

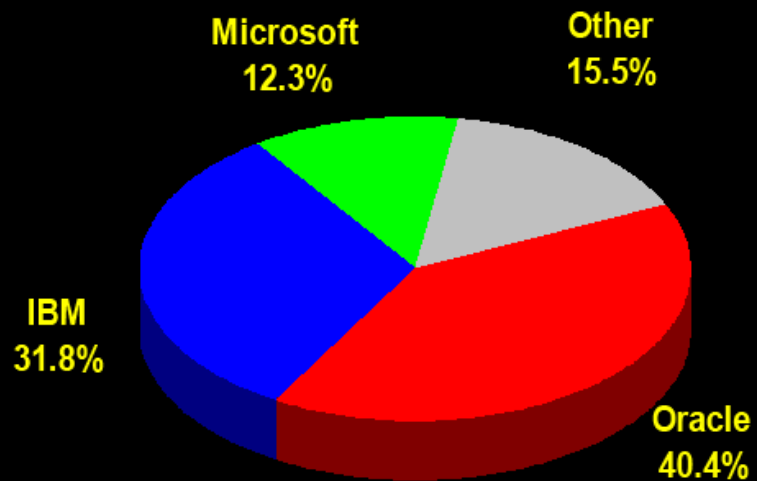
Oracle Database Overview

Hong Lee

Relational Database Management System (RDBMS)

- RDBMS is based on the **relational model** as introduced by E. F. Codd. Data and the relationships are stored in the form of tables. Referential integrity between tables is often enforced by the combination of a primary key and a foreign key.
- RDBMS offers strong consistency guarantees, it uses transactions that provide "all-or-nothing", meaning each unit of work performed in a database must either complete entirely or have no effect at all.
- RDBMS provides strong **concurrency** control. Its concurrency mechanisms manage and support multiple users accessing the same group of resources (such as tables, rows).
- RDBMS interface is flexible and offers data independence. Uses interface with RDBMS in **SQL** – a standard interactive and programming language for querying and modifying data and managing databases.
- Such RDBMS include Microsoft SQL Server, DB2, Sybase and Oracle.

Database Market Share



What is an Instance?

- A database **instance**, or an 'instance' is made up of the background processes/threads needed by the database software.
- These processes usually include a process monitor, session monitor, lock monitor, database writer, etc. They will vary from database vendor to database vendor.
- An instance controls 0 or more databases
- A database can have 1 or more instances

What is a Schema?

- A SCHEMA IS NOT A DATABASE, AND A DATABASE IS NOT A SCHEMA.
- A database application schema is the set of database objects (tables, indexes, triggers, etc.) that owned by a user that apply to a specific application.
- These objects are relational in nature, and are related to each other, within a database to serve a specific functionality.
- For example payroll, purchasing, order, etc. Usually several schemas coexist in a database.

Tables, Indexes, Constraints

- **Table** - a set of columns that contain data. In the old days, a table was called a file.
- **Row** - a set of columns from a table reflecting a record.
- **Index** - an object that allows for fast retrieval of table rows. Every primary key and foreign key should have an index for retrieval speed.
- **Primary key (PK)** - 1 or more columns in a table that makes a record unique.
- **Foreign key (FK)** - a common column between 2 tables that define the relationship between those 2 tables.

The Three Normal Forms

First Normal Form: All column values are atomic - Indivisible

Table: tblOrder1		
OrderId	CustomerId	Items
1	4	5 hammer, 3 screwdriver, 6 monkey wrench
2	23	1 hammer
3	15	2 deluxe garden hose, 2 economy nozzle
4	2	15 10' 2x4 untreated pine board
5	23	1 screwdriver
6	2	5 key

Record: 1 of 6

Table: tblOrder3				
OrderId	CustomerId	OrderItem#	Quantity	Item
1	4	1	5	hammer
1	4	2	3	screwdriver
1	4	3	6	monkey wrench
2	23	1	1	hammer
3	15	1	2	deluxe garden hose
3	15	2	2	economy nozzle
4	2	1	15	10' 2x4 untreated pine board
5	23	1	1	screwdriver
6	2	1	5	key

Record: 1 of 9

The Three Normal Forms

Second Normal Form: All column values depends on the value of the primary key

Table: tblOrder4							
	OrderId	CustomerId	OrderDate	OrderItem#	Quantity	ProductId	ProductDescription
▶	1	4	5/1/94	1	5	32	hammer
	1	4	5/1/94	2	3	2	screwdriver
	2	23	5/9/94	1	1	32	hammer
	3	15	7/4/94	1	2	113	deluxe garden hose
	3	15	7/4/94	2	2	121	economy nozzle
	4	2	8/1/94	1	15	1024	10' 2x4 untreated pine boards
	5	23	8/2/94	1	1	2	screwdriver
	6	2	8/2/94	1	5	52	key
*							
Record: 1		of 8					

Table: tblOrder			
	OrderId	CustomerId	OrderDate
▶	1	1	5/1/94
	2	3	5/9/94
	3	1	7/4/94
	4	2	8/1/94
	5	1	8/2/94
	6	2	8/2/94
*			
Record: 1		of 6	

Table: tblOrderDetail					
OrderId	OrderItem#	Quantity	ProductId	ProductDescription	
1	1	5	32	hammer	
1	2	3	2	screwdriver	
2	1	1	32	hammer	
3	1	2	113	deluxe garden hose	
3	2	2	121	economy nozzle	
4	1	15	1024	10' 2x4 untreated pine boards	
5	1	1	2	screwdriver	
6	1	5	52	key	
Record: 1		of 8			

The Three Normal Forms

Third Normal Form: No column value depends on the value of any other column except the primary key.

Table: tblOrder4							
	OrderId	CustomerId	OrderDate	OrderItem#	Quantity	ProductId	ProductDescription
▶	1	4	5/1/94	1	5	32	hammer
	1	4	5/1/94	2	3	2	screwdriver
	2	23	5/9/94	1	1	32	hammer
	3	15	7/4/94	1	2	113	deluxe garden hose
	3	15	7/4/94	2	2	121	economy nozzle
	4	2	8/1/94	1	15	1024	10' 2x4 untreated pine boards
	5	23	8/2/94	1	1	2	screwdriver
	6	2	8/2/94	1	5	52	key
*							
Record: 1		of 8					

Table: tblOrder			
	OrderId	CustomerId	OrderDate
▶	1	1	5/1/94
	2	3	5/9/94
	3	1	7/4/94
	4	2	8/1/94
	5	1	8/2/94
	6	2	8/2/94
*			
Record: 1		of 6	

tblOrderDetail				
	OrderId	OrderItem#	Quantity	ProductId
▶	1	1	5	32
	1	2	3	2
	2	1	1	32
	3	1	2	113
	3	2	2	121
	4	1	15	1024
	5	1	1	2
	6	1	5	52
*	0	0	0	0
Record: 1		of 8		

tblProduct	
	ProductId
▶	2
	32
	52
	113
	121
	1024
*	0
Record: 1 of 6	

DBA Tasks

System DBA

- Installing and upgrading the database software and application tools
- Allocating system storage and planning future storage requirements for the database system
- Creating database and its parameters
- Creating database storage structures (tablespaces)
- Creating database objects (tables, views, indexes)
- Create users and grant database privileges
- Setup database security and auditing
- Setup database backup
- Recover database when necessary
- Setup database monitoring
- Database optimization and performance tuning
- Perform database maintenance (reorgs, collect stats)
- Design and Implement database high availability strategy
- Contact database vendor for technical support
- Ensuring compliance with the database license agreement

DBA Tasks

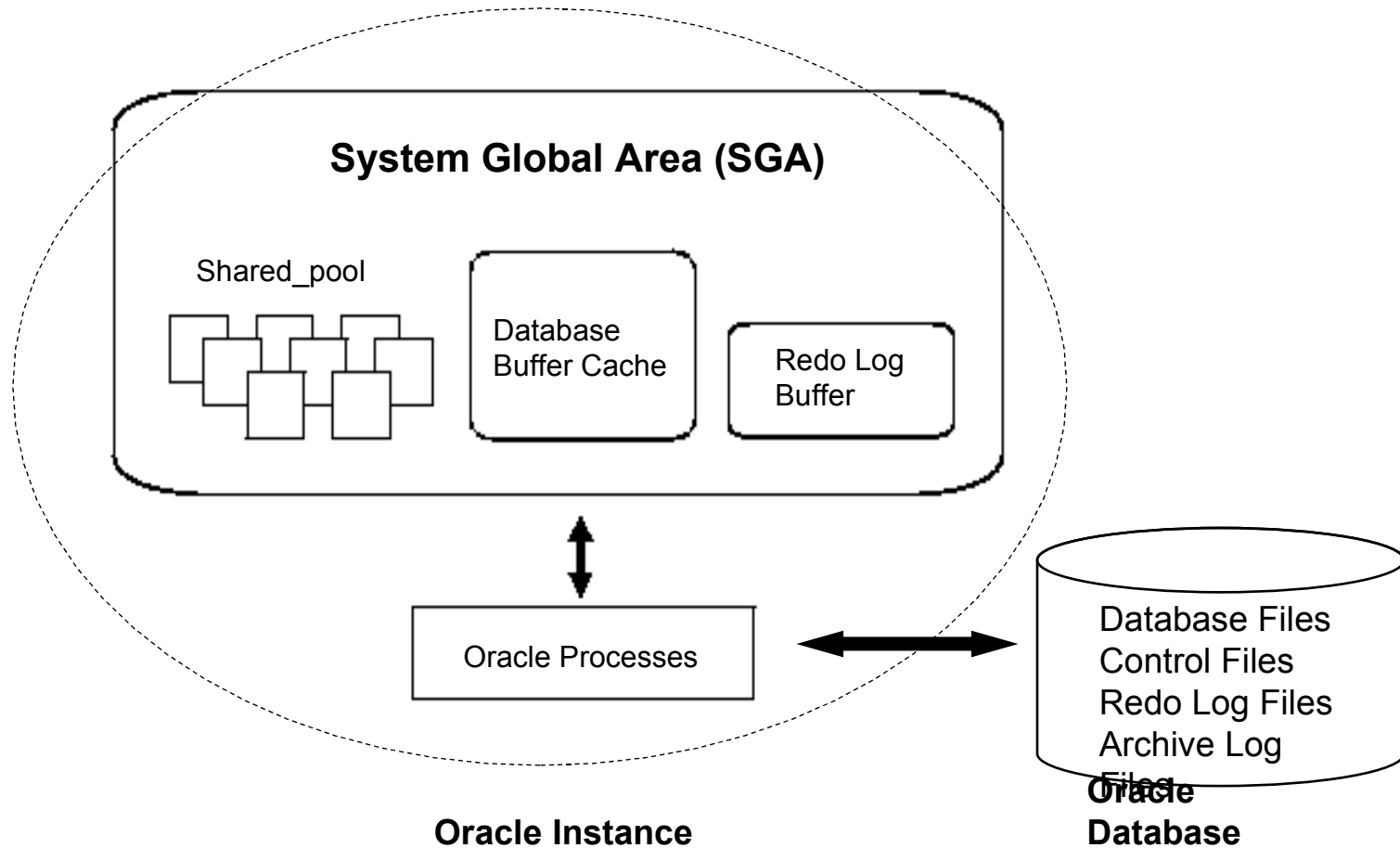
Application DBA

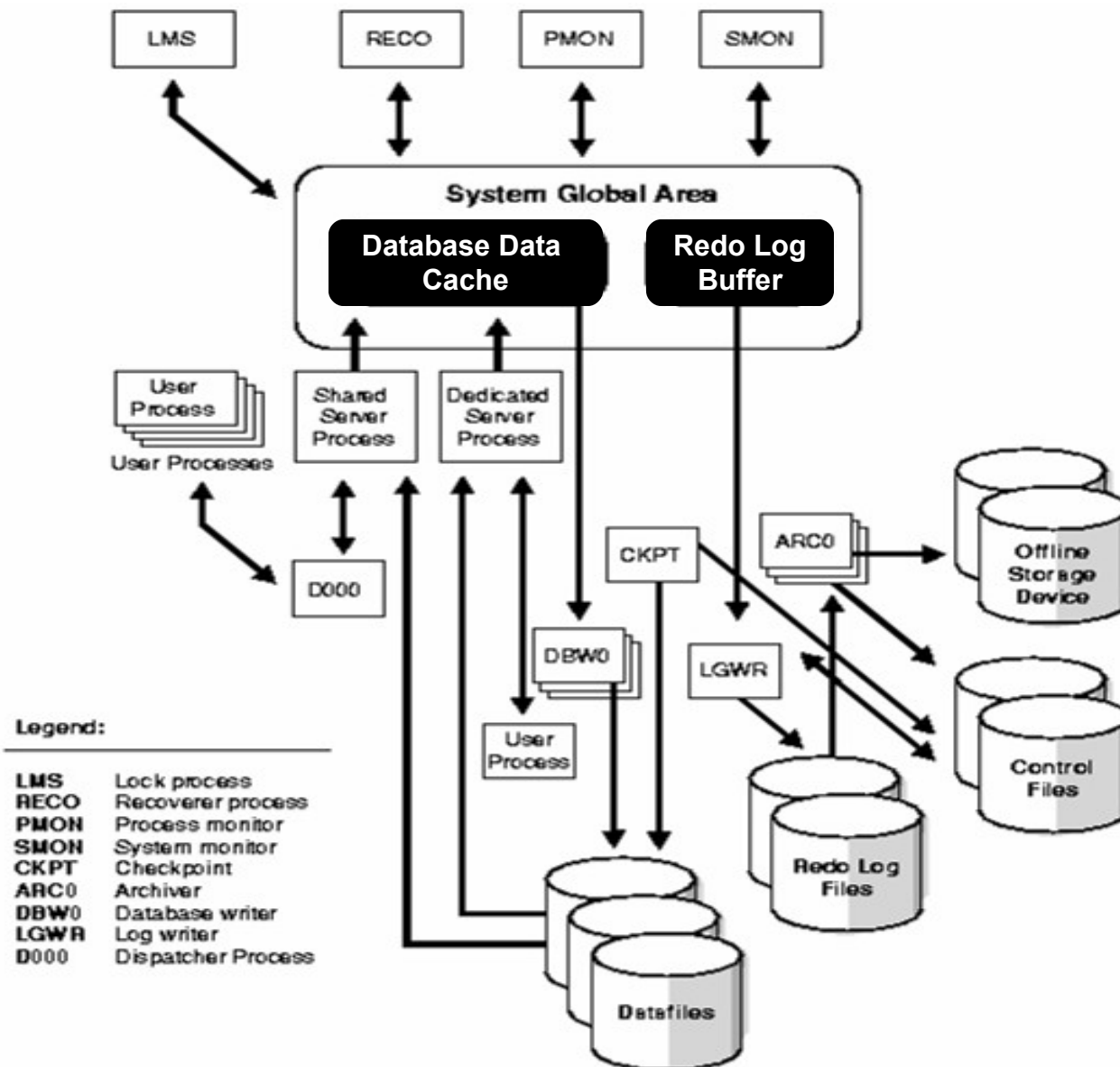
- Reviewing database designs and application functionalities with the business, developers, and data modelers
- Reviewing database structure changes that provided by application developers and data modelers
- Implement the database structure such as tables, indexes
- Working with application developers to tune the performance of the database
- Reviewing and tuning the SQL scripts
- Designing and implementing the database migration
- Helping load/unload data
- Database refreshing and cloning
- Data replications

Oracle Instance and Database

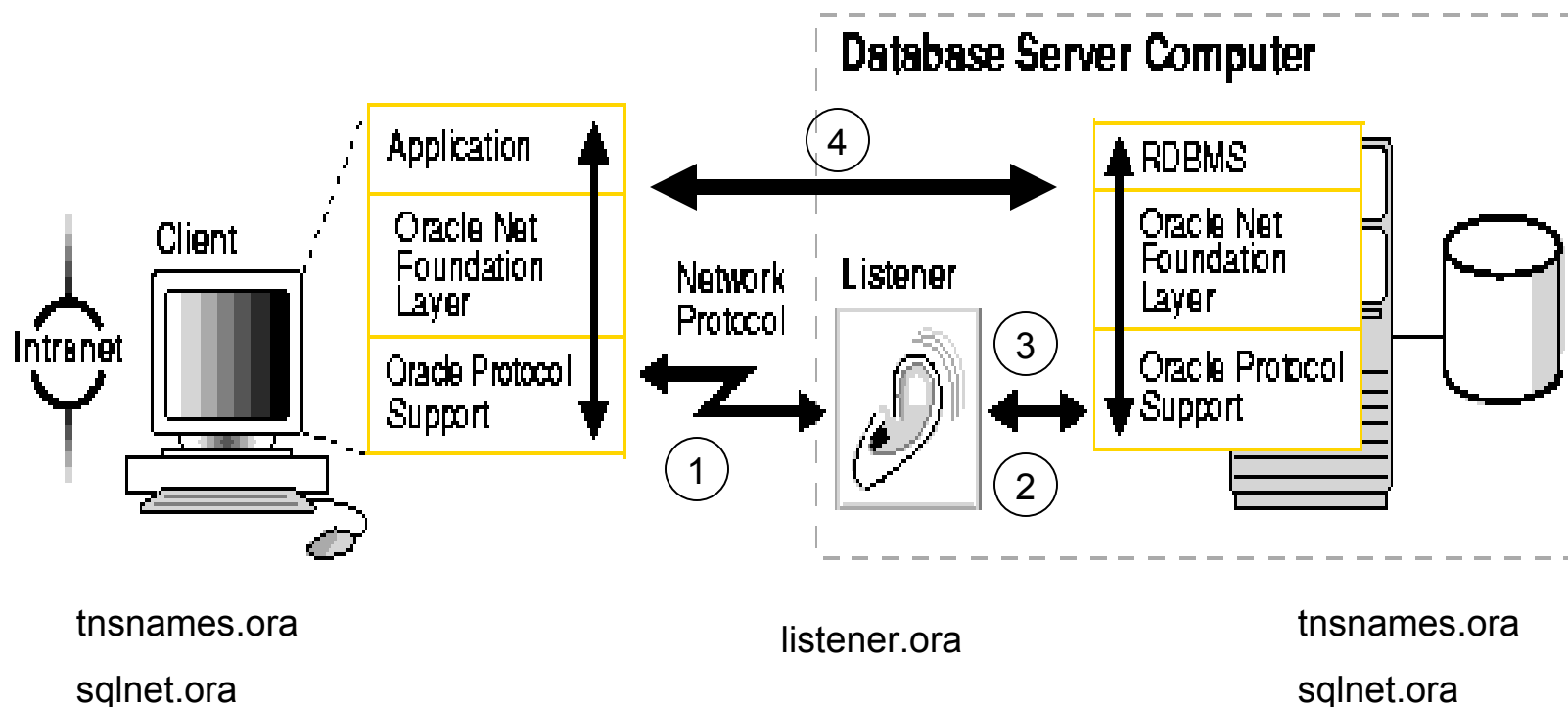
- **Oracle Instance**
 - **Oracle background processes:**
 - SMON – System Monitoring
 - PMON – Process Monitoring
 - CKPT – Checkpoint process
 - ARC0 – Archive log process
 - LGWR – Log writer
 - ...
 - **Memory**
 - SGA – System Global Area
 - PGA – Program(Private) Global Area
- **Oracle Database**
 - Data files
 - Control files
 - Redo log files
 - Archive log files
 - Parameter files

A Simple View of Oracle Instance and Database



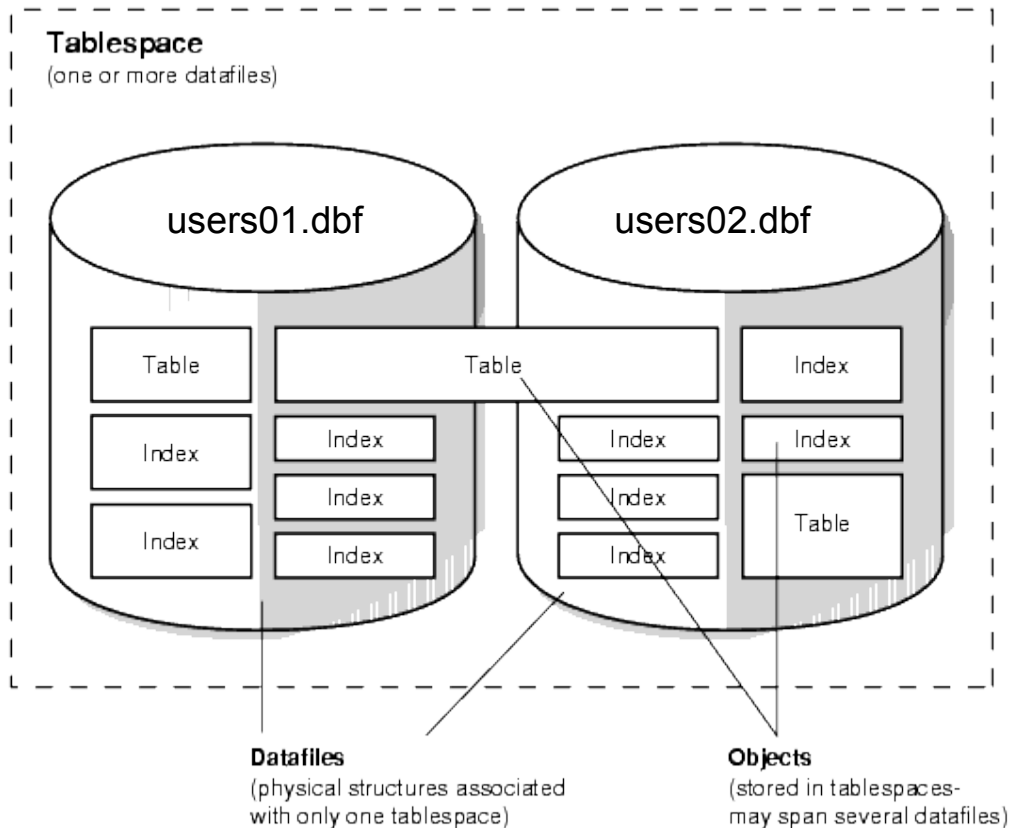


How do I connect to the Oracle database



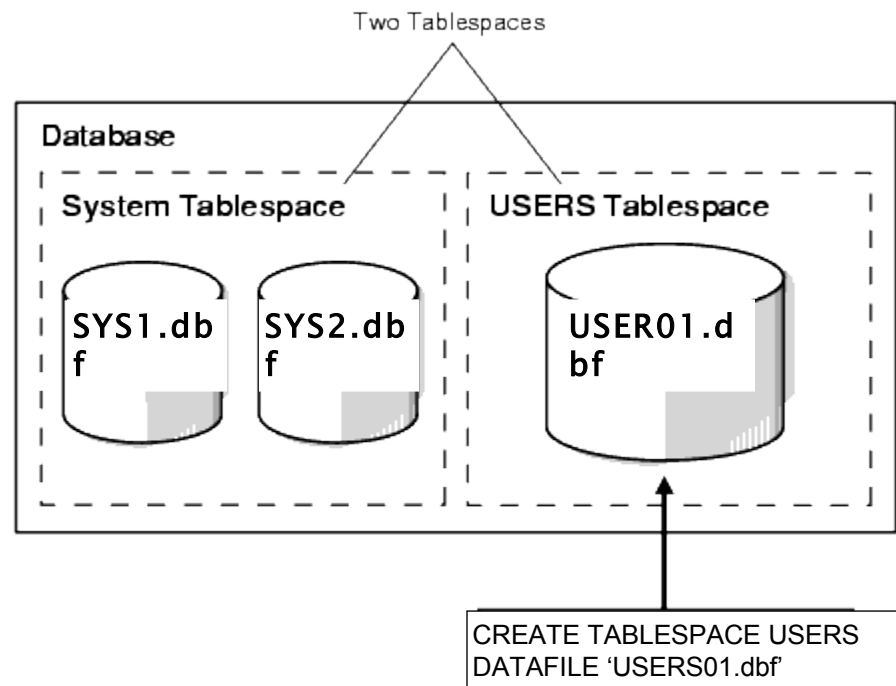
What is a Tablespace?

A tablespace is a logical storage unit in an Oracle database.



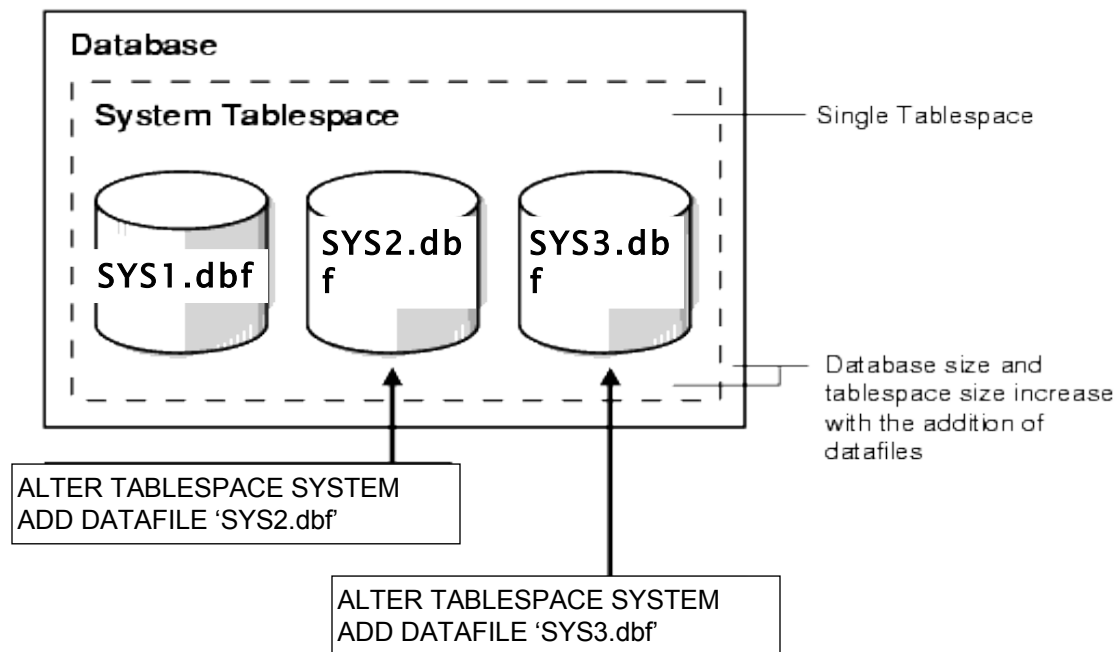
Database Space Management

- Add a new tablespace



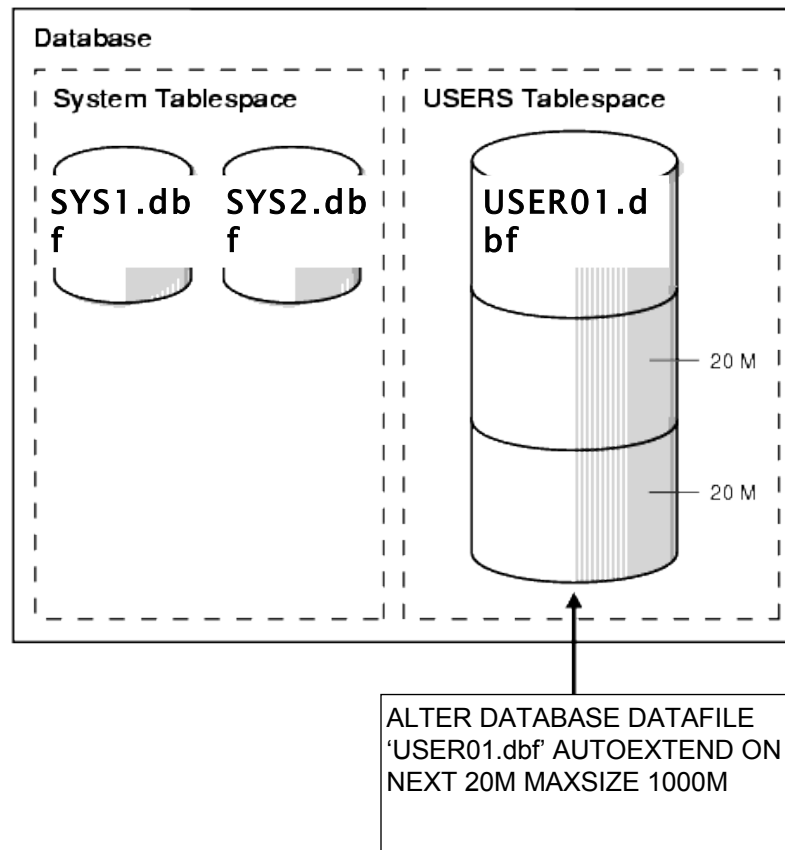
Database Space Management

- Add datafiles to a tablespace



Database Space Management

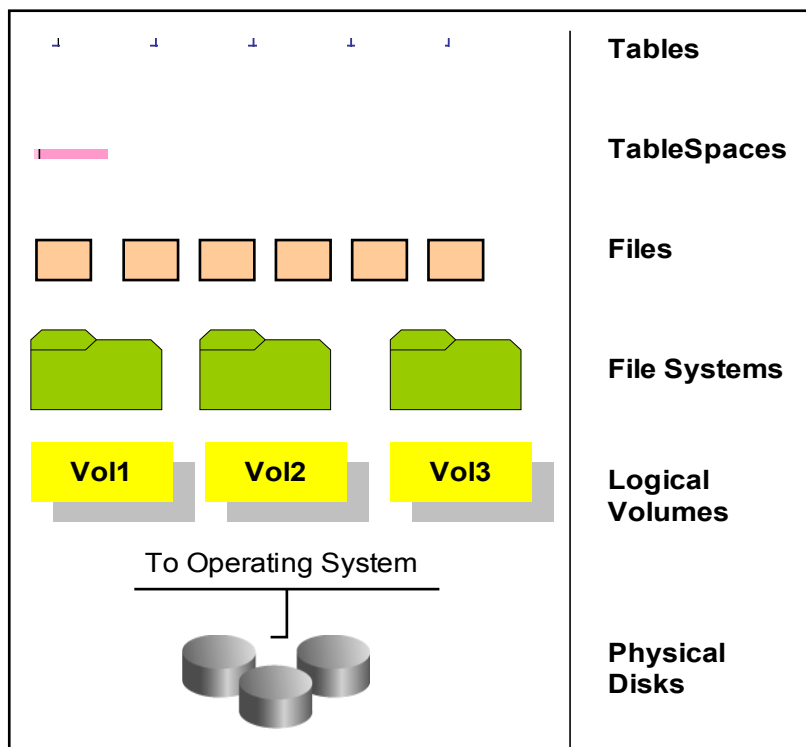
- Dynamically sizing a datafile



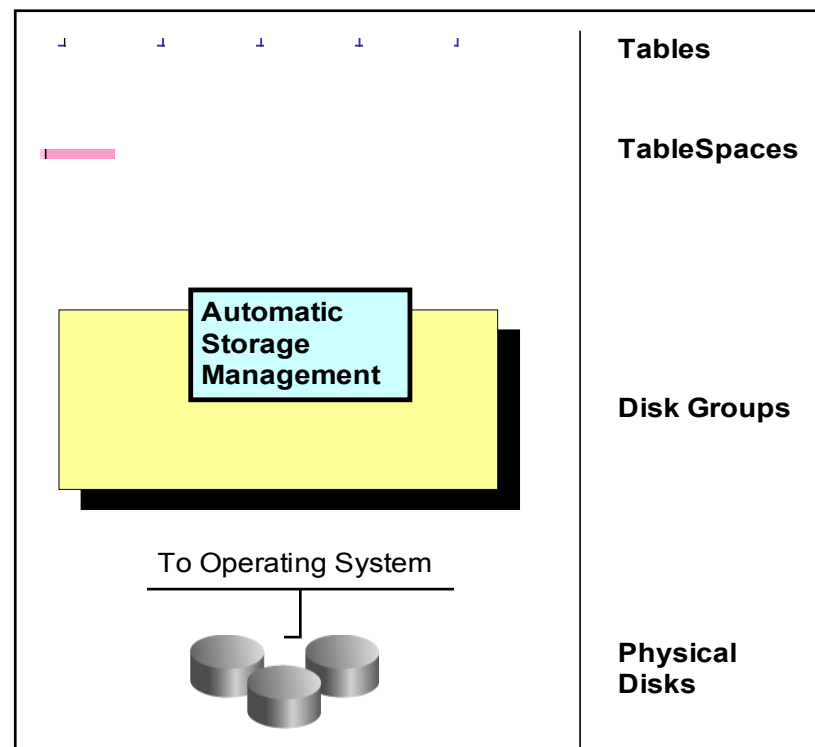
Automatic Storage Management (ASM)

- ASM is a *database instance* that provides:
 - Load balancing in parallel across disk drives
 - Prevention of disk space fragmentation
 - Online disk space reorganization
 - Data redundancy to provide fault tolerance
- ASM instance - Instance that manages the diskgroup metadata
- Disk Groups
 - Logical grouping of raw disks
 - Determines file mirroring options
- ASM Disks - LUN presented to ASM
- ASM Files - Includes database files

Volume Management vs ASM



Traditional Volume Management



With Oracle's ASM configuration

- Direct I/O
- Asynchronous I/O
- Striping and Mirroring

No File System Buffers

ASM Best Practices



AUTOMATIC STORAGE MANAGEMENT

ASM BEST PRACTICES REVIEW

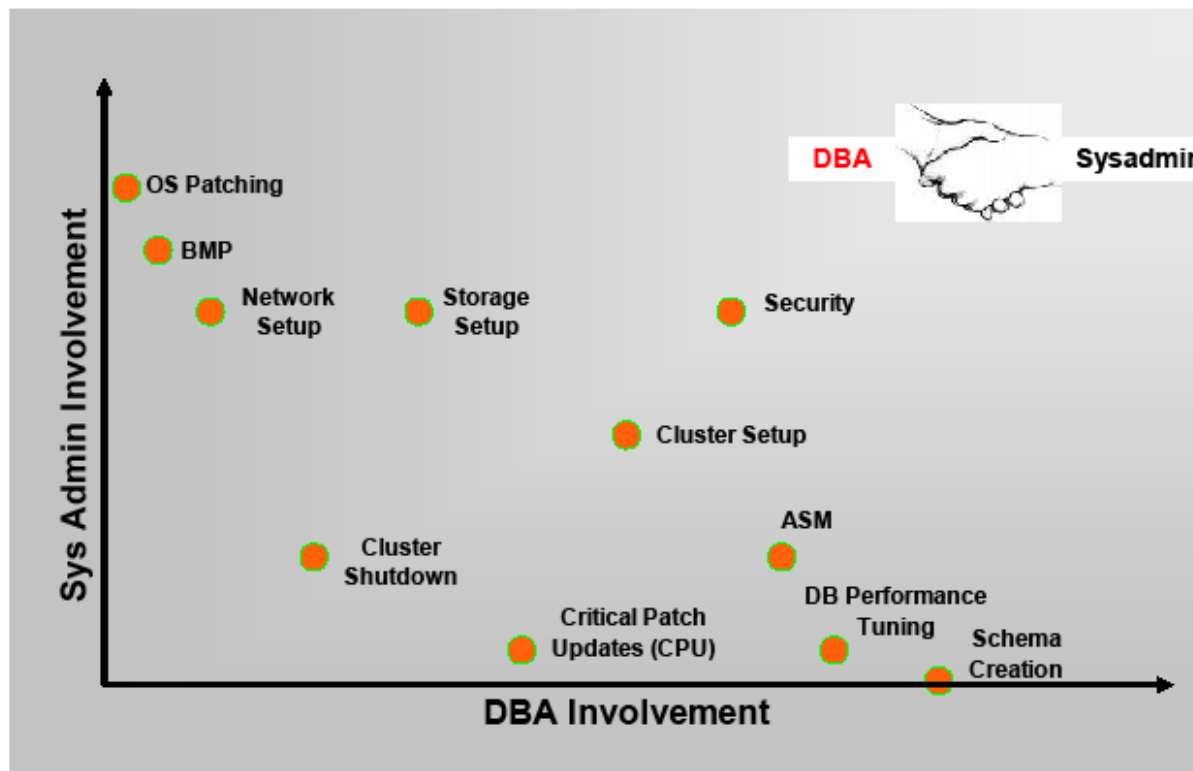
- Hardware RAID stripe size to be ideally 1MB.
OR choose the max size up to 1MB (128/256/512 etc)
- Use small disks with highest RPM
- Use large LUNs to reduce LUN management overhead
- Set ASM diskgroups on disks or arrays that are not shared with other applications
- Do not use a Logical Volume Manager (LVM)
- Use the Oracle ASMLIB feature

Install Software and Create Database

- Kernel settings:
 - # Shmmax set to half of the physical mem.
 - **kernel.shmmax = 4294967296**
 - kernel.shmall = 2097152
 - kernel.shmmni = 4096
 - fs.file-max = 327679
 - kernel.sem=250 32000 100 128
 - net.ipv4.ip_local_port_range = 1024 65000
 - net.core.rmem_default=262144
 - net.core.wmem_default=262144
 - net.core.rmem_max=262144
 - net.core.wmem_max=262144
- OS Patches
- Run “root.sh”
- Oracle id: (ora1adm, ora5adm, ora9adm)
- Directories:
 - /u01 – Oracle software
 - /u02 ~ /u09 – Oracle database
- X-window is required

Sysadmin and DBA

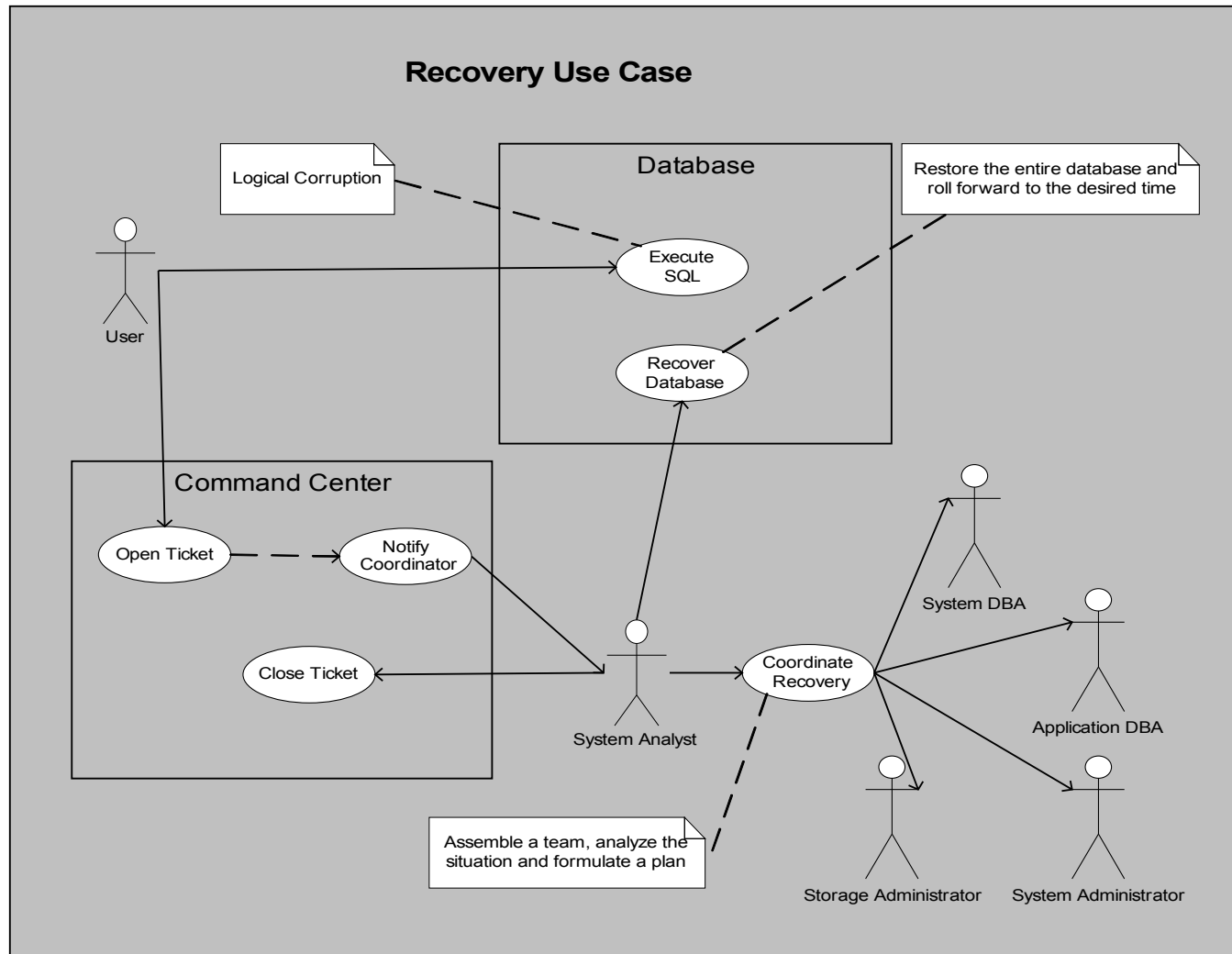
Operations versus Roles



Oracle Backup and Recovery

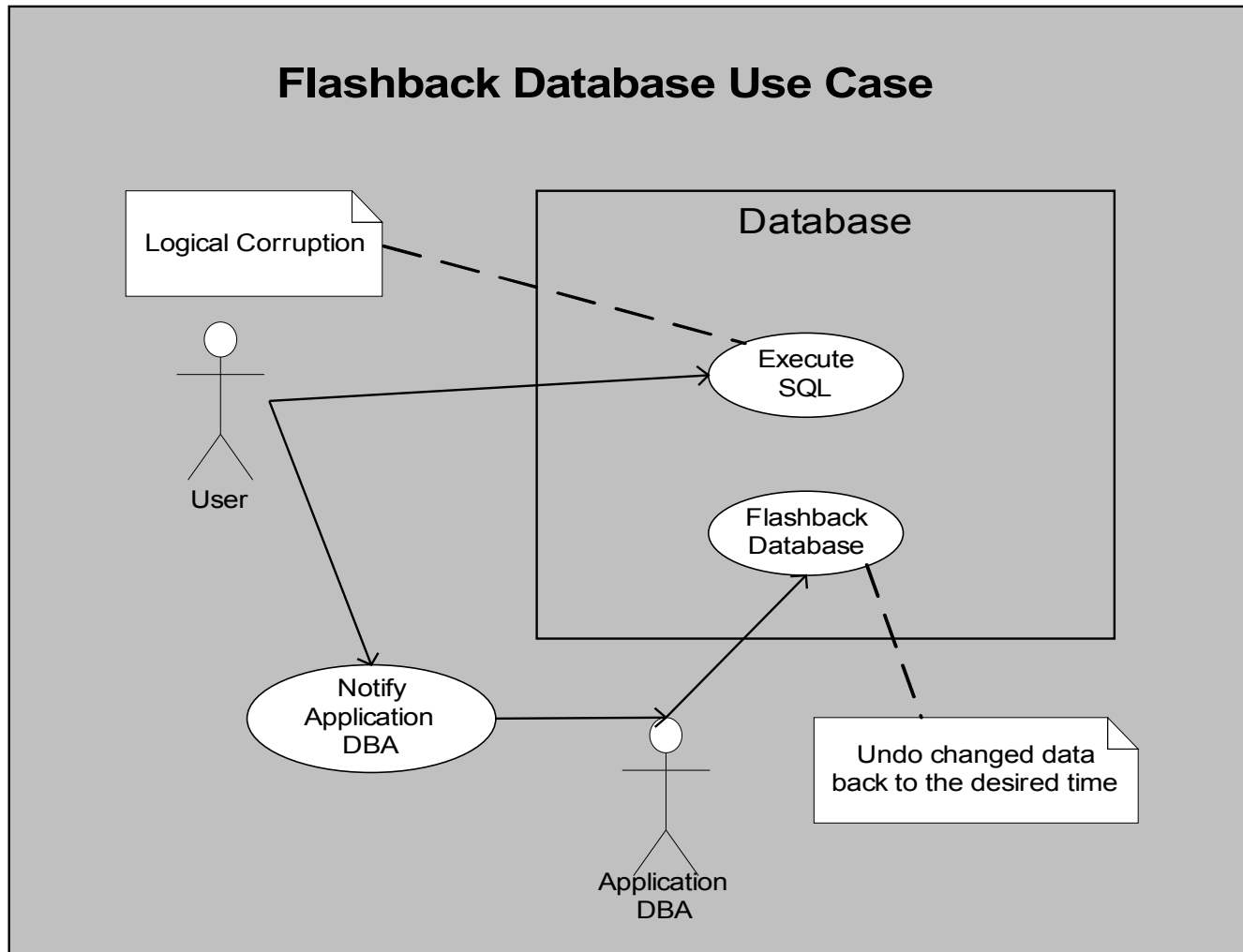
- SMON – System Monitor
 - Background process that automatic recover the database after a crash
- Export/Import
 - Fast unload/load data and structure to a dump file
 - Can only recover to when the export was taken
 - Import will be slow for large database
 - Best suited for Dev/Test, refreshing
- Data Pump
 - Newer version of export and import
 - Parallelism
 - Can stop and restart
- RMAN (Recover Manager)
 - Oracle backup and recover tool (language)
 - Able to recover database to point-in-time
 - Integrated with many media management tools
- Flashback recovery
 - New technology that use Flashback Area and Undo space to undo the changes
 - Best suited for logical data corruption (user error)

Recovery with RMAN and tape



Recovery with Flashback

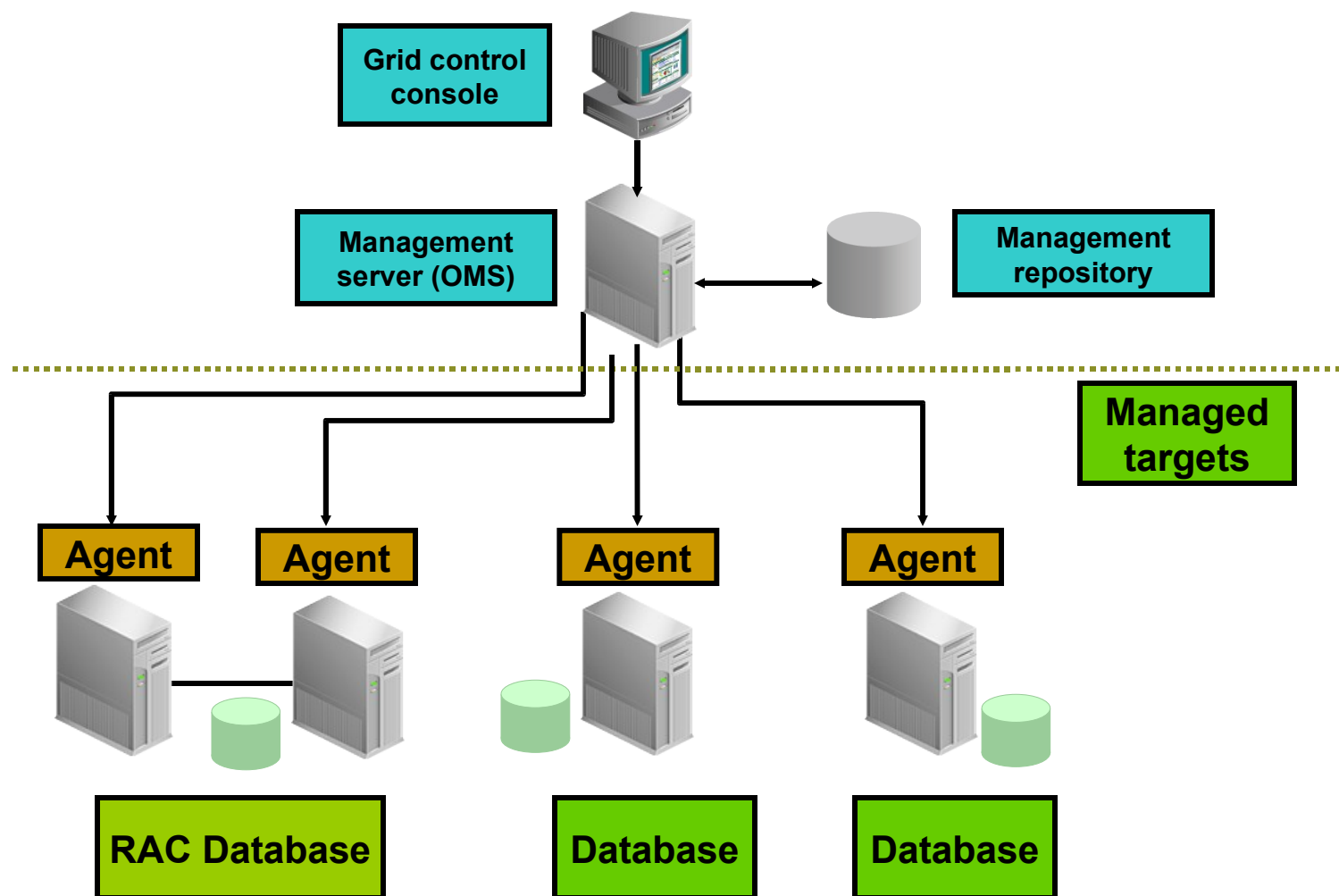
Flashback Database Use Case



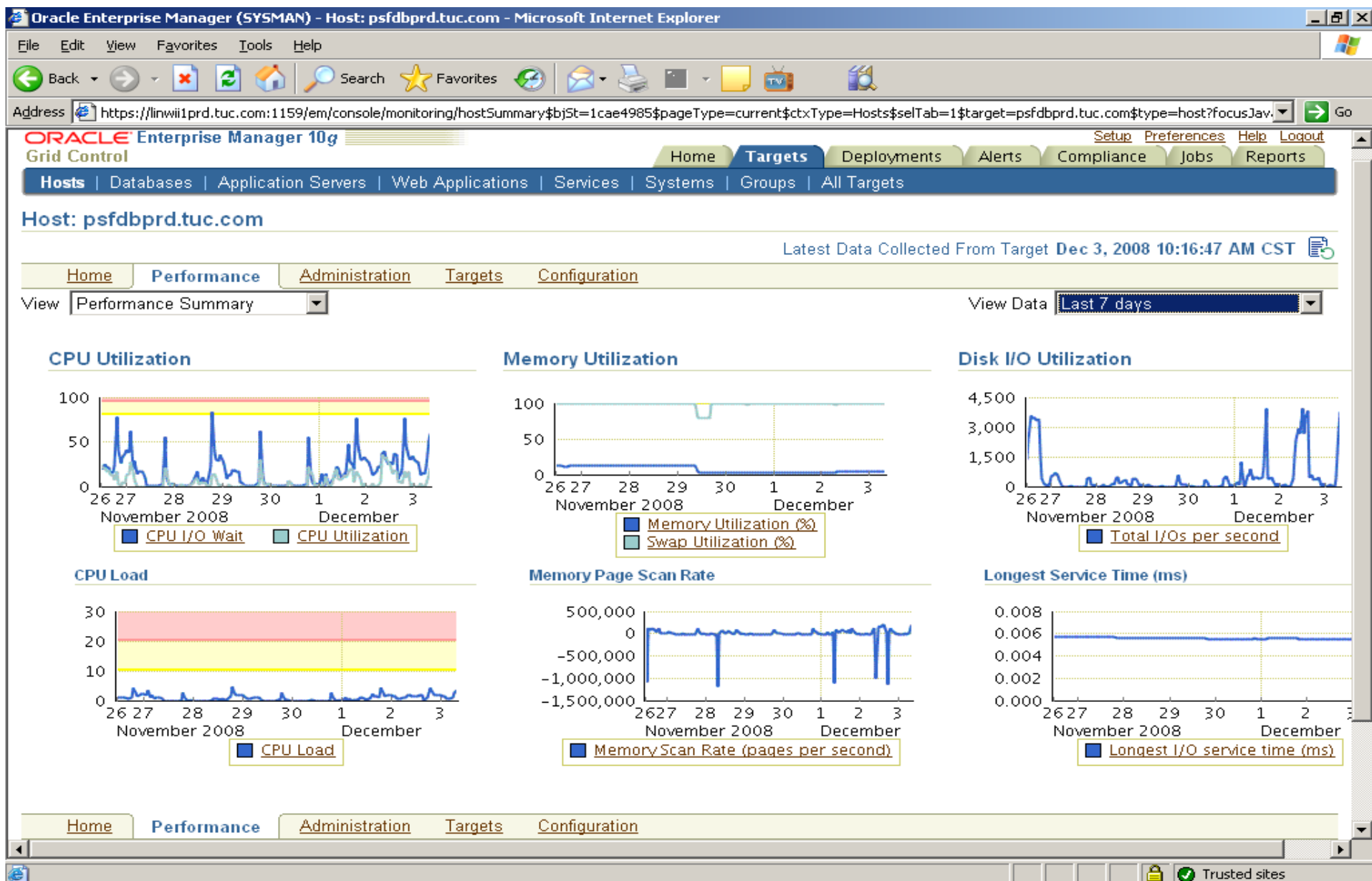
Database Monitoring

- What:
 - Database up and down
 - Database alert log error
 - Database directory usage (archive log, software)
 - Database backup status
 - Tablespace space usage
 - Database listener up and down
- How:
 - K-shell scripting integrated with NSM
 - Oracle Enterprise Manager (OEM)/Grid Control

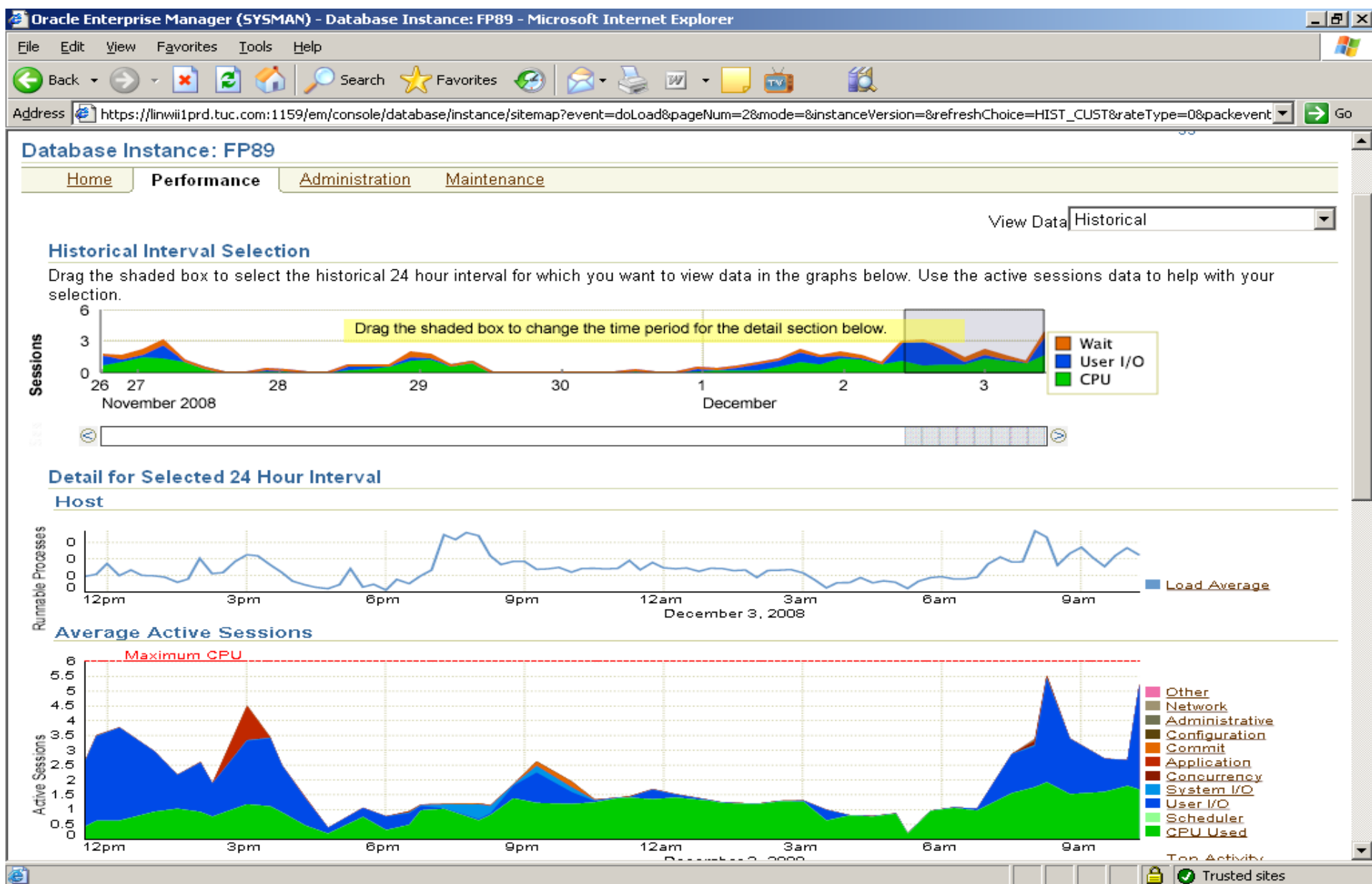
Oracle Enterprise Manager (OEM) / Grid Control



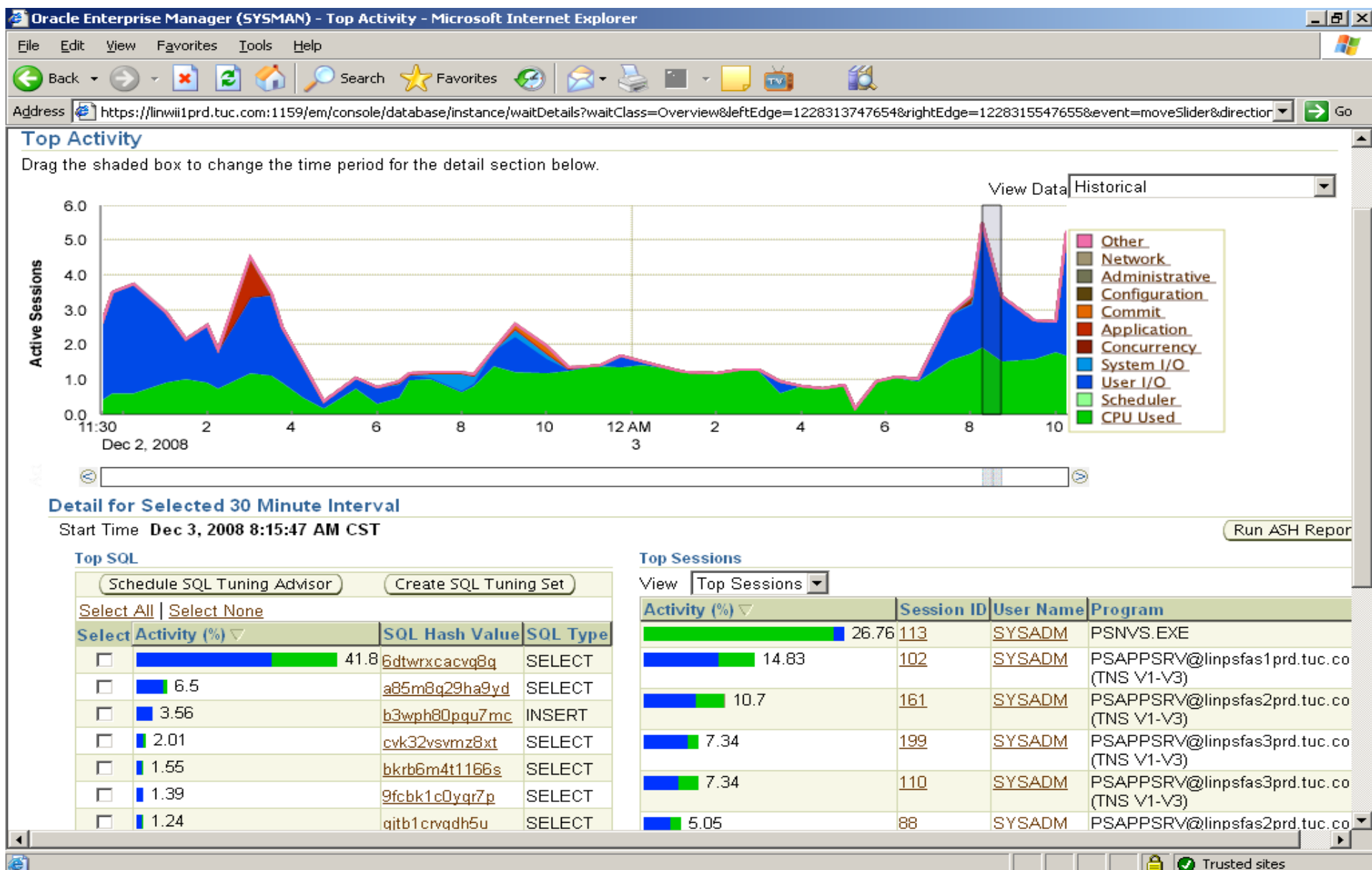
OEM/Grid Control – Server Performance



OEM/Grid Control – Database Performance



OEM/Grid Control – Top Activity



OEM/Grid Control – Top SQL

Oracle Enterprise Manager (SYSMAN) - SQL Details: 6dtwrxcacvq8q - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Refresh Print Mail New Window TV Find

Address https://linwii1prd.tuc.com:1159/em/console/database/instance/sqlDetail?event=doLoad&target=FP89&type=oracle_database&sql_id=6dtwrxcacvq8q&planHashValue=-1&refreshCh Go

```
SELECT 'X' from PS_ITEM_ACTIVITY WHERE BUSINESS_UNIT = :1 and CUST_ID = :2 and ITEM = :3 and ITEM_LINE = :4 and (GROUP_TYPE = 'R' or GROUP_TYPE = 'C') and ITEM_SEQ_NUM = 1
```

Details

Select the plan hash value to see the details below. Plan Hash Value

[Statistics](#) [Activity](#) [Plan](#) [Tuning Information](#)

Summary

Drag the shaded box to change the time period for the detail section below.

Active Sessions

9:56 12 PM 2 4 6 8 10 12 AM 2 4 6 8 10
Dec 2, 2008 3

latch: cache buffers chains
read by other session
db file sequential read
CPU Used

Detail for Selected 30 Minute Interval

Start Time **Dec 3, 2008 8:15:47 AM** [Run ASH Report](#)

Activity (%)	SID	User	Program	Service	Plan Hash Value
32.94	102	SYSADM	PSAPPSRV@linpsfas1prd.tuc.com (TNS V1-V3)	FP89	2506457568
19.71	161	SYSADM	PSAPPSRV@linpsfas2prd.tuc.com (TNS V1-V3)	FP89	2506457568
13.82	199	SYSADM	PSAPPSRV@linpsfas3prd.tuc.com (TNS V1-V3)	FP89	2506457568
13.24	110	SYSADM	PSAPPSRV@linpsfas3prd.tuc.com (TNS V1-V3)	FP89	2506457568
8.82	210	SYSADM	PSAPPSRV@linpsfas3prd.tuc.com (TNS V1-V3)	FP89	2506457568
8.53	88	SYSADM	PSAPPSRV@linpsfas2prd.tuc.com (TNS V1-V3)	FP89	2506457568
2.35	200	SYSADM	PSAPPSRV@linpsfas3prd.tuc.com (TNS V1-V3)	FP89	2506457568

Trusted sites

OEM/Grid Control – SQL Tuning

Oracle Enterprise Manager (SYSMAN) - SQL Details: 6dtwrxcacvq8q - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Refresh Mail Print Write New Folder TV

Address https://linwii1prd.tuc.com:1159/em/console/database/instance/sqlDetail?event=doLoad&target=FP89&type=oracle_database&sql_id=6dtwrxcacvq8q&planHashValue=2506457568 Go

ORACLE Enterprise Manager 10g

Grid Control

Home **Targets** Deployments Alerts Compliance Jobs Reports

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

Database Instance: FP89 > [Top Activity](#) > [SQL Details: 6dtwrxcacvq8q](#) Logged in As SYSTEM

Switch to SQL ID View Data

Text

```
SELECT 'X' from PS_ITEM_ACTIVITY WHERE BUSINESS_UNIT = :1 and CUST_ID = :2 and ITEM = :3 and ITEM_LINE = :4 and (GROUP_TYPE = 'R' or GROUP_TYPE = 'C') and ITEM_SEQ_NUM = 1
```

Details

Select the plan hash value to see the details below. Plan Hash Value

[Statistics](#) [Activity](#) **Plan** [Tuning Information](#)

Data Source [Snapshot \(24943\)](#) Capture Time **Dec 3, 2008 10:15:47 AM** Parsing Schema **SYSADM** Optimizer Mode **ALL_ROWS**

View ☐ Graph ☒ Table

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

Operation	Object	Object Type	Order	Rows	Size (KB)	Cost	Time (sec)	CPU Cost	I/O Cost
SELECT STATEMENT			3	0	0.000	4	0	0	0
TABLE ACCESS BY INDEX ROWID	PS_ITEM_ACTIVITY	TABLE	2	1	0.029	4	1	29,679	4
INDEX RANGE SCAN	PSAITEM_ACTIVITY	INDEX	1	1	0.000	3	1	21,564	3

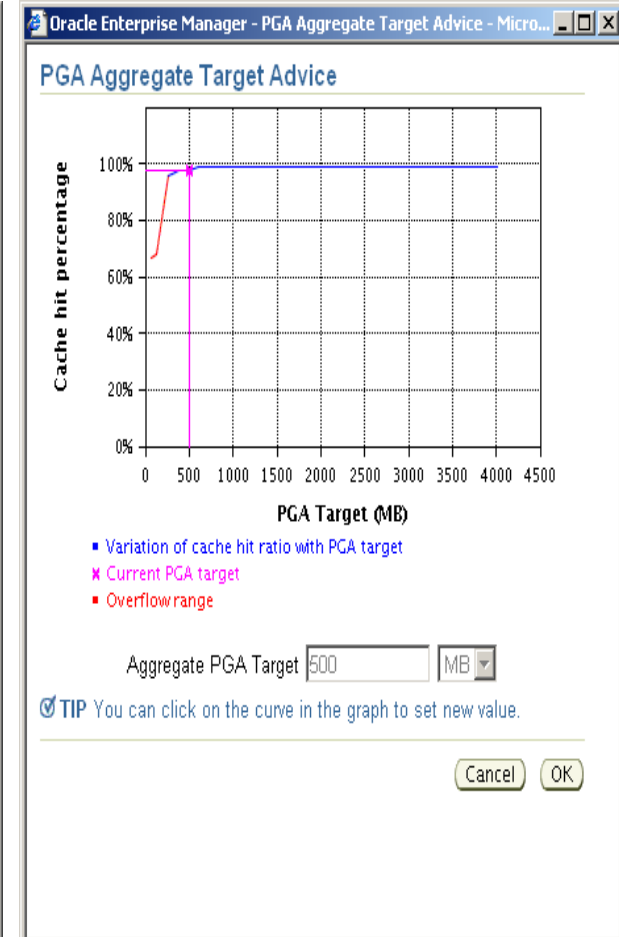
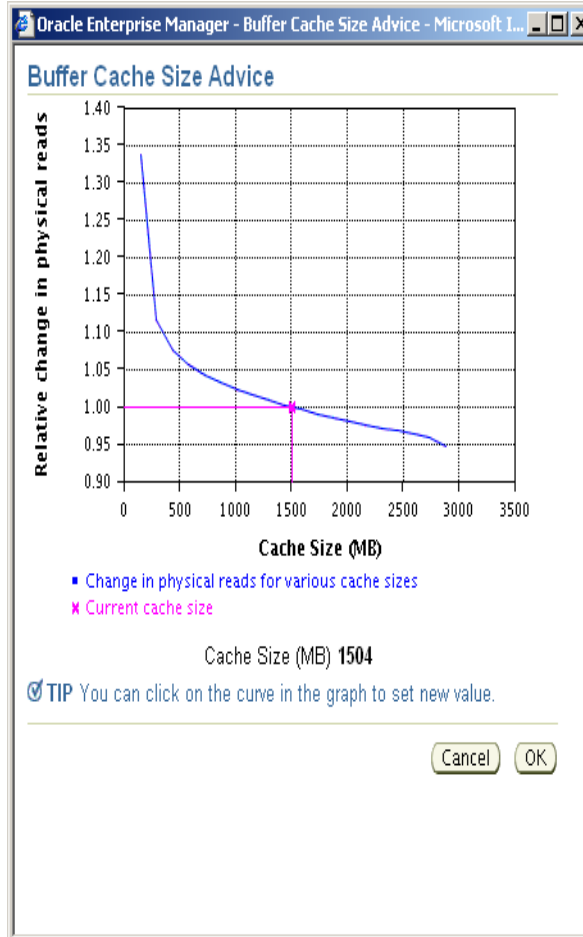
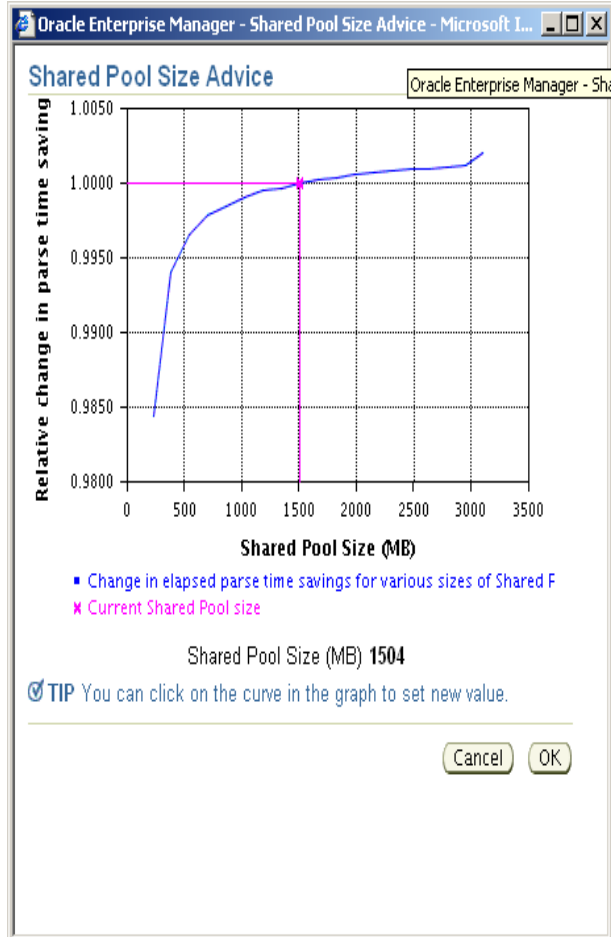
[Show Explain Rewrite](#)

[Statistics](#) [Activity](#) **Plan** [Tuning Information](#)

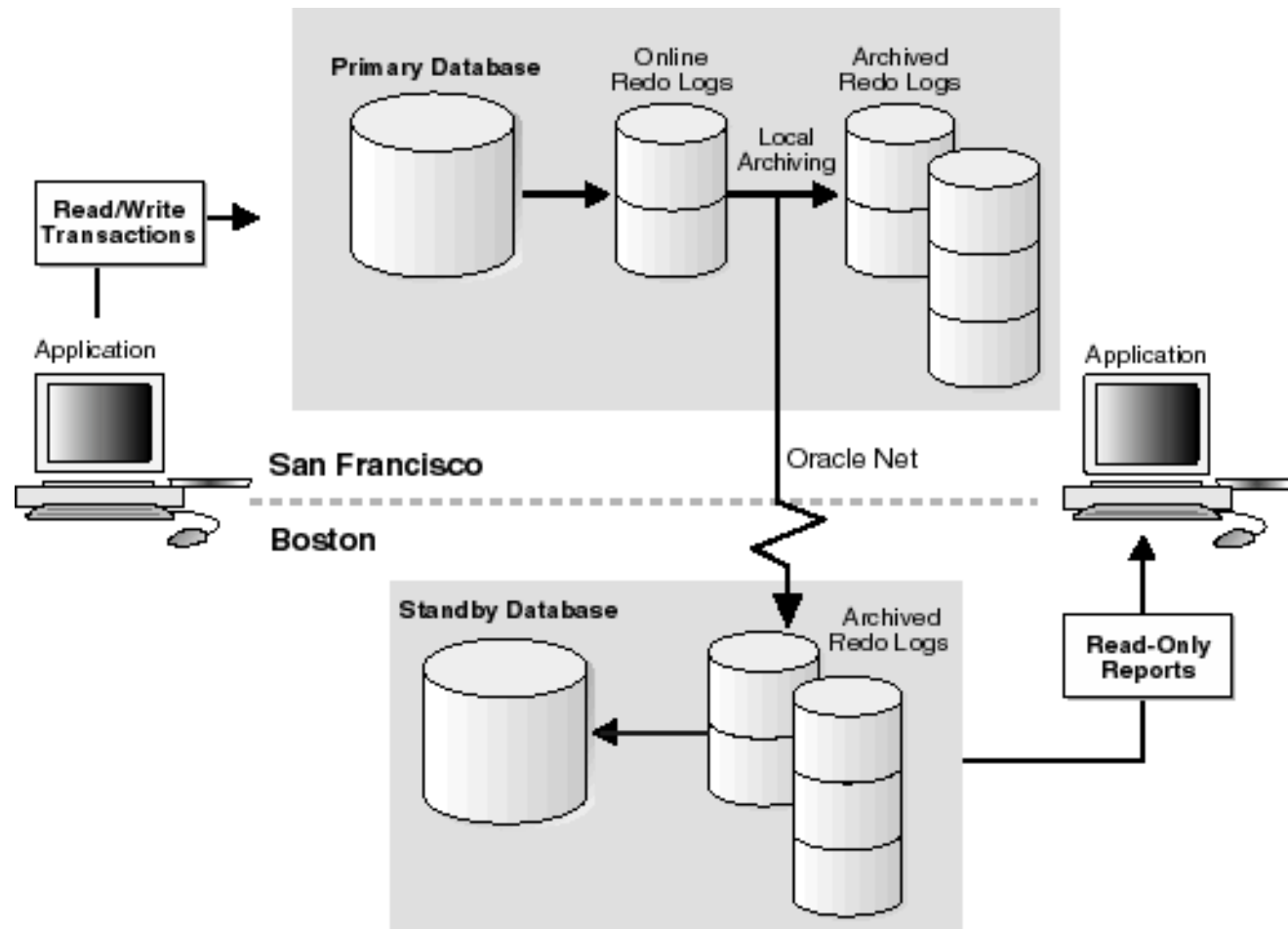
Home | **Targets** | [Deployments](#) | [Alerts](#) | [Compliance](#) | [Jobs](#) | [Reports](#) | [Setup](#) | [Preferences](#) | [Help](#) | [Logout](#)

Trusted sites

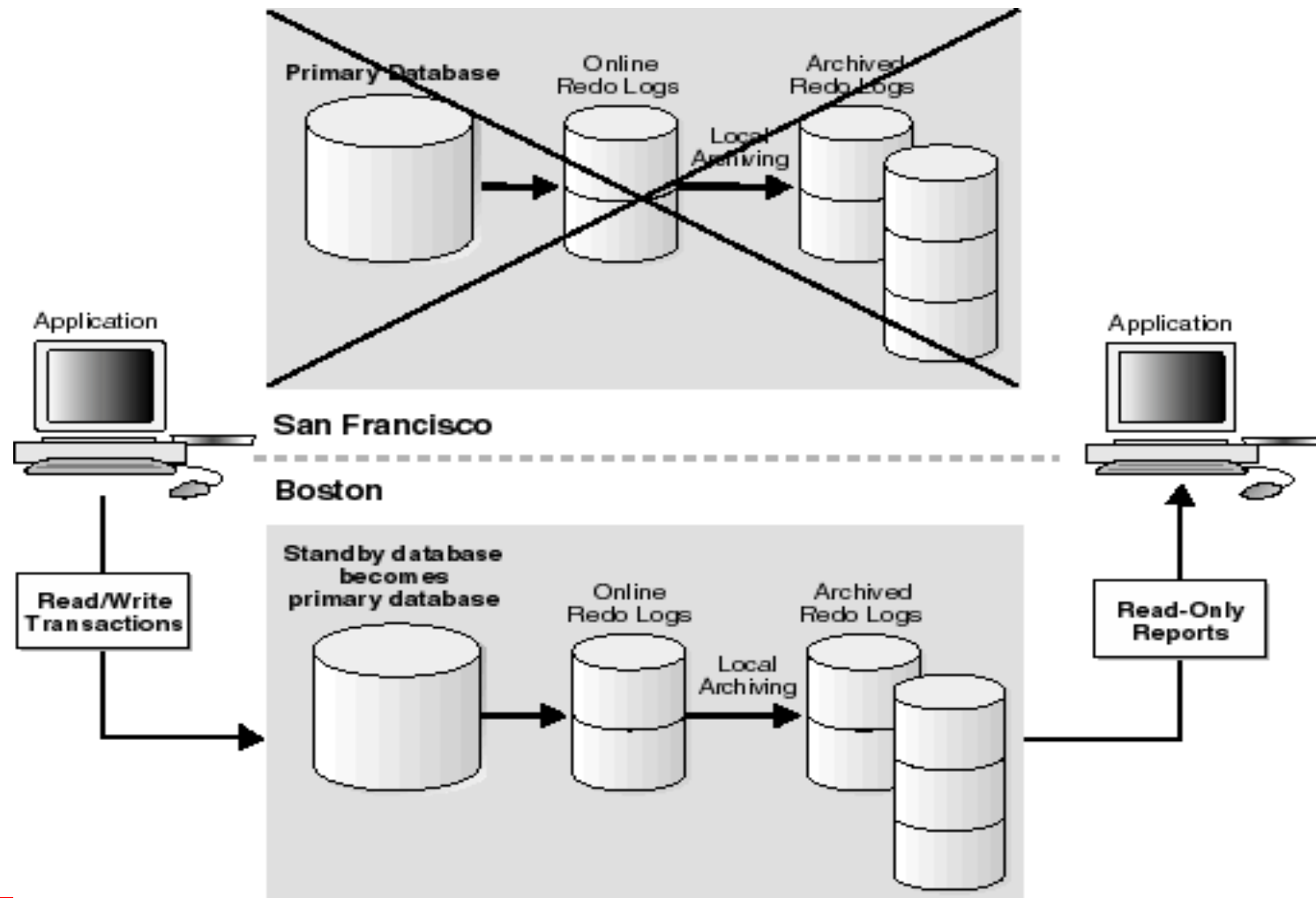
OEM/Grid Control – Memory Advice



High Availability – Standby Database

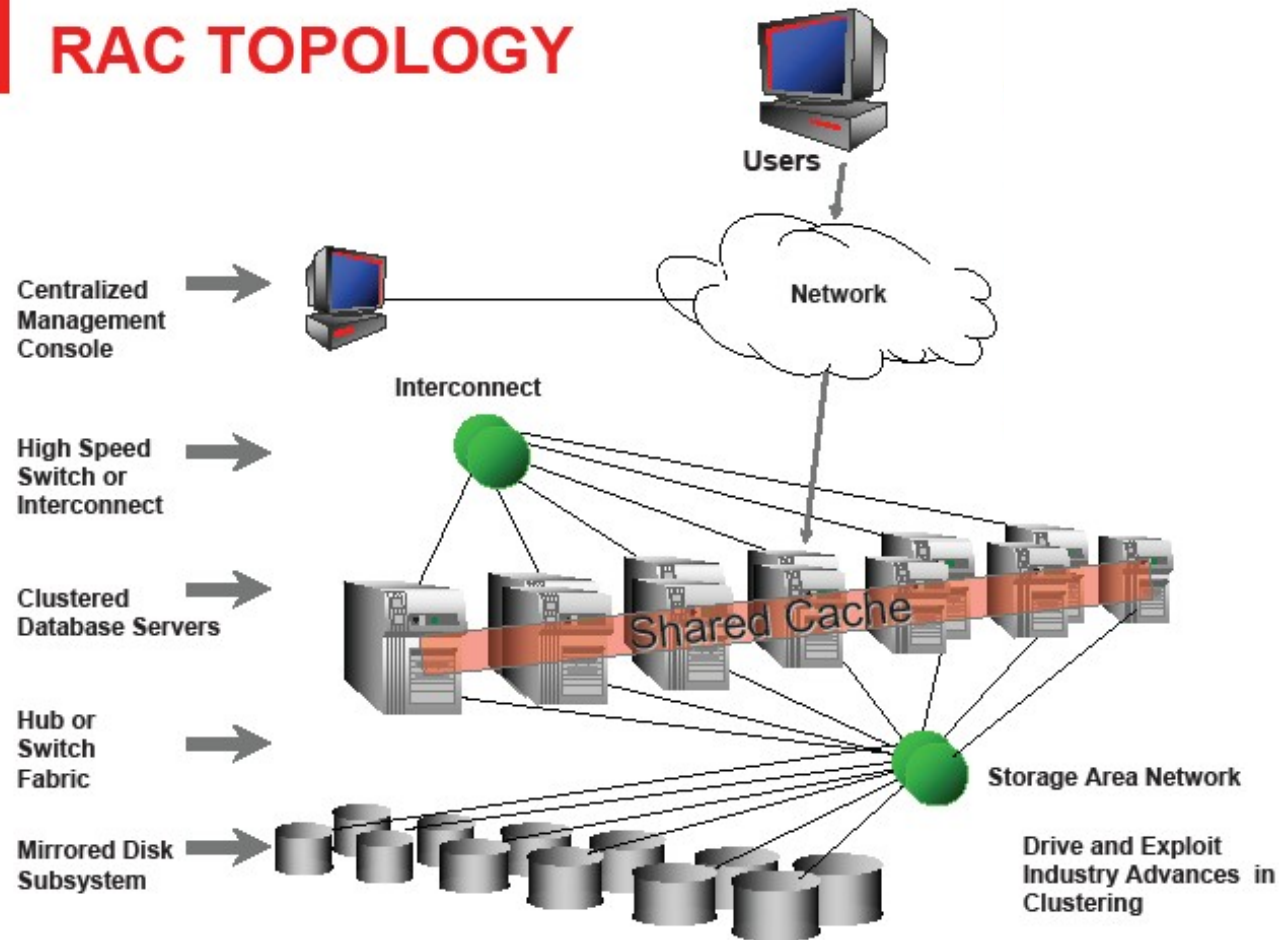


High Availability – Standby Database Failover



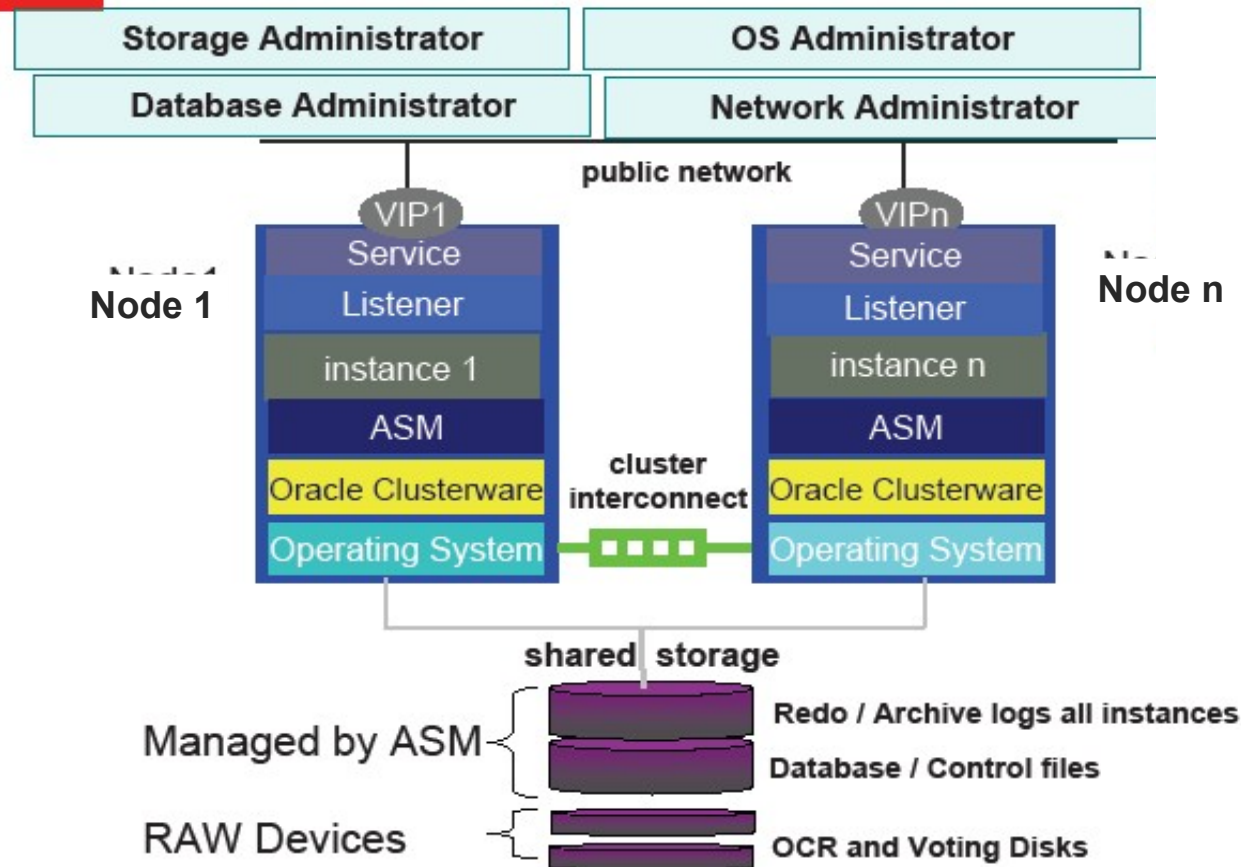
High Availability – Real Application Cluster

RAC TOPOLOGY



High Availability – Real Application Cluster

The RAC Team



High Availability – Real Application Cluster



Network

Interconnect Configuration

- Use UDP over Gigabit Ethernet
- OS Bonding/teaming to “virtualize” interconnect
 - Bond two or more GigE cards for performance reasons
 - Failover & Load-balancing & Improved bandwidth
- Set UDP send/receive buffers high enough
 - Platform dependant – typically 256K is adequate
 - `net.core.rmem_max, net.core.wmem_max, net.core.rmem_default, net.core.wmem_default`
- Use a Switch
 - crossover cable **not** supported

High Availability – Real Application Cluster

OS Configuration

OS Pre Install Configuration Items

- Validate compatibility matrix for RAC
- Configure Public IP
- Configure Private IP (172.16.* or 192.168.* or 10.10.*)
- Configure Virtual IP on DNS or /etc/hosts only
- Check ping from all nodes to all nodes from both public and private IP's
- Configure the Hangcheck Timer on all nodes
- Configure SSH
- Configure User Equivalence
- Install and Configure ASMLib
- Configure Raw Devices or OCFS2 for OCR/Voting/ASM spfile

A large, stylized graphic featuring a black 'Q' and a black 'A' with a red ampersand in the center. Overlaid on this graphic are the words 'QUESTIONS' and 'ANSWERS' in a bold, sans-serif font. 'QUESTIONS' is in blue and 'ANSWERS' is in yellow, both with black outlines.

QUESTIONS ANSWERS