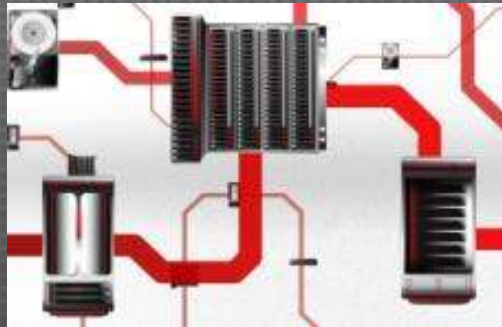# Simple
Reliable
Affordable

ORACLE®

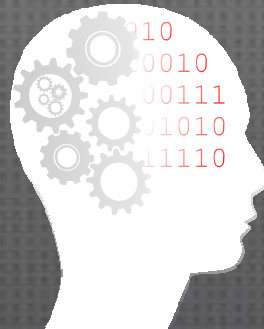# The Oracle Database Appliance I/O and Performance Architecture

Tammy Bednar, Sr. Principal Product Manager, ODA

Growing Business Critical Services and Data
High Availability Solutions Desirable

Costly and Complex

Specific Skills Required

Risk of Failure

ORACLE

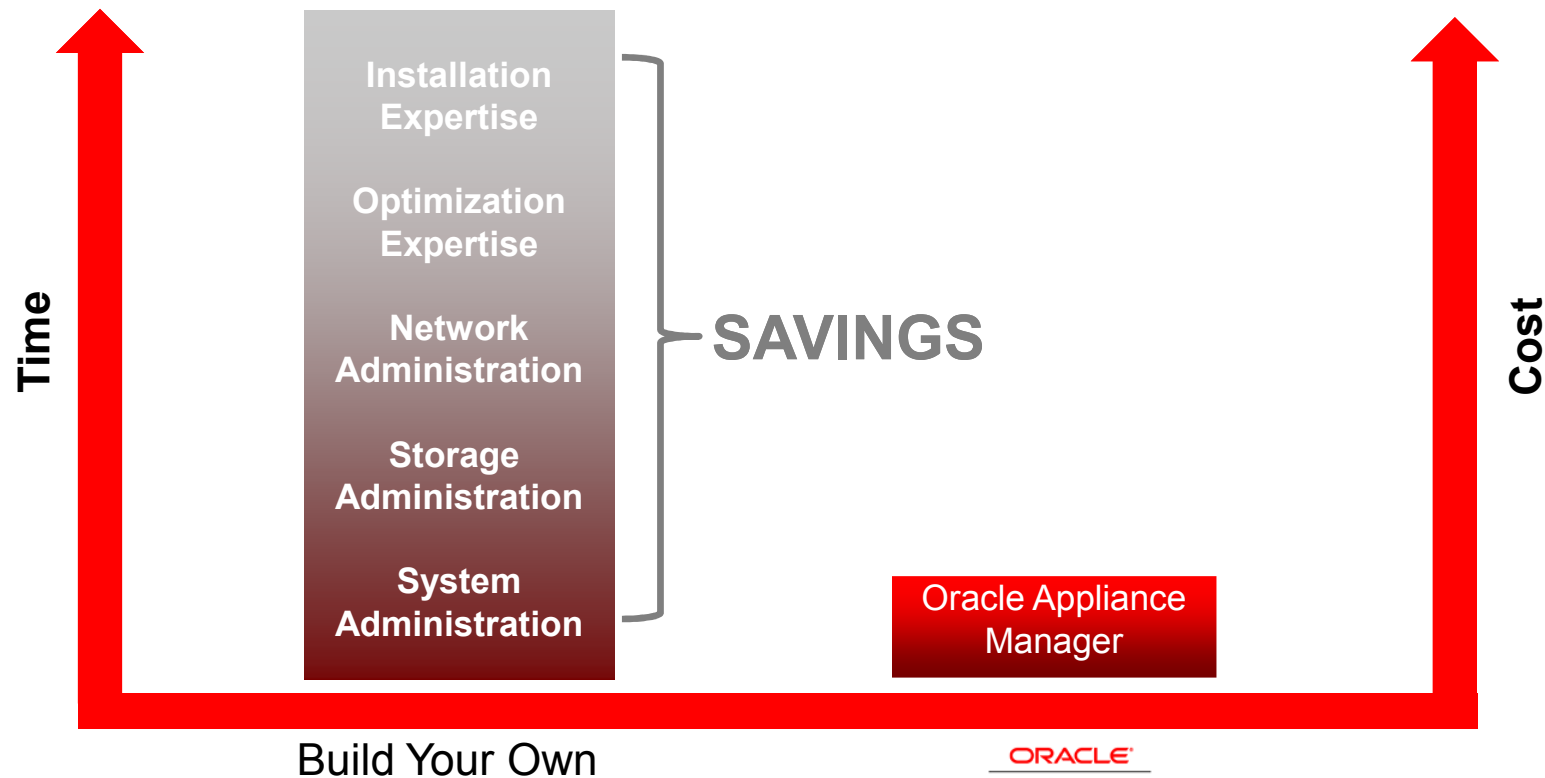# Oracle Database Appliance
Simple. Reliable. Affordable.

Simple.

Simple to Install, Manage and Maintain

Time

Installation Expertise

Optimization Expertise

Network Administration

SAVINGS

Storage Administration

System Administration

Oracle Appliance Manager

Cost

Build Your Own

ORACLE
DATABASE APPLIANCE

ORACLE

Rapidly Deploy A Database Cluster
Simple to Install
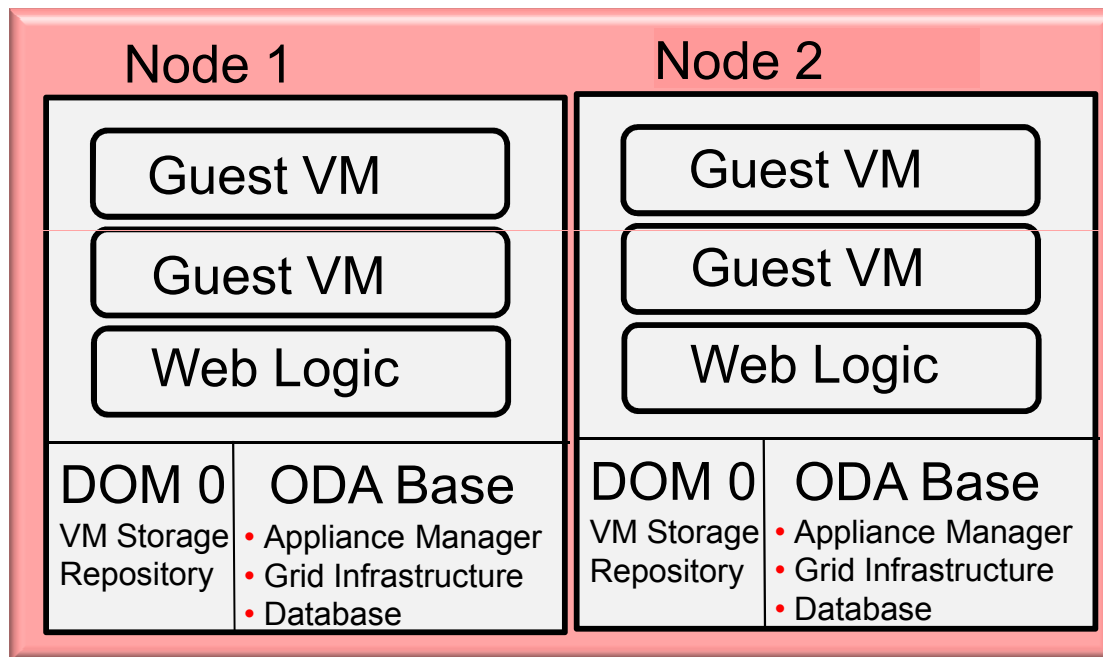
Rack the system

Cable the system

Wizard-driven install

ORACLE

Bare Metal or Virtualized?

How does the Virtualized Platform work?

Oracle Database Appliance

Node 1	Node 2
Guest VM	Guest VM
Guest VM	Guest VM
Web Logic	Web Logic

DOM 0	ODA Base	DOM 0	ODA Base
VM Storage Repository	• Appliance Manager • Grid Infrastructure • Database	VM Storage Repository	• Appliance Manager • Grid Infrastructure • Database

- Database runs in the 'ODA Base' domain with access to shared storage
- Oracle Web Logic templates provide application HA
- Domains provide application isolation
- Appliance Manager provides:
  - VM Template and Domain management

ORACLE

Oracle Database Appliance
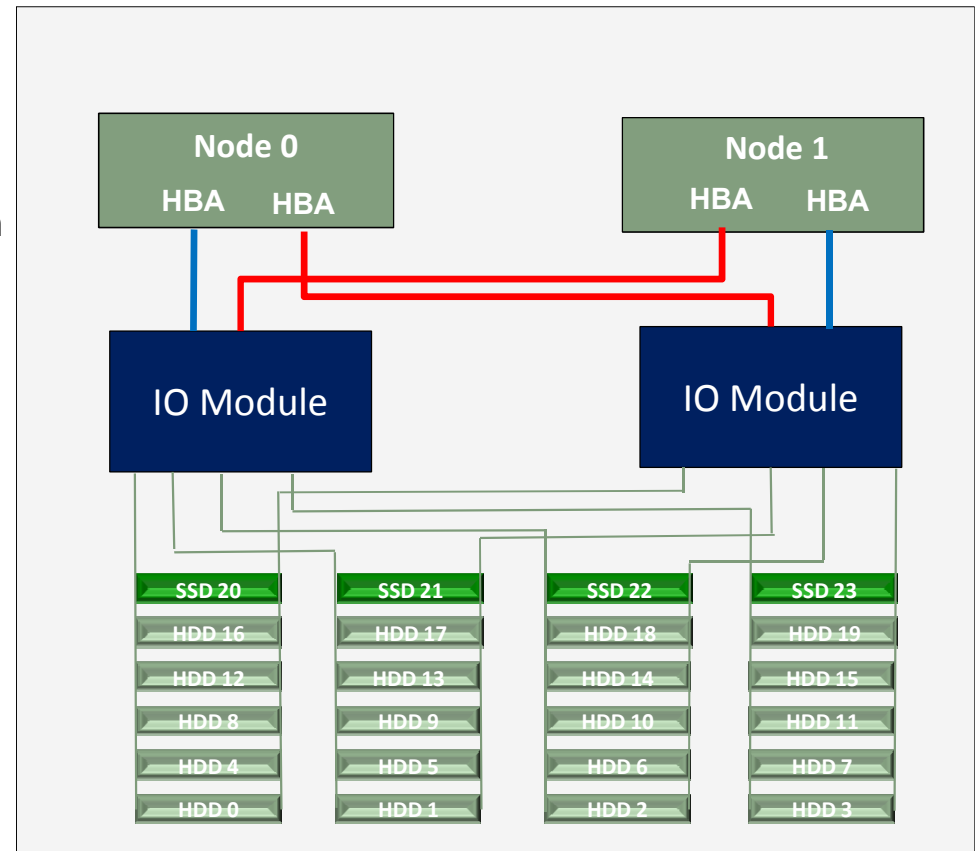## Simple. Reliable. Affordable.

ORACLE®
DATABASE APPLIANCE

Reliable.

ORACLE

Fully Redundant Hardware

- Two dual-socket Oracle Linux servers

- Redundant 10GBase-T interconnect

- Double-mirroring or triple-mirroring storage redundancy

- Redundant hot-swappable power, cooling, and fans

ORACLE

ODA X3-2 Redundant Storage Architecture

- Each Server Node
  - 2x HBA
  - In case of HBA failure
    - Multipath software transparently manages both paths for the database

- Storage Shelf
  - 2x IO Modules (Controllers)
    - Each connects to all 24 HDDs to protect against failure
  - Redundant HDDs and SSDs
    - ASM stripes data across HDDs to protect against failure

- Configuration
  - Load balances IO evenly across adapters and ports

Node 0		Node 1	
HBA	HBA	HBA	HBA

IO Module	IO Module

SSD 20	SSD 21	SSD 22	SSD 23
HDD 16	HDD 17	HDD 18	HDD 19
HDD 12	HDD 13	HDD 14	HDD 15
HDD 8	HDD 9	HDD 10	HDD 11
HDD 4	HDD 5	HDD 6	HDD 7
HDD 0	HDD 1	HDD 2	HDD 3

Highly Reliable Software

- Oracle Database 11*g* Enterprise Edition
  - Real Application Clusters (RAC)
  - RAC One Node
  - Single Instance

- Oracle Grid Infrastructure
  - Automatic Storage Management (ASM)
  - Oracle Clusterware

- Oracle Linux
- Oracle Appliance Manager

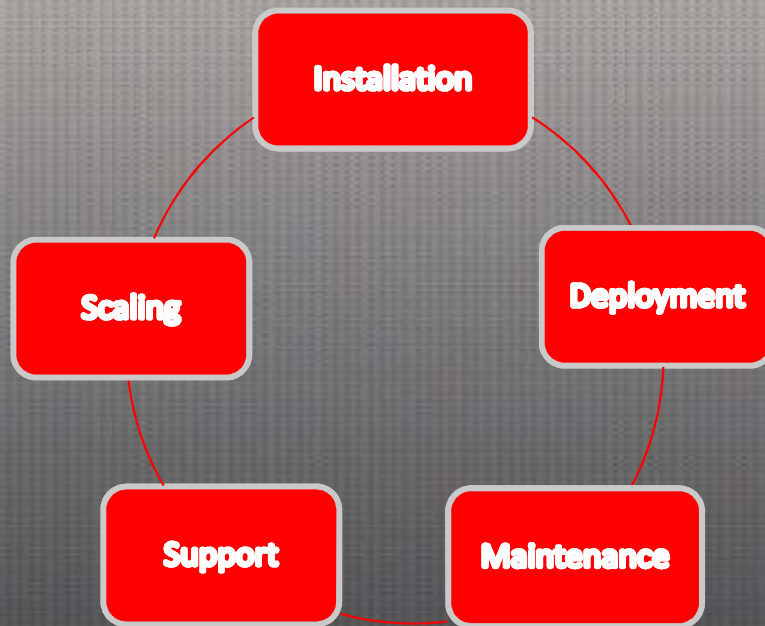ORACLE

Oracle Database Appliance
Simple. Reliable. Affordable.

ORACLE®
DATABASE APPLIANCE

Affordable.

ORACLE

What Could You Do with 2000 Extra Hours?

Installation

Deployment

Scaling

Support

Maintenance

ORCInternational

The Oracle Database Appliance simplifies time-consuming DBA tasks and saves:

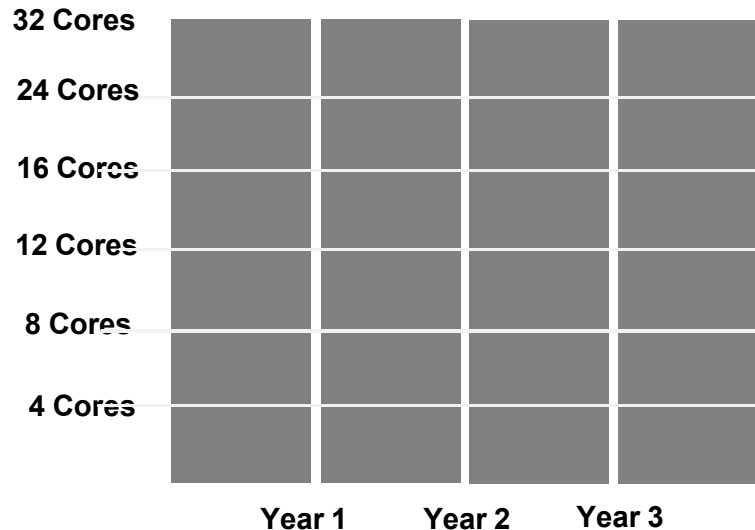**835 hours in first year**

669 hours each subsequent year

http://www.oracle.com/us/products/database/database-appliance-vs-sql-server-1434947.pdf
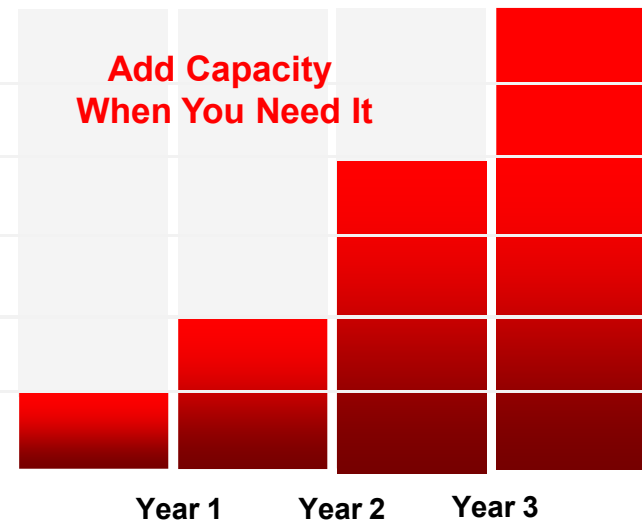
ORACLE

Capacity On Demand Licensing

Option 1: Build Your Own
License 32 Cores for Anticipated Growth

Option 2: Buy Database Appliance
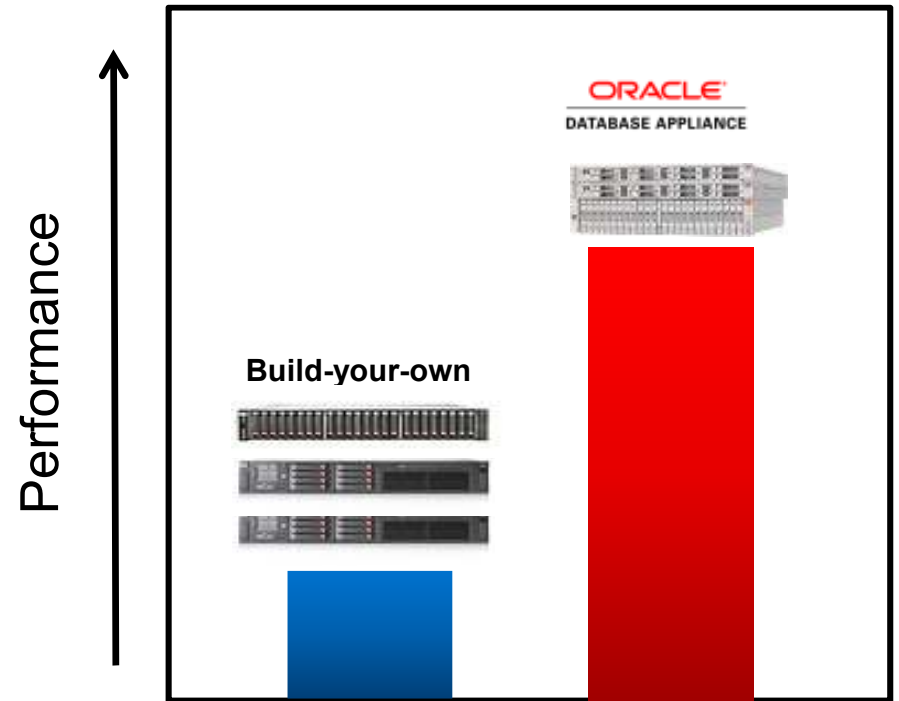*License as You Grow and Save Significantly*

32 Cores

24 Cores

Add Capacity When You Need It

16 Cores

OR

12 Cores

8 Cores

4 Cores

Year 1   Year 2   Year 3

Year 1   Year 2   Year 3

Purchase Capacity Up Front

Purchase Capacity-on-Demand

Best-in-Class Performance

Performance

ORACLE®
DATABASE APPLIANCE

Build-your-own

ORACLE

Oracle Database Appliance X3-2
Up To 2x the Performance
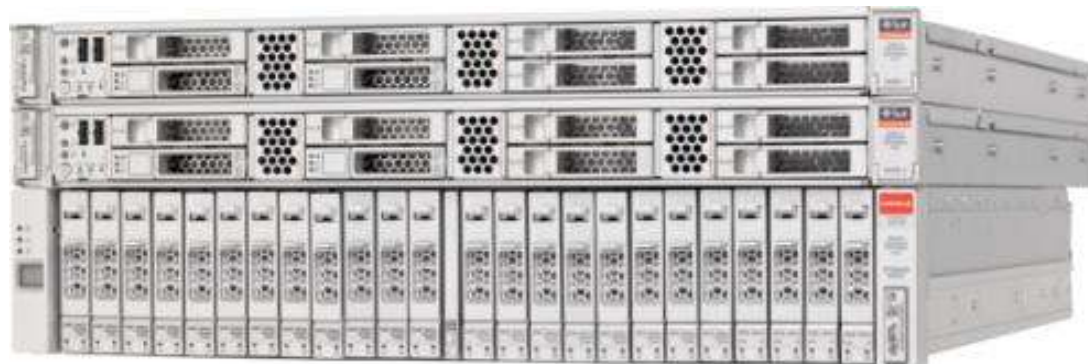
2x Processing Power

- 33% more cores: 32 Intel Xeon processor E5-2690 cores
- 2.7x the memory: 512 GB of main memory

10x Networking Bandwidth

- Redundant 10GBase-T Private Interconnect
- Four Public 10GBase-T Ethernet Ports
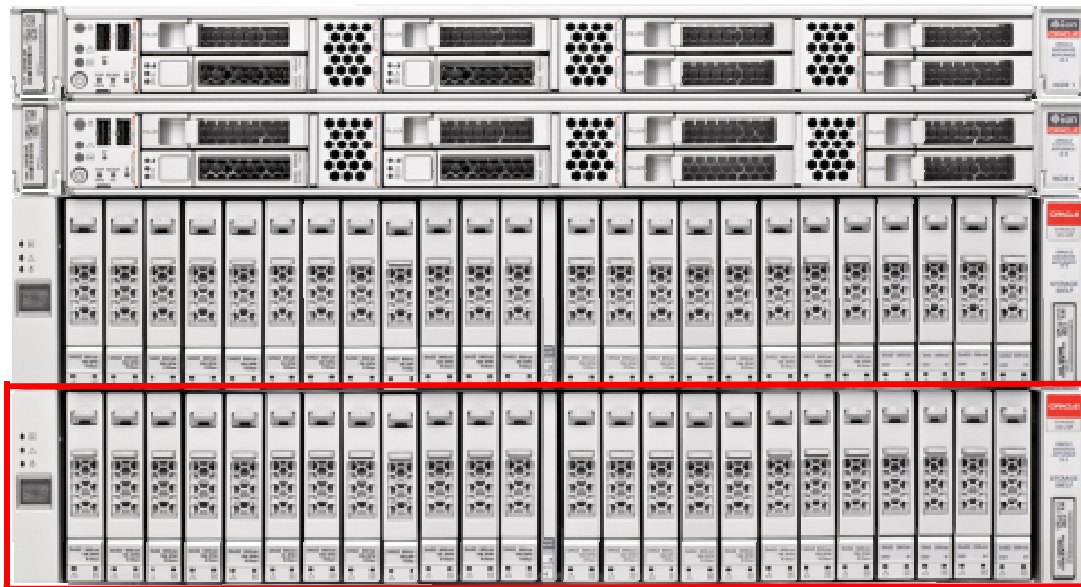
4x Storage Capacity

- 2x Storage Capacity 18 TB Raw Disk Storage
- 2.7 x Flash: 800 GB Raw Solid State Storage
- Storage expansion doubles the capacity

ORACLE

ODA X3-2 Storage Expansion Shelf
Zero-Admin/Online Storage Expansion

Double Available Storage Capacity

- Additional 18 TB HDD, 36 TB Total
- Additional 800GB Flash, 1.6TB total

Zero Administration

- Automatically integrates when plugged in
- Data automatically distributes to new shelf

Online Expand Storage

- Hot-plug storage expansion shelf
- No database downtime

ORACLE

Processor Performance Has Doubled!

- Number of cores has increased by 1.33x

- Per core performance has increased by 1.5x

- Processor performance has doubled – 1.33 x 1.5 = 2x

- Supporting memory has increased by 2.7x

ORACLE

Overall System Performance
Is I/O Performance Important?

- I/O performance is probably the most important factor in modern Intel systems performance

- CPU clock speeds (and memory) keep increasing rapidly but the bandwidth to disk is not keeping pace

- How does ODA solve this problem and why is it better than traditional approaches?

ORACLE

Best-in-Class Performance

- Optimal data layout
  - Ideal disk group configuration
  - Data striping with ASM
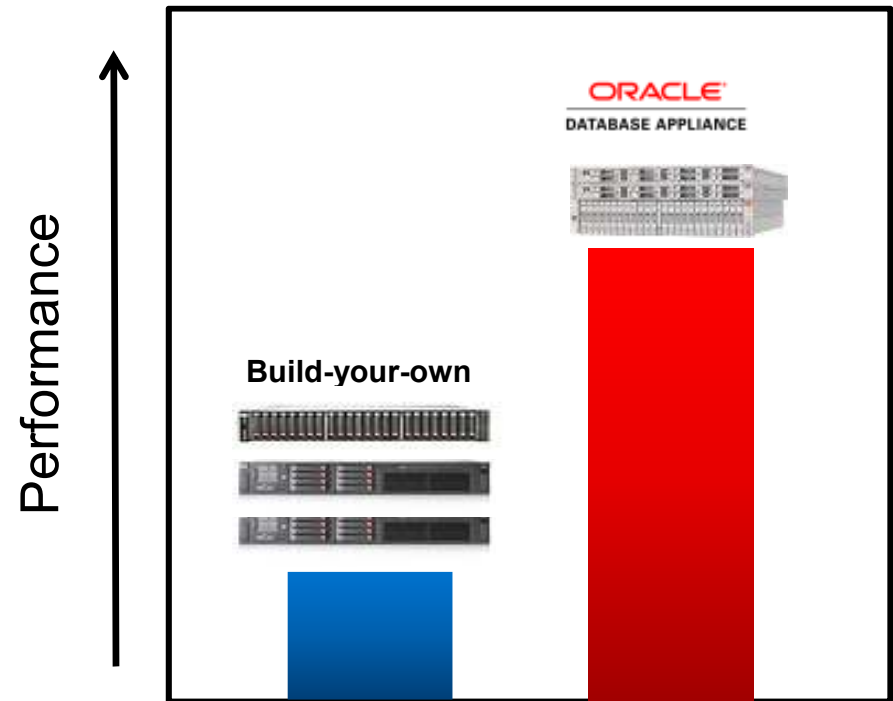
Storage Management
Initial Configuration

- Discovers disks

- Creates partitions

- Sets up multipath

- Creates diskgroups and lays out data for best performance
  - DATA for database data
  - RECO for archive logs for backup data
  - REDO for redo logs

ORACLE

Oracle Database Appliance X3-2
## Superior I/O Performance Architecture

- Superior performance architecture
  - Higher performance architecture to traditional approaches
  - "Database-aware" performance architecture
  - Performance stays predictable over time
  - High performance does not compromise availability

- Linear performance increase with storage expansion

- ODA X3-2 also delivers a superior performance in the Virtualized Platform

ORACLE

Database Aware Performance
Optimized for the Oracle Database

- I/O Path optimization on ODA X3-2
  - Redo writes to REDO Disk group made up of SSDs
  - Database writes blocks to DATA Diskgroup residing in Outer HDD Platter
  - Archiving writes blocks to RECO Diskgroup residing in Inner HDD Platter
- ASM stripes data on all spindles

ORACLE

Storage Expansion
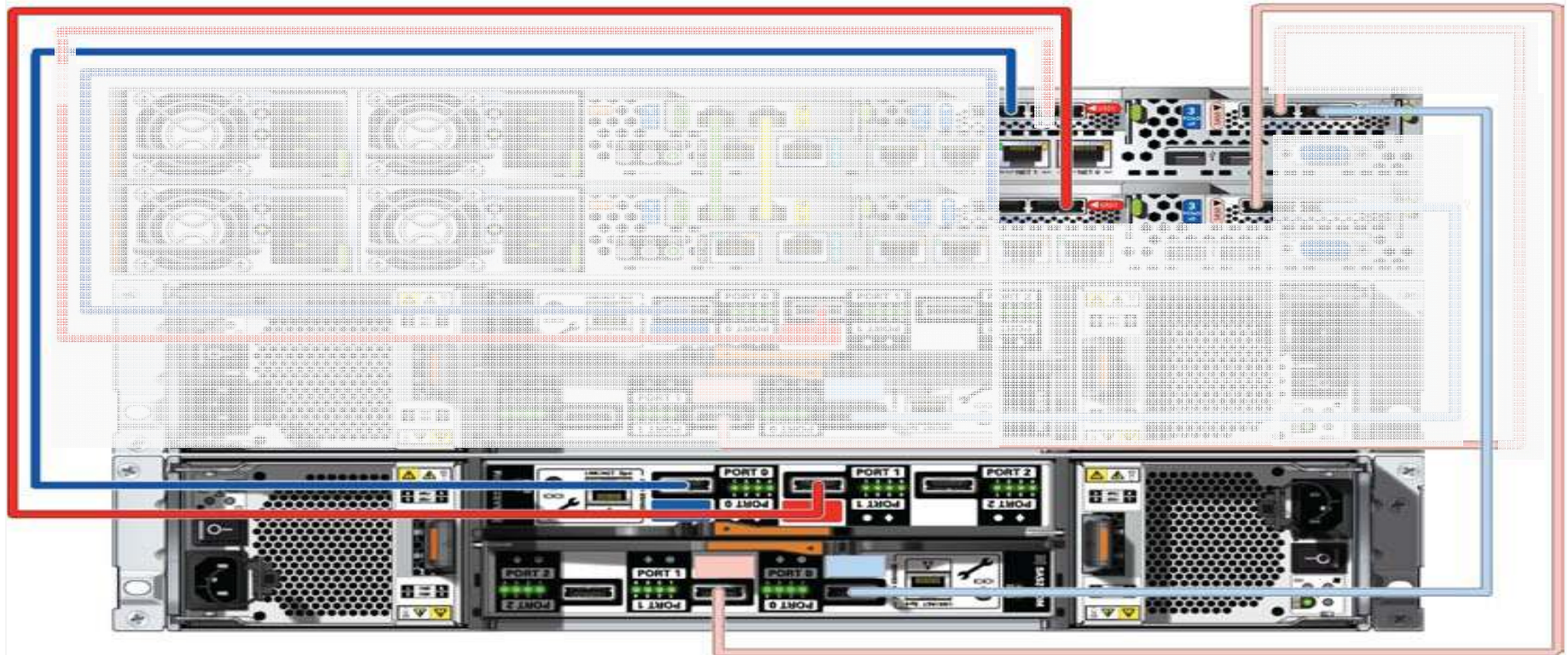
ORACLE

IO Performance

1 x Storage Shelf	IOPS	Bandwidth
Flash	200,000	2 GB/Sec
HDD	3300	3.5 GB/Sec

2 x Storage Shelf	IOPS	Bandwidth
Flash	400,000	4 GB/Sec
HDD	6600	5.5 GB/Sec

*** Performance measured while the workload is running in both nodes
   4K I/O Size

ORACLE

Virtualized Platform Performance
Provides Bare Metal I/O Performance

Oracle Database Appliance

Node 1	Node 2
Guest VM	Guest VM
Guest VM	Guest VM
Web Logic	Web Logic

| DOM 0	ODA BASE	DOM 0	ODA BASE
VM Storage Repository	• Appliance Manager • Grid Infrastructure • Database	VM Storage Repository	• Appliance Manager • Grid Infrastructure • Database
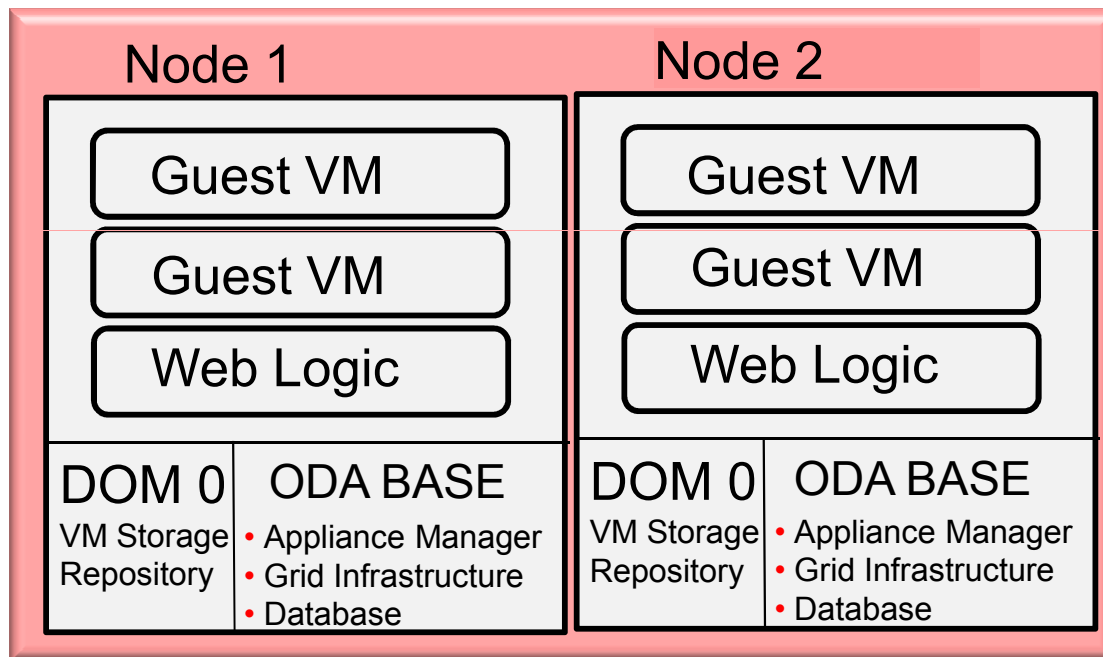
- Virtualized environments typically don't perform well for I/O intensive workloads

- Database is an I/O intensive workload

- With ODA, database I/O is not virtualized

- Database I/O does not incur a VM tax i.e. performs great!

ORACLE

Best-in-Class Performance

- **Optimal data layout**
  - Ideal disk group configuration
  - Data striping with ASM

- **Direct-attached storage**
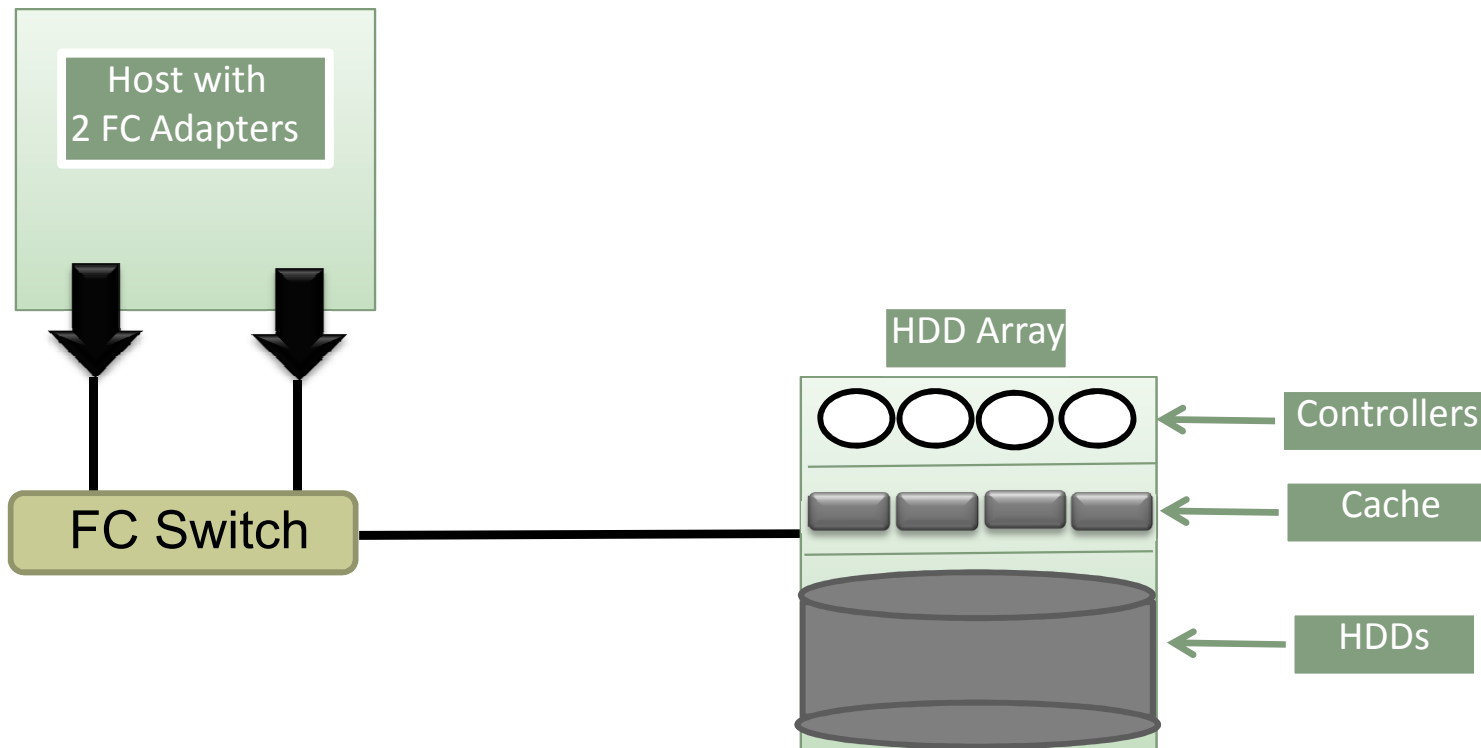 - Eliminates SAN/NAS bottlenecks
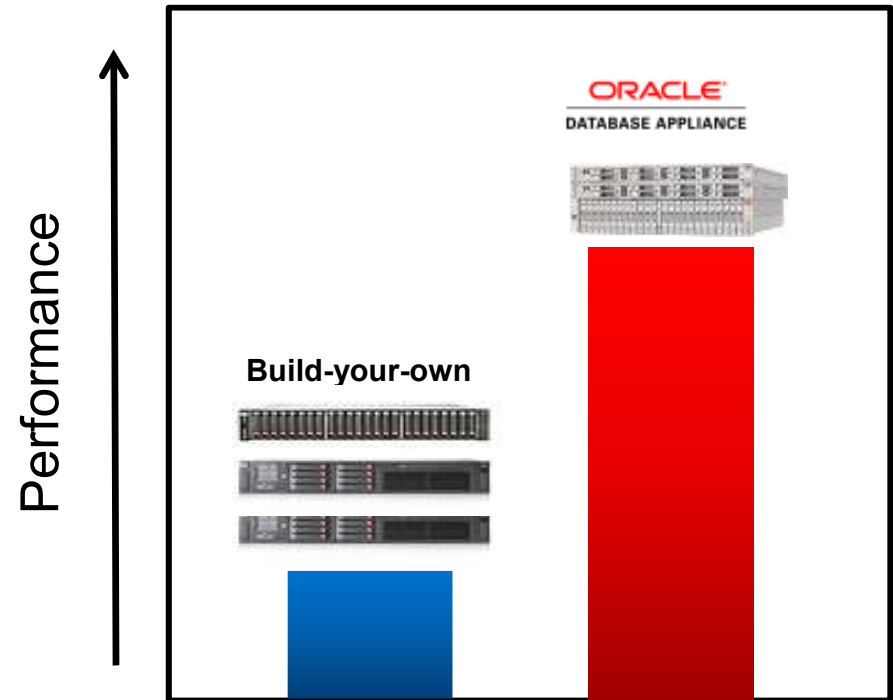
ORACLE

SAN/NAS vs. Oracle Database Appliance

Why is the Oracle Database Appliance Performance
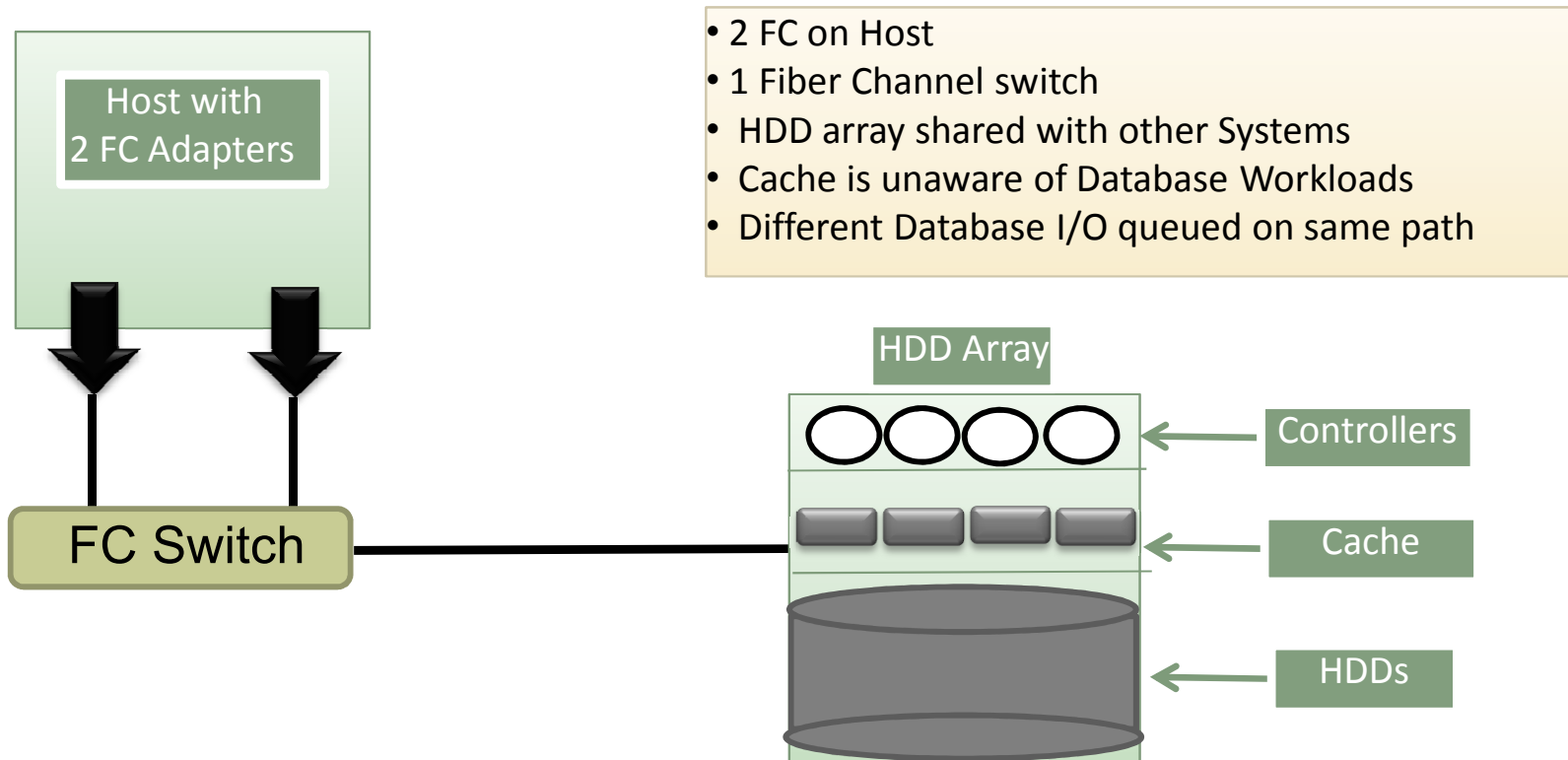Architecture Superior to Traditional SAN/NAS ?
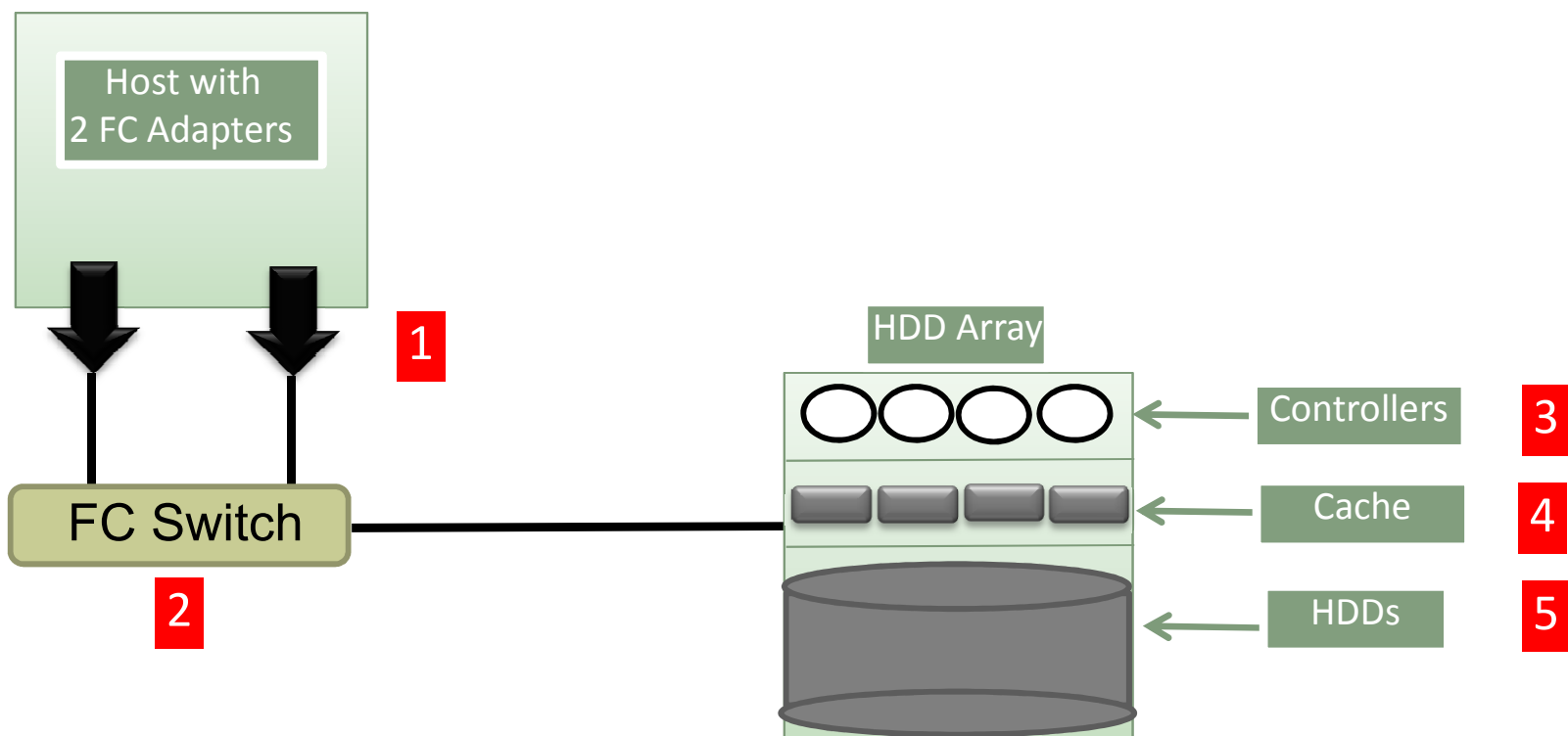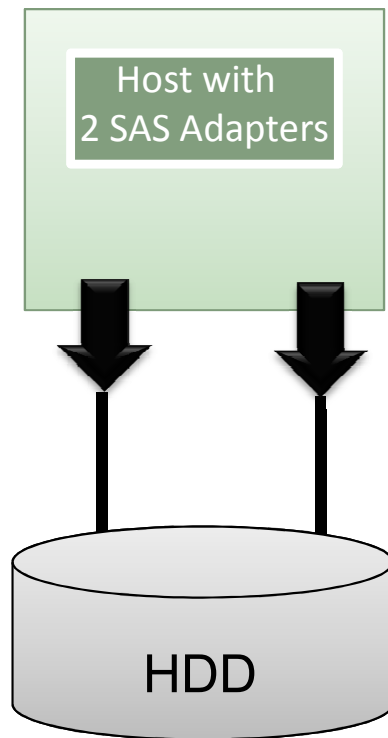
ORACLE

Typical SAN Architecture

Host with
2 FC Adapters

FC Switch

HDD Array

Controllers

Cache

HDDs

Unbalanced setup equals Unpredictable Performance

Host with
2 FC Adapters

- 2 FC on Host
- 1 Fiber Channel switch
- HDD array shared with other Systems
- Cache is unaware of Database Workloads
- Different Database I/O queued on same path

FC Switch

HDD Array

Controllers

Cache

HDDs

Multiple Queues affects Performance and Diagnosis

Host with
2 FC Adapters

1

FC Switch

2

HDD Array

Controllers **3**

Cache **4**

HDDs **5**

ORACLE

Direct Attached Oracle Database Appliance X3-2

Host with
2 SAS Adapters

HDD

- HDDs are directly attached eliminating multiple queues

- SAS adapters provide 3x bandwidth vis-à-vis FC adapters, improving performance

- Makes expansion easy and predictable

- Less complexity. Easy to tune.

What about Flash Card Vendors ?

- Most prominent vendor is Fusion I/O

- They perform great but aren't redundant

- Customer has to choose – performance OR availability?

ORACLE

Best-in-Class Performance

- **Optimal data layout**
  - Ideal disk group configuration
  - Data striping with ASM

- **Direct-attached storage**
  - Eliminates SAN/NAS bottlenecks

- **Out-of-the-box fully tuned**
  - Increases throughput
  - Improves response time
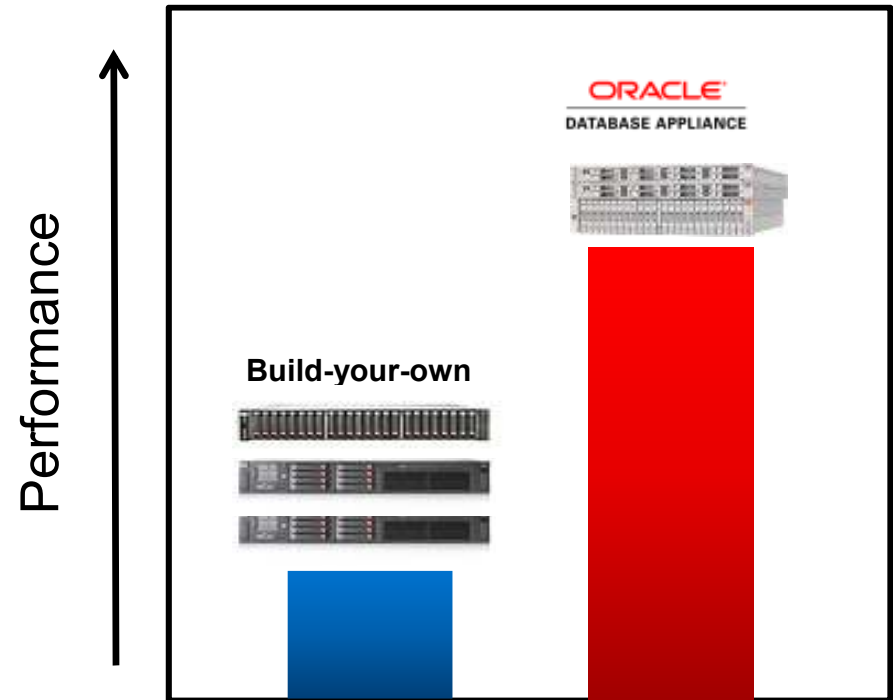
ORACLE

Provisioning – Oracle Database Appliance X3-2
Database Templates Sized for Performance

| Database Class	CPU Cores	Memory	Number of Databases
Very Small	1	8 GB	32
Small	2	16 GB	16
Medium	4	32 GB	8
Large	6	48 GB	4
Very Large	12	96 GB	2
Extra Extra Large	16	128 GB	2

ORACLE

Provisioning – Oracle Database Appliance X3-2
Database Templates Sized for Performance

Database Class	System Global Area	Program Global Area	Number of Processes	Log Buffer, Redo Log Size
Very Small	4096-8192 MB	2048-4096 MB	200	16 MB, 1 GB
Small	8192-16384 MB	4096-8192 MB	400	16 MB, 1 GB
Medium	16384-24576 MB	8192-12288 MB	800	32 MB, 2 GB
Large	24576-49152 MB	12288-24576 MB	1200	64 MB, 4 GB
Very Large	49152-65536 MB	24576-32768 MB	2400	64 MB, 4 GB
Extra Extra Large	65536 MB	32768 MB	3600	64 MB, 4 GB

ORACLE

Summary
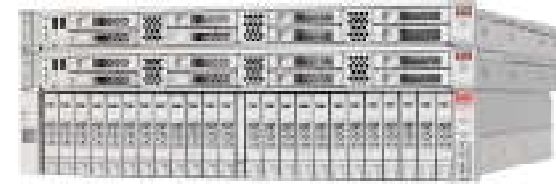
- Simple to deploy, manage and maintain your database, application and web tier

- Best-in-class availability

- Best-in-class performance

- Built-in scalability

- Capacity-on-demand licensing for Oracle database and applications

- Solution-in-a-Box

FOR MORE INFORMATION

oracle.com/databaseappliance

ORACLE

Q&A

ORACLE

Hardware and Software

ORACLE®

Engineered to Work Together

ORACLE