Exadata Demystified

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(and now DMA)

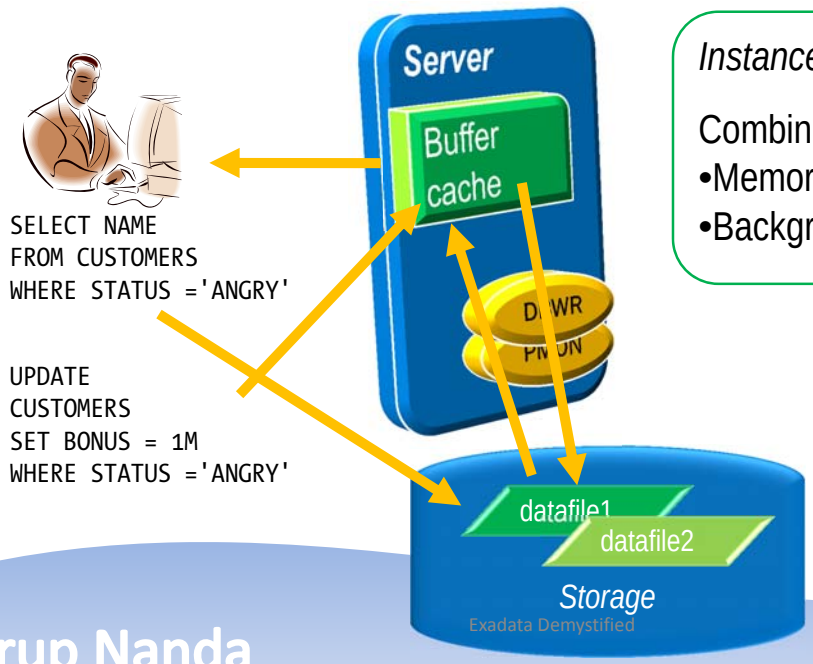
Why this Session?

- If you are
  - an Oracle DBA
    - Familiar with RAC, 11gR2 and ASM
  - about to be a Database Machine Administrator (DMA)
- How much do you have to learn?
- How much of you own prior knowledge I can apply?
- What's different in Exadata?
- What makes it special, fast, efficient?
- Do you have to go through a lot of training?

What is Exadata

- Is an *appliance* containing
  - Storage, Flash Disks, Database Servers, Infiniband Switches, Ethernet Switches, KVM (some models)
- But is *not* an appliance. Why?
  - additional software to make it a better database machine
  - Components can be managed independently
- That's why Oracle calls it a **Database Machine** (DBM)
- And **DMA** – Database Machine Administrator

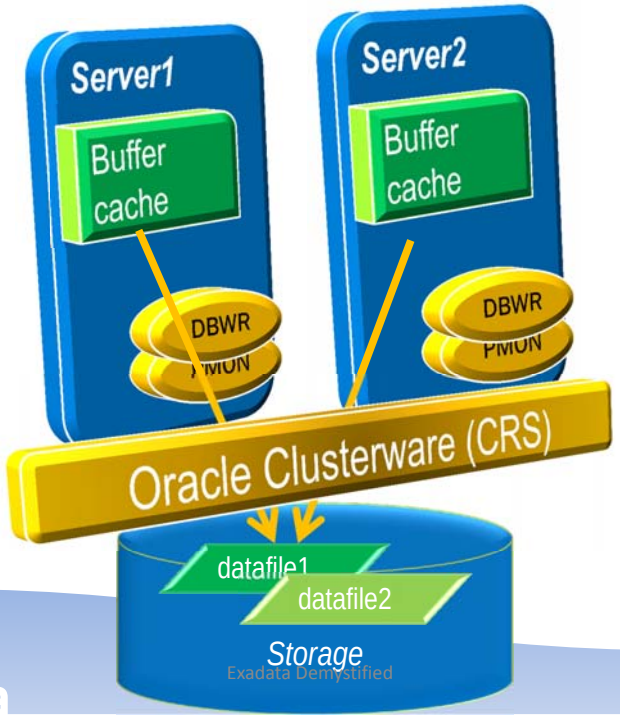
Anatomy of an Oracle Database



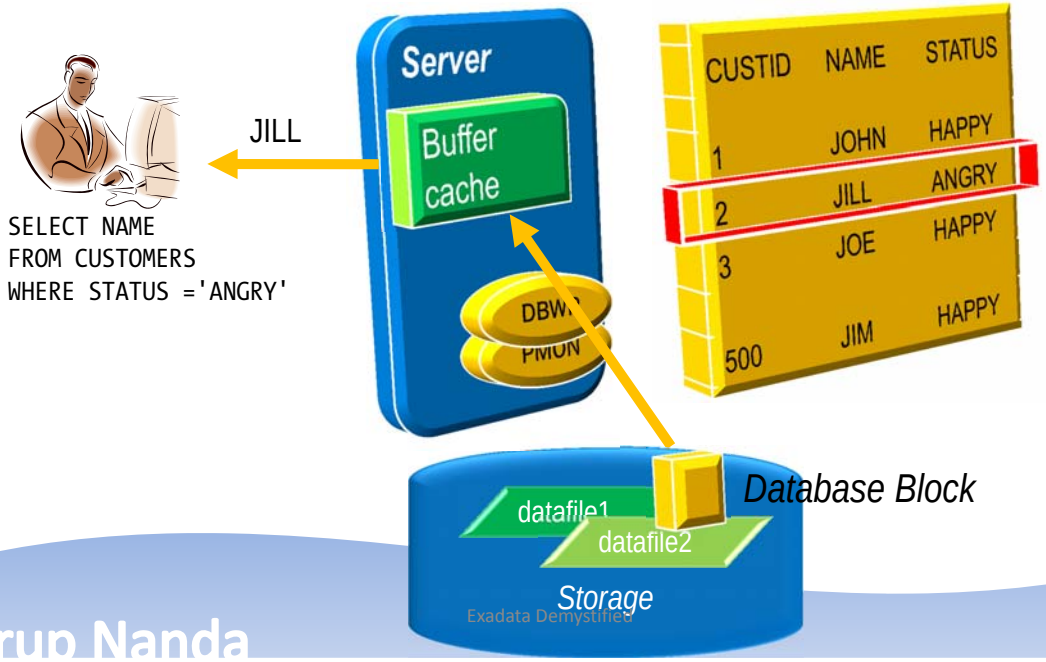
Instance

Combination of
- Memory Areas
- Background Processes

RAC Database



Query Processing



Components for Performance

- CPU
- Memory
- Network
- I/O Controller
- Disk

Less I/O = better performance

What about SAN Caches?

- Success of SAN caches is built upon predictive analytics
- They work well, if a small percentage of *disk* is accessed most often
  - The emphasis is on *disk*; not *data*
- Most database systems
  - are way bigger than caches
  - need to get the data to the memory to process
    --> I/O at the disk level is still high
- Caches are excellent for filesystems
  ➔ or very small databases

What about In-Memory DBs

- Memory is still more expensive
- How much memory is enough?
- You have a 100 MB database and 100 MB buffer cache
- The whole database will fit in the memory, right?
- NO!
- Oracle database fills up to 7x DB size buffer cache

http://arup.blogspot.com/2011/04/can-i-fit-80mb-database-completely-in.html

The Solution

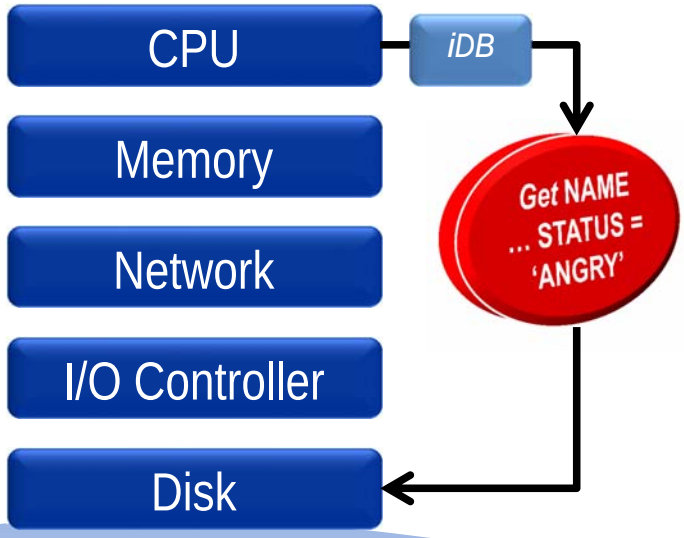
- A typical query may:
  - Select 10% of the entire storage
  - Use only 1% of the data it gets
- To gain performance, the DB needs to shed weight
- It has to get less from the storage
  - → Filtering at the storage level
  - → The storage must be cognizant of the data

```
SELECT NAME
FROM CUSTOMERS
WHERE STATUS ='ANGRY'
```

→ ***Filtering should be Applied Here***

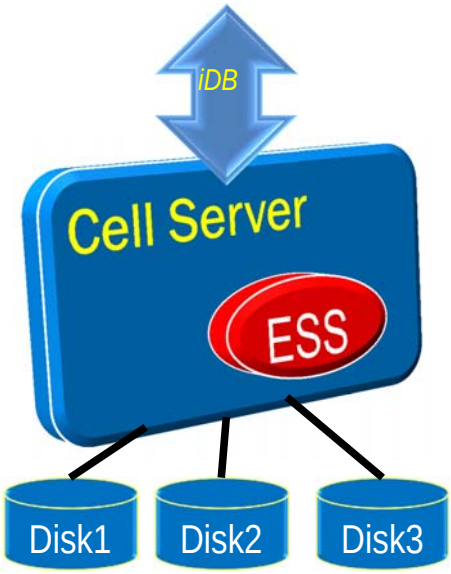
CPU
Memory
Network
I/O Controller
Disk

The Magic #1



The communication between CPU and Disk carries the information on the query – columns and predicates. This occurs as a result of a special protocol called iDB.

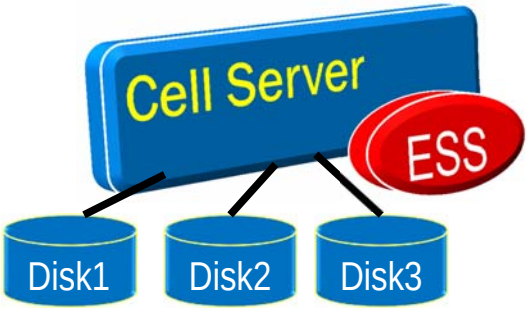
Magic #2 Storage Cell Server



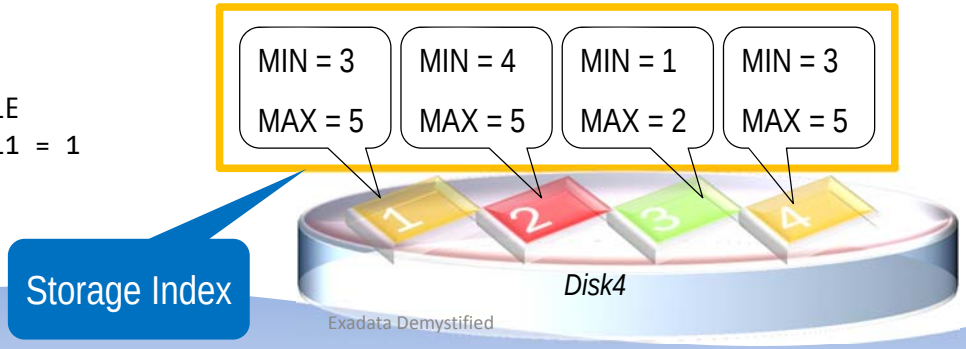
- Cells are Sun Blades
- Run Oracle Enterprise Linux
- Software called Exadata Storage Server (ESS) which understands iDB

Magic #3 Storage Indexes

Storage Indexes store in memory of the Cell Server the areas on the disk and the MIN/MAX value of the column and whether NULL exists. They eliminate disk I/O.




```
SELECT …
FROM TABLE
WHERE COL1 = 1
```



Checking Storage Index Use

```
select name, value/1024/1024 as stat_value
from v$mystat s, v$statname n
where s.statistic# = n.statistic#
and n.name in (
  'cell physical IO bytes saved by storage index',
  'cell physical IO interconnect bytes returned by smart
  scan’)
```

Output

```
STAT_NAME   STAT_VALUE
---------- ----------
SI Savings    5120.45
Smart Scan    1034.00
```

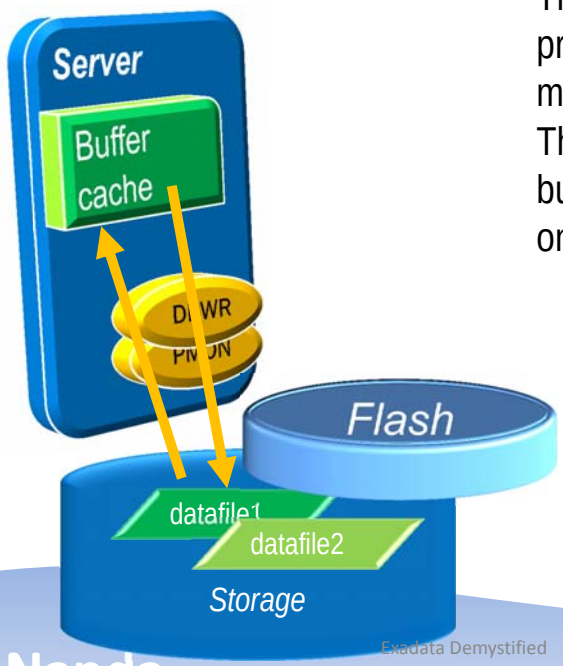
Why Not?

- Pre-requisite for Smart Scan
  - Direct Path
  - Full Table or Full Index Scan
  - > 0 Predicates
  - Simple Comparison Operators
- Other Reasons
  - Cell is not offload capable
    - The diskgroup attribute cell.smart_scan_capable set to FALSE;
  - Not on clustered tables, IOTs, etc.

Disabling Smart Scans

```
cell_offload_processing =
true;
_kcfis_storageidx_disable
d = true;
```


Magic #4 Flash Cache

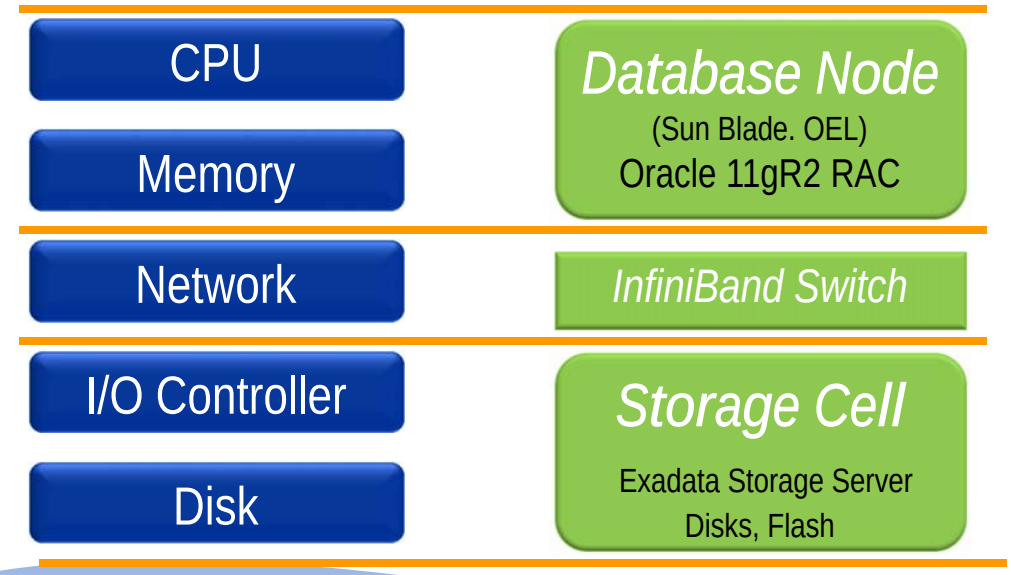


These are flash cards presented as disks; not memory to the Storage Cells. They are similar to SAN cache; but Oracle controls what goes on there and how long it stays.

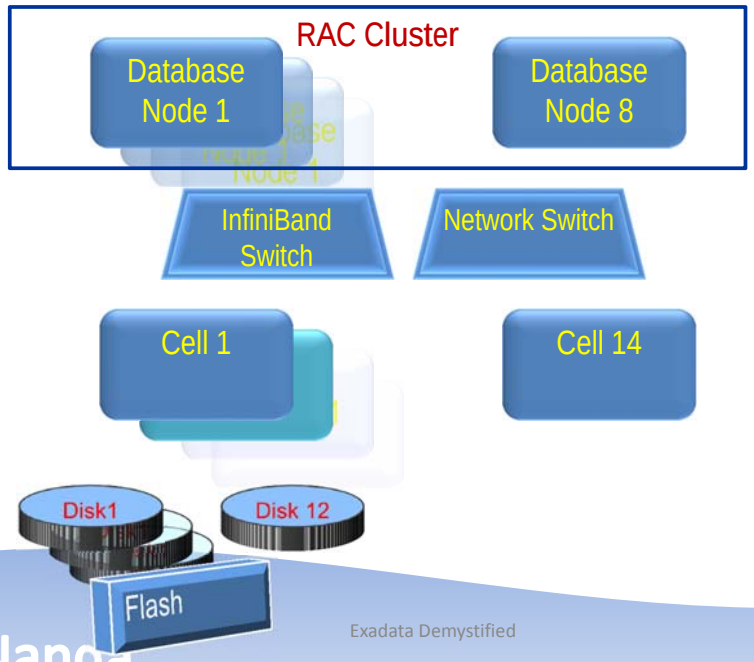
Magic #5 Process Offloading

- Bloom Filters
- Functions Offloading
  - Get the functions that can be offloaded
    - `V$SQLFN_METADATA`
- Decompression
  - (Compression handled by Compute Nodes)
- Virtual Columns

Components

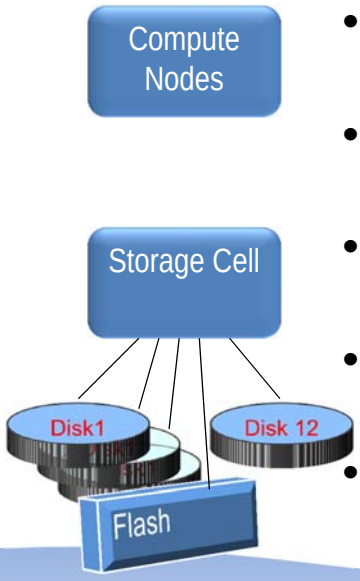


Put Together: One Full Rack



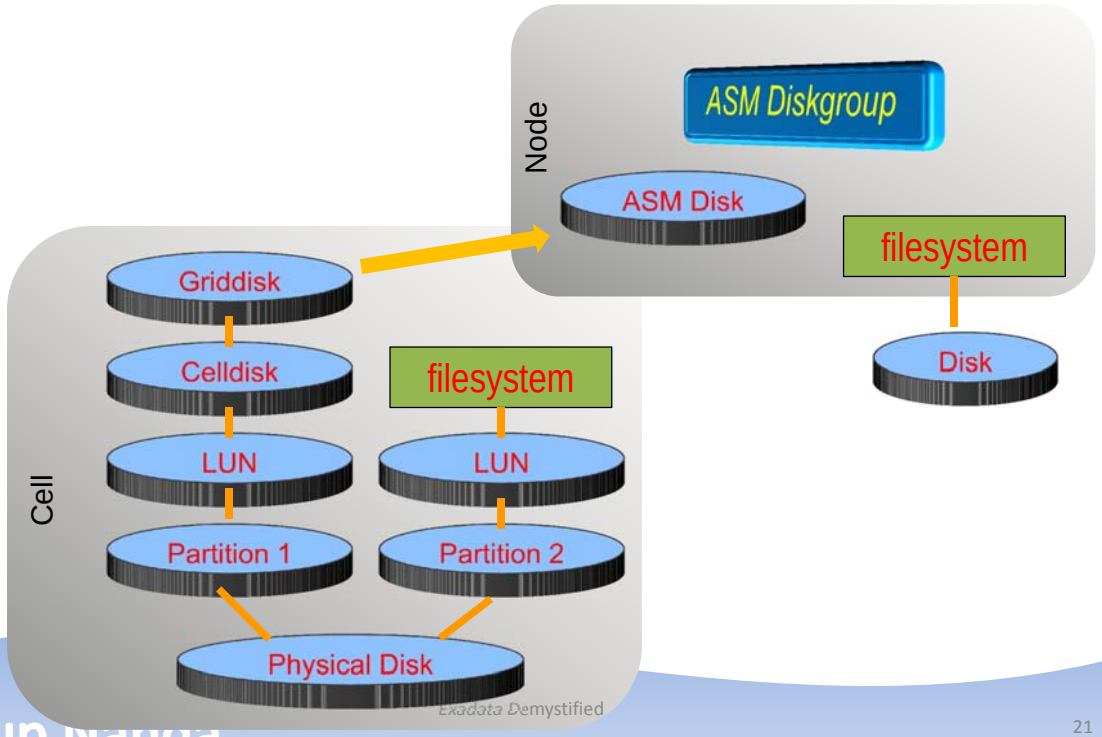
Clients connect to the database nodes.

Disk Layout

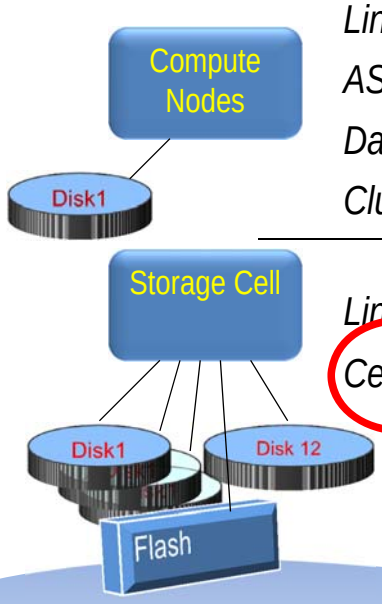


- Disks (hard and flash) are connected to the cells.
- The disks are partitioned at the cell
- Some partitions are presented as filesystems
- The rest are used for ASM diskgroups
- All these disks/partitions are presented to the compute nodes

Disk Presentation



Command Components



Linux Commands – vmstat, mpstat, fdisk, etc.

*ASM Commands – SQL*Plus, ASMCMD, ASMCA*

Database Commands – startup, alter database, etc.

Clusterware Commands – CRSCTL, SRVCTL, etc.

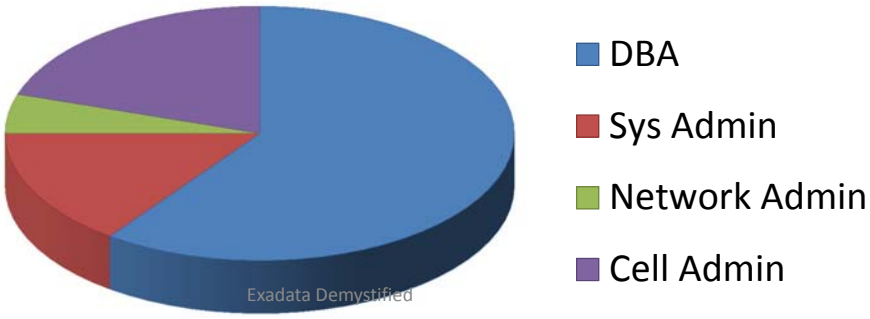
Linux Commands – vmstat, mpstat, fdisk, etc.

CellCLI – command line tool to manage the Cell

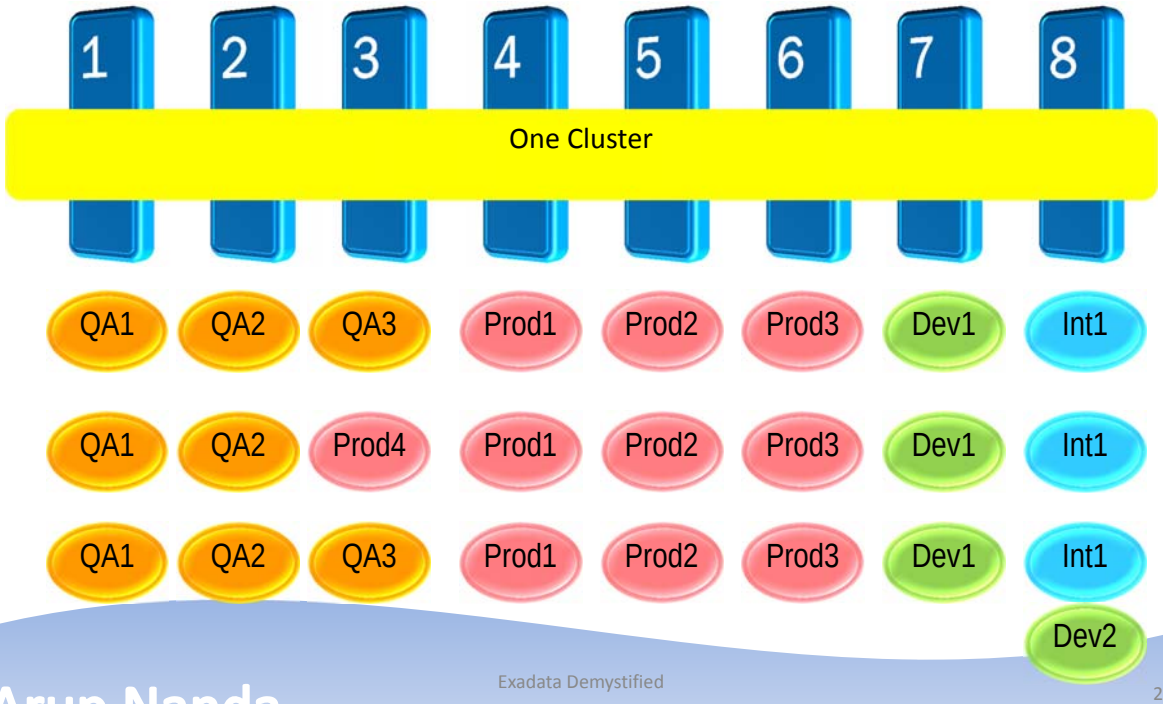
5-part Linux Commands article series
http://bit.ly/k4mKQS
4-part Exadata Command Reference article series
http://bit.ly/lljFl0

Administration Skills

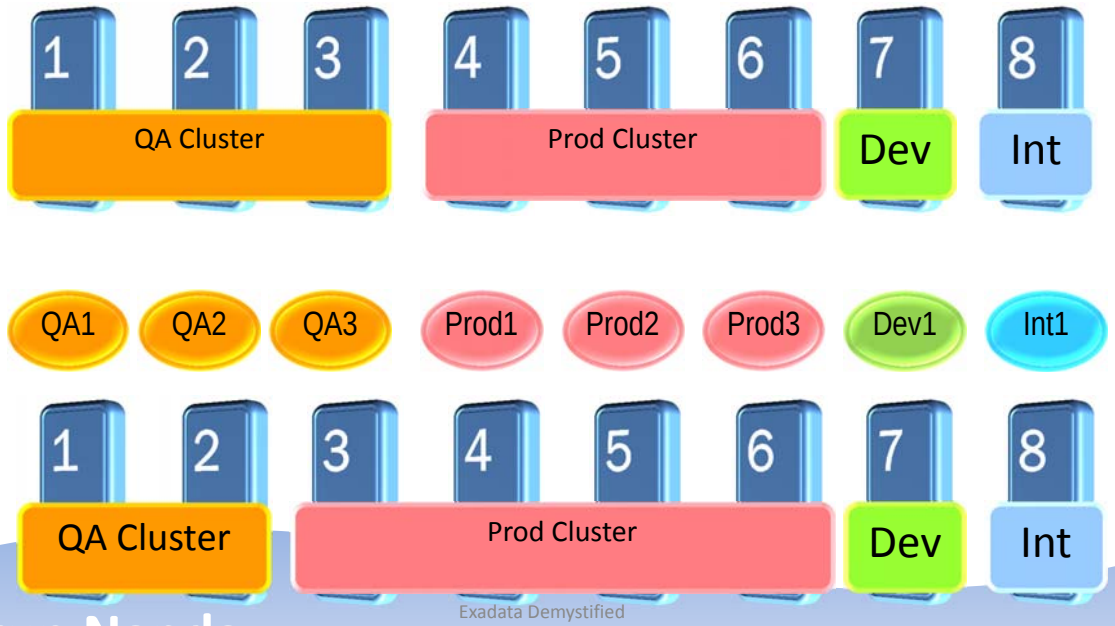
Skill	Needed
System Administrator	15%
Storage Administrator	0%
Network Administrator	5%
Database Administrator	60%
Cell Administration	20%



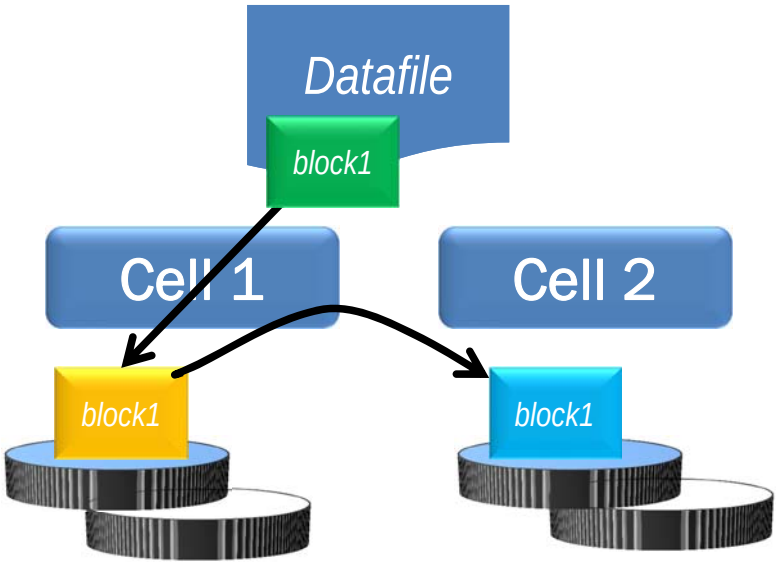
One Cluster?



Many Clusters?



Disk Failures



Other Questions

Q: Do clients have to connect using Infiniband?

A: No; Ethernet is also available

Q: How do you back it up?

A: Normal RMAN Backup, just like an Oracle Database

Q: How do you create DR?

A: Data Guard is the only solution

Q: Can I install any other software?

A: Nothing on Cells. On nodes – yes

Q: How do I monitor it?

A: Enterprise Manager, CellCLI, SQL Commands

Summary

- Exadata is an Oracle Database running 11.2
- The storage cells have added intelligence about data placement
- The compute nodes run Oracle DB and Grid Infra
- Nodes communicate with Cells using iDB which can send more information on the query
- Smart Scan, when possible, reduces I/O at cells even for full table scans
- Cell is controlled by CellCLI commands
- DMA skills = 60% RAC DBA + 15% Linux + 20% CellCLI + 5% miscellaneous

Resources

- My Articles
  - 5-part Linux Commands article series http://bit.ly/k4mKQS
  - 4-part Exadata Reference article series http://bit.ly/lljFl0
- OTN Page on Exadata
  - http://www.oracle.com/technetwork/database/exadata/index.html
- Tutorials
  - http://www.oracle.com/technetwork/tutorials/index.html
- OTN Exadata Forum
  - https://forums.oracle.com/forums/forum.jspa?forumID=829
- Exadata SIG
  - http://www.linkedin.com/groups?home=&gid=918317

Thank You!

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