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BEST PRACTICES FOR VIRTUALISING ORACLE DATABASES

REPLATFORMING, COST REDUCTION & PERFORMANCE BENEFITS

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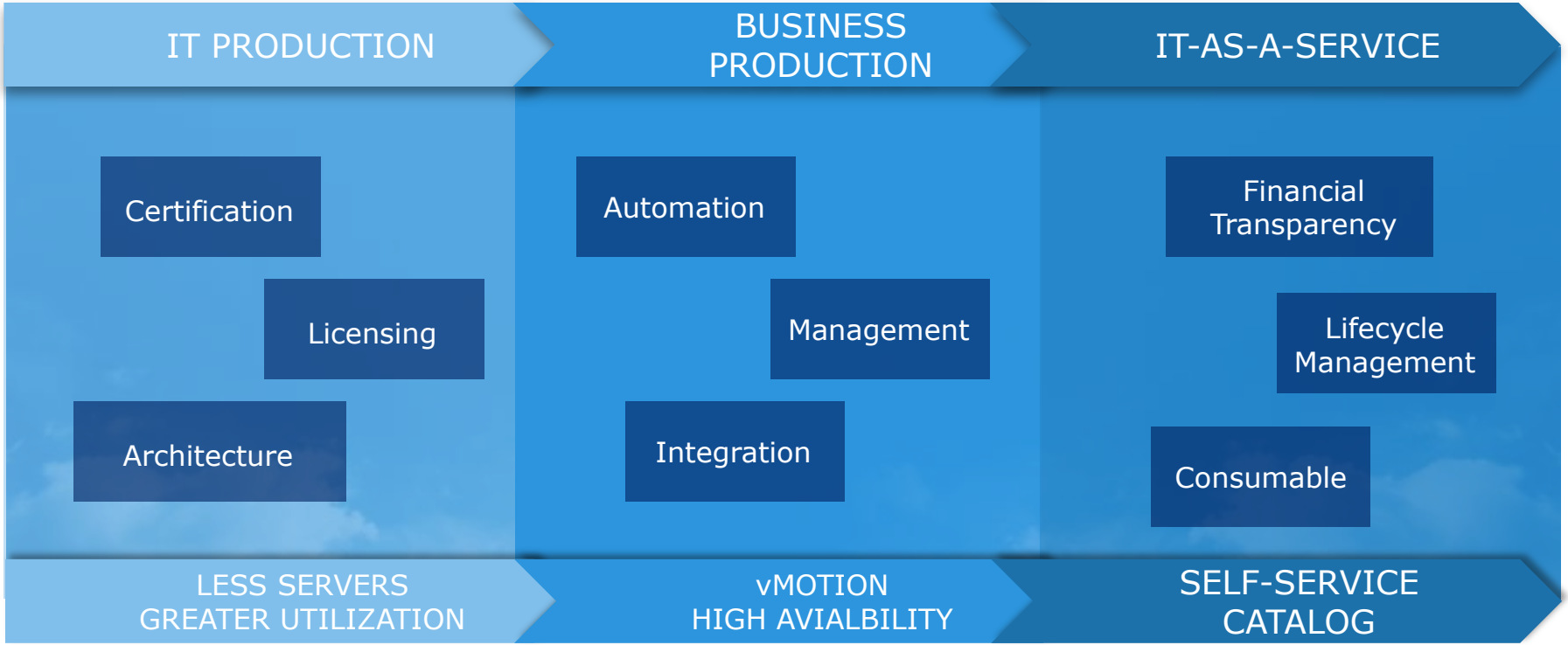
Virtualization Conversation



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Database re-platforming: Goals

1. *Maximize use of license investment*
2. Maintain or (better even) improve performance
3. Reduce downtime / increase SLAs
4. Avoid Vendor lock-in
5. Simplify server & storage refresh cycles
6. Speed up provisioning of new databases
7. Improve security, compliance and auditing
8. Simplify management

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Why look at licensing?

- Oracle DB licensing is expensive
  - Midsize server (24 cores):

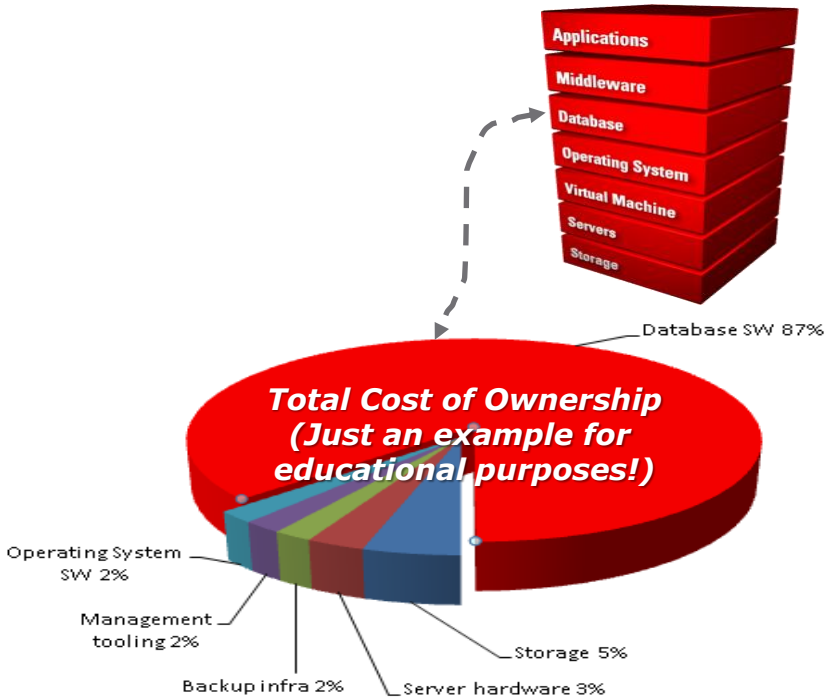
  HW ~ $ 50,000

  SW ~ $ 483,000 @ 50% discount

  5Y maintenance ~ $531,000

  (Enterprise Edition + basic options)

  - What if we add RAC? Active DG? Pluggable DB?
- Large part of the TCO of a database infrastructure stack



If we can save 10% on db licenses…
We easily justified 50% more expensive infrastructure

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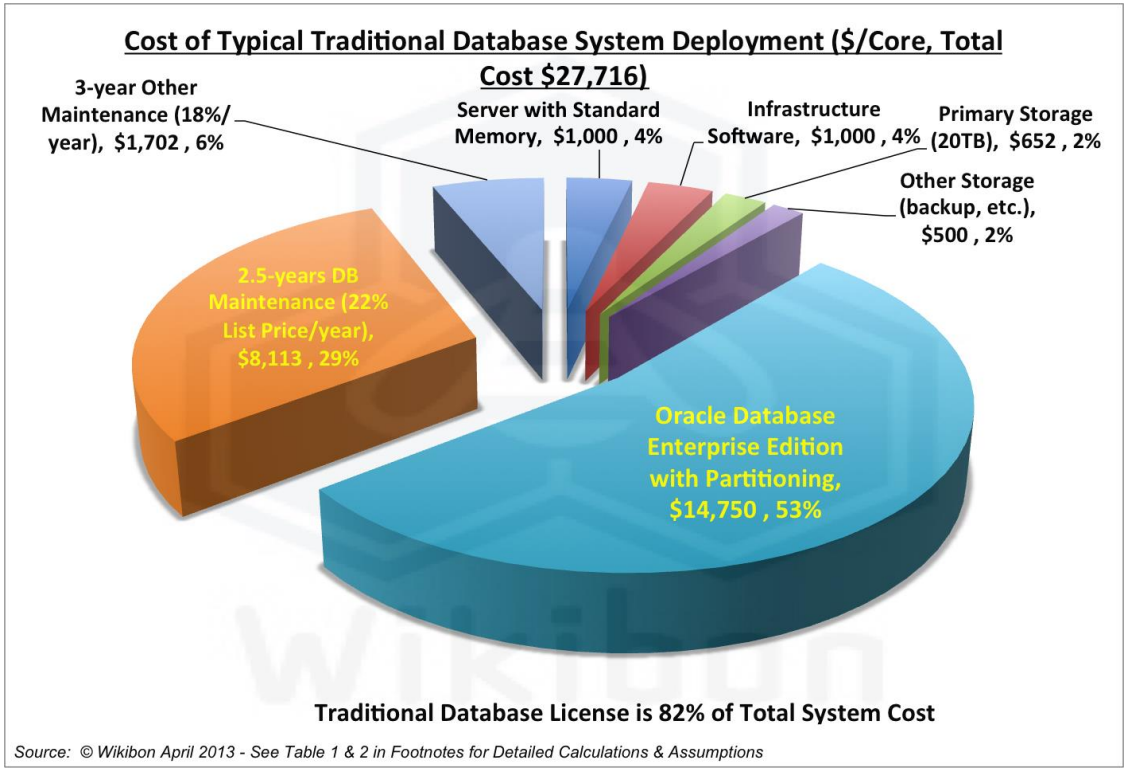
Validation: Wikibon Research



Wikibon Article: [Virtualization of Oracle Evolves to Best Practice for Production Systems]

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Before we start…

Beware of the license demon

100% SURE YOU ARE COMPLIANT?

ORACLE LICENSE MANAGEMENT SERVICES

If needed…
Bring in the superheroes
They help you with licensing & legal issues

LC

Licenseconsulting.eu

House of Brick TECHNOLOGIES

House of Brick Technologies

Madora Consulting

Madora Consulting UK

EMC²

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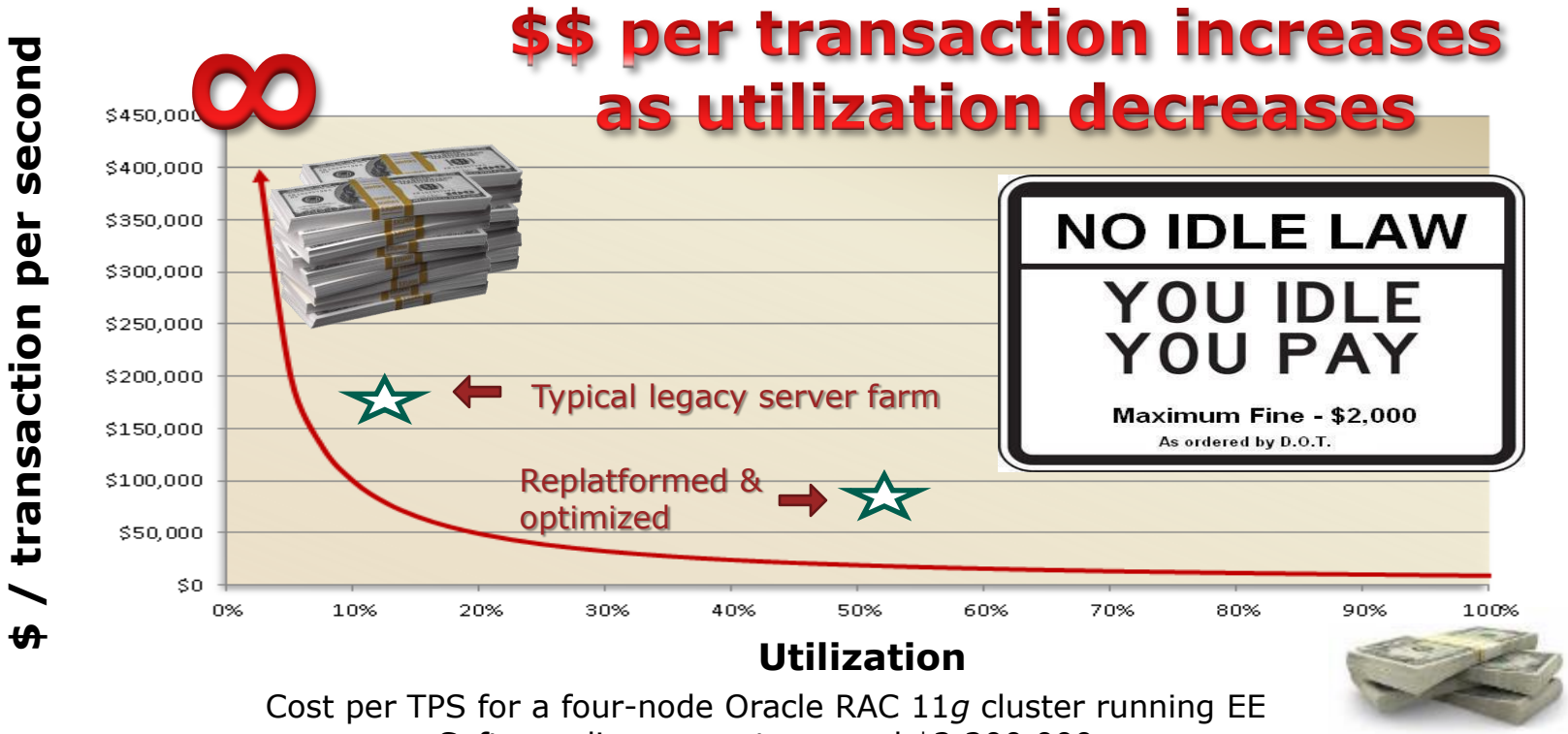
Transaction cost vs. utilization



Cost per TPS for a four-node Oracle RAC 11*g* cluster running EE
Software license cost: around $2,200,000
TPS: Around 4,000 at peak utilization

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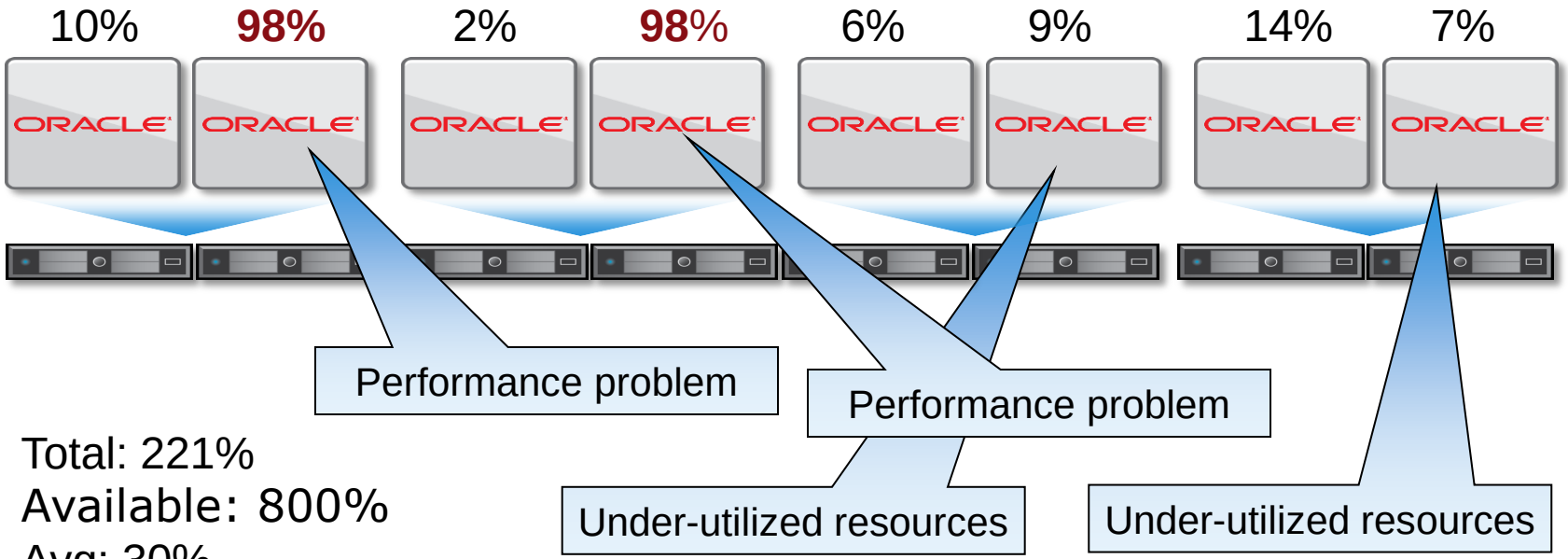
Classic problem of resource management

(applied to DB processing power)



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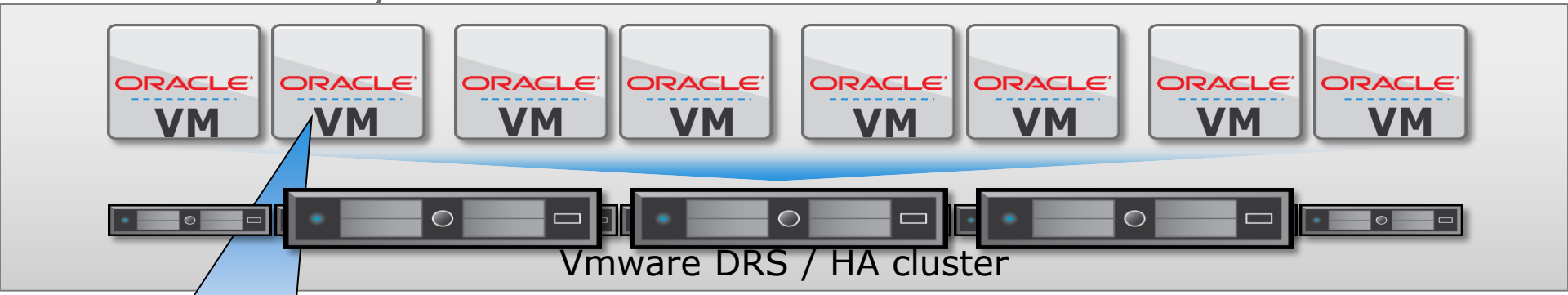
Resource Management

"Mainframe style"



Assign CPU & memory "shares" to guarantee Production SLAs

Move CPU resources / workloads where needed

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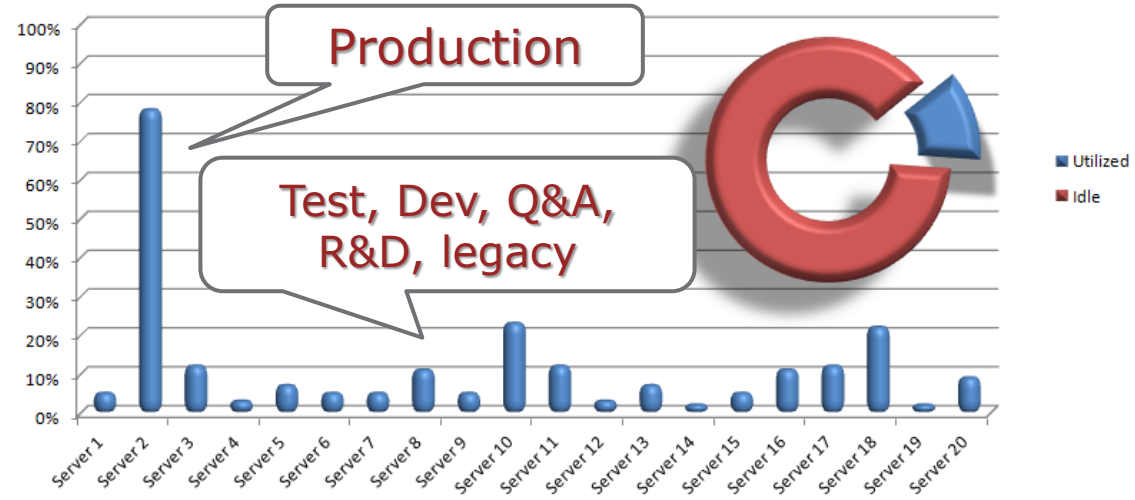
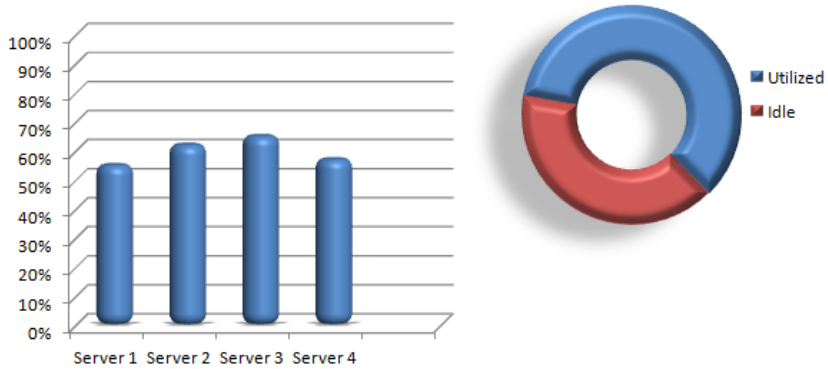


Typical legacy database server farm:

- Physically deployed
- Oversized
- Outdated platforms
- Very poor CPU utilization
- IO & CPU bottlenecks
- Servers running mix of:
  - Apps, middleware & DB
  - Tooling
  - Replication & Backup



Optimized database server farm:

- Virtualized
- Significantly less CPUs on Modern HW
- High average CPU utilization
- No I/O bottlenecks
- Sized correctly
- Servers running ONLY Oracle
- Minimal required licenses & options

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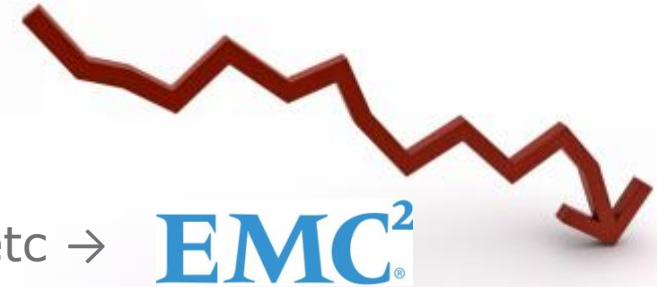
5 steps to TCO reduction

Getting the best Return on Investment



1. Replatform for lowest $ / transaction
   - And eliminate I/O problems, backup, etc → EMC²
2. Virtualize servers to drive up CPU utilization
3. Remove unnecessary licensed options
   - Or go to different license model (i.e. Standard Edition)
4. Only run DB transactions on licensed CPU
5. Re-negotiate license contracts → Madora Consulting
   - Suspend maintenance, etc
   - Avoid non-compliance, audits, support issues, …

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ROAD BLOCK #1: SUPPORT

ORACLE NOT SUPPORTED ON VMWARE?

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My Oracle Support note 249212.1

Purpose

Explain to customers how Oracle supports our products when running on V

Scope & Application

For Customers running Oracle products on VMware virtualized environment

Support Status for VMware Virtualized Environments

Oracle has not certified any of its products on VMware virtualized environments. Oracle Support will assist customers running Oracle products on VMware in the following manner: **Oracle will only provide support for issues that either are known to occur on the native OS, or can be demonstrated not to be as a result of running on VMware.**

If a problem is a known Oracle issue, Oracle support will recommend the appropriate solution on the native OS. If that solution does not work in the VMware virtualized environment, the customer will be referred to VMware for support. **When the customer can demonstrate that the Oracle solution does not work when running on the native OS, Oracle will resume support, including logging a bug with Oracle Development for investigation if required.**

If the problem is determined not to be a known Oracle issue, we will refer the customer to VMware for support. When the customer can demonstrate that the issue occurs when running on the native OS, Oracle will resume support, including logging a bug with Oracle Development for investigation if required.

NOTE: Oracle has not certified any of its products on VMware. **For Oracle RAC, Oracle will only accept Service Requests as described in this note on Oracle RAC 11.2.0.2 and later releases.ment**

Oracle Support will assist customers running Oracle products on VMware
… in the following manner…

Source: My Oracle Support website, VMware Oracle Support Statement

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Is Oracle certified to run on VMWare?

By Mike Dietrich-Oracle on Jan 17, 2011

This question in similar occurences gets asked during ***every*** **Upgrade Workshop** at least once. People would like to know if they can run an **Oracle Database** or **Oracle Real Application Clusters** or **Oracle Grid Control** or **Oracle Fusion Middleware** or ... in an VM environment with **VMWare's virtualisation products**.

And the answer is: **Yes, you can!! But** ... there's a **fine print** you should take care on before setting up virtual environments with a different solution than XEN based **Oracle VM**.

Please read **Note:942852.1 - VMWare Certification for Oracle Products** and **Note:249212.1 - Support Position for Oracle Products Running on VMWare Virtualized Environments** for further details:

Oracle blog:
Is Oracle certified
to run on VMware?

Comments:

Considering the fact that Oracle is probably the most expesive database available in the market these days, I would think that they would be a little more mature to try and support VMware.

Posted by **Charl** on January 18, 2011 at 11:56 PM CET #

Charl, thanks for your comment - and I believe there's a misunderstanding because of the wording sequence of the support note. We DO SUPPORT Oracle on VMware environments. You just have to take into consideration in case of a failure that it could happen that you'll have to be able to reproduce misbehaviour of an Oracle product

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ROAD BLOCK #2: LICENSE COST

LICENSE COST HIGHER ON VMWARE VS PHYSICAL OR OTHER HYPERVISORS?

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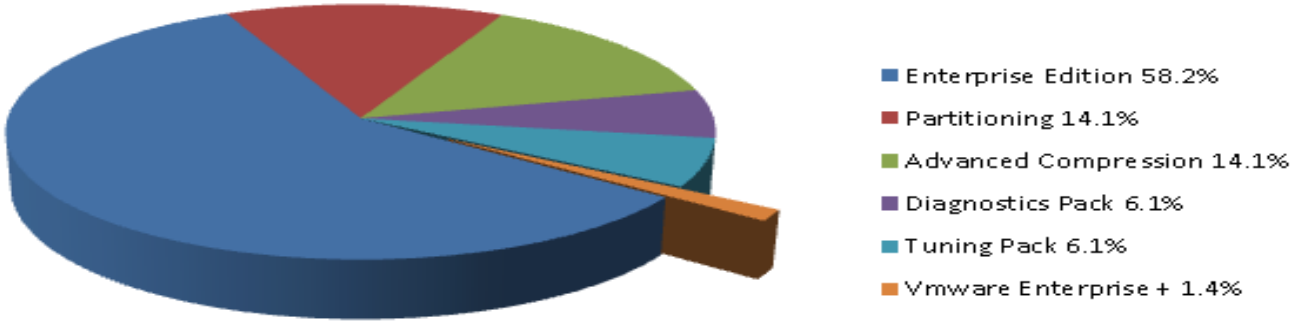
VMware - Expensive?



- Vmware licenses make up less than 2% of total SW licensing
- Will even be lower if you go to 8 cores/socket (common)
- Or if you use Oracle RAC or other additional options

Server: Dual-Socket, 12 core X64
DB licenses: Oracle Enterprise + Partitioning + Advanced Compression + Diagnostics & Tuning pack
VMware licenses: Enterprise Plus (most expensive type)

Based on publicly available list pricing - All other costs (HW&SW) ignored for simplicity

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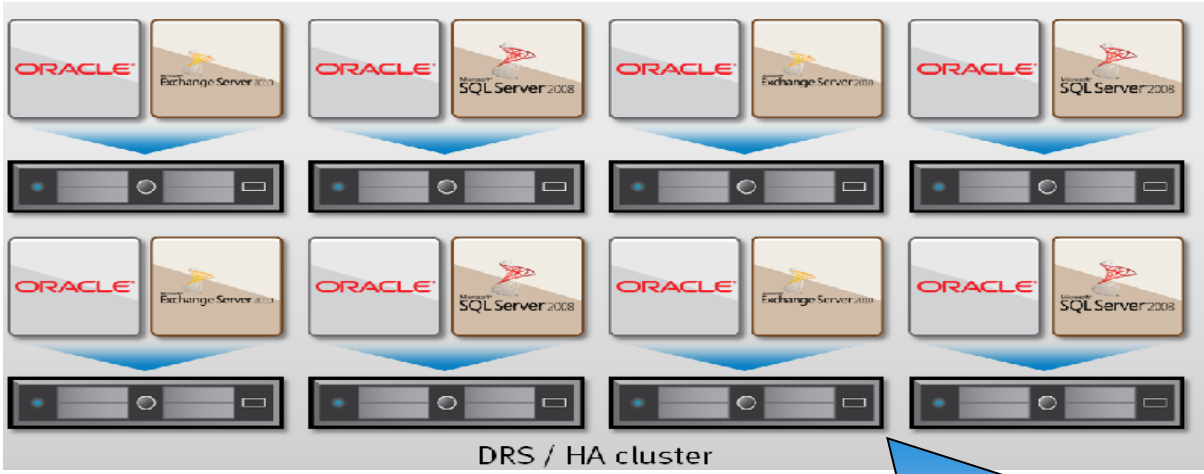
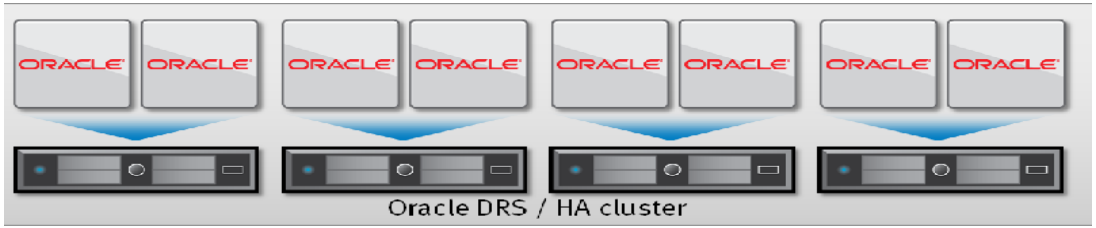
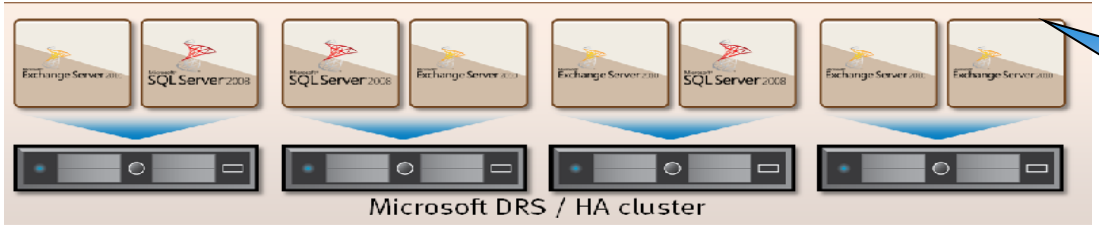


Poorly managed licensing
(Expensive – requires 8 servers fully licensed)





Well managed licensing
(Savings – only requires 4 servers fully licensed)

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ROAD BLOCK #3: SCALABILITY

MAXIMUM WORKLOAD ON A SINGLE VM

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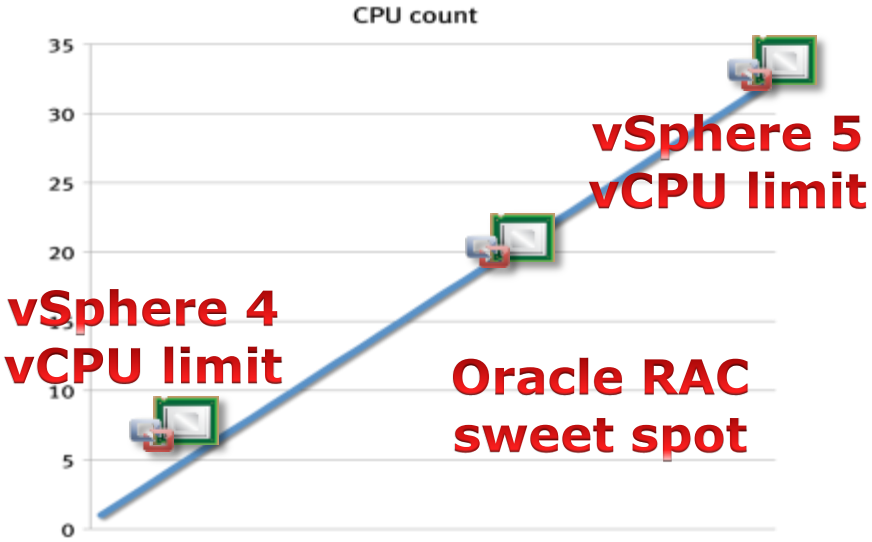
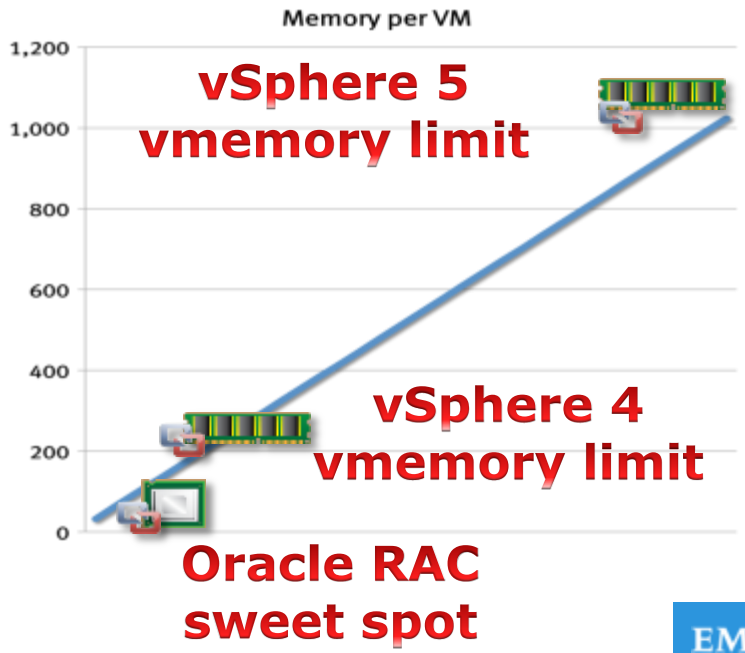
vSphere 5 - limits on vCPUs and memory

vSphere 6: 128 vCPU / 4 TiB memory per VM





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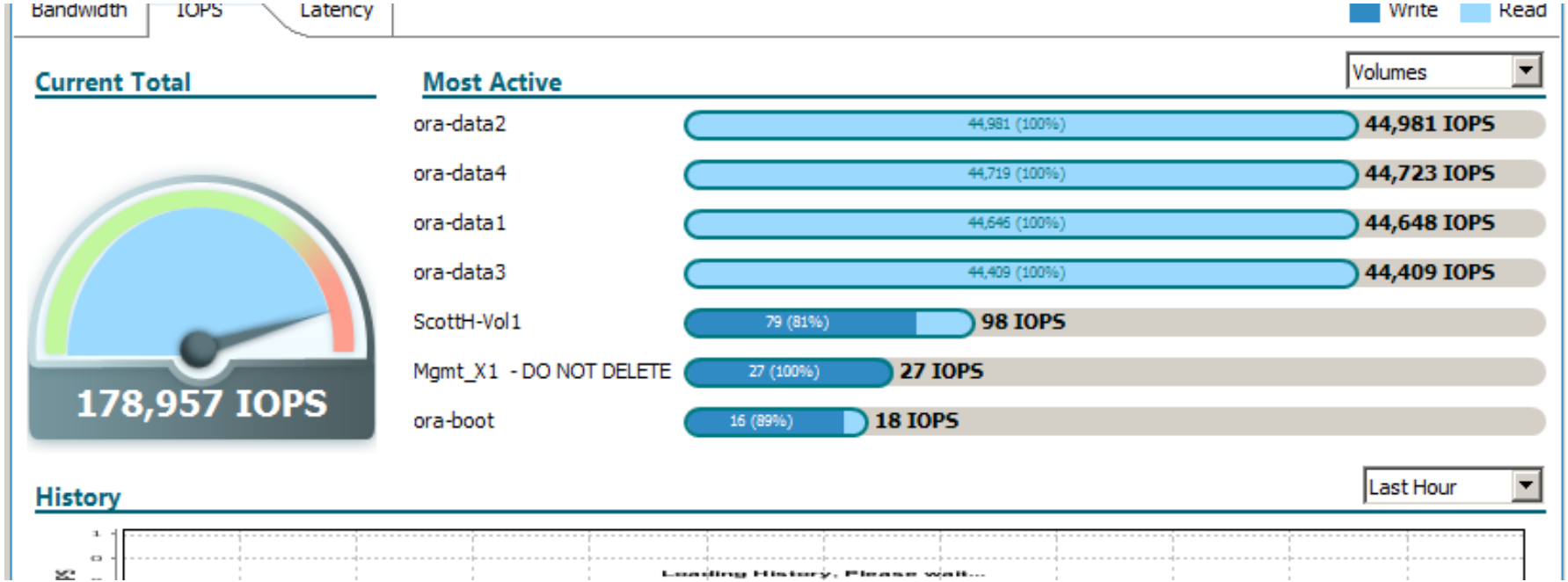
Performance example with SLOB

Lab test: 1 v2.4 X-Brick, 3 VM's Oracle 11.2.0.4.0, VMDKs



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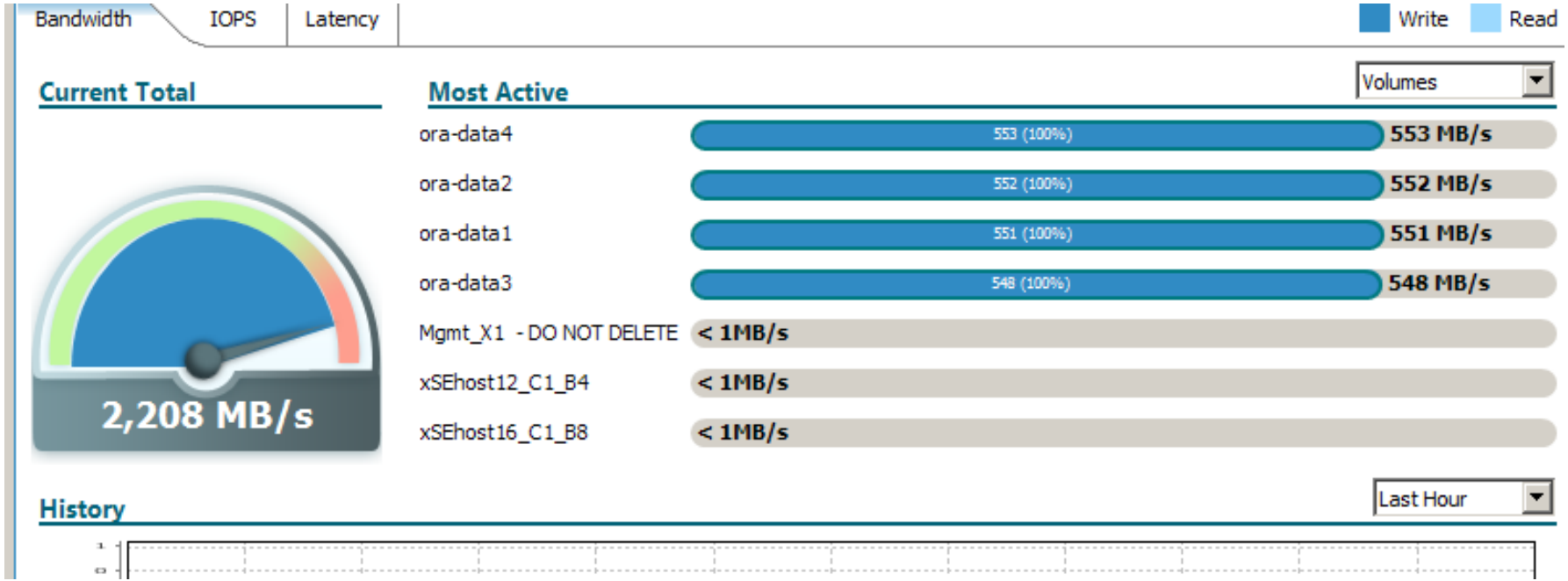
Performance example with SLOB

Bandwidth



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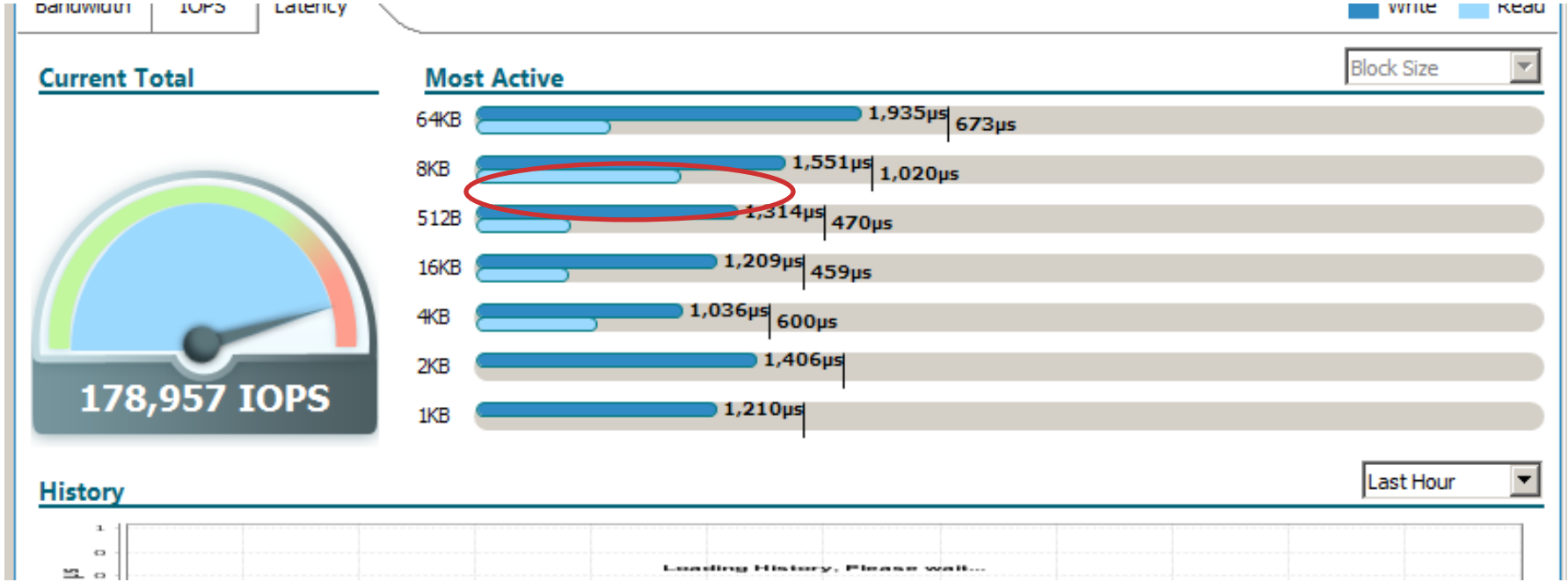
Performance example with SLOB

Latency (nearly all I/O is 8K random)



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ROAD BLOCK #4: OVERHEAD

PERFORMANCE IMPACT OF VIRTUALIZATION

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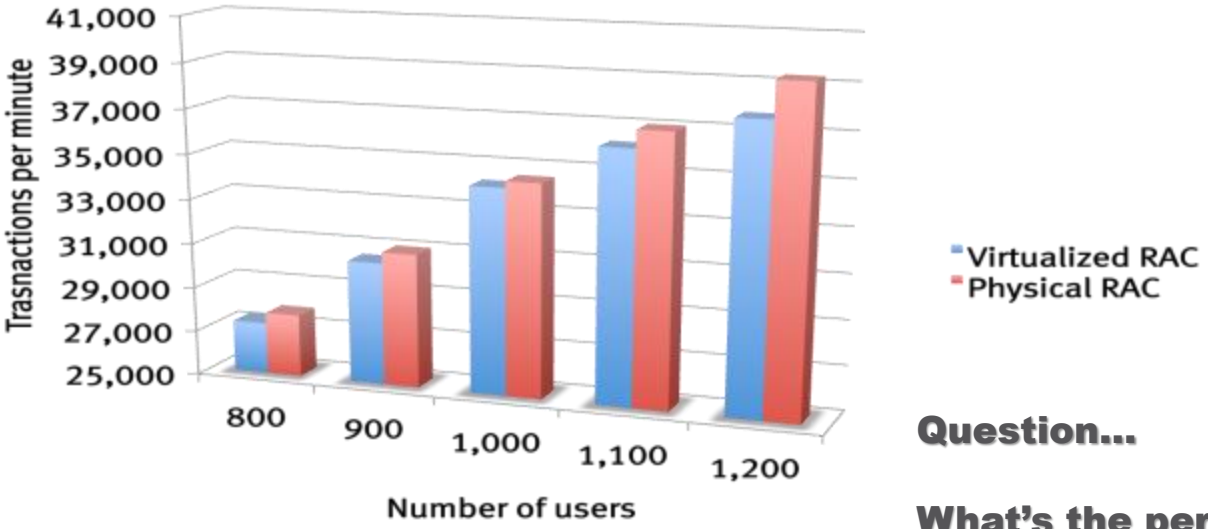
Performance overhead physical vs. virtual

EMC IT analysis: ~ 4% (vSphere 5.1!)



Question…

What's the performance overhead of:

- **Oracle RAC ?**
- **Host replication ?**
- **Advanced Compression ?**
- **Transparent table encryption ?**

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ROAD BLOCK #5: PLATINUM SUPPORT

ONE STOP SHOPPING FOR SUPPORT?

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VMware extended support for oracle

Total Ownership

VMware Support will accept accountability for any Oracle-related issue reported by a customer. By being accountable, VMware Support will drive the issue to resolution regardless of which vendor (VMware, Oracle, or others) is responsible for the resolution. In most cases, reported issues can be resolved via configuration changes, bug fixes, or feature enhancements by one of the involved vendors.

In the rare situation that another vendor is unable or unwilling to provide a satisfactory technical resolution, VMware Support will immediately notify the customer, assist in escalation and explore other potential technical workarounds with the customer.

VMware will also assist its customers with technical issues for other Oracle software products, besides the Oracle Database and provide similar escalation assistance if needed.

Besides technical assistance, VMware Support will advocate on the customer's behalf to:

- Provide any relevant evidence that virtualization does not play a part in the Oracle product technical problem
- Engage Oracle Support in resolving the customer's technical issue, escalating management attention as appropriate

http://www.vmware.com/support/policies/oracle-support.html

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EMC support for Oracle on VMware

EMC E-Lab and VMware have tightly collaborated on support for use of Oracle Database 11g in VMware environments. This includes extensive testing and qualification of VMware virtualization software with EMC and Oracle technologies, combined with EMC and VMware joint support.

In addition, EMC and VMware have documented a series of Proven Solutions which outlines how to design, deploy, and manage VMware virtualization software in EMC and Oracle environments. Through seamlessly integrating VMware into EMC and Oracle environments, IT organizations can dramatically increase hardware utilization, consolidate servers, and improve efficiency.

http://www.emc.com/solutions/application-environment/oracle/oracle-virtualization-vmware.htm

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ROAD BLOCK #6:
NO INTEGRATED STACK

OPTIMIZED SYSTEM FOR DATABASE WORKLOADS?

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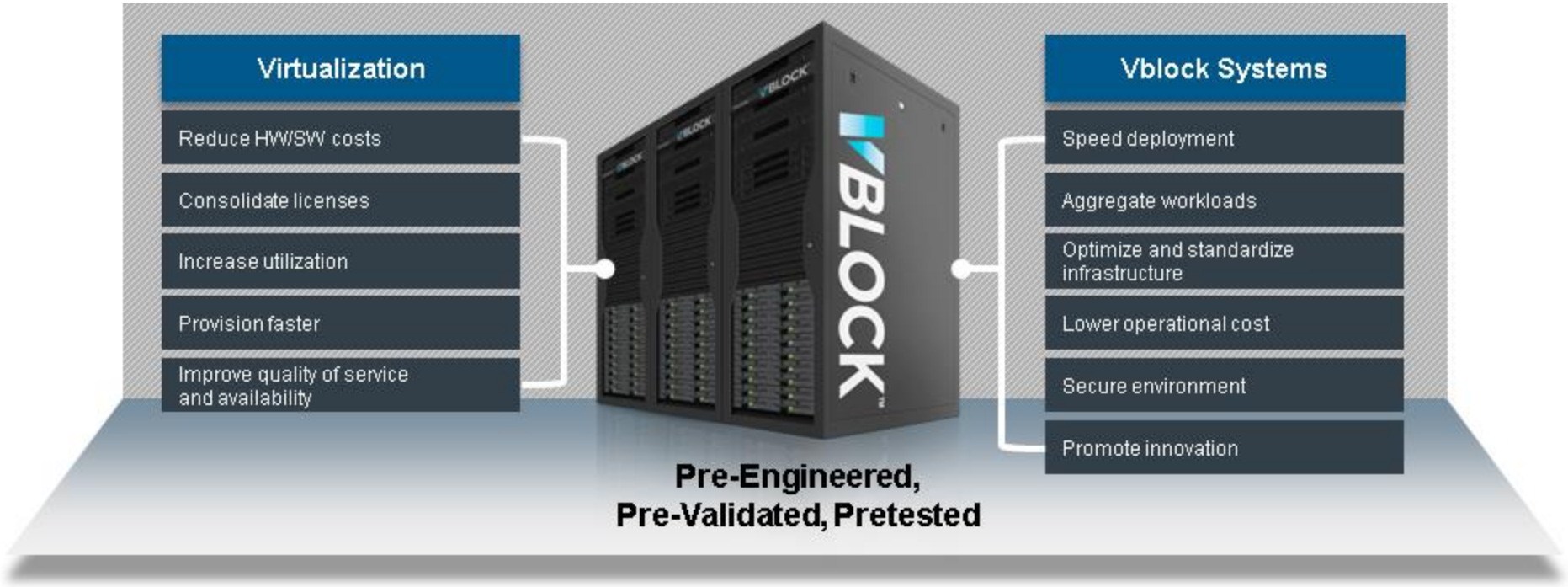
EMC/VCE VBLOCK OPTIMIZED SYSTEM

Single SKU – All-Flash - optimized for database workloads



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Oracle on VMware

Best practices and guidelines

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Avoid compliancy issues

Make sure you are ALWAYS compliant with licensing

- Prohibit illegal live migrations
  - IO fencing, rules, network isolation
- Audit movements
  - Insurance policy against the license police
- Be careful with management tools
  - Vcenter 6.x & cross-cluster migrations? (!)
- Know the rules
  - 10-day rule? Sub-server partitioning? SE vs EE? CPU based vs NUP? Etc etc.
  - Don’t hesitate to hire external license consulting (LMS audits can be much more expensive)
- CxO / IT management: Make your DBA team responsible for being compliant
  - Let them report every 6 months

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Capitalize on better infrastructure

Replace or enhance expensive licensed options where possible

- Advanced Compression -> Storage compression
  - Works for ALL data
  - No additional license
- RAC -> VMware HA
  - Reduces complexity, improves performance and eliminates $$$ license
  - No free lunch: HA is active/passive (failover = few minutes, crash restart)
- Active Data Guard -> SAN replication
  - Replicate an ENTIRE Business Landscape AT ONCE (1 point of control)
  - RELIABLE (zero dataloss or async – but always consistent), independent from DB, OS, Server, etc
  - Improves failover/failback scenarios (no standby rebuild)
  - No Force Logging or even archive logging required

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Choose the best CPU available

Based on $/transaction (TPC-C per core)

CPU power

- The more powerful the CPU is per core, the more workload you can run with the same footprint (Without adding licenses!)

Memory size

- Oracle runs better with lots of RAM (SGA)
- More RAM allows more VM's per host

TPC-C benchmark for OLTP

- The industry standard – but not all servers listed (Oracle "Engineered" systems are missing…)
- If you're creative you can find similar CPUs and their TPC ratings – or look at SPEC ratings to compare CPU power

Powerful CPU cores are more efficient

- High TPC-C and/or SPEC ratings will allow you to drive higher consolidation ratios - And provide better performance

Minimize overhead where possible

- VMware: 4% (verified by EMC) – vSphere 5.1 (!)
- Oracle RAC – 10%? (conservative estimate)

Processor types and TPC ratings	TpmC/Core
Intel X5690	87758
Intel E7-8870	63199
Intel E5-2690	100574
Intel E5-2643	100574

Note: Intel E5-2697v2 ~ 115,000 TpmC/Core (estimate)
Intel E5-v3 ~ 125,000 TpmC/core (estimate)
SPARC T5 ~ 66,800 TpmC/Core (used in SPARC Supercluster T5)
IBM POWER 7+ ~ 150,000, POWER 8 200,000+ (but beware of core factor)

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Eliminate I/O bottlenecks

- Driving up CPU utilization only possible if we can feed data quickly enough to/from the CPU
  - Some apps need high bandwidth (measured in Mbyte/s)
  - Some apps need many IOPS (I/Os per second) at low latency
- Traditional "spinning disk" storage is limited
  - Disk Capacity is high, bandwidth and latency is poor
- Solution: Flash based storage
  - Either Hybrid Disk + Flash or All-flash
- Typical All-flash Array metrics:
  - 100,000's of IOPS @ sub-millisecond latency
  - Many Gigabytes/s bandwidth
  - Not sensitive to mixed workloads
  - Some beneficial side effects (inline compression, de-duplication, zero-overhead snapshots, …)

VMAX3

XtremIO

ORACLE DATABASE

EMC²

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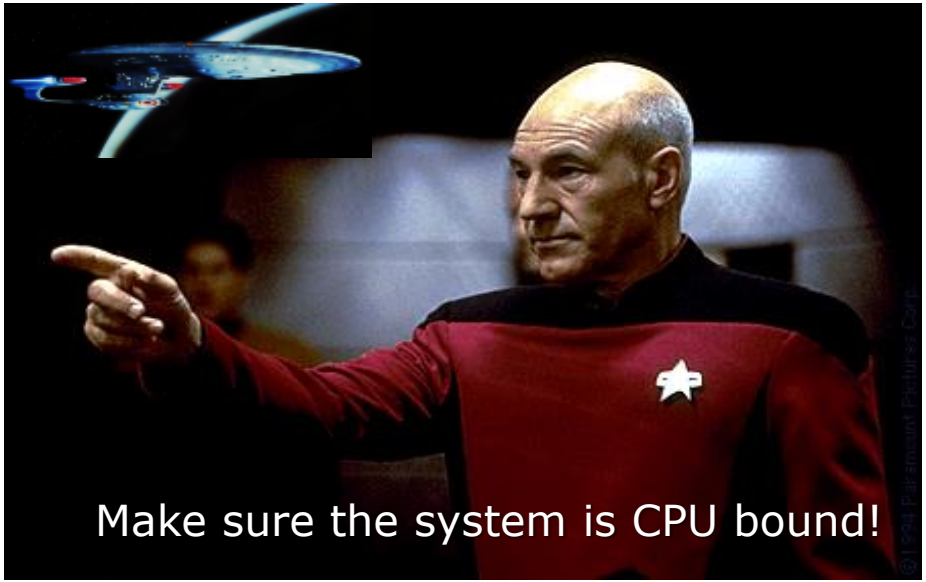
Databases shouldn't have high I/O wait

- Adding CPU does not speed up I/O bottlenecks
  - Memory does somewhat
- IOPS are relatively (!) cheap
- CPU cycles are expensive
  - Because of licenses
- Consolidation leads to
  - Higher IO requirements
  - I/O bottlenecks
  - Bandwidth issues
- Flash storage can solve these limitations



STORAGE IS NO LONGER THE BOTTLENECK

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Other Best Practices for virtualizing Oracle

- Enable hugepages
- Tune NUMA settings
- Honour storage best practices
  - Data layout
  - Disk alignment
  - Multipath/IO balancing
- No parasite workloads
  - Middleware / apps
  - Monitoring agents
  - Replication/mirroring etc
  - ETL
- Run standardized benchmarks
  - Not (only) your own app
  - SLOB for I/O
  - Swingbench for CPU
- Run failure tests
  - Kill a physical server
  - Pull an FC cable
  - … etc
- Use Virtualization-aware management tools

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Enjoy freedom of choice

Break dependency from the lock-in dragon

- What's a Virtual Machine anyway?
  - Configuration files
  - Data set
- Both can be moved to other platforms
  - Different hypervisors
  - Different servers
  - Different storage

(But… Keep running on EMC ;-)

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"Oracle as a Service"

Next Steps into the Cloud- "Database as a Service"

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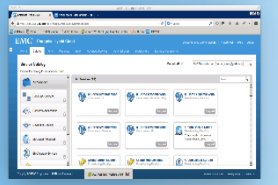
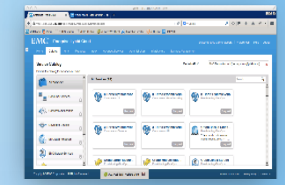
Cloud Enabled Infrastructure



OLTP, Mix Workload, Batch, DW,
Big Data, NoSQL



Operational Management
Infrastructure

Self-Service and Automation
Cloud

Financial Transparency
Solution

CA and DR
VPLEX
RecoverPoint

VIRTUALIZED Infrastructure
vSphere
ViPR
NSX

Backup and Recovery
Data Domain
Avamar

vmware®
vCloud® Air™
vCloud Air™ Network

VBLOCK
VXBLOCK
VXRACK

Accelerated Deployment
Converged Infrastructure

EMC² SYMMETRIX VMAX
EMC² ISILON
EMC² XtremIO
SCALEIO
EMC² VNX SERIES

BYO

Delivering Best of All Worlds

EMC² Pivotal RSA VCE virtustream vmware

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EMC & VMware Deep Integration

Enabling A Superior Private Cloud Environment

AUTOMATED PROVISIONING

Integrations between EMC VMAX, VNX, Avamar & Data Domain and VMware vRealize

Integrations between EMC VMAX, VNX & Virtual Storage Integrator (VSI) and VMware vCenter

SELF-SERVICE

VMware vRealize Self-service Portal

MONITORING

Integrations between EMC Storage Analytics and VMware vCenter Operations Manager & Log Insight

METERING & CHARGEBACK

VMware vRealize Automation Center & vCenter Chargeback and IT Business Management
Suite

SECURE MULTI-TENANCY

VMware vRealize Automation Center

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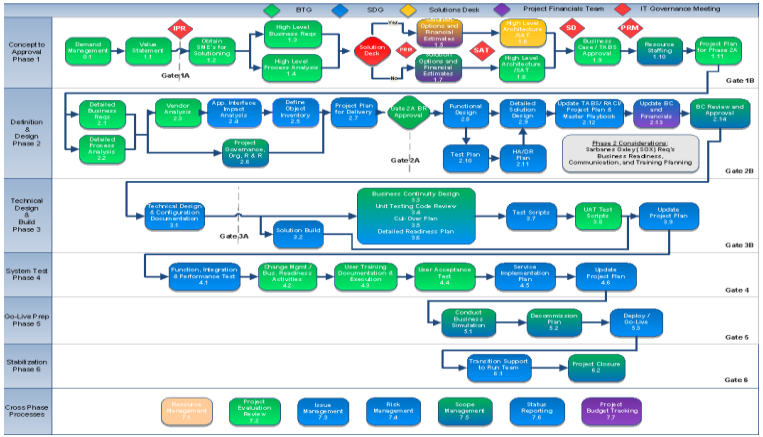
EMC IT: Past vs. Present

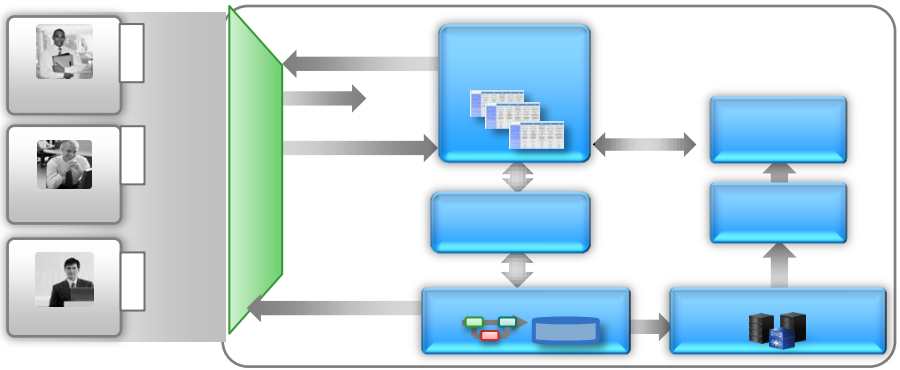
Strategy → **Design and Approve** → **Order Equipment** → **Build** → **Test** → **Deploy**

Previous Timeline: ~4 Months



Custom Configurable
Manual Solution

New Timeline: < 1 Hour



Standard Automated
Delivered

Order and Build On Demand

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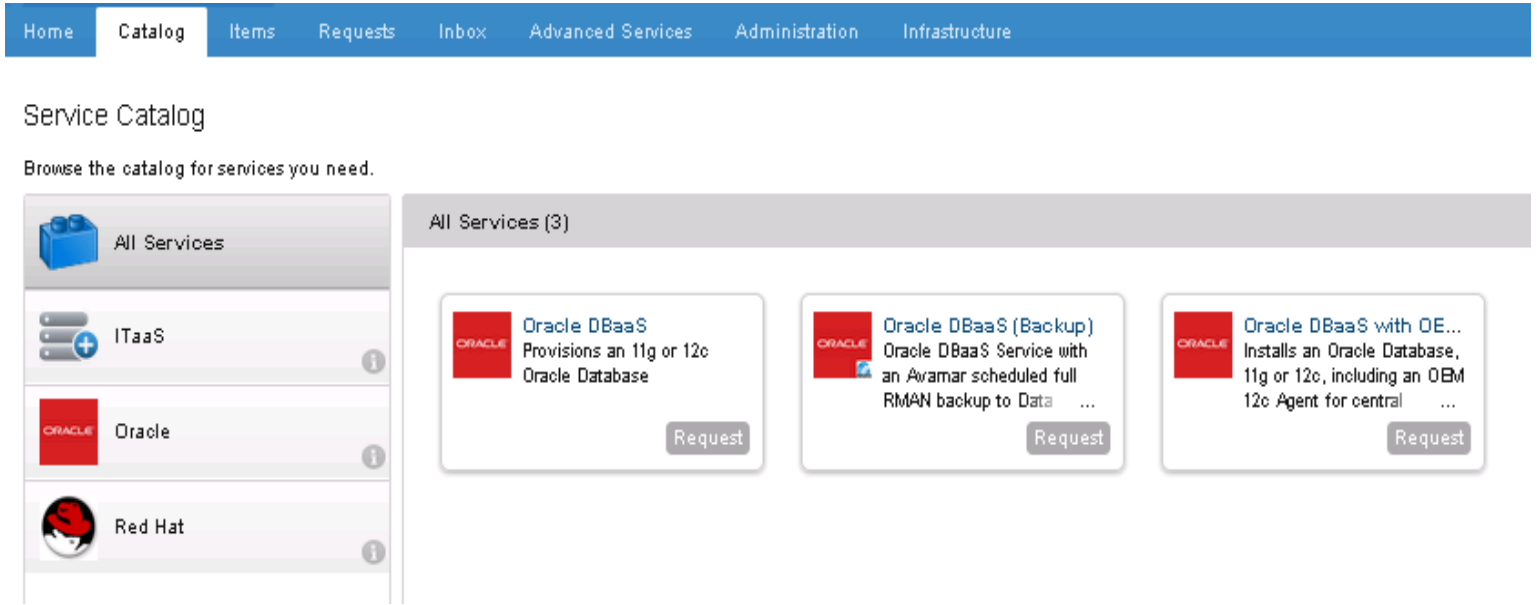
Enabling and Provisioning Oracle DBaaS

vRealize Automation Service Catalog



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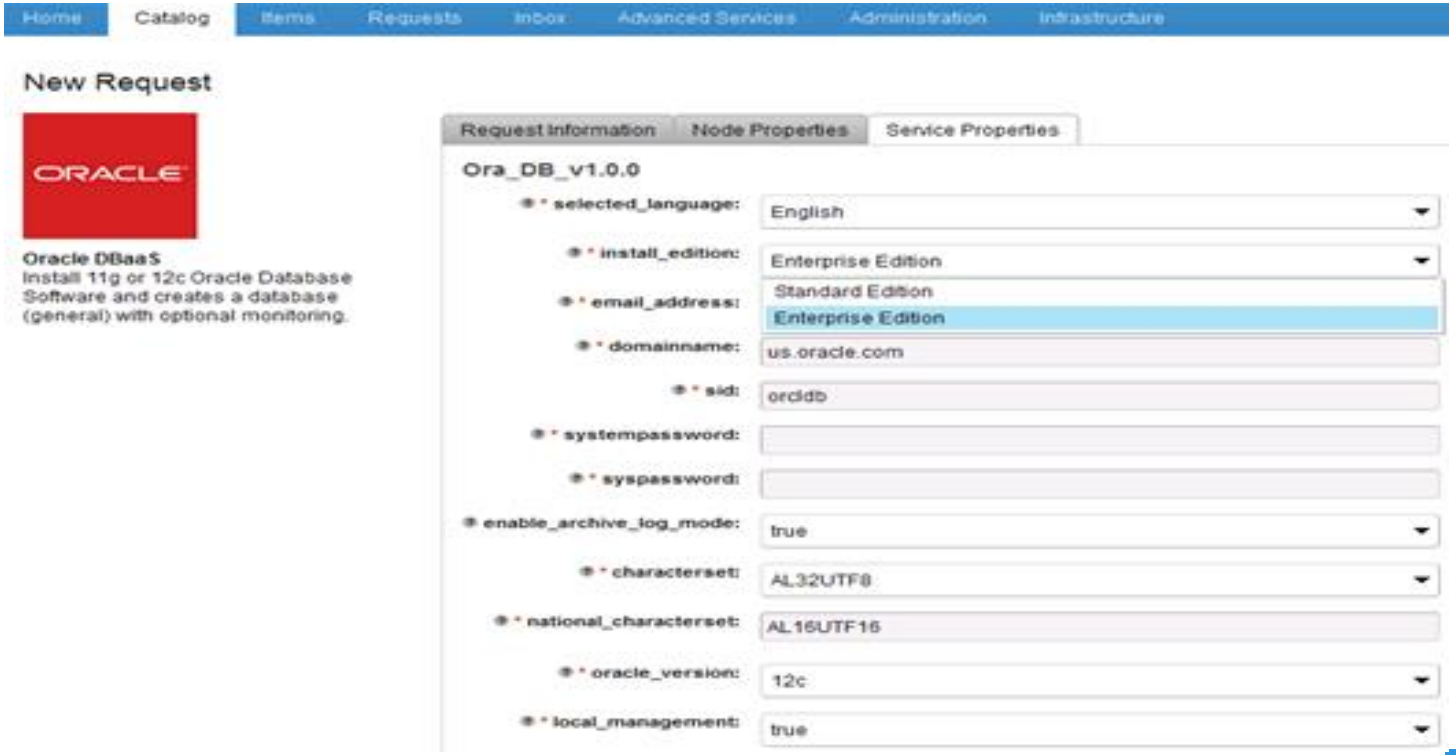
Enabling and Provisioning Oracle DBaaS

Provisioning an Oracle database – Day 1



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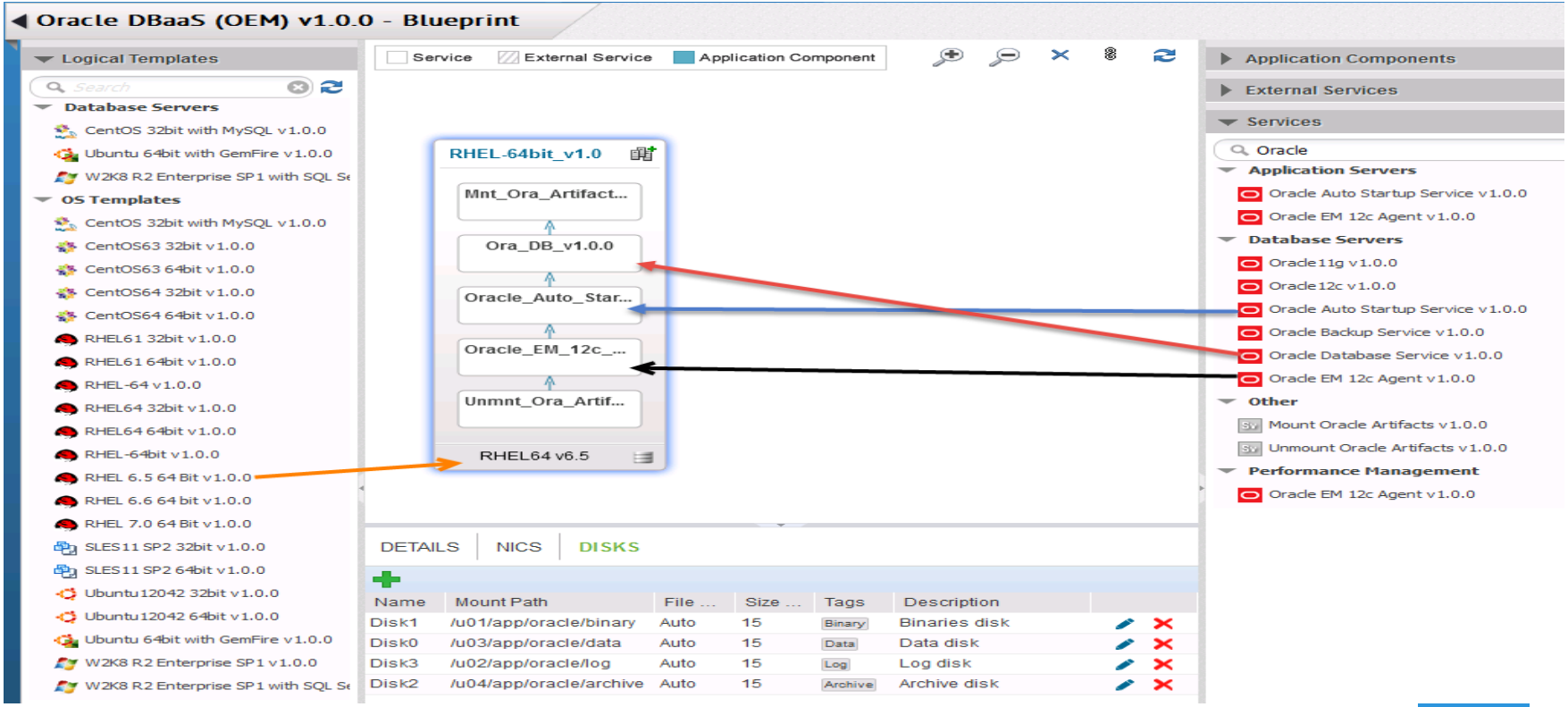
Oracle DBaaS Enabling and Provisioning

vRealize Automation Application Services – *Application Blueprint*



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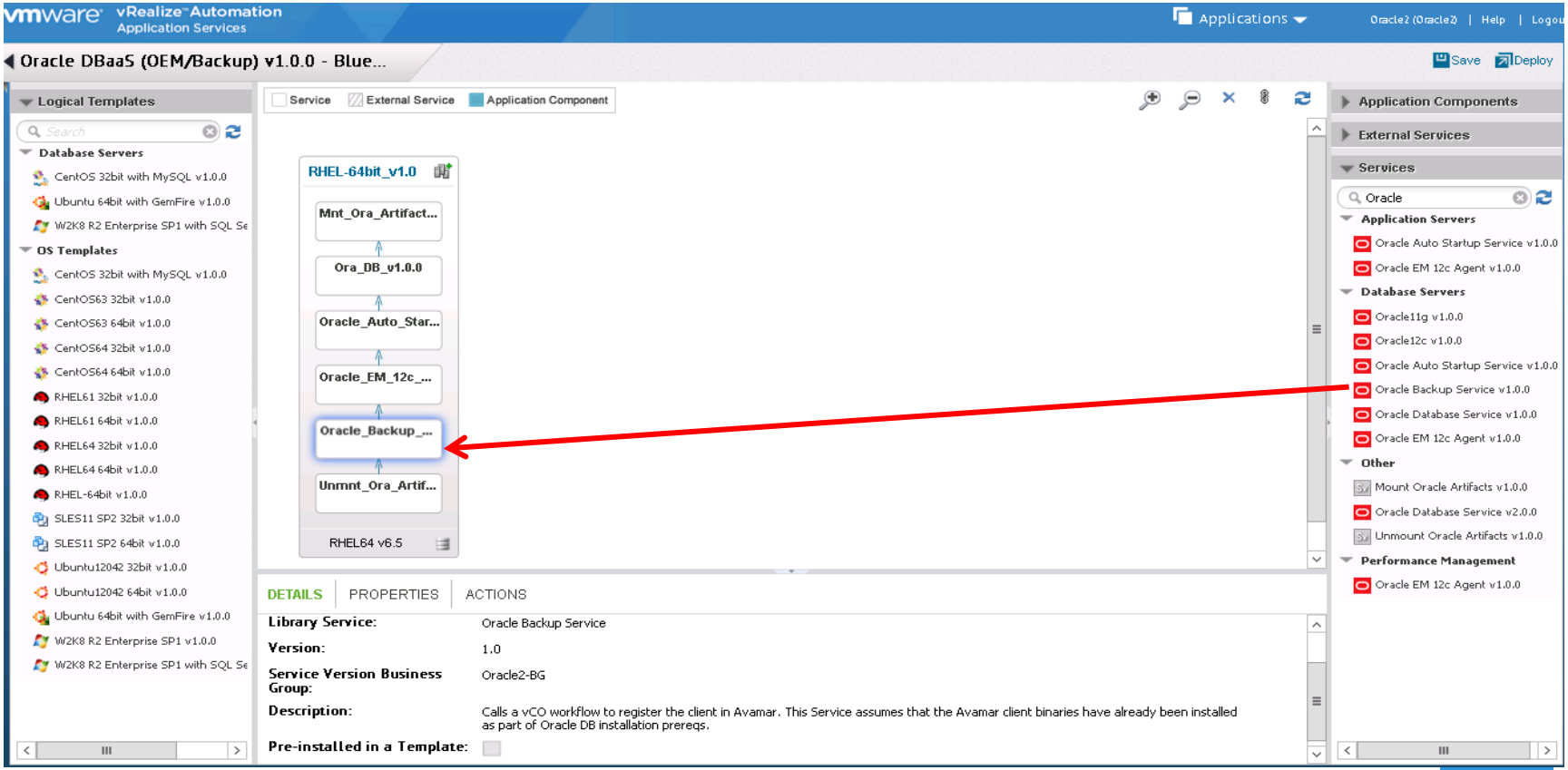
Oracle DBaaS Enabling and Provisioning

vRealize Automation Application Services – *Application Blueprint*



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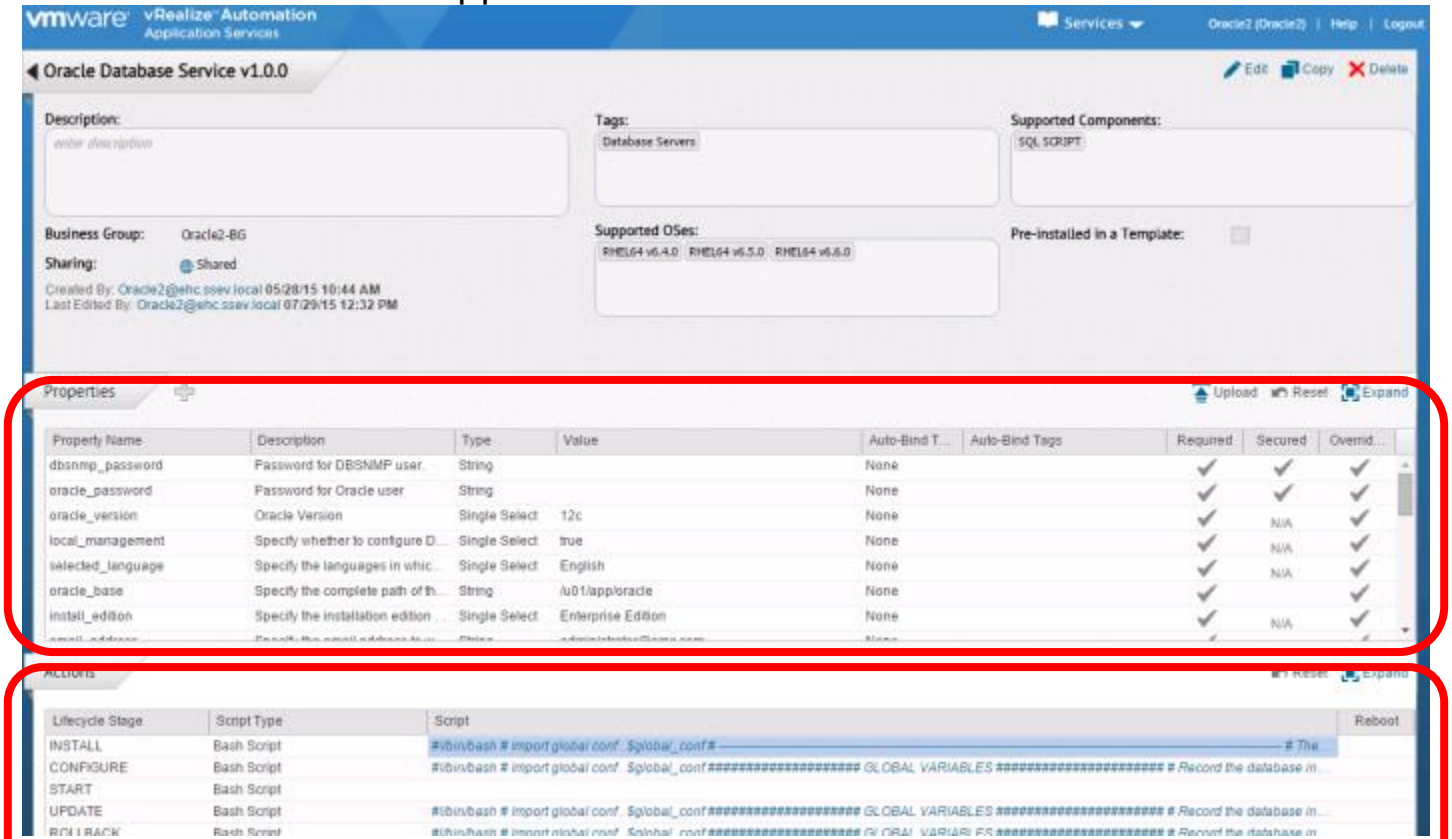
Oracle DBaaS Enabling and Provisioning

vRealize Automation Application Services – *Service*



What properties does a service require?

What does a service *do* when being Installed or Configured?

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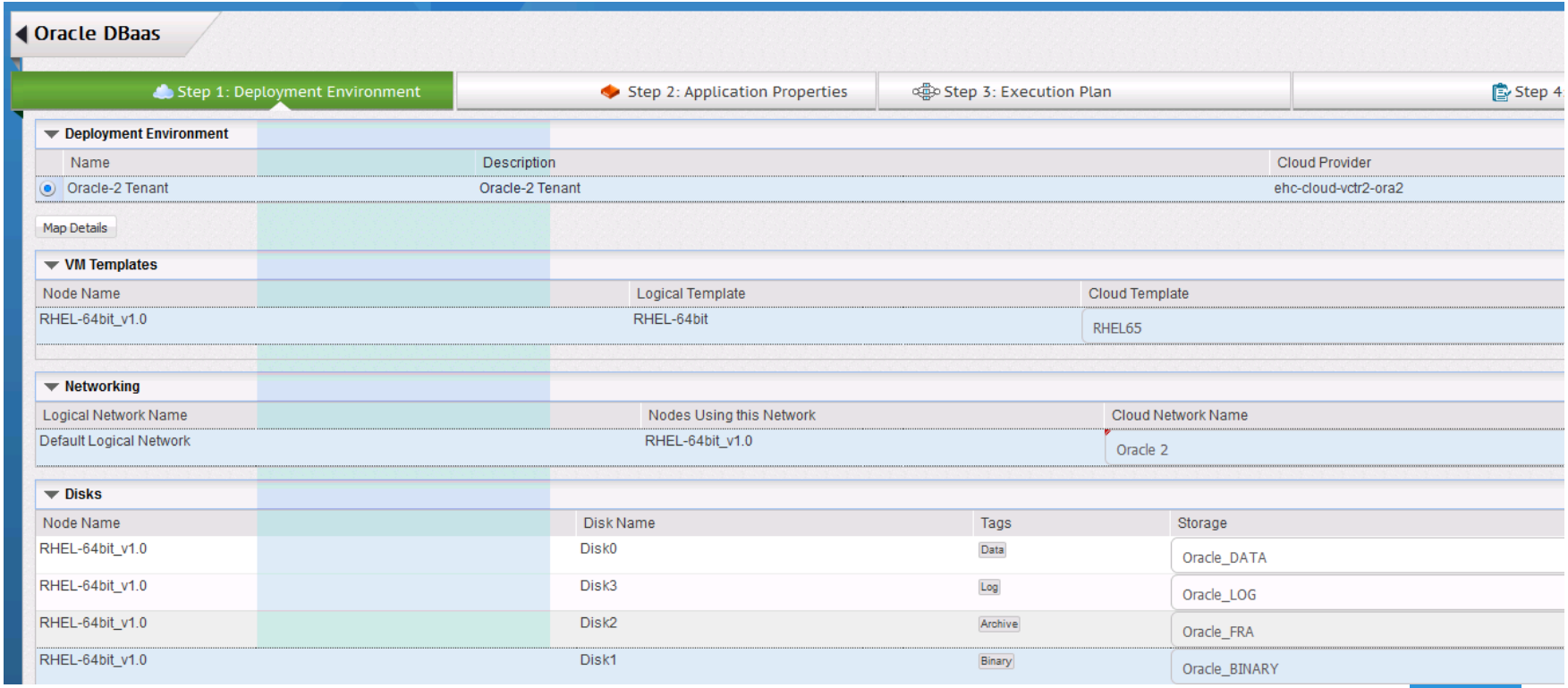
Enabling and Provisioning Oracle DBaaS

vRealize Automation Application Services – Deployment Profile



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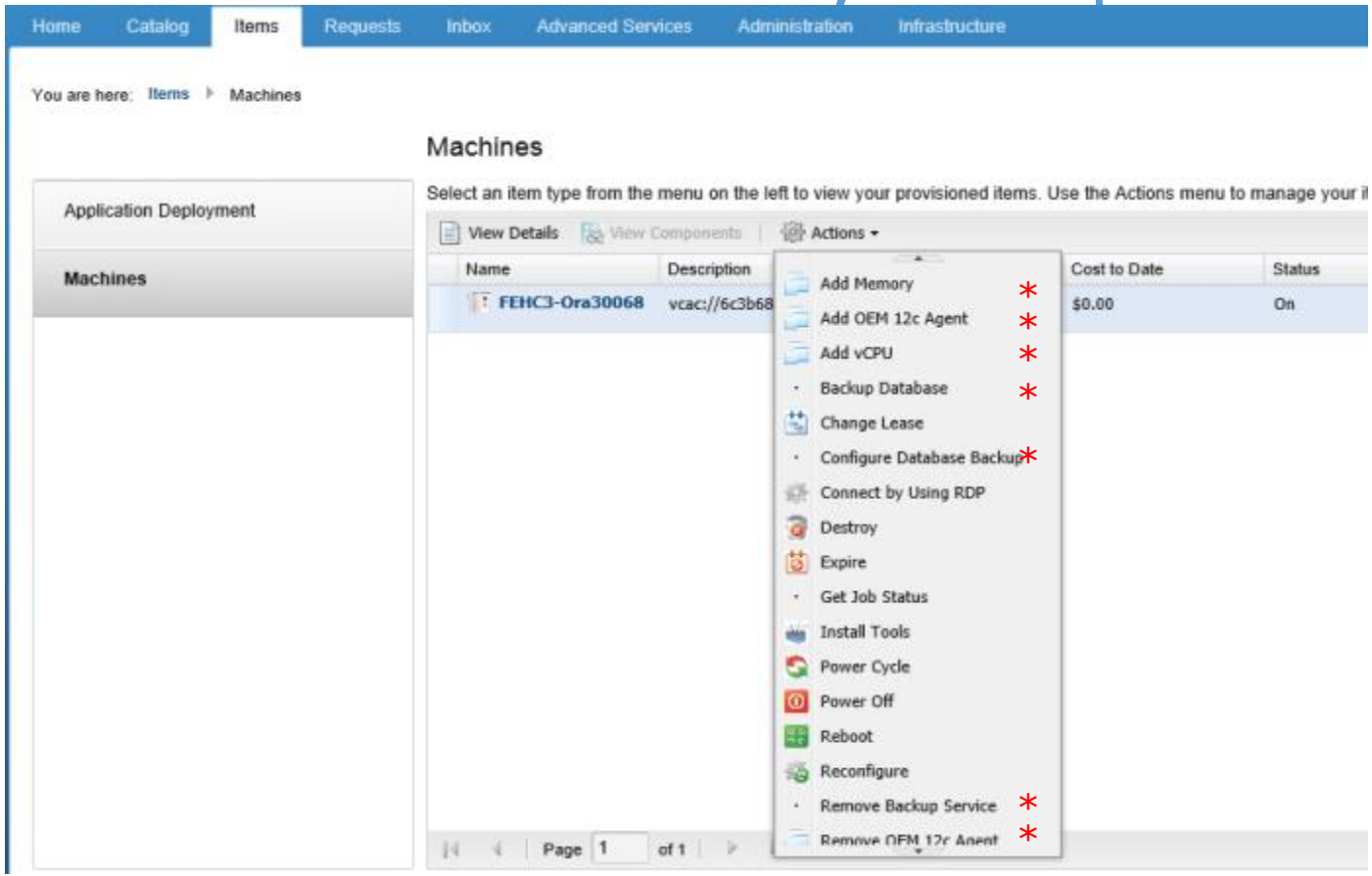
Oracle DBaaS - Day 2 Operations



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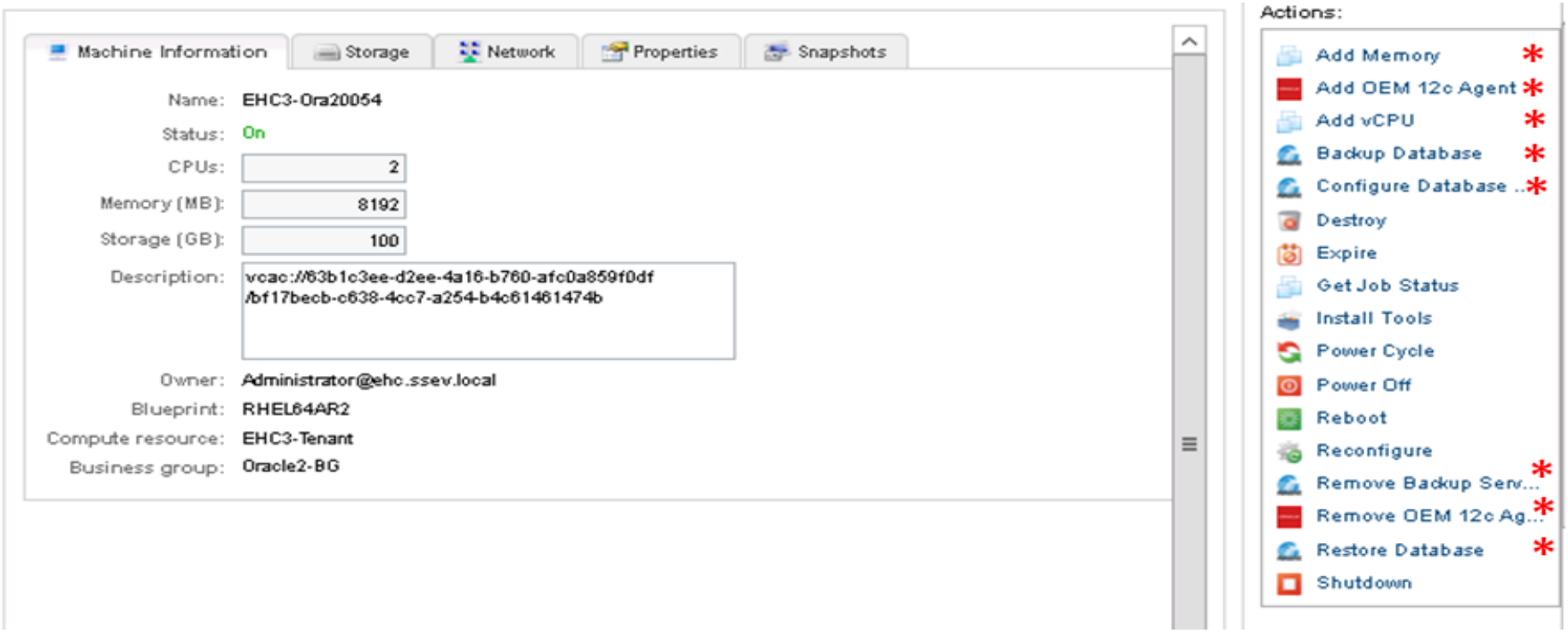
Oracle DBaaS Day 2 Operations

Overview



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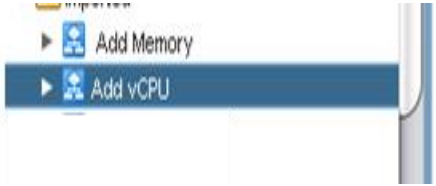
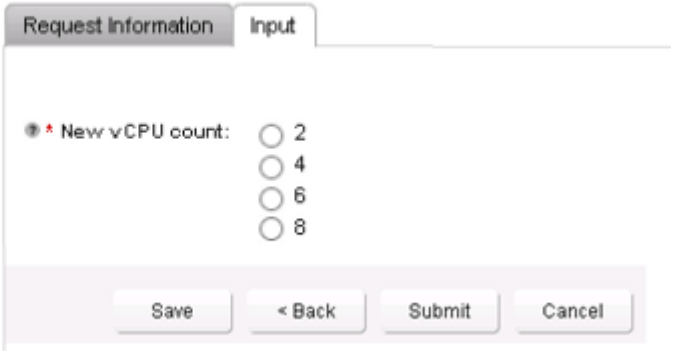
Oracle DBaaS Day 2 Operations

Add vCPU to a virtual machine



New Request

Add vCPU
Increase the vCPU count of a virtual machine.



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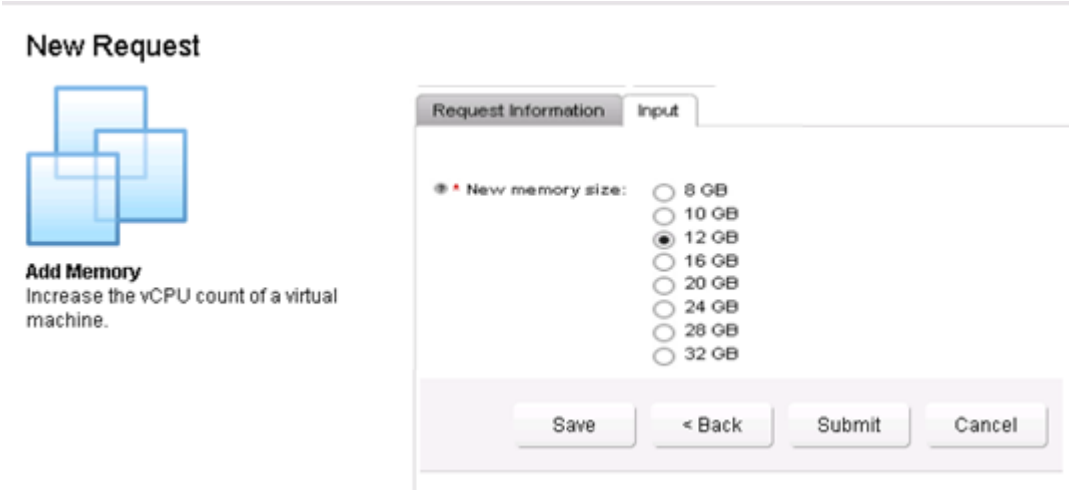
Oracle DBaaS Day 2 Operations

Add memory to a virtual machine



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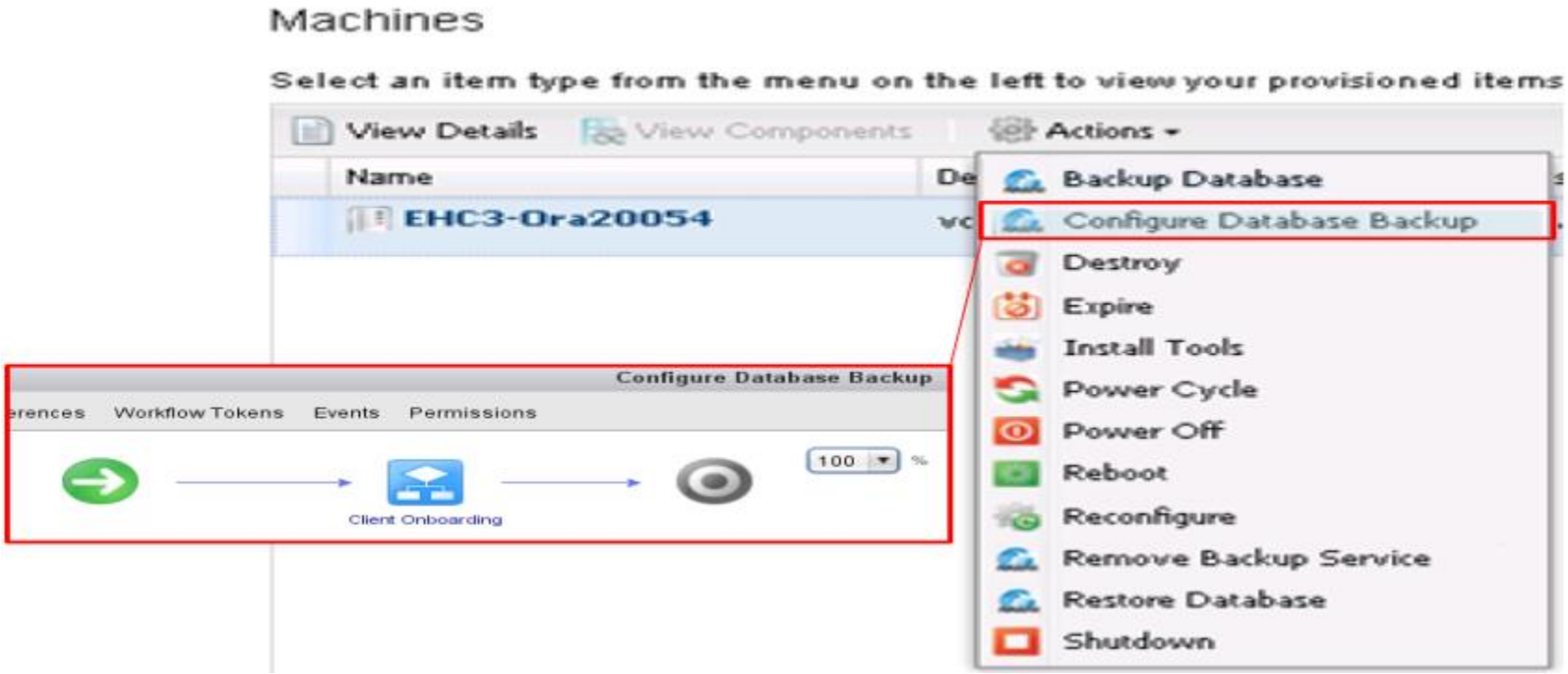
Oracle DBaaS Day 2 Operations

Add/Remove Oracle DBaaS Backup



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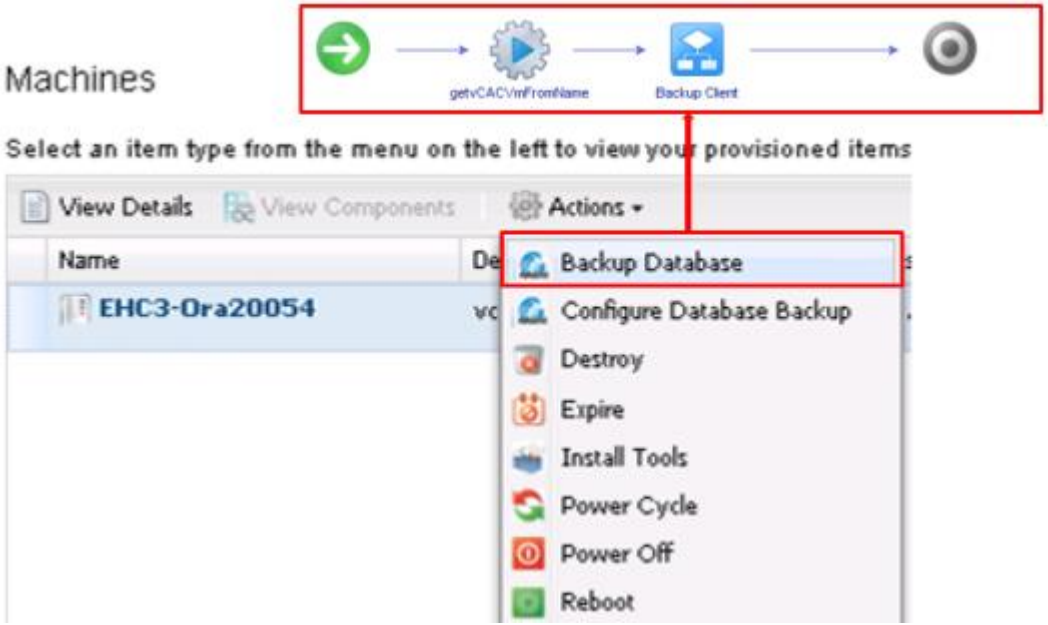
Oracle DBaaS Backup and Recovery

On-Demand Backup as a Resource Action



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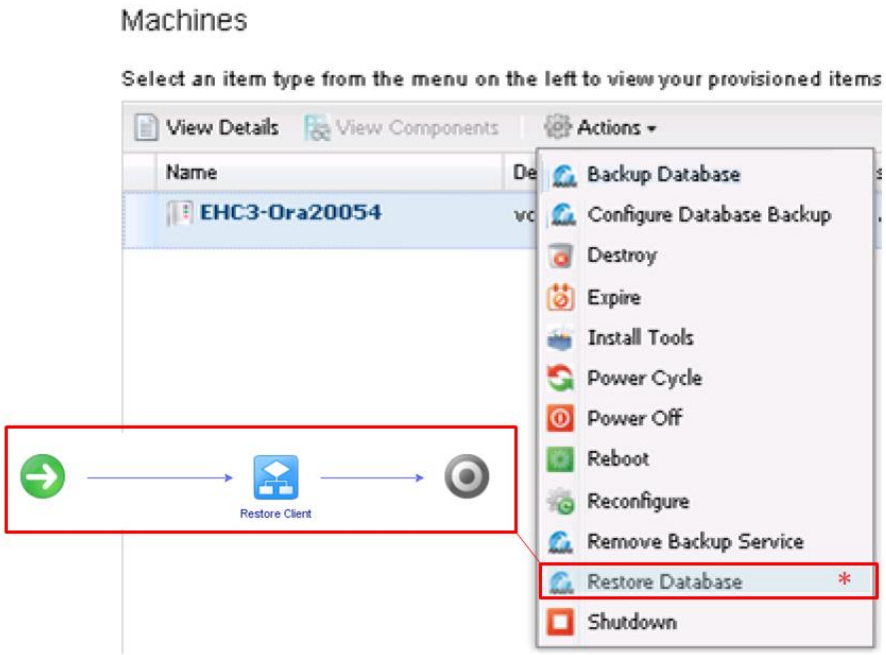
Oracle DBaaS Backup and Recovery

Oracle DBaaS Recovery



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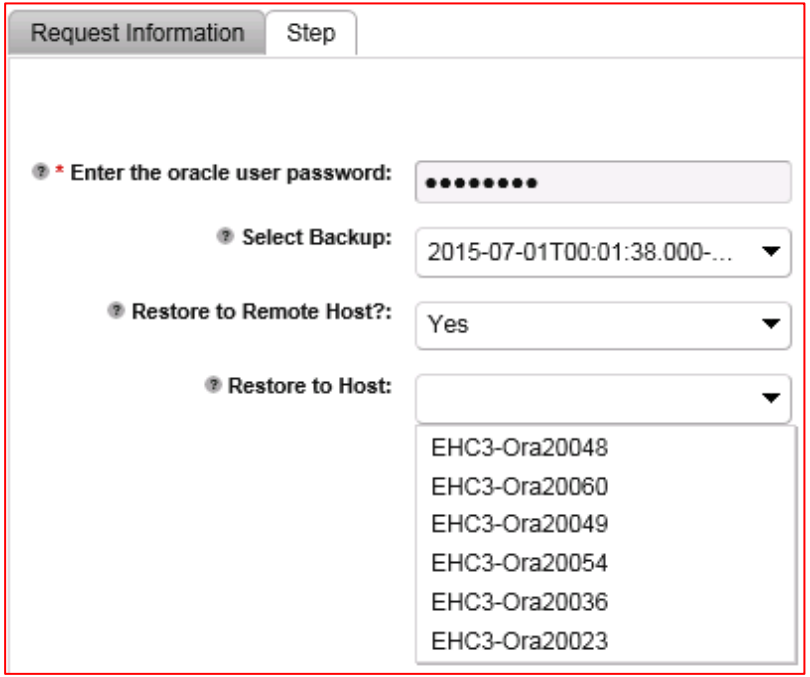
Oracle DBaaS Backup and Recovery

Restore Oracle database forms



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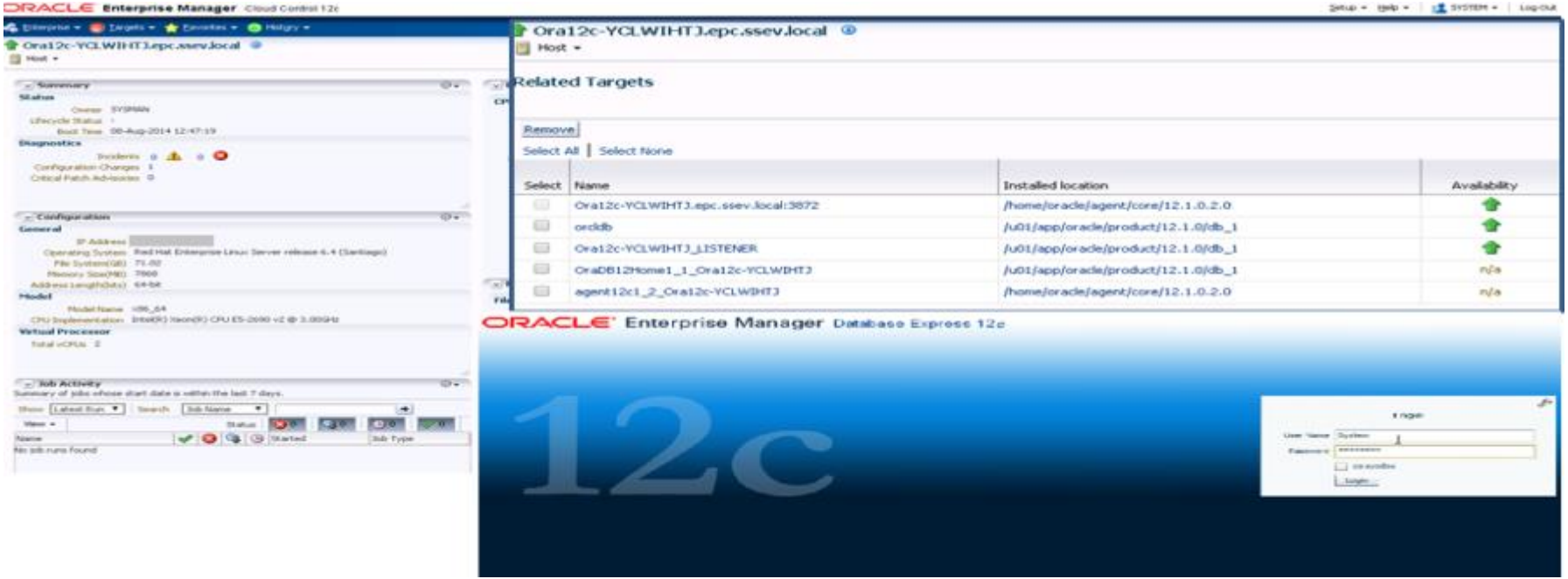
Monitoring Oracle DBaaS

Oracle Enterprise Manager Cloud Control 12c monitoring



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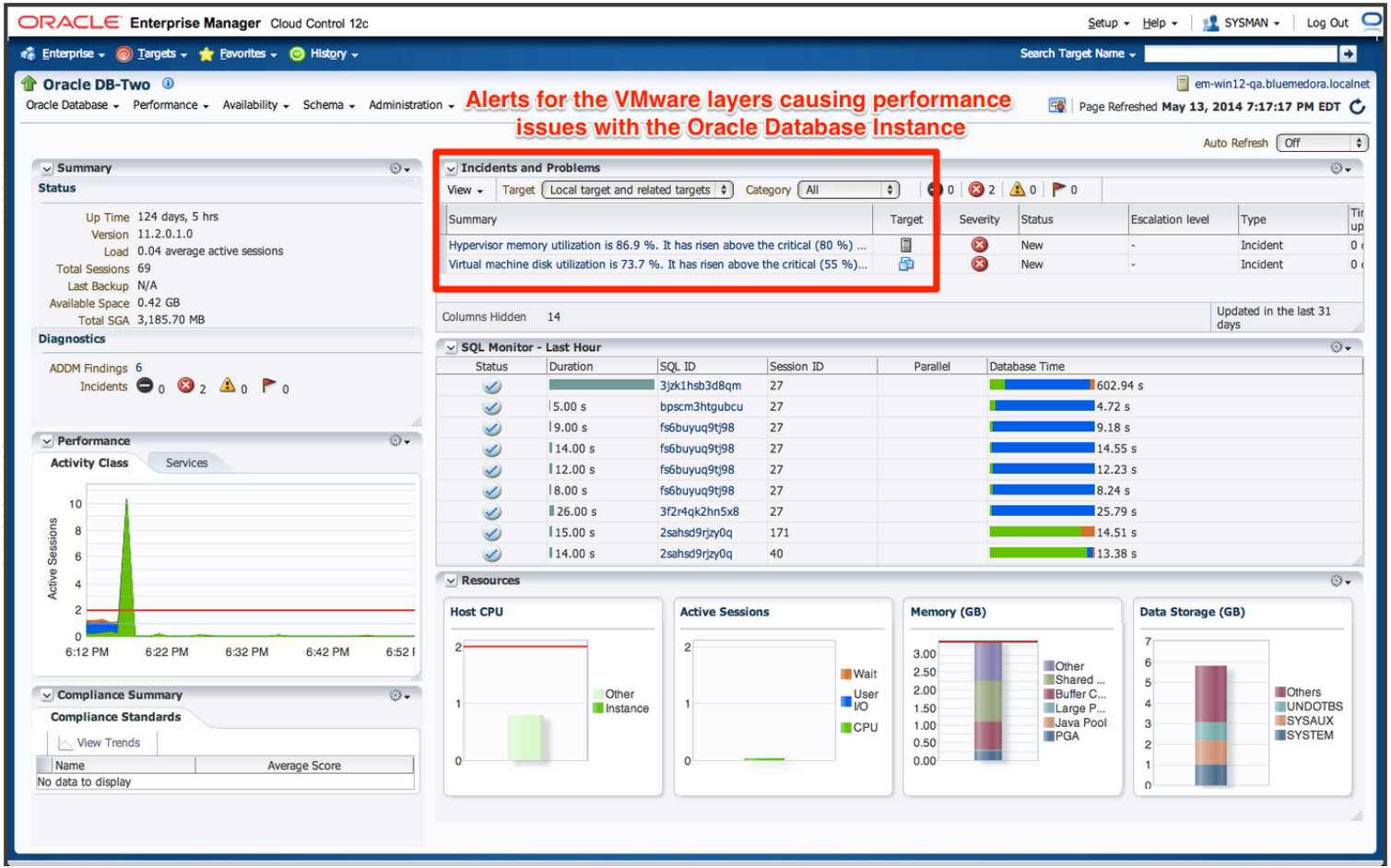
Extends Oracle Cloud to VMware – Performance View



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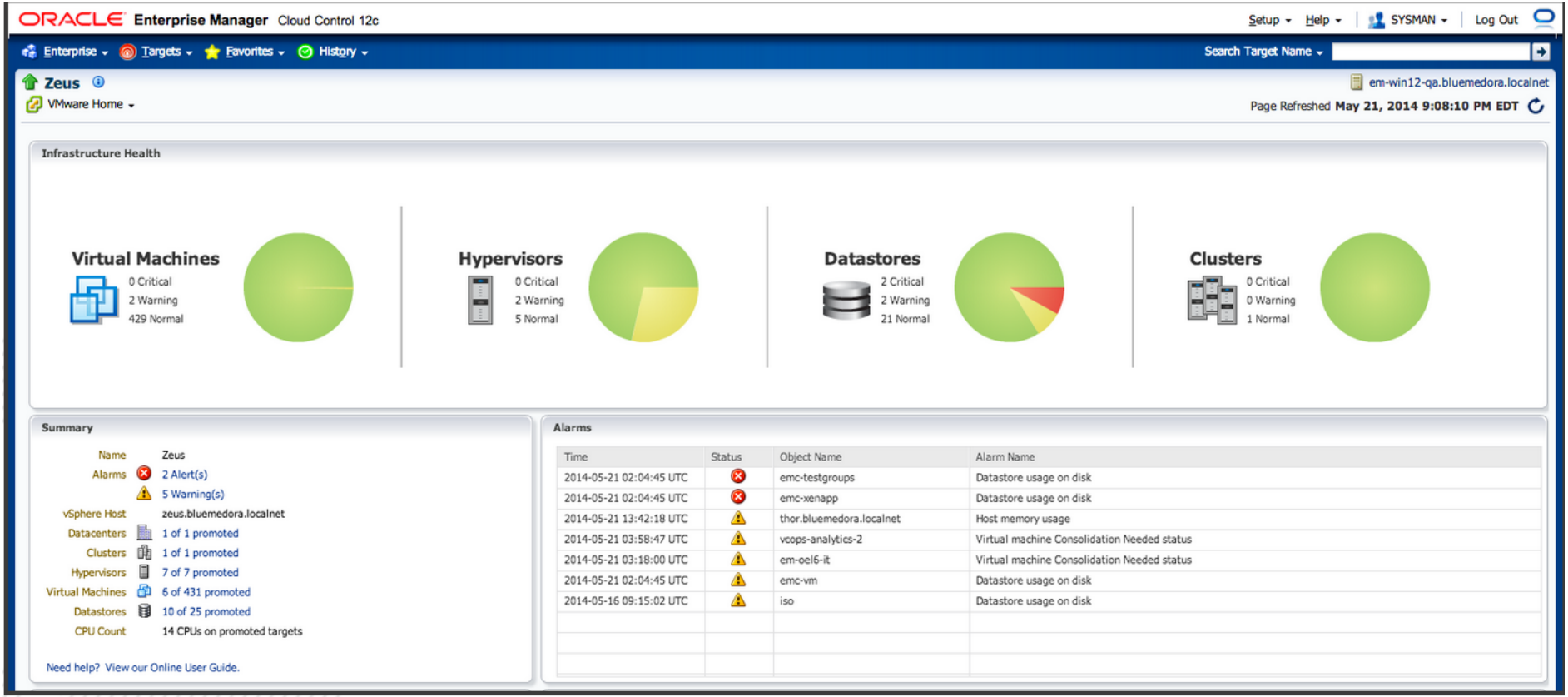
Extends Oracle Cloud to VMware – VMware Status



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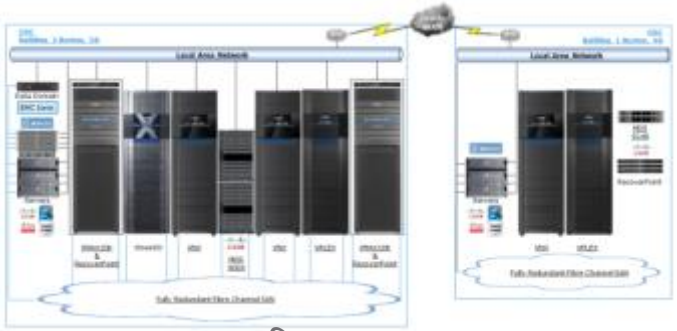
EMC/Oracle Solutions Center

Oracle Campus, Reston, VA



OSC Infrastructure

- Shared services for Oracle & EMC
  - Over 500 servers
  - Over 1PB EMC storage
  - Fully Virtualized on VMware
- Provides infrastructure for
  - Oracle's Training & demos
  - EMC Demos
  - EMC POCs
- Oracle Integration Demos
  - Storage integration, cloning & replication
  - HA Stretched clusters
  - Management tooling

Leverage EMC at Oracle Solution Centers

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References

My Blog "Dirty Cache"

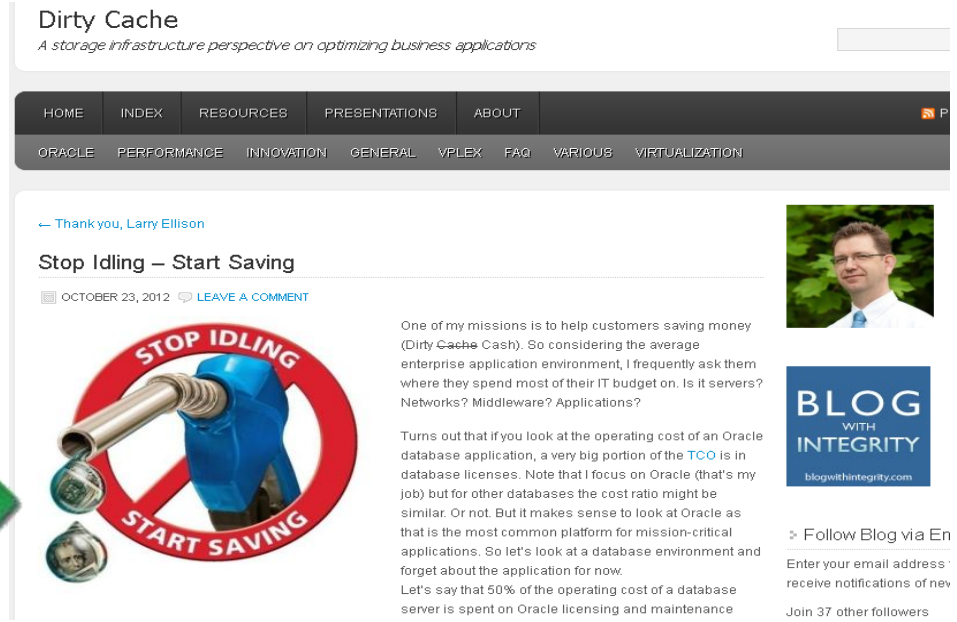
http://bartsjerps.wordpress.com

Everything Oracle @ EMC (community):

http://emc.com/everythingoracle

XtremIO

http://xtremio.com/



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