



BCA1985

Oracle Databases Best Practices on vSphere

Kannan Mani, Technical Solution Architect, VMware, Inc.

Bryan Bond, SR Storage and Virtualization Admin., eMeter

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Agenda

Customer: eMeter – Oracle Databases on VMware

Why Deploy Oracle Databases on VMware?

Workload Characterization Study with EMC and Cisco UCS

Best Practices

Oracle Support and Licensing

Summary



eMeter Oracle Virtualization on VMware

Bryan Bond, SR Storage and Virtualization Admin

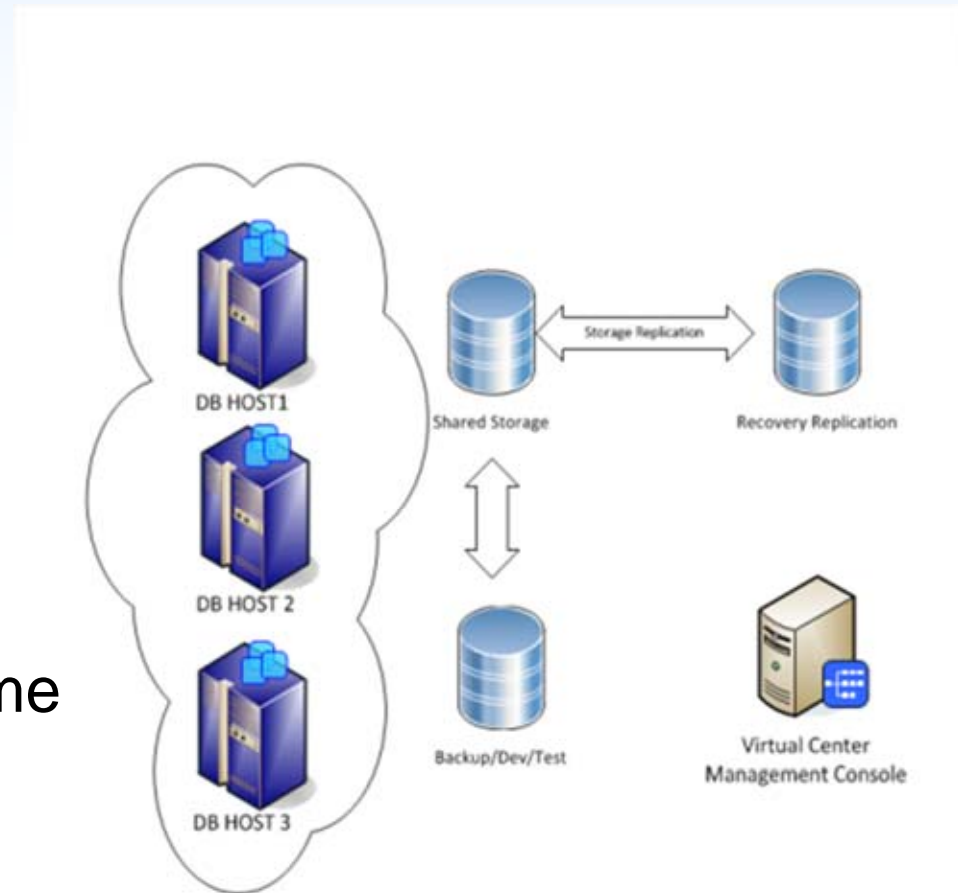
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Business Requirements to Virtualizing Oracle Databases on vSphere in Production

- Reduce delivery time
- Increase availability
- Provide deployment options to customers
- Provide easier HW upgrade paths
- Provide DR strategy
- Reduce costs

Virtualized Oracle Architecture on VMware

- 7x times Reduced Data
- 23% increased the Query throughput
- 4x times increased the DB VM Provisioning Time



Virtualizing Oracle Databases on vSphere – Benefits

- Single management point for systems
- System based snapshots
- HA/DRS
- Reduced deployment time
- System portability
- HW flexibility/utilization
- Rapid replication and recovery
- Reduced storage consumption (thin provisioning, de-duplication)

VMware Features Leveraged

- VMware DRS
- VMware vMotion
- VMware HA
- Templates/Cloning
- Resource reservations
- Integrated Storage based snapshots

Future Plans for Oracle Virtualization

- Productize Virtual Oracle Deployments
- SRM deployments

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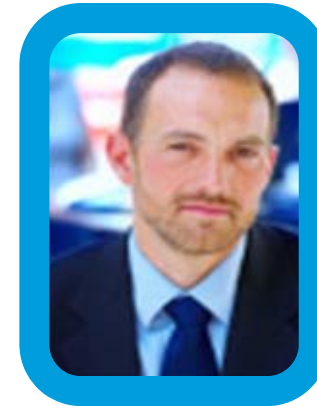
CIOs and IT Operations Want to Virtualize More...

Organizations are on the path to 100% virtualization for:

- Consolidation and infrastructure efficiency
- Simpler management
- Built-in availability
- Greater Agility

“Our CIO told the team that we need to virtualize as much as we can as soon we can”

VI Admin, VMware Customer



... But Sometimes DB Owners Need Convincing

“The Database admin vetoed the virtualization project, he felt it was too risky”

VI Admin, VMware Customer



Tier 1 applications raise unique questions:

- ❓ Will my DB perform well?
- ❓ Will my ISV support me?
- ❓ What's in it for me? Will my database run better?

Why Deploy Oracle Databases on VMware?

Oracle Licensing

Consolidate licensing

- > Potentially Increase utilization of Oracle licenses
(Depends on Degree of Consolidation)
-

DB Consolidation

Reduce hardware costs by > 50%

- > Consolidate servers by 4X - 20X
-

DB On Demand

Provision databases on demand

- > Minutes to provision in production and in the lab
-

Quality of Service

Increase application Quality of Service

- > Scale dynamically
- > Built-in high availability and simple disaster recovery

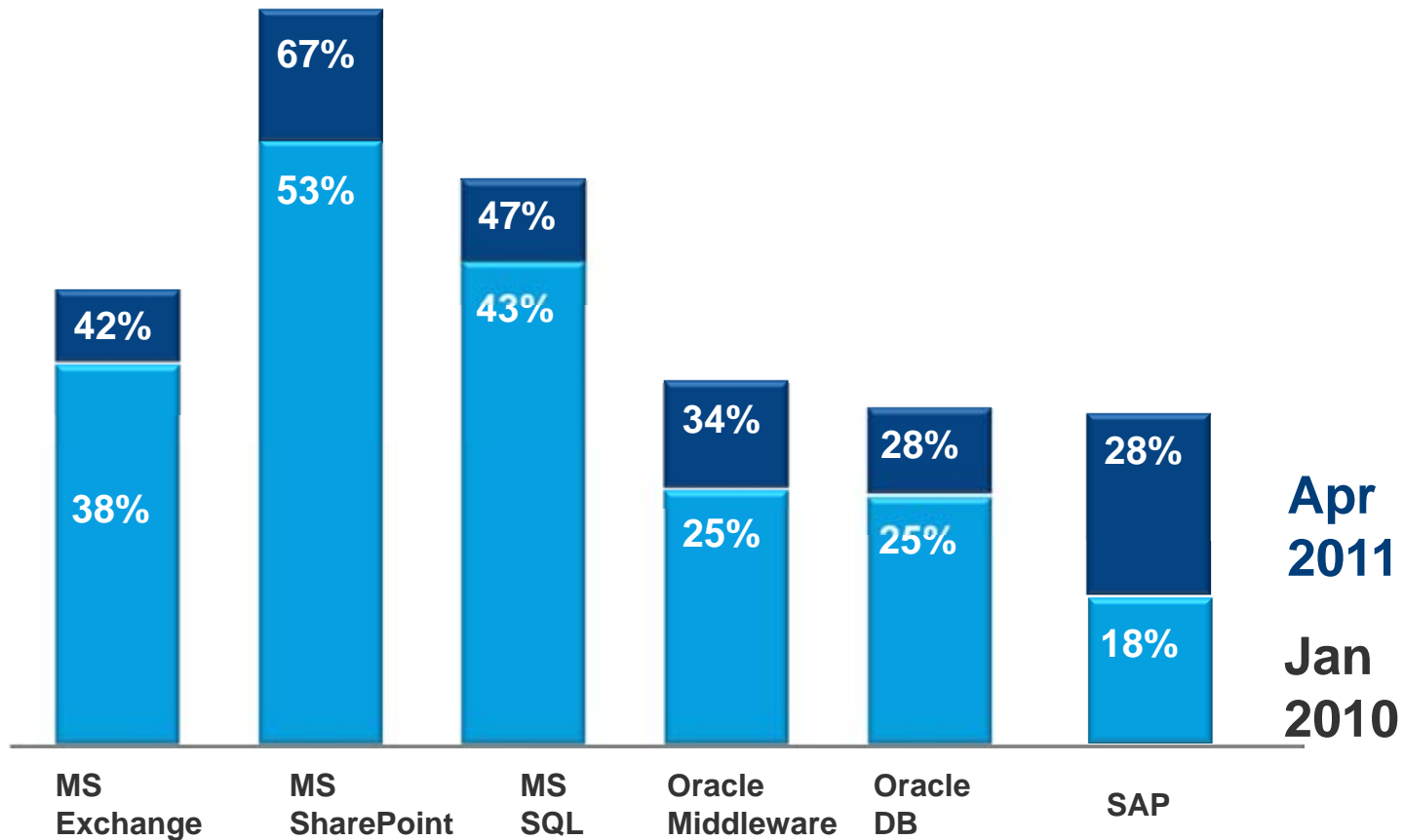
Maximum Scalability and Performance With vSphere 5

Application's Performance Requirements

% of Applications	95% of Apps Require		ESX 1	ESX 2	VMware Inf. 3.0/3.5	VMware vSphere 4	VMware vSphere 5
	CPU	1 to 2 CPUs	1 VCPUs	2 VCPUs	4 VCPUs	8 VCPUs	32 VCPUs
	Memory	< 4 GB at peak	2 GB per VM	3.6 GB per VM	16/64 GB per VM	256 GB per VM	1,000 GB per VM
	Network	<2.4 Mb/s	<.5Gb/s	.9 Gb/s	9 Gb/s	30 Gb/s	>36Gb/s
	IOPS	< 10,000	<5,000	7,000	100,000	300,000	1,000,000

The Trend Is Clear

% of Workload Instances Running on VMware in Customer Base



Source: VMware customer survey, Jan 2010 and April 2011 interim results,
Data: Total number of instances of that workload deployed in your organization and the percentage of those instances that are virtualized

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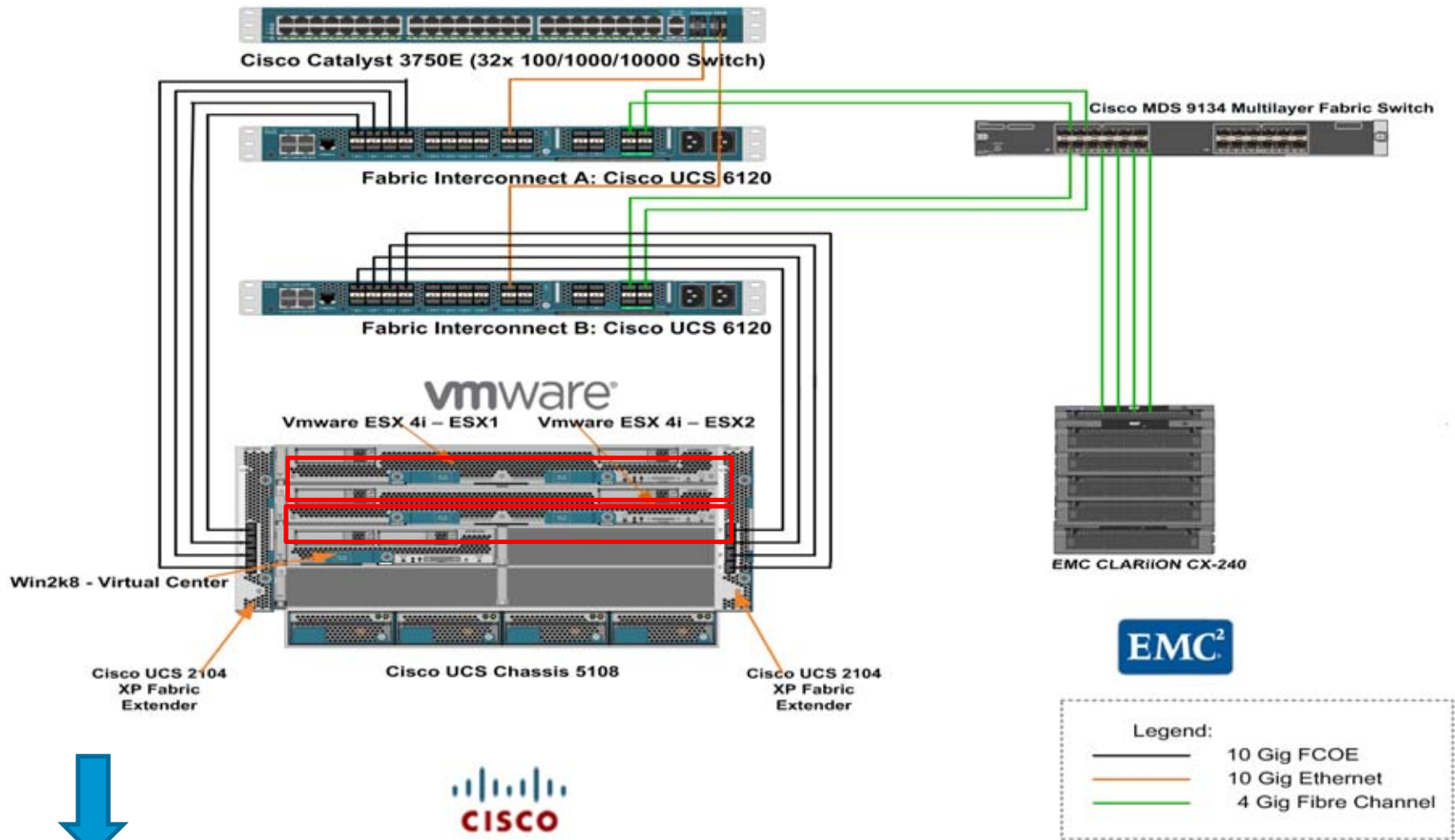
Workload Characterization Study with EMC and Cisco UCS

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Oracle Databases on vSphere Workload – Architecture

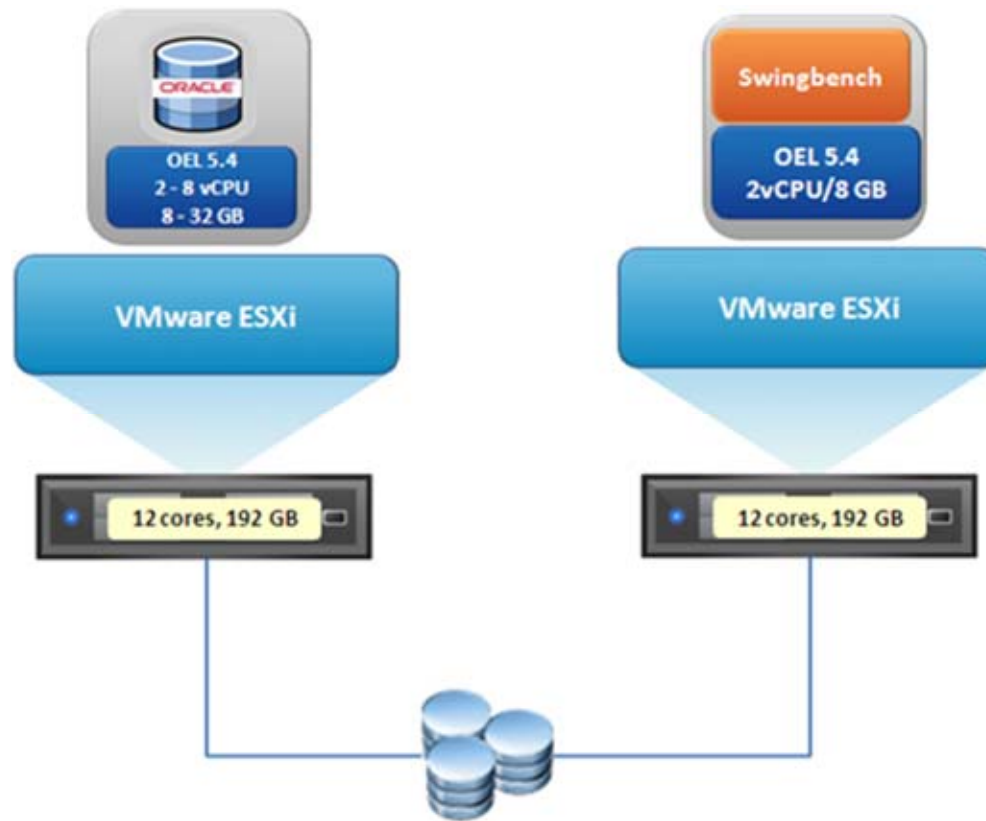


Download http://www.vmware.com/files/pdf/partners/oracle/Oracle_Databases_on_VMware_-_Workload_Characterization_Study.pdf

Test Scenarios

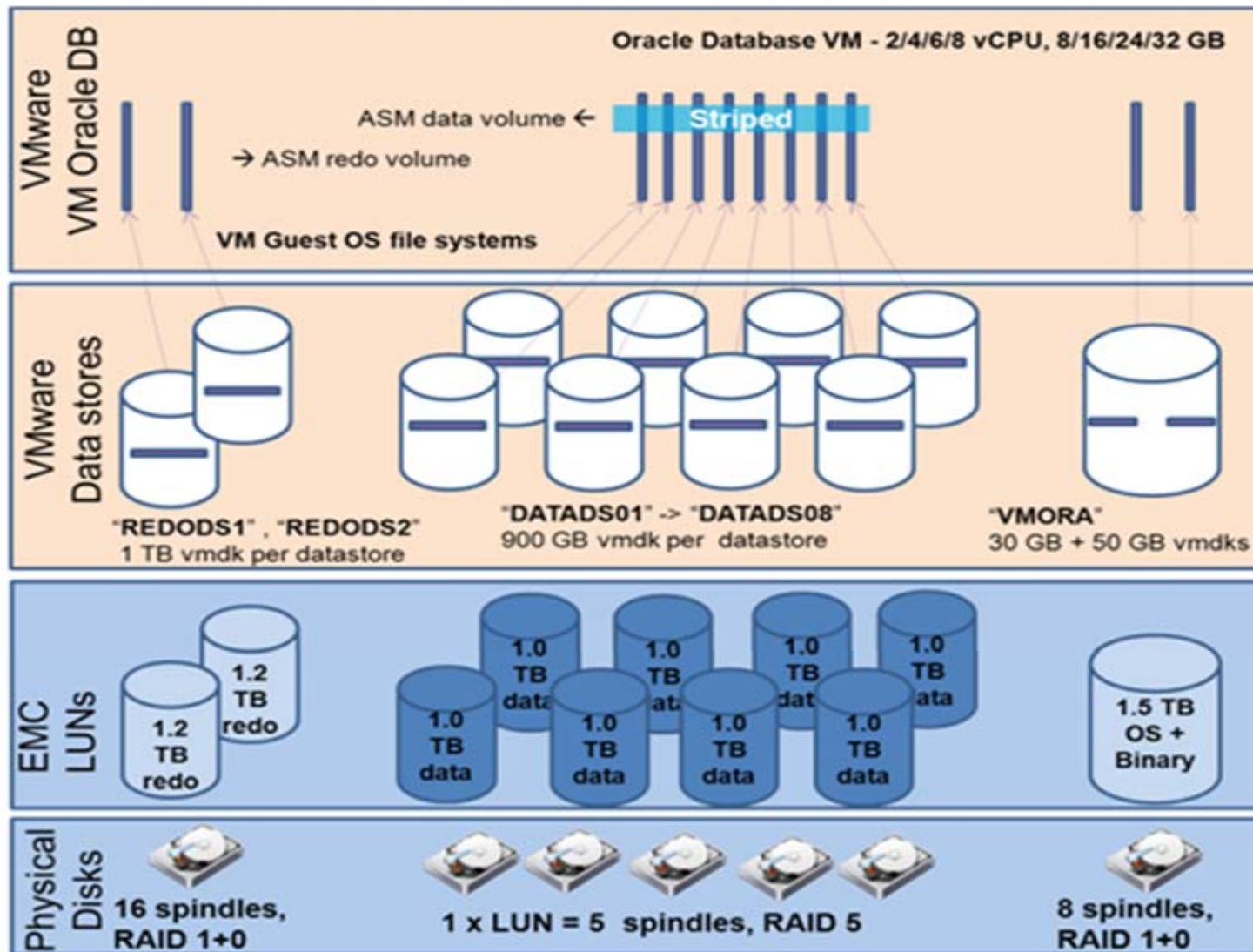
Scenario	Virtual Machine (vCPU, RAM)	Test Description
Scaling up single Oracle database virtual machine (HT OFF)	2vCPU/8GB 4vCPU/16GB 6vCPU/24GB 8vCPU/32GB	<ul style="list-style-type: none"> • Run Swingbench Large Scale Oracle Entry Benchmark user load against each VM configuration • 4 separate test runs • 300 concurrent users • Min and max think time = 5 and 10ms respectively
Scaling out and consolidating multiple virtual machines running an Oracle Database (HT ON)	4vCPU/16GB (1 – 5 VMs)	<ul style="list-style-type: none"> • Run Swingbench Large Scale Oracle Entry Benchmark user load against each VM configuration • 5 separate test runs • 200 concurrent users per VM • Min and max think time = 50 and 100ms respectively
Live migration of Oracle database in a virtual machine (vMotion)	4vCPU/16GB	<ul style="list-style-type: none"> • Run Swingbench Large Scale Oracle Entry Benchmark user load • 300 concurrent users • Min and max think time = 5 and 10ms respectively
VMware hot add CPU of Oracle database in a virtual machine	2vCPU/8GB (Hot Add 2 vCPU)	<ul style="list-style-type: none"> • Run Swingbench Large Scale Oracle Entry Benchmark user load • 100 concurrent users • Min and max think time = 5 and 10ms respectively

Single Virtual Machine – Scale Up Test



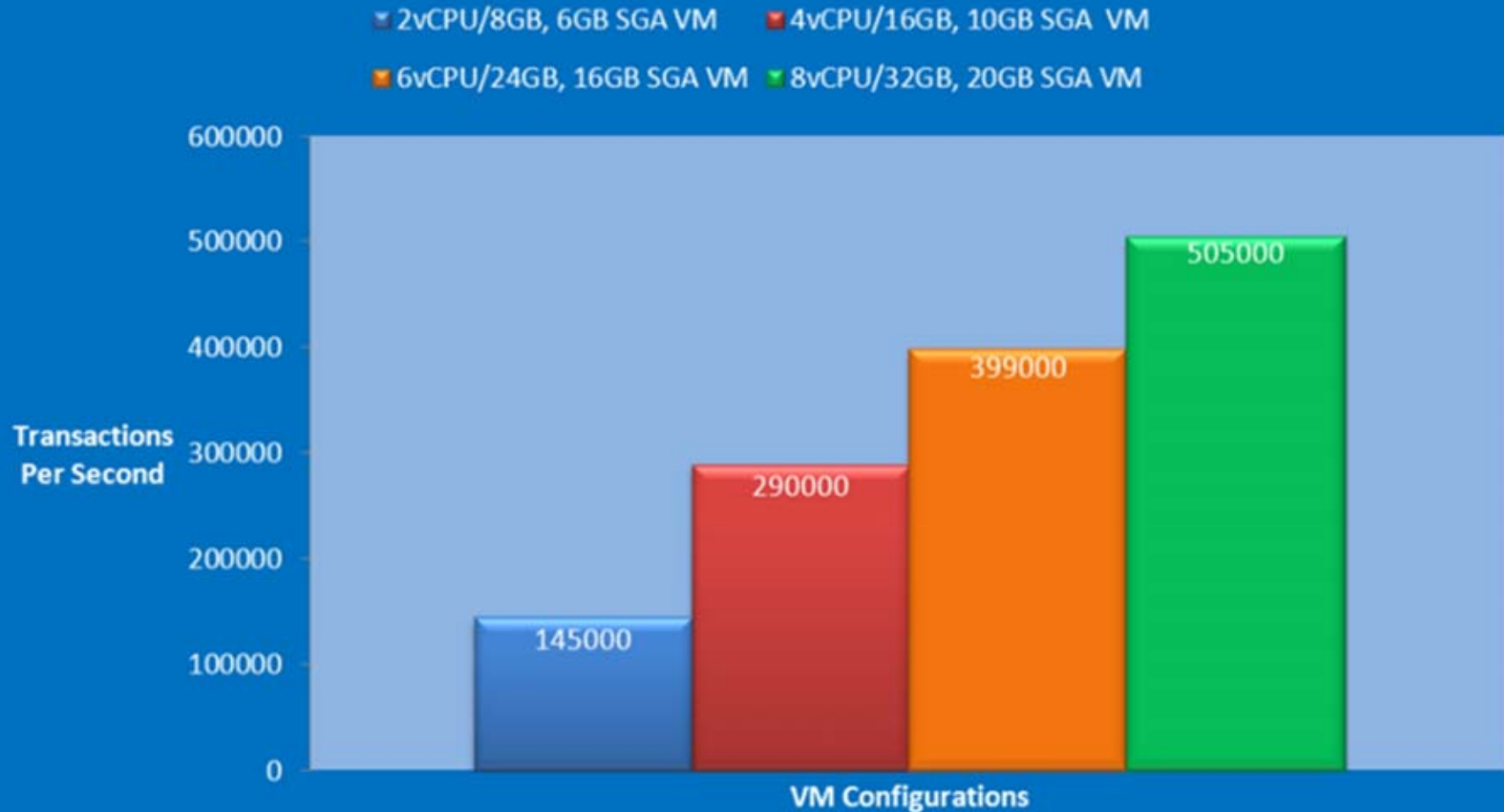
No. of vCPUs	Database Size (TB)	Concurrent Users (Min, Max think time - ms)	Virtual Machine Memory	Oracle Server SGA Size
2	1.1	300 (5,10)	8GB	6GB
4	1.1	300 (5,10)	16GB	10GB
6	1.1	300 (5,10)	24GB	16GB
8	1.1	300 (5,10)	32GB	20GB

Storage Layout for Single Virtual Machine

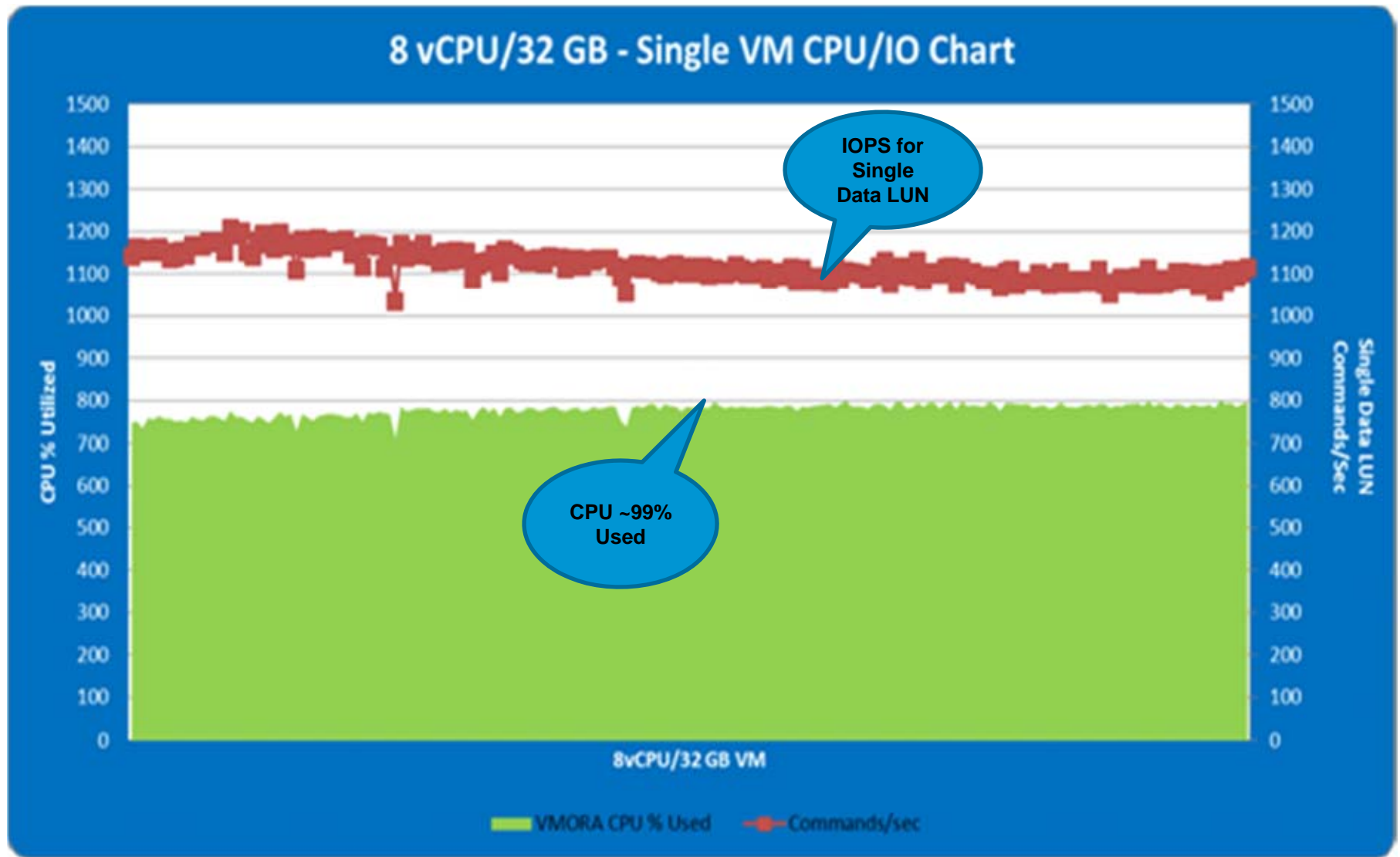


Scaling Up Oracle Databases on VMware vSphere 4.1

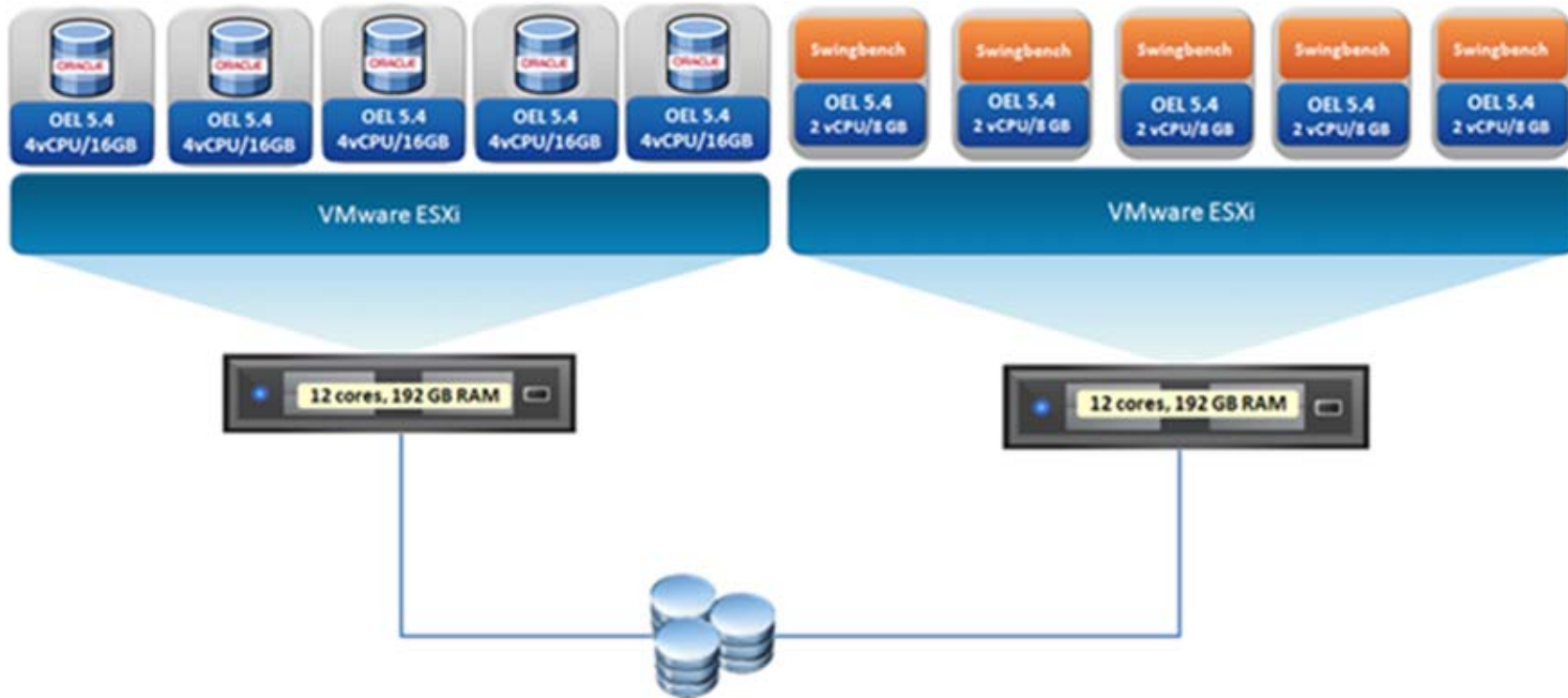
Oracle 11gR2 SI Database Scaling on VMware vSphere



Single Virtual Machine CPU/IO Chart – 8vCPU/32GB

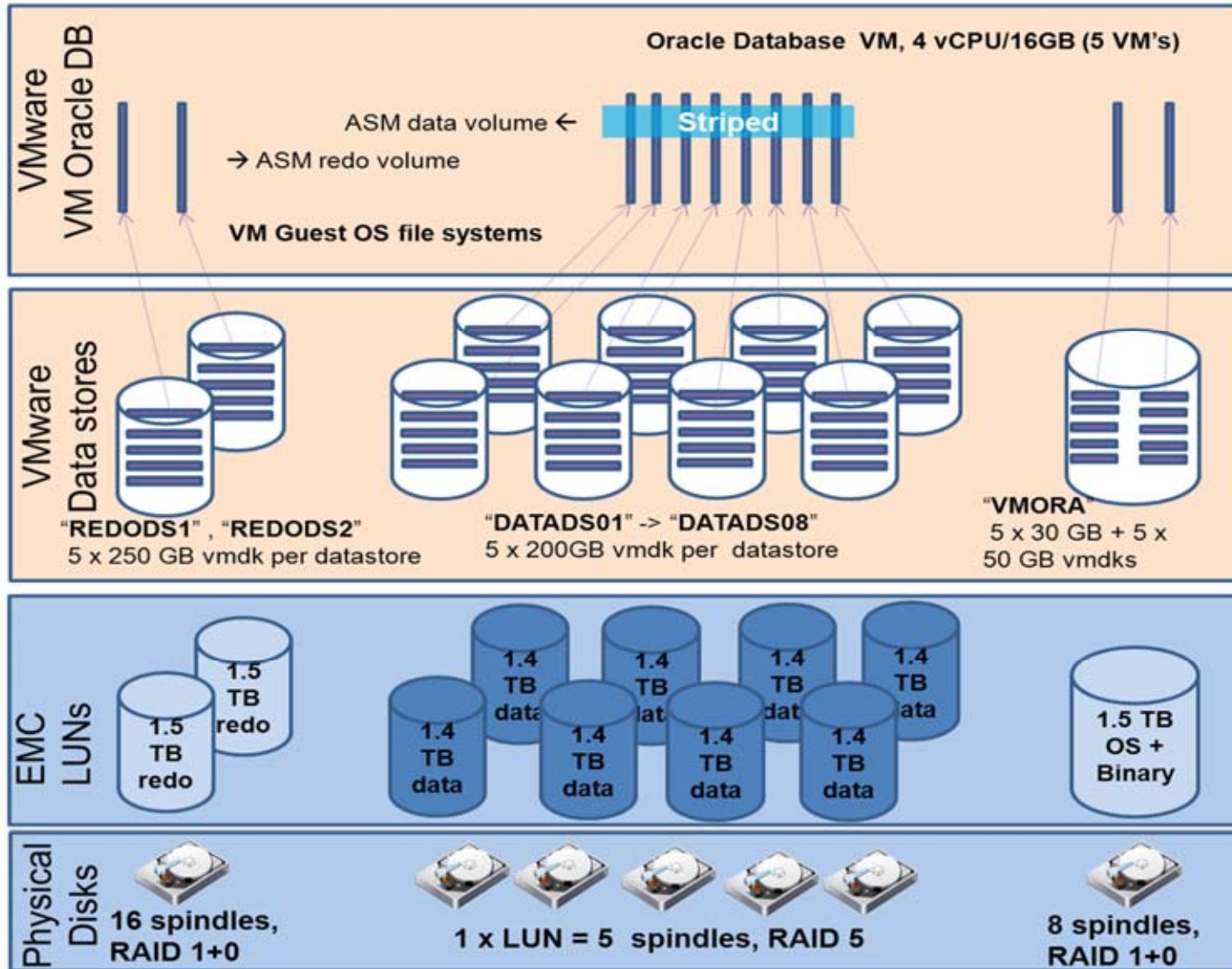


Multiple Virtual Machines – Scale Out Test

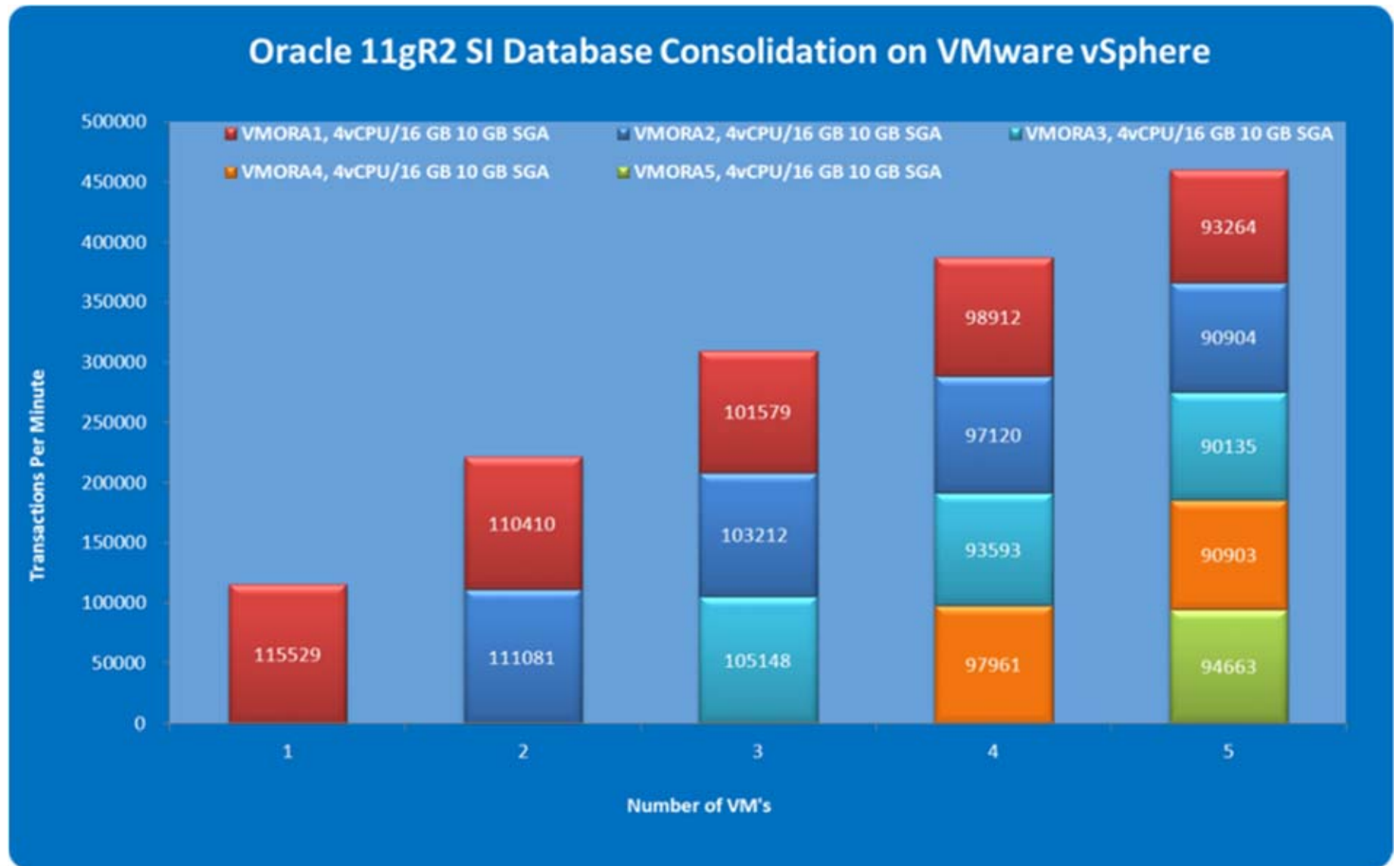


No. of vCPUs per VM	Database Size (TB)	Concurrent Users (Min, Max think time –ms)	Virtual Machine Memory	Oracle Server SGA Size
4 (1 - 5 VMs)	1.1TB	200 (50,100)	16GB	10GB

Storage Layout for Multiple Virtual Machines



Scaling Oracle Databases on VMware vSphere – Consolidation



Workload Management: vSphere vMotion™

VMware vMotion

- Move running virtual machines across ESX host
- Stable VMware technology

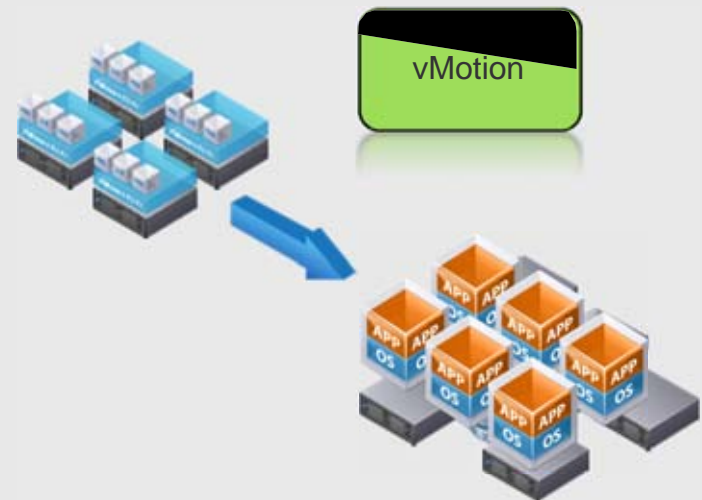
Tool For Database Administrators

- Zero downtime maintenance
- Migrate live databases
- Little impact to users

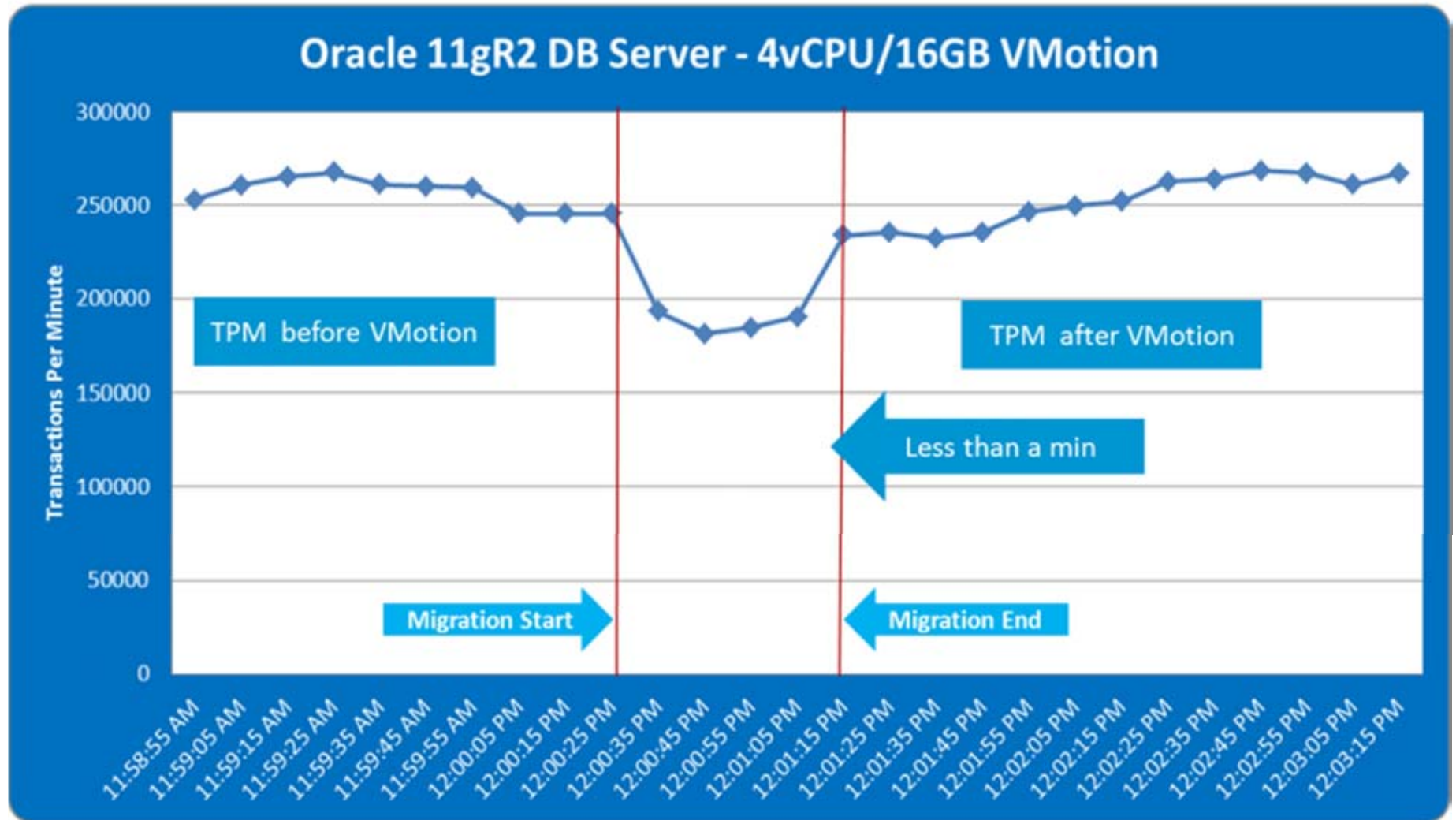
The Point Is

- How would a DBA do this without vMotion?
- Without vMotion:
 - Significant downtime
 - And at what cost to the business?

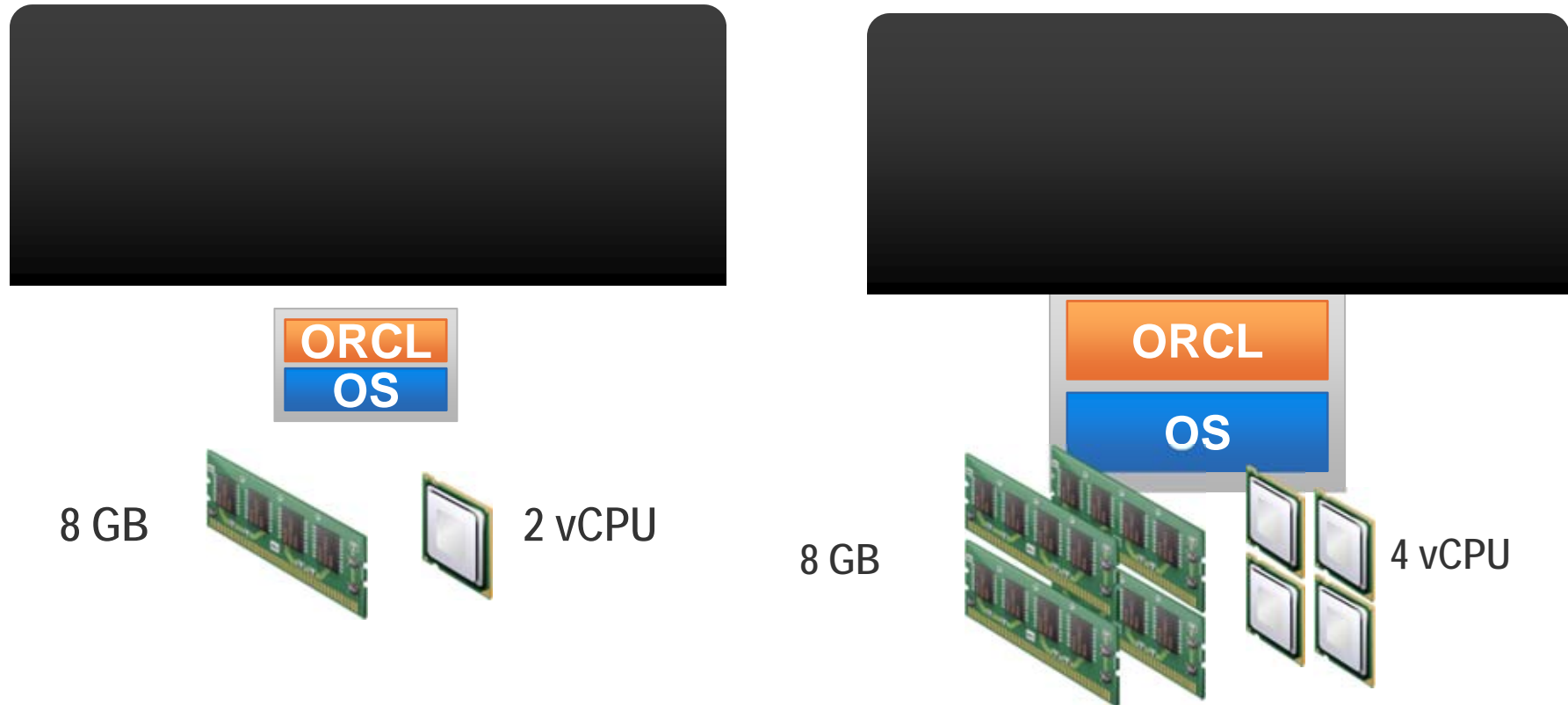
Live Oracle Database Migrations *Infrastructure Abstraction*



Oracle 11gR2 DB Server – vMotion

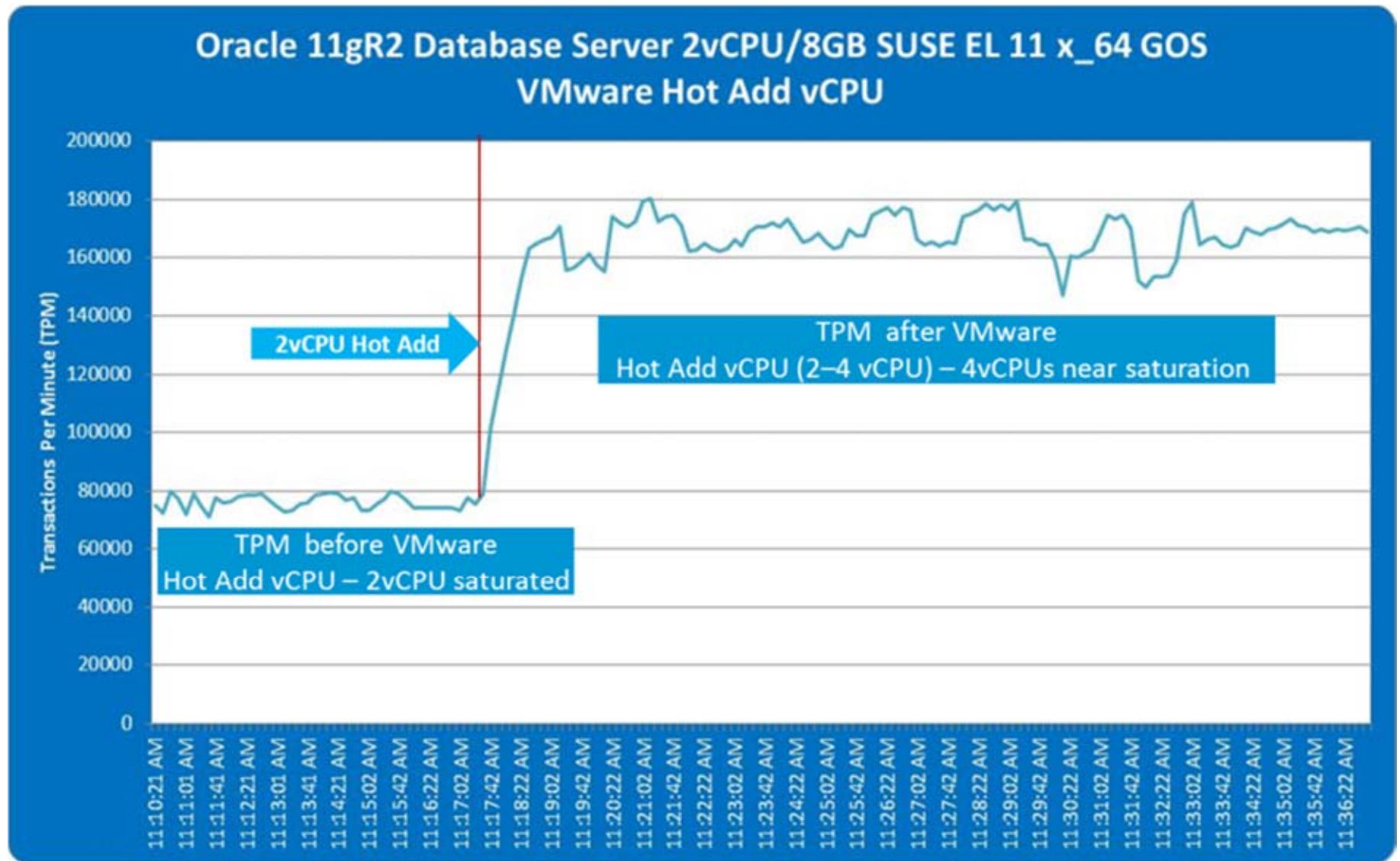


Hot-add Capacity to Guarantee QoS



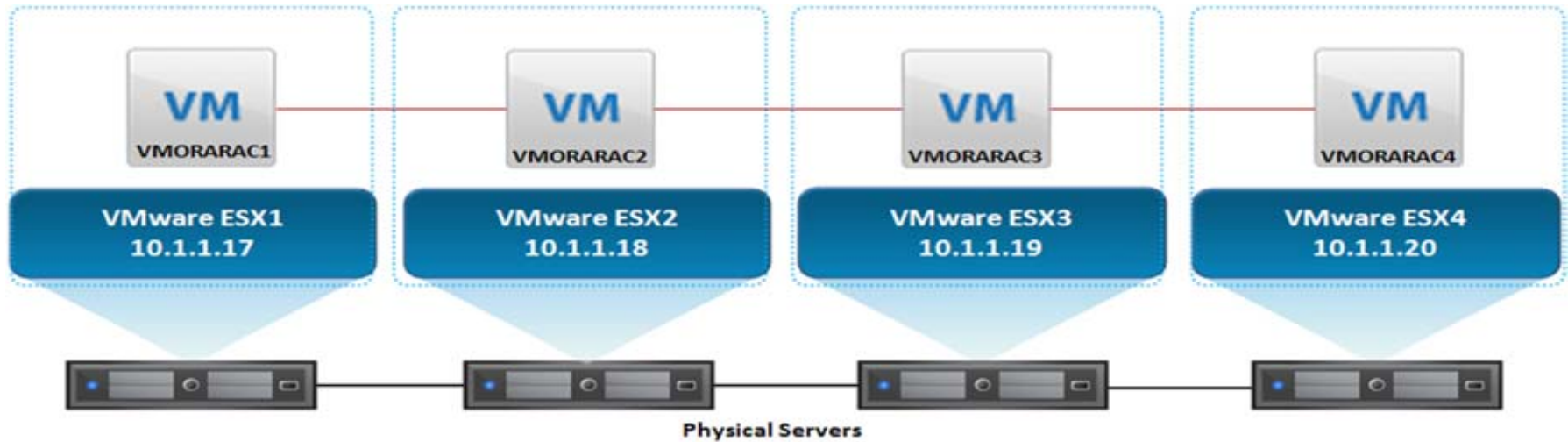
- > Hot-add capacity with zero application downtime
- > Minutes to stabilize VM and recover from SLA violation
- > Other options include vMotion to more powerful host & add instance for fast scale-out

Oracle 11gR2 DB Server – VMware Hot Add CPU



Oracle RAC on VSphere

Oracle RAC Node VM – vMotion Test Configuration



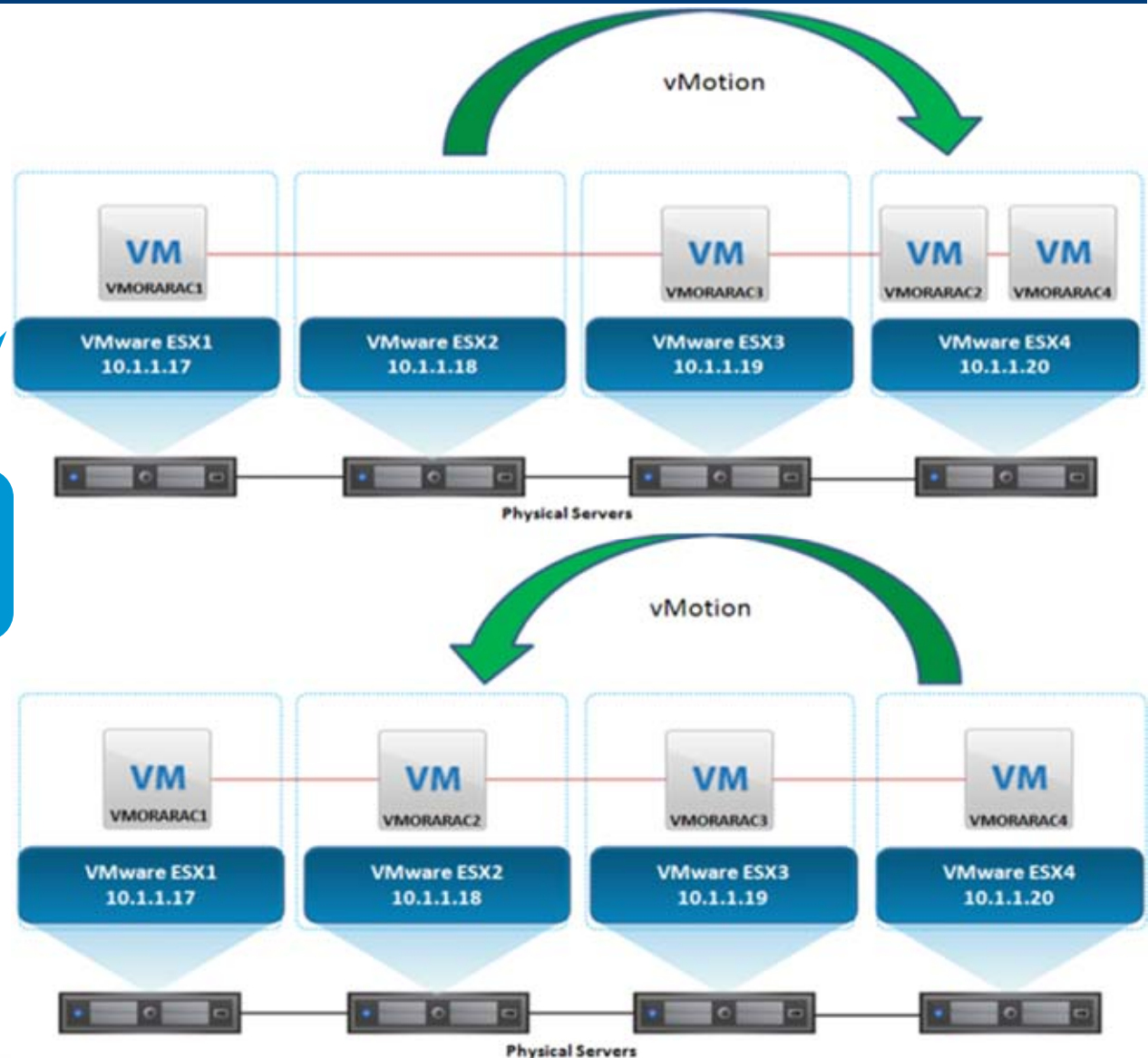
ESX Host	RAC Node VM	# of vCPUs	Memory (GB)	Oracle SGA (GB)
ESX1 – 12 Core, 192GB RAM	VMORARAC1	8	64	40
ESX2 – 12 Core, 192GB RAM	VMORARAC2	8	64	40
ESX3 – 12 Core, 192GB RAM	VMORARAC3	8	64	40
ESX4 – 12 Core, 192GB RAM	VMORARAC4	8	64	40

Oracle RAC Node VM – vMotion Testing Steps

Step 1: Migrate the Oracle RAC node VMORARAC2 from ESX2 (10.1.1.18) to ESX4 (10.1.1.20) so that ESX2 can be taken down for a firmware upgrade

All the VM's are Running at 50% CPU Utilized

Step 2: After the Hardware maintenance is completed on ESX2, move VMORARAC2 from ESX4 (10.1.1.20) back to ESX2 (10.1.1.18)



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General Best Practices



VMware vSphere 4.1



- Create a computing environment optimized for vSphere
 - Enable required setting for ESX Server BIOS – ie VT, Turbo mode, HT
 - Disable unnecessary foreground and background processes on GOS
- Create golden images of optimized operating systems using vSphere cloning technologies
- Upgrade to vSphere ESX 4 for 10- 20 % Performance boost.
- Allow vSphere to choose the best virtual machine monitor based on the CPU and guest operating system combination – Virtual machine setting has to be selected Automatic for the CPU/MMU Virtualization option
- Use Oracle recommended installation guidelines for respective Operating System – Same as Physical
- To minimize time drift in virtual machines follow guidelines in KB articles 1006427(Linux) and 1318(Windows)
 - KB 1006427 – Timekeeping best practices for Linux guests – <http://kb.vmware.com/kb/1006427>
 - KB 1318 – Timekeeping best practices for Windows <http://kb.vmware.com/kb/1318>



Download [http://www.vmware.com/files/pdf/partners/oracle/Oracle_Databases_on_VMware - Best Practices Guide.pdf](http://www.vmware.com/files/pdf/partners/oracle/Oracle_Databases_on_VMware_-_Best_Practices_Guide.pdf)

Virtual CPUs Best Practices



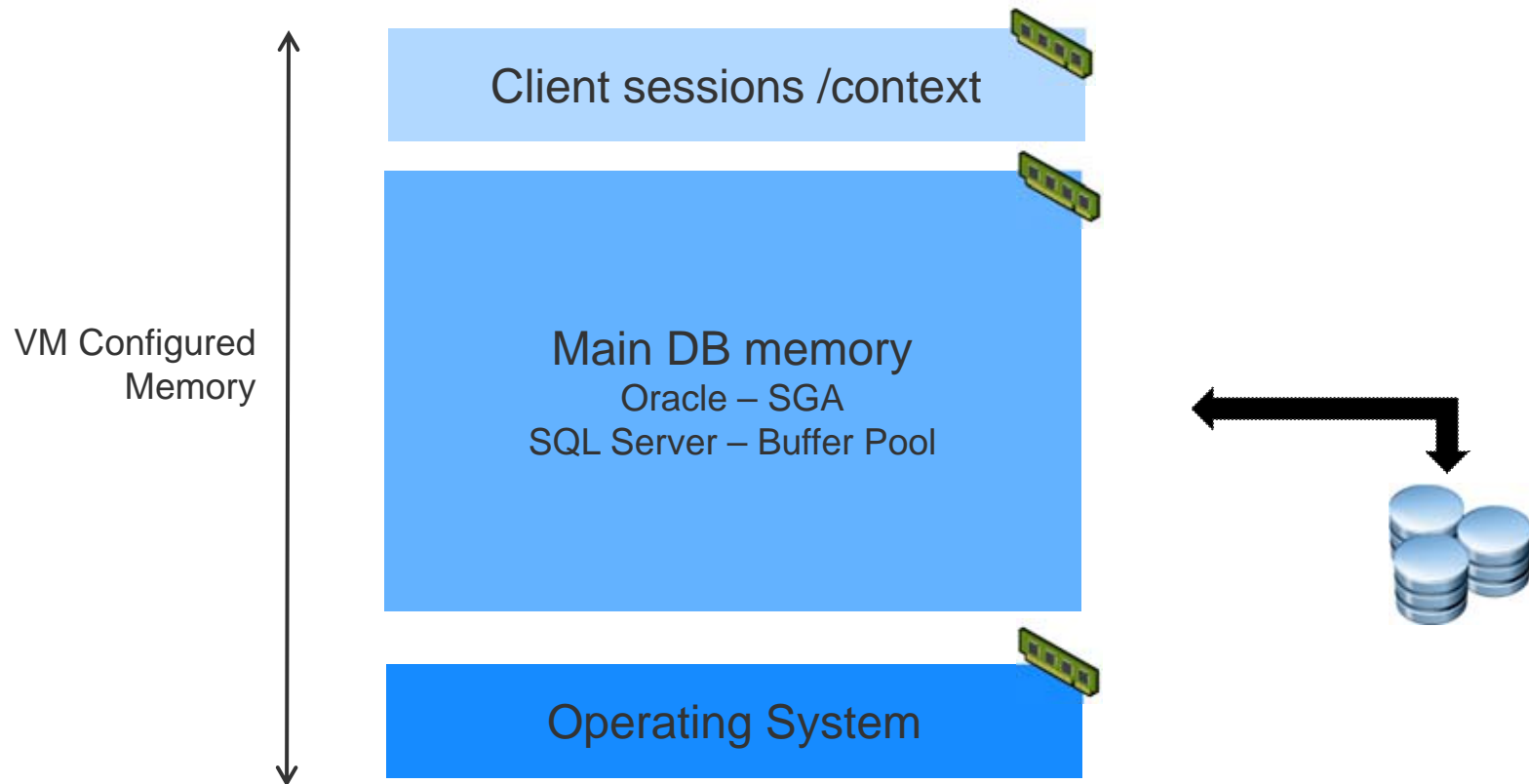
- **Do not over-allocate vCPUs; try to match the exact workload**
- **If the exact workload is unknown, start with fewer vCPUs initially and increase later if necessary**
- **For larger production workloads, the total number of vCPUs assigned to all VMs should be less than or equal to the total number of cores on the ESX Server**
- vCPU over commit can be done once you the work load is known
- **Enable hardware-assisted virtualization**
- **Avoid remote NUMA access by sizing the # of vCPU \leq # of cores on a NUMA node (processor socket)**
- **Be aware of hyper-threading, a hyper-thread does not provide the full power of a physical core**

Virtual Memory Best Practices



- **Do not over-commit memory** until VC reports that steady state usage is below the amount of physical memory on the server
- **Do not disable the balloon driver** (installed with VMware Tools)
- **Set the memory reservation to SGA size plus OS**
(Reservation and Configured Memory may be the same)
- Enable HW assisted virtualization in the ESX host bios and on the VM
- Set CPU/MMU Virtualization Option to Automatic
 - vSphere will choose best Virtual Machine Monitor option base on CPU/Guest OS
- Use Large Memory Pages
 - Consult Oracle Admin Guide for sizing of SGA
- **To avoid NUMA remote memory access, size VM memory \leq Memory per NUMA node**

APPROXIMATE DB Memory Architecture (high level)



Large DB memory => caches more data blocks => can minimize access to disk
So set memory reservation to protect this

Network Best Practices



- Separate infrastructure traffic from VM traffic for security and isolation
- Use NIC teaming for availability and load balancing
- Take advantage of Net I/O Control to converge network and storage traffic onto 10GE
- Use VMXNET3 Para virtualized network Adapter Drivers to increase performance
 - Reduces overhead versus vlane or E1000 emulation
 - Need VMware Tools to enable VMXNET3

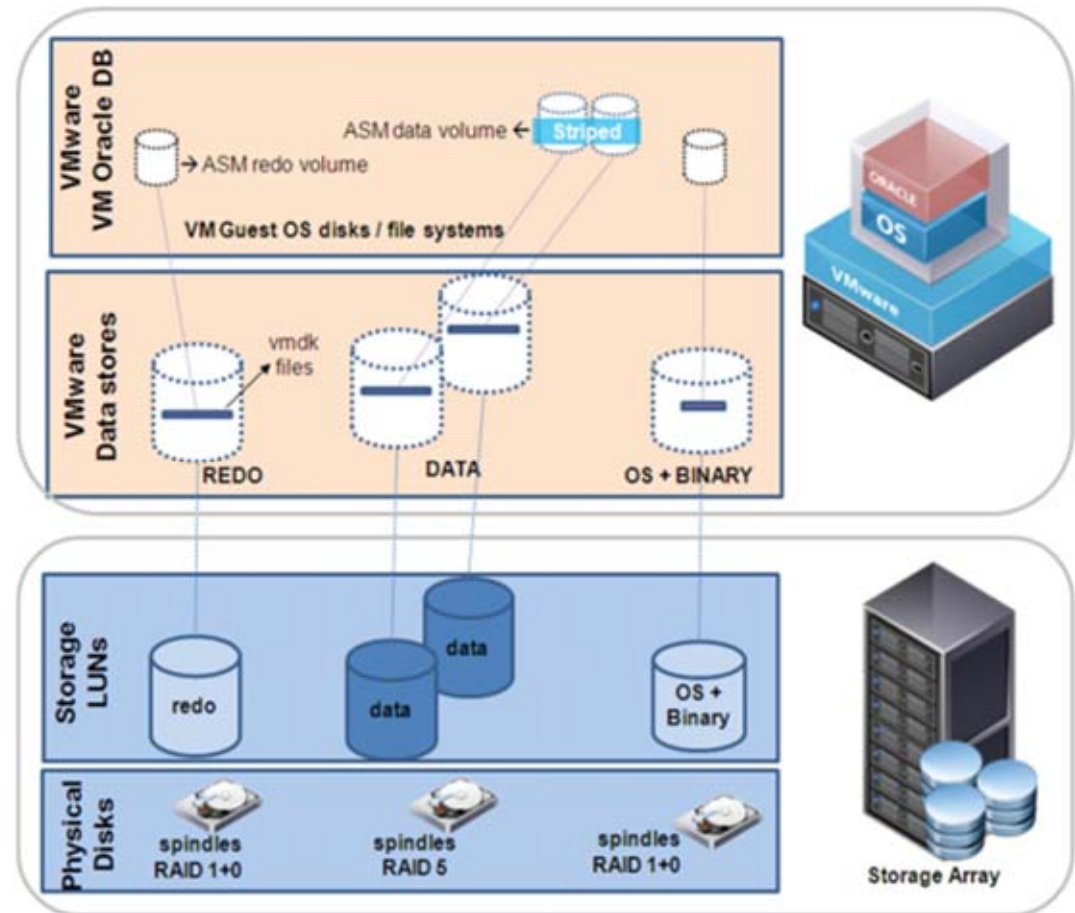
Storage



Storage Virtualization Concepts

- Storage array – consists of physical disks that are presented as logical disks (storage array volumes or LUNs) to the ESX Server

- Storage array LUNs** – formatted as VMFS volumes
- Virtual disks** – presented to the guest OS; can be partitioned and used in guest file systems



Storage Best Practices



- Use vSphere VMFS for single instance Oracle database deployments
- For IP-based storage iSCSI and NFS, enable jumbo frames
- Create dedicated data stores to service database workloads
- Make sure VMFS is properly aligned – Use VMware vCenter to create VMFS partitions, since it automatically aligns the partitions
- Use Oracle Automatic Storage Management (ASM)
- Follow your storage vendors best practices documentation when laying out the Oracle database
- Use Para virtualized SCSI adapters for Oracle datafiles with demanding workloads
- When using VMFS for data storage **format VMDK files as *eagerzeroedthick***
- **Use multiple vSCSI adapters** and evenly distribute target devices

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Oracle Support for VMware

- Oracle MyOracleSupport (Metalink) 249212.1 defines Oracle's VMware support policy most broadly
- Support facts:
 - Oracle RAC included for **11.2.0.2 and above (Updated Nov 8,2010)**
 - Oracle will accept SRs on VMware for bugs already known to Oracle
 - Oracle *may* accept SRs on VMware for bugs that are not seen by Oracle as being caused by virtualization
 - Oracle maintains (as do most ISVs) the right to require physical reproduction if they suspect VMware is "at fault"
- VMware's technology partner EMC and system integrator House of Brick have support statements for Oracle on VMware:
 - <http://www.emc.com/solutions/application-environment/oracle/oracle-virtualization-vmware.htm>
 - www.houseofbrick.com/oracle-on-vmware
- VMware Oracle Support - <http://vmware.com/support/policies/oracle-support.html>

Oracle Licensing

For all of the following situations: License FULL machine

Once “fully licensed” you can deploy unlimited VMs!

STANDARD EDITION ONE

- Licensed by SOCKET
- Limited to TWO SOCKETS
- Must license FULL machine



$$\$5,800 \times 2 =$$

\$11,600

STANDARD EDITION

- Licensed by SOCKET
- Limited to FOUR SOCKETS
- Must license FULL machine(s)



$$\$17,500 \times 4 =$$

\$70,000

ENTERPRISE EDITION

- Licensed by CORE
- Apply x86 factor of 0.5 to cores
- Must license FULL machine



$$\$47,500 \times 16 \times 0.5$$

\$380,000

Pricing per *Oracle Technology Global Price List*, January 29, 2009

Licensing: Hard versus Soft Partitioning

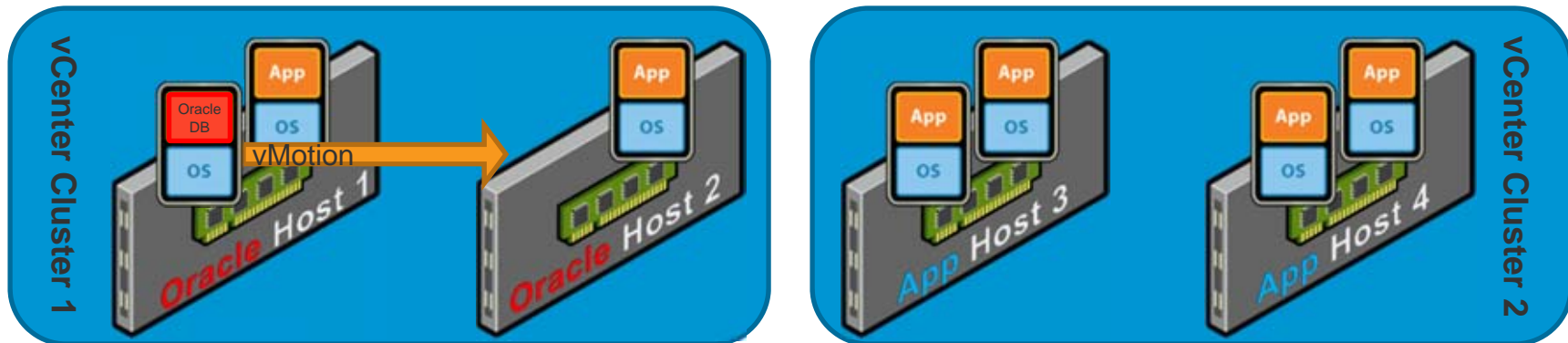
Oracle licenses via HARD and SOFT PARTITIONING of physical systems

- HARD = “fixed”; allows sub-system licensing
- SOFT = “fluid”; requires full-system licensing
- **Once FULLY LICENSED, a soft-partitioned server can run multiple instances of Oracle AT NO ADDITIONAL CHARGE**
- This was largely academic in the physical realm
- In the virtual realm, this could potentially cause concern: how many DBs can a customer squeeze onto one system?
 - Only the virtualization solution limits the # of DBs on a fully-licensed box
- **Oracle counts VMware as a SOFT PARTITION TECHNOLOGY**
 - Need to license “entire server”

Soft Partition License – In a Typical Blade Configuration

Example: A DRS Cluster with Oracle

- Four blades, each with 4 CPU cores; each VM is 2 vCPU (2-core)



“But Oracle tells me I have to license EVERY server in the ESX cluster!”

- Solution:
 - Both Oracle hosts must be licensed for all 8 cores on 2 blades
 - Same physical or virtual: $(8 \text{ cores}) \times (0.5 \text{ x86 factor}) = 4 \text{ licenses}$
 - Free to move that Oracle DB VM back and forth between Host 1 & 2
 - **Do not let Oracle DB VMs migrate to App Host 3 or App Host 4!**
 - Create VMware vCenter logical clusters to isolate Oracle hosts and comply
 - See Gartner Research Doc ID #G00165003 for similar guidance

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Benefits of Oracle Databases on VMware

Server Consolidation

- Fully utilize hardware
 - Maintain application isolation
 - Scale dynamically and right-size infrastructure
-

Rapid Provisioning

- Streamline activation, deployment, and validation of servers
 - Avoid manual configuration errors
-

Workload Management

- Zero downtime maintenance
 - Migrate live databases
 - DRS
-

High Availability

- VMware vMotion, HA
 - Without clustering or RAC
-

Business Continuity

- VMware vCenter™ Site Recovery Manager
- Hardware reduction at failover site
- Comprehensive testing of DR solution

Summary

- Performance is not an issue anymore
 - Get immediate ROI by deploying Oracle databases on vSphere
 - DBAs should not fear virtualization; their skills are fully transferable
 - Both production DBAs and database architects include VMware virtualization
- Use vMotion and Dynamic Resource Scheduler to manage your Oracle environment
 - Without vMotion, how can DBAs perform zero downtime maintenance
 - Customize DRS to meet business needs
- Use VMware Hot Add CPU feature without restarting the Oracle Database or the Virtual Machine
- Don't leave your database non-virtualized or the business is exposed
- Virtualization should be part of a customer's compliance strategy
- Yes we have an Oracle support statement **249212.1** –
Now with **RAC 11.2.0.2** included



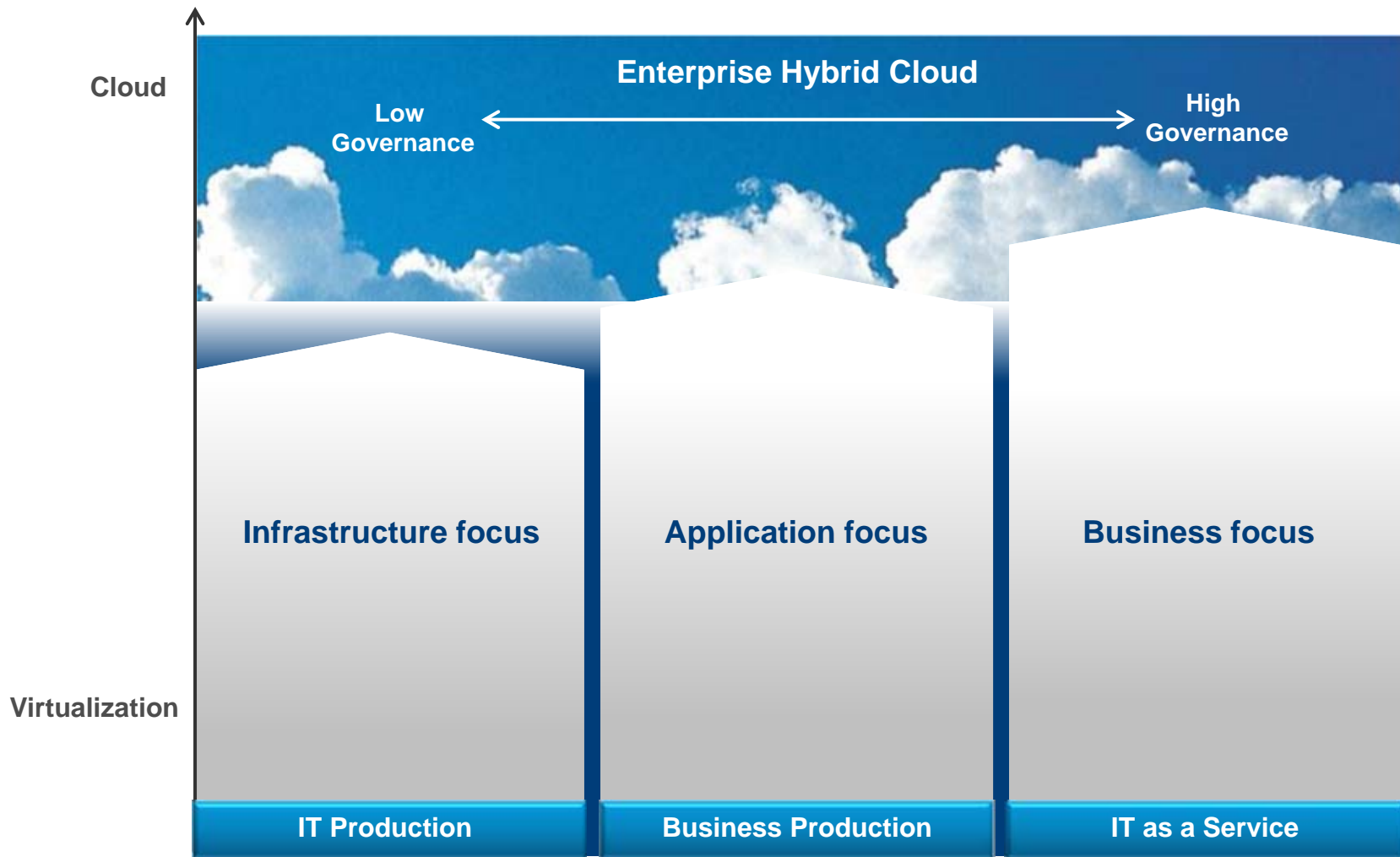
Thank you!

<http://www.vmware.com/oracle>

<http://blogs.vmware.com/apps/oracle/>

Q&A

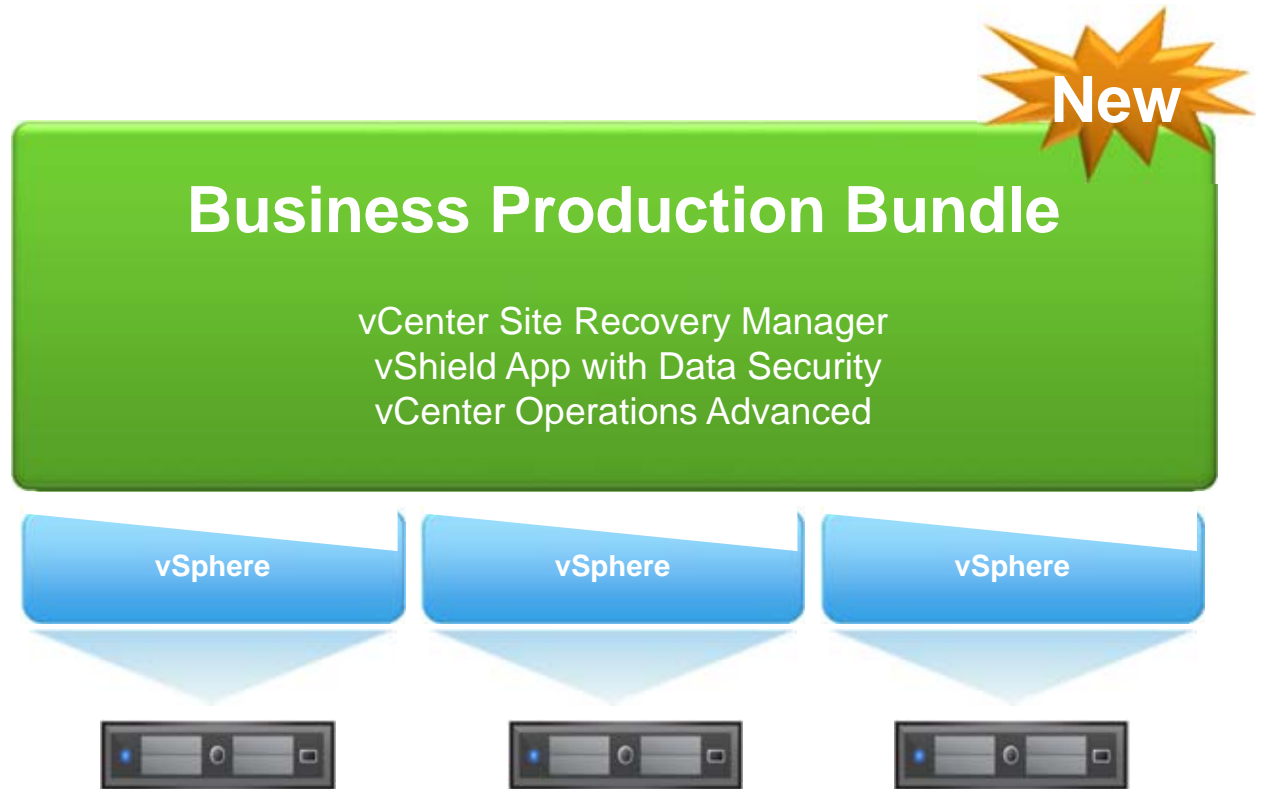
Journey to IT Transformation – Accelerate and Amplify



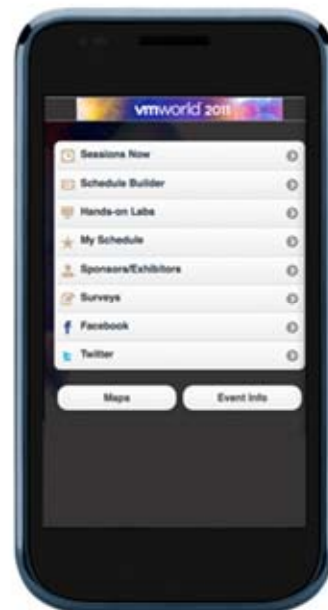
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Maximize the benefits of virtualizing business critical applications

- ✓ Automated Disaster Recovery
- ✓ Dynamic Security
- ✓ Automated Operations



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