figure 306 should appear.

```
                                Command Entry
                                                        Request level:   7
Previous commands and messages:
   > ping loopback
     Verifying connection to host system LOOPBACK at address 127.0.0.1.
     PING request 1 from 127.0.0.1 took 57 ms. 256 bytes. TTL 64.
     PING request 2 from 127.0.0.1 took 0 ms. 256 bytes. TTL 64.
     PING request 3 from 127.0.0.1 took 0 ms. 256 bytes. TTL 64.
     PING request 4 from 127.0.0.1 took 0 ms. 256 bytes. TTL 64.
     PING request 5 from 127.0.0.1 took 0 ms. 256 bytes. TTL 64.
     Round-trip (in milliseconds) min/avg/max = 0/11/57
     Connection verification statistics: 5 of 5 successful (100 %).

                                                               Bottom
Type command, press Enter.
===>

F3=Exit   F4=Prompt   F9=Retrieve   F10=Include detailed messages
F11=Display full      F12=Cancel    F13=Information Assistant   F24=More keys
```

Figure 306. PING LOOPBACK display - Successful Ping messages

2. To test the TCP/IP code, the Ethernet adapter, and the Ethernet LAN, specify the Internet address of the local adapter as defined in the host table:

   ```
   PING RMTSYS(*INTNETADR) INTNETADR('9.4.73.129')
   ```

   Or, enter:

   ```
   PING RMTSYS(SYSNAMA)
   ```

   TCP/IP sends data to the Ethernet adapter, and instructs the adapter to send the data to its own Ethernet address. If you have the correct configuration, the display shown in Figure 307 appears.

```
                                  Command Entry
Request level:   4
 Previous commands and messages:
    > ping asm02
      Verifying connection to host system RCHASM02.rchland.ibm.com at address
        9.5.69.211.
      PING request 1 from 9.5.69.211 took 34 ms. 256 bytes. TTL 64.
      PING request 2 from 9.5.69.211 took 27 ms. 256 bytes. TTL 64.
      PING request 3 from 9.5.69.211 took 9 ms. 256 bytes. TTL 64.
      PING request 4 from 9.5.69.211 took 9 ms. 256 bytes. TTL 64.
      PING request 5 from 9.5.69.211 took 10 ms. 256 bytes. TTL 64.
      Round-trip (in milliseconds) min/avg/max = 9/17/34
      Connection verification statistics: 5 of 5 successful (100 %).

                                                                        Bottom
 Type command, press Enter.
 ===>

 F3=Exit   F4=Prompt   F9=Retrieve   F10=Include detailed messages
 F11=Display full      F12=Cancel    F13=Information Assistant   F24=More keys
```

Figure 307. PING RMTSYS display - Successful Ping messages

If the PING execution ends unsuccessfully, the display shown in Figure 308 appears.

```
                                  Command Entry
Request level:   5
 Previous commands and messages:
    > PING '194.140.3.1'
      Verifying connection to host system 194.140.3.1.
      No response from host within 1 seconds for connection verification 1.
      No response from host within 1 seconds for connection verification 2.
      No response from host within 1 seconds for connection verification 3.
      No response from host within 1 seconds for connection verification 4.
      No response from host within 1 seconds for connection verification 5.
      Connection verification statistics: 0 of 5 successful (0 %).

                                                                        Bottom
 Type command, press Enter.
 ===>

 F3=Exit   F4=Prompt   F9=Retrieve   F10=Include detailed messages
 F11=Display full      F12=Cancel    F13=Information Assistant   F24=More keys
```

Figure 308. PING RMTSYS - Unsuccessful Ping messages

If you received unsuccessful PING messages, you should attempt the following tasks:

1. Check your configuration steps on the local system.
2. Check the configuration at the remote system.
3. Make sure the remote system is not powered down or TCP/IP is up and running.

If you have other error messages, see Appendix E, “TCP/IP Problem Analysis” in *OS/400 TCP/IP Configuration and Reference*, SC41-5420.

A.1.2 TCP/IP configuration using Operations Navigator

This section covers how to perform the following tasks for TCP/IP using Operations Navigator:

- Accessing a basic TCP/IP configuration
- Configuring a TCP/IP interface
- Configuring the domain and host name for TCP/IP
- Configuring host table entries for TCP/IP
- Configuring a TCP/IP route
- Starting and stopping TCP/IP
- Verifying a TCP/IP connection (Ping)

A.1.2.1 Accessing the TCP/IP configuration

AS/400 Operations Navigator is a powerful graphical interface for Windows 95, Windows 98, Windows NT, and Windows 2000 clients. To use Operations Navigator, you must have Client Access installed on your Windows 95, Windows 98, and Windows NT PC and have a connection to the AS/400 system that you want to configure.

TCP/IP allows you to connect an AS/400 system to a network. To reach the point where you can configure TCP/IP for your AS/400 system using Operations Navigator, perform the following steps:

1. Start Operations Navigator by clicking **Start->Programs->IBM AS400 Client Access->AS/400 Operations Navigator**. The AS/400 Operations Navigator window appears (Figure 309).
2. Double-click the **AS/400 Systems** icon (A). It gives you a list of all the AS/400 systems that you can access.
3. Double-click the AS/400 system (AS1) (B) that you want to configure.
4. Double-click **Networks** (C).
5. Double-click **Protocols** (D).
6. Right-click **TCP/IP** (E) in the right panel to see the context menu (Figure 309).

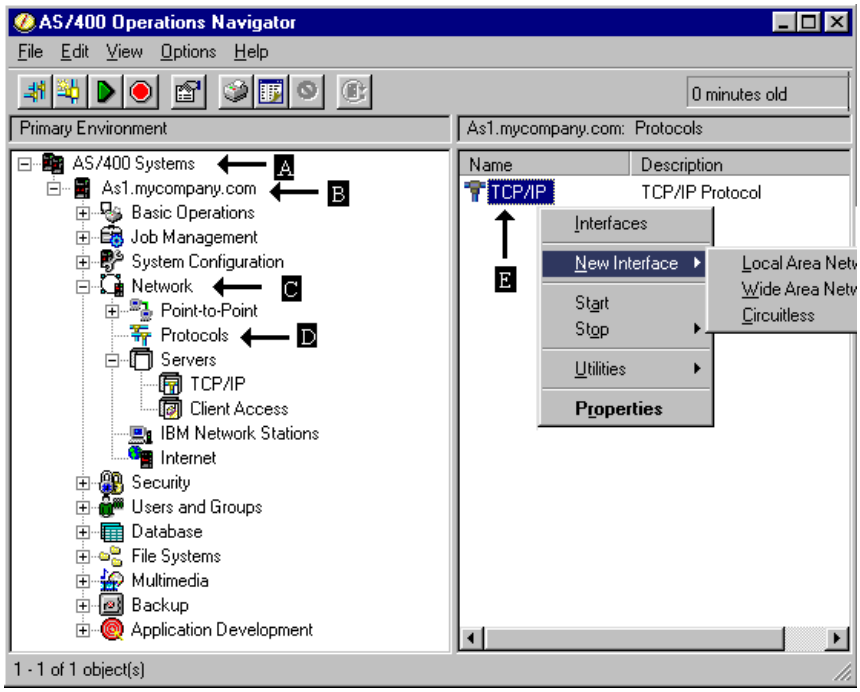

Figure 309. Operations Navigator protocols

You are now ready to start your configuration process.

A.1.2.2 Configuring a line for TCP/IP

The communication objects for AS/400 TCP/IP are the line descriptions, controller descriptions, and device descriptions. Operations Navigator allows you to configure a line for an Ethernet or a Token-Ring network adapter. When TCP/IP starts the line, controller and device descriptions are automatically varied on. If the controller and device descriptions do not exist, TCP/IP automatically creates them.

The procedure to create a line and to add TCP/IP support to it and the procedure to add TCP/IP support to an existing line are similar. In this section, we show a combination of both procedures with notes to point out where the differences occur.

The configuration wizard takes you through the steps that are needed to configure a line for TCP/IP for the AS/400 system. To use the configuration wizard, perform the following steps:

1. Access the TCP/IP context menu using the steps in A.1.2.1, “Accessing the TCP/IP configuration” on page 536.
2. Select **New Interface** from the context menu (Figure 309). Depending on your version and release, you may see the next selection menu Local Area Network, Wide Area Network, or Circuitless. Click **Local Area Network**. You should now see the first window of the TCP/IP wizard interface. Click **Next**. The New TCP/IP Interface Type window appears (Figure 310 on page 538).

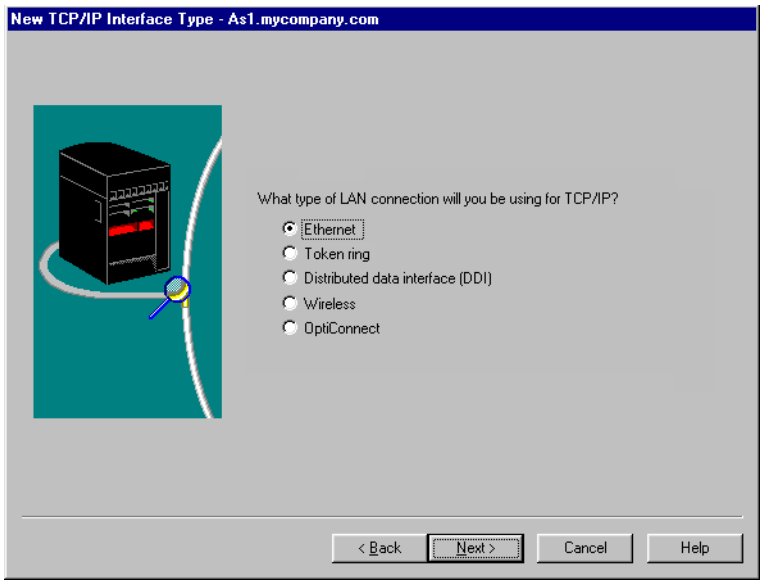

Figure 310. Select Interface Type

3. Select the type of connection you will define for TCP/IP (Ethernet, Token-Ring). In our example, we selected Ethernet. If you select Token-Ring, you may see different parameters to define. Click **Next**. The New TCP/IP Interface Resource window appears (Figure 311).

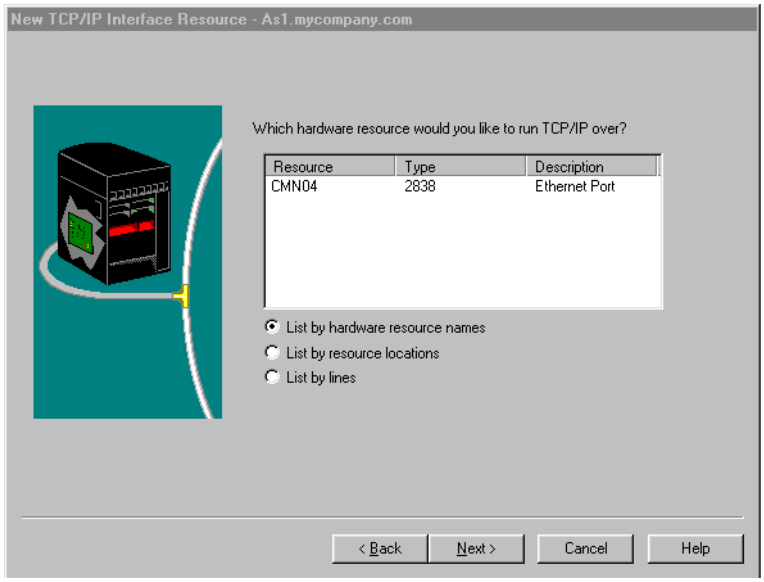

Figure 311. Select Hardware Resource

4. The New TCP/IP Interface Resource window shows all the hardware on your system that matches your type selection. In our example, we have one Ethernet adapter (CMN04). You should use the buttons on the window to determine the location of the adapter. You can also use the buttons to list communication lines that are currently defined. Right-click the hardware resource you want to configure. Click **Next**. The Choosing a Line window appears (Figure 312) if a line is already defined for the hardware resource you selected. Go to the next step. The Creating a New Line Description window

appears (Figure 313) if there are not any lines defined using the selected resource. Go to step 6.

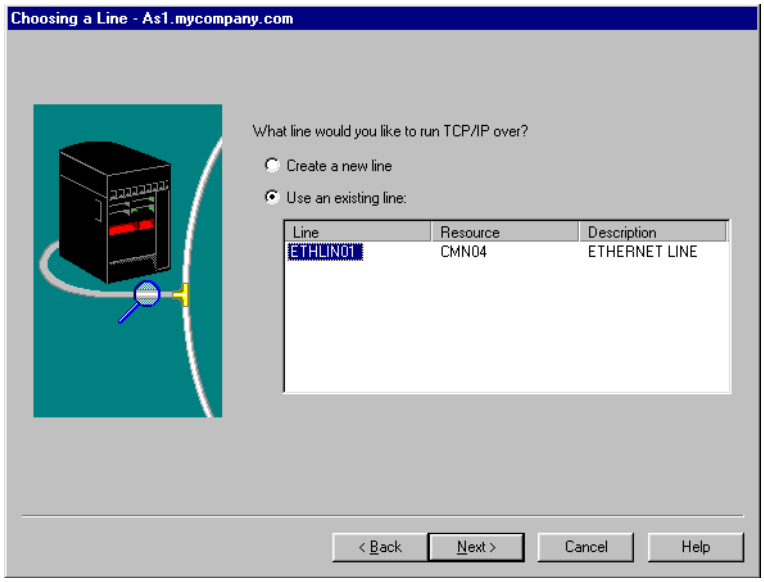

Figure 312. Choosing a Line

5. To configure a TCP/IP interface on an existing line, click **Use an existing line**, and select the line to use from the list provided. Click **Next**. Then go to step 8. To create a new line, click **Create a new line**, and click **Next**. Then, continue with step 6.

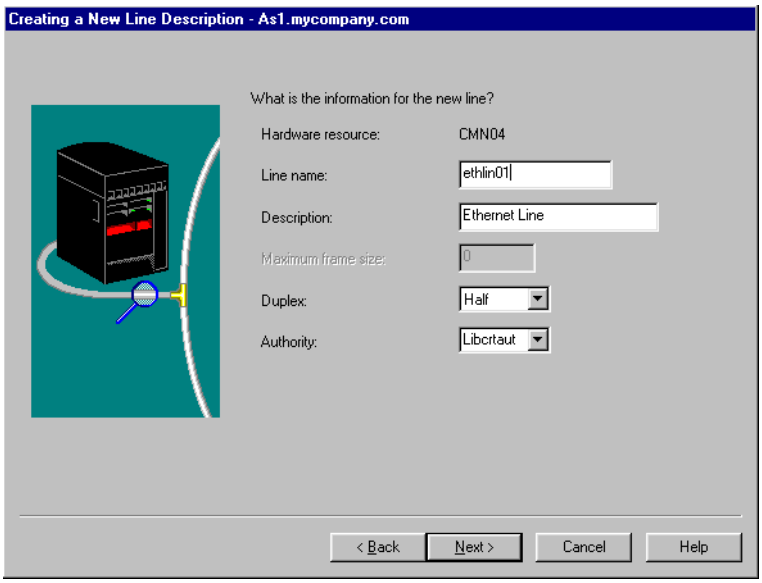

Figure 313. Creating a New Line Description

6. Enter a Name and a Description for the new line. Select the appropriate values for Duplex and Authority based on your environment. The Help button provides additional information to assist you in determining your correct values. The Duplex value is based on the type of network hardware you are using to construct your physical LAN. Click **Next**. The Ethernet Line Characteristics window appears (Figure 314 on page 540).

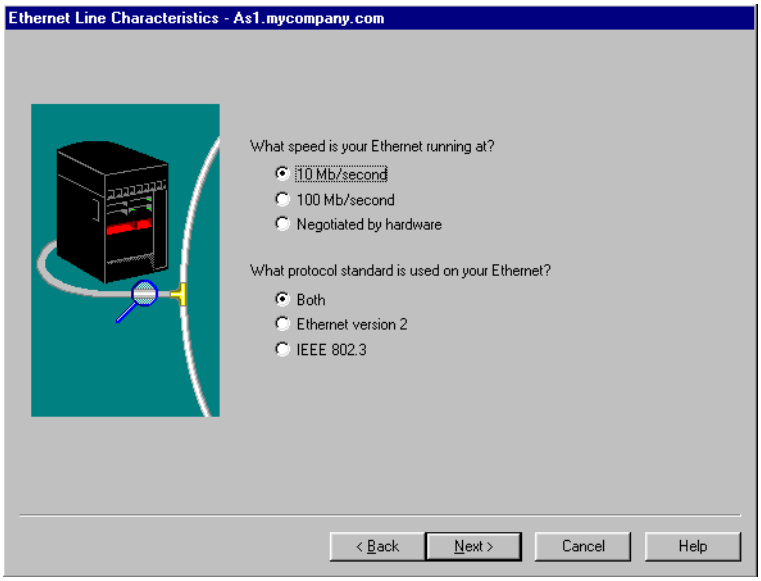

Figure 314. Ethernet Line Characteristics

7. Select the speed at which your LAN is running. Select the protocol standards that you want to support on this adapter. Click **Next**. The TCP/IP Interface Settings window appears (Figure 315).

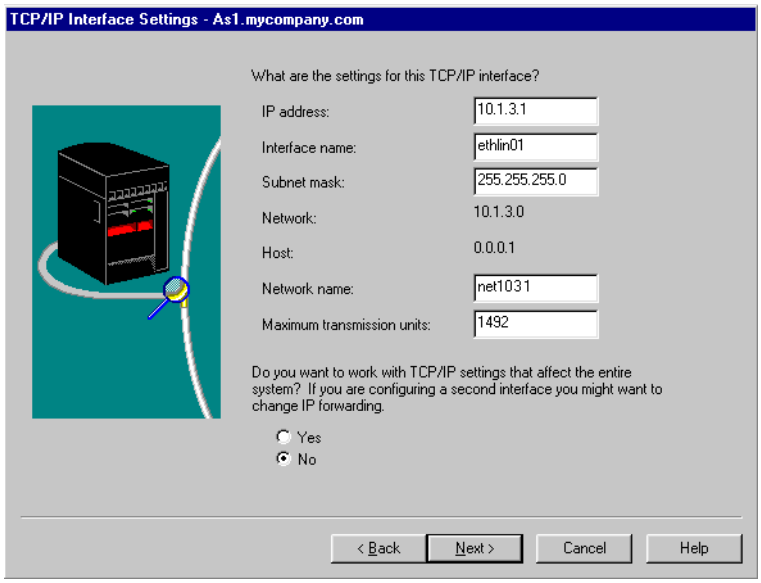

Figure 315. TCP/IP Interface Settings

8. The TCP/IP Interface Settings window (Figure 315) allows you to assign an IP address to your network adapter. Enter the IP address, the Interface name (we used line name), and the Subnet mask for this IP address.

   For the IP address and Subnet mask parameter, you specify the value provided by the LAN administrator or Internet Service Provider (ISP). For the IP Address and Subnet Mask, the system and does a “logical AND” to determine the Network and Host values displayed in the window. The subnet

mask and the IP address enable IP protocol to determine where to send the data it receives.

Network name specifies the name of the network for which you are defining interfaces and routes for the given network address.

The *Maximum transmission unit (MTU)* specifies the maximum size (in bytes) of IP datagram that you can send on this interface. The maximum size specified for a particular route should not be larger than the smallest MTU that is supported by any router or gateway in that route. If the MTU size is larger than the smallest MTU in the route, the router with the small MTU will fragment the packet. This can increase the traffic on the segment and lead to performance degradation. The Help button provides additional information about MTU.

After you specify all the values, click **Next**. The TCP/IP Routing window displays (Figure 316).

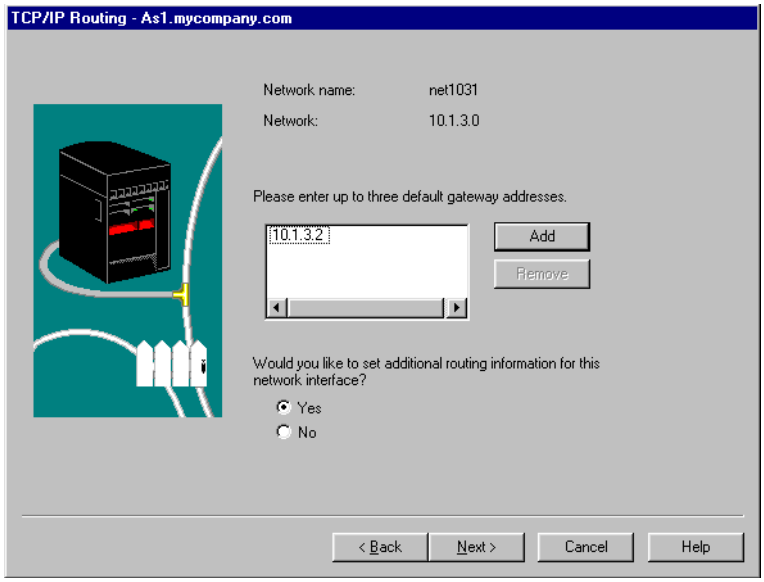

Figure 316. TCP/IP Routing

9. The window in Figure 316 is where you list the gateways to which this route directly connects. A *gateway* is a piece of hardware that connects two or more network segments. It is often called a *router*. You can define up to three gateway addresses. If your AS/400 system is only attached to a single network, then you do not need to specify any gateway addresses. This is also where you specify additional routing information for this interface. This may be used for load balancing or to define multiple routes for backup purposes. Click the **Yes** button to configure additional route information. Click **Next**. The TCP/IP Routing window (Figure 317 on page 542) displays.

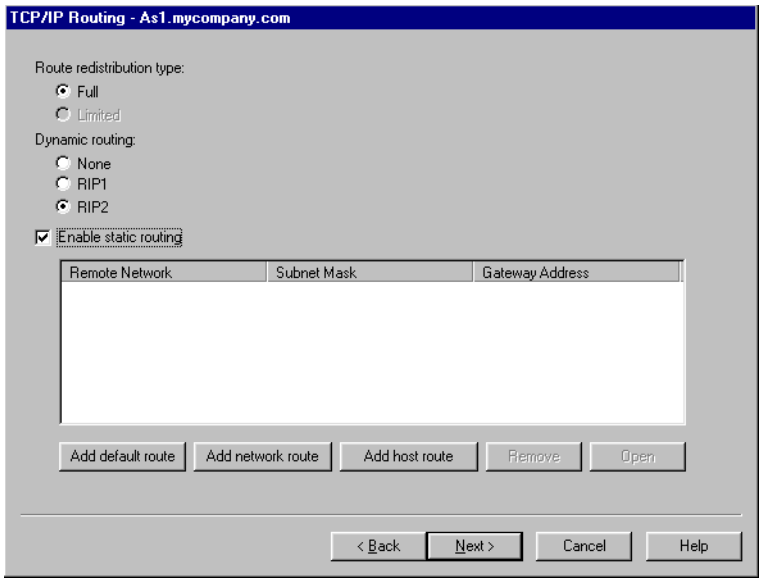

Figure 317. TCP/IP Routing additional information

10. The TCP/IP routing additional information window allows you to specify if these routes should be published to the network using RIP1 or RIP2. You can also define default routes, network routes, and routes to a specific host. Click the appropriate button to add the required routes. In this example, we clicked **Add default route**. The Add Default Route window (Figure 318) appears.

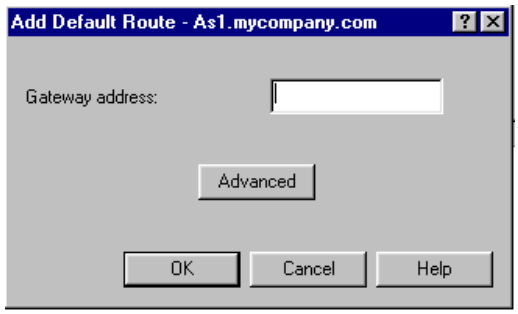

Figure 318. Add Default Route

11. Each of the Add route windows has an Advanced button. Specify the gateway address. Click the **Advanced** button. The Advanced Routing Settings window (Figure 319) appears.

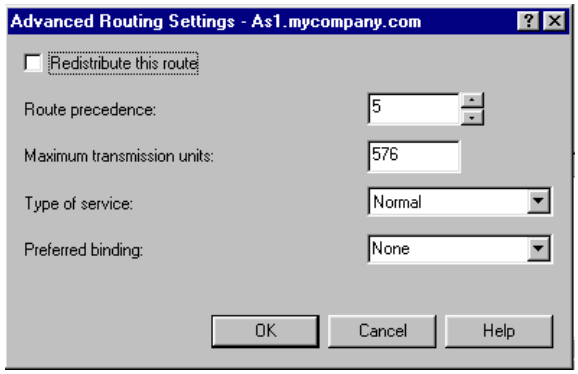

Figure 319. Advanced Routing Settings

12. The Advanced Routing Settings window allows you to specify information about the route. If you leave Route precedence set to 5, then route selection will work as it has always worked. If you set the route precedence to a value of less than 5, this route will not be a preferred route to the destination network. If the route precedence is set to a value greater than 5, then the route will be considered as a preferred route to the destination network. Or, you may have multiple interfaces defined to the same network, and you have multiple routes defined using the interfaces, and the route precedence of these routes are set to the same value greater than 5. In this case, the TCP/IP traffic will be balanced across all the interfaces with routes defined.

    Set the values that you need, and click **OK**. If you do not need to set any advanced values, click **Cancel**.

    When you have added all the route information you need, click **OK** until the TCP/IP Routing window (Figure 317) displays. Click **Next**. The Servers to be Started window (Figure 320) appears.

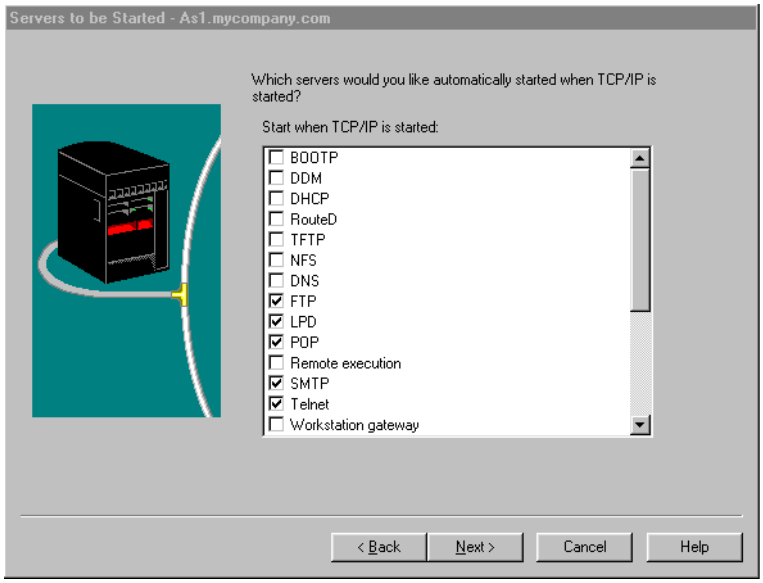

Figure 320. Define Servers to Start when TCP/IP is started

13. From the Servers to be Started window (Figure 320), select all the currently installed servers that you want to start automatically when TCP/IP starts. If

you want to have a particular server automatically started when TCP/IP starts, select the corresponding check box. If you have BOOTP, DHCP, and BOOTP/DHCP servers, only one of them can be selected. After you select all the servers to start, click **Next**. The Start TCP/IP Interface window (Figure 321) appears.

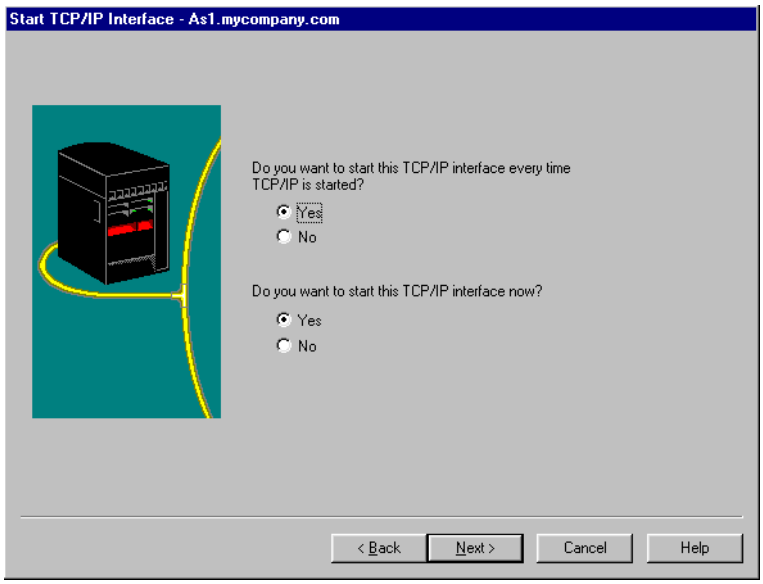

Figure 321. Interface start options

14. From the Start TCP/IP Interface window, you identify whether you want this TCP/IP interface started whenever you start TCP/IP and whether you want this TCP/IP interface to start now. If you choose to start the TCP/IP interface here, the interface begins testing when you click **Next**. After a successful test, the New TCP/IP Interface Summary window (Figure 322) appears.

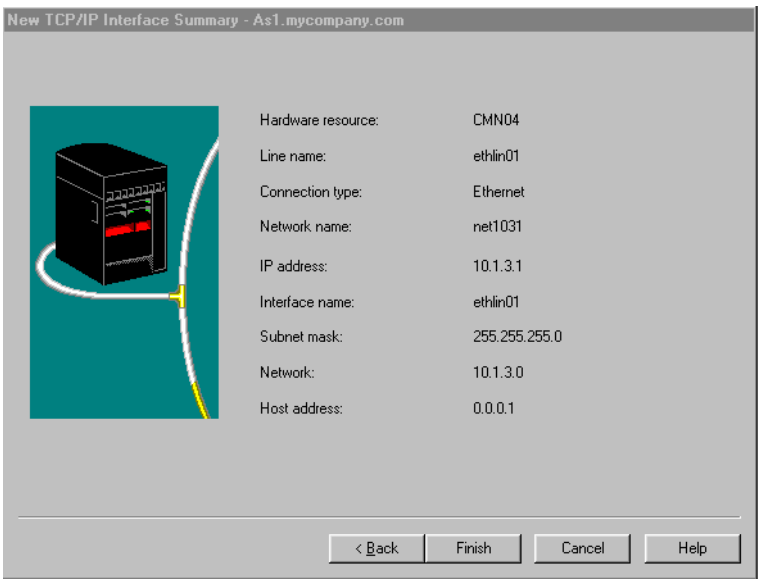

Figure 322. New TCP/IP Interface Summary

15. Verify that all the information displayed is correct. If you need to make changes, click **Back** to go back to the correct window and make your changes. If all the values are correct, click **Finish**.

You have now defined a TCP/IP interface using Operations Navigator.

A.1.2.3 Changing TCP/IP properties

The TCP/IP attributes of the AS/400 system are accessible from Operations Navigator using the properties selection of the context menu. To use the Operations Navigator, perform the following steps:

1. Access the TCP/IP context menu using the steps explained in A.1.2.1, “Accessing the TCP/IP configuration” on page 536.
2. Select **Properties** (E) from the context menu to make detailed changes to the configuration of your TCP/IP interface. Figure 323 on page 546 shows the TCP/IP Properties window. Click **Host Domain Information** to specify the host domain information for your AS/400 TCP/IP communication. Specify the host name, the domain name, and up to three domain name servers. You can also specify the search order and set advanced TCP/IP settings.
   - **Host name**: Specifies the name for the AS/400 system. You may not always remember a host by its IP address, but you may find it easier to remember hosts by a name. The host name can be combined with the domain name to make a fully qualified name.
   - **Domain name**: The domain name is a descriptive label for your organization such as your_workplace.com. The two parts of the local domain name are the local domain name and the local host.
   - **Domain name servers**: List up to three domain server IP address. The system uses the domain servers in the order that you list them. The domain name servers performs host name resolution by translating the host name into an IP address.
   - **Search order**: Specifies whether you want the local host table searched before the domain name server. Figure 323 on page 546 shows the Host Domain Information dialog.

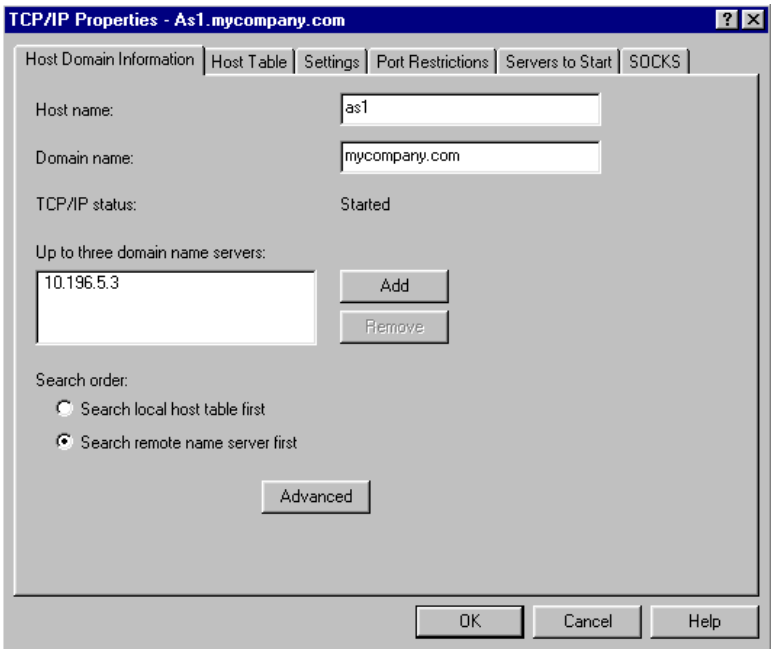

Figure 323. Host Domain Information

3. Click **Advanced** to set additional DNS values. The Advanced Host Domain Information window (Figure 324) appears. The default values shown work in most environments. If you have intermittent trouble resolving names to IP addresses, you may want to increase the number of attempts and the interval between attempts. If these values are set too high, you may experience a long wait time before an “unknown host” message is displayed.

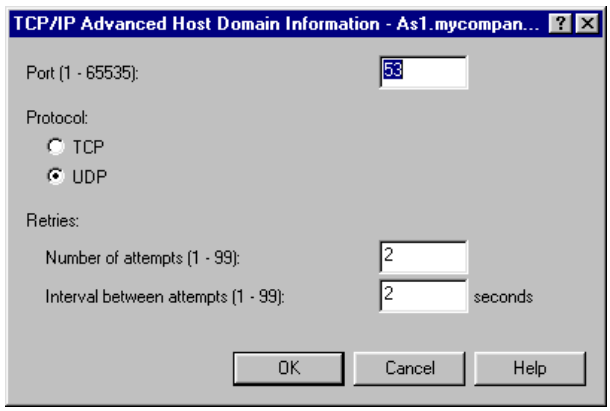

Figure 324. Advanced Host Domain Information settings

4. Click the **Host Table** tab to add and remove host table entries. If you are using the Domain Name System (DNS), you do not necessarily need to add entries here. Figure 325 shows the Host Table dialog.

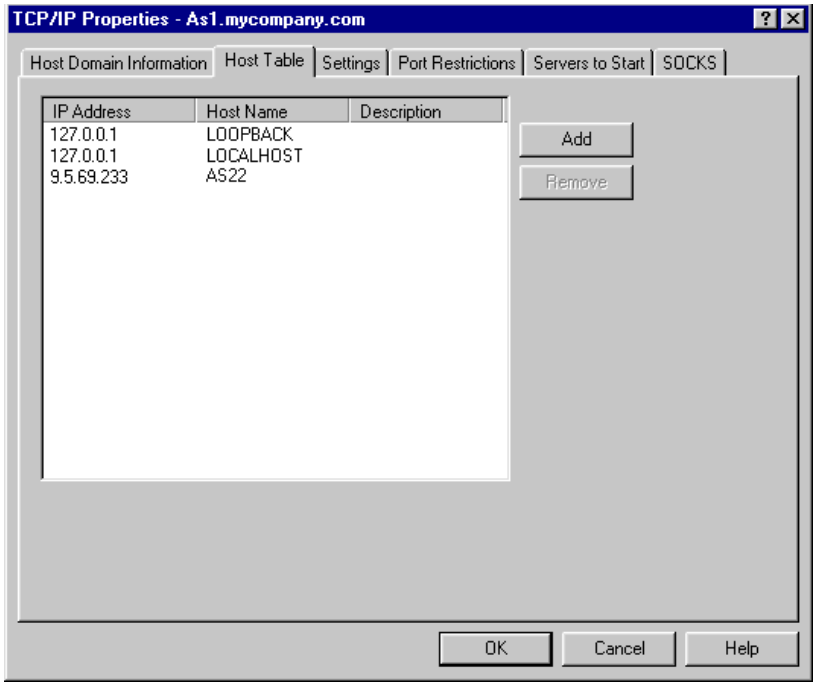

Figure 325. Host Table

5. Click the **Settings** tab to specify IP datagram forwarding, to select a TCP urgent pointer convention, and to enter a TCP keep-alive time. You can also use the settings page to log protocol errors, enable IP source routing, and enter a buffer size, time-out, and other values.

   IP forwarding specifies whether you want the IP layer to forward IP datagrams between different networks. This specifies whether the IP layer acts as a gateway (router). It allows the AS/400 system to pass IP datagrams that come in one adapter to another adapter.

   The TCP keep-alive field specifies the amount of time, in minutes, that TCP waits before sending a probe to the other side of a connection. TCP sends the probe when the connection is otherwise idle, even when there is no data to be sent. Figure 326 on page 548 shows the Settings dialog.

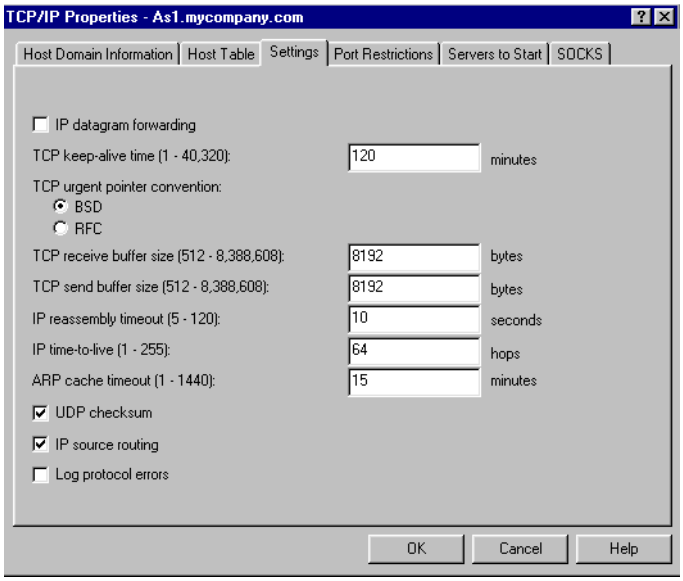

Figure 326. TCP/IP Settings

6. Click the **Port Restriction** tab to limit port use to a user profile name. If you want to restrict a single port, you must specify the same starting and ending port number. Figure 327 shows the Port Restrictions dialog.

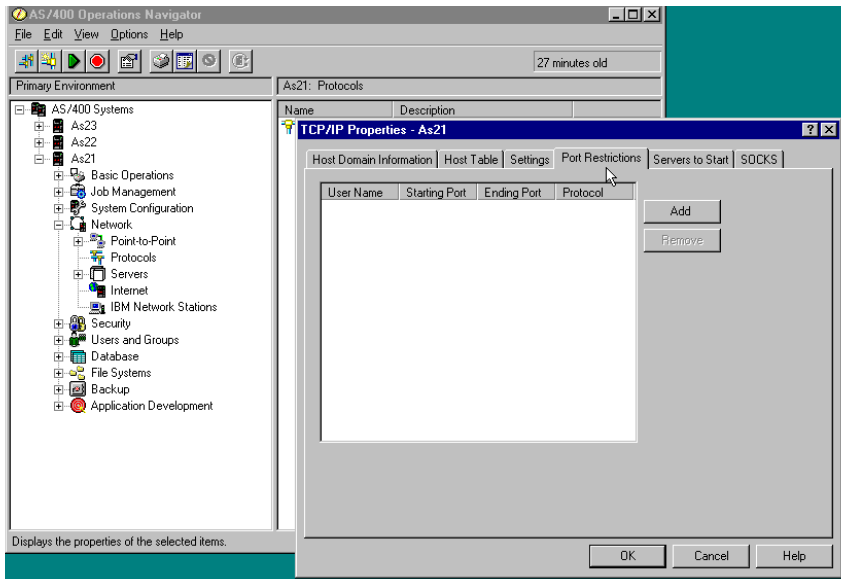

Figure 327. Port Restrictions

7. Click the **Servers to Start** tab to select the currently installed servers that you want to start automatically when TCP/IP starts. Check the servers corresponding check box. If you have BOOTP, DHCP, and BOOTP/DHCP servers, only one of them can be selected. Figure 328 shows the Servers to Start dialog.

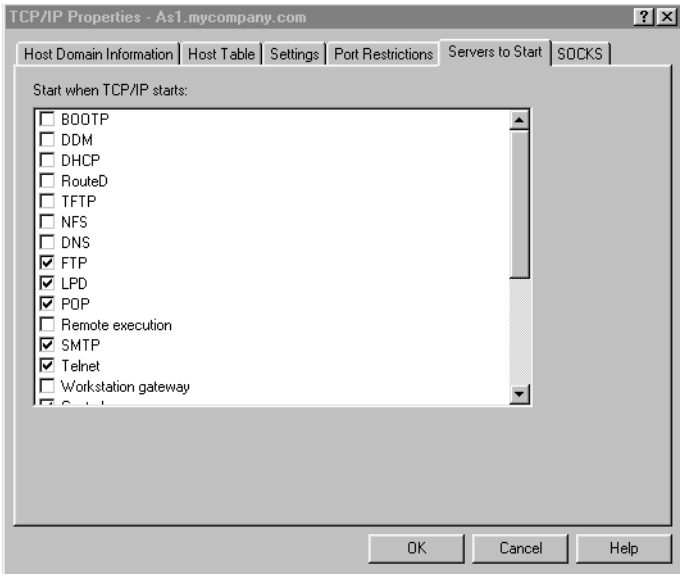

Figure 328. Servers to Start

8. Click the **SOCKS** tab to define the TCP client connection to internal secure networks and to less secure networks. You can define a direct connection to servers in the internal secure network. Users must have *IOSYSCFG special authority to change information on this dialog. Figure 329 shows the SOCKS dialog.

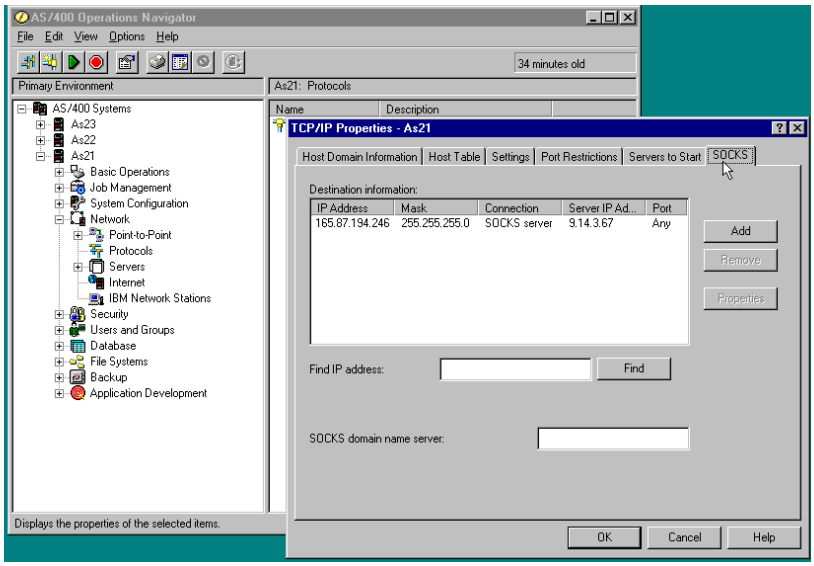

Figure 329. SOCKS

9. After completing changes to the TCP/IP Properties Dialog, click **OK** to save the configuration file and close the window.

A.1.2.4 Configuring host table entries

You must configure host table entries for TCP/IP if you want the users of your AS/400 system to use easily remembered names rather than IP addresses. If you

are using the Domain Name System (DNS), you do not need to configure host table entries.

The host table provides the advantage of not having to remember actual Internet addresses for systems in the network. The host table accomplishes this task by mapping Internet addresses to TCP/IP host names. The local host table on your AS/400 system contains a list of the Internet addresses and related host names for your network.

Before you begin configuring your host table entries for TCP/IP, you need to know the IP addresses of your hosts. You also need the to know the host names and descriptions of the hosts that you want to include in the host table.

To configure host table entries for TCP/IP using Operations Navigator, perform the following steps:

1. Select the appropriate TCP/IP window, as follows:
   a. Start Operations Navigator by clicking **Start ->Programs->IBM Client Access->AS/400 Operations Navigator**. The AS/400 Operations Navigator window appears (Figure 330).
   b. Double-click the **AS/400 Systems** icon (A). A list of all the AS/400 systems should appear that can be configured.
   c. Double-click the AS/400 system you want to configure (B).
   d. Double-click **Networks** (C).
   e. Double-click **Protocols** (D).
   f. Right-click **TCP/IP** to open a context menu (E).
2. Select **Properties** from the context menu (F). Figure 330 shows the context menu - Properties option.

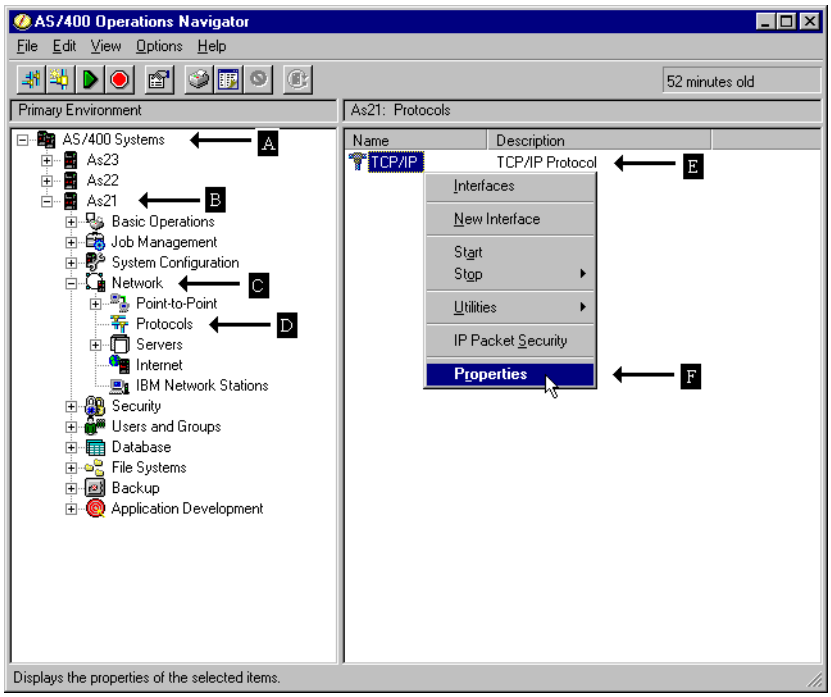

Figure 330. Context menu - Properties

3. Click the **Host table** (A) tab as shown in Figure 331.
4. Click the **Add** (B) button to specify the IP address, hostname, and description of the host that you want to include in the host table. Figure 331 shows the TCP/IP Host Table entry dialog.

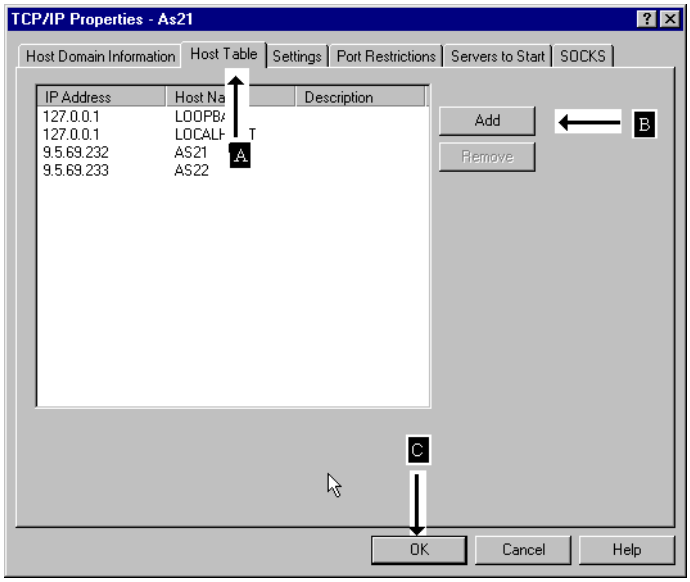

Figure 331. TCP/IP Host Table entry

5. Click **OK** (C) to save the configuration file and close the window.

A.1.2.5 Configuring the domain and host name

You must configure the local domain and host name if you use a remote name server that requires a full domain to resolve an IP address. The local domain name is information that is provided by:

- The network provider
- The local network administrator

This is a “true” intranet if the name is created by the customer.

Within TCP/IP, the primary name associated with your system can have more than one name (your system can have more than one name). It is called your local domain and host name. This is important if you later want to set up e-mail, LPR, and ANYNET. They require the local domain and host name. File transfer and Simple Network Management Protocol use these names, but do not require them.

To configure a local domain and host name for TCP/IP, perform the following steps:

1. Select the appropriate TCP/IP window as follows:
   a. Start Operations Navigator be clicking **Start->Programs->IBM Client Access->AS/400 operations Navigator**.
   b. Double-click your **AS/400 Systems** icon (A). It should give you a list of all the AS/400 systems that you can configure.

c. Double-click the AS/400 system for which you want to configure a domain and host name (B).

d. Double-click **Networks** (C).

e. Double-click **Protocols** (D).

f. Right-click **TCP/IP** to open a context menu (E).

g. Select **Properties** from the context menu (F). Figure 332 shows the context menu - Properties option.

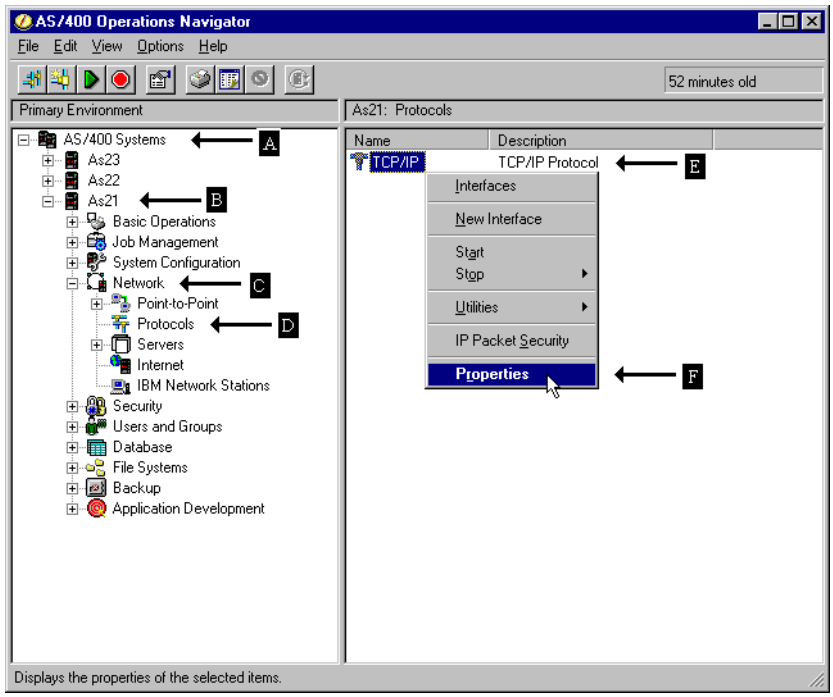

Figure 332. Context menu - Properties

h. Click the **Host Domain Information** tab (A) as shown in Figure 333.

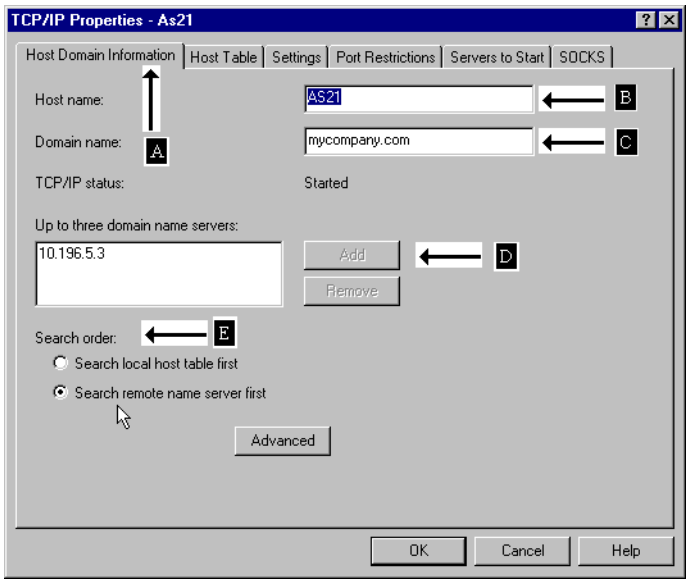

Figure 333. Host Domain Information

2. Specify your host name (B) and domain name (C). You can also select the search order (D), set advanced TCP/IP settings, and specify up to three domain name servers.
3. Click **OK** to save the configuration file.

A.1.2.6 Configuring a TCP/IP route

A network can consist of many interconnected networks. A route must be defined for your system to communicate with a system on another network. If you want to reach remote networks, you need to configure a TCP/IP route for your AS/400 system.

A TCP/IP interface must be defined before defining a route. A TCP/IP interface implicitly defines a direct route. This is because interfaces define a route to a network to which the AS/400 system is directly connected. Routes added using the AS/400 route commands are called *indirect routes* because they define a route to a network to which the AS/400 system is not connected to directly.

The NextHop Internet address for a route definition must exist on a network to which one or more TCP/IP interfaces are connected. The NextHop Internet address usually defines a router or gateway.

Specify the IP address of the router as the default routing entry on the AS/400 system (next hop). This tells the AS/400 system to look for this router if it cannot find a TCP/IP address on its own local network. If you do not configure a TCP/IP route, your AS/400 system cannot reach systems that are on other networks. You may also want to configure a TCP/IP route to give TCP/IP clients access to your AS/400 system.

You do not need to manually configure the routes that tell TCP/IP how to reach the local networks. AS/400 TCP/IP generates these routes automatically from the configuration information for the interfaces every time that TCP/IP starts. Any changes that you make to the routing information take effect immediately.

To configure a TCP/IP route, perform the following steps:

1. Select the appropriate TCP/IP window, as follows:
   a. Double-click your **AS/400 Systems** icon (A) and it should give you a list of all the AS/400 systems that you are configuring.
   b. Double-click the AS/400 system that you want to configure a TCP/IP route for (B).
   c. Double-click **Network** (C).
   d. Double-click **Protocols** (D).
   e. Right-click **TCP/IP** to open a context menu (E). Select **New Interface** (F). Figure 334 shows the context menu - New Interface option.

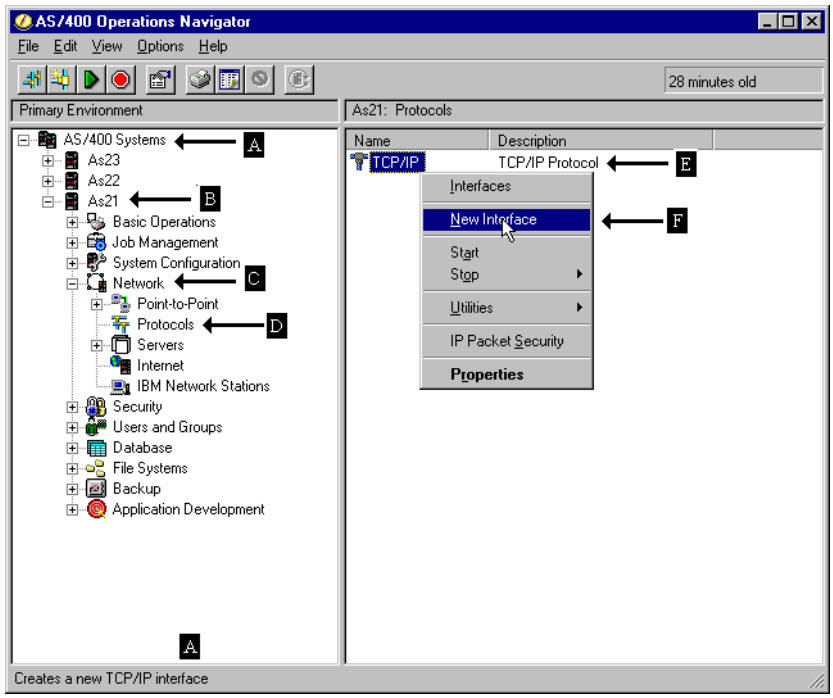

Figure 334. Context menu - New Interface

2. Follow the wizard's instruction to configure your TCP/IP route. Figure 335 shows the first window of the TCP/IP Interface wizard.

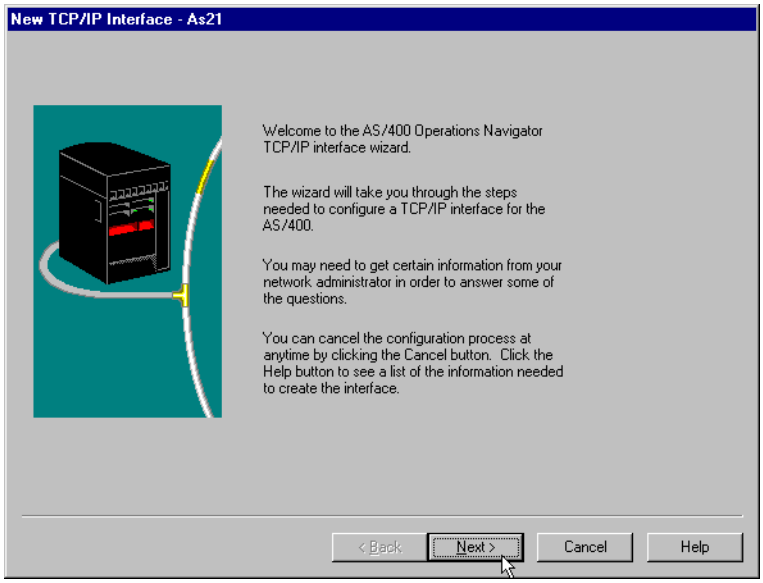

Figure 335. TCP/IP Wizard Interface

A.1.2.7 Starting and stopping TCP/IP

Starting TCP/IP initializes and activates the TCP/IP process, starts the TCP/IP interfaces, and starts the TCP/IP server jobs. TCP/IP must be started before any TCP/IP process can be performed on the AS/400 system. Starting TCP/IP only starts the TCP/IP application jobs that have the AUTOSTART configuration attribute value of *Yes. After starting TCP/IP, the QTCPIP job in the QSYSWRK subsystem is started. The QTCPIP job is used for activating and deactivating TCP/IP interfaces.

When TCP/IP or ANYNET is already active, use the Start TCP/IP Server (STRTCPSVR) command to start additional TCP/IP Application Servers.

Starting TCP/IP

To start TCP/IP, follow this process:

1. Select the appropriate TCP/IP window as follows:
   a. Double-click the **AS/400 Systems** icon (A) in the Operations Navigator tree to give you a list of the AS/400 systems that you are configuring.
   b. Double-click the AS/400 system that you want to start TCP/IP processing (B).
   c. Double-click **Network** (C).
   d. Double-click **Protocol** (D).
   e. Right-click **TCP/IP** to open the context menu (E).
2. Select **Start** (F) to initialize and activate TCP/IP processing, start TCP/IP interfaces, and start TCP/IP server jobs. Figure 336 on page 556 shows the context menu to start TCP/IP and the Start TCP/IP dialog.

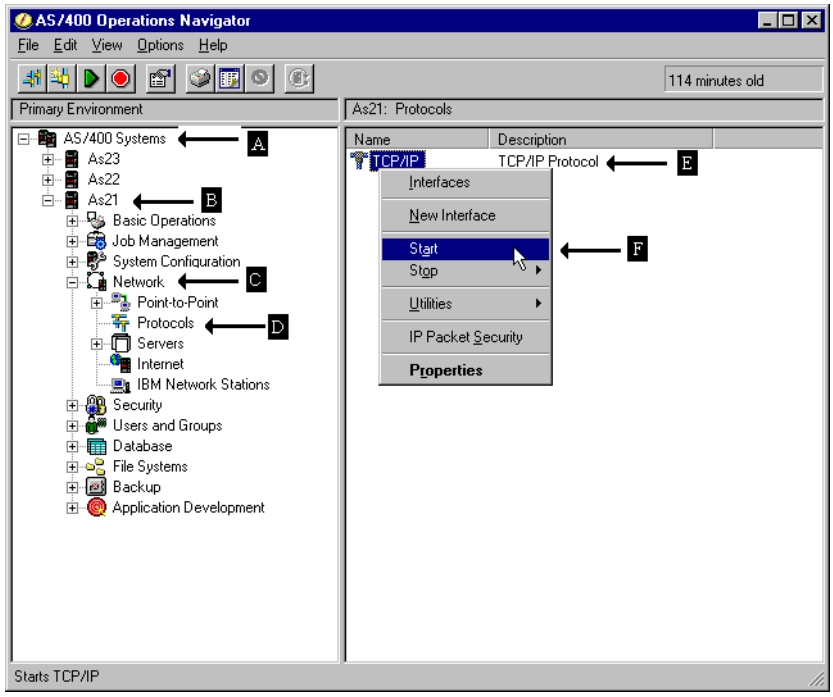

Figure 336. Start TCP/IP

Stopping TCP/IP

Stopping TCP/IP ends all TCP/IP processing, all active TCP/IP interfaces, and all TCP/IP connections on the AS/400 system on which you are working. Unless ENDSVR (*NO) is specified, all TCP/IP server jobs for agents that are currently active in QSYSWRK subsystem are ended. There is no confirmation display shown when stopping TCP/IP, so this should be done with caution. There are two possible values when stopping TCP/IP: controlled and immediately. Follow these steps to stop TCP/IP by using Operations Navigator:

1. Perform the following steps:
   a. Double-click the **AS/400 Systems** icon (A) in the Operations Navigator tree to give you a list of the AS/400 systems that you are configuring
   b. Double-click the AS/400 system you want to stop TCP/IP processing (B).
   c. Double-click **Network** (C).
   d. Double-click **Protocol** (D).
   e. Right-click **TCP/IP** to open a context menu (E).
2. Select **Stop** (F).
3. Select **Controlled** or **Immediately** (G). Figure 337 shows the Stop TCP/IP dialog.

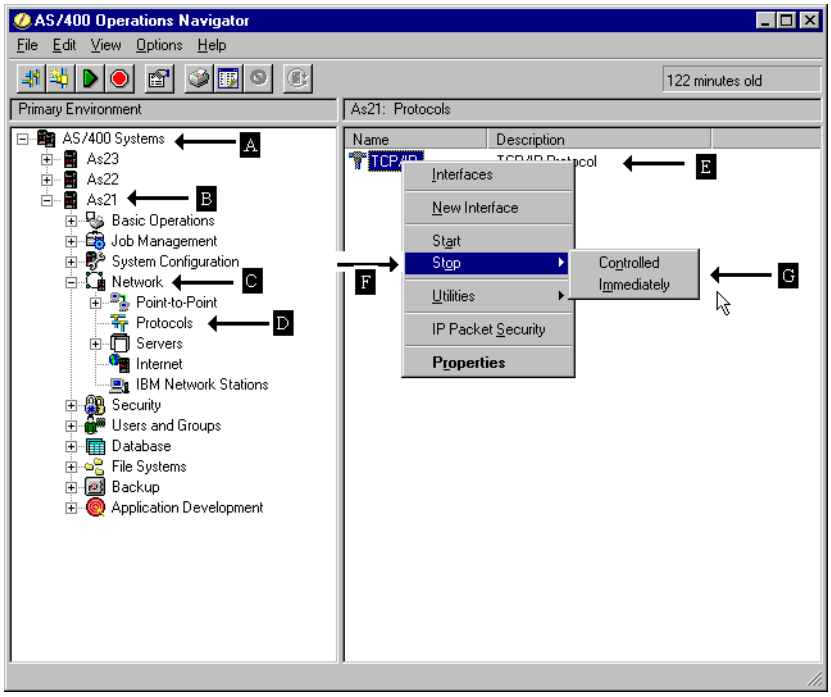

Figure 337. Stop TCP/IP

A.1.2.8 Verifying a TCP/IP connection (ping)

Verifying a network connection (ping) function is one of the best problem determination tools around for quick diagnosis of a problem in your TCP/IP network. Ping tests the TCP/IP connection between a system and the remote system specified on the remote system parameter. It tells you if you can see the host to which you are trying to connect.

When you ping a machine, you send an Internet Control Message Protocol (ICMP) echo request to that machine. A successful reply means that the network's primary transport and communication systems are functioning properly.

To ping a machine using Operations Navigator, perform the following steps:

1. Double-click the **AS/400 Systems** icon (A), and it should give you a list of all the AS/400 Systems that you can configure.
2. Double-click **Network** (B).
3. Double-click **Protocol** (C).
4. Select **TCP/IP** (D).
5. Right-click **TCP/IP** to open a context menu (E).
6. Select **Utilities** (F).
7. Select **Ping** (G). Figure 338 on page 558 shows the Ping dialog.

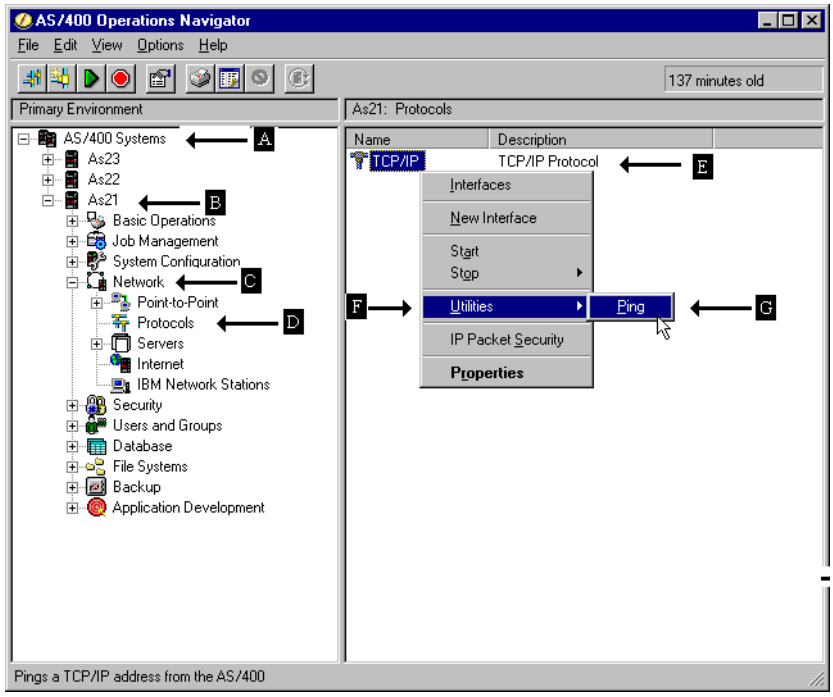

Figure 338. Ping from Operations Navigator

8. As shown in Figure 339, type the IP address or host name of the interface of the host to which you want to test connectivity, and click **Ping Now**. The results of the ping are displayed. Figure 339 shows the Ping from dialog.

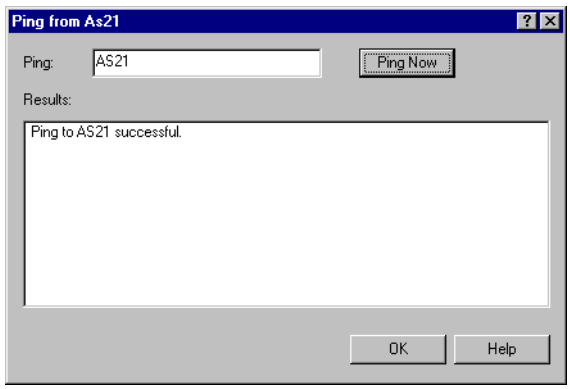

Figure 339. Ping from dialog

A.2 Connecting through a gateway or different network

If you have to connect with a remote host in a different network or subnetwork to the local host (or you use a gateway), it is necessary to configure a route. For example, suppose someone using a PC is attempting to use the TELNET application to start a remote terminal session on this AS/400 system. Obviously, the application on the PC must know the route or path to reach the AS/400 system. However, your AS/400 system must also be able to determine the route back to the PC. If the PC and your AS/400 system are not on the same network, a routing entry must exist both on the PC and on the AS/400 system.

A TCP/IP interface must be defined before defining a route. A TCP/IP interface implicitly defines a direct route. This is because interfaces define a route to a network to which the AS/400 system is directly connected. Routes added using the route commands are called *indirect routes* because they define a route to a network that the AS/400 system is not connected to directly. The NEXTHOP Internet address for a route definition must exist on a network to which one or more TCP/IP interfaces are connected. The NEXTHOP Internet address usually defines a router or gateway. Use the Work with TCP/IP Route Entries display to add route information or to display, change, print, or remove route information.

A.2.1 Scenario

In this scenario (Figure 340), there are two Ethernet networks. We want to connect our first network to the second one. We need a route to know how to go to the 9.5.7.128 network.

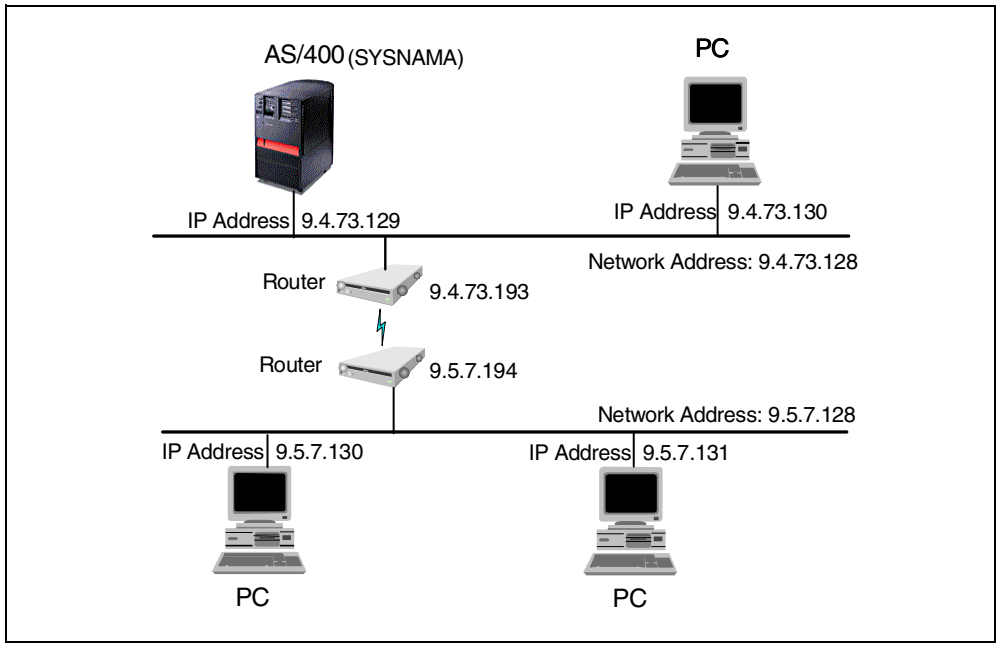

Figure 340. Two Ethernet LANs connected with routers example

A.2.2 Route configuration

To configure a TCP/IP route, perform the following steps:

1. Select option **2** (Work with TCP/IP routes) from the CFGTCP menu, and press Enter. The display shown in Figure 341 on page 560 appears.

```
                          Work with TCP/IP Routes

Type options, press Enter.
  1=Add   2=Change   4=Remove   5=Display

     Route            Subnet           Next             Preferred
Opt  Destination      Mask             Hop              Interface

     *DFTROUTE        *NONE            9.4.73.193       *NONE

                                                                      Bottom
F3=Exit      F5=Refresh   F6=Print list   F11=Display type of service
F12=Cancel   F17=Top      F18=Bottom
```

Figure 341. CFGTCP menu display - Work with TCP/IP Routes

2. Select option **1** (Add) to add an entry to the TCP/IP routes. The display shown in Figure 342 appears.

```
                        Add TCP/IP Route (ADDTCPRTE)

Type choices, press Enter.

Route destination  . . . . . > 9.5.7.128    *Note 1
Subnet mask  . . . . . > '255.255.255.128'
Type of service  . . . . . *NORMAL       *MINDELAY, *MAXTHRPUT...
Next hop . . . . . > '9.4.73.193'
Preferred binding interface  . .  *NONE
Maximum transmission unit  . . .  *IFC          576-16388, *IFC
Route metric . . . . . 1             1-16
Route redistribution . . . . . *NO           *NO, *YES
Duplicate route priority . . . . 5             1-10

                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 342. Add TCP/IP Route (ADDTCPRTE) display

Although there are five parameter values to define a route, you only need to type three of them and assume the others. These values are:

- The route destination: 9.5.7.128
- The subnet mask: 255.255.255.128
- The Internet address of the next system on the route, Next hop: 9.4.73.193

Note 1: Depending on your configuration, the last route destination octet may need to be a “1”.

Appendix B. System 21 products and dependencies

The System 21 product set is divided into key business areas. Each business area is supported by a number of application modules.

The following sections detail the application modules by business area including application pre-requisites.

B.1 Finance

The System 21 Finance application modules are detailed in Table 85.

Table 85. Finance application modules

Application	Description	Essential pre-requisites
PL	Accounts Payable	GL, SL, CS
SL	Accounts Receivable	GL, SL, CS
FI	Advanced Financial Integrator	GL, IN
BP	Bacstel	GL, PL, SL
CS	Cash Management	GL, PL, SL
FA	Fixed Assets	FB
GL	General Ledger	Local (DX / IT / US)

B.2 Customer Service and Logistics

The System 21 Customer Service and Logistics application modules are detailed in Table 86.

Table 86. Customer Service and Logistics application modules

Application	Description	Essential pre-requisites
AI	Application Interface	IN, Premonos EDI
AO	Advanced Order Entry	OE, IN, PM, RQ,SL
CR	Customer Returns	IN, OE,SL
DR	Distribution Requirements Planning	IN, OE, PM, RQ, GL, SL, PL
DY	Document Processing	IN
FC	Forecasting	IN, GL
IN	Inventory Management	(None)
OE	Sales Order Processing	IN, SL
JC	Job Management	GL, SL
PM	Purchase Order Management	IN, PL, GL
RQ	Requisitioning	IN, PM, GL, PL
SA	Sales Analysis	IN, OE

Application	Description	Essential pre-requisites
SS	Service Management	IN, OE, SL, GL
TP	Transport Planning	IN, OE
TS	Telesales	IN, OE
US	US Sales Tax	OE
WH	Warehousing	IN
WT	World Trade	IN, GL

B.3 Production

The System 21 Production application modules are detailed in Table 87.

Table 87. Production application modules

Application	Description	Essential pre-requisites
CP	Capacity Planning	IN, PD or MD, PC or MP or MR
MP	Master Production Scheduling	IN, PD (MD optional)
MR	Material requirements Planning	IN, PD (MD optional), PC or MP or MRIN
PD	Product Data Management	IN
PC	Production Control and Costing	IN, PD (MD optional)
MD	Production PDM	IN, PD
MK	Production Schedule Control	IN, MD, MR
MJ	Production Support	IN, PD, PC or MK

B.4 Automotive

The System 21 Automotive application modules are detailed in Table 88.

Table 88. Automotive application modules

Application	Description	Essential pre-requisites
AC	Advanced Customer Scheduling	IN, OE, SL, GL
AG	Advanced Receiving	IN, OE, SL, GL, VS
AS	Advanced Shipping	IN, OE, SL, GL, AC
VS	Vendor Scheduling	IN, OE, SL, GL

B.5 Drinks

The System 21 Drinks application modules are detailed in Table 89.

Table 89. Drinks application modules

Application	Description	Essential pre-requisites
DA	Drinks Sales Analysis	DI, DO
DI	Drinks Inventory	(None)
DO	Drinks Sales Order Processing	DI, SL
DP	Drinks Purchase Management	DI, DP
DS	Drinks Telesales	DI, DO
DB	Drinks Bonded Inventory	DI, DO
DD	Drinks Distribution Requirements Planning	DO, DP
DE	Drinks EDI	DI
DN	Drinks US Bonded Inventory	DI, DO, DB
DT	Drinks Transport Planning	DI, DO
DW	Drinks Warehousing	DI

B.6 Style Distribution

The System 21 Style Distribution application modules remain consistent with the standard Customer Service and Logistics modules detailed in Table 86 on page 561. Table 90 on page 564 illustrates the generic application code for the Style Distribution product set.

Table 90. Style Distribution application modules

Application	Description	Essential pre-requisites
ST	Style Distribution	Each Style Distribution application requires the equivalent standard Customer Service & Logistics application to be loaded. AI CR DR FC IN OE PM RQ SA WH WT Also load the libraries OSLD1F3 and OSLD2F3 as required for these applications.

B.7 Style Production

The System 21 Style Production application modules are detailed in Table 91.

Table 91. Style Production application modules

Application	Description	Essential pre-requisites
P1	Style Product Data Management	ST
P2	Style Production scheduling	P1
P3	Style Materials Planning	P1
P4	Style Production Control	P1

B.8 Client Applications

The System 21 Client Applications modules are detailed in Table 92.

Table 92. Client Applications modules

Application	Description	Essential pre-requisites
S1	System 21 Explorer (includes Designer)	AM, CF and any required applications
VP	Visualise	GL and System 21 Explorer

B.9 Additional modules

Additional System 21 application modules are detailed in Table 93.

Table 93. Additional modules

Application	Description	Essential pre-requisites
QS	Quality System	CI, IN, PM, PC

Appendix C. Suggested schedule for Machine Manager

The following tables contain suggestions for setting up Machine Manager, to run for Distribution, Manufacturing and Finance, both for Day Start and Day End.

C.1 Day Start

Table 94 lists suggested jobs to run during the Auto Day Start process. The column called *F. key to use* indicates which function key to use to set up the job. When *F. key to use* is not specified, type the supplied command from the table in the *Request Data* field in the task setup screen.

This is not an exhaustive list. Refer to the Geac Information Sheet number 260 for further details.

Table 94. Suggested ADS jobs for Machine Manager

Day Start Seq	Description	Job name	Command or application task to run	F. key to use	Day mask SMTWTFS	Sched time
10	Hold PWRDWNSYS Job Queue		HLDJOBQ JOBQ(PWRDWNSYS)	F10	1111111	999999
20	Start QINTER		STRSBS SBSD(QINTER)		1111111	999999
30	Start IBM cleanup		STRCLNUP *IMMED		1111111	999999
40	Start QBATCH		STRSBS SBSD(QBATCH)		1111111	999999
50	Start QSPL		STRSBS SBSD(QSPL)		1111111	999999
60	Start QPGMR		STRSBS QPGMR		1111111	999999
70	Start TCP/IP		STRTCP		1111111	999999
80	Start Host Servers		STRHOSTSVR *ALL		1111111	999999
90	Clear Inventory Record Locks File		CLRPFM OSLD1F3/INP99		1111111	999999
100	Start WFBACK3		STRSBS IPGAMP4/WFBACK3		1111111	999999
110	Start Work Management		STRWM nnn (nnn = Environment name)		1111111	999999
120	Work Management Transaction recover		WMRECOVER nnn (nnn = Environment name)		1111111	999999
130	Work Management Extract to History		EWMARCH nnn (nnn = Environment name)		1111111	999999

140	Work Management Performance Extract		EWPERF nnn (nnn = Environment name)		1111111	999999
150	Work Management Process Remodelling Extract		EWMRMDLXT nnn (nnn = Environment name)		1111111	999999
1000 to 2999	Start application background jobs		See Table 96 on page 570 for a list of subsystem names and background job-end task codes.		1111111	999999
4000	Invoice print and posting	OE_INVOICE	Application: OE/ /03 Task: 3032	F20	1111111	999999
4100	Sales Analysis Update	SAL_HIS_UPD	Application: SA/ /03 Task: 9000	F20	1111111	999999
4200	Daily Sales Analysis Update	DAILY_UPD	Application: SA/ /03 Task: 1160	F20	1111111	999999
4300	Weekly Sales Analysis Update	WEEKLY_UPD	Application: SA/ /03 Task: 1170	F20	1000000	999999
9900	ENDDAY Initiation		SBMENDDAY	F10	1111111	999999
9999	Delete ADS Overrides		DLTADSOVR	F10	1111111	999999

C.2 Day End

Table 95 lists suggested jobs to run during the Auto Day End process. The column called *F. key to use* indicates which function key to use to set up the job. When *F. key to use* is not specified, type the supplied command from the table in the *Request Data* field in the task setup screen.

This is not an exhaustive list. Refer to the Geac Information Sheet number 260 for further details.

Table 95. Suggested ADE jobs for Machine Manager

Day End Seq	Description	Job name	Command or application task to run	F. key to use	Day mask	Sched time
10	Change QSYSOPR Message Queue (*DFT)		CHGMSGQ MSGQ(QSYSOPR) DLVRY(*DFT)		1111111	999999
20	End Subsystem QINTER		ENDSBS QINTER *IMMED		1111111	999999

30	End Subsystem QSPL		ENDSBS QSPL *IMMED		1111111	999999
40	End Subsystem QPGMR		ENDSBS QPGMR *IMMED		1111111	999999
50	End Work Management functions		ENDWM nnn (nnn = Environment name)		1111111	999999
60	End Subsystem WFBACK3		ENDSBS WFBACK3		1111111	999999
1000 to 2999	End Application background jobs		See Table 97 on page 571 for a list of subsystem names and background job end task codes.		1111111	999999
3000	Clear Machine Manager Log		CLRMNGLOG KEEP(7)	F10	0000001	999999
3010	Clear MM History Log		CLRMNGHST KEEP(7)		0000001	999999
3020	Run Common Functions Day End		CALL PGM(IPGCFP4/ICF706CL)	F10	0000001	999999
3030	Application Manager Day End		CALL PGM(IPGAMP4/XA803CLP)	F10	0000001	999999
3040	Clean User Allocations		CLNUSRALC		0000001	999999
4000	Allocation Reconciliation	IN_QTALREC	Application: IN/ /03 Task: 2080	F20	0111110	999999
4010	On Order Reconciliation	IN_QTORREC	Application: IN/ /03 Task: 2090	F20	0111110	999999
4020	Update credit management statistics	UPDCRDMSTS	Application: SL/ /03 Task: 2310	F20	0111111	999999
4030	Reconcile orders allocated but not shipped	OE_RECSLU	Application: OE/ /03 Task: 8035 - with update Tasks: 8036 - without update	F20	0111111	999999
4040	Reconcile orders shipped but not invoiced	OE_RECGDNU	Application: OE/ /03 Task: 8037 - with update Tasks: 8038 - without update	F20	0111111	999999
4050	Reconcile back orders	OE_RECBOWU	Application: OE/ /03 Task: 8034 - with update Tasks: 8035 - without update	F20	0111111	999999

4060	Inventory week end update	IN_WEEKEND	Application: IN/ /03 Task: 1310	F20	0000001	999999
4070	Reset GL Background Subsystem Data Area		CHGDTAARA DTAARA(OSLGLD3/GLSBSDTA (11 1)) VALUE('0')		1111111	999999
9000	Machine Manager Submit Power Down		SBMPWRDWN	F10	0000001	999999
9100	Machine Manager Release Power Down Job Queue		RLSJOBQ JOBQ(PWRDWNSYS)		1111111	999999
9200	Run Day Start		RUNADSJOB		1111110	999999
9999	Delete ADE Overrides		DLTADEOVR	F10	1111111	999999

C.3 Subsystems and background jobs

Table 96 and Table 97 list the application task codes used by Machine Manager to start and end background processing.

Note

All subsystems, except GLBACK3, are started using the AS/400 command STRSBS. All background jobs are started and ended using an Application Manager Task code, except for, SLBACK3, PLBACK3, and CSBACK3.

Table 96. Auto Day Start subsystems and background start-up tasks

Subsystem name	Background job name	Background task description	Start-up job name	Start-up Task	Start -up Program [1]
ACBACK3	AC_EDIVAL	Validation	AC_EDIVA	AC/0071	AC900S(_A)
ACBACK3	AC_COMPAR	Comparison	AC_COMPAR	AC/0072	AC900S(_C)
ACBACK3	AC_ACCEPT	Release/EDI Update	AC_ACCEPT	AC/0073	AC900S(_E)
ACBACK3	AS_ASNSND	ASN EDI Send	AS_ASNSND	AS/0072	AS900S(_A)
ACBACK3	CONFIRMDSP	Confirm Ship Updates	CONFIRMDSP	AS/0081	AS498S
ACBACK3	AS_SHIPLBL	Shipping Labels	AS_SHIPLBL	AS/0074	AS900S(SL)
CSBACK3	CSUPDATE	Balance Update	[2]		
DYBACK3	DY_DOCEXT	Doc. Extract	DY_DOCASM	DY/0052	DY050ASM
GLBACK3	GLUPDATE	Balance Update	GL_START	GL/0001	GL952CLP
INBACK3	IN_STKMON	Stock	IN_SBMSSM	IN/0065	IN245SBM

INBACK3	PM_OERSVTN	Reservations	IN_SBMMRM	IN/0075	IN246SBM
INBACK3	OE_ADPRICE	Pricing	AP_PRICE	OE/0020	OE377SBM
INBACK3	OE_INVRFSH	Invoice Refresh	OE_SBMIRM	IN/0081	OE975ASB
INBACK3	OE_RESGEN	Restrictions	OE_SBMRM	IN/0083	OE379ASB
INBACK3	CONFIRMDSP	Confirm Ship Updates	CONFIRMDSP	AS/0080	IN498S
INBACK3	IN_STKUP	Stock Update API	IN_SBMSUM	IN/0033	IN411ASB(05)
OSLMJ	MJ_CONTROL	Transaction Manager	MJ_CONTROL	PD/5051	MJ100CL
PCBACK3	CN_ORDUPDT	Work Order Create	CN_WRKORDS	CN/0009	CN500SBM
PLBACK3	PLUPDATE	Balance Update			
SLBACK3	SLUPDATE	Balance Update			
TPBACK3	TP_CONTROL	Control	TP_SBMJOBS	TP/0088	TPU11SBM
TPBACK3	TP_CRTRQ	Create Requirements	TP_SBMJOBS	TP/0088	TPU11SBM
TPBACK3	TP_AMDRQ	Amend Requirements	TP_SBMJOBS	TP/0088	TPU11SBM
TPBACK3	TP_SOPKRQ	Sales to Picks Transfer	TP_SBMJOBS	TP/0088	TPU11SBM
TPBACK3	TP_PKSORQ	Picks to Sales Transfer	TP_SBMJOBS	TP/0088	TPU11SBM
WHBACK3	PUTAWAY	Rcpts for Put-away	WH_STRPRM	WH/0010	WH580SBM
WHBACK3	CONFIRMUPD	Confirmation update	WH_SBMCNFU	WH/0014	WH581SBM
WHBACK3	REPLNMTOM	Replenishment	WH_SBMRPLM	WH/0018	WH582SBM
WHBACK3	MONITOR	Serious Errors	WH_SBMERR	WH/0022	WH583SBM
WHBACK3	CONFIRMDSP	Confirm Ship	WH_SBMCNFD	WH/0026	WH584SBM
WHBACK3	CONFIRMISS	Confirm Mtr Issue	WH_SBMMISS	WH/0030	WH585SBM
WTBACK3	S	Invoice Transfer	WT_SBMINTR	WT/0020	WT603SBM
WTBACK3		Pre-dispatch Transfer	WT_SBMPDTR	WT/0030	WT803SBM
WTBACK3		SPEX for Windows Transfer	WT_SBMSWTR	WT/0040	WT633SBM

Notes
[1] The notation in () next to the program name indicates the initial return code value defined on the task code setup.
[2] The startup job information is absent where the background is an autostart job defined to the subsystem description.

Table 97. Auto Day End subsystems and background ending tasks

Subsystem name	Background job name	Background task description	End job name	End task	End job Program [1]
ACBACK3	AC_EDIVAL	Validation	AC_EDIVALE	AC/0074	AC900E(B)
ACBACK3	AC_COMPAR	Comparison	AC_COMPARE	AC/0075	AC900E(D)
ACBACK3	AC_ACCEPT	Release/EDI Update	AC_ACCEPTE	AC/0076	AC900E(F)
ASBACK3	AS_ASNSND	ASN EDI Send	AS_ASNSNDE	AS/0073	AS900E(_A)

ASBACK3	CONFIRMDSP	Confirm Ship Updates	CONFIRMEND	AS/0082	AS498E
ASBACK3	AS_SHIPLBL	Shipping Labels	AS_SHPLBLE	AS/0075	AS900E(SL)
CSBACK3	CSUPDATE	Balance Update	[2]		
DYBACK3	DY_DOCEXT	Doc. Extract	DY_DOCATM	DY/0053	DY050ATM
GLBACK3	GLUPDATE	Balance Update	GL_END	GL/0002	GL953CLP
INBACK3	IN_STKMON	Stock	IN_TRMSSM	IN/0070	IN245TRM
INBACK3	PM_OERSVTN	Reservations	IN_TRMMRM	IN/0080	IN246TRM
INBACK3	OE_ADPRICE	Pricing	AP_ENDPRC	OE/0030	OE377TRM
INBACK3	OE_INVRFSH	Invoice Refresh	OE_TRMIRM	IN/0082	OE975ATR
INBACK3	OE_RESGEN	Restrictions	OE_TRMRM	IN/0084	OE379ATR
INBACK3	CONFIRMDSP	Confirm Ship Updates	CONFIRMEND	AS/0081	IN498E
INBACK3	IN_STKUP	Stock Update API	IN_TRMSUM	IN/0034	IN411ATM
OSLMJ	MJ_CONTROL	Transaction Manager			
PCBACK3	CN_ORDUPDT	Work Order Create	CN_WRKORDT	CN/0010	CN500TRM
PLBACK3	PLUPDATE	Balance Update			
SLBACK3	SLUPDATE	Balance Update			
TPBACK3	TP_CONTROL	Control	TP_ENDJOS	TP/0089	TPU11TRM
TPBACK3	TP_CRTRQ	Create Requirements	TP_ENDJOS	TP/0089	TPU11TRM
TPBACK3	TP_AMDRQ	Amend Requirements	TP_ENDJOS	TP/0089	TPU11TRM
TPBACK3	TP_SOPKRQ	Sales to Picks Transfer	TP_ENDJOS	TP/0089	TPU11TRM
TPBACK3	TP_PKSORQ	Picks to Sales Transfer	TP_ENDJOS	TP/0089	TPU11TRM
WHBACK3	PUTAWAY	Rcpts for Put-away	WH_TRMPRCM	WH/0012	WH580TRM
WHBACK3	CONFIRMUPD	Confirmation update	WH_TRMCNFU	WH/0016	WH581TRM
WHBACK3	REPLNMTOM	Replenishment	WH_TRMRPLM	WH/0020	WH582TRM
WHBACK3	MONITOR	Serious Errors	WH_TRMERR	WH/0024	WH583TRM
WHBACK3	CONFIRMDSP	Confirm Ship	WH_TRMCNFD	WH/0028	WH584TRM
WHBACK3	CONFIRMISS	Confirm Mtr Issue	WH_TRMMISS	WH/0032	WH585TRM
WTBACK3		Invoice Transfer	WT_TRMINTR	WT/025	WT603TRM
WTBACK3		Pre-dispatch transfer	WT_TRMPDTR	WT/0030	WT803TRM
WTBACK3		SPEX for windows transfer	WT_TRMSWTR	WT/045	WT633TRM

Notes

[1] The notation in () next to the program name indicates the initial return code value defined on the task code setup.

[2] The end job information is absent where the background is an autostart job defined to the subsystem description. Use the End Subsystem (ENDSBS) command to end these jobs.

Appendix D. Support

System 21 support is a service that is offered to System 21 customers on an annual maintenance agreement. Customers who pay for maintenance on their System 21 applications are entitled to the latest releases of the software, latest releases of the documentation, and access to the support services provided by the support centers.

Various support services are outlined in this section. For further clarification or discussion, contact your respective Support Center.

D.1 Support Centers

Geac System 21 Support Centers provide assistance to customers who encounter problems with their software. This service is provided at no additional charge to customers who are covered by a current maintenance agreement. The Support Centers provide remedies to faults on supported versions of System 21.

The Support Centers do their best to start and continue remedial work on errors that seriously affect software operation. When appropriate, workarounds are offered to bring a customer on-line as quickly as possible.

The Support Centers consist of Financial, Distribution, Manufacturing, and Technical teams suitable to providing support services in all situations. These teams at each Support Center are best suited to provide you the most knowledgeable, personal level of support since they are the most familiar with the System 21 applications and the details of your initial implementation.

D.1.1 Support process

Customers can log software issues with their respective Support Center via a toll-free hot line, Internet e-mail, or the Geac Web site. When calling the hot line, the customer's first contact is with a call router who is responsible for securing contact information and general information about the customer's problem. The call router also works with the customer to establish the appropriate prioritization for their call. From there, the call router places the call in a specific call queue or transfer the call to a Software Support Consultant (SSC).

An SSC with the appropriate expertise to address the customer's issue takes the call and contacts the customer. The SSC determines whether the issue has already been reported to the Product Center. If not, it uses available resources to attempt to duplicate the issue taking the exact steps as the user. Once duplicated, the customer's issue is logged to the Product Center for resolution.

The SSC monitors each issue logged to the Product Center until its timely resolution, coordinates the delivery of the resolution to the customer, and obtains closure agreement on the customer's call.

Support Consultants also monitor and respond to issues that are e-mailed or logged on the Geac Web site. The issue is logged and the customer is contacted by phone or e-mail.

D.1.2 Eligibility of coverage

A customer is eligible for support if they have a current maintenance agreement with Geac and their account is current. These maintenance agreements are renewed on an annual basis.

D.1.3 Americas Support Center

Support on System 21 in the Americas is available from 7:00 a.m. to 7:00 p.m. Central Standard Time (CST). The Americas Support Center serves all U.S. and Western Canadian customers, and also provides second level support to licensed distributors in Latin America and Quebec.

The contact information for the Americas Support Center is listed here:

- **Phone**: 1-800-522-8721 (JBA-USA1)
- **Fax**: 972-714-0467
- **E-mail**: support@jbana.com
- **Address**: 1425 Greenway Dr. Suite 650, Irving, TX 75038

D.1.4 Northern Europe Support Center

Support on System 21 in the UK is available from 8:00 a.m. to 6:00 p.m. Greenwich Mean Time (GMT). The Northern Europe Support Center services all UK customers and provides second level support to licensed distributors throughout Northern Europe.

The contact information for the Northern Europe Support Center is listed here:

- **Phone**: (44) 845-304-3456
- **Fax**: (44) 161-935-3457
- **E-mail**: customer_support@jba.co.uk
- **Address**: 1st Floor, Quay West, Trafford Wharf Road, Salford, Manchester, M17 1PL

D.1.5 Web sites

The latest information relating to Geac's ERP line of products including System 21 can be obtained by accessing Geac Web site at: `http://www.geac.com`.

After receiving a password to the "customer only" sections, you can obtain Product Support Documentation and other general information as it pertains to the policies and procedures of the Support Centers. You can log your support issues over the Web. For details of this capability, please contact the respective Support Center.

D.2 Product support documentation

The Customer Support Centers and the Product Center produces three type of documents to communicate problems, software fixes, changes, and general support information to customers, and Geac employees and affiliates worldwide. The three different document types are:

- **Functional Briefs**

  Functional Briefs (FBs), previously released as Mandatory Operating Procedures (MOPs), are issued for the express purpose of describing a new

procedure. This procedure could be to describe how to install a new feature that may cover more than one module. FBs generally provide instructions and setup information on new features that are introduced through PTFs.

- **Alerts**

  A Support Alert is generally intended to advise of a potential problem within the System 21 software. In many cases, a solution, workaround, or PTF is referenced to correct the problem.

- **Information Sheets**

  An Information Sheet typically contains general information, tips, and configuration recommendations for the System 21 software.

D.3 Electronic Customer Support (ECS)

Geac provides dial-in support services via an ECS dial-in configuration. ECS links are necessary for communication between the customer and Customer Support Systems for quick diagnosis and problem resolution. This communication method also allows the Professional Services groups to perform technical consulting and programming assistance remotely.

As a part of the software installation, an ECS dial-in connection is configured for remote communication. After ECS capabilities are configured on a customer's AS/400 system, the customer authorizes all activities by invoking a session, which calls Customer Support AS/400.

A System 21 consultant uses a user ID and password provided by the customer to sign on to the customer's AS/400 system. The consultant can then trouble shoot problems, download program fixes, or perform other required tasks from a remote site. The customer or the consultant may terminate the ECS connection when the consultant completes their work.

For further details about ECS capabilities, contact the respective Support Center.

D.4 PTFs

Program temporary fixes (PTFs) are the means by which updates to the system are delivered. General Availability (GA) PTFs are released above a version and service pack level as the method for delivering fixes to system issues.

PTFs are issued by module and by version number. They are also issued sequentially. Take care to ensure that they are not applied out of sequence. See 6.7, "System 21 PTF and new release installation" on page 188, for more information on PTFs.

D.5 User and focus groups

User groups and focus groups meet periodically. Most meet once a year, but some meet more frequently. User and focus groups are structured geographically, vertically, and functionally. The user and focus groups are self-funded, and the members of each group define their meetings and activities. For information about the user and focus groups in your area or industry, contact your respective Customer Support Center.

Appendix E. National language versions on AS/400 systems

Table 98 and Table 99 on page 579 show national language version feature codes and some of the values associated with each national language version.

Table 98. National language versions on the AS/400 system

National language version (NLV)	Feature code	Release	Lang. ID	EBCDIC CCSID	Key board	CHRID	ASCII (*)
Albanian	2995	V4R1M0	SQI	500	ALI	697 500	850
Arabic	2954	V3R1M0	ARA	420	CLB	235 420	864
Belgian Dutch	2963		NLB	500	BLI	697 500	850
Belgian English	2909	V4R1M0	ENB	500	BLI	697 500	850
Belgian French	2966		FRB	500	BLI	697 500	850
Brazilian Portuguese	2980		PTB	37	BRB	697 37	850
Bulgarian	2974	V4R1M0	BGR	1025	BGB	1150 1025	855
Canadian French MNCS	2981		FRC	500	CAI	697 500	850
Croatian	2912	V3R1M0	HRV	870	YGI	959 870	852
Czech	2975	V3R1M0	CSY	870	CSB	959 870	852
Danish	2926		DAN	277	DMB	697 277	850
Dutch Netherlands	2923		NLD	37	NEB	697 37	850
English Uppercase	2950		ENP	37	USB	697 37	437
English Uppercase and Lowercase	2924		ENU	37	USB	697 37	437
English Uppercase DBCS (Japanese, No Lowercase)	2938		ENP	5026	JKB	1172 290	897
English Uppercase DBCS (Japanese, Upper/Lowercase)	2938		ENP	5035	JKB	1172 1027	897
English Uppercase and Lowercase DBCS (Traditional Chinese)	2984		CHT	937	TAB	1175 37	1114
English Uppercase and Lowercase DBCS (Simplified Chinese)	2984		CHS	935	RCB	1174 836	1115
English Uppercase and Lowercase DBCS (Korean)	2984		KOR	933	KOB	1173 833	1088
Estonian	2902	V4R1M0	EST	1122	ESB	1307 1122	922
Farsi	2998	V3R1M0	FAR	1097	IRB	1219 1097	1098
Finnish	2925		FIN	278	FNB	697 278	850
French	2928		FRA	297	FAB	697 297	850
French MNCS	2940		FRS	500	SFI	697 500	850
German	2929		DEU	273	AGB	697 273	850
German MNCS	2939		DES	500	AGI	697 500	850

National language version (NLV)	Feature code	Release	Lang. ID	EBCDIC CCSID	Key board	CHRID	ASCII (*)
Greek	2957		ELL	875	GNB	925 875	869
Hebrew	2961	V3R1M0	HEB	424	NCB	941 424	862
Hungarian	2976	V3R1M0	HUN	870	HNB	959 870	852
Icelandic	2958		ISL	871	ICB	697 871	850
Italian	2932		ITA	280	ITB	697 280	850
Italian MNCS	2942		ITS	500	ITI	697 500	850
Japanese (Katakana) DBCS	2962		JPN	5026	JKB	1172 290	897
Korean DBCS	2986		KOR	933	KOB	1173 833	1088
Laotian	2906	V4R2M0	LAO	1132	LAB	1341 1132	1133
Latvian	2904	V4R1M0	LVA	1112	LVB	1305 1112	921
Lithuanian	2903	V4R1M0	LTU	1112	LTB	1305 1112	921
Macedonian	2913	V4R1M0	MKD	1025	MKB	1150 1025	855
Norwegian	2933		NON	277	NWB	697 277	850
Polish	2978		PLK	870	PLB	959 870	852
Portuguese (**)	2922		PTG	37	PRB	697 37	850
Portuguese MNCS (**)	2996		PTG	500	PRI	697 500	850
Romanian	2992	V4R1M0	ROM	870	RMB	959 870	852
Russian	2979	V3R1M0	RUS	1025	RUB	1150 1025	866
Serbian Cyrillic	2914	V4R1M0	SRB	1025	SQB	1150 1025	855
Simplified Chinese DBCS	2989		CHS	935	RCB	1174 836	903
Slovakian	2994	V3R1M0	SKY	870	SKB	959 870	852
Slovenian	2911	V3R1M0	SLO	870	YGI	959 870	852
Spanish	2931		ESP	284	SPB	697 284	850
Swedish	2937		SVE	278	SWB	697 278	850
Thai	2972	V3R1M0	THA	9030	THB	1279 838	874
Traditional Chinese DBCS (ROC)	2987		CHT	937	TAB	1175 37	1114
Turkish	2956		TRK	1026	TRB	1152 1026	857
Vietnamese	2905	V4R2M0	VNM	1130	VNB	1336 1130	1258

Notes:
(*) Most commonly used PC code page. Actual used code page depends on PC setup.
(**) The language ID for Portuguese and Portuguese MNCS is the same, PTG. Customers using Portuguese MNCS with the PRI keyboard must ensure that the CCSID job attribute is set to 500.

Table 99. Languages without national language version

Language	Lang. ID	EBCDIC CCSID	Key-board	CHRID	ASCII (*)
Afrikaans (South Africa)	AFR	37	USB	697 37	437
Australian English (Australia)	ENA	37	USB	697 37	437
Byelorussian (Belarus)	BEL	1025	RUB	1150 1025	1131
Irish Gaelic (Ireland)	GAE	285	UKB	697 285	850
Serbian Latin (Serbia)	SRL	870	YGI	859 870	852
Spanish (Argentina)	ESP	284	SSB	697 284	850
UK English (United Kingdom)	ENG	285	UKB	697 285	850
Ukrainian (Ukraine)	UKR	1123	UAB	1326 1123	1125
Urdu (Pakistan)	URD	918	PKB	1160 918	868

Appendix F. Special notices

This publication is intended to help IT professionals who want to implement Geac System 21on the AS/400 system. The information in this publication is not intended as the specification of any programming interfaces that are provided by IBM or Geac.

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Operating System/400	OS/2
OS/400	PAL
RS/6000	SAA
S/390	Service Director
SP	SP1
SP2	System/38
System/390	WebSphere
Wizard	XT
400	Lotus
Lotus Notes	Domino
Notes	Tivoli
TME	NetView
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Appendix G. Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

G.1 IBM Redbooks

For information on ordering these publications see “How to get IBM Redbooks” on page 587.

- *AS/400 System Handbook*, GA19-5486
- *AS/400 Server Capacity Planning*, SG24-2159
- *AS/400 Printing V*, SG24-2160
- *The System Administrator’s Companion to AS/400 Availability and Recovery*, SG24-2161
- *DB2/400 Advanced Database Function*, SG24-4249
- *AS/400 Hierarchical Storage Management*, SG24-4450
- *AS/400 Performance Management V3R6/V3R7*, SG24-4735
- *Inside AS/400 Client Access for Windows 95/NT V3R1M2*, SG24-4748
- *DB2/400: Mastering Data Warehousing Functions*, SG24-5184
- *V4 TCP/IP for AS/400: More Cool Things Than Ever,* SG24-5190
- *AS/400 Client Access Express for Windows: Implementing V4R4M0*, SG24-5191
- *Management Central: A Smart Way to Manage AS/400 Systems*, SG24-5407
- DB2 UDB for AS/400 Object Relational Support, SG24-5409
- *Slicing the AS/400 with Logical Partitioning: A How to Guide*, SG24-5439
- *Developing Cross-Platform DB2 Stored Procedures*, SG24-5485

The following redbooks are no longer available in hardcopy format and can only be viewed or downloaded online at: `http://www.redbooks.ibm.com`

At the site, click **Redbooks Online**. Then, on the next page, enter the publication number in the Redbook Search field and click **Submit Search**. Once the results appear, click the title of the book you want to view or download.

- *Speak the Right Language with Your AS/400 System*, SG24-2154
- *AS/400 Client/Server Performance Using Windows Clients*, SG24-4526
- *AS/400 Performance Explorer Tips and Techniques,* SG24-4781
- *AS/400 Communication Performance Investigation,* SG24-4895

G.2 IBM Redbooks collections

Redbooks are also available on the following CD-ROMs. Click the CD-ROMs button at http://www.redbooks.ibm.com/ for information about all the CD-ROMs offered, updates and formats.

CD-ROM Title	Collection Kit Number
System/390 Redbooks Collection	SK2T-2177
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RS/6000 Redbooks Collection (PDF Format)	SK2T-8043
Application Development Redbooks Collection	SK2T-8037
IBM Enterprise Storage and Systems Management Solutions	SK3T-3694

G.3 Other resources

These publications are also relevant as further information sources:

- *Ethernet and Token Ring Configuration Guide*, G544-5240
- *ADSTAR Distributed Storage Manager for AS/400 Administrator's Guide*, GC35-0315
- *ILE RPG for AS/400 V4R4 Reference*, SC09-2508
- *BEST/1 Capacity Planning Tool*, SC41-3341
- *Client Access for Windows 95/NT - Setup*, SC41-3512
- *OS/400 Server Concepts and Administration,* SC41-3740
- *AS/400 System Operations,* SC41-4203
- *Backup Recovery and Media Services,* SC41-4345
- *National Language Support,* SC41-5101
- *AS/400 Local Device Configuration*, SC41-5121
- *DB2 for AS/400 Query Manager Use*, SC41-5212
- *OS/400 Security - Reference,* SC41-5302
- *Backup and Recovery,* SC41-5304
- *OS/400 Work Management Guide,* SC41-5306
- *Distributed Data Management*, SC41-5307
- *OS/400 Performance Tools/400,* SC41-5340
- *BEST/1 Capacity Planning Tool*, SC41-5341
- *Backup Recovery and Media Services for AS/400*, SC41-5345
- *Remote Work Station Support*, SC41-5402
- *TCP/IP Configuration and Reference,* SC41-5420
- *TCP/IP Fastpath Setup,* SC41-5430
- *AS/400 Integration with Windows NT Server*, SC41-5439

- *Client Access Express for Windows - Setup*, SC41-5507
- *AS/400 Client Access Express for Windows ODBC User's Guide*, SC41-5509
- *International Application Development*, SC41-5603
- *DB2 for AS/400 SQL Programming,* SC41-5611
- *DB2 for AS/400 SQL Reference Guide*, SC41-5612
- *DB2 for AS/400 Database Programming*, SC41-5701
- *DB2 for AS/400 Query Management Programming*, SC41-5703
- *DB2 Multisystem on AS/400,* SC41-5705
- *Data Management,* SC41-5710
- *Integrated File System Introduction,* SC41-5711
- *DDS Reference,* SC41-5712
- *Printer Device Programming,* SC41-5713
- *CL Reference,* SC41-5722
- *AS/400 Client Access Express Host Servers,* SC41-5740
- *System API Programming*, SC41-5800
- *System API Reference,* SC41-5801
- *DB2 for AS/400 SQL Call Level Interface,* SC41-5806

G.4 Referenced Web sites

These Web sites are also relevant as further information sources:

- Visit the Geac System 21 home page at: `http://system21.geac.com`
- Visit the IBM Web site, specializing in System 21 information, at: `http://system21.ibm.com`
- Download redbook PDFs, view redpieces and redpapers, and locate information on redbooks at: `http://www.redbooks.ibm.com`
- Visit the Geac home page at: `http://www.geac.com`
- Access the JBA home page at: `http://websrv1.jba.co.uk`
- Visit the IBM home page at: `http://www.ibm.com`
- For information on server consolidation, see: `http://www.as400.ibm.com/sc`
- For information on BRMS and HSM, refer to: `http://www.as400.ibm.com/hsmcomp`
- Various configurations and set up information for setting up a TCP connection to the AS/400 system over a LAN, and access to the Internet, are documented on the Web at: `http://as400service.rochester.ibm.com`
- Information regarding the Benchmark Centers can be found on the Web at: `http://www.as400.ibm.com/developer/cbc`
- Information on the Teraplex Integration Center can be found at: `http://www.as400.ibm.com/developer/bi/teraplex`

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Glossary

Alerts A document published by Geac to alert customers of known software defects and remedies.

application A group of software objects that are integrated together to serve a common function, such as inventory management or accounts receivable.

autostart job A batch job doing repetitive work or one-time initialization work that is associated with a particular subsystem. Autostart jobs are automatically started each time the subsystem is started.

batch job A task or group of tasks you submit for batch processing. Batch jobs require little or no interaction with the user.

batch processing A method by which the system selects batch jobs from a job queue in the order of priority and queue position and processes them in a background environment. Contrast with interactive processing.

BI Business Intelligence

CISC See *Complex Instruction Set Computer*.

client/server A relationship between processes running on separate machines. The server process is a provider of software services. The client is a consumer of those services.

Complex Instruction Set Computer (CISC) A computer that uses the traditional processor architecture to process instructions. Contrast with Reduce Instruction Set Computing (RISC).

CPU Central processing unit.

CPW Commercial processing workload.

database A collection of information about all objects managed by the server.

DBCS See *double-byte character set*.

DDM Distributed data management.

DDS Data definition specifications.

DLL See *dynamic link library*.

double-byte character set (DBCS) A set of characters in which each character is represented by 2 bytes. Languages such as Japanese, Chinese, and Korean, which contain more symbols than can be represented by 256 code points, require double-byte character sets.

dynamic link library (DLL) A set of routines that are bound to the application at run time rather than at link time.

EDI See *electronic data interface*.

electronic data interface (EDI) A method of transmitting business information over a network, between two businesses or trading partners. The partners must agree to follow approved national or industry standards for translating and exchanging information.

graphical user interface (GUI) Computer interface that is graphically-based as opposed to being character-based. System 21 Explorer provides a graphical interface to a standard 5250 terminal emulation.

GUI See *graphical user interface*.

HTML Hypertext Markup Language.

ICF Interactive communication feature.

IFS Integrated file system.

Information Sheets A document published by Geac to notify customers of new products, procedures, and other company information.

initial program load (IPL) This is the AS/400 equivalent of booting up a PC.

interactive processing A job started for a person who signs on to a work station. Interactive jobs required constant user interaction with system and application programs. Contrast with batch processing.

IPL See *initial program load*.

job queue An AS/400 object that controls the order in which submitted jobs are released and processed.

LAN See *local area network*.

LDA See *local data area.*

local area network (LAN) The physical connection that allows the transfer of information among devices located on the sam premises. Contrast with wide area network (WAN).

local data area (LDA) The LDA is a fixed length AS/400 data area that is part of every AS/400 job, but not shared by other jobs. System 21 uses the LDA to pass information between programs.

LPP License Program Products

MOP Mandatory operating procedures.

NLS See *national language support*

ODBC See *Open Database Connectivity*.

ODP Open data path.

OLE Object Linking and Embedding.

Open Database Connectivity (ODBC) This is Microsoft defined technology and refers to the provision of standard interface s to any database. ODBC is a vehicle for translating SQL statements, sending requests to the database, and bringing back the data.

PTF Program temporary fix

push buttons A type of GUI control used to initiate actions when clicked on with a mouse. System 21 push buttons are used to replace traditional AS/400 function keys.

RAMP-C A generic interactive commercial application that is divided into transaction types called classes 1, 2, 3, and 4. Each transaction type represents a different complexity of work.

Reduced Instruction Set Computing (RISC) A processor architecture based on simple processor instructions, different from the traditional CISC (complex instruction set computer). PowerPC-based CPU models use this RISC architecture.

RISC See *Reduced Instruction Set Computing*.

role In System 21 Explorer, a job title to which certain activities are assigned.

SBCS See *Single Byte Character Set*.

Single Byte Character Set (SBCS) A character set in which each character is represented by a one-byte code. Contrast with double-byte character set (DBCS).

source code The uncompiled program instructions used to create the program objects.

SQL See *Structured Query Language*.

Structured Query Language (SQL) A fourth generation language used as an industry standard for relational database access. Can be used to create database and to retrieve, add, modify, or delete data from database. Is not a complete programming language because it does not contain control flow logic.

submit The process of placing a batch job into a job queue.

system A term used to describe both hardware and software that are integrated together.

TCP/IP Transmission Control Protocol/Internet Protocol.

WAN See *wide area network*.

wide area network (WAN) A data communications network designed to serve an area beyond the range of a local are network, for example, public and private packet-switching networks, and national telephone networks. Contrast with local area network (LAN).

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