Case Study: Implementing the Oracle Grid Computing on Dell Hardware for Multiple ERP Applications

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Agenda

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❖ **Oracle Enterprise Grid Model**

❖ **Grid Design and Implementation**

❖ **Database Grid Scalability**

❖ **Applications Test Methodology**

❖ **Performance Test Results**

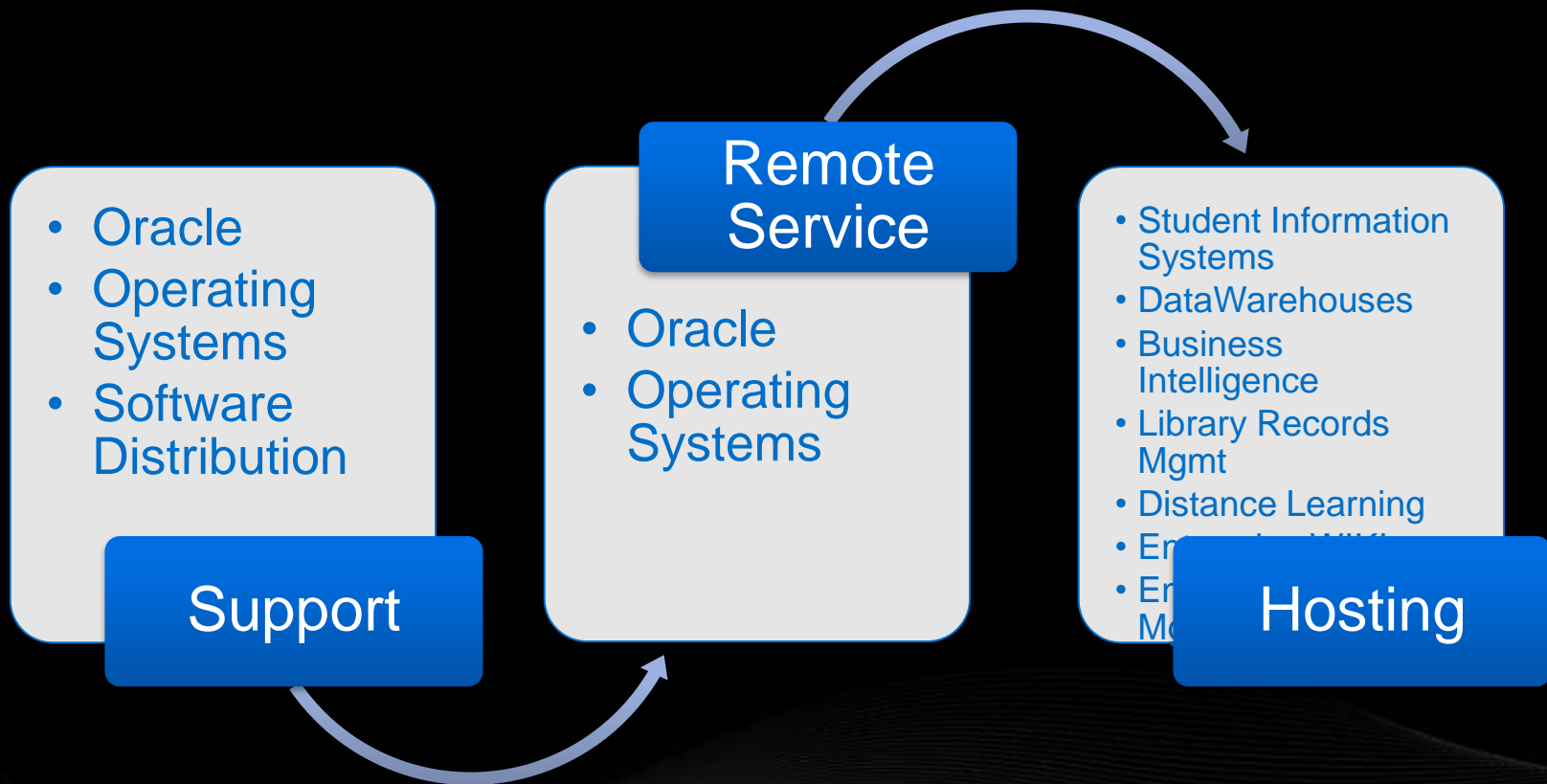❖ **QA**

Introduction to SUNY POC Project

ITEC within SUNY

- ITEC is part of the AST – Alliance for Strategic Technologies

- Work with sister organizations:
  - SUNY Learning Network, SUNYNET, SUNY Connect
  - Center for Professional Development, SICAS

- Applications:
  - SunGuard: Banner – Student Info System, Luminis (Portal), ODS, EDW (data warehousing)
  - ExLibris: Aleph500 library automation
  - Atlassian: Confluence Enterprise Wiki
  - AtTask: @task Enterprise Project Management

Introduction to SUNY POC Project

History of ITEC

Support

- Oracle
- Operating Systems
- Software Distribution

Remote Service

- Oracle
- Operating Systems

Hosting

- Student Information Systems
- DataWarehouses
- Business Intelligence
- Library Records Mgmt
- Distance Learning
- Enterprise Wiki
- En... M...

Introduction to SUNY POC Project

Challenges

Problems

- A lot of systems
- Too much variety
- Difficult to Manage
- Low Resource Utilization
- Numerous Single Points of Failure

Desires

- Fewer Systems
- Less Variety
- Ease of Management
- Improved Resource Utilization
- High Availability

Introduction to SUNY POC Project

Grid Computing to the Rescue

- Promises to address all our desires

- But – how to demonstrate it will work

- Without substantial investment?

- How about a Proof-of-Concept?

Desires

- Fewer Systems
- Less Variety
- Ease of Management
- Improved Resource Utilization
- High Availability

Introduction to SUNY POC Project

Dell, SUNY ITEC, Oracle and SunGuard Joint POC project:

- Consolidate 10 Banner ERP Applications
- In single Grid made of Dell hardware
- Capacity: 10 campuses, 170,000 students
- Performance Requirements:

  11,000 students simultaneous actions

  Response time: < 1 second at peak time

  Throughputs: 70,000 courses registration

  per hour during peak time

Oracle Enterprise Grid Model

- **Traditional Corporate Computing model:**
  - Consists of island-like systems
  - Little or no resource sharing
  - Hard to dynamically adapt changing workload

- **Enterprise Grid Computing Model**
  - Consolidate databases, applications, servers and storage connected by high speed network onto a common Grid platform.
  - Provide various server and storage resources as services to applications using databases
  - Integrate all the resources to allow provisioning on demand: dynamically provisioning to meet the workload needs

Oracle Enterprise Grid Model

- – MegaGrid: a joint project by Oracle, Dell, EMC and Intel.
- – Candidate for Grid model:
  Multiple services by multiple tiered applications
  Large number of resources: servers, network,
  storages
- – A case study for SUNY ITEC Grid design for multiple ERP systems on Dell hardware
- ▪ Oracle 10g Features for Grid Computing
  - – Clustering technology
  - – Database services
  - – Automatic Storage Management
  - – Oracle Enterprise Manager Grid Control
  - – Load balancing

Grid Design and Implementation

- **Multi-Tier Proof of Concept (POC) Environment**
  - Server Grid:
    - . Application servers offer application services using VM
    - . Database servers offer database services for applications
  - Storage Grid:
    - . ASM provides storage services for all the databases
    - . ASM virtualizes the storage services using ASM diskgroups
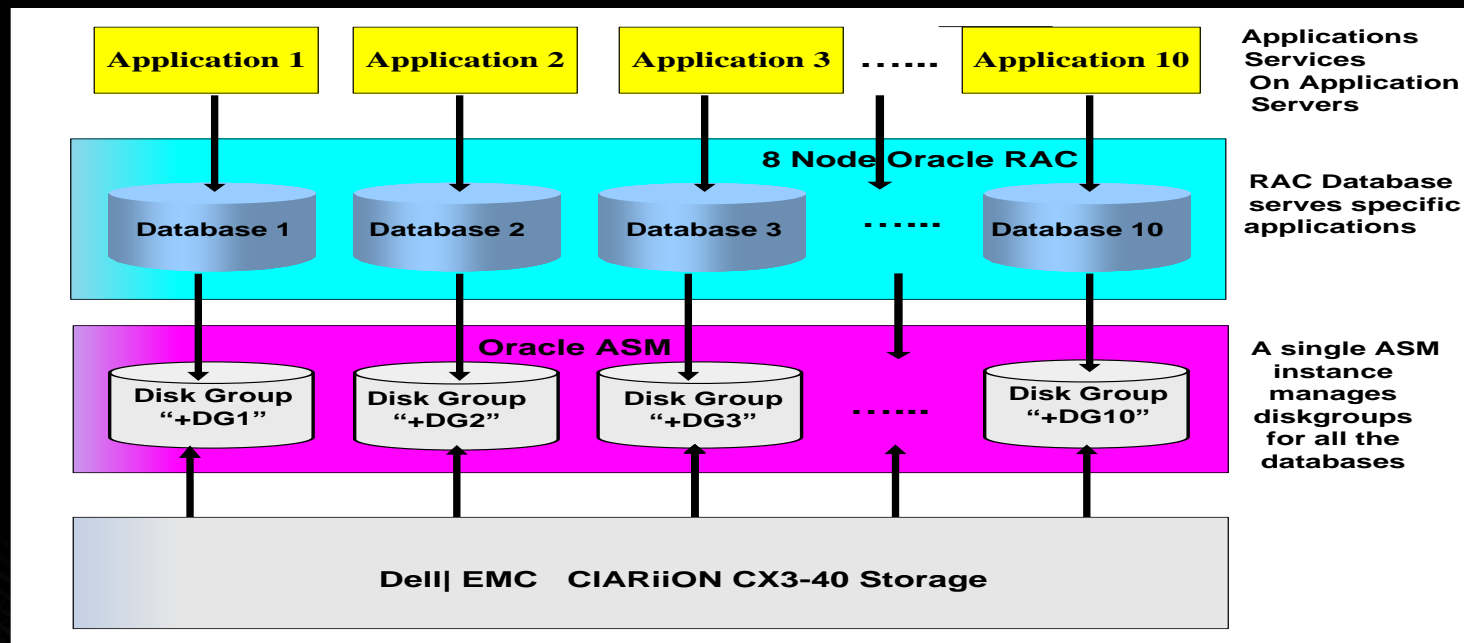
Grid Design and Implementation

Multi-tier Hardware Configuration of the Grid
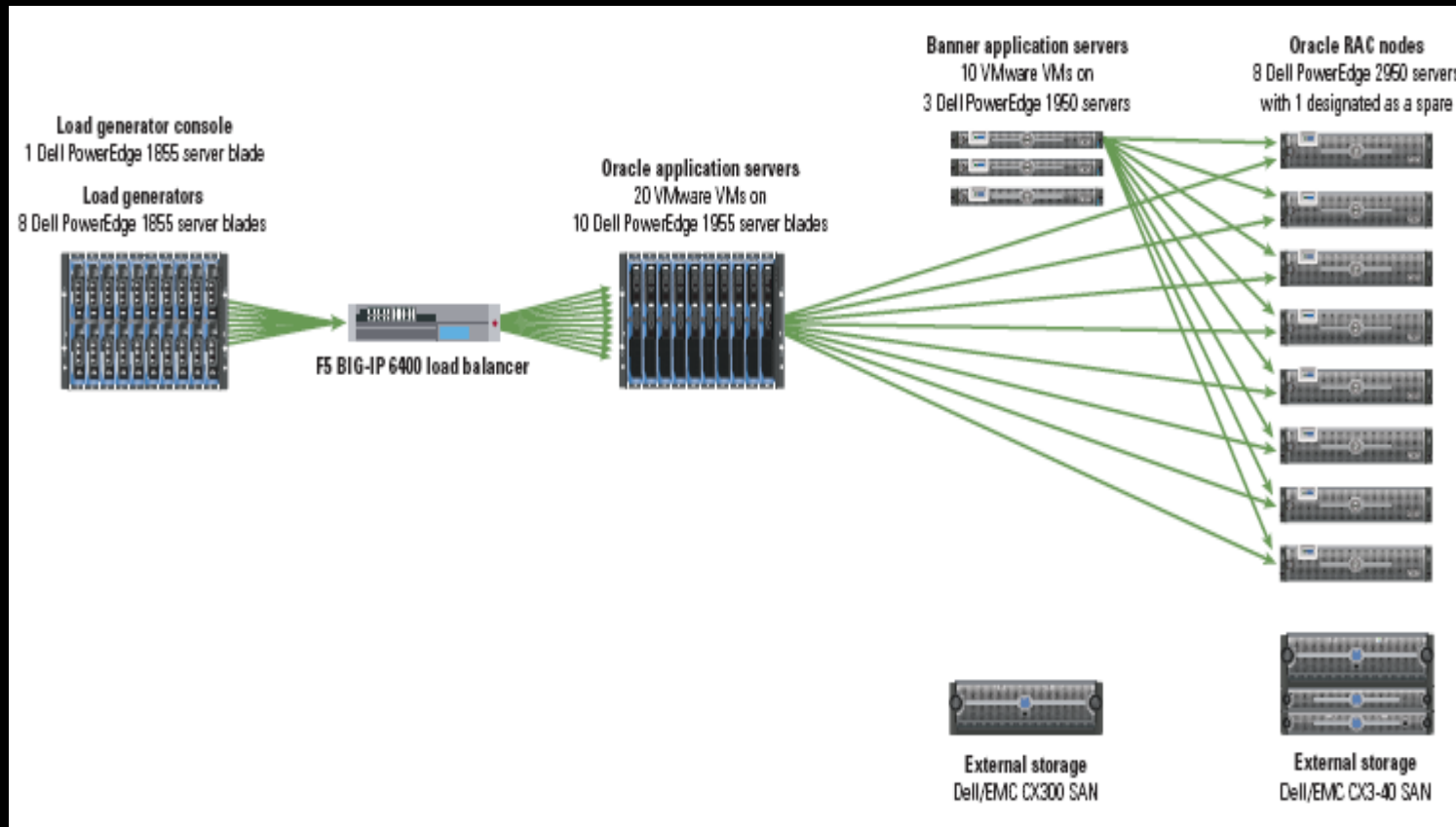
Grid Design and Implementation

- **Database Grid Architecture Design :**
  - Consolidate 10 databases on a single 8 node RAC to provide 10 database services for 10 ERP applications
  - Initial 3 instances for each database service
  - Dynamic database instance reallocation
  - Allow provisioning of additional nodes on demand
  - Enterprise Manager Grid control for Grid Management
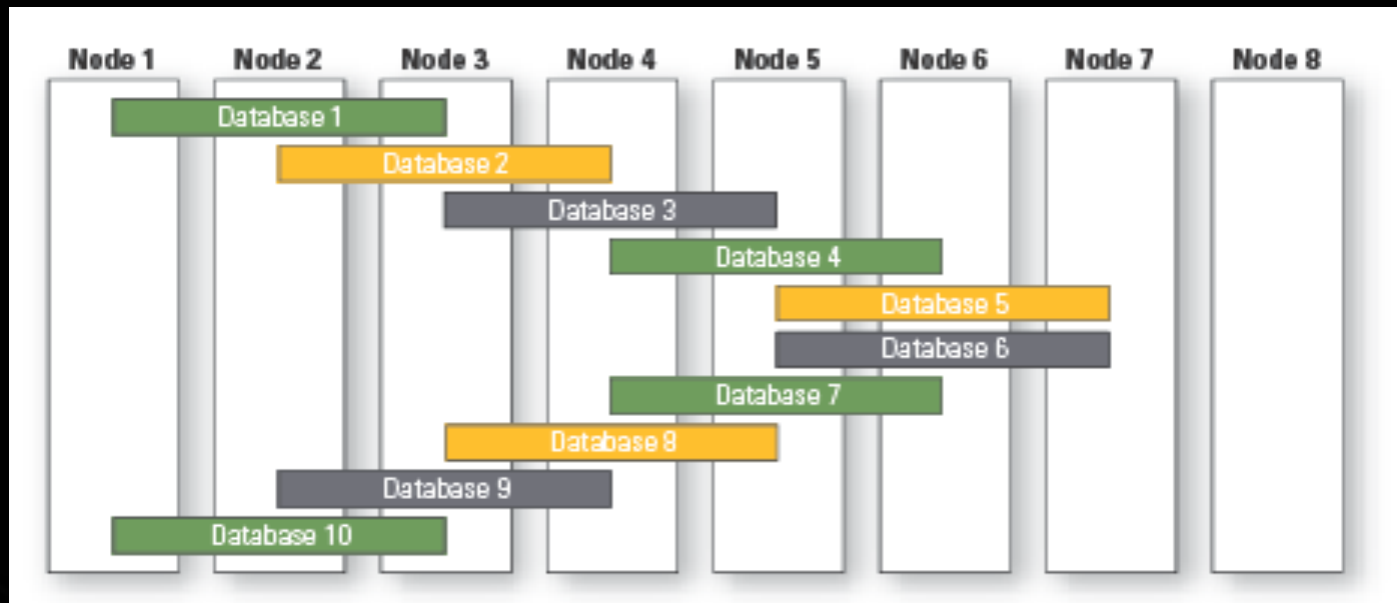
Grid Design and Implementation

- **Database services**
  - **Create 3 instances per each database service**

    ```
    $srvctl add service –d DB2 –s db2_srv –r db21, db22, db23
        $srvctl status service -d db2
        Service db2_s is running on instance(s) db23, db22, db21
    ```
  - **Connect to Database using services in tnsnames.ora**

    ```
    DB2_OLTP =
      (DESCRIPTION =
        (ADDRESS = (PROTOCOL = TCP)(HOST = bnode1-vip)(PORT = 1521))
        (ADDRESS = (PROTOCOL = TCP)(HOST = bnode2-vip)(PORT = 1521))
        (ADDRESS = (PROTOCOL = TCP)(HOST = bnode3-vip)(PORT = 1521))
        (LOAD_BALANCE = yes)
        (CONNECT_DATA =
        (SERVER = DEDICATED)
        (SERVICE_NAME = db2_srv.us.dell.com)
        (FAILOVER_MODE =
        (TYPE = SELECT)
        (METHOD = BASIC)
        (RETRIES = 180)
        (DELAY = 5))))
    ```
  - **Dynamic database instance reallocation**

Grid Design and Implementation

- **Database Grid built on 10g RAC**
  - Based on Dell | Oracle Tested and Validated Configuration:
  - Eight database servers
  - Two private interconnect network switches
  - Fibre Channel storage connections with dual HBAs
  - Dell EMC CX3-40 SAN with 45 spindles
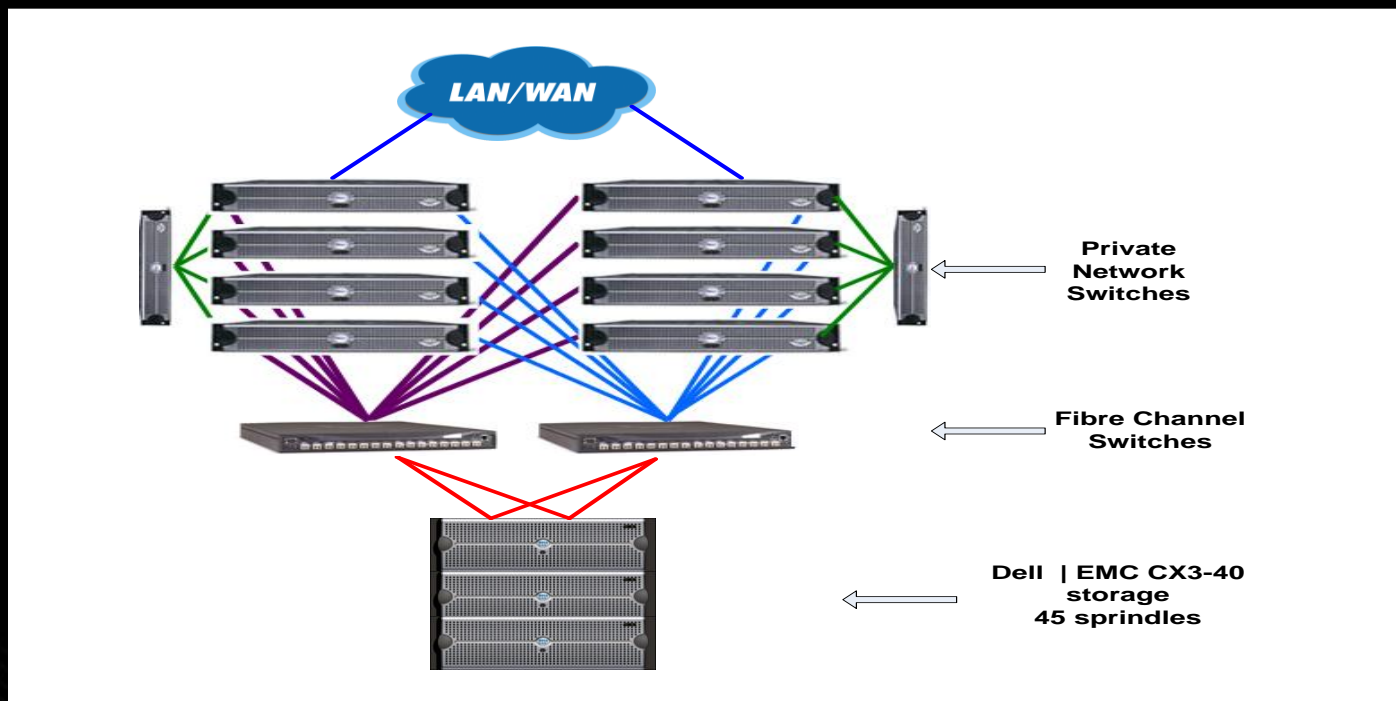
Grid Design and Implementation

- **Storage Grid Implementation for Storage Services**
  - Redundant IO Paths between PE 2950 and CX3-40 :
  - Two HBAs per server
  - Two Fiber Channel Switches
  - Two CX3-40 storage processors SPA and SPB
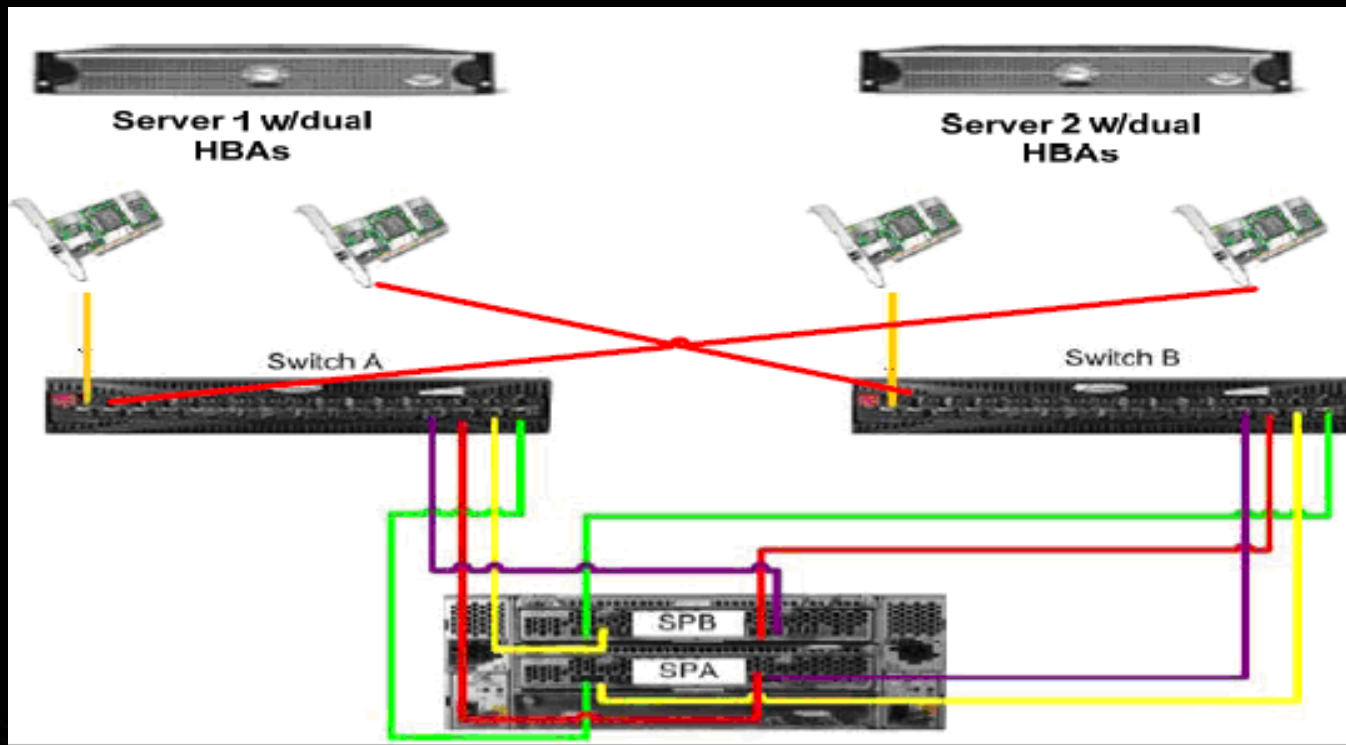
Grid Design and Implementation

- **Storage Grid Implementation for storage services**
    - A single ASM instance/server for all 10 databases
    - Ten ASM diskgroups created for 10 database
    - 7 Raid Groups: 4 disks per Raid Group in Raid 10
    - Each diskgroup: two LUNs from different SPs and and different Raid Groups
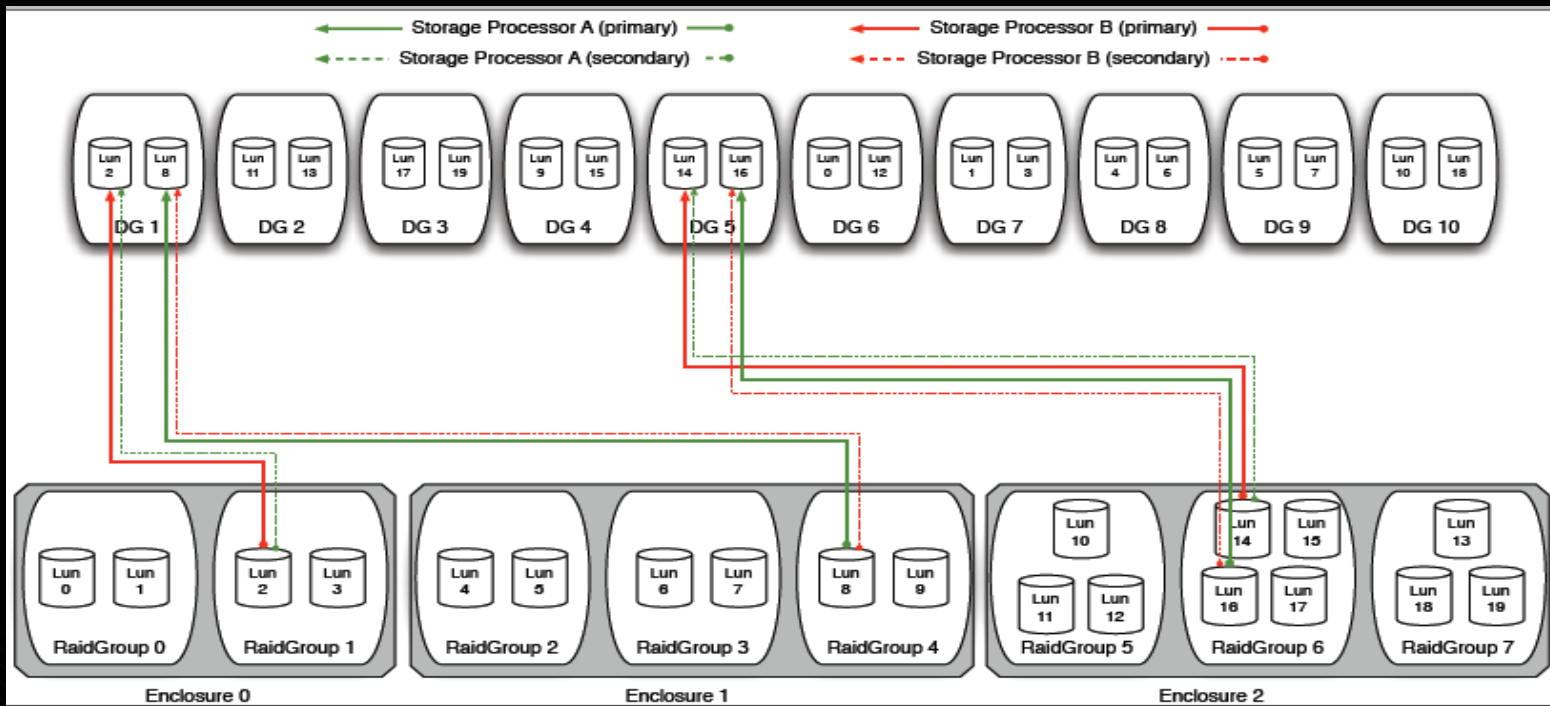
Grid Design and Implementation

- **Enterprise Manager Grid Control for Grid Management**
  - Oracle Enterprise Manager Grid Control(10.2.0.3)
  - Manage both Applications services and Database services
  - Dynamic Database Instance Management
  - Allow provisioning of additional nodes on demand
  - Performance Monitoring
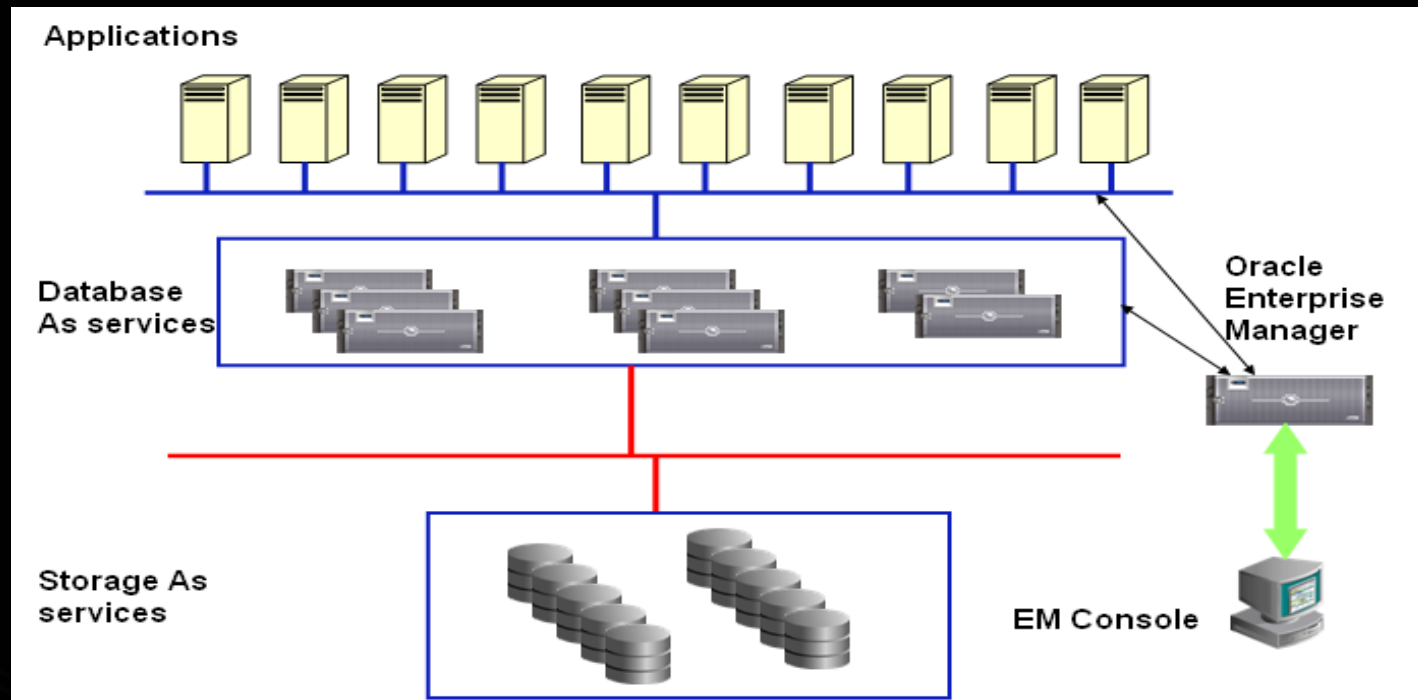
Grid Design and Implementation

– Databases on the Grid

Grid Design and Implementation

– **All the servers monitored by Oracle Enterprise Manager**
  • Monitor the performance and workload of the entire Grid

Database Grid Scalability

- **Use Grid Control to test:**
  - Dynamic Database Instance Management
  - Dynamic Scale out Grid

- **Dynamic Database Instance Management**
  - Add instance to a database service:
    For example, add the four instance db44 to db4:

Database Grid Scalability

– **Add instance to a database**

Database Grid Scalability

– **Drop an instance to a database**
   For example, drop the four instance db44 from db4:

Database Grid Scalability

- **Dynamic scale out the Grid to a new node**
  - Prepare a new node (OS, network, access to the shared storage, EM agent install)
  - Scale out the RAC to a new node using EM Provisioning Pack
    - Use "One Click Extend Cluster Database" procedure
    - Predefined deployment procedure in EM provisioning

Database Grid Scalability

- **Select the database to be extended**
- **Select the new server and fill the server information**
- **Submit the RAC extend Job**

Database Grid Scalability

- **Specify the reference host and the node to add**
- **Specify the credentials and submit the job**

▼ Reference host options - (bnode6)

Reference host   bnode6 ▾
Select the reference host for extend.

Working directory   /tmp
A working directory on the source host, is required to stage files for cloning. Supply the name of an existing directory on the host.

Home Location	Files To Exclude
/crs/oracle/oracle/product/10.2.0/crs	log,crs/init,racg/dump,srvm/log,cdata,EMStagedPatches
/opt/oracle/product/10.2.0/db_1	log,EMStagedPatches,oratab,*.trc,*.dbf,cdump
/opt/oracle/product/10.2.0/db_1	log,EMStagedPatches,oratab,*.trc,*.dbf,cdump

▶ Oracle Home Shared Storage Options

Select New Nodes
Select the destination hosts and enter the respective Virtual Node Names.

(Add...) (Import From File...)   ▼

Host	Private Node Name	Private IP (Optional)	Virtual Node Name	Virtual IP (Optional)	Working Directory
bnode7	bnode7-priv	10.1.17.94	bnode7-vip	155.1.18.90	/tmp

☑ TIP Select hosts that are managed by agents of version 10.2.0.3.0

Database Grid Scalability

- **Check the job status**

Database Grid Scalability

Before adding bnode7   After adding bnode7

Database Grid Scalability

- **Lessons Learned**
  - CRS inventory was missing on the existing RAC nodes
  - Required crs inventory recreated before adding new node
  - Steps to recreate crs inventory from Oracle engineers
    - Shutdown clusterware and the databases
    - Backup the databases
    - Backup OCR and Votingdisk
    - Cleanup Oracle clusterware on all the nodes
    - Reinstall Oracle clusterware on all the nodes to have new crs inventory
    - Restore the OCR from its backup
    - Start all the database services using new clusterware
  - Grid control issue with date
    - The tests required resetting system date
    - Inconsistent date between Grid control and targeted servers caused issue with Grid control

Applications Test Methodology

POC Test Basis

- Based on work done in 2006 with Texas Tech
- We narrowed the breadth of tests
- Increased the user load from 1 campus to 10
- Focused on peak user load: student registration
- Use LoadRunner workload generators to simulate simultaneous user actions

Applications Test Methodology

Users

Function	# Virtual Users per Large DB	# Virtual Users per Small DB
Student Registration (A)	320	80
Student Registration (B)	320	80
View Class List	200	50
Add/Drop Classes	160	40
View Grades	800	200
Total	1,800	450

Applications Testing methodology

Testing Points (users)

Function	1+1	3+3	5+5
Student Registration (A)	400	1200	2000
Student Registration (B)	400	1200	2000
View Class List	250	750	1250
Add/Drop Classes	200	600	1000
View Grades	1000	3000	5000
Total	2,250	6,750	11,250

Applications Testing methodology

5+5
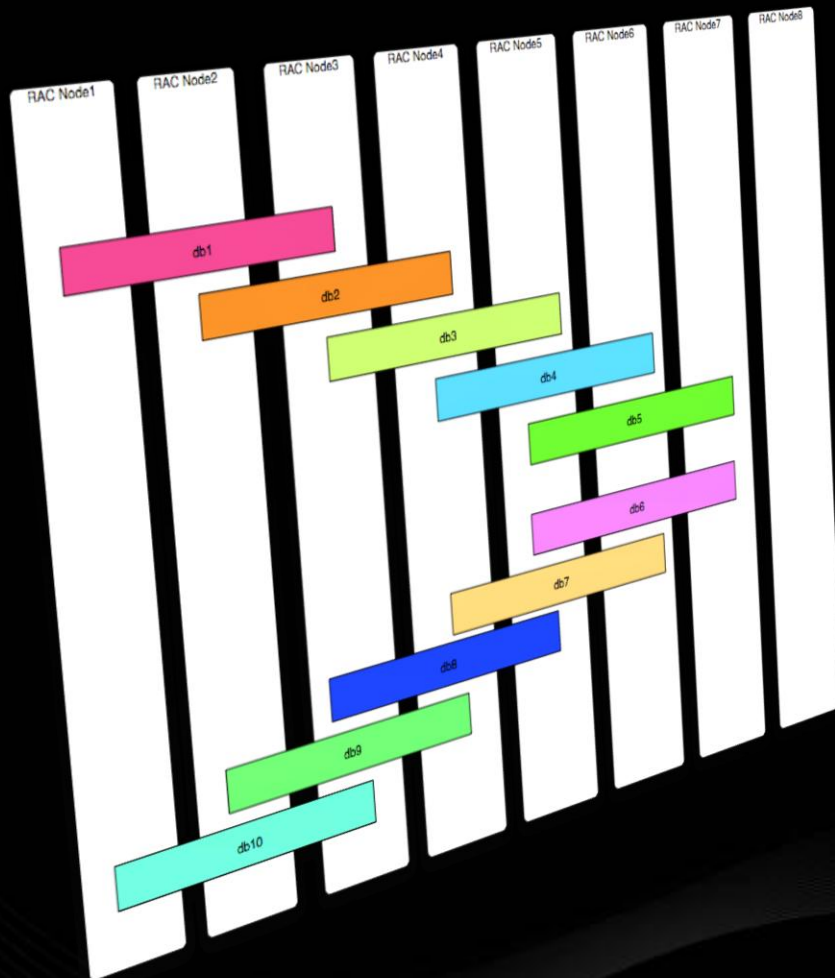
- 5 large + 5 small
- 11,250 users
- Bell-curve distribution of load (2,4,6,4,2)

Performance Test Results

Response time vs # of users
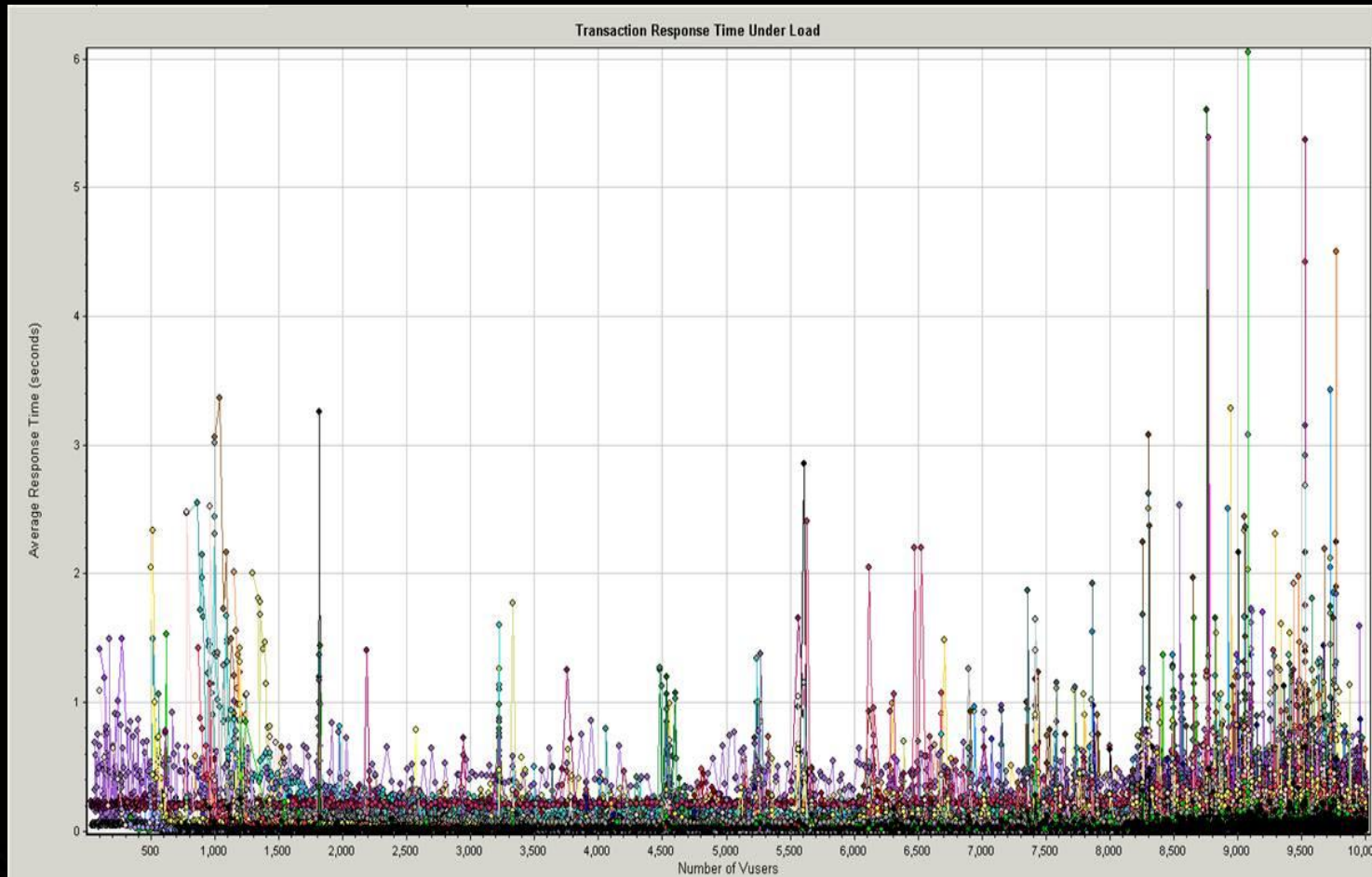
Performance Test Results

Traditional Registration Response Time
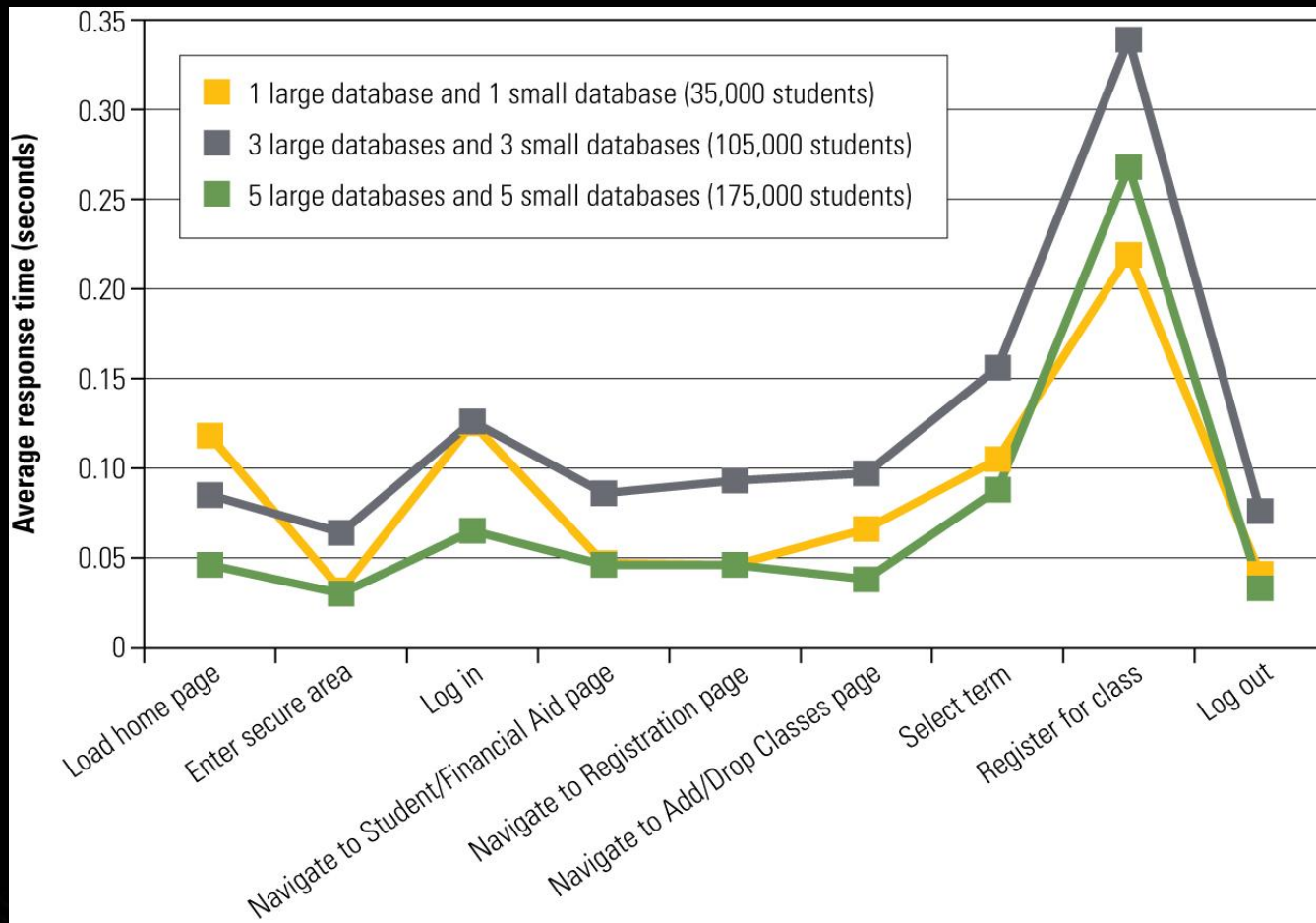
Performance Test Results

Traditional Registration Total Response Time

Workload	Total Response Time for Traditional Student Registration Process	Number of Database Servers	Average CPU Utilization
1 Large Campus + 1 Small Campus	0.7 sec	3	25%
3 Large Campuses + 3 Small Campuses	1.1 sec	5	31%
5 Large Campuses + 5 Small Campuses	0.8 sec	6	30%

Performance Test Results

Application Throughput:

Student Registration Real World Comparison

	Dell-SUNY POC	Buffalo State (November 14, 2007)	Multiplication Factor
Maximum Student Course Registrations in a single 15 minute period	20,267	1,172	18x
Maximum Student Course Registrations over a one hour period	67,807	1,820	37x

Performance Test Results

Application Throughput:

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Conclusions

The Grid on Dell hardware can be scaled out to handle the needs of the multiple large campuses with the capacity of handling:

- Users loads from 11,000 simultaneous users actions with sub-second response times

- 70,000 courses registered in a hour, 37 times of
  a SUNY school of 11,000 students

- More than 6 sample schools of 175,000 students total

- The database instance on the Grid can be dynamically
  added, dropped and relocated on demand

- Grid infrastructure itself can be dynamically scaled out
  on demand

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- Oracle: Rajat Nigam, Tom Kopec, Austin Laird, John MacDougal, Marc Kelberman
- SunGrard: Pat Masterson, Rob McQue, Jennifer O'Brian
- F5: Keith Keeling

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Q/A

THANK YOU