IBM Systems and Technology Group

IBM Benchmark Index

Terry Brennan
brennant@us.ibm.com

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Notes to Presenter

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Notes to Presenter (Cont.)

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Any performance data contained in this document was determined in a controlled environment. Actual results may vary significantly and are dependent on many factors including system hardware configuration and software design and configuration. Some measurements quoted in this document may have been made on development-level systems. There is no guarantee these measurements will be the same on generally-available systems. Some measurements quoted in this document may have been estimated through extrapolation. Users of this document should verify the applicable data for their specific environment.

Revised February 6, 2004

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Notes on Benchmarks and Values

The benchmarks and values shown herein were derived using particular, well configured, development-level computer systems. Unless otherwise indicated for a system, the values were derived using external cache, if external cache is supported on the system. Buyers should consult other sources of information to evaluate the performance of systems they are considering buying and should consider conducting application oriented testing. For additional information about the benchmarks, values and systems tested, contact your local IBM office or IBM authorized reseller or access the following on the Web:

TPC	http://www.tpc.org	Linpack	http://www.netlib.no/netlib/benchmark/performance.ps
Pro/E	http://www.proe.com	SPEC	http://www.spec.org
GPC	http://www.spec.org/gpc	NotesBench Mail	http://www.notesbench.org
VolanoMark	http://www.volano.com	STREAM	http://www.cs.virginia.edu/stream/

Unless otherwise indicated for a system, the performance benchmarks were conducted using AIX V4.3 or AIX 5L. IBM C Set++ for AIX and IBM XL FORTRAN for AIX with optimization were the compilers used in the benchmark tests. The preprocessors used in some benchmark tests include KAP 3.2 for FORTRAN and KAP/C 1.4.2 from Kuck & Associates and VAST-2 v4.01X8 from Pacific-Sierra Research. The preprocessors were purchased separately from these vendors. Other software packages like IBM ESSL for AIX and MASS for AIX were also used in some benchmarks.

The following SPEC and Linpack benchmarks reflect microprocessor, memory architecture, and compiler performance of the tested system (XX is either 95 or 2000):

- SPECintXX - SPEC component-level benchmark that measures integer performance. Result is the geometric mean of eight tests comprising the CINTXX benchmark suite. All of these are written in the C language. SPECint_baseXX is the result of the same tests as CINTXX with a maximum of four compiler flags that must be used in all eight tests.
- SPECint_rateXX - Geometric average of the eight SPEC rates from the SPEC integer tests (CINTXX). SPECint_base_rateXX is the result of the same tests as CINTXX with a maximum of four compiler flags that must be used in all eight tests.
- SPECfpXX - SPEC component-level benchmark that measures floating-point performance. Result is the geometric mean of ten tests, all written in FORTRAN, included in the CFPXX benchmark suite. SPECfp_baseXX is the result of the same tests as CFPXX with a maximum of four compiler flags that must be used in all ten tests.
- SPECfp_rateXX - Geometric average of the ten SPEC rates from SPEC floating-point tests (CFPXX). SPECfp_base_rateXX is the result of the same tests as CFPXX with a maximum of four compiler flags that must be used in all ten tests.
- SPECweb96 - Maximum number of Hypertext Transfer Protocol (HTTP) operations per second achieved on the SPECweb96 benchmark without significant degradation of response time. The Web server software is ZEUS v.1.1 from Zeus Technology Ltd.
- SPECweb99 - Number of conforming, simultaneous connections the Web server can support using a predefined workload. The SPECweb99 test harness emulates clients sending the HTTP requests in the workload over slow Internet connections to the Web server. The Web server software is Zeus from Zeus Technology Ltd.
- SPECweb99_SSL - Number of conforming, simultaneous SSL encryption/decryption connections the Web server can support using a predefined workload. The Web server software is Zeus from Zeus Technology Ltd.
- SPEC OMP2001 - Measures performance based on OpenMP applications.
- SPECsfs97_R1 - Measures speed and request-handling capabilities of NFS (network file server) computers.

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Notes on Benchmarks and Values (Cont.)

- SPECjAppServer200X (where X is 1 or 2) - Measures the performance of Java Enterprise Application Servers using a subset of J2EE APIs in a complete end-to-end Web application.

The Linpack benchmark measures floating-point performance of a system.
- Linpack DP (Double Precision) - n=100 is the array size. The results are measured in megaflops (MFLOPS).
- Linpack SP (Single Precision) - n=100 is the array size. The results are measured in MFLOPS.
- Linpack TPP (Toward Peak Performance) - n=1,000 is the array size. The results are measured in MFLOPS.
- Linpack HPC (Highly Parallel Computing) - solves the largest system of linear equations possible. The results are measured in GFLOPS.

STREAM is a simple synthetic benchmark program that measures sustainable memory bandwidth (in MB/s) and the corresponding computation rate for simple vector kernels. Both standard and tuned results may be reported. http://www.cc.virginia.edu/stream/

VolanoMark is a 100% pure Java server benchmark that creates long-lasting network client connections in groups of 20 and measures how long it takes for the clients to take turns broadcasting their messages to the group. The benchmark reports a score as the average number of messages transferred by the server per second.

- The following Transaction Processing Performance Council (TPC) benchmarks reflect the performance of the microprocessor, memory subsystem, disk subsystem, and some portions of the network:
  - tpmC - TPC Benchmark C throughput measured as the average number of transactions processed per minute during a valid TPC-C configuration run of at least twenty minutes.
  - $/tpmC - TPC Benchmark C price/performance ratio reflects the estimated five year total cost of ownership for system hardware, software, and maintenance and is determined by dividing such estimated total cost by the tpmC for the system.
  - QppH is the power metric of TPC-H and is based on a geometric mean of the 17 TPC-H queries, the insert test, and the delete test. It measures the ability of the system to give a single user the best possible response time by harnessing all available resources. QppH is scaled based on database size from 30GB to 10TB.
  - QthH is the throughput metric of TPC-H and is a classical throughput measurement characterizing the ability of the system to support a multiuser workload in a balanced way. A number of query users is chosen, each of which must execute the full set of 17 queries in a different order. In the background, there is an update stream running a series of insert/delete operations. QthH is scaled based on the database size from 30GB to 10TB.
  - $/QphH is the price/performance metric for the TPC-H benchmark where QphH is the geometric mean of QppH and QthH. The price is the five-year cost of ownership for the tested configuration and includes maintenance and software support.

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Notes on Benchmarks and Values (Cont.)

The following graphics benchmarks reflect the performance of the microprocessor, memory subsystem, and graphics adapter:

- SPECxpc results - Xmark93 is the weighted geometric mean of 447 tests executed in the x11perf suite and is an indicator of 2D graphics performance in an X environment. Larger values indicate better performance.
- SPECplb results (graPHIGS) - PLBwire93 and PLBsurf93 are geometric means of literal and optimized Picture Level Benchmark (PLB) tests for 3D wireframe and 3D surface tests, respectively. Larger values indicate better performance.
- SPECopc results - Viewperf 7 (3dsmax-01, DRV-08, DX-07, Light-05, ProE-01, UGS-01) and Viewperf 6.1.2 (AWadvs-04, DRV-07, DX-06, Light-04, medMCAD-01, ProCDRS-03) are weighted geometric means of individual viewset metrics. Larger values indicate better performance.

The following graphics benchmarks reflect the performance of the microprocessor, memory subsystem, graphics adapter and disk subsystem.

- SPECapc Pro/Engineer 2000i2 results - PROE2000I2_2000370 was developed by the SPECapc committee to measure UNIX and Windows workstations in a comparable real-world environment. Larger numbers indicate better performance.

The NotesBench Mail workload simulates users reading and sending mail. A simulated user will execute a prescribed set of functions 4 times per hour and will generate mail traffic about every 90 minutes. Performance metrics are:

- NotesMark - transactions/minute (TPM).
- NotesBench users - number of client (user) sessions being simulated by the NotesBench workload.
- $/NotesMark - ratio of total system cost divided by the NotesMark (TPM) achieved on the Mail workload.
- $/User - ratio of total system cost divided by the number of client sessions successfully simulated for the NotesBench Mail workload measured. Total system cost is the price of the server under test to the client, including hardware, operating system, and Domino Server licenses.

Application Benchmarks

- SAP - Benchmark overview information: http:// www.sap-ag.de/solutions/technology/bench.htm; Benchmark White Paper September, 2000; http://www.sap-ag.de/solutions/technology/pdf/50020428.pdf.
- PeopleSoft - To get information on PeopleSoft benchmarks, contact PeopleSoft directly or the PeopleSoft/IBM International Competency Center in San Mateo, CA.
- Oracle Applications - Benchmark overview information: http://www.oracle.com/apps_benchmark/
- Baan - The Baan benchmark demonstrates the scalability of Baan ERP solutions. The test results provide the number of Baan Reference Users (BRUs) that can be supported on a specific system. BRU is a single on-line user or a batch unit workload. These metrics are consistent with those used internally by both IBM and Baan to size systems. To get more information on Baan benchmarks, go to http://www.ssaglobal.com.
- J.D. Edwards Applications - Product overview information at http://www.jdedwards.com.

Revised December 9, 2003

Notes on Performance Estimates

rPerf

- rPerf (Relative Performance) is an estimate of commercial processing performance relative to other pSeries systems. It is derived from an IBM analytical model which uses characteristics from IBM internal workloads, TPC and SPEC benchmarks. The rPerf model is not intended to represent any specific public benchmark results and should not be reasonably used in that way. The model simulates some of the system operations such as CPU, cache and memory. However, the model does not simulate disk or network I/O operations.
- rPerf estimates are calculated based on systems with the latest levels of AIX 5L and other pertinent software at the time of system announcement. Actual performance will vary based on application and configuration specifics. The IBM @server pSeries 640 is the baseline reference system and has a value of 1.0. Although rPerf may be used to approximate relative IBM UNIX commercial processing performance, actual system performance may vary and is dependent upon many factors including system hardware configuration and software design and configuration.
- All performance estimates are provided "AS IS" and no warranties or guarantees are expressed or implied by IBM. Buyers should consult other sources of information, including system benchmarks, and application sizing guides to evaluate the performance of a system they are considering buying. For additional information about rPerf, contact your local IBM office or IBM authorized reseller.

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List of Sources

TPC	http://www.tpc.org
SPEC	http://www.spec.org
Linpack	http://www.netlib.org/benchmark/performance.pdf
Pro/E	http://www.proe.com
GPC	http://www.spec.org/gpc
NotesBench	http://www.notesbench.org
VolanoMark	http://www.volano.com
STREAM	http://www.cs.virginia.edu/stream/
SAP	http://www.sap.com/benchmark/
Oracle Applications	http://www.oracle.com/apps_benchmark/

PeopleSoft - To get information on PeopleSoft benchmarks, contact PeopleSoft directly

Baan	http://www.ssaglobal.com
Microsoft Exchange	http://www.microsoft.com/exchange/evaluation/performance/default.asp
Fluent	http://www.fluent.com/software/fluent/fl5bench/fullres.htm
Top500 Supercomputers	http://www.top500.org/

Revised April 1, 2004

The purpose of this presentation is to report benchmark results in both tablular and graphical formats. For competitive analysis, visit System Sales and COMP.

http://w3.ibm.com/sales/systems/

http://w3.ibm.com/sales/competition/compdlib.nsf/pages/comp

Changes from last month:
- Removed the standard charts for each benchmark (which can be viewed at Ideas International)
- Added pSeries analysis charts in support of the announcement

For the latest news, visit:

http://pokgsa.ibm.com/gsa/pokgsa/home/b/r/brennant/web/public/benchmark/index.html

Terry Brennan (brennant@us.ibm.com) welcomes your suggestions and input to these charts.

IBM News in the Last Month:

- **IBM** @server **pSeries**®
  - Published new #1 results on the 1.9 GHz POWER5™ IBM @server p5 570 in the following benchmarks:
    - 16-way TPC-C*
    - 8-way TPC-C**.
    - 4-way TPC-C**
    - 16-way SAP SD 2-Tier*
    - 8-way SAP SD 2-Tier*
    - 4-way SAP SD 2-Tier*
    - SPECfp2000
    - 16-way SPECint_rate2000
    - 8-way SPECint_rate2000
    - 4-way SPECint_rate2000
    - 16-way SPECfp_rate2000
    - 8-way SPECfp_rate2000

    - 4-way SPECfp_rate2000
    - 16-way SPECjbb2000
    - 8-way SPECjbb2000
    - 4-way SPECjbb2000
    - 2-way SPECjbb2000
    - 8-way (and overall) SPECsfs_R1.v3 SMP
    - 16-way SPEC OMPM2001
    - 8-way SPEC OMPM2001
    - 16-way Linpack HPC (non-vector)
    - 8-way Linpack HPC (non-vector)
    - 4-way Linpack HPC (non-vector)

  - Published new #1 results on the 1.65 GHz p5-520 and p5-550 in the following benchmarks:
    - 4-way SPECsfs_R1.v3 SMP
    - 2-way SPEC OMPM2001
    - 2-way Linpack HPC (non-vector)

  Never before has a company backed up the introduction of a new server with this number of #1 results (35 in all.) See the charts later in this presentation for further detail. http://**ibm.com**/eserver/benchmarks

  * Running DB2® Universal Database™ 8.1 on AIX 5L™ V5.2.

  ** Running Oracle 10G on AIX 5L™ V5.2.

  All results are as of 07/13/04.

IBM News in the Last Month:

- **IBM** @server®
    - IBM dominates the latest TOP500 List of Supercomputers.
        - IBM has 224 systems on the list. HP has 84 less than IBM!
        - IBM has 3 of the top 10, more than anybody else.
        - IBM has 10 of the top 20 and 68 of the top 100.
        - IBM has 50% of the installed power!
        - IBM has 150 out of the 266 Linux Clusters.

All results are as of 07/13/04.

IBM News in the Last Month:

- **IBM** @server **xSeries®**
  - Published the first 1-way Microsoft® Exchange MAPI Messaging Benchmark 3 result with a score of 3,800 on a 1-way 3.2 GHz Intel® Xeon™ x206.

- **IBM** @server **BladeCenter™**
  - Published an SAP SD 2-tier result of 428 users (1.99 second average response time) on an IBM @server BladeCenter with a single 2-way 3.2 GHz Xeon DP HS20 blade running DB2® UDB 8.1 on Windows® Server 2003 Enterprise Edition. This result placed 2nd in 2-way performance in this benchmark. The top 2-way performance of 433 users was just published on the IBM @server i5 520 using the 1.65 GHz POWER5™ processor. The BladeCenter result beats the HP result of 408 users (1.97 second ART) on the 2-way 3.2 GHz Intel Xeon ProLiant Model BL20p G2 running SQL Server 2000 on Windows Server 2003 Enterprise Edition. Using the same processor, the BladeCenter outperformed the HP blade by almost 5%! And don't forget that Sun result of 320 users (1.83 second ART) on their "2-way" (actually a 4-core) 1.2 GHz UltraSPARC IV Sun Fire E4900 running Oracle 9i on Solaris 9. Sun is trying to position their servers against Intel servers but their performance is simply lacking -- the BladeCenter beat it by 35% straight up and by 170% on a per-processor basis!!!

  - Less than two weeks after publishing this 2-way result, published another SAP SD 2-tier result, this time of 700 users (1.97 second average response time) on a BladeCenter with a single 4-way 3.0 GHz Xeon MP HS40 blade running DB2 UDB 8.1 on Windows Server 2003 Enterprise Edition. HP has yet to publish a 4-way blade result using the latest Xeon processors. (They did publish a 4-way blade result of 480 a year ago with a 2.0 GHz Xeon MP.) The top 4-way result in this benchmark is 880 on an HP rx4640-8 running HP-UX. Better comparisons can be drawn with other 4-way Windows results.
    - 770 on a 2.4 GHz Opteron HP ProLiant running SQL Server
    - 720 on a 3.0 GHz Xeon MP IBM x365 running DB2 UDB 8.1 (the current top 4-way IA-32 result)
    - Only 717 on an Itanium® 2 rx4640 running SQL Server

  The BladeCenter is demonstrates outstanding 4-way IA-32 performance AND delivers all the advantages of the BladeCenter architecture.

All results are as of 07/13/04.

IBM News in the Last Month:

- **IBM TotalStorage®**
  - Published an SPC result for the SAN Volume Controller. The configuration consisted of four SAN Volume Controllers sitting in front of six FAStT 600 Storage Servers and presenting the entire storage pool as a single image. Each of the FAStT 600 units was configured with three backend EXP 700 enclosures and a total of 56 drives (4 enclosures [base plus three expansion enclosures] x 14 drives per enclosure). The workload generator for the result was a single IBM pSeries 690 configured with four Fibre Channel connections and connected to the SAN Volume Controllers via dual redundant 2109-F32 switches The tested configuration used a data-space (ASU capacity) of 5,025GB (useable capacity) protected by Mirroring. The Configured Storage Capacity utilized 87% of the Physical Storage Capacity of 12,237GB, while the ASU Capacity utilized 98% of the Addressable Storage Capacity. The IBM SAN Volume Controller achieved #8 in the SPC-1 Top Ten Performance Table with a result of 44,507.73 SPC-1 IOPS.

- **IBM @server iSeries™**
  - No activity this month
- **IBM @server zSeries®**

  - No activity this month
- **IBM @server 325 (e325)**

  - No activity this month
- **DB2**
  - Published #1 TPC-C and SAP SD 2-tier results with pSeries on the p5-570
- **WebSphere®**
  - No activity this month
- **IntelliStation®**
  - No activity this month

All results are as of 07/13/04.

Competitive News:

- **HP (Xeon)**
  - Published an SAP SD 3-Tier result of 17,184 users (1.70 second average response time) on an 8-way 1.1 GHz Itanium 2 (mx2 dual processor module) rx4640-8 running Oracle 10g on HP-UX. This database server was supported by 29 4-way Itanium 2 application servers. HP has published the only other results in the last year on this benchmark:
    - 11,200 on an 8-way 2.8 GHz Xeon ProLiant with 21 application servers
    - 8.016 on a 4-way 3.0 GHz Xeon ProLiant with 16 application servers
    - 7,800 on a 4-way 1.5 GHz Itanium 2 rs4640 with 16 application servers

- **HP (Itanium)**
  - Published an SAP SD 2-tier result of 880 users (1.89 second average response time) on a 4-way 1.5 GHz Itanium 2 rx4640-8 running Oracle 9i on HP-UX 11i. This is the top 4-way performance in version 4.7 of this benchmark. Two months ago, HP published a result of 717 users (1.95 second ART) on a 4-way rx4640 running SQL Server on Windows. As usual, HP-UX outperforms Windows on Itanium. If a customer wanted to compare a 4-way Xeon result with this 4-way Itanium result, just weeks ago the xSeries performance team published an SAP SD 2-tier result of 720 users (1.93 second ART) on the 3.0 GHz Xeon MP x365 running DB2 on Windows. Although the performance is 18% less, the cost savings of the x365 are probably dramatic. And the p5-570 delivered a 4-way result of 1,330 users.
  - Published two SPECjbb2000 results using the Itanium mx2 dual processor module:
    - 563,437 ops/sec on a 32-way rx8620
    - 319,197 ops/sec on a 16-way rx7620
  - These are 5th at 32-way and 16-way performance in this benchmark. They are surpassed by the recent Fujitsu PrimePower 1.89 GHz results of 663,133 and 402,133 respectively. There are also higher Itanium results available at each n-way.
  - Published an SAP SD 2-tier result of 1,240 users (1.90 second average response time) on an 8-way 1.5 GHz Itanium 2 rx7620 running SQL Server 2000 on Windows Server 2003 Enterprise Edition. HP has published higher 8-way Itanium results--1,500 on the rx7620 running Oracle on HP-UX and 1,320 on the rx4640-8 also running Oracle on HP-UX (and using the mx2 dual processor module.) HP also published this identical result on their PA-RISC rp4440 running Oracle on HP-UX. The most interesting comparison is with a Bull result of 1,300 which used SQL Server on Windows. Windows does not perform as well as HP-UX on Itanium but Bull beat HP's Windows result by over 2%. And the p5-570 delivered an 8-way result of 2,600 users.

All results are as of 07/13/04.

Competitive News:

- **Dell**
  - Published two Microsoft Exchange MMB3 results, one taking the top position from HP.
    - The first result was 8,100 MMB3 on a 4-way 3.0 GHz Xeon MP PowerEdge 6650. This beat the HP DL585 Opteron and became the top result in this benchmark.
    - The second result was 7,200 MMB3 on a 4-way 2.8 GHz Xeon MP PowerEdge 6650. This placed 4th overall but is the lowest 4-way result in this benchmark. Other than to show scalability, it is curious why Dell published this result.

  - Published an SAP SD 2-Tier Parallel result of 1,350 users (1.97 second average response time) on a 2 node configuration, each a 4-way 3.0 GHz Xeon MP PowerEdge 5560 running Oracle 9i on Red Hat Linux. This is the first SD Parallel result published by anyone in over 2 years. SAP describes this benchmark, "The SD Parallel Benchmark results were achieved with database parallel means such as DB2 for OS390, Oracle Real Application Clusters (RAC), and Oracle Parallel Server (OPS) using a round robin data distribution or without a round robin distribution." It was not stated in the result whether or not it used a round robin distribution. Given that this is not a normal 2-tier SAP SD result (in which the application servers and DB servers all run on the same system), it is difficult to draw direct benchmark comparisons. However, a customer just looking to support 1,350 users would look at this result and compare it to, perhaps, the standard 2-tier 4-way Itanium HP rx4640 result of 1,320 users.

- **Sun**
  - Published an SAP SD 2-Tier result of 10,175 users (1.95 second average response time) on a claimed 72-way (but really a 104-"core") 1.2 GHz UltraSPARC IV Sun Fire E25K running Oracle 9i on Solaris 9. This is the #2 overall result in this benchmark and the top version 4.7 result. But their per-processor performance is only 97.8 users per processor. Remember that the p5-570 delivered 316 users per processor.

  - Published a SPECweb99_SSL result of 2,500 simultaneous secure connections on a 2-way 2.4 GHz Opteron 250 Sun Fire V20z running SUSE Linux. This is the top 2-way result in this benchmark. The previous top 2-way result of 2,340 was also by Sun on a 2.2 GHz Opteron system. The SPECweb_SSL benchmark shows increased performance when run with a 64-bit operating system. Because of this, the top results at each n-way are dominated by Itanium and Opteron.

All results are as of 07/13/04.

Competitive News:

- **NEC**
  - Published a TPC-C result of 683,575 tpmC ($5.99 $/tpmC, avail. 9/1/04) on a 32-way 1.5 GHz Itanium 2 Express5800/1320Xd running Oracle 10g on SUSE Linux. This is the new #1 32-way Itanium result. It beats the April result of 609,467 tpmC ($6.78 $/tpmC, also avail. 9/1/04) that NEC ran on the same server and software. The total cost of the configuration did decrease slightly but the majority of the drop in price/performance was due to the increase in performance. The p690 did over 1M tpmC with 32 processors. And the 16-way p5-570 delivered 809,144 tpmC.

- **Unisys**
  - Published two TPC-C results:
    - 212,511 ($4.72 $/tpmC, avail. 6/14/04) on a 16-way 2.2 GHz Xeon ES7000 Orion 540 running SQL Server 2000 Enterprise Edition on Windows Server 2003, Datacenter Edition
    - 237,869 ($5.08 $/tpmC, avail, 6/14/04) on a 16-way 3.0 GHz Xeon ES7000 Orion 540 running SQL Server 2000 Enterprise Edition on Windows Server 2003, Datacenter Edition
  - The top 16-way performance is 309,036 tpmC ($4.49 $/tpmC) on the Itanium Unisys ES7000 Aries 420. The top 16-way Xeon performance is also Unisys on the ES7000 Orion 540 at 237,869. The top 16-way price/performance is $4.49 on that Itanium Unisys. The previous top Xeon price/performance was $5.08 $/tpmC also on a Unisys. Unisys continues to try to position themselves in the 16-way and higher market using the TPC-C benchmark.

- **Bull**
  - Published a TPC-C result of 175,366.24 tpmC ($4.53 $/tpmC, avail 6/30/04) on an 8-way 1.5 Ghz Itanium NovaScale 5080 running SQL server 2000 Enterprise Edition on Windows 2003 server, Datacenter Edition. This is the first 8-way TPC-C Itanium result ever published and would have been the #1 8-way TPC-C performance except the p5-570 delivered 371,044 tpmC. The previous #1 8-way performance was published on the IBM x445 (156,105.72 tpmC, $4.31 $/tpmC, avail. 8/31/04).

  - Published an SAP SD 2-tier result of 2,230 users (1.73 second average response time) on a 16-way 1.5 GHz Itanium 2 NovaScale 5160 running SQL Server 2000 on Windows Server 2003 Datacenter Edition. This follows on their March result of 1,300 users that was run on an 8-way. This finishes behind the HP 16-way rx8620 result of 2,880 from last December. It just beats the Fujitsu Siemens 16-way UltraSPARC PrimePower 900 result of 2,200. It is the #2 16-way result in this benchmark. It loses badly to the 16-way p5-570 result of 5,056 users.

All results are as of 07/13/04.

Competitive News:

- **LangChao Electronics**
  - Published an SAP SD 2-tier result of 500 users (1.76 second average response time) on a 4-way 1.5 GHz Itanium 2 SP3000 running SQL Server 2000 on Windows Server 2003 Enterprise Edition. This result was probably submitted to certify the system to run SAP. It was not submitted as a performance demonstration of the system because, if it was, it is a terrible result. It ties in 4-way performance with a very old HP 2.0 GHz Xeon ProLiant result. The 4-way 3.0 GHz x365 supported 720 users. The top Itanium result is 880 users on an HP rx4640-8.

- **Fujitsu Siemens**
  - Published three SAP SD 2-tier results.
    - A result of 167 users (1.96 second average response time) on a 1-way 1.8 GHz Pentium M BX300 running SAP DB on SUSE Linux.
    - A result of 385 users (1.95 second ART) on the 2-way 3.2 GHz Xeon DP Primergy BX600 running SAP DB on SUSE Linux.
    - A result of 347 users (1.92 second ART) on the 2-way 1.5 GHz Itanium 2 Primergy RXI300 running SQL Server 2000 on Windows Server 2003 Enterprise.
  - The Pentium result is the first 1-way SD 2-tier result, even going back to all previous versions shown on the SAP website. There are no comparisons to make. The Xeon result was the #3 2-way performance when it was announced, behind the IBM eServer i5 result of 433 users and the HP ProLiant blade result of 408 users (which used the same processor as the Primergy.) But the newer (6/07/04) BladeCenter result of 428 users beats this also. The Itanium result is really odd--it loses not only to the Fujitsu Xeon result but also to the eServer POWER5 i5 520, the BladeCenter Xeon HS20, and to the HP Xeon blade.

All results are as of 07/13/04.

Industry Leading Performance

	Benchmark	1st	2nd	3rd
OLTP:	TPC-C V5 Single System	pSeries 690	HP	pSeries p5-570
Business Intelligence:	TPC-H 100GB v2	IBM @server 325	LangChao	xSeries 445
	TPC-H 300GB v2	IBM @server 325	HP	xSeries 445
	TPC-H 1TB v2	Fujitsu	HP	HP
	TPC-H 3TB v2	HP	Fujitsu	Sun
	TPC-H 10TB v2	pSeries 690	HP	
ERP:	SAP APO DP	Unisys	pSeries 690	HP
	SAP SD 2 Tier R/3	Fujitsu	Sun	Sun
	SAP SD 3 Tier R/3	pSeries 690	pSeries 690	Unisys
	Oracle Apps Std. 11i v11.5.9	pSeries p5-570		
	Oracle Apps Std. 11i RAC	pSeries 655	xSeries 445	HP
	Baan 2 Tier (DB & App)	pSeries 680	pSeries 680	Bull
	Baan 3 Tier (DB)	RS/6000® S80	RS/6000 S80	Bull
	Baan 3 Tier (App)	RS/6000 S80	iSeries SB3	HP
	Siebel PSPP	HP	pSeries 690	Unisys
	PeopleSoft (JDE) B2B e-fulfill	pSeries 680	Sun	HP
	PeopleSoft (JDE) HTML client	pSeries 690	iSeries 890	iSeries 890
e-business:	TPC-W 10K	xSeries 440	Dell	Dell
	TPC-W 100K	Unisys	Dell	xSeries 430
	SPECweb99	HP	pSeries 690	HP
	SPECweb99_SSL	HP	HP	HP
	SPECjbb2000	Fujitsu	HP	Fujitsu
	NotesBench R6 Mail	HP	iSeries i5-520	xSeries 235
	NotesBench R6 iNotes	iSeries 890	Sun	Sun
	Microsoft Exchange 2003	Dell	HP	HP
	SPECsfs97_R1 V2.0	pSeries 690	HP	pSeries 690
	SPECsfs97_R1 V3.0	Panasas	pSeries p5-570	pSeries 690
Sci/Tech:	Linpack	EarthSim	LLNL	Los Alamos

Benchmark results are found at www.ideasinternational.com/benchmark/bench.html, www.www.spec.org, or www.tpc.org,   All results are as of 07/13/04.

Industry Leading Price/Performance

Solution	Benchmark	1st	2nd	3rd
OLTP:	TPC-C V5 Single System	HP	Dell	HP
Business Intelligence:	TPC-H 100GB v2	Sun	Sun	HP
	TPC-H 300GB v2	Sun	Sun	HP
	TPC-H 1TB v2	HP	pSeries 655	Unisys
	TPC-H 3TB v2	HP	HP	Fujitsu
	TPC-H 10TB v2	HP	pSeries 690	
e-business	TPC-W 10K	Dell	Dell	Dell
	TPC-W 100K	Dell	xSeries 370	Unisys
	NotesBench R6 Mail	xSeries 225	xSeries 235	HP
	NotesBench R6 iNotes	Sun	xSeries 235	Sun

Benchmark results are found at www.ideasinternational.com/benchmark/bench.html, www.www.spec.org, or www.tpc.org,   All results are as of 07/13/04.

Industry Leading Performance

Benchmark	Company	Performance	Price/Performance	Date	Avail Date
TPC-C V5	IBM p690	1,025,486 tpmC	$5.43 $/tpmC	02/17/04	08/16/04
Single System	HP Superdome	1,008,144 tpmC	$8.33 $/tpmC	11/04/03	04/14/04
	IBM p5-570	809,144 tpmC	$4.95 $ $/tpmC	07/12/04	09/30//04
TPC-H 100GB	IBM e325	12,216 QphH	$70 $/QphH	07/29/03	11/08/03
Version 2	LangChao SP3000	5,618 QphH	yuan 897/QphH	04/14/04	04/15/04
	IBM x445	5,602 QphH	$73 $/QphH	06/30/03	12/31/03
TPC-H 300GB	IBM e325	13,195 QphH	$65 $/QphH	07/29/03	11/08/03
Version 2	HP Proliant	12,995 QphH	$203 $/QphH	04/09/02	06/20/02
	IBM x445	6,551 QphH	$66 $/QphH	08/31/04	03/02/04
TPC-H 1TB	Fujitsu PrimePower	34,492 QphH	$141 $/QphH	11/13/02	01/31/04
Version 2	HP Superdome	25,805 QphH	$203 $/QphH	10/29/02	10/30/02
	HP ProLiant	22,361 QphH	$253 $/QphH	02/06/02	06/20/02
TPC-H 3TB	HP Superdome	45,247 QphH	$109 $/QphH	09/25/03	03/25/04
Version 2	Fujitsu PrimePower	34,345 QphH	$147 $/QphH	08/26/03	01/31/04
	Sun Fire 15K	28,948 QphH	$184 $/QphH	04/30/03	04/07/03
TPC-H 10TB	IBM p690	62,214 QphH	$243 $/QphH	02/27/03	5/20/03
Version 2	HP Superdome	49,104 QphH	$118 $/QphH	01/05/04	03/25/04
TPC-W 10K	IBM x440	21,139 WIPS	$33 $/WIPS	9/12/02	12/31/02
	Dell PowerEdge	10,449 WIPS	$28 $/WIPS	8/26/02	8/22/02
	Dell PowerEdge	7,783 WIPS	$25 $/WIPS	1/28/02	1/28/02
TPC-W 100K	Unisys ES7000	10,439 WIPS	$107 $/WIPS	7/10/01	7/10/01
	Dell PowerEdge	9,708 WIPS	$35 $/WIPS	5/31/02	5/31/02
	IBM x430	7,555 WIPS	$137 $/WIPS	5/01/01	6/08/01

Industry Leading Price/performance

Benchmark	Company	Performance	Price/Performance	Date	Avail Date
TPC-C V5	HP ProLiant	18,318 tpmC	$1.68 $/tpmC	04/14/04	04/14/04
Single System	Dell PowerEdge	22,052 tpmC	$1.85 $/tpmC	02/18/04	02/18/04
	HP Proliant	35,030 tpmC	$1.88 $/tpmC	03/02/04	03/17/04
TPC-H 100GB	Sun V250	1,442 QphH	$23 $/QphH	09/16/03	11/26/03
Version 2	Sun V440	2,428 QphH	$28 $/QphH	09/16/03	11/26/03
	HP ProLiant	1,386 QphH	$28 $/QphH	08/15/03	08/15/03
TPC-H 300GB	Sun V250	1,283 QphH	$27 $/QphH	09/16/03	11/26/03
Version 2	Sun V440	3,090 QphH	$40 $/QphH	04/05/04	04/05/04
	HP ProLiant	4,063 QphH	$43 $/QphH	09/26/03	09/26/03
TPC-H 1TB	HP ProLiant	3,385 QphH	$59 $/QphH	11/12/03	11/12/03
Version 2	IBM p655	20,221 QphH	$69 $/QphH	12/08/03	06/08/04
	Unisys ES7000	5,199 QphH	$120 $/QphH	10/15/03	10/15/03
TPC-H 3TB	HP ProLiant	22,387 QphH	$93 $/QphH	03/02/04	03/02/04
Version 2	HP Superdome	44,247 QphH	$109 $/QphH	09/25/03	03/25/04
	Fujitsu PrimePower	34,345 QphH	$147 $/QphH	08/26/03	02/22/04
TPC-H 10TB	HP Superdome	49,104 QphH	$118 $/QphH	01/05/04	03/25/04
Version 2	IBM p690	62,214 QphH	$266 $/QphH	12/05/02	5/15/03
TPC-W 10K	Dell PowerEdge	7,783 WIPS	$24.50 $/WIPS	01/28/02	01/28/02
	Dell PowerEdge	6,622 WIPS	$25.70 $/WIPS	12/19/01	12/19/01
	Dell PowerEdge	10,449 WIPS	$27.60 $/WIPS	08/22/02	08/22/02
TPC-W 100K	Dell PowerEdge	9,708 WIPS	$34.60 $/WIPS	05/31/02	05/31/02
	IBM x370	6,045 WIPS	$76.67 $/WIPS	05/31/01	05/31/01
	e-@ction ES 7	10,439 WIPS	$106.73 $/WIPS	07/10/01	07/10/01

Benchmark	Company	Perf.
Baan 2 Tier	IBM p680	11,886
(DB & App)	IBM p680	9,622
	Bull EPC 2450	9,622
Baan 3 Tier	IBM RS/6000	10,000
(DB)	IBM RS/6000	9,966
	Bull EPC2400	9,966
Baan 3 Tier	IBM RS/6000	9,275
(App)	IBM i840	8,925
	HP rp8400	8,470
PeopleSoft (JDE)	IBM p680	1,029
B2B e-fulfill	Sun E6500	639
	HP V2500	485
PeopleSoft (JDE)	IBM p690	15,385
HTML client	IBM i890	14,148
	IBM i890	11,067
Linpack	Earth Sim	35,860
	LLNL	19,940
	Los Alamos	19,470
Siebel	HP Superdome	32,000
	IBM p690	30,000
	Unisys	30,000

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Baan Sizing Guide for October 2001 plus the latest to be
certified benchmark reports (4/01/2002)

Benchmark	Company	Perf.	Price/ Perf.
NotesBench	IBM x225	14,500	$4.54
R6 Mail	IBM x235	16,100	$5.54
	HP ProLiant	16,000	$5,59
NotesBench	Sun V250	2,300	$6.50
R6 iNotes	IBM x235	3,000	$7.10
	Sun V880	8,399	$19.30

Benchmark	Company	Perf,	Ave. Resp. Time
SAP APO DP	Unisys ES7000	586,319	
	IBM p690	474,162	
	HP pr8400	252,811	
SAP SD 2 Tier	Fujitsu	13,000	1.87
R/3 4.7	Sun E25k	10,175	1.97
	Sun E20k	8,000	1.81
SAP SD 3 Tier	IBM p690	47,528	1.88
R/3 4.6C	IBM p690	47,008	1.97
	Unisys ES7000	26,000	1.97
Oracle Apps Std..	IBM p5-570	15,004	.49
11i v11.5.9			
Oracle Apps Std..	IBM p655	21,168	.52
11i RAC	IBM x445	18,368	.59
	HP ProLiant	7,504	1.19

Benchmark	Company	Performance	Resp Time
SPECweb99	HP rp8420	23,000	
	IBM p690	21,000	
	HP rp8420	20,200	
SPECweb99_SSL	rx8620	9,060	
	rx7620	5,388	
	HP rp8400	4,700	
SPECjbb2000	Fujitsu PrimePower	1420177	
	HP Superdome	1,008,604	
	Fujitsu PrimePower	835,479	
SPECsfs97_R1 V2.0	IBM p690	167,007	1.08
	HP Alpha	154,654	1.15
	IBM p690	111,687	1.39
SPECsfs97_R1 V3.0	Panasas	305,805	1.76
	IBM p5-570	145,362	1.17
	IBM p690	136,200	1.02

Benchmark	Company	Perf.	Price/ Perf.
NotesBench	HP Proliant BL2p	120,000	$8.67
R6 Mail	IBM i5 520	24,000	$10.45
	IBM x235	16,100	$5.54
NotesBench	IBM i890	28,500	
R6 iNotes	Sun E2900	20,000	$18.16
	Sun V1280	10,700	$28.26
Microsoft	Dell PowerEdge	8,100	
Exchange 2003	HP Proliant	7,800	
	HP Proliant	7,300	

All results are as of 07/13/04.

Transaction Performance - TPC-C V5 Non-Clustered

tpmC

$/tpmC

Only one competitive result is higher than the 16-way p5-570!

- IBM p690 32-way DB2: 1,025,486 / $5.43
- HP Superdome 64-way Oracle: 1,008,114 / $8.33
- IBM p5-570 16-way DB2: 809,144 / $4.95
- HP Superdome 64-way SQL Server: 786,646 / $6.49
- IBM p690 32-way Oracle: 768,839 / $8.55
- Any Sun Result: tpmC ✗

	IBM p690 32-way DB2	HP Superdome 64-way Oracle	IBM p5-570 16-way DB2	HP Superdome 64-way SQL Server	IBM p690 32-way Oracle
Avail. date:	08/16/04	04/14/04	09/30/04	10/23/03	02/29/04
Result date:	02/17/04	11/04/03	07/13/04	08/27/03	09/12/03

Source: www.tpc.org

All results are as of 07/13/04.

Transaction performance - Single system TPC-C V5
(Representative large systems ranked by processor efficiency – tpmC/CPU)

System	CPU	Avail.	$/tpmC	Database	OS	tpmC	tpmC/CPU
IBM p5-570 (1.9 GHz POWER5)	16	09/30/04	$4.95	IBM DB2 8.1	AIX 5L V5.3	809,144	50,571
IBM p5-570 (1.9 GHz POWER5)	8	09/30/04	$5.26	Oracle 10G	AIX 5L V5.3	371,044	46,380
IBM p690 (1.9 GHz POWER4+)	32	08/16/04	$5.43	IBM DB2 8.1	AIX 5L V5.2	1,025,486	32,046
IBM p690 (1.7 GHz POWER4+)	32	02/29/04	$8.55	Oracle 10G	AIX 5L V5.2	768,839	24,026
NEC Exp 5800 (1.5 GHz Itanium 2)	32	9/01/04	$6.78	Oracle 10G	SUSE LINUX	609,467	19,045
NEC Exp 5800 (1.5 GHz Itanium 2)	32	12/01/03	$7.74	SQL EE	Windows DCE	577,531	18,048
HP Superdome (1.5 GHz Itanium 2)	64	04/14/04	$8.33	Oracle 10G	HP-UX 11.i	1,008,144	15,752
IBM p690 (1.3 GHz POWER4™)	32	5/31/03	$17.75	Oracle 9i	AIX 5L V5.2	427,760	13,367
HP Superdome (1.5 GHz Itanium 2)	64	10/23/03	$6.49	SQL EE	Windows DCE	786,646	12,291
HP Superdome (875 MHz PA-RISC)	64	12/31/03	$11.66	Oracle 10G	HP-UX 11.i	541,673	8,463
Fujitsu PP2000 (SPARC64 563 MHz)	128	2/28/02	$28.58	SymfoWARE	Solaris 8	455,818	3,561
Sun Fire E25K, E20K, 15K, 12K, 6800, 4800, 3800, V1280, V880, V480		No	Published	Results			?

All results are as of 07/13/04.

Source: http://www.tpc.org

Transaction performance - Single system TPC-C V5
(Top 10 8-way and above systems rank by processor efficiency - tpmC/CPU)

System	CPU	Avail.	$/tpmC	Database	OS	tpmC	tpmC/CPU
IBM p5-570 (1.9 GHz POWER5)	16	09/30/04	$4.95	IBM DB2 8.1	AIX 5L V5.3	809,144	50,571
IBM p5-570 (1.9 GHz POWER5)	8	09/30/04	$5.26	Oracle 10G	AIX 5L V5.3	371,044	46,380
IBM p690 (1.9 GHz POWER4+)	32	08/16/04	$5.43	IBM DB2 8.1	AIX 5L V5.2	1,025,486	32,046
IBM p690 (1.7 GHz POWER4+)	32	02/29/04	$8.55	Oracle 10G	AIX 5L V5.2	768,839	24,026
IBM p690 (1.7 GHz POWER4+)	32	11/8/03	$8.25	IBM DB2 8.1	AIX 5L V5.2	763,898	23,871
Bull NovaScale 5080 C/S	8	6/30/04	4.53	SQL Server 2000 EE		175,366	21,920
NEC Exp 5800 (1.5 GHz Itanium 2)	32	9/01/04	$5.99	Oracle 10G	SUSE LINUX	683,575	21,361
IBM p690 (1.7 GHz POWER4+)	32	11/8/03	$11.13	IBM DB2 8.1	AIX 5L V5.2	680,613	21,269
IBM xSeries 445 (3.0 GHz Xeon™)	8	8/31/04	$4.31	SQL Server 2000 EE		156,105	19,513
NEC Exp 5800 (1.5 GHz Itanium 2)	32	9/01/04	$6.78	Oracle 10G	SUSE LINUX	609,467	19,045
Sun Fire E25K, E20K, 15K, 12K, 6800, 4800, 3800, V1280, V880, V480		No	Published	Results			?

All results are as of 07/13/04.

Source: http://www.tpc.org

Transaction performance - Single system TPC-C V5
(Representative competition ranked by efficiency – tpmC/CPU)

System	CPU	Avail.	$/tpmC	Database	OS	tpmC	tpmC/CPU
IBM p5-570 (1.9 GHz POWER5)	16	09/30/04	$4.95	IBM DB2 8.1	AIX 5L V5.3	809,144	50,571
IBM p5-570 (1.9 GHz POWER5)	4	09/30/04	$5.62	Oracle 10G	AIX 5L V5.3	194,391	48,597
IBM p5-570 (1.9 GHz POWER5)	8	09/30/04	$5.26	Oracle 10G	AIX 5L V5.3	371,044	46,380
HP rx5670 (1.5 GHz Itanium 2)	4	3/05/04	$3.94	Oracle 10G	Red Hat Linux	136,111	34,027
HP rx5670 (1.5 GHz Itanium 2)	4	12/31/03	$7.25	Oracle 10G	HP-UX 11.i	131,639	32,909
IBM p690 (1.9 GHz POWER4+)	32	08/16/04	$5.43	IBM DB2 8.1	AIX 5L V5.2	1,025,486	32,046
HP rx5670 (1.5 GHz Itanium 2)	4	8/1/03	$4.97	SQL EE	Windows EE	121,065	30,266
IBM p690 (1.7 GHz POWER4+)	32	02/29/04	$8.55	Oracle 10G	AIX 5L V5.2	768,839	24,026
NEC Exp 5800 (1.5 GHz Itanium 2)	32	9/01/04	$6.78	Oracle 10G	SUSE LINUX	609,467	19,045
NEC Exp 5800 (1.5 GHz Itanium 2)	32	12/01/03	$7.74	SQL EE	Windows DCE	577,531	18,048
HP Superdome (1.5 GHz Itanium 2)	64	04/14/04	$8.33	Oracle 10G	HP-UX 11.i	1,008,144	15,752
IBM p690 (1.3 GHz POWER4™)	32	5/31/03	$17.75	Oracle 9i	AIX 5L V5.2	427,760	13,367
HP Superdome (1.5 GHz Itanium 2)	64	10/23/03	$6.49	SQL EE	Windows DCE	786,646	12,291
HP Superdome (875 MHz PA-RISC)	64	12/31/03	$11.66	Oracle 10G	HP-UX 11.i	541,673	8,463
Fujitsu PP2000 (SPARC64 563 MHz)	128	2/28/02	$28.58	SymfoWARE	Solaris 8	455,818	3,561
Sun Fire E25K, E20K, 15K, 12K, 6800, 4800, 3800, V1280, V880, V480		No	Published	Results			?

All results are as of 07/13/04.

Source: http://www.tpc.org

TPC-C Comparisons

4-way through 8-way

	tpmC	$/tpmC

The 4-way IBM POWER5 result is higher than all previous 8-way results!!

	x365	HP DL585	HP rx5670	p5-570	HP DL760	x455	Bull (Itan)	p5-570
tpmC	102,667	105,687	136,111	194,391	115,025	156,105	175,366	371,044
$/tpmC	$3.52	$3.23	$3.94	$5.62	$7.69	$4.31	$4.53	$5.26
Avail Date.	03/05/04	05/03/04	03/31/04	09/30/04	05/30/03	05/30/03	08/31/04	09/30/04

← **4-way** →← **8-way** →
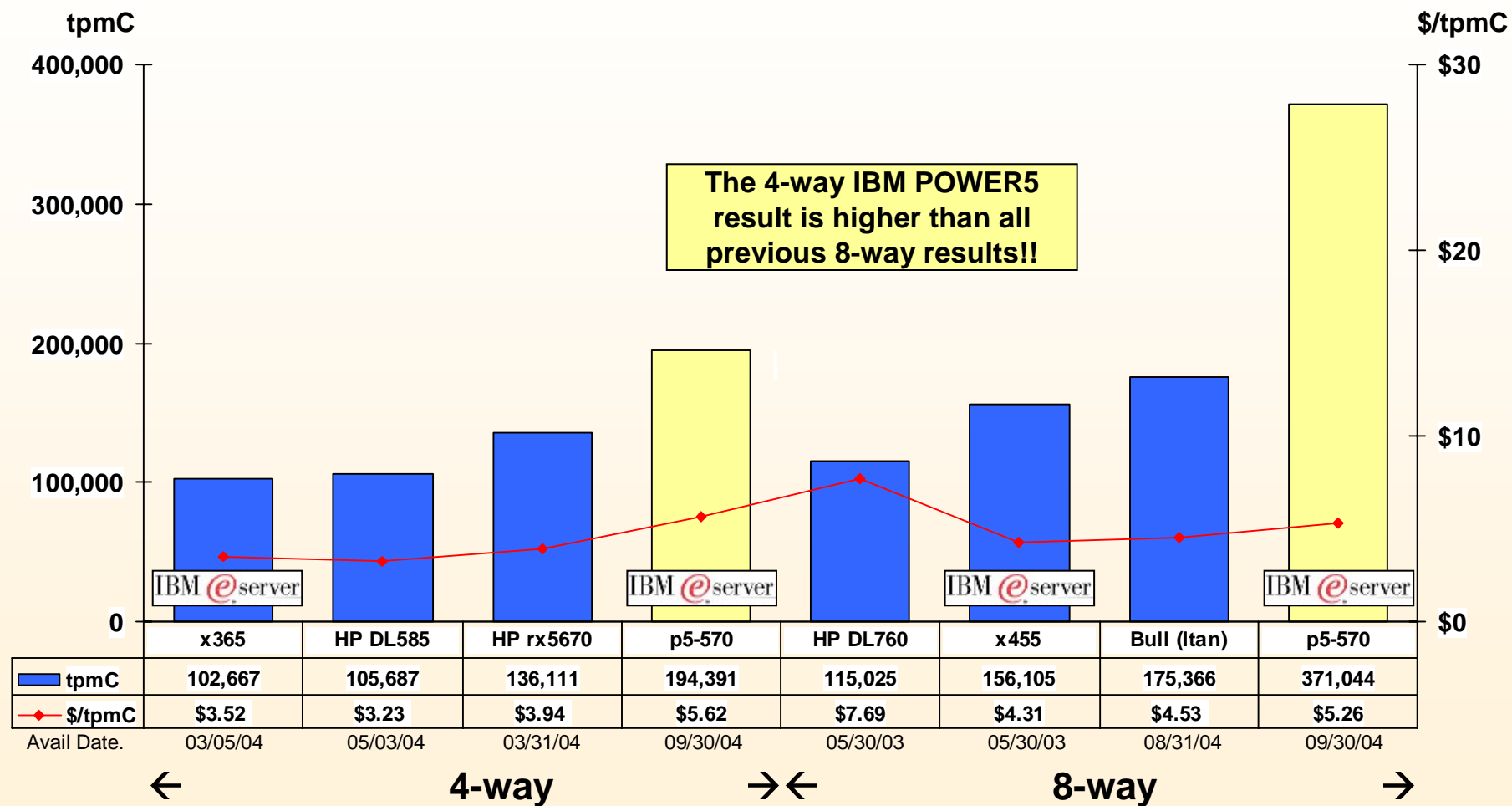
All results are as of 07/13/04.

Source: www.tpc.org

TPC-C Comparisons

8-way through 16-way

The 8-way IBM POWER5 result is higher than all previous 16-way results!!

	HP DL760	x455	Bull (Itan)	p5-570	HP rx8620	Uni ES7000	p5-570
tpmC	115,025	156,105	175,366	371,044	301,225	309,036	809,144
$/tpmC	$7.69	$4.31	$4.53	$5.26	4.56	4.49	4.95
Avail Date.	05/30/03	05/30/03	08/31/04	09/30/04	04/15/04	01/30/04	09/30/04

← **8-way** →← **16-way** →
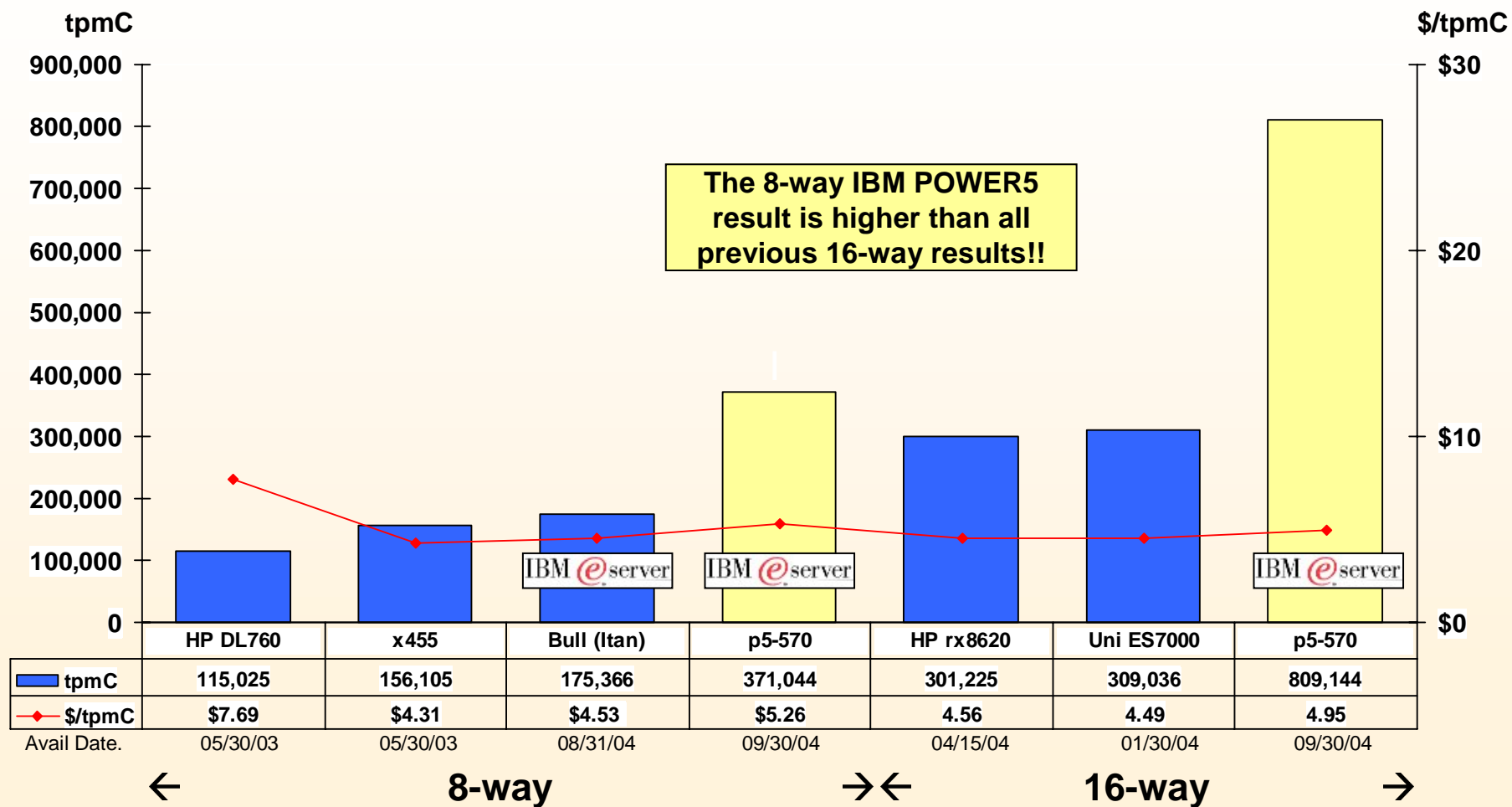
All results are as of 07/13/04.

Source: www.tpc.org

TPC-C Comparisons

16-way through 32-way

The 16-way IBM POWER5 result is higher than all previous 32-way competitive results!!

	HP rx8620	Uni ES7000	p5-570	Uni ES7000	NEC Ex5800	IBM p690
tpmC	301,225	309,036	809,144	304,148	609,467	1,025,486
$/tpmC	4.56	4.49	4.95	$6.18	6.78	5.43
Avail Date.	04/15/04	01/30/04	09/30/04	04/28/04	09/01/04	09/30/04

← **16-way** →← **32-way** →
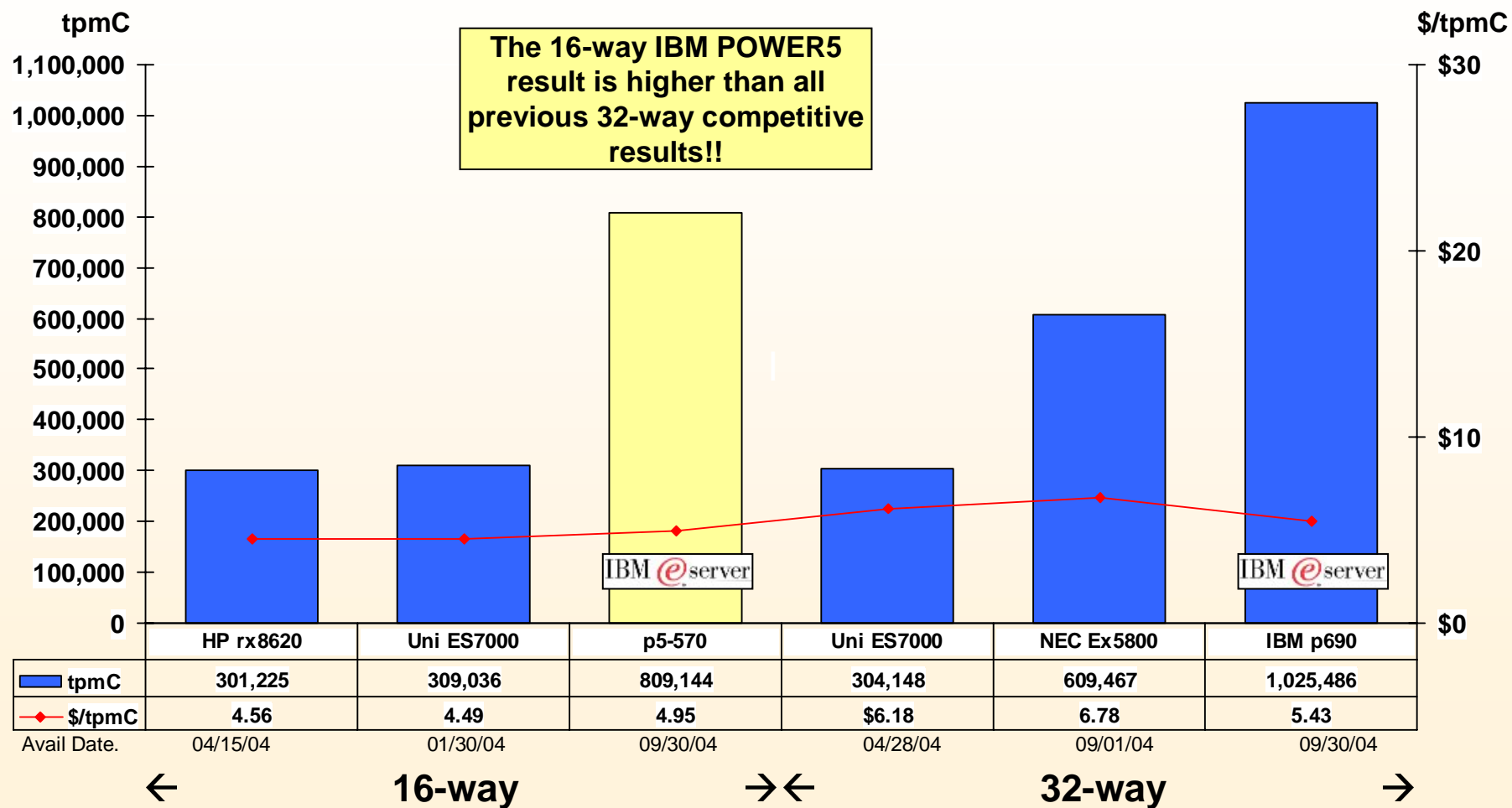
All results are as of 07/13/04.

Source: www.tpc.org

IBM p5-570 vs. Fastest Itanium
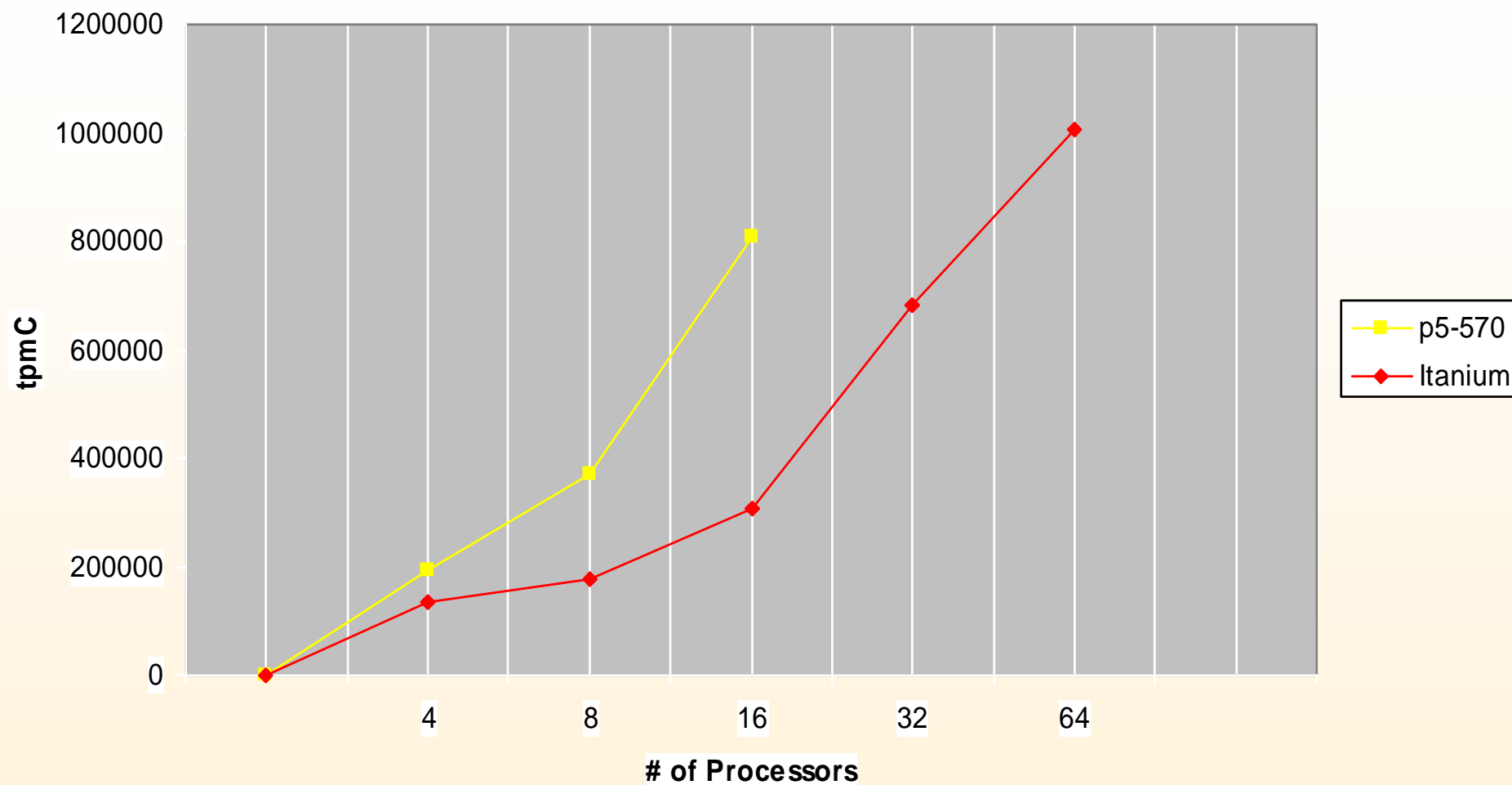
# CPU's	tpmC	$/tpmC	System	Availability
4	194.391	$5.62	p5-570	09/03/04
8	371,044	$5.26	p5-570	09/30/04
16	809,144	$4.95	p5-570	09/30/04

# CPU's	tpmC	$/tpmC	System	Availability
4	136111	3.94	HP Integrity rx5670 Linux	3/5/04
8	175366	4.53	Bull NovaScale Itanium	6/30/04
16	309037	4.49	Unisys ES7000 Aries 420	1/30/04
32	683535	5.99	NEC Express5800/1320Xd	9/1/04
64	1008144	8.33	HP Integrity Superdome	4/14/04

All results are as of 07/13/04.

POWER5 – More TPC Performance per Processor
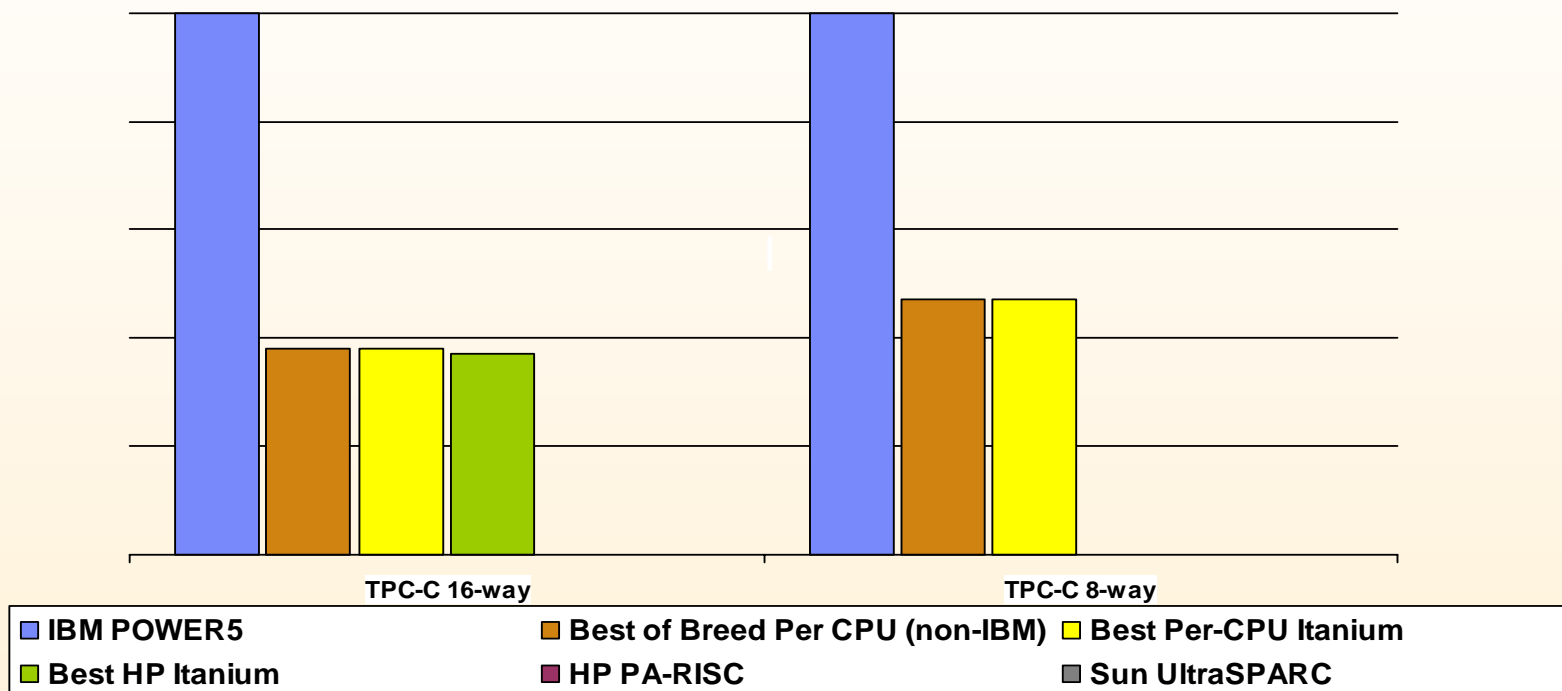
Performance per Processor (normalized to POWER5)

TPC-C 16-way   **TPC-C 8-way**

■ **IBM POWER5**	■ **Best of Breed Per CPU (non-IBM)**	■ **Best Per-CPU Itanium**
■ **Best HP Itanium**	■ **HP PA-RISC**	■ **Sun UltraSPARC**

16-way IBM p5-570 TPC-C result of 809,144 tpmC, $4.95/tpmC, avail. 09/30/04

16-way Unisys ES7000 TPC-C result of 309,037 tpmC, $4.49/tpmC, avail. 01/30/04

16-way HP rx8620 TPC-C result of 301,225 tpmC, $4.56/tpmC, avail. 04/15/04

8-way IBM p5-570 TPC-C result of 371,044 tpmC, $5.26/tpmC, avail. 09/30/04

8-way Bull NovaScale 5080 result of 175,366 tpmC, $4.53/tpmC, avail. 06/30/04

Source: www.tpc.org

All results are as of 07/13/04

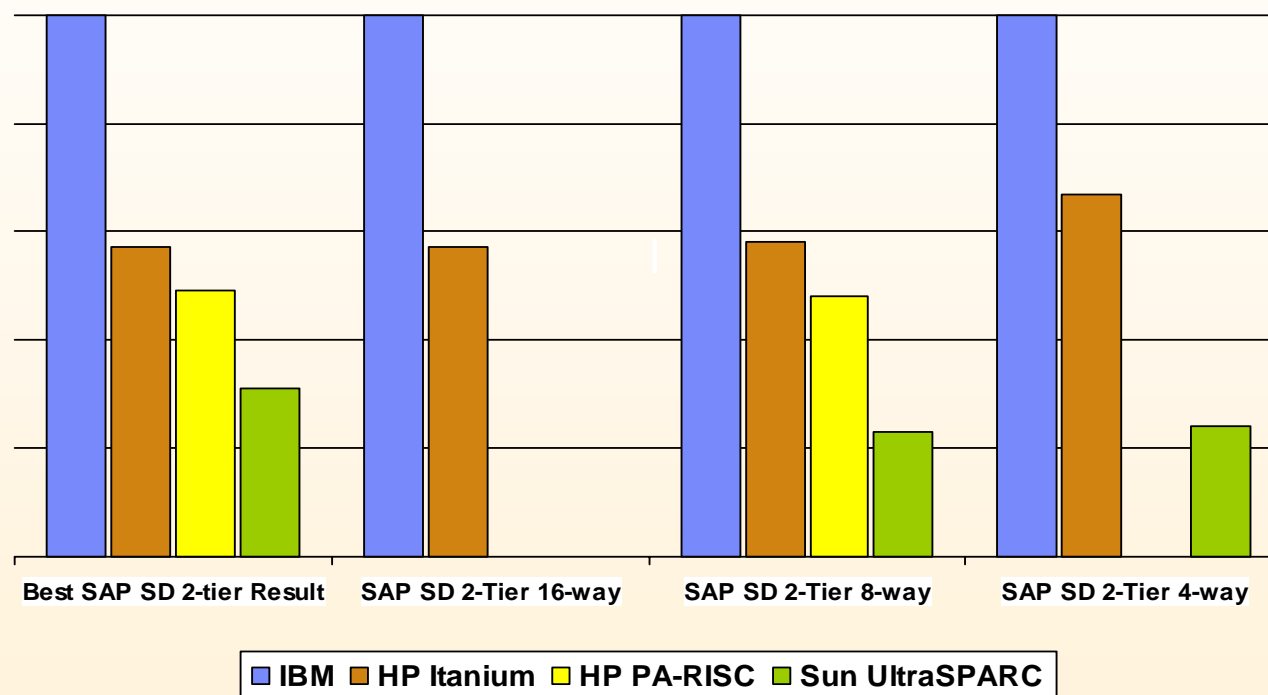# POWER5 – More SAP Performance per Processor

Performance per Processor (normalized to POWER5)

Chart categories: Best SAP SD 2-tier Result, SAP SD 2-Tier 16-way, SAP SD 2-Tier 8-way, SAP SD 2-Tier 4-way

Legend: ■ IBM ■ HP Itanium ■ HP PA-RISC ■ Sun UltraSPARC

Benchmarks	p5-570 Result	HP Itanium Result	HP Itanium System	HP PA-RISC Result	HP PA-RISC System	Sun Result	Sun System
SAP SD 2-tier Best	5,056	2880	HP rx8620	1,240	HP rp4440	10,175	Sun Fire 25k
SAP SD 2-tier 16-way	5,056	2880	HP rx8620	DNP		DNP	
SAP SD 2-tier 8-way	2,600	1500	HP rx7620	1,240	HP rp4440	600	V880
SAP SD 2-tier 4-way	1,313	880	HP rx4640	DNP		320	Sun Fire E4900

Source: www.sap.com/benchmark/
All results are as of 07/13/04
"Processor" is defined as a "core" according to SPEC definitions.

SAP SD 2-Tier R/3 (Ranked by efficiency – Users/CPU)

Configuration	Software Releases	CPU's or Cores	Number of Benchmark Users	Users/CPU
IBM p5-570 (1.9 GHz POWER5) 128GB Memory	SAP R/S 4.70 AIX 5L V5.3, DB2 UDB 8.1	16	5,056 @ 1.99 sec	316
IBM p5-570 (1.9 GHz POWER5) 64GB Memory	SAP R/S 4.70 AIX 5L V5.3, DB2 UDB 8.1	8	2,600 @ 1.99 sec	325
IBM p5-570 (1.9 GHz POWER5) 32GB Memory	SAP R/S 4.70 AIX 5L V5.3, DB2 UDB 8.1	4	1,313 @ 1.97 sec	328
HP rx8620 (1.5 GHz Itanium 2) 64GB Memory	SAP R/3 4.70 HP-UX 11, Oracle 9i	16	2,880 @ 1.95 sec	180
HP rp4440-8 (1.0 GHz PA-8800) 32GB Memory	SAP R/3 4.70 HP-UX 11, Oracle 9i	8	1,240 @ 1.97 sec	155
IBM p650 (1.45 GHz POWER4+) 64GB Memory	SAP R/3 4.6C AIX 5L V5.2, DB2 UDB 8.1	8	1,220 @ 1.95 sec	152
IBM p690 (1.3 GHz POWER4) 64GB Memory	SAP R/3 4.6C AIX 5L V5.1, DB2 UDB 7.2	32	4,128 @ 1.89 sec	129
Sun 25K (1.2 GHz US IV) 576GB Memory	SAP R/3 4.70 Solaris 9, Oracle 9i	104	10,175 @1.95 sec	98
Sun 15K (1.2 GHz US III) 576GB Memory	SAP R/3 4.6C Solaris 9, Oracle 9i	72	5,775 @ 1.62 sec	80
Sun 15K (1.2 GHz US III) 576GB Memory	SAP R/3 4.6C Solaris 9, Oracle 9i	104	8,000 @ 1.81 sec	77
Sun V880 (900 MHz US III) 32GB Memory	SAP R/3 4.6C Solaris 8, DB2 UDB 7.2	8	600 @ 1.96 sec	75
Sun E20K (1.2 GHz US IV) 288GB Memory	SAP R/3 4.70 Solaris 9, Oracle 9i	72	5,050 @ 1.72 sec	70

Source: http://www.sap.com/benchmark/
CPU defined according to the SPEC definition of "core".

All results are as of 07/13/04.

SAP SD 2-Tier R/3
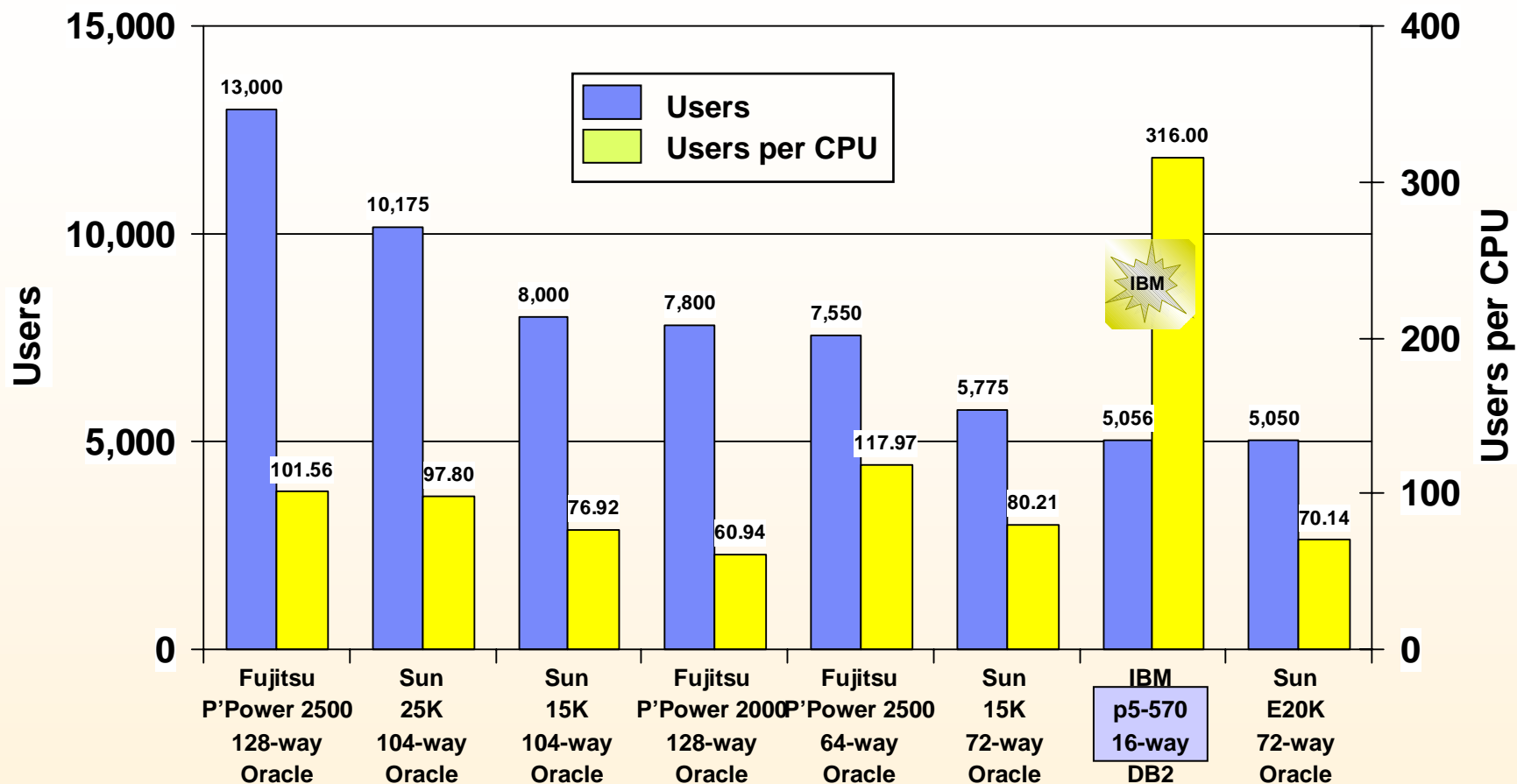
The 16-way p5-570 beat all competitive systems that have less than 64 processors.

Source: http://www.sap.com/benchmark/

Processor defined according to the SPEC definition of "core".

All results are as of 07/13/04.

POWER5 vs. Sun UltraSPARC IV

 # Users

 # Users per Processor

Legend:
- # Users
- # Users per Processor

Chart values:
- IBM p5-570 POWER5 16-way DB2: # Users = 5,056; # Users per Processor = 316.00
- Sun E20K UltraSPARC IV 72-way Oracle: # Users = 5,050; # Users per Processor = 70.14
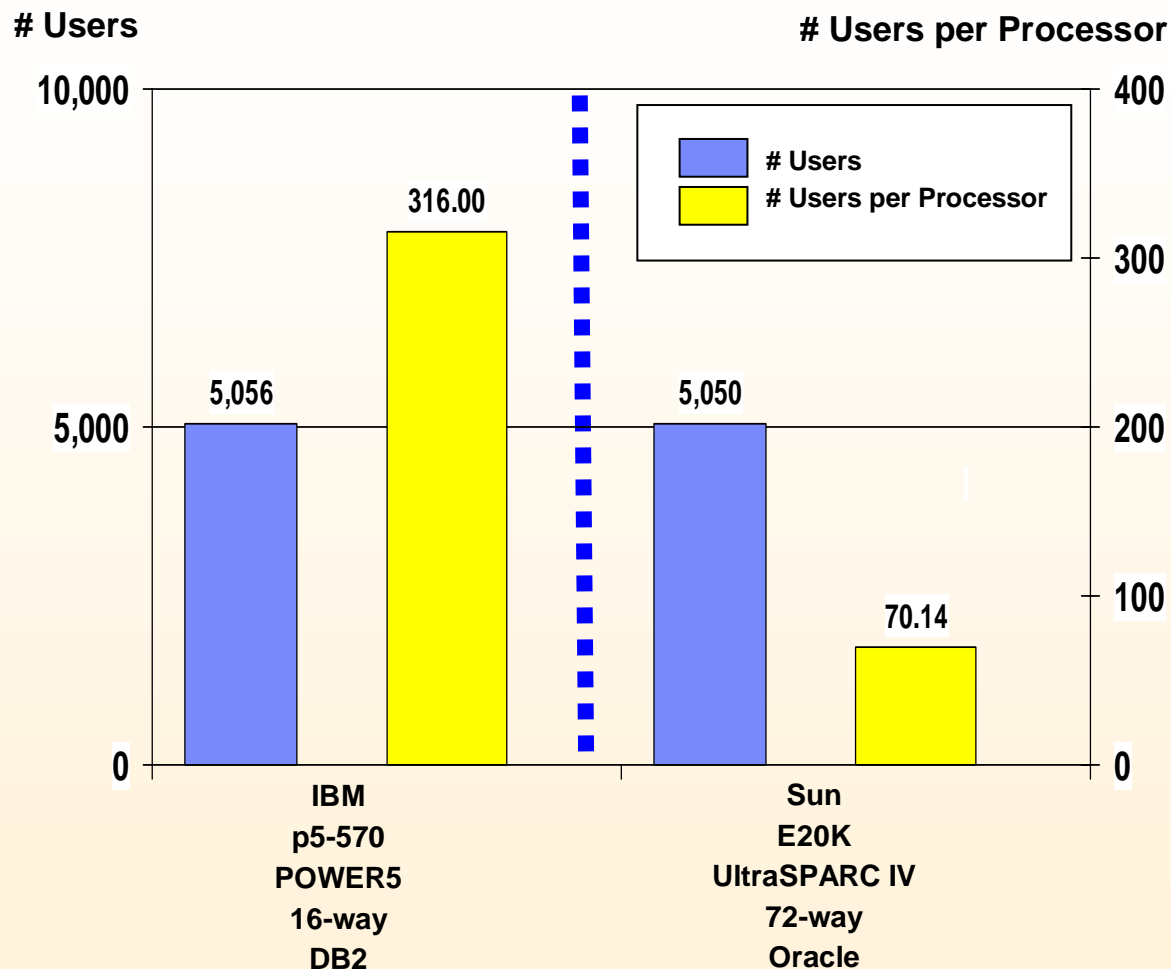
Running SAP SD 2-tier, the IBM p5-570 with 16 processors beat the Sun E20K with 72 processors.

POWER5 Math: 16 > 72

Sun just does not add up!

Source: http://www.sap.com/benchmark/

Processor defined according to the SPEC definition of "core".

If you use the Sun definition of processor, then IBM used 8 "processors" to beat Sun's 36 "processors."

All results are as of 07/13/04.

p5-570 – Outstanding Scaling

 # SAP Users
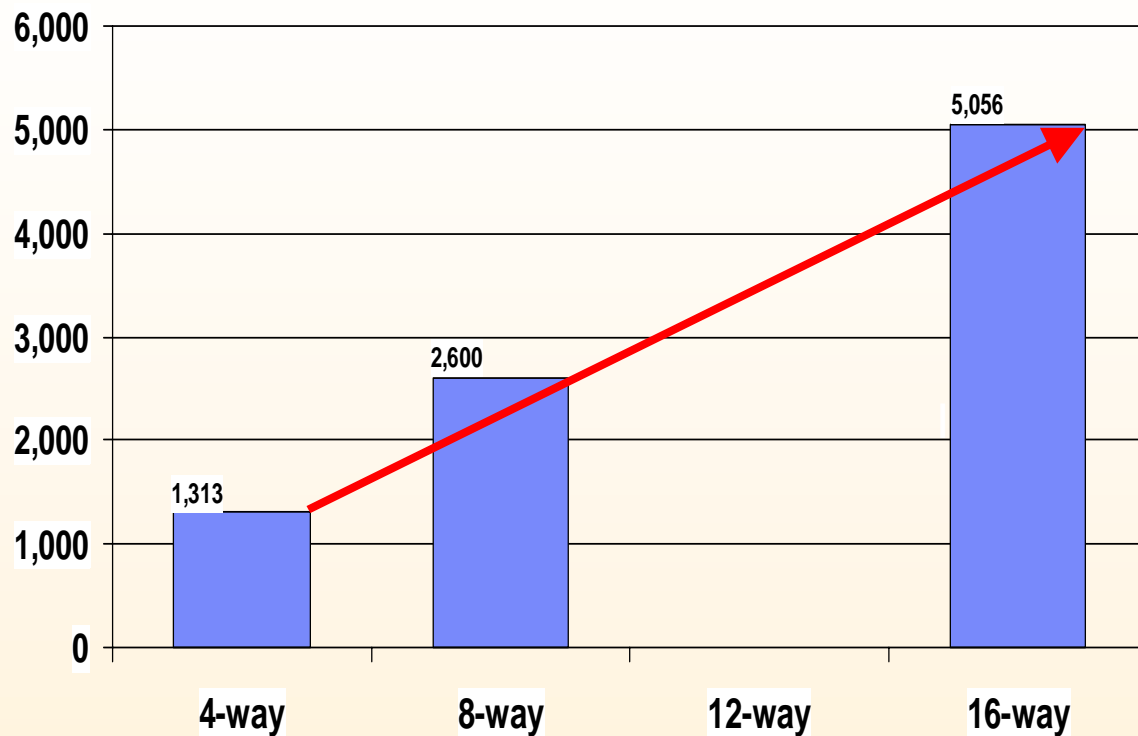
The p5-570 scaled almost linearly from 4-way all the way to 16-way in SAP SD.

Legend:
- TPC-C
- SAP SD 2-Tier

Source: www.sap.com/benchmark/ and www.tpc.org

All results are as of 07/13/04.

SAP SD 3-Tier R/3

 # Users

Average Response Time (sec.)

	pSeries 690 32-way DB2 8.1	pSeries 690 32-way DB2 7.2	Unisys ES7000 32-way MSFT SQL	pSeries 680 24-way DB2	Bull Escala 24-way DB2
# Users	47,528	47,008	26,000	25,560	25,560
Avg Response Time	1.88	1.97	1.97	1.92	1.95

This benchmark is more indicative of actual customer configurations. But neither HP nor Sun has challenged IBM on the high-end.

IBM *e*server
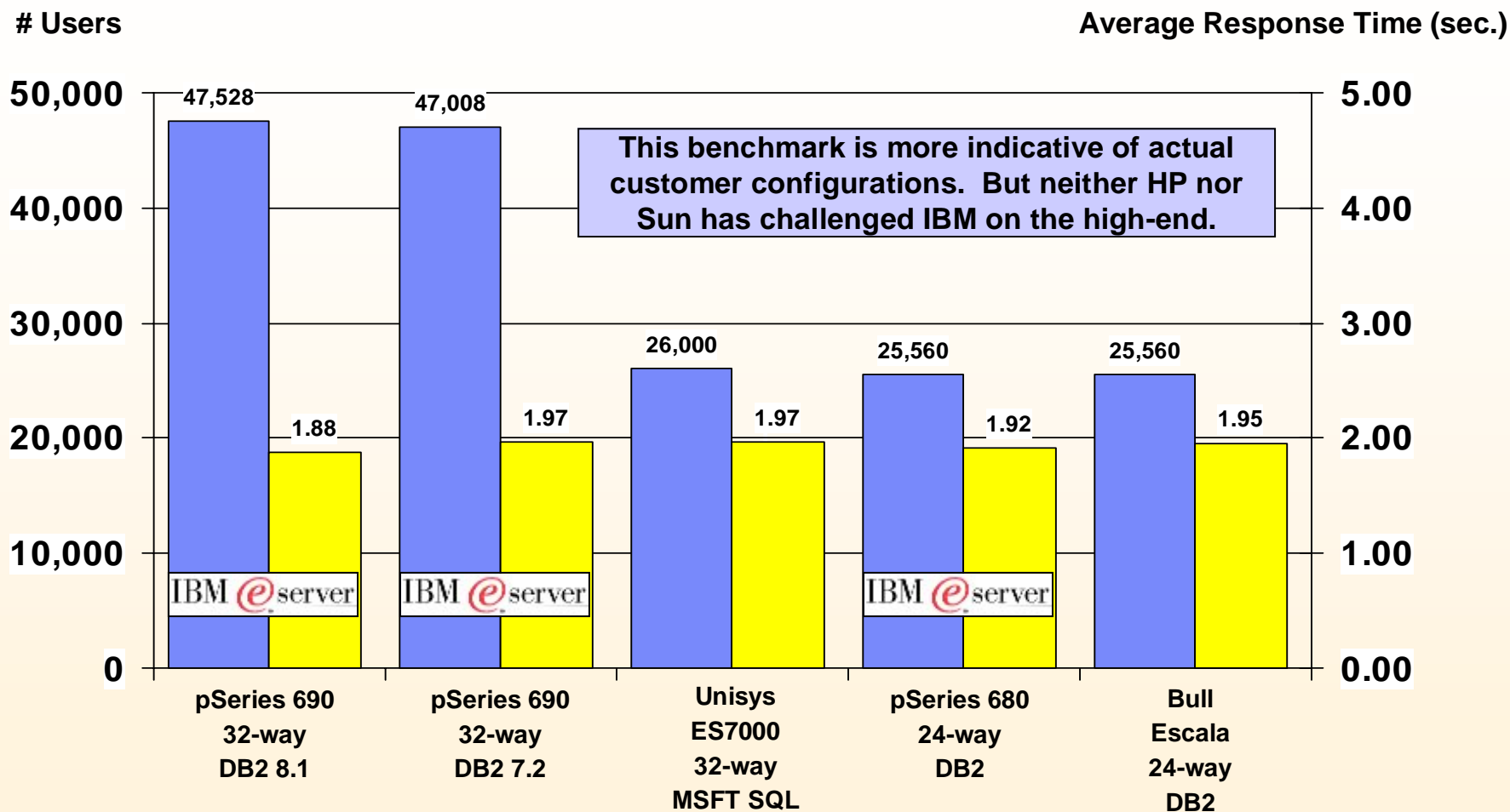
All results are as of 07/13/04.

Oracle Apps Standard Benchmark 11i v11.5.9

Users

Ave. Response Time (sec.)

The first result ever published on this version of the Oracle Applications Standard benchmark.

15,004

0.55

IBM *e* server

p5-570
16-way

16,000 — 5.00

12,000 — 4.00

— 3.00

8,000 — 2.00

4,000 — 1.00

0 — 0.00
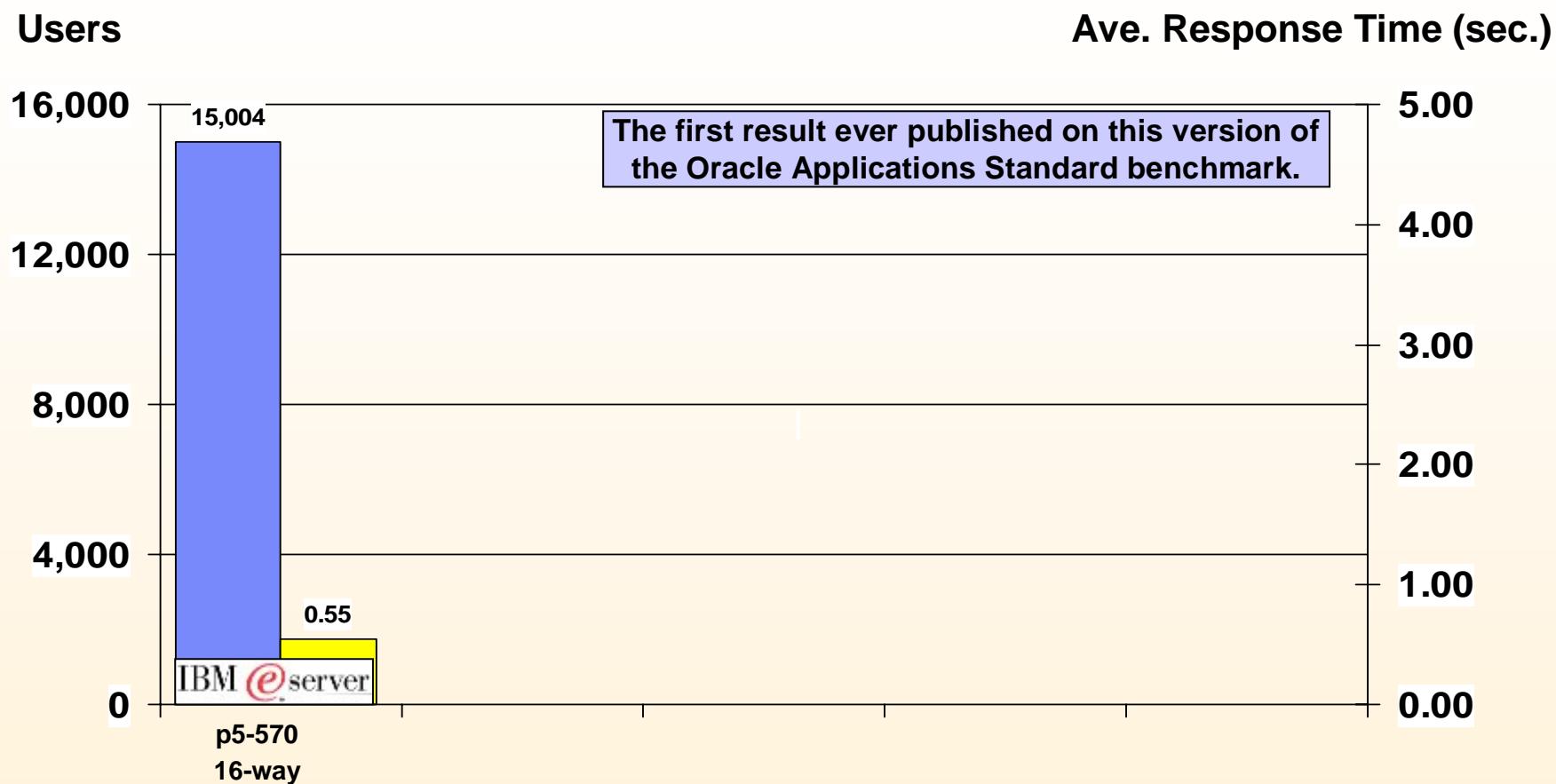
Source: www.oracle.com/apps_benchmark/html/index.html?results.html

All results are as of 07/13/04.

SPECjbb2000

Overall (1,600,000 scale)
- Fujitsu 112-way: 1420177
- HP 64-way: 1008604
- Fujitsu 64-way: 835479
- Fujitsu 32-way: 663133
- IBM 16-way: 633106
- HP 64-way: 614385

16-way (900,000 scale)
- IBM p5-570: 633106
- Fujitsu P'Power: 402961
- HP rx8620: 341098
- HP S'Dome: 322604
- Fujitsu P'Power: 283176

8-way (400,000 scale)
- IBM p5-570: 328996
- Fujitsu P'Power: 213956
- HP rx7620: 190393
- HP S'Dome: 181369
- Fujitsu P'Power: 148885

4-way (200,000 scale)
- IBM p5-570: 170127
- Verari Quatrex: 133427
- Verari Quatrex: 124849
- Dell P'Edge: 118031
- HP rx5670: 116466

All results are as of 07/13/04.

All measurements indicate Operations per Second.

Source: www.spec.org

IBM results submitted to SPEC as of July 13,2004.

SPECjbb2000

System	CPU	MHz	JVM	CPU's	Results	Results / CPU
IBM @server **p5-570**	**POWER5**	**1900**	**1.4.2**	**2**	**86,267**	**43,133**
IBM @server **p5-570**	**POWER5**	**1900**	**1.4.2**	**4**	**170,127**	**42,532**
IBM @server **p5-570**	**POWER5**	**1900**	**1.4.2**	**8**	**328,996**	**41,125**
IBM @server **p5-570**	**POWER5**	**1900**	**1.4.2**	**16**	**633,106**	**39,569**
HP Superdome	**Itanium 2**	**1500**	**1.4.2**	**32**	**574,912**	**17,966**
HP rp8420	**PA-8800**	**1000**	**1.4.2**	**32**	**574,452**	**17,952**
IBM @server **p690**	**POWER4+**	**1700**	**1.4**	**32**	**553,480**	**17,296**
HP Superdome	**Itanium 2**	**1500**	**1.4.2**	**64**	**1,008,604**	**15,759**
IBM @server **p650**	**POWER4+**	**1450**	**1.4**	**8**	**114,892**	**14,362**
Sun Fire 6800	**UltraSPARC III**	**1200**	**1.4**	**24**	**231,121**	**9,630**
Sun Fire 6900	**UltraSPARC III**	**1200**	**1.4.2**	**48**	**421,773**	**8,787**
Sun Fire 15K	**UltraSPARC III**	**1050**	**1.4**	**72**	**433,166**	**6,016**
Sun Fire 15K	**UltraSPARC III**	**1050**	**1.4**	**104**	**602,270**	**5,791**
Sun	**UltraSPARC IV**				**DNP**	

All results are as of 07/13/04.

DNP = Did Not Publish
"CPU" is defined as a "core" according to SPEC definitions.
Source: www.spec.org/osg/jbb2000/results   IBM results submitted to SPEC as of July 13,2004.
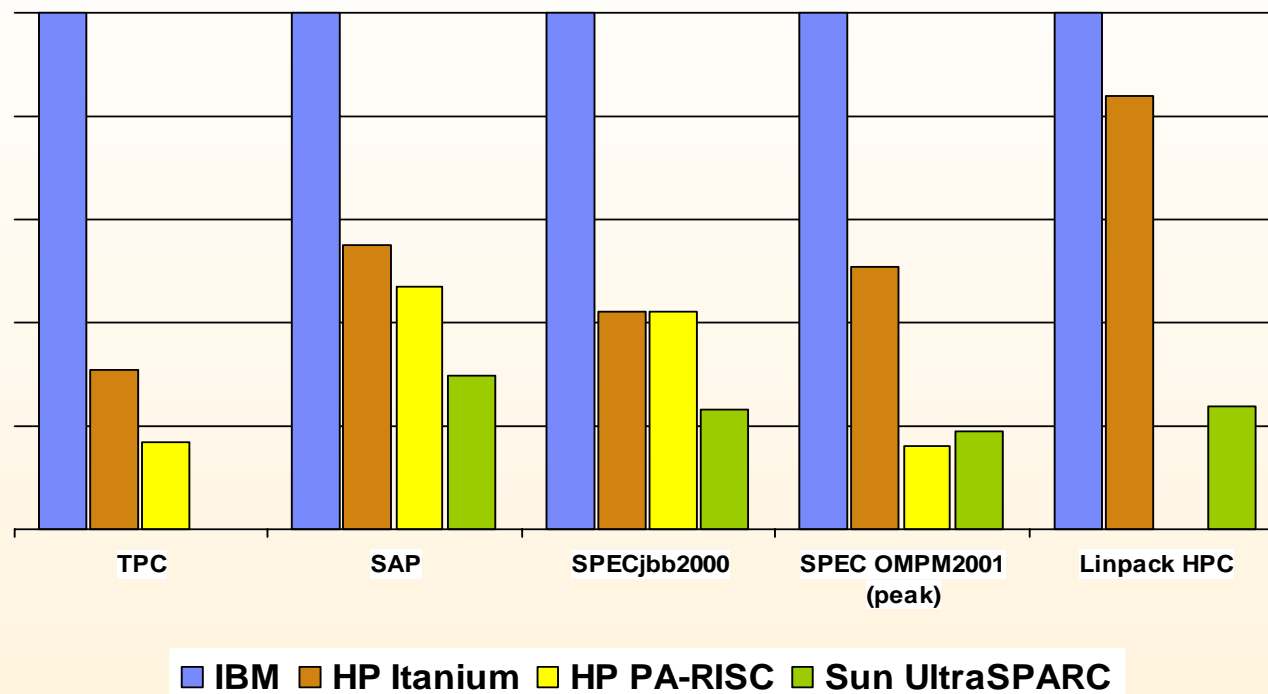
POWER5 – More Performance per Processor

Performance per Processor (normalized to POWER5)

Legend: ■ IBM ■ HP Itanium ■ HP PA-RISC ■ Sun UltraSPARC

Categories: TPC, SAP, SPECjbb2000, SPEC OMPM2001 (peak), Linpack HPC

16-way IBM p5-570 TPC-C result of 809,144 tpmC, $4.95/tpmC, avail. 09/30/04
64-way HP Superdome (Itanium) TPC-C result of 1,008,144 tpmC, $8.33/tpmC, avail. 4/14/04
64-way HP Superdome (PA-RISC) result of 541,673 tpmC, $11.66/tpmC, avail. 01/30/04

Benchmark Results per processor	p5-570 Result	HP Itanium Result	HP Itanium System	HP PA-RISC Result	HP PA-RISC System	Sun Result	Sun System
SAP SD 2-tier Best	328	180	HP rx8620	155	HP rp4440	98	Sun Fire 25k
SPECjbb2000 Best	42,532	17,966	HP S'Dome	17,952	HP rp8420	9,630	Sun Fire 6800
SPEC OMPM2001peak Best	3,403	1,721	HP rx8620	549	HP S'Dome	27	Sun Fire 6800
Linpack Best	6.88	5.745	HP rx5670	DNP		DNP	

Confused by "Per-Processor" Claims?

In 2003, Sun published an SAP SD 2-tier result of 5,775 users on a 72-way UltraSPARC III Sun Fire 15K
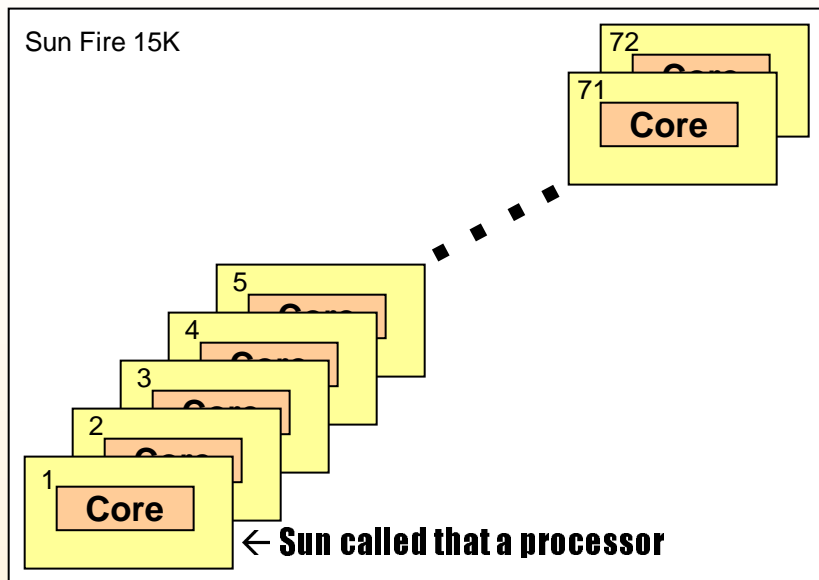
In 2004, Sun published an SAP SD 2-tier result of 5,050 users on a 36-way UltraSPARC IV Sun Fire 20K
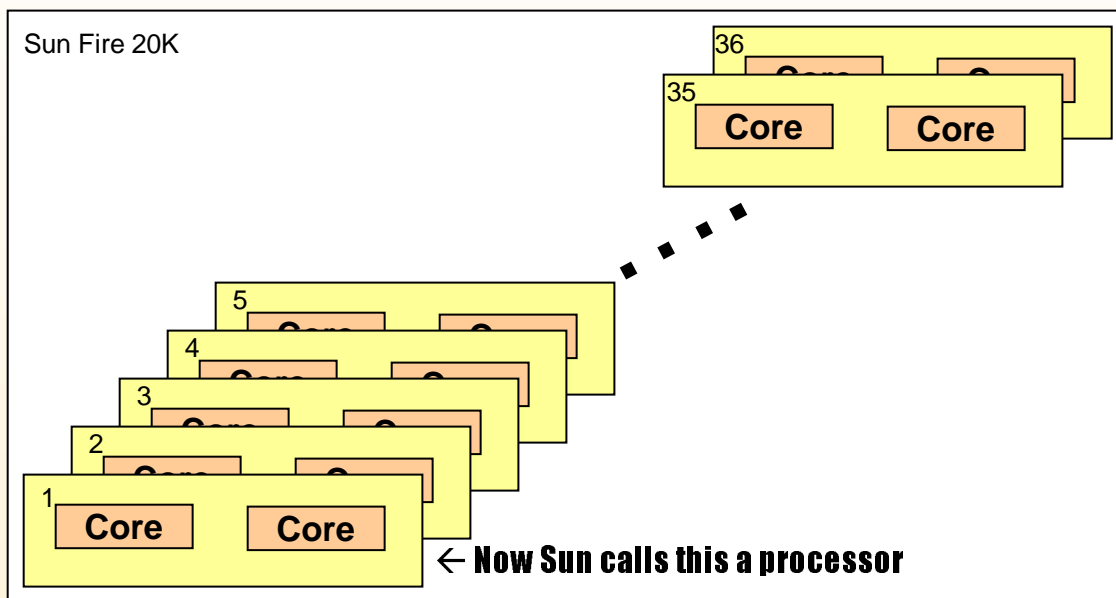
In the first result, each "core" was an UltraSPARC III processor.

In the second result, each "core" is now called an UltraSPARC III "pipeline."

Sun claims that they've "doubled their per-processor performance."

Confused by "Per-Processor" Claims?

POWER4+
POWER5
PA-RISC 8800
UltraSPARC IV

Sun calls this
a single processor
that runs two threads
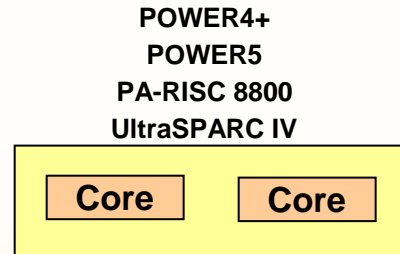
| Core | Core |

IBM, HP, Intel and AMD
all call this
a single chip
with two processors

"Tolliver *(Mark, Sun's chief strategy officer)* said the company considers each UltraSparc IV a single processor. In this, it differs from HP and IBM, which count a dual-core chip as two processors."

Sun revamps servers with UltraSparc, Opteron, 2/09/04
CNET News.com | http://news.com.com/2100-1010-5156216.html?tag=sas.email

Software companies that charge per-processor are charging Sun for two processors on the UltraSPARC IV. SPEC now lists results by "cores" rather than processors to avoid this confusion.

Each core in the UltraSPARC IV is an UltraSPARC III "pipeline".

Sun is delivering the same UltraSPARC III performance* but claiming "double the per processor performance."

* SAP SD 2-tier results:
    5,775 users on a 72-way 72-"core" UltraSPARC III Sun Fire 15K
    5,050 users on a 36-way 72-"core" UltraSPARC IV Sun Fire 20K

Who Has the Lead in Multi-Threading?

"Executing on Sun's Throughput Computing strategy, the dual-thread UltraSPARC IV processor marks the first milestone in Sun's Chip Multi-threading (CMT) roadmap." (http://www.sun.com/processors/UltraSPARC-IV/)

"Tolliver *(Mark, Sun's chief strategy officer)* said the dual-core processors mark the start of its "throughput computing" era, in which a chip handles multiple software tasks, or "threads," simultaneously…

CNET News.com   http://news.com.com/2100-1010-5156216.html?tag=sas.email

This is UltraSPARC IV – a chip with two cores, each of which runs one thread.

UltraSPARC IV

Thread 1 → **Core** → Thread 1

Thread 1 → **Core** → Thread 1

POWER4

Thread 1 → **Core** → Thread 1

Thread 1 → **Core** → Thread 1
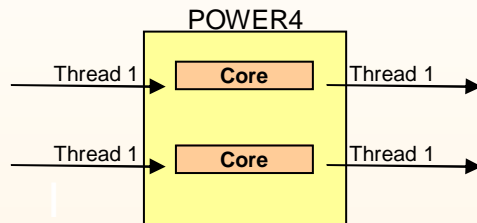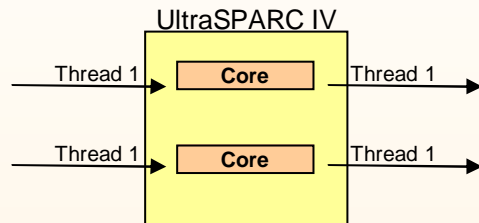
This is POWER4 (delivered in 2000) – a chip with two cores, each of which runs one thread

This is POWER5 – a chip with two cores, each of which runs multiple threads simultaneously.

POWER5

Thread 1 → **Core** → Thread 2

Thread 2 → **Core** → Thread 1

Thread 3 → **Core** → Thread 4

Thread 4 → **Core** → Thread 3
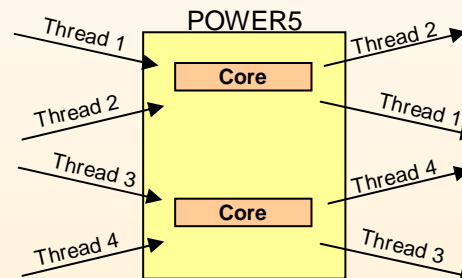
POWER4 beats* the per-processor performance of UltraSPARC IV.

Sun is 4 years behind IBM in multi-threading.

POWER5 delivers over 3 times the per-processor performance of UltraSPARC IV**

*   Based on 32-"core" SPECint_rate by 47% and on 32-"core" SPECfp_rate by 68%!
** Based on SAP SD 2-tier results: 5,056 users on a 16-way IBM eServer p5 570; 10,175 users on a 104-"core" Sun Fire E20K

TOP500 List of Supercomputers

Semiannual independent ranking of top 500 supercomputers in the world

TOP500 -- June 2004

Legend: Other, L Nwx, NEC, Dell, HPQ, Cray, SGI, Sun, IBM

Top 10: IBM 3, HPQ 2
Top 100: IBM 68, HPQ 10
Top 500: IBM 224, HPQ 140

June 2004 Aggregate Performance

- Self 2%
- Other 14%
- NEC 6%
- Dell 3%
- HP 19%
- Cray 2%
- SGI 3%
- Sun 1%
- IBM 50%
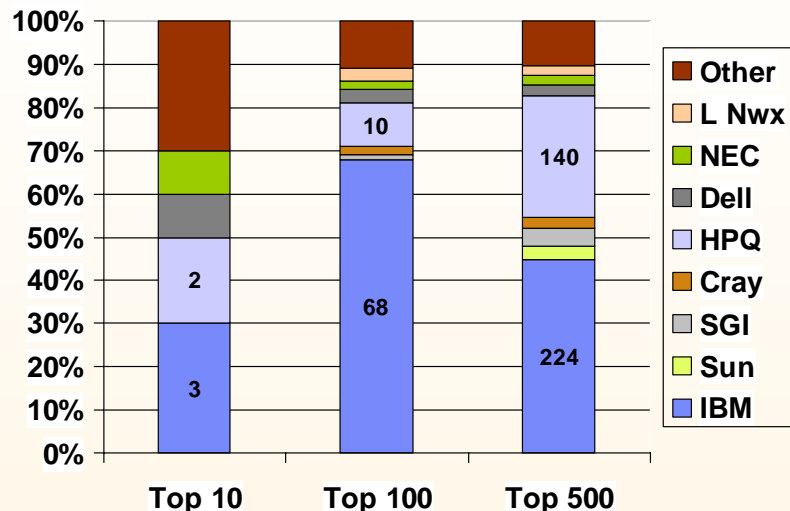
IBM is the dominant vendor:

- Most entries on list with 224 (44.8%)!
- Most installed aggregate throughput with over 407 Teraflops (50%)!
- Most in Top10 by any single vendor (3)!
- Most in Top20 with 10 systems (55%)!
- Most in Top100 systems with 68 (68%)!
- Most Linux Clusters with 150 (51%)!
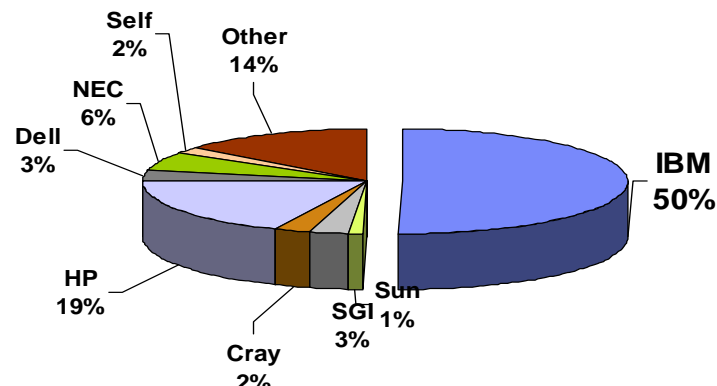
Total Number of Linux Clusters

For the 1st time -- Linux clusters are more than ½ the list

X-axis: Nov-00, Jun-01, Nov-01, Jun-02, Nov-02, Jun-03, Nov-03, Jun-04

Series: IBM, Other, HPQ, SGI, Sun, Dell
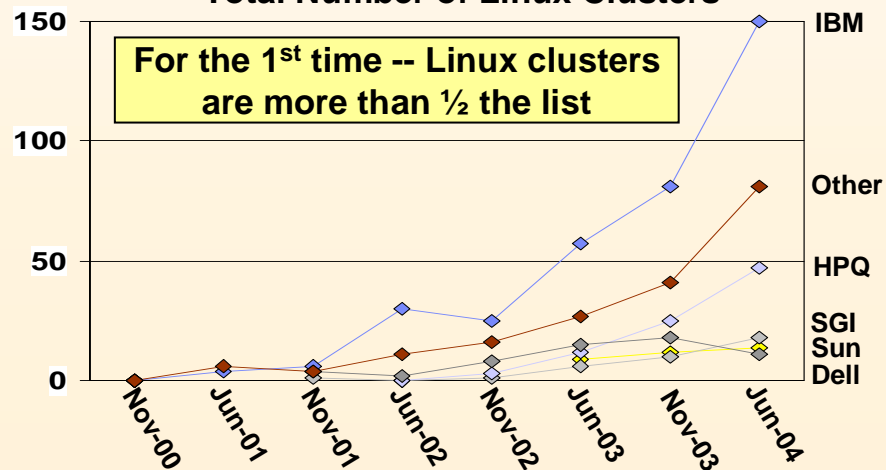
Source: TOP500 List of Supercomputers, University of Mannheim & University of Tennessee - June 2004 - www.top500.org

TOP500

Product Line

Charts

DB2 -- #1 Performance

DB2 sets records and delivers better per-processor performance than Oracle!

System	CPU	Avail.	$/tpmC	Database	OS	tpmC	tpmC/CPU
IBM p5-570 (1.9 GHz POWER5)	16	09/30/04	$4.95	IBM DB2 8.1	AIX 5L V5.3	809,144	50,571
IBM p5-570 (1.9 GHz POWER5)	8	09/30/04	$5.26	Oracle 10G	AIX 5L V5.3	371,044	46,380
IBM p5-570 (1.9 GHz POWER5)	4	09/30/04	$5.62	Oracle 10G	AIX 5L V5.3	194,391	48,597
HP rx5670 (1.5 GHz Itanium 2)	4	3/05/04	$3.94	Oracle 10G	Red Hat Linux	136,111	34,027
HP Superdome (1.5 GHz Itanium 2)	64	04/14/04	$8.33	Oracle 10G	HP-UX 11.i	1,008,144	15,752

Configuration	Software Releases	CPU's	Number of Users	Users per CPU
IBM p5-570 (1.9 GHz POWER5)	AIX 5L V5.3, DB2 UDB 8.1	16	5,056 @ 1.99 sec	316
IBM p5-570 (1.9 GHz POWER5)	AIX 5L V5.3, DB2 UDB 8.1	8	2,600 @ 1.99 sec	325
IBM p5-570 (1.9 GHz POWER5)	AIX 5L V5.3, DB2 UDB 8.1	4	1,313 @ 1.97 sec	328
HP rx8620 (1.5 GHz Itanium 2)	HP-UX 11, Oracle 9i	16	2,880 @ 1.95 sec	180
HP rp4440-8 (1.0 GHz PA-8800)	HP-UX 11, Oracle 9i	8	1,240 @ 1.97 sec	155
Sun 25K (1.2 GHz US IV)	Solaris 9, Oracle 9i	104	10,175 @1.95 sec	98
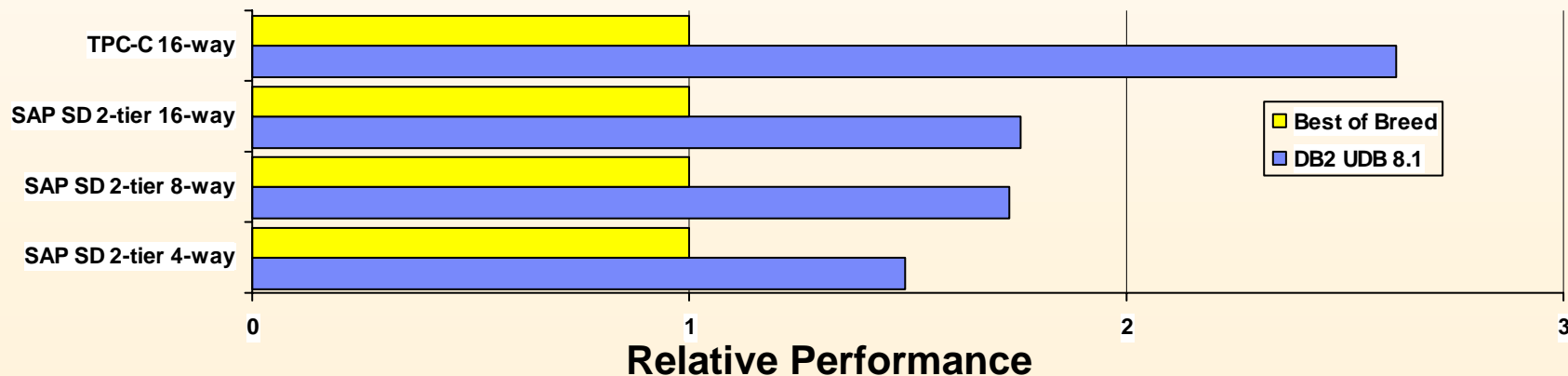
Legend:
- Best of Breed
- DB2 UDB 8.1

Chart categories (Relative Performance):
- TPC-C 16-way
- SAP SD 2-tier 16-way
- SAP SD 2-tier 8-way
- SAP SD 2-tier 4-way

X-axis: Relative Performance (0 to 3)

16-way IBM p5-570 TPC-C result of 809,144 tpmC, $4.95/tpmC, avail. 09/30/04
16-way Unisys ES7000 TPC-C result of 309,037 tpmC, $4.49/tpmC, avail. 01/30/04

Benchmarks	# CPU's	GHz	POWER5 Result	Former BoB Result	POWER5 Faster By	Former Best of Breed (BoB) System
SAP SD 2-tier	16w	1.90	5,056	2880	75.6%	HP rx8620
SAP SD 2-tier	8w	1.90	2,600	1500	73.3%	HP rx7620
SAP SD 2-tier	4w	1.90	1,313	880	49.2%	HP rx4640

Source:
www.tpc.org
www.sap.com/benchmark/
All results are as of 07/13/04

POWER5 vs. Best of Breed
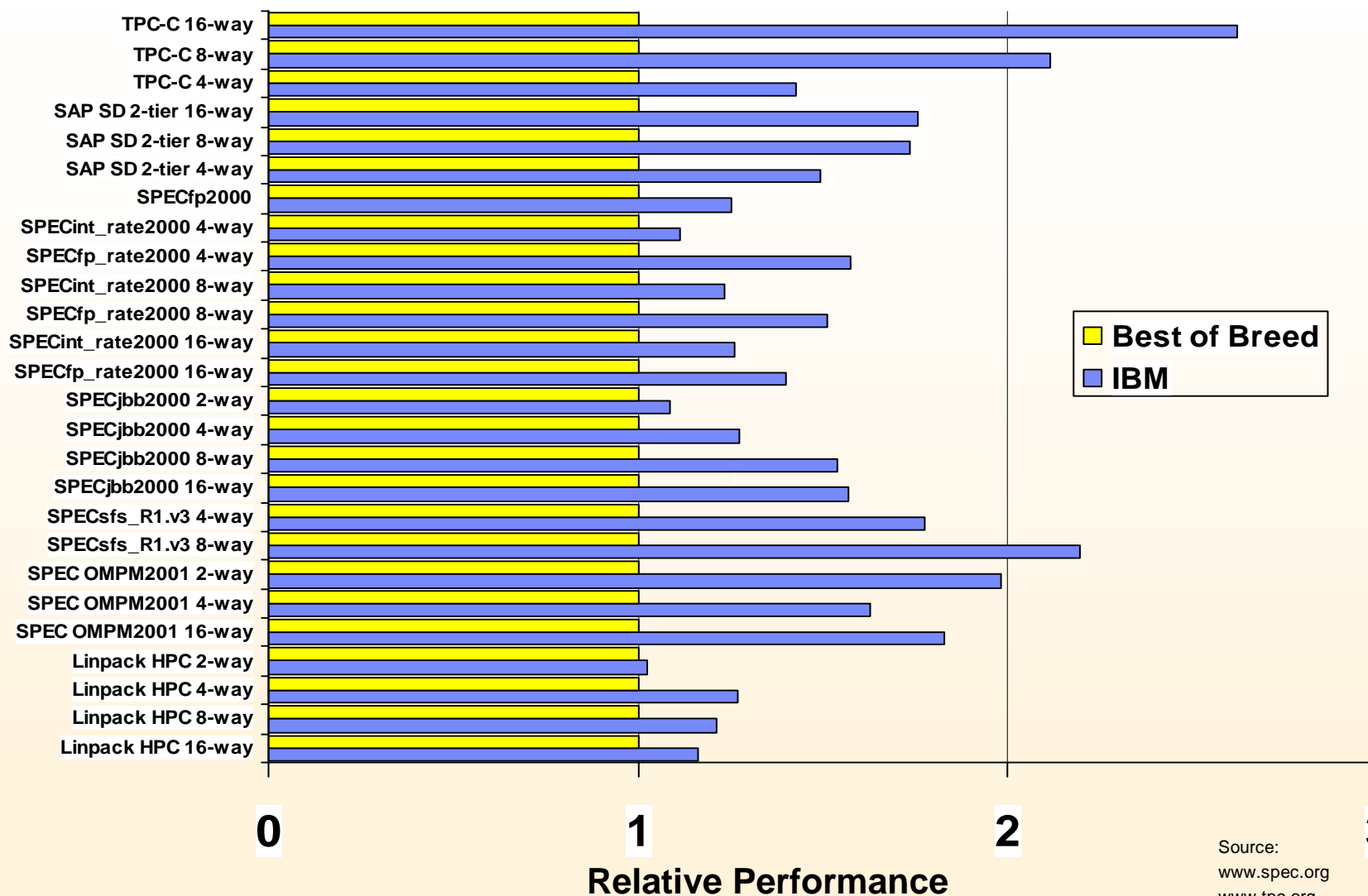
Relative Performance

Legend:
- Best of Breed
- IBM

Categories (top to bottom):
TPC-C 16-way, TPC-C 8-way, TPC-C 4-way, SAP SD 2-tier 16-way, SAP SD 2-tier 8-way, SAP SD 2-tier 4-way, SPECfp2000, SPECint_rate2000 4-way, SPECfp_rate2000 4-way, SPECint_rate2000 8-way, SPECfp_rate2000 8-way, SPECint_rate2000 16-way, SPECfp_rate2000 16-way, SPECjbb2000 2-way, SPECjbb2000 4-way, SPECjbb2000 8-way, SPECjbb2000 16-way, SPECsfs_R1.v3 4-way, SPECsfs_R1.v3 8-way, SPEC OMPM2001 2-way, SPEC OMPM2001 4-way, SPEC OMPM2001 16-way, Linpack HPC 2-way, Linpack HPC 4-way, Linpack HPC 8-way, Linpack HPC 16-way

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www.tpc.org
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See next page for data used in this graph.

POWER5 vs. Best of Breed

Comparing the best available results vs. POWER5

Benchmarks	# CPU's	GHz	POWER5 Result	Former BoB Result	POWER5 Faster By	Former Best of Breed (BoB) System
TPC-C	16w	1.90	809,144	309037	161.8%	Unisys ES7000 Aries 420
TPC-C	8w	1.90	371,044	175366	111.6%	Bull NovaScale 5080
TPC-C	4w	1.90	194,391	136111	42.8%	HP rx5670
SAP SD 2-tier	16w	1.90	5,056	2880	75.6%	HP rx8620
SAP SD 2-tier	8w	1.90	2,600	1500	73.3%	HP rx7620
SAP SD 2-tier	4w	1.90	1,313	880	49.2%	HP rx4640
SPECfp2000	1w	1.90	2,702	2161	25.0%	HP rx4640
SPECint_rate2000	4w	1.90	76.3	68.6	11.2%	ProLiant DL585
SPECfp_rate2000	4w	1.90	130	82.7	57.2%	SGI Altix 3000
SPECint_rate2000	8w	1.90	147	119	23.5%	Fujitsu Primepower 650
SPECfp_rate2000	8w	1.90	249	165	50.9%	SGI Altix 3000
SPECint_rate2000	16w	1.90	294	233	26.2%	Fujitsu Primepower 850
SPECfp_rate2000	16w	1.90	460	329	39.8%	SGI Altix 3000
SPECjbb2000	2w	1.90	86,267	79544	8.5%	Tyan 2.4 GHz Opteron
SPECjbb2000	4w	1.90	170,127	133427	27.5%	Verari 2.4 GHz Opteron
SPECjbb2000	8w	1.90	328,996	213956	53.8%	Fujitsu Primepower 650
SPECjbb2000	16w	1.90	633,106	402961	57.1%	Fujitsu Primepower 900
SPECsfs_R1.v3	4w	1.65	75,839	42706	77.6%	p655
SPECsfs_R1.v3	8w	1.90	145,362	66235	119.5%	HP AlphaServer GS1280
SPEC OMPM2001	2w	1.65	5,228*	2,637	98.3%	HP rx2600 (1 GHz)
SPEC OMPM2001	4w	1.90	13,613*	8,356	62.9%	IBM p655
SPEC OMPM2001	16w	1.90	38,282*	20,958	82.7%	SGI Altix 3000
Linpack HPC	2w	1.65	11.78	11.49	2.5%	HP rx5670
Linpack HPC	4w	1.90	27.52	21.71	26.8%	HP rx5670
Linpack HPC	8w	1.90	53.8	44.4	21.2%	HP rx7620
Linpack HPC	16w	1.90	103.1	88.8	16.1%	HP rx8620

16-way IBM p5-570 TPC-C result of 809,144 tpmC, $4.95/tpmC, avail. 09/30/04
16-way Unisys ES7000 TPC-C result of 309,037 tpmC, $4.49/tpmC, avail. 01/30/04
8-way IBM p5-570 TPC-C result of 371,044 tpmC, $5.26/tpmC, avail. 09/30/04
8-way Bull NovaScale 5080 result of 175,366 tpmC, $4.53/tpmC, avail. 06/30/04
4-way IBM p5-570 TPC-C result of 194,391 tpmC, $/tpmC, avail. 09/30/04
4-way HP rx5670 TPC-C result of 136,111 tpmC, $3.94/tpmC, avail. 03/05/04

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POWER5 vs. Fastest Itanium

Relative Performance

Legend: Fastest Itanium, IBM

Benchmarks: TPC-C 16-way, TPC-C 8-way, TPC-C 4-way, SAP SD 2-tier 16-way, SAP SD 2-tier 8-way, SAP SD 2-tier 4-way, SPECfp2000, SPECint_rate2000 4-way, SPECfp_rate2000 4-way, SPECint_rate2000 8-way, SPECfp_rate2000 8-way, SPECint_rate2000 16-way, SPECfp_rate2000 16-way, SPECjbb2000 2-way, SPECjbb2000 4-way, SPECjbb2000 8-way, SPECjbb2000 16-way, SPEC OMPM2001 2-way, SPEC OMPM2001 4-way, SPEC OMPM2001 16-way, Linpack HPC 2-way, Linpack HPC 4-way, Linpack HPC 8-way, Linpack HPC 16-way

See next page for data used in this graph.

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POWER5 vs. Fastest Itanium 2

Comparing the best available Itanium 2 results vs. POWER5

Benchmarks	# CPU's	GHz.	POWER5 Result	Fastest Itanium	POWER5 Faster by	Fastest Itanium System
TPC-C	16w	1.90	809,144	309037	161.83%	Unisys ES7000 Aries 420
TPC-C	8w	1.90	371,044	175366	111.58%	Bull NovaScale 5080
TPC-C	4w	1.90	194,391	136111	42.82%	HP rx5670
SAP SD 2-tier	16w	1.90	5,056	2880	75.56%	HP rx8620 1.5 GHz Itanium
SAP SD 2-tier	8w	1.90	2,600	1500	73.33%	HP rx7620
SAP SD 2-tier	4w	1.90	1,313	880	49.20%	HP rx4640
Oracle Apps 11.5.9	8w	1.90	15,004	DNP		
SPECfp2000	1w	1.90	2,702	2161	25.03%	HP rx4640
SPECint_rate2000	4w	1.90	76	64.2	18.85%	HP rx4640
SPECfp_rate2000	4w	1.90	130	82.7	57.19%	SGI Altix 3000
SPECint_rate2000	8w	1.90	147	117	25.64%	HP rx8620
SPECfp_rate2000	8w	1.90	249	165	50.91%	SGI Altix 3000
SPECint_rate2000	16w	1.90	294	232	26.72%	HP rx8620
SPECfp_rate2000	16w	1.90	460	329	39.82%	SGI Altix 3000
SPECjbb2000	2w	1.90	86,267	61517	40.23%	HP rx2600
SPECjbb2000	4w	1.90	170,127	116466	46.07%	HP rx5670
SPECjbb2000	8w	1.90	328,996	190393	72.80%	HP rx7620
SPECjbb2000	16w	1.90	633,106	341098	85.61%	HP rx8620
SPECsfs_R1.v3	4w	1.65	75,839	DNP		
SPECsfs_R1.v3	8w	1.90	145,362	DNP		
SPEC OMPM2001	2w	1.65	5,228*	2,637	98.26%	HP rx2600 (1 GHz)
SPEC OMPM2001	4w	1.90	13,613*	6,886	97.69%	HP rx7620
SPEC OMPM2001	16w	1.90	38,282*	20,958	82.66%	SGI Altix 3000
Linpack HPC	2w	1.65	12	11.49	2.52%	HP rx5670
Linpack HPC	4w	1.90	28	21.71	26.76%	HP rx5670
Linpack HPC	8w	1.90	54	44.4	21.17%	HP rx7620
Linpack HPC	16w	1.90	103	88.8	16.10%	HP rx8620

16-way IBM p5-570 TPC-C result of 809,144 tpmC, $4.95/tpmC, avail. 09/30/04
16-way Unisys ES7000 TPC-C result of 309,037 tpmC, $4.49/tpmC, avail. 01/30/04
8-way IBM p5-570 TPC-C result of 371,044 tpmC, $5.26/tpmC, avail. 09/30/04
8-way Bull NovaScale 5080 result of 175,366 tpmC, $4.53/tpmC, avail. 06/30/04
4-way IBM p5-570 TPC-C result of 194,391 tpmC, $/tpmC, avail. 09/30/04
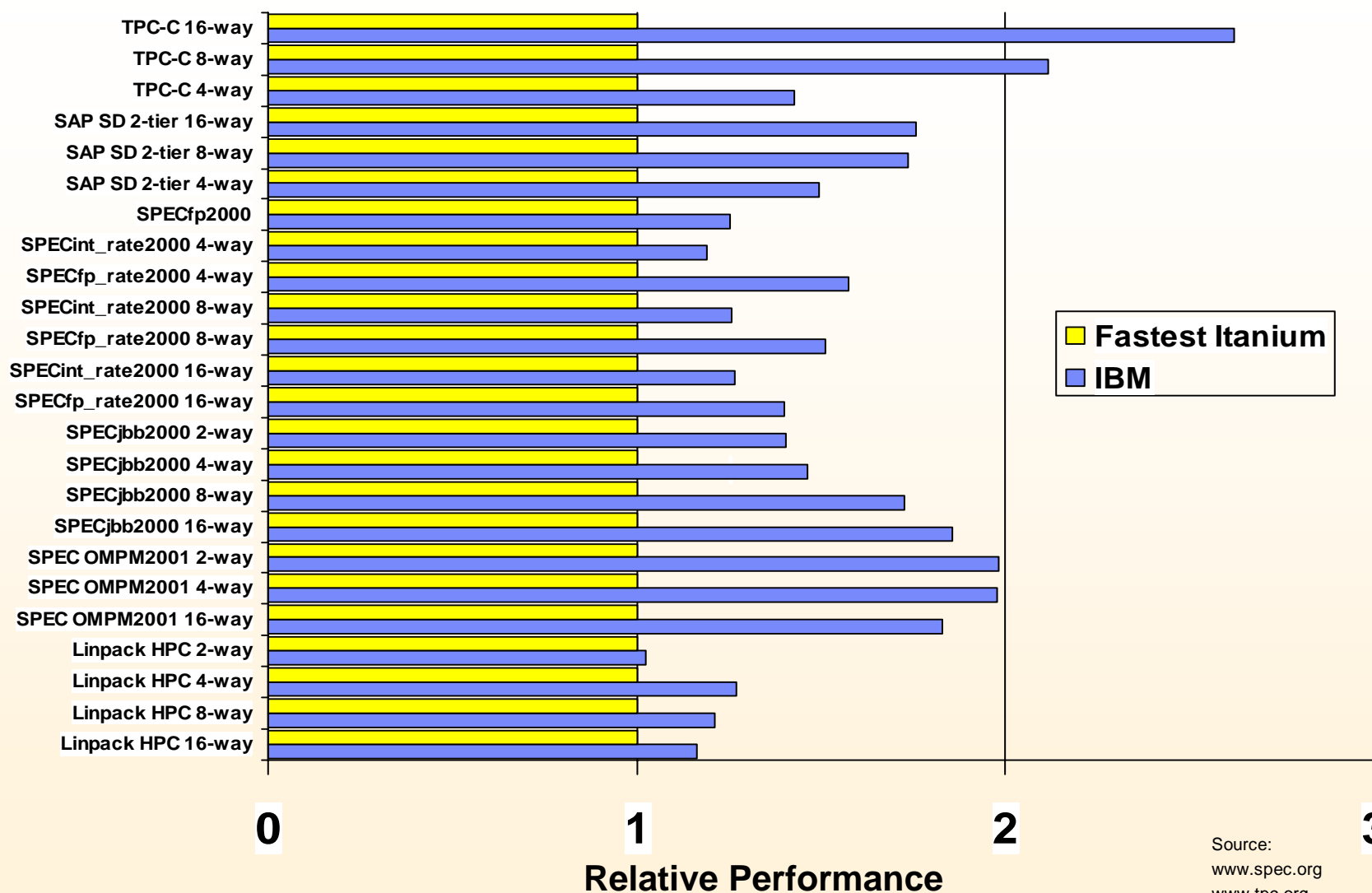4-way HP rx5670 TPC-C result of 136,111 tpmC, $3.94/tpmC, avail. 03/05/04

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www.sap.com/benchmark/
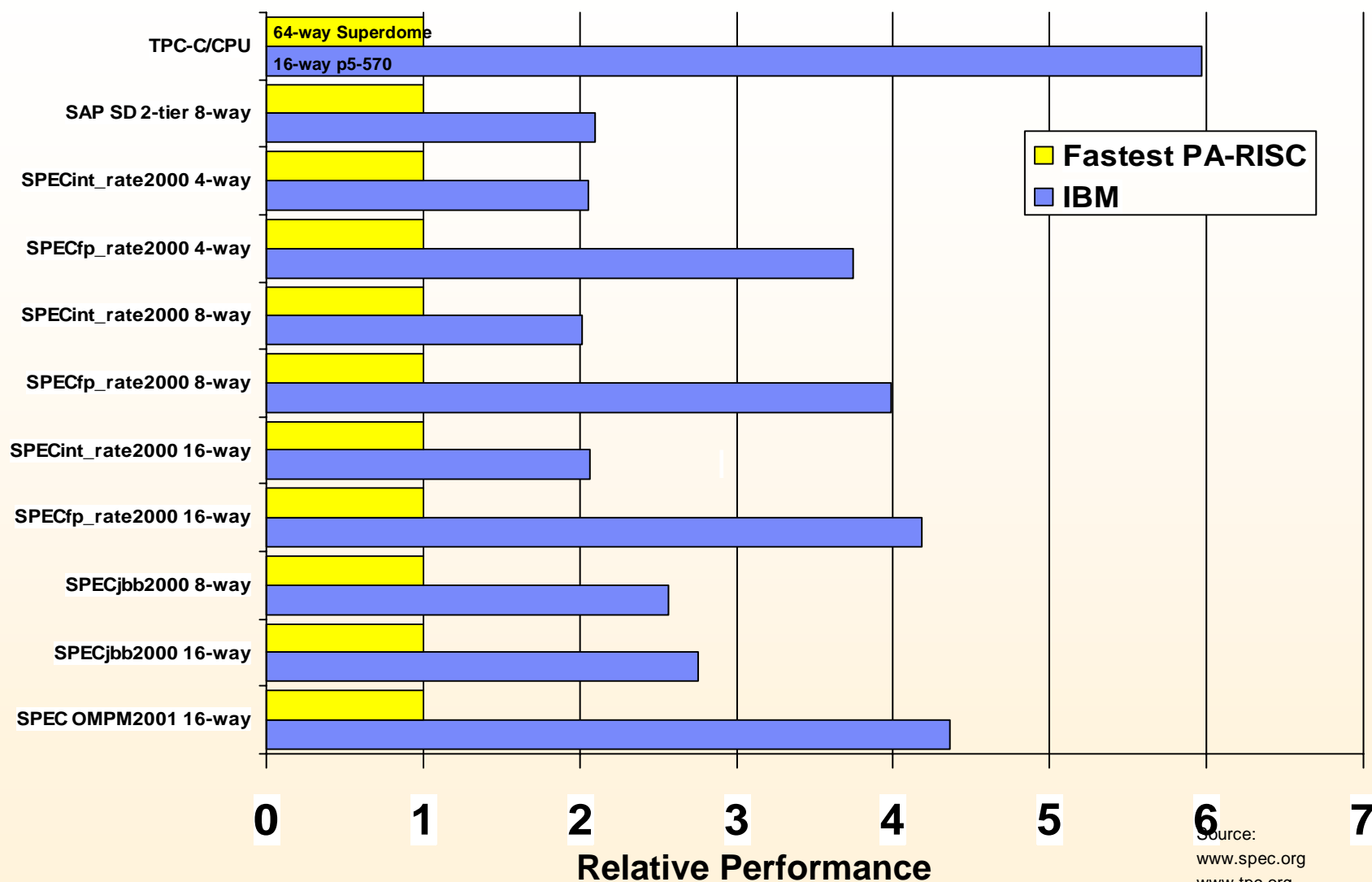http://performance.netlib.org/performance/html/PDSreports.html

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POWER5 vs. Fastest HP PA-RISC

Chart: Relative Performance comparison (Fastest PA-RISC = yellow, IBM = blue)

Benchmark	Notes
TPC-C/CPU	64-way Superdome / 16-way p5-570
SAP SD 2-tier 8-way	
SPECint_rate2000 4-way	
SPECfp_rate2000 4-way	
SPECint_rate2000 8-way	
SPECfp_rate2000 8-way	
SPECint_rate2000 16-way	
SPECfp_rate2000 16-way	
SPECjbb2000 8-way	
SPECjbb2000 16-way	
SPEC OMPM2001 16-way	

Legend: **Fastest PA-RISC** (yellow), **IBM** (blue)

X-axis: 0 1 2 3 4 5 6 7 — **Relative Performance**

See next page for data used in this graph.

Source:
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www.tpc.org
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POWER5 vs. Fastest PA-RISC

Comparing the best available PA-RISC results vs. POWER5

Benchmarks	# CPU's	GHz	POWER5 Result	Fastest PA-RISC Result	POWER5 Faster By	Fastest PA-RISC System
tpmC/CPU	16w	1.90	50,571	8,464	491%	64-way 875 MHz HP Superdome
TPC-C	8w	1.90	371,044	DNP		
TPC-C	4w	1.90	194,391	DNP		
SAP SD 2-tier	16w	1.90	5,056	DNP		
SAP SD 2-tier	8w	1.90	2,600	1240	109.7%	rp4440 1.0 GHz
SAP SD 2-tier	4w	1.90	1,313	DNP		
Oracle Apps 11.5.9	8w	1.90	15,004	DNP		
SPECfp2000	1w	1.90	2,702	DNP		
SPECint_rate2000	4w	1.90	76.3	37.1	105.7%	HP rp3440-8
SPECfp_rate2000	4w	1.90	130.0	34.7	274.6%	HP rp4440-8
SPECint_rate2000	8w	1.90	147.0	73.2	100.8%	HP rp4440-8
SPECfp_rate2000	8w	1.90	249.0	62.5	298.4%	HP rp7420-8
SPECint_rate2000	16w	1.90	294	142	107.0%	HP rp8420-16
SPECfp_rate2000	16w	1.90	460	110	318.2%	HP rp8420-16
SPECjbb2000	2w	1.90	86,267	DNP		
SPECjbb2000	4w	1.90	170,127	DNP		
SPECjbb2000	8w	1.90	328,996	127986	157.1%	HP rp7410 875 MHz
SPECjbb2000	16w	1.90	633,106	230292	174.9%	HP rp8400 875 MHz
SPECsfs_R1.v3	4w	1.65	75,839	DNP		
SPECsfs_R1.v3	8w	1.90	145,362	DNP		
SPEC OMPM2001	2w	1.65	5,228*	DNP		
SPEC OMPM2001	4w	1.90	13,613*	DNP		
SPEC OMPM2001	16w	1.90	38,282*	8,788	335.6%	HP Superdome 875 MHz
Linpack HPC	2w	1.65	12	DNP		
Linpack HPC	4w	1.90	28	DNP		
Linpack HPC	8w	1.90	54	DNP		
Linpack HPC	16w	1.90	103	DNP		

16-way IBM p5-570 TPC-C result of 809,144 tpmC, $4.95/tpmC, avail. 09/30/04
8-way IBM p5-570 TPC-C result of 371,044 tpmC, $5.26/tpmC, avail. 09/30/04
64-way HP Superdome result of 541,673 tpmC, $11.66/tpmC, avail. 01/30/04

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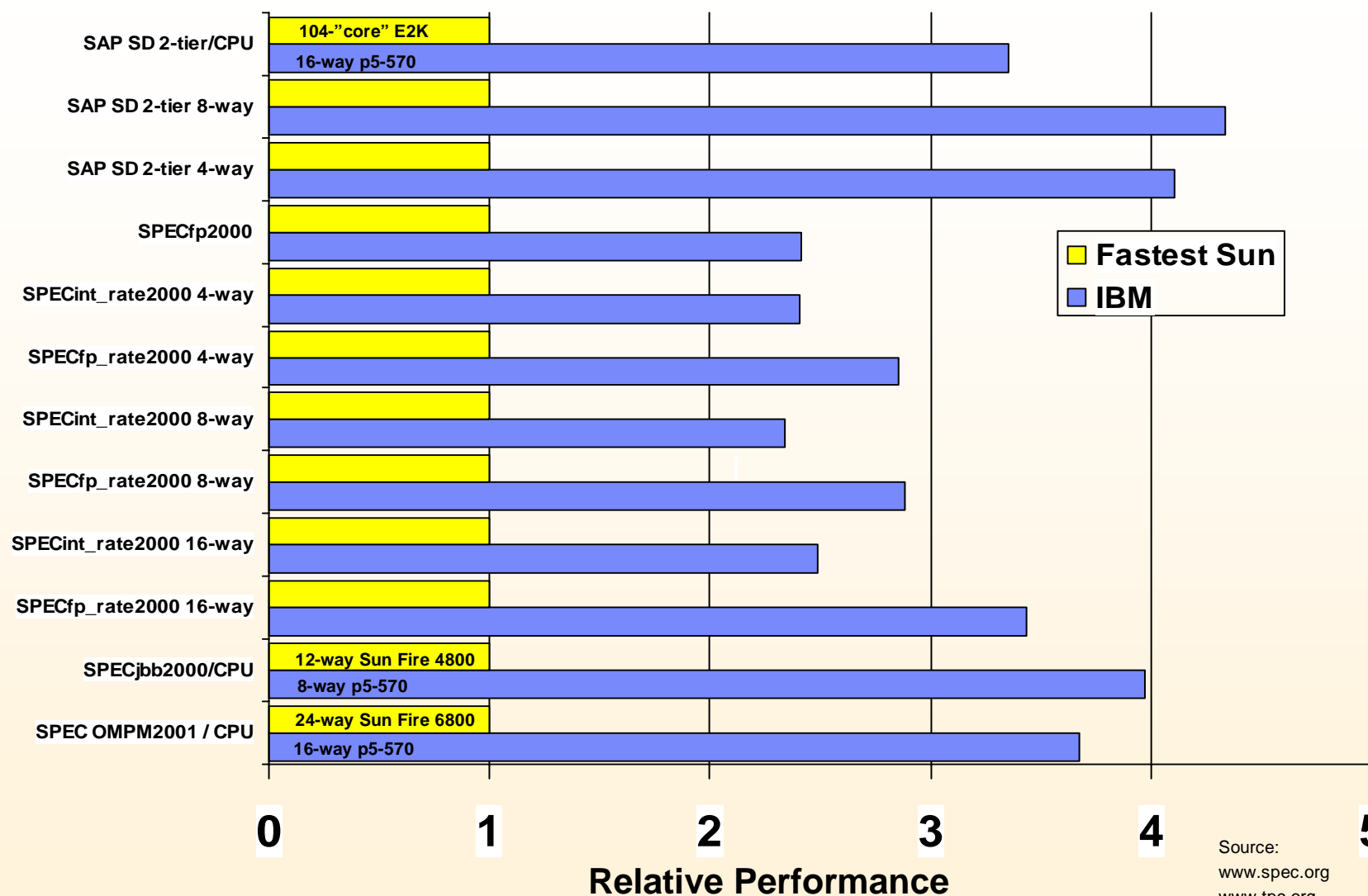www.tpc.org
www.sap.com/benchmark/
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POWER5 vs. Sun

Relative Performance

Benchmark	Data
SAP SD 2-tier/CPU	104-"core" E2K / 16-way p5-570
SAP SD 2-tier 8-way	
SAP SD 2-tier 4-way	
SPECfp2000	
SPECint_rate2000 4-way	
SPECfp_rate2000 4-way	
SPECint_rate2000 8-way	
SPECfp_rate2000 8-way	
SPECint_rate2000 16-way	
SPECfp_rate2000 16-way	
SPECjbb2000/CPU	12-way Sun Fire 4800 / 8-way p5-570
SPEC OMPM2001 / CPU	24-way Sun Fire 6800 / 16-way p5-570

Legend:
- ☐ Fastest Sun (yellow)
- ☐ IBM (blue)

See next page for data used in this graph.

POWER5 vs. Fastest Sun

Comparing the best available SPARC results vs. POWER5

Benchmarks	# CPU's	GHz	POWER5 Result	Fastest Sun Result	POWER5 Faster By	Fastest Sun System
TPC-C	16w	1.90	809,144	DNP		
TPC-C	8w	1.90	371,044	DNP		
TPC-C	4w	1.90	194,391	DNP		
SAP SD 2-tier/CPU	16w	1.90	316	97.8	235%	104-way E25K 1.2 GHz
SAP SD 2-tier	8w	1.90	2,600	600	333%	V880 900 MHz
SAP SD 2-tier	4w	1.90	1,313	320	310%	E4900 1.2 GHz
Oracle Apps 11.5.9	8w	1.90	15,004	DNP		
SPECfp2000	1w	1.90	2,702	1118	141%	Sun Blade 2000 1.2 GHz
SPECint_rate2000	4w	1.90	76.3	31.7	140%	Sun V480
SPECfp_rate2000	4w	1.90	130.0	45.5	185%	Sun V480
SPECint_rate2000	8w	1.90	147.0	62.8	134%	Sun V880
SPECfp_rate2000	8w	1.90	249.0	86.3	188%	Sun V880
SPECint_rate2000	16w	1.90	294	118	149%	Sun E4900
SPECfp_rate2000	16w	1.90	460	134	243%	Sun E4900
SPECjbb2000	2w	1.90	86,267	DNP		
SPECjbb2000	4w	1.90	170,127	DNP		
SPECjbb2000/CPU	8w	1.90	41,124	10,354	297%	12-way Sun Fire 4800
SPECjbb2000	16w	1.90	633,106	DNP		
SPECsfs_R1.v3	4w	1.65	75,839	DNP		
SPECsfs_R1.v3	8w	1.90	145,362	DNP		
SPEC OMPM2001	2w	1.65	5,228*	DNP		
SPEC OMPM2001	4w	1.90	13,613*	DNP		
SPEC OMPM2001 / CPU	16w	1.90	2,392*	651	267%	24-way Sun Fire 6800
Linpack HPC	2w	1.65	12	DNP		
Linpack HPC	4w	1.90	28	DNP		
Linpack HPC	8w	1.90	54	DNP		
Linpack HPC	16w	1.90	103	DNP		

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POWER5 vs. Sun UltraSPARC IV

IBM publishes results in all the major benchmarks to demonstrate performance across all workloads.

Benchmark	POWER5	Results*	UltraSPARC IV	Results*
SPECint2000			Have not published	
SPECfp2000	1-way p5-570	#1 Performance	Have not published	
SPECint_rate2000	4/8/16-way p5-570	#1 4/8/16-way Performance	8 to 48-"core"	Lost badly to POWER4
SPECfp_rate2000	4/8/16-way p5-570	#1 4/8/16-way Performance	8 to 48-"core"	Lost badly to POWER4
SPECweb99			Have not published	
SPECweb99_SSL			Have not published	
SPECjbb	2/4/8/16-way p5-570	#1 2/4/8/16-way Performance	48-"core"	Lost badly to 32-way POWER4
SPECsfs V2			Have not published	
SPECsfs V3	4-way p5-550 8-way p5-570	#1 4-way Performance #1 8-way Performance	Have not published	
TPC-C (DB2)	16-way p5-570	#1 16-way Performance	Have not published	
TPC-C (Oracle)	4/8-way p5-570	#1 4/8-way Performance	Have not published	
TPC-H			Have not published	
SAP SD 2-tier	2-way i5-520 4/8-way p5-570 16-way p5-570	#1 2-way Performance #1 4/8-way Performance #1 16-way, Beats Sun 72-"core"	4-"core" 72-"core" 104-"core"	Lost badly to 2-way POWER5 Worse than 72-way UltraSPARC III Per-CPU loses to POWER5 by 223%
Lotus Notesbench	2-way i5-520	#1 2-way Performance	24-"core"	Lost by 29% to 32-way POWER4
Oracle Applications	8-way p5-570	#1 Overall Performance	Have not published	
Oracle Apps RAC			Have not published	
Linpack HPC	2/4/8/16-way p5-570	#1 2/4/8/16-way Performance	Have not published	
STREAM	Published		72-way F25K	
SPECompM2000	2/4/8/16-way p5-570	#1 2/4/8/16-way Performance	Have not published	
Fluent 5	Published		Have not published	
Ansys	Published	Top Performance	Have not published	
Abacus	Published	Top Performance	Have not published	
Star-CD	Published	Top Performance	Have not published	

* Comments applicable on date of publishing of benchmark results

As of 07/13/04.