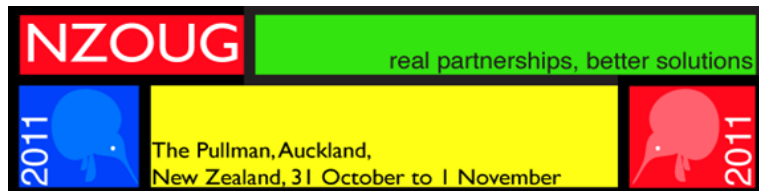


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# IMPLEMENTING ORACLE GRID: CUSTOMER CASE STUDIES



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ACE Director  
Dell Oracle Solutions Engineering

# About Author

- Kai Yu, *kai\_yu@dell.com*
  - 16 years with Oracle Technology
  - Focus on Oracle RAC, Oracle VM and Oracle EBS
  - Oracle ACE Director, author and frequent presenter
  - IOUG Oracle RAC SIG President (2009-2010)
  - IOUG Virtualization SIG Board Member
  - 2011 OAUG Innovator of Year Award Winner
  - Oracle Blog: <http://kyuoracleblog.wordpress.com/>
- Dell Oracle Solutions Engineering: [www.dell.com/oracle](http://www.dell.com/oracle)
  - Oracle Technology Solutions on Dell systems/storages
  - Dell | Oracle Solutions Components
  - Solutions stack: servers, storage, network, OS, virtualization, Oracle RAC, Oracle Applications



# Our Engineering Lab



# Agenda

- Oracle Enterprise Grid Model
- SUNY POC Project
  - Business Requirements
  - Grid Design and Implementation
  - Database Grid Scalability
  - Application Performance Tests
- Dell 16 Node Grid Infrastructure for Oracle EBS DBs
  - Oracle EBS Database Grid Design
  - Grid Implementation on Oracle 11gR2 RAC
  - Deploying Oracle EBS Databases on the Grid



# Oracle Enterprise Grid

- Challenges to the Traditional Corporate Computing Architecture
  - Consists of island-like systems
  - Little or no resource sharing: low resources utilization
  - Hard to dynamically adapt changing workload
  - A lot of systems, too many Variety, difficult to manage



# Oracle Enterprise Grid

- Enterprise Grid Architecture

- Consolidate databases, applications onto a common Grid platform based on Dell servers and storage resource.
- Provide Platform as a Service for the databases
- Provide Database as a Services based on cluster Infrastructure for multiple applications.
- Integrate all the resources to allow provisioning on demand: dynamically provisioning to meet the workload needs
- Scalability and High Availability and Flexibility

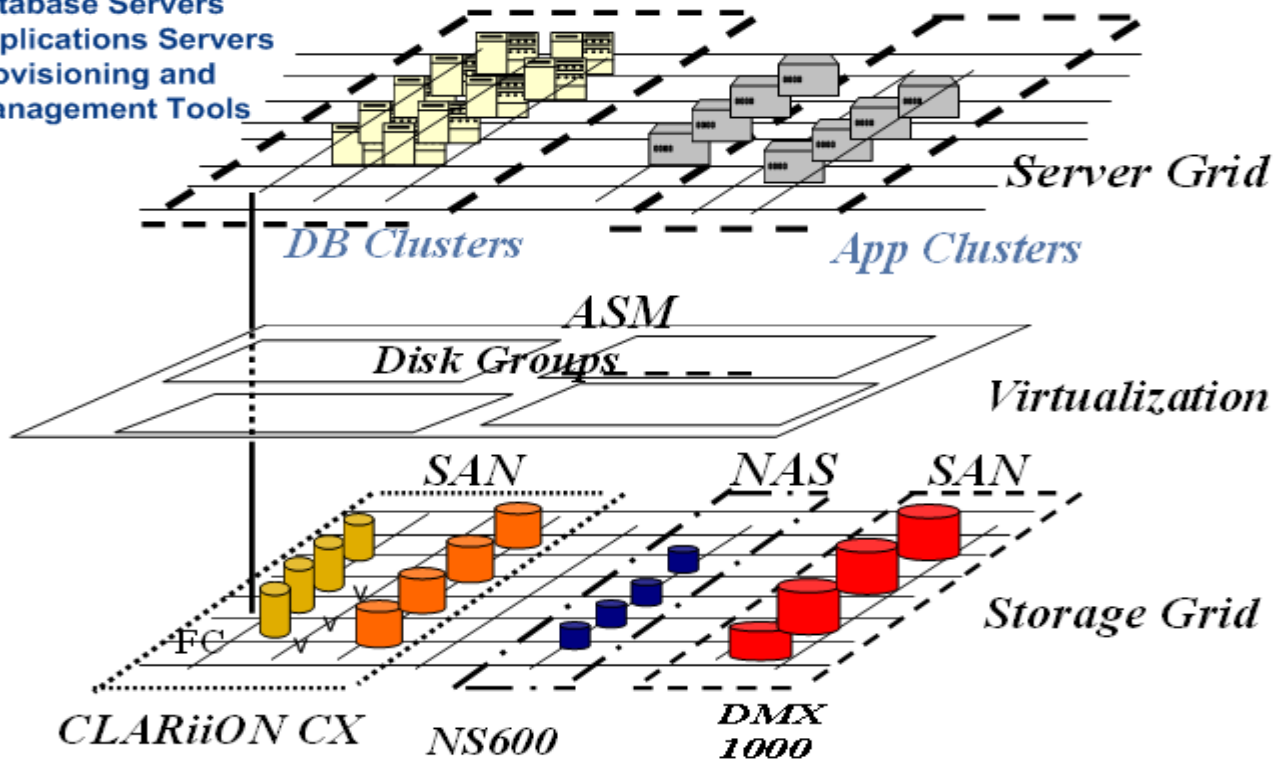


# Oracle Enterprise Grid

- History: Mega Grid, A Joint project by Oracle, Dell, EMC and Intel

## MegaGrid Architecture

- Storage
- Database Servers
- Applications Servers
- Provisioning and Management Tools



# Oracle Enterprise Grid

- Mega Grid:
  - Candidate for Grid model:
  - Multiple services by multiple tiered applications
  - Large number of resources: servers, network storages
  - Case studies: SUNY ITEC Grid and Dell IT Oracle EBS DB Grid
- Oracle Technology Features for Grid Computing
  - Clustering technology: Oracle Clusterware and RAC
  - Database services
  - Automatic Storage Management
  - Oracle Enterprise Manager Grid Control
  - Load balancing





# SUNY Project: Business Requirements

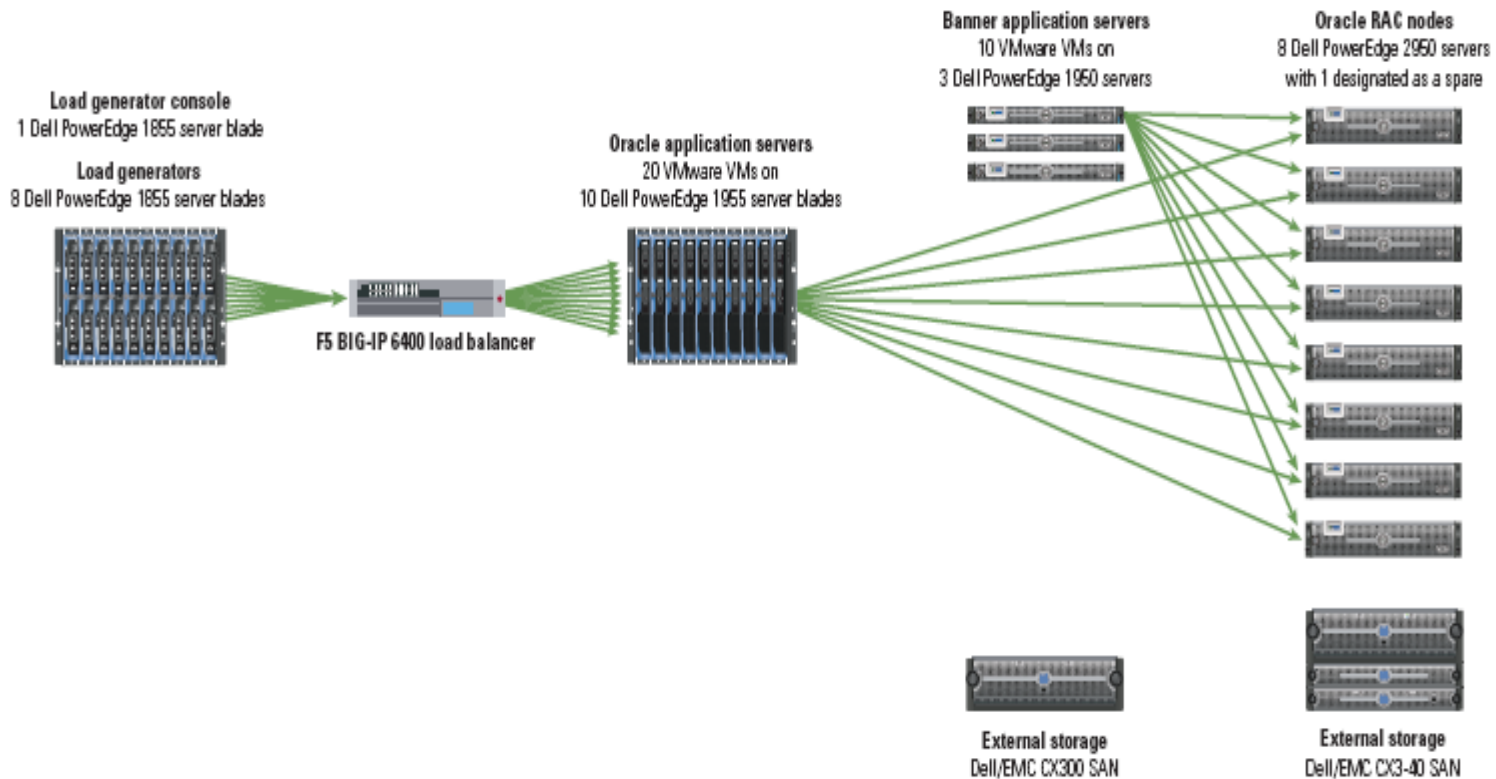
- SUNY (State University of New York System) Project:  
SUNY ITEC: SUNY Information Technology Exchange Center  
ITEC: Consolidate all applications of multiple SUNY campus  
Challenges:



- Grid Computing to Rescue
  - Address all the desires
  - But – how to demonstrate it will work
  - Without substantial investment?
  - How about a Proof-of-Concept?

# Grid Design and Implementation

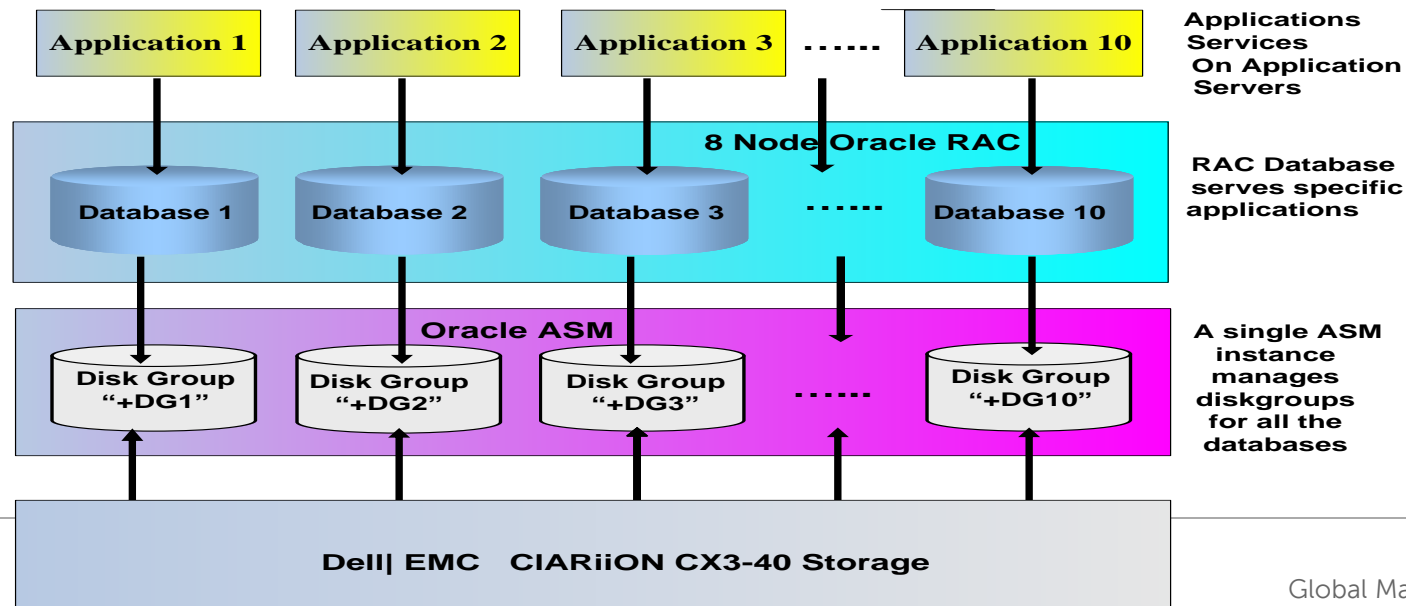
- Multi-tier Hardware Configuration of the Grid



# Grid Design and Implementation

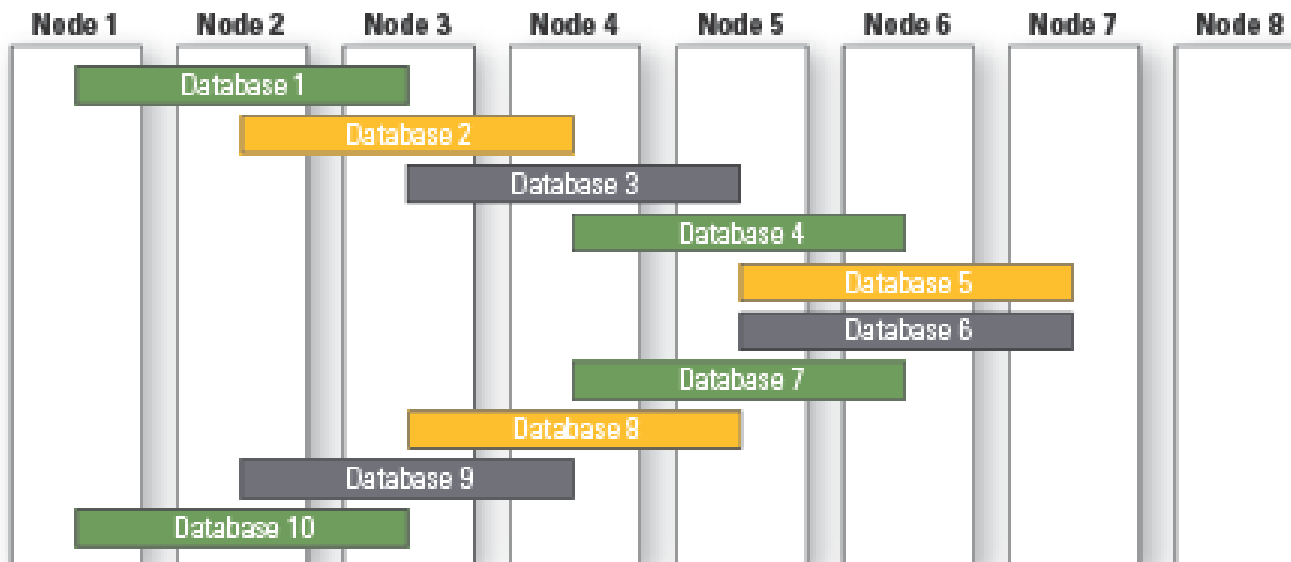
- TWO LAYERS OF GRID
  - Servers:
    - Application servers offer application services using VM
    - Database servers offer database services for applications
  - Storage:
    - ASM provides storage services for all the databases
    - ASM virtualizes the storage services using ASM diskgroups

## Implementation Architecture



# 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



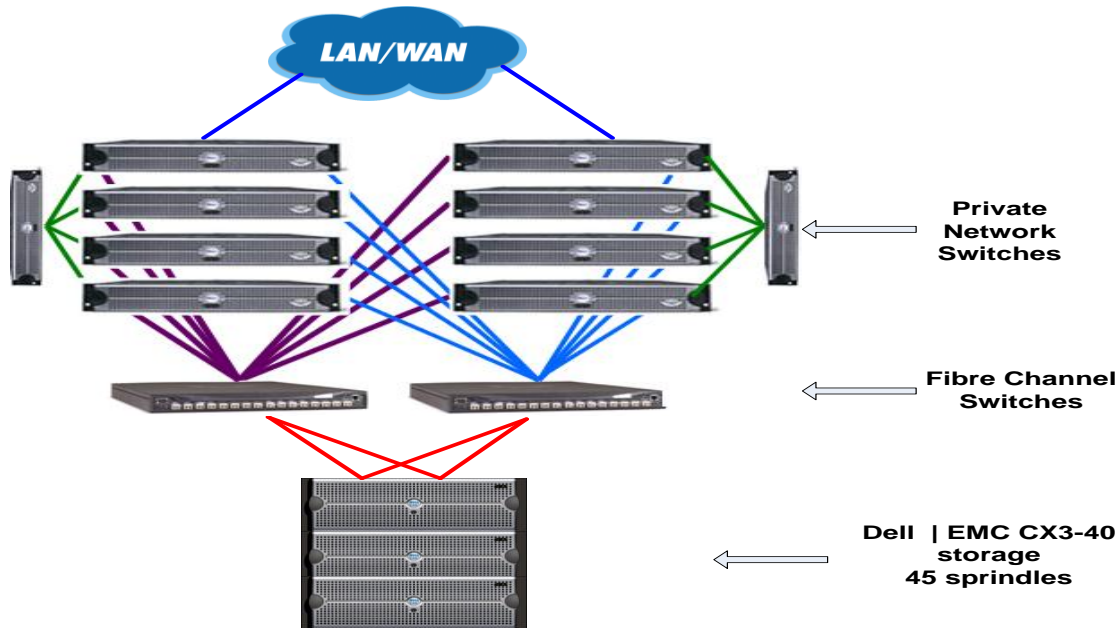
# Grid Design and Implementation

- 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
  - Dynamic database instance reallocation
- Database services built on Oracle RAC
  - Eight database servers
  - Two private interconnect network switches
  - Fibre Channel storage connections with dual HBAs
  - Dell EMC SAN with 45 spindles



# Grid Design and Implementation

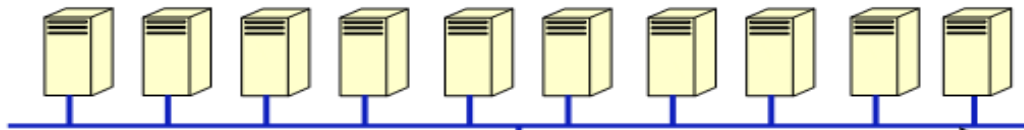
- Storage Grid Implementation for Storage Services
  - Redundant IO Paths between PE 2950 and CX3-40:
    - Two HBAs per server
    - Two Fiber Channel Switches
    - Two CX3-40 storage processors SPA and SPB



# Grid Design and Implementation

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

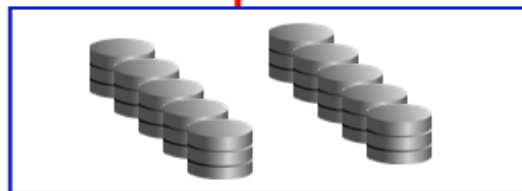
## Applications



## Database As services



## Storage As services



Oracle  
Enterprise  
Manager



EM Console



# Grid Design and Implementation

## Databases on the Grid

ORACLE Enterprise Manager 10g  
Grid Control

Setup Preferences Help Logout  
Home Targets Deployments Alerts Compliance Jobs Reports

Hosts | Databases | Application Servers | Web Applications | Services | Systems | Groups | All Targets

### Databases

Page Refreshed Sep 26, 2007 7:39:18 PM CDT

Search   [Advanced Search](#)

Select	Name	Type	Status	Alerts	Policy Violations	Compliance Score (%)	Version	Sessions: CPU	Sessions: I/O	Sessions: Other	Instance CPU (%)
<input checked="" type="radio"/>	<a href="#">db1.us.dell.com</a>	Cluster Database		0 4	21 29 7	89	10.2.0.3.0	n/a	n/a	n/a	n/a
<input type="radio"/>	<a href="#">db10.us.dell.com</a>	Cluster Database		0 3	21 28 7	89		n/a	n/a	n/a	n/a
<input type="radio"/>	<a href="#">db2.us.dell.com</a>	Cluster Database		0 3	20 28 6	89		n/a	n/a	n/a	n/a
<input type="radio"/>	<a href="#">db3.us.dell.com</a>	Cluster Database		0 3	20 28 6	89	10.2.0.3.0	n/a	n/a	n/a	n/a
<input type="radio"/>	<a href="#">db4.us.dell.com</a>	Cluster Database		0 3	20 29 6	88		n/a	n/a	n/a	n/a
<input type="radio"/>	<a href="#">db5.us.dell.com</a>	Cluster Database		0 2	16 19 4	88		n/a	n/a	n/a	n/a
<input type="radio"/>	<a href="#">db6.us.dell.com</a>	Cluster Database		0 1	8 10 2	91	10.2.0.3.0	n/a	n/a	n/a	n/a
<input type="radio"/>	<a href="#">db9.us.dell.com</a>	Cluster Database		0 0	12 10 2	85	10.2.0.3.0	n/a	n/a	n/a	n/a
<input type="radio"/>	<a href="#">emrep.us.dell</a>	Database Instance		0 2	10 11 4	91	10.1.0.4.0	.06	0		1.5





# Grid Design and Implementation

- All the servers monitored by Oracle Enterprise Manager Monitor the performance and workload of the entire Grid

Oracle Enterprise Manager (SYSMAN) - Hosts - Mozilla

http://enterprise-mgr.us.dell:4889/em/console/targets\$ctxType=Hosts

Page Refreshed Jan 18, 2007 1:00:16 PM CST

Search  Go Advanced Search

Remove Configure Add Previous 1-25 of 29 Next 4

Select	Name	Status	CPU Util %	CPU Load (5min)	Mem Util %	Swap Util %	Total IO/sec
<input type="checkbox"/>	<a href="#">banapp1.suny.com</a>		2.48 ✓	.13 ✓	43.88 ✓	0 ✓	26.6
<input type="checkbox"/>	<a href="#">banapp10.suny.com</a>		2.18 ✓	.2 ✓	41.1 ✓	0 ✓	26.16
<input type="checkbox"/>	<a href="#">banapp11.suny.com</a>		1.15 ✓	0 ✓	37.09 ✓	0 ✓	26.84
<input type="checkbox"/>	<a href="#">banapp12.suny.com</a>		2.22 ✓	.1 ✓	34.29 ✓	0 ✓	27.96
<input type="checkbox"/>	<a href="#">banapp13.suny.com</a>		2.49 ✓	.01 ✓	32.59 ✓	0 ✓	26.89
<input type="checkbox"/>	<a href="#">banapp14.suny.com</a>						
<input type="checkbox"/>	<a href="#">banapp15.suny.com</a>		2.52 ✓	.04 ✓	33.98 ✓	0 ✓	11.92
<input type="checkbox"/>	<a href="#">banapp16.suny.com</a>		5.17 ✓	.1 ✓	42.99 ✓	0 ✓	26.66
<input type="checkbox"/>	<a href="#">banapp17.suny.com</a>		2.16 ✓	.06 ✓	43.41 ✓	0 ✓	25.99
<input type="checkbox"/>	<a href="#">banapp18.suny.com</a>		2.12 ✓	.03 ✓	31.57 ✓	0 ✓	12.8
<input type="checkbox"/>	<a href="#">banapp19.suny.com</a>		1.97 ✓	.02 ✓	34.6 ✓	0 ✓	25.68
<input type="checkbox"/>	<a href="#">banapp2.suny.com</a>		2.42 ✓	.75 ✓	36.61 ✓	0 ✓	28.01
<input type="checkbox"/>	<a href="#">banapp20.suny.com</a>		2.39 ✓	.06 ✓	41.2 ✓	0 ✓	27.19
<input type="checkbox"/>	<a href="#">banapp3.suny.com</a>		2.64 ✓	.1 ✓	32.53 ✓	0 ✓	26.42
<input type="checkbox"/>	<a href="#">banapp4.suny.com</a>		2.69 ✓	.83 ✓	37.86 ✓	0 ✓	22.38
<input type="checkbox"/>	<a href="#">banapp5.suny.com</a>		2.56 ✓	.06 ✓	31.17 ✓	0 ✓	12.19
<input type="checkbox"/>	<a href="#">banapp6.suny.com</a>		5.43 ✓	.79 ✓	50.1 ✓	0 ✓	27.84
<input type="checkbox"/>	<a href="#">banapp7.suny.com</a>		2.4 ✓	.01 ✓	44.54 ✓	0 ✓	27.53
<input type="checkbox"/>	<a href="#">banapp8.suny.com</a>		2.24 ✓	.25 ✓	31.4 ✓	0 ✓	12.25
<input type="checkbox"/>	<a href="#">banapp9.suny.com</a>		2.23 ✓	.04 ✓	41.06 ✓	0 ✓	25.78
<input type="checkbox"/>	<a href="#">bnode1</a>		5.43 ✓	.06 ✓	34.6 ✓	0 ✓	32.53
<input type="checkbox"/>	<a href="#">bnode2</a>		2.42 ✓	.03 ✓	36.61 ✓	0 ✓	36.61
<input type="checkbox"/>	<a href="#">bnode3</a>		2.39 ✓	.79 ✓	31.57 ✓	0 ✓	37.86
<input type="checkbox"/>	<a href="#">bnode4</a>		2.4 ✓	.06 ✓	42.99 ✓	0 ✓	50.1
<input type="checkbox"/>	<a href="#">bnode5</a>		2.24 ✓	.83 ✓	50.1 ✓	0 ✓	44.54



# 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:



## Add Instance: Host

Name of the Database Instance to be added

The following list of hosts have database software installed and are currently configured for this cluster. Select a host to which you want to add a database instance. This host should have access to the shared storage used by this database.

Select	Host	Existing Database Instances
<input type="radio"/>	bnode1	
<input type="radio"/>	bnode2	
<input checked="" type="radio"/>	bnode3	
<input type="radio"/>	bnode4	db41
<input type="radio"/>	bnode5	db42
<input type="radio"/>	bnode6	db43
<input type="radio"/>	bnode7	



This wizard guides you through the steps required to add a database instance to the cluster database. The wizard will add the host. At each step, checks are performed to ensure all prerequisites are satisfied for database instance.

## Cluster Credentials

Enter the cluster credentials for the install owner of the Oracle Home from which the cluster database is to be added.

\* Username   
 \* Password

## ASM Credentials

Enter the credentials of the SYSDBA user running the asm instance.

\* Username   
 \* Password   
 ASM Instance **+ASM6\_bnode6**  
 \* Connect As   
 Save as Preferred Credential



# Database Grid Scalability

Add an instance to a database

ORACLE Enterprise Manager 10g  
Grid Control

Home Targets Deployments Alerts Compliance

Job Activity | Job Library

Job Run: ADDINSTANCE\_DB4.US.DELL.COM\_000027 >

Execution: db4.us.dell.com

Page Refreshed Aug 29, 2008 3:48:46 PM CDT [Delete Run]

## Summary

The Stop and Suspend operations will wait for the current step to complete. A suspended job can be resumed later, at the next step.

Status	<b>Running</b>	Type	<b>Add Instance</b>
Scheduled	<b>Aug 29, 2008 3:47:47 PM (UTC-05:00)</b>	Owner	<b>SYSMAN</b>
Started	<b>Aug 29, 2008 3:47:47 PM (UTC-05:00)</b>	Description	<b>AddInstance Job:</b>
Ended		Oracle Home	<b>/opt/oracle/product/10.2.0/db_1</b>
Elapsed Time			
Notification	<b>No</b>		

Targets:

Status:

[Expand All](#) | [Collapse All](#)

Name	Targets	Status	Started	Ended
Execution: db4.us.dell.com	db4.us.dell.com	Running	Aug 29, 2008 3:47:47 PM (UTC-05:00)	
Step: add_instance	db4.us.dell.com_db43	Running	Aug 29, 2008 3:47:52 PM (UTC-05:00)	

```
oracle@bnode3:~  
[oracle@bnode3 ~]$ srvctl status database -d db4  
Instance db41 is running on node bnode4  
Instance db42 is running on node bnode5  
Instance db43 is running on node bnode6  
[oracle@bnode3 ~]$
```

```
oracle@bnode3:~  
[oracle@bnode3 ~]$ srvctl status database -d db4  
Instance db41 is running on node bnode4  
Instance db42 is running on node bnode5  
Instance db43 is running on node bnode6  
Instance db44 is running on node bnode3
```



# Database Grid Scalability

Drop an instance from a database

For example, drop the four instance db44 from db4:

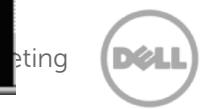
The screenshot shows the Oracle Enterprise Manager 10g Grid Control interface. The main heading is "Delete Instance: Database Instance". Below this, a message states: "The following list of database instances are currently part of this cluster database. Select the database instance to delete. The files related to this database instance will be deleted." A table lists the instances:

Select	Database Instance	Host
<input type="radio"/>	db41	bnode4
<input type="radio"/>	db42	bnode5
<input type="radio"/>	db43	bnode6
<input checked="" type="radio"/>	db44	bnode3

Below the table, the "Job Run" details for "DELETEINSTANCE\_DB4.US.DELL.COM\_000028" are shown. The job was scheduled for "Aug 29, 2008 4:06:34 PM (UTC-05:00)" and targets "db4.us.dell.com". The job status is "Succeeded" and completed at "Aug 29, 2008 4:07:33 PM (UTC-05:00)".

At the bottom, a terminal window shows the command "srvctl status database -d db4" and its output:

```
oracle@bnode3:~$ srvctl status database -d db4
Instance db41 is running on node bnode4
Instance db42 is running on node bnode5
Instance db43 is running on node bnode6
oracle@bnode3:~$
```



# Database Grid Scalability

- Dynamic scale out the Grid By adding 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

ORACLE Enterprise Manager 10g  
Grid Control

Home Targets **Deployments** Alerts Compliance Jobs Reports

General | Provisioning

### Deployment Procedure Manager

Procedures Procedure Completion Status Recycle Bin

Deployment procedures are best practices provided by Oracle for various Provisioning and Patching tasks. Procedures created by Oracle cannot be edited, but can be extended using 'Create Like', so that you can customize the procedure to fit your environment. For more details click Help.

Search Text Fields   [Advanced Search](#)

|   1-25 of 33

Select	Procedure	Type	Description	Last Modified By	Version	Last Updated
<input type="radio"/>	<a href="#">Oracle Clusterware / RAC Provisioning For Windows</a>	RAC Provisioning	This procedure assists in installing/cloning and configuring a cluster database (a Real Application Cluster - RAC database) on a selection of hosts as specified by the Oracle Database Oracle Clusterware and Oracle Real Application Clusters Installation Guide. <a href="#">i</a>	Oracle	3.46	Sep 24, 2007 2:47:31 AM CDT
<input type="radio"/>	<a href="#">Oracle Clusterware / RAC Provisioning For UNIX</a>	RAC Provisioning	This procedure assists in installing/cloning and configuring a cluster database (a Real Application Cluster - RAC database) on a selection of hosts as specified by the Oracle Database Oracle Clusterware and Oracle Real Application Clusters Installation Guide. <a href="#">i</a>	Oracle	3.46	Sep 24, 2007 2:47:30 AM CDT
<input checked="" type="radio"/>	<a href="#">One Click Extend Cluster Database</a>	RAC Provisioning	This procedure will extend an existing cluster database to a set of new nodes. Oracle Clusterware and Oracle Database will be extended and configured by the procedure. <a href="#">i</a>	Oracle	3.46	Sep 24, 2007 2:47:29 AM CDT
<input type="radio"/>	<a href="#">Delete/Scale down</a>	RAC Provisioning	This procedure deletes nodes from Oracle Real	Oracle	3.46	Sep 24, 2007 2:47:28 AM CDT



# Database Grid Scalability

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

## Extend Real Application Clusters

### Select Real Application Clusters (RAC)

Select the Oracle Real Application Clusters (RAC) you wish to extend. The Clusterware and Automatic Storage Management (ASM) will also be extended if these do not already exist.

Search

[Expand All](#) | [Collapse All](#)

Select Name	Member Nodes	Oracle Home	Platform	Product
<input type="checkbox"/> Available Cluster Databases <input type="button" value="Previous 1 - 5 of 10"/>				
<input checked="" type="radio"/> <input type="button" value="db5.us.dell.com (2)"/>	bnode6, bnode5	/opt/oracle/product/10.2.0/db_1	Red Hat Enterprise Linux AS release 4 (Nahant Update 5)	Oracle Database 10.2.0.3.0
<input type="radio"/> <input type="button" value="db6.us.dell.com (2)"/>	bnode6, bnode5	/opt/oracle/product/10.2.0/db_1	Red Hat Enterprise Linux AS release 4 (Nahant Update 5)	Oracle Database 10.2.0.3.0
<input type="radio"/> <input type="button" value="db7.us.dell.com (3)"/>	bnode4, bnode5, bnode6	/opt/oracle/product/10.2.0/db_1	Red Hat Enterprise Linux AS release 4 (Nahant Update 5)	Oracle Database 10.2.0.3.0
<input type="radio"/> <input type="button" value="db8.us.dell.com (3)"/>	bnode4, bnode5, bnode3	/opt/oracle/product/10.2.0/db_1	Red Hat Enterprise Linux AS release 4 (Nahant Update 5)	Oracle Database 10.2.0.3.0
<input type="radio"/> <input type="button" value="db9.us.dell.com (4)"/>	bnode2, bnode3, bnode4, bnode1	/opt/oracle/product/10.2.0/db_1	Red Hat Enterprise Linux AS release 4 (Nahant Update 5)	Oracle Database 10.2.0.3.0
<input type="button" value="Next"/>				

### Select New Nodes

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

Host	Private Node Name	Private IP (Optional)	Virtual Node Name	Virtual IP (Optional)	Working Directory	Remove
bnode7	<input type="text" value="bnode7-priv"/>	<input type="text" value="10.1.17.94"/>	<input type="text" value="bnode7-vip"/>	<input type="text" value="155.1.18.90"/>	<input type="text" value="/tmp"/>	<input type="button" value="Remove"/>
<input type="button" value="Remove all"/>						



# Database Grid Scalability

- Check the job status

ORACLE Enterprise Manager 10g Setup Preferences Help Logout

Grid Control Home Targets Deployments Alerts Compliance Jobs Reports

General | Provisioning

[Procedure Completion Status](#) >

Page Refreshed Dec 9, 2006 4:59:28 PM CST

View Data

## Status

### General Information

Run	crs_db5.us.dell.com_2006-12-03_12-01-24PM	Created On	Dec 3, 2006 12:01:38 PM CST
Procedure	One Click Extend Cluster Database	Scheduled	Dec 3, 2006 12:01:43 PM CST
Procedure Version	3.46	Start Date	Dec 3, 2006 12:01:43 PM CST
Error Handling Mode	Stop On Error	Last Updated	Dec 4, 2006 12:42:14 PM CST
Status	Succeeded	Completed Date	Dec 4, 2006 12:42:14 PM CST
Owner	SYSMAN	Elapsed Time	88831 Seconds

### Status Detail

[Expand All](#) | [Collapse All](#)

Name	Status	Type	Description
One Click Extend Cluster Database	Succeeded		This procedure will extend an existing cluster database to a set of new nodes. Oracle Clusterware and Oracle Database will be extended and configured by the procedure.
<a href="#">Initialize Deployment Procedure</a>	Succeeded	Computational	Initializes the current Deployment Procedure execution. Derived variables are set with computations. Do not disable or delete this step.
<a href="#">Create directory</a>	Succeeded	Parallel	Creates first-level directories under / (requires root privileges).
<a href="#">Create directory for All</a>		Parallel	Creates first-level directories under / (requires root privileges).



# Database Grid Scalability

Before adding bnode7

After adding bnode7

Select	Name	Member Nodes
▼	Available Cluster Databases	
⤴	Previous 1 - 5 of 11	
○	▶ db4.us.dell.com (3)	bnode5, bnode6, bnode4
⊙	▼ db5.us.dell.com (2)	bnode6, bnode5
	crs (6)	bnode1, bnode4, bnode5, bnode6, bnode2, bnode3
	+ASM6_bnode6 (2)	bnode6, bnode5
○	▶ db6.us.dell.com (2)	bnode6, bnode5
○	▶ db7.us.dell.com (3)	bnode5, bnode4, bnode6
○	▶ db8.us.dell.com (3)	bnode4, bnode5, bnode3

Select	Name	Member Nodes
▼	Available Cluster Databases	
⤴	Previous 1 - 5 of 11	
○	▶ db4.us.dell.com (3)	bnode5, bnode6, bnode4
○	▼ db5.us.dell.com (3)	bnode7, bnode6, bnode5
	crs (7)	bnode1, bnode2, bnode3, bnode4, bnode5, bnode6, bnode7
	+ASM7_bnode7 (3)	bnode7, bnode6, bnode5
⊙	▶ db6.us.dell.com (2)	bnode6, bnode5
○	▶ db7.us.dell.com (3)	bnode5, bnode4, bnode6
○	▶ db8.us.dell.com (3)	bnode4, bnode5, bnode3

bnode7 added to db5

```

root@bnode7:~
[oracle@bnode7 ~]$ srvctl status database -d db5
Instance db51 is running on node bnode5
Instance db52 is running on node bnode6
Instance db53 is running on node bnode7
[oracle@bnode7 ~]$ srvctl status database -d db6
Instance db61 is running on node bnode6
Instance db64 is running on node bnode5
Instance db63 is running on node bnode7
[oracle@bnode7 ~]$ srvctl status nodeapps -n bnode7
VIP is running on node: bnode7
GSD is running on node: bnode7
Listener is running on node: bnode7
ONS daemon is running on node: bnode7
[oracle@bnode7 ~]$ ps -ef | grep pmon
oracle      3890      1289    0 23:30 pts/2        00:00:00 grep pmon
oracle      5645          1    0 14:23 ?                00:00:00 asm_pmon_+ASM7
oracle     10776          1    0 14:24 ?                00:00:00 ora_pmon_db53
oracle     12346          1    0 14:24 ?                00:00:00 ora_pmon_db63
    
```





# Application Performance Tests

## 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



# Application Performance Tests

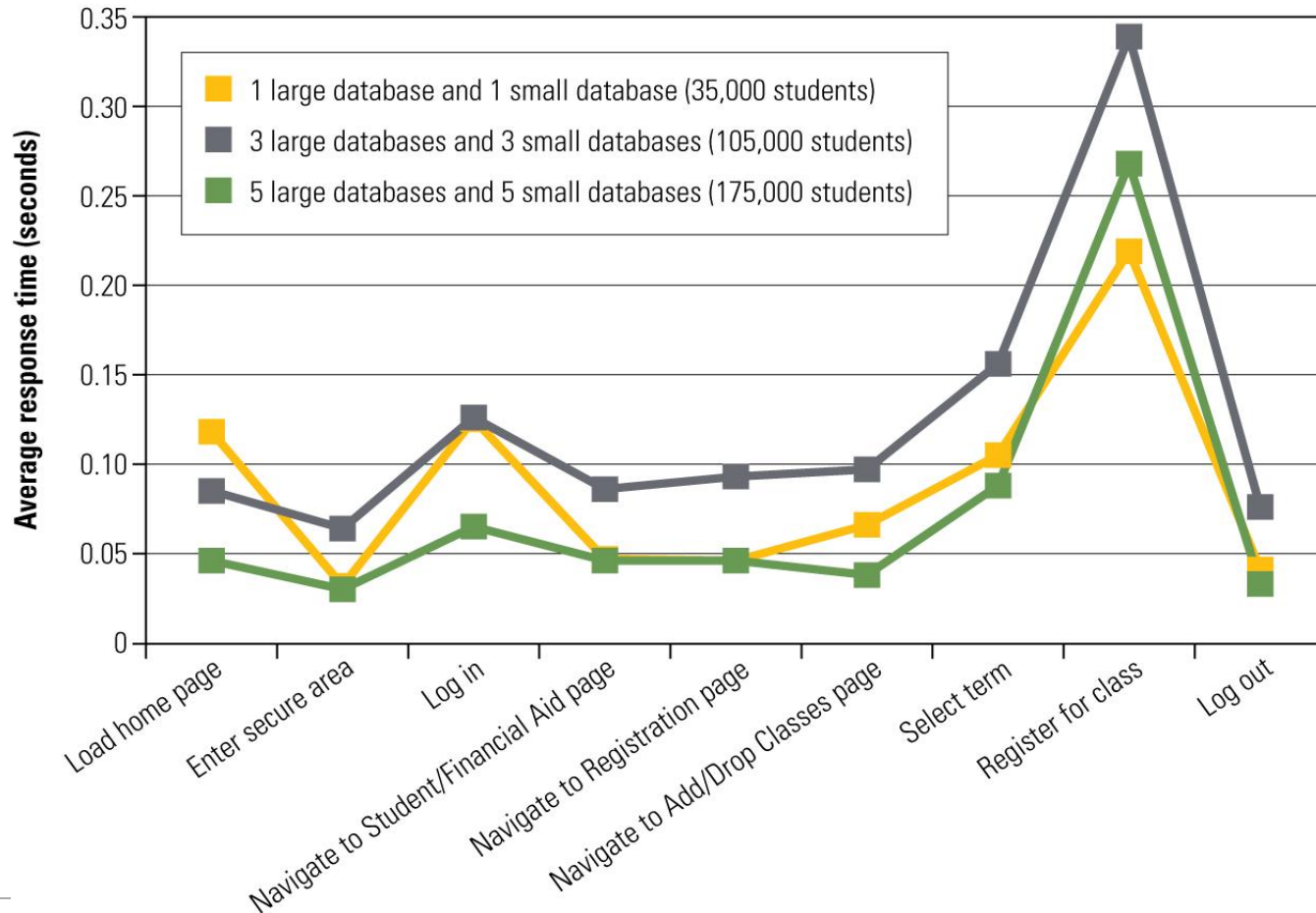
Testing Points (users)

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



# Application Performance Tests

## Traditional Registration Response Time



# Application Performance Tests

Traditional Registration Total Response Time

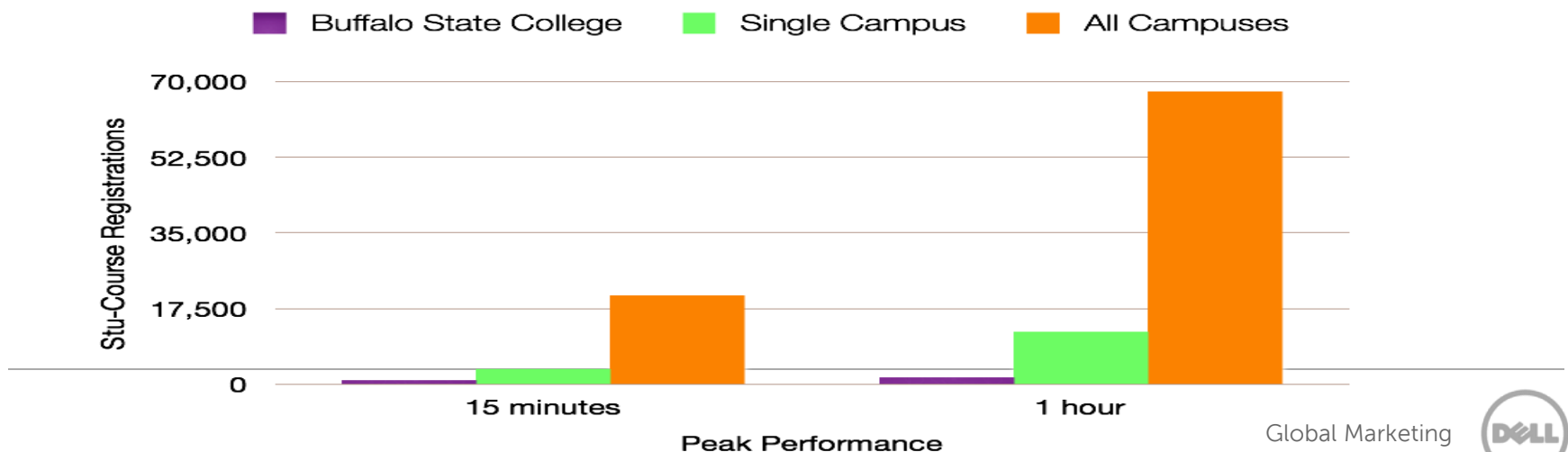
<b>Workload</b>	<b>Total Response Time for Traditional Student Registration Process</b>	<b>Number of Database Servers</b>	<b>Average CPU Utilization</b>
1 Large Campus + 1 Small Campus	0.7 sec	3	25%
3 Large Campuses + 3 Small Campuses	1.1 sec	5	31%
5 Large Campuses + 5 Small Campuses	0.8 sec	6	30%



# Application Performance Tests

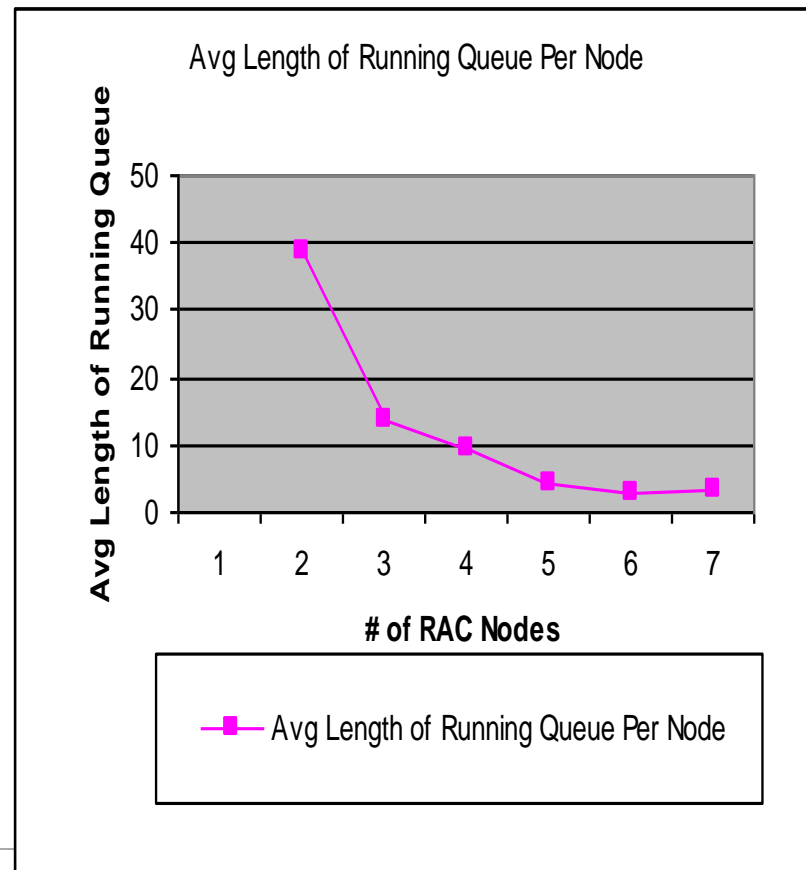
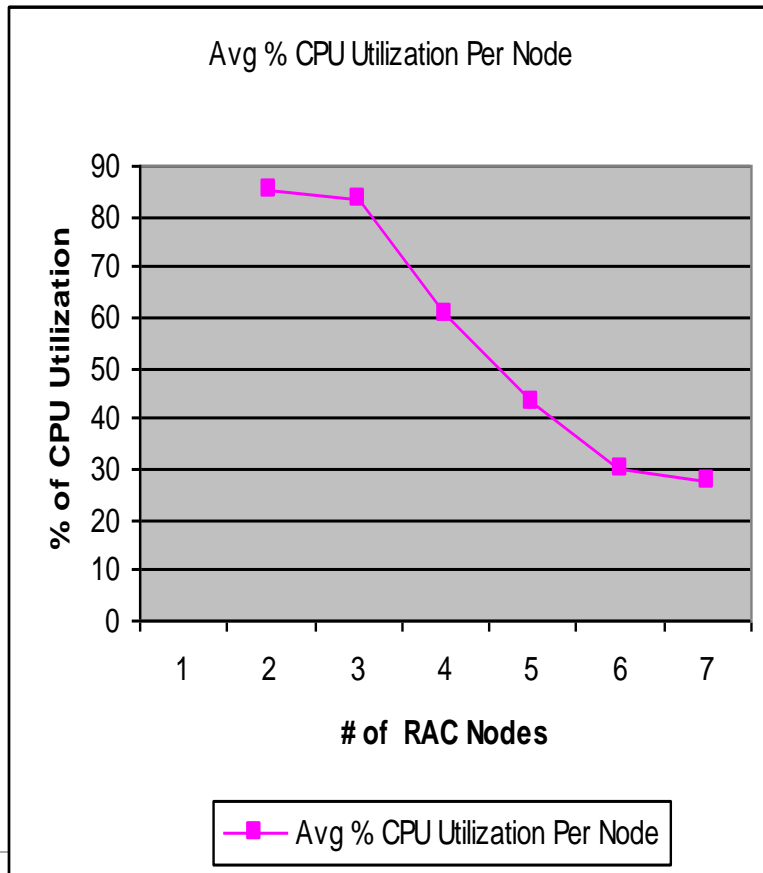
## Application Throughput: Student Registration Real World Comparison

	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



# Application Performance Tests

Scalability test of the Grid : run 5+5 with less nodes:



# Application Performance Tests

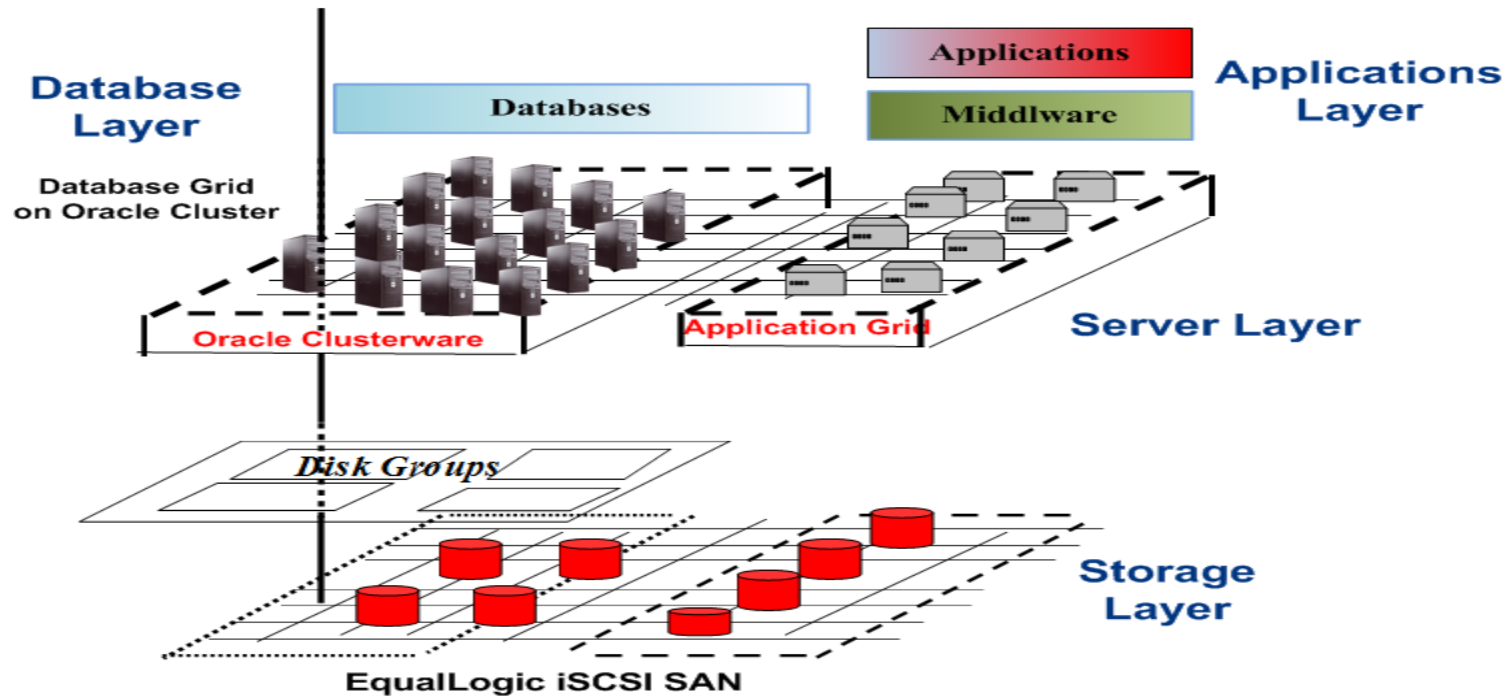
The Grid can be scaled out to handle the needs of the multiple large campuses with the capacity of handling:

- 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



# Dell 16 Node Oracle EBS DB Grid Design

- Oracle EBS Database Grid Design
  - Based on 16 Node Oracle 11g R2 Grid Infrastructure
  - Consolidate multiple Oracle EBS Databases
  - Support multiple versions of Oracle E-Business Suites
  - Support multiple versions of Oracle Databases

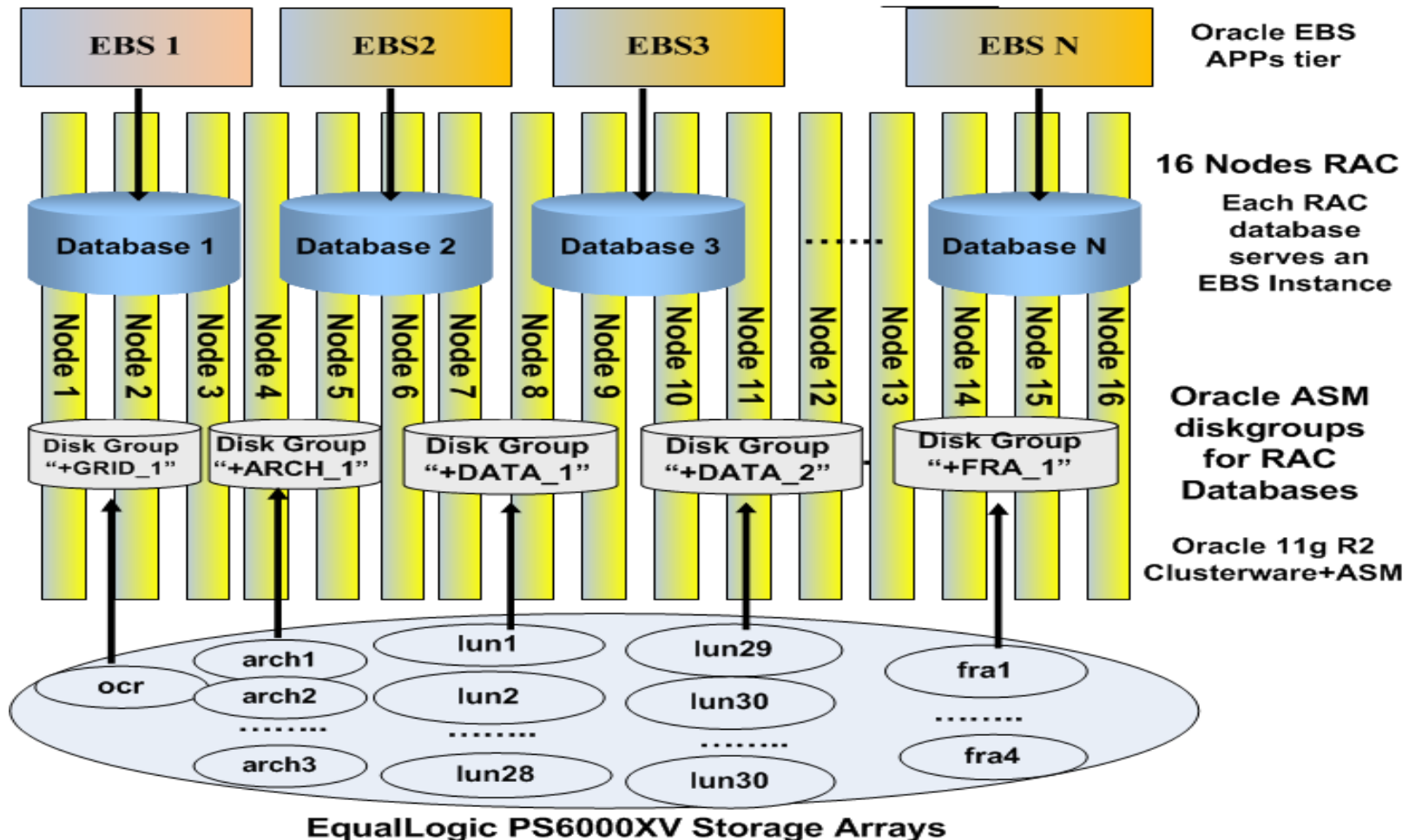




# Dell 16 Node Oracle EBS DB Grid Design

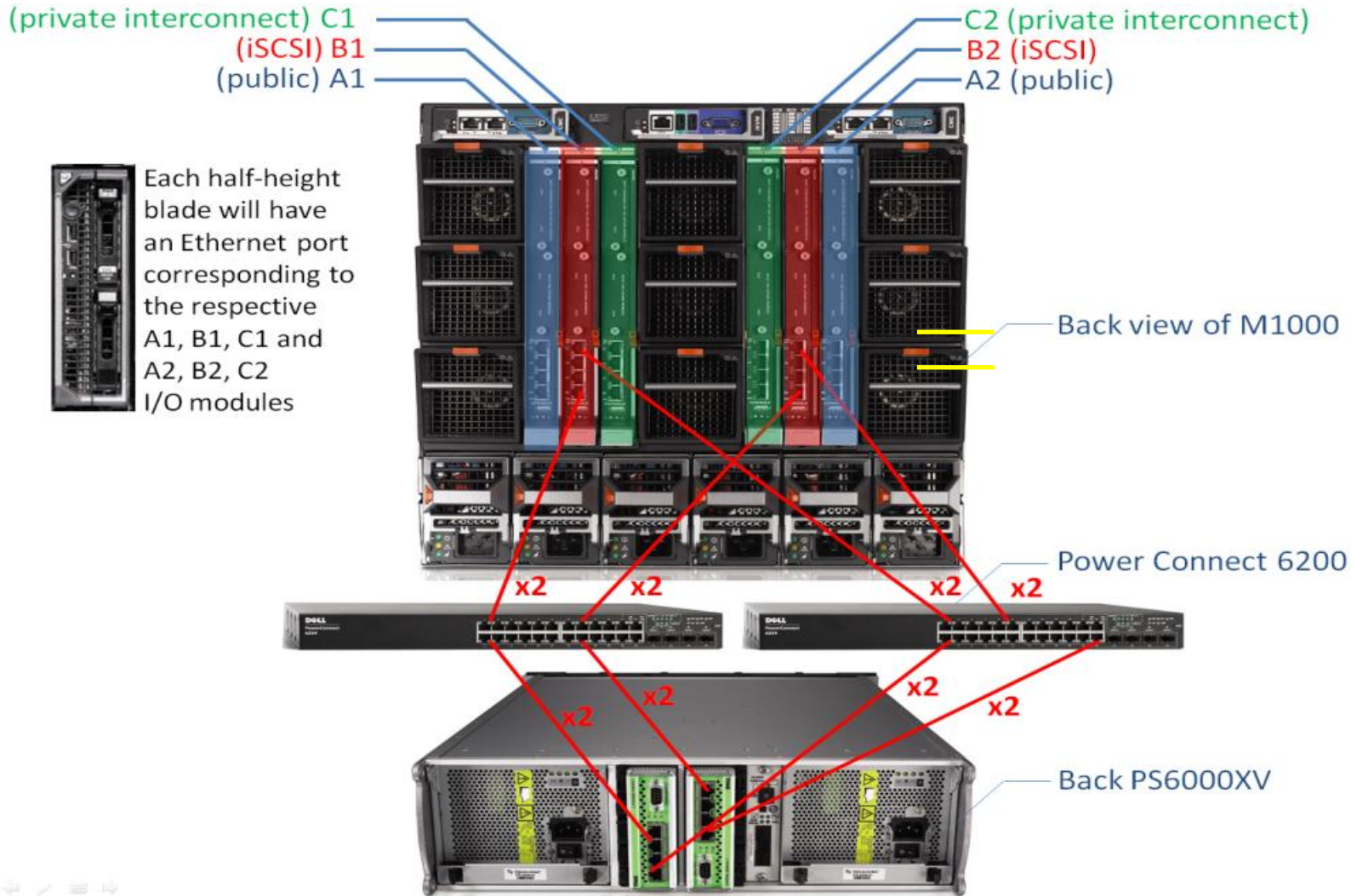
- Grid System Architecture Design

## Database Grid Architecture Design



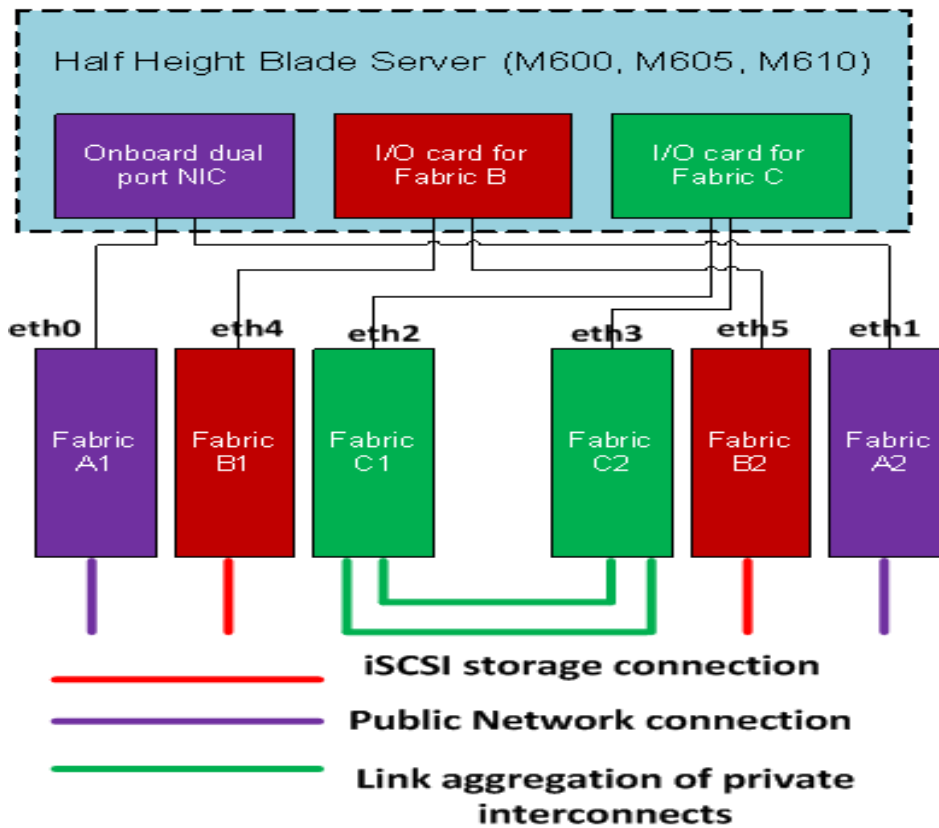
# Dell 16 Node Oracle EBS DB Grid Design

- Scalable Grid Hard Infrastructure Design



# Grid Implementation on Oracle 11gR2 RAC

- 11gR2 Grid Infrastructure configuration
  - OS: OEL 5U5 Kernel: 2.6.18-194.17.4.0.1.el5 x86\_64
  - Networks configuration



eth0 for public,  
eth2 and eth3 forms bond0  
for private interconnect  
eth4 and eth5 connected to  
EqualLogic Storage  
through two redundant  
switches

32 IPs for iSCSI connections

16 Public IPs:

16 Private IPs

16 VIPs

3 SCAN-IPs

# Grid Implementation on Oracle 11gR2 RAC

- EqualLogic iSCSI SAN volumes, Raid 1+0 configuration
  - Data Volumes: 17 Lun: 700GB , DATA\_1 diskgroup: 12 TB
  - Data Volumes: 9 Lun: 700GB, DATA\_2 diskgroup: 6.4TB
  - Reserved for 21 reserved. Total: 47 \* 700GB=32TB
  - Data Volume: OCR : 3GB, GRID\_1 diskgroup: 3GB
  - Data Volumes: ARCH0-7 : 250GB, ARCH\_1 diskgroup: 2TB
  - Data Volumes: FRA0-7 : 250GB, FRA\_1 diskgroup: 2TB
- Establishing host access to EqualLogic volumes
  - Use iscsiadm utility to create iSCSI interfaces
  - Discover the iSCSI volumes
  - Login to iSCSI storage
  - Creation storage multipath devices using Device Mapper
- 11g R2 Grid Infrastructure Configuration
  - GI Oracle HOME(Clusterware and ASM)

■



# Grid Implementation on Oracle 11gR2 RAC

```
SQL> /  
  
ARCH_1 /u02/oradata/asm/archive_lun04 250.004883  
ARCH_1 /u02/oradata/asm/archive_lun01 250.004883  
ARCH_1 /u02/oradata/asm/archive_lun03 250.004883  
ARCH_1 /u02/oradata/asm/archive_lun02 250.004883  
DATA_1 /u02/oradata/asm/data_lun13 700.004883  
DATA_1 /u02/oradata/asm/data_lun17 700.004883  
DATA_1 /u02/oradata/asm/data_lun20 700.004883  
DATA_1 /u02/oradata/asm/data_lun05 700.004883  
DATA_1 /u02/oradata/asm/data_lun01 700.004883  
DATA_1 /u02/oradata/asm/data_lun21 700.004883  
DATA_1 /u02/oradata/asm/data_lun06 700.004883  
DATA_1 /u02/oradata/asm/data_lun16 700.004883  
DATA_1 /u02/oradata/asm/data_lun07 700.004883  
  
DATA_1 /u02/oradata/asm/data_lun18 700.004883  
DATA_1 /u02/oradata/asm/data_lun15 700.004883  
DATA_1 /u02/oradata/asm/data_lun12 700.004883  
DATA_1 /u02/oradata/asm/data_lun08 700.004883  
DATA_1 /u02/oradata/asm/data_lun03 700.004883  
DATA_1 /u02/oradata/asm/data_lun09 700.004883  
DATA_1 /u02/oradata/asm/data_lun02 700.004883  
DATA_1 /u02/oradata/asm/data_lun04 700.004883  
DATA_2 /u02/oradata/asm/data_lun33 700.004883  
DATA_2 /u02/oradata/asm/data_lun24 700.004883  
DATA_2 /u02/oradata/asm/data_lun27 700.004883  
DATA_2 /u02/oradata/asm/data_lun32 700.004883  
DATA_2 /u02/oradata/asm/data_lun29 700.004883  
  
DATA_2 /u02/oradata/asm/data_lun34 700.004883  
DATA_2 /u02/oradata/asm/data_lun26 700.004883  
DATA_2 /u02/oradata/asm/data_lun28 700.004883  
DATA_2 /u02/oradata/asm/data_lun31 700.004883  
FRA_1 /u02/oradata/asm/fra_lun04 250.004883  
FRA_1 /u02/oradata/asm/fra_lun01 250.004883  
FRA_1 /u02/oradata/asm/fra_lun03 250.004883  
FRA_1 /u02/oradata/asm/fra_lun02 250.004883  
GRID_1 /u02/oradata/asm/ocr_css1 3.00292969
```

Shared NAS mounted on all 16 nodes  
/u01/app/grid/product/11.2.0.2/grid\_1  
Must run multicast patch before running  
root.sh during GI install  
Listener running in GI home

The ASM diskgroups and ASM disks  
create on the EqualLoigc volumes.



# Grid Implementation on Oracle 11gR2 RAC

- Multiple Oracle HOMEs
  - On shared NAS mounted on all 16 nodes, but registered on requested instance nodes
- Pre-11gR2 version databases with 11gR2 GI
  - Required to ping CRS on all 16 nodes

```
$GRID_HOME/bin/crsctl pin css -n ausmegnovdev01  
ausmegnovdev02 ausmegnovdev03  
ausmegnovdev04 ausmegnovdev035  
ausmegnovdev06 ausmegnovdev07  
ausmegnovdev08 ausmegnovdev09 ausmegnovdev10  
ausmegnovdev11 ausmegnovdev12 ausmegnovdev13  
ausmegnovdev14 ausmegnovdev15 ausmegnovdev16
```
  - To list pinned node(s):

```
[oracle@ausmegnovdev01.us.dell.com /home/oracle]  
$ $GRID_HOME/bin/olsnodes -t -n  
ausmegnovdev01 1 Pinned  
ausmegnovdev02 2 Pinned  
.  
.  
ausmegnovdev16 16 Pinned
```
- Multiple Database services: database instances allocation



# Deploying Oracle EBS Databases on Grid

- Deployment Methods
  - Fresh Install
    - EBS Release 12.1.1 with 11gR1 DB
    - Can be used for new projects/systems
    - For Novora EBS 11i with 11gR1 DB to be upgraded to R12 with 11gR2 DB
  - Clone
    - Cloning is the method we use most as we are migrating the EBS databases from individual physical database servers to the Grid to consolidate the environments
    - Cloning keeps Oracle Home versions and patch levels, configuration, and all business data and setups
    - AD Clone registers the Oracle Home and configure the instance environments, such as listener, tns, etc.



# Deploying Oracle EBS Databases on Grid

The screenshot displays the Oracle Applications Manager web interface. The browser window title is "Oracle Financials 11i Web Space - Windows Internet Explorer provided by Dell Client Engineering Team". The address bar shows "http://newfrontier.us.dell.com:8033/". The page header includes "ORACLE Applications Manager" and navigation links for "Support Cart", "Setup", "Home", "Logout", and "Help". The main content area is titled "Applications Dashboard: gebd2tt" and features a navigation menu with "Overview", "Performance", "Critical Activities", "Diagnostics", "Business Flows", and "Security".

The "Applications System Status" section shows data retrieved on 21-09-2011 at 18:24:41. It contains a table with the following data:

Host	Platform	Host Status	Admin	Database	Concurrent Processing	Forms	Web
<a href="#">AUSMEGNOVDEV05</a>	LINUX Intel	✓		✓			
<a href="#">AUSMEGNOVDEV06</a>	LINUX Intel	✓					
<a href="#">JANGOAPP01</a>	LINUX Intel	✓	✓		⊞	✓	✓

The "Configuration Changes (last 24 hours)" section shows data retrieved on 21-09-2011 at 18:24:41. It lists:

- Patches Applied: 0
- Site Level Profile Options: 0
- Applications Context Files Edited: 0

The "System Alerts" section shows data retrieved on 21-09-2011 at 18:24:41. It lists:

- New Alerts: 0
- New Occurrences: 131
- Open Alerts: 0
- Open Occurrences: 0

The "Web Components Status" section shows data retrieved on 19-01-2011 at 19:58:22. It lists:

- PL/SQL Agent: Unavailable
- Servlet Agent: Unavailable
- JSP Agent: Unavailable
- Discoverer: Unavailable
- Personal Home Page: Unavailable
- TCF: Unavailable

The "User Initiated Alerts" section shows data retrieved on 21-09-2011 at 18:24:42. It lists:

- New Alerts: 0
- New Occurrences: 0
- Open Alerts: 0
- Open Occurrences: 0

A tip at the bottom states: "TIP The information shown above (with the exception of Web Components Status section) is retrieved from the system". The footer includes "Local intranet | Protected Mode: Off" and a 100% zoom level.





# Comparison and Savings of Before and After Consolidation

Comparison	Before	After
Number of servers	30+	16
Database instances	30+	50+, Have the capacity for 100+
Storage	50+TB total of all servers and DBs	32TB
Cloning Time	3-5 days/env (10-12 envs/quarter)	2-3days/env (12-15 envs/quarter)
Patching time	2hrs each server – 60+ hours/quarter	10 hours total/quarter
DBA time	4 full time	2 full time
Cost	\$\$\$	\$\$



# Reference

1. [Scaling SunGuard Higher Education Banner Software on Dell Hardware](#), Dell Power Solutions, August 2008, Dave Jaffe, Kai Yu, Dan Brint, Dell Power Solutions,, August 2008.  
<http://www.dell.com/downloads/global/power/ps3q08-20080283-SUNY.pdf>
2. [Project MEGAGRID: Practical Guidance for Deploying Large Clusters of GRID](#), An Oracle, Dell, EMC, Intel Joint White Paper, December 2004,
3. [Case study: Implementing the Oracle Grid Computing for Multiple ERP Applications](#), Oracle OpenWorld Beijing 2010, Dec 14th, 2010, Beijing, China.
4. [Consolidate Oracle E-Business Suite Databases in Oracle Database 11g Release 2 Grid: Case Study](#), John Tao & Kai Yu, Oracle OpenWorld 2011, Session ID #0845
5. Database as a Service - How does Dell do it in a Consolidated Private Cloud? Sreekanth Chintala and Ravi Kulkarni, Oracle Open World 2011, Session ID #10109



# Thank You and QA

Contact me at [kai\\_yu@dell.com](mailto:kai_yu@dell.com) or visit Kai's Oracle Blog at <http://kyuoracleblog.wordpress.com/>

My OOW 2011

■ Conference  
Presentation Schedules

Posted by: [kyuoracleblog](#) | August 13, 2011

I will present or participate as a panellist of the following OOW sessions:

- 1. Ensure the High Availability and Stability of Oracle RAC: Storage and Network Side Story , Session #09385, 10/2/2011, Sunday, 01:30 PM, Moscone West - 2005*
- 2. Launching the IOUG Virtualization SIG: 360 Degrees of Virtualization for Oracle DBA... , session #28900, IOUG Virtualization panel, 10/2, Sunday, 04:00 PM, Moscone West - 2009*
- 3. Consolidate Oracle E-Business Suite Databases in Oracle Database 11g Release 2 Grid: Case Study, session#08945, 10/4/2011, Tuesday, 10:15 AM, Intercontinental - Intercontinental Ballroom A*
- 4. Configuring and Managing a Private Cloud with Oracle Enterprise Manager , Oracle OpenWorld 2011 session#06980 , 10/4/2011, Tuesday, 05:30 PM, Moscone South - 309, San Francisco*
- 5. Upgrading Oracle Enterprise Manager, Using Best Practices , Oracle OpenWorld 2011 session#0733, 10/6/2011, Thursday, 01:30 PM, Intercontinental - Intercontinental Ballroom A*

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ACE Director

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