Virtualizing Business Critical SQL Servers

Tips, Tricks, and Other Goodies to Ensure Your Success

SQL Saturday Lincoln – October 6, 2012

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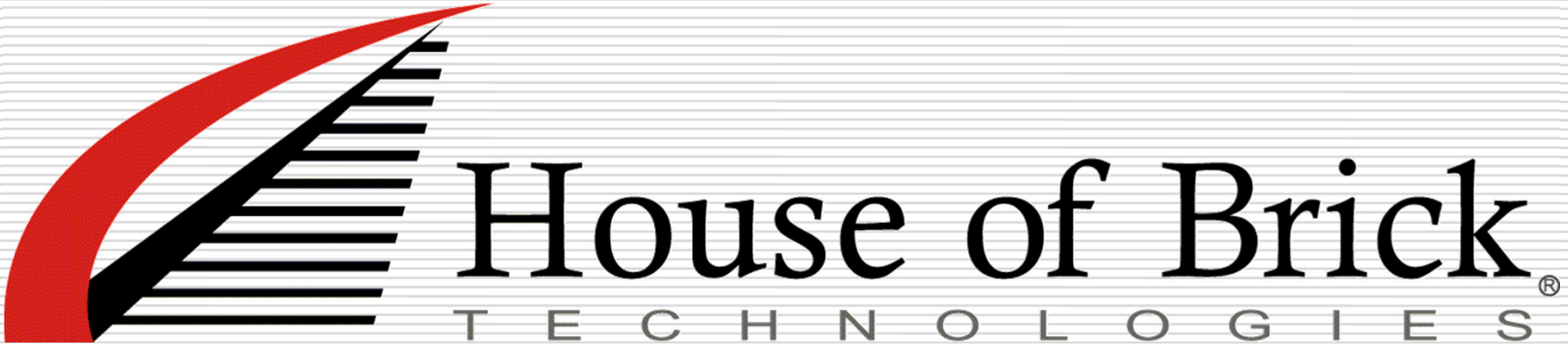


About House of Brick

- 14 year old Omaha-based company
- Leader: Tier-1 VMware, Database Performance
- Rock-solid reputation for optimizing the entire system stack to maximize Tier-1 performance

- House of Brick key service value components
  - Hybrid/private cloud architectures for complex Tier-1 workloads
  - Legacy to virtualization, and private/hybrid cloud system replatforming
  - SQL Server and Oracle virtualization specialties
  - Short term assessments and proof-of-concept projects
  - Long-term project analysis, PM, implementation, & validation

About Us

VMware CERTIFIED ADVANCED PROFESSIONAL 5 DATACENTER DESIGN

Microsoft CERTIFIED IT Professional
Database Administrator 2008
Database Administrator on SQL Server® 2005
Database Developer 2008

David Klee

@kleegeek

- SQL Server on VMware team lead
- Experience in VMware, Microsoft, Linux, networking, security, application development technologies

Microsoft CERTIFIED IT Professional

Andy Galbraith

@DBA_Andy

- SQL Server Consultant
- Experience in SQL Server, clustering, performance tuning

Agenda

- Why Virtualize Business Critical SQL Servers?
- Physical Stack Fundamentals
- VM-Layer Fundamentals
- Designing the New Infrastructure
- Performance Baselining, Benchmarking, and Monitoring
- Disaster Recovery, High Availability

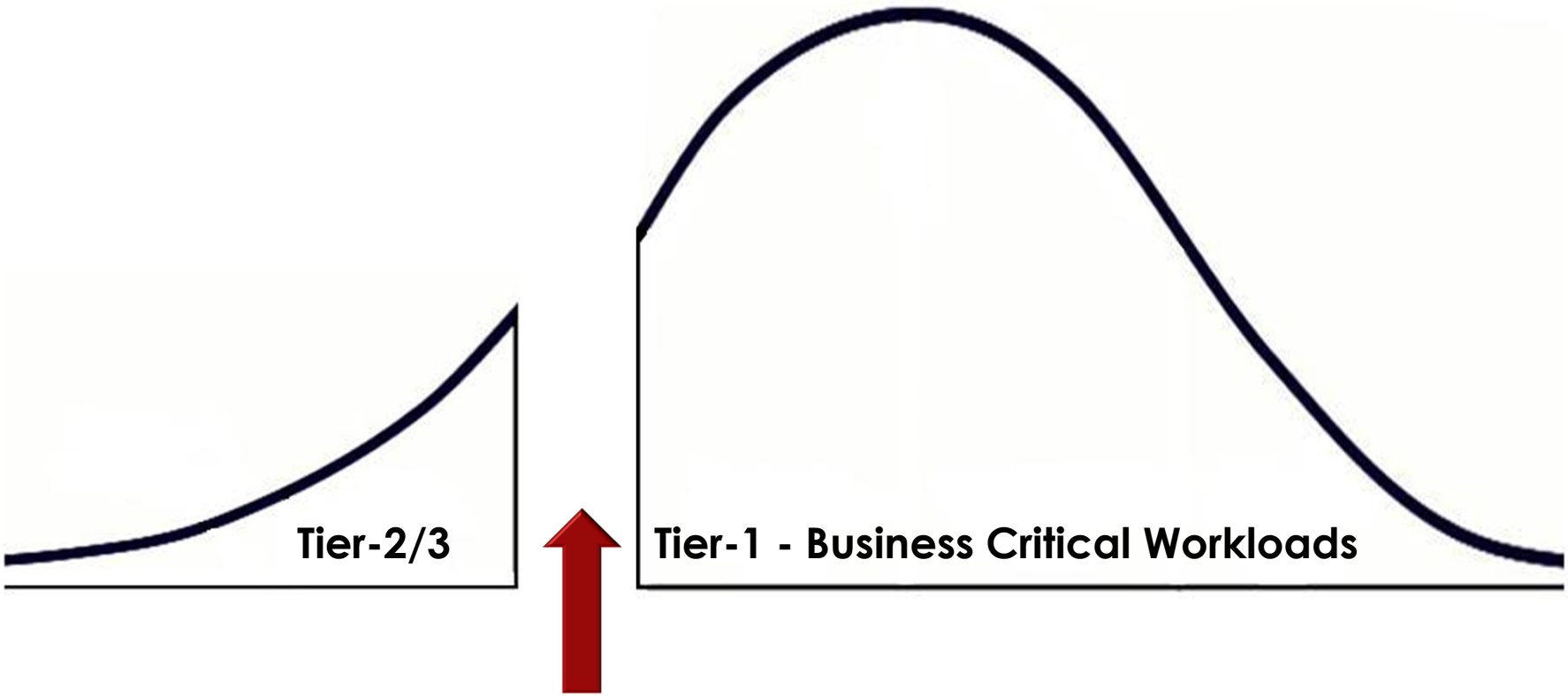
Your Trends

- Do you have a virtualization strategy?
- Have you tried to virtualize SQL Server?
- Was it successful?
- Are your production SQL Servers virtual?
- Why not?
- Do you have a plan for 100% virtual Tier-1?

Six Reasons to Virtualize

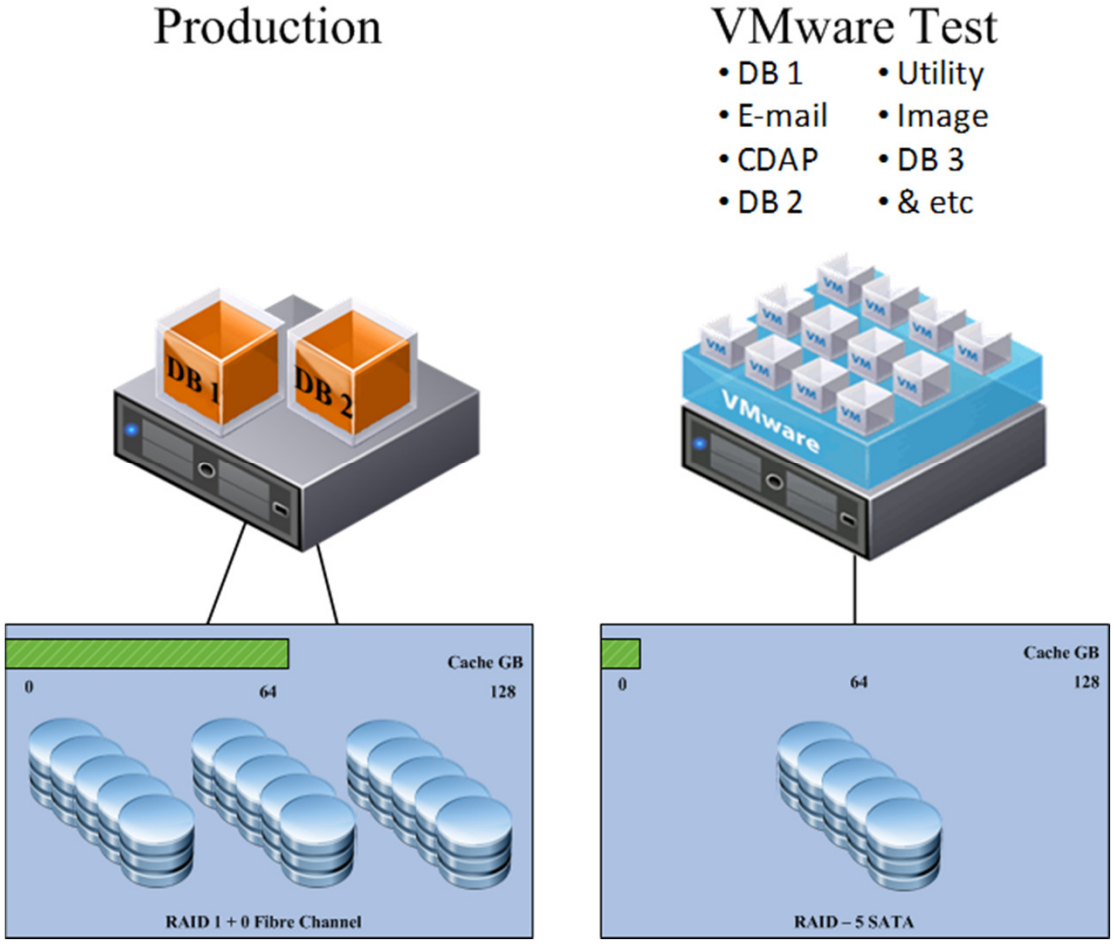
- Consolidation
- Near 100% reliable Disaster Recoverability (DR)
- Product release cycle optimization
- High Availability (HA)
- Cost Reduction, including license optimization
- Security

Tier-1 vs. Everything Else



Myth – Cannot Run Tier-1 Virtualized

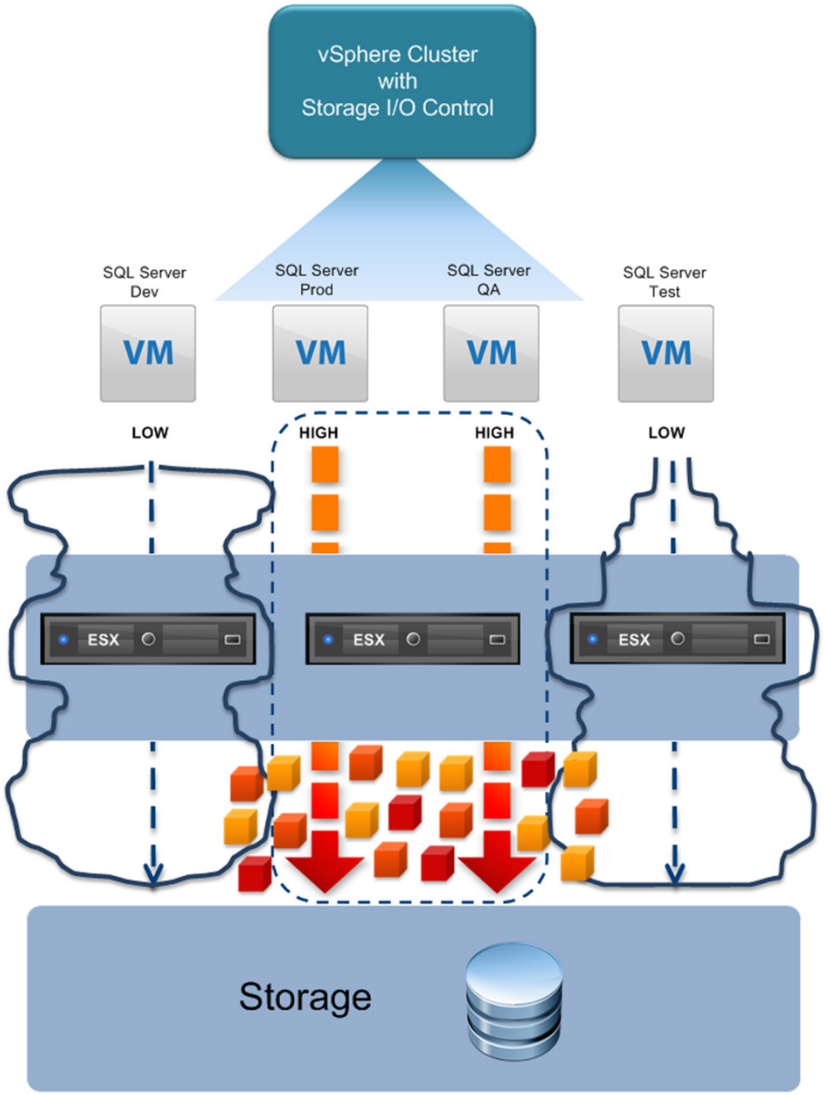
- Common concerns
  - Performance
  - Licensing
  - Support
  - Database size
- Most problems: I/O
- Most Difficult Problem: Environmental, not technical



Apples to Apples Proofing Environment?

Performance Concerns

- **Dev and QA traditionally isolated**
  - Separate servers
  - Hardware partitioning
  - Avoid "Noisy Neighbor" problem
- **The new paradigm**
  - x86 commodity hardware
  - vSphere DRS
  - Lower CAPEX
- **vSphere benchmarks**
  - 2008 – 102K IOPs, 1.4% I/O wedge
  - 2010 – 1M IOps, 100 microsecond wedge



Support Concerns

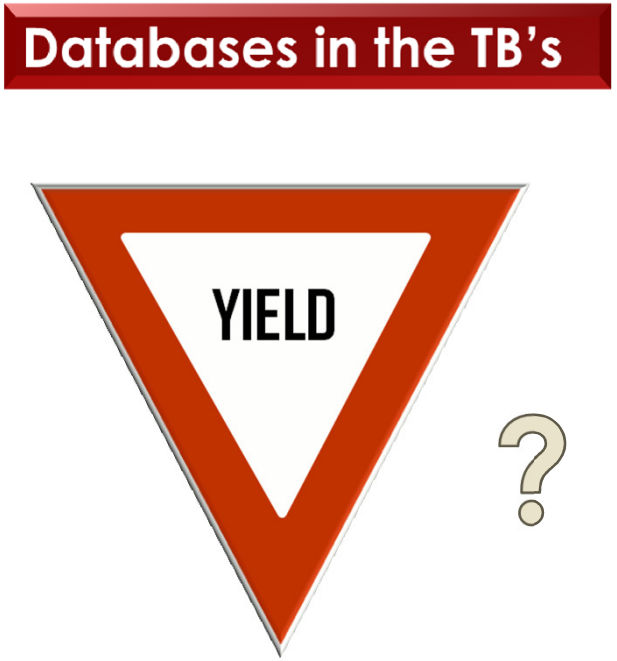
- Policy for support of VMware published for years
- Officially supported via Server Virtualization Validation Program (SVVP)
- Known issues support
- VMware Customer Support Statement and TSANet
  - http://vmware.com/support/policies/ms_support_statement.html

Microsoft KB 897615

- Official support statement
- VMware offers full support and total ownership

Database Size Myths

- **Database size has no impact on performance. *Period*.**
- **Database performance factors**
  - Execution counts
  - Concurrent connections
  - SQL I/O access paths
- **Large database concerns**
  - Backup/Recovery throughput
  - DR operations
  - One-time migration
- **No distinction between physical and virtual**



Licensing Concerns

Dedicated SQL Server vSphere cluster

- Maximum consolidation
- Maximum SQL Server license optimization
- Maximum utilization of vSphere tooling

vSphere SQL Server Sub-cluster

- Frequently reduces SQL Server license requirements
- Consolidation ratios tend to be lower than dedicated SQL Server clusters

Licensing (SQL Server 2008)

- Consolidation Rules (SQL Server 2008/2008 R2)
  - Datacenter Edition – Unlimited VMs if all sockets in host are licensed
  - Enterprise Edition – 4 VMs per license if all sockets in host are licensed

Licensing (SQL Server 2012)

- Consolidation Rules (SQL Server 2012)
  - There is no more Datacenter Edition
  - Enterprise Edition
    - Unlimited consolidation if and only if:
      - All cores (not sockets) in host are licensed
      - Software assurance (SA)
        - Without SA, only 1 VM/core license
    - Minimum of 4 core licenses required per socket, even if only single or dual core
    - Unlimited VMs with SA if upgrading from SQL Server 2008 EE + SA

Licensing Details

- **When VMs move, licenses don't necessarily move with them:**
  - With Standard Edition, licenses can only proactively move **once every 90 days** in a **non-failover situation**.
  - With Enterprise and Datacenter Editions, you have unlimited license mobility rights
    - 2012 also require Software Assurance (SA) for unlimited mobility!

- **For more details on licensing SQL Server on vSphere, refer to Microsoft.com:**
  - 2008R2: SQL2008R2_LicensingQuickReference-updated.pdf
  - 2012: SQL Server 2012 Licensing Quick Reference Guide.pdf

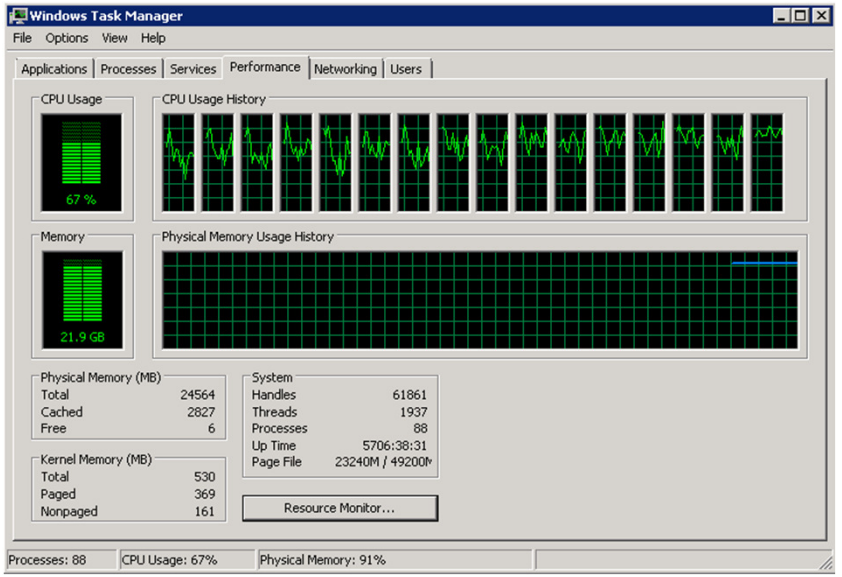
- **NOTE: Licensing Individual VMs is different!**
  - Still must obey 4 core minimum!

Virtual Storage Presentation

- Virtual Machine Disk (VMDK/VMFS)
  - Preferred for Tier-1
  - Maximum ESXi-level storage tooling
- Raw Device Mapping–Virtual (RDM-V)
  - More configuration and operations overhead
  - Reduced ESXi-level storage tooling
- RDM-P
  - Maximizes SAN-level tooling transparency
  - Even less ESXi-level storage tooling
  - No snapshots or vMotion
- Direct-mounted (In-guest iSCSI)
  - No ESXi-level storage tooling
  - vMotion works

Tier-1 Analysis - Profiling Physical

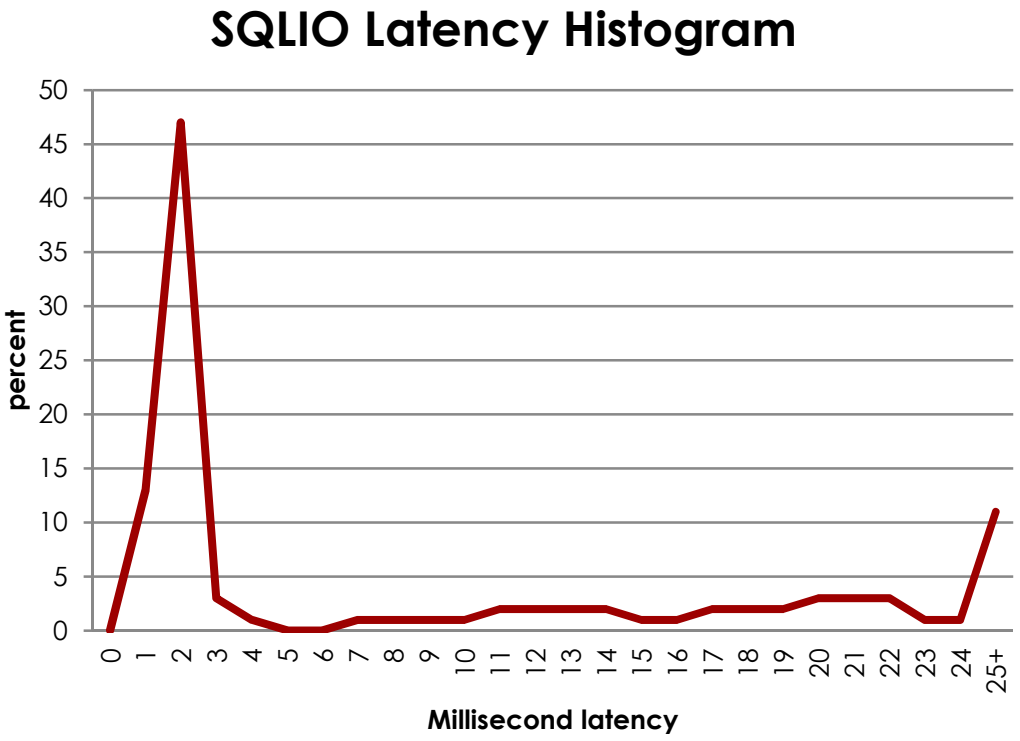
- CPU – Count, Speed, Average, and Peak Utilization
- Memory – Amount, Utilization, Active
- Windows Perfmon – CPU, RAM, Network, Disks statistics
- Disk Performance
- Storage Benchmarking
- Environmental Growth Planning
- SQL Server health check



http://sqlserverperformance.wordpress.com

Tier-1 Analysis – Storage

- SQLIO – I/O performance and latency benchmark
- Throughput metrics:
  - IOs/sec
  - MBs/sec
- Latency metrics:
  - Avg. (ms): < 25



- Microsoft Download: SQLIO Disk Subsystem Benchmark Tool
- tools.davidklee.net – SQLIO Analyzer

Tier-1 Analysis – Storage

- IOMeter – I/O Performance Stressor
- www.iometer.org

Read/Write %	Type	Block	Threads / # Outstanding per Thread	Similar to…
80/20	Random	8K	# cores / start low & increase until IOPs limit reached	Typical OLTP data files
0/100	Sequential	2K - 60K	1 / 1	Transaction Log
100/0	Sequential	64K - 512K	1 / 16	Table Scans
0/100	Sequential	256K	1 / 16	Bulk load
100/0	Random	32K	# cores / 1	SSAS Workload
100/0	Sequential	1MB	1 / 32	Backup
0/100	Random	8K-256K	# cores / start low & increase until IOPs limit reached	Checkpoints

Source: SQLPASS 2011 DBA-413-M Slide 48

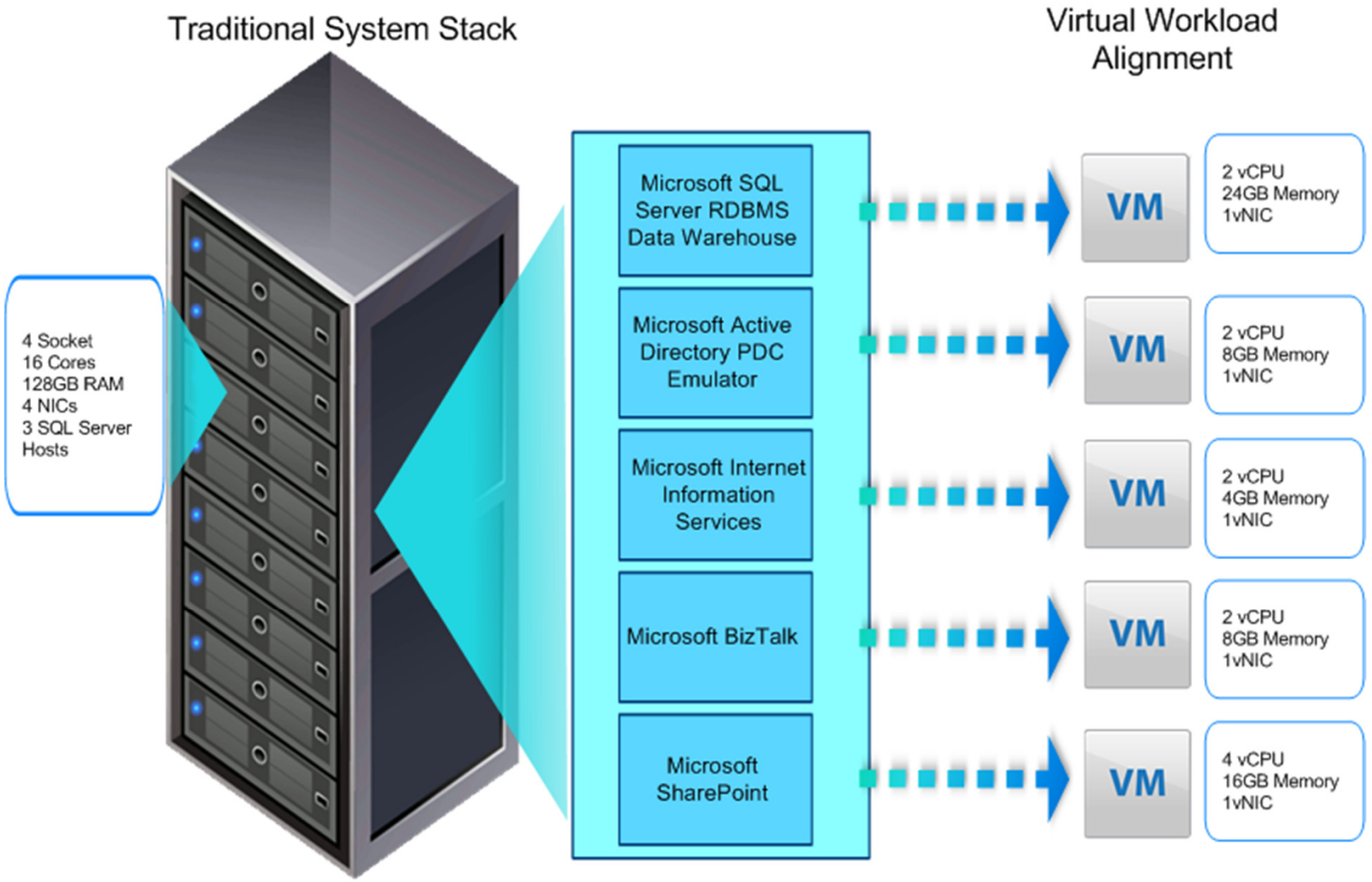
Tier-1 Analysis – Perfmon

- Memory: Available Mbytes, Pages / sec, Page Faults / sec
- Processor: % Processor Time
- Physical Disk: Disk Read Bytes/sec and Disk Write Bytes/sec
- System: Processor Queue Length
- SQL Server: Databases: Transactions / sec
- SQL Server: SQL Statistics: SQL Compilations / sec, SQL Re-Compilations / sec, Batch Requests / sec

Now What?

- Design your virtual environment carefully.
- Scale Up? More vHardware on less VMs.
- Scale Out?
  - More VMs?
  - More instances on less VMs?

Atomic Workloads



VMware Hardware Configuration

- Disable BIOS “green” settings (power savings, etc.)
- Ensure CPUs are set to high performance mode
- Enable virtualization extensions (i.e. Intel VT-x)
- Disable Automatic Server Recovery (HP)
- Enable Hyper-Threading (Intel)
- 64-bit VMs preferred (32-bit is soon to be extinct)

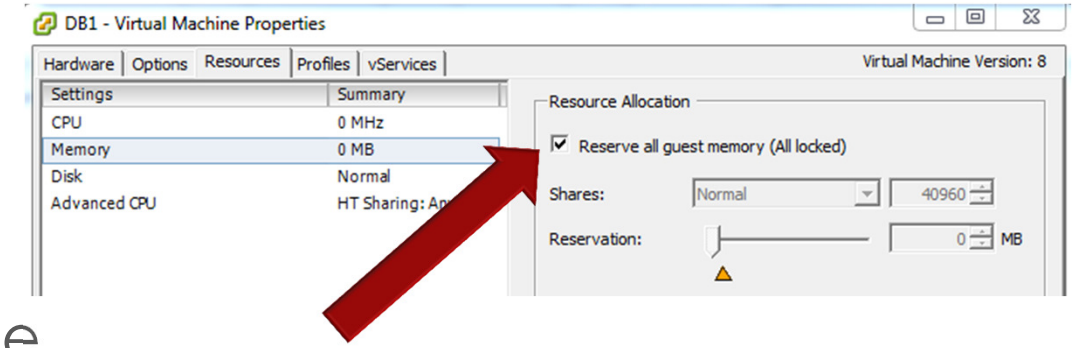
Tier-1 - vCPU

- Start conservative. Do not over-allocate vCPUs.
- vCPU Ready Time
  - 300ms average
  - 500ms high water mark

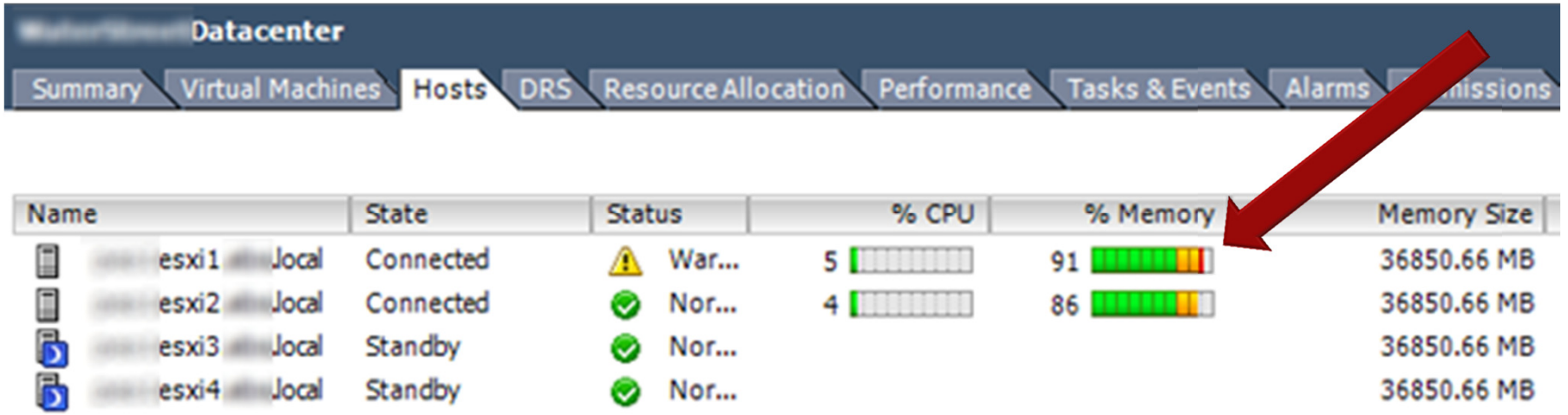
CPU measures the amount of time a virtual machine waits in the queue in a ready-to-run state before it can be scheduled on a CPU. Higher wait times result in slower virtual machine performance.

Tier-1 - vMemory

- Full RAM reservations for production Tier-1 workloads



- Do NOT oversubscribe
- Do NOT over-allocate host RAM
- No ballooning allowed! (Don't disable balloon driver)

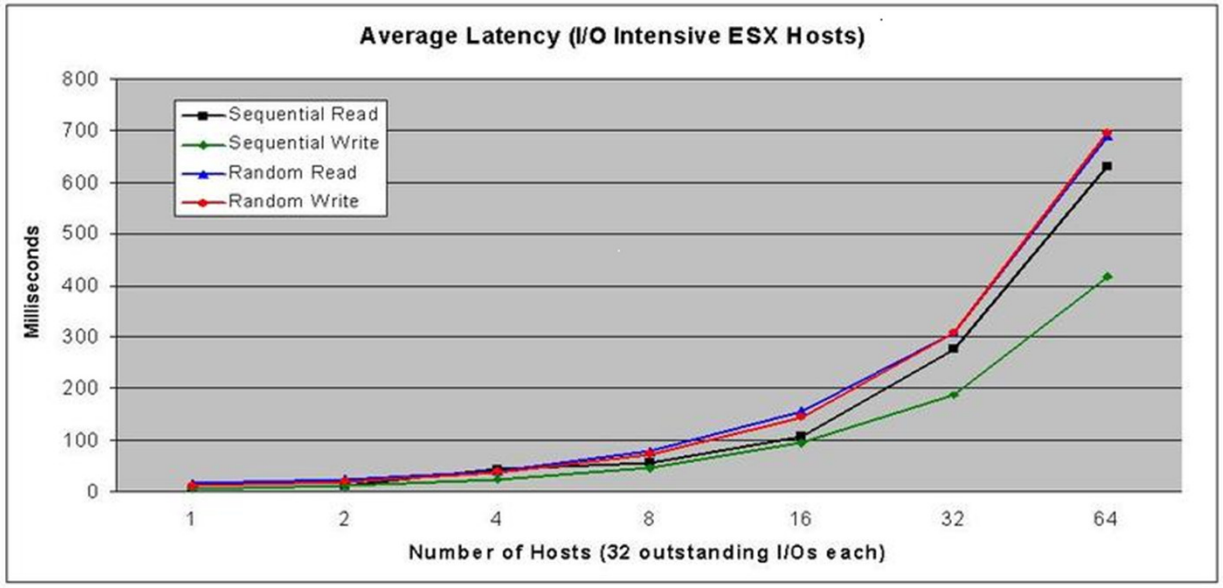


Tier-1 - vStorage

- Performance is top priority
  - RAID-10 or RAID-5
  - *I'll repeat. Performance is **TOP** priority.*
- **Independence Rule.** Design for absolute workload object independence
  - *Monitor usage and split workloads if red lines are exceeded*
  - Can go down to one disk group per LUN
  - Can go down to one LUN per VMware datastore
  - Can go down to one datastore per virtual hard drive file (VMDK)

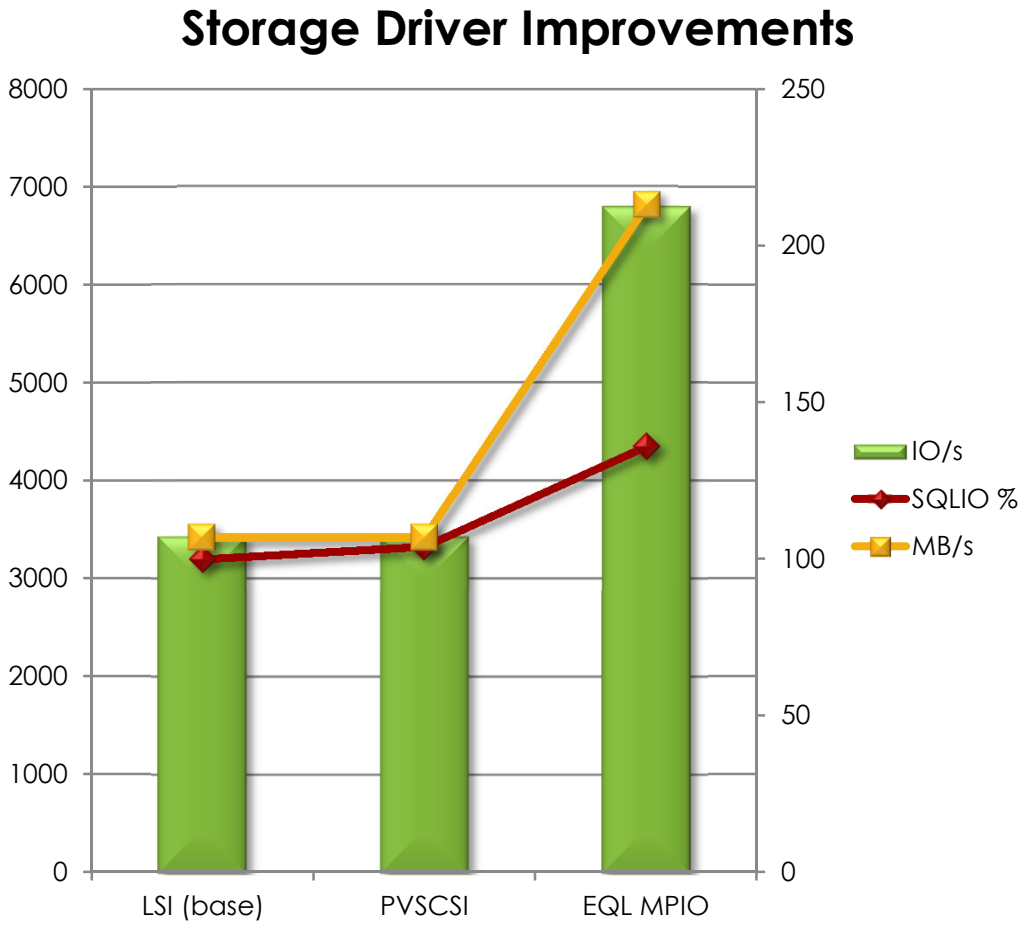
Tier-1 - vStorage

- Storage performance attributes
  - <25ms average I/O latency times
  - <50% average spindle busy
  - >60MB/s sustained writes (at a bare minimum after piercing cache)



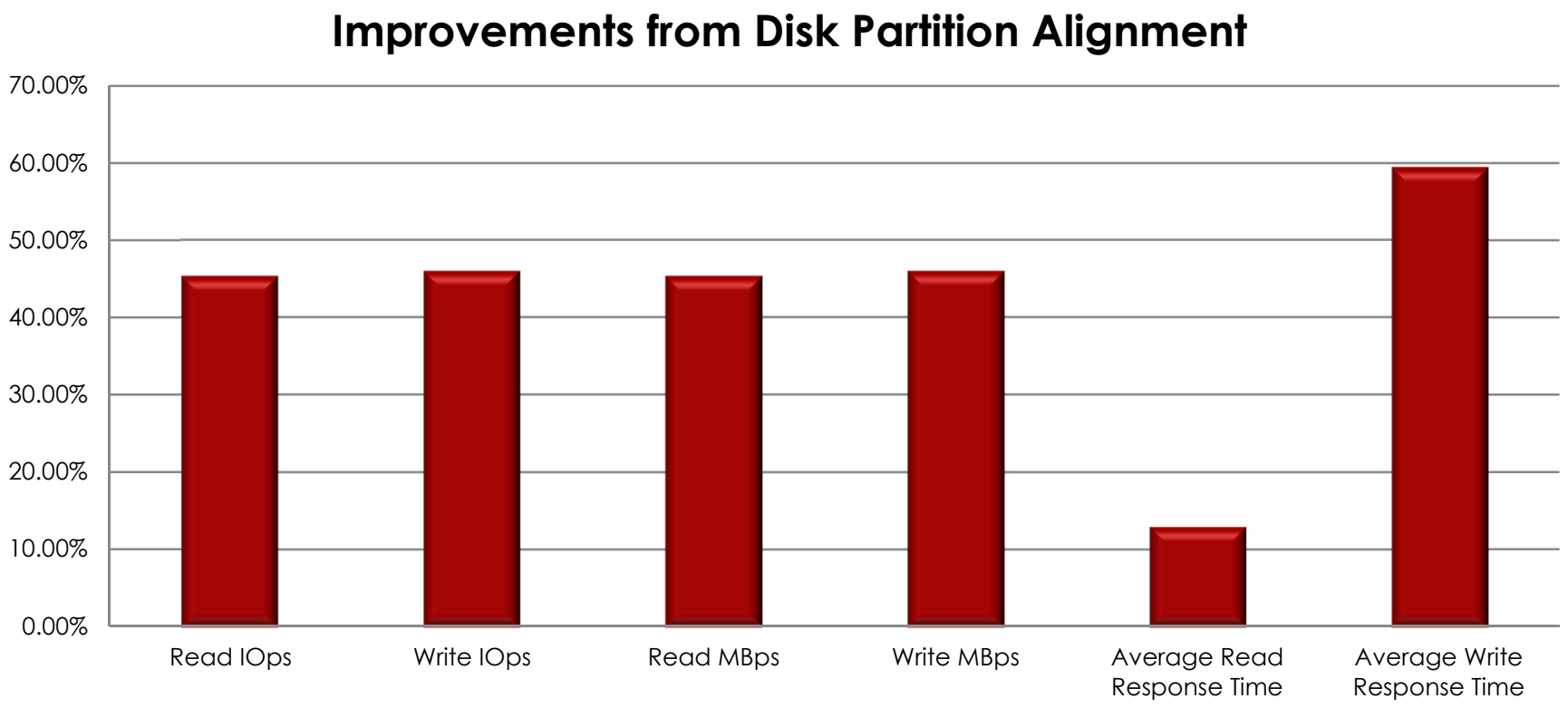
Tier-1 - vStorage

- Paravirtual (PVSCSI) Driver
- Multipathing Drivers
  - EMC PowerPath VE
  - Equallogic MPIO
- Profiling with benchmarking tools
  - SQLIO
  - IOMeter



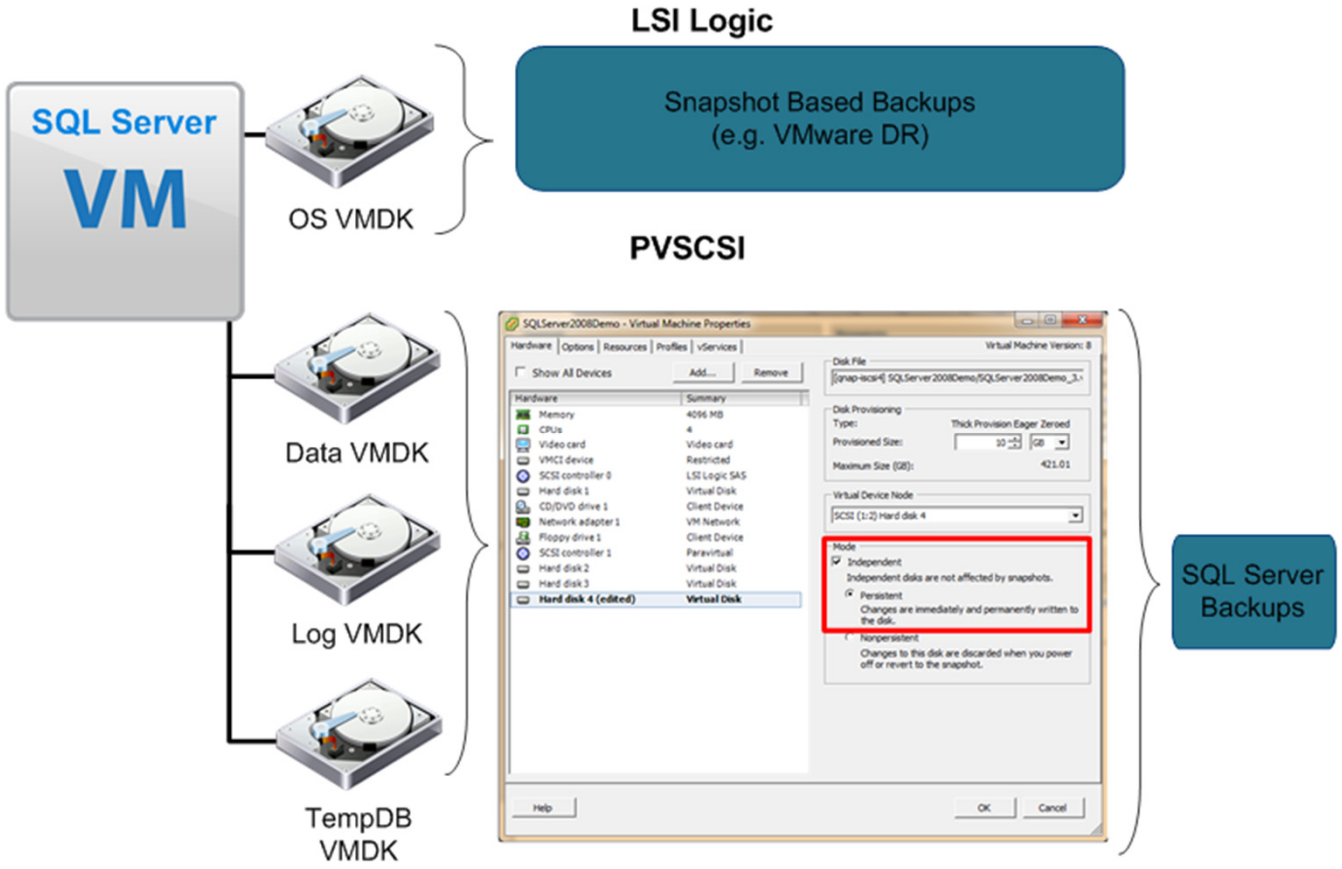
Tier-1 - vStorage

- Disk block alignment (not just a Windows 2003 problem)
  - (**46%** sequential I/O, **24%** random I/O performance improvement)
  - 1MB offset usually works great



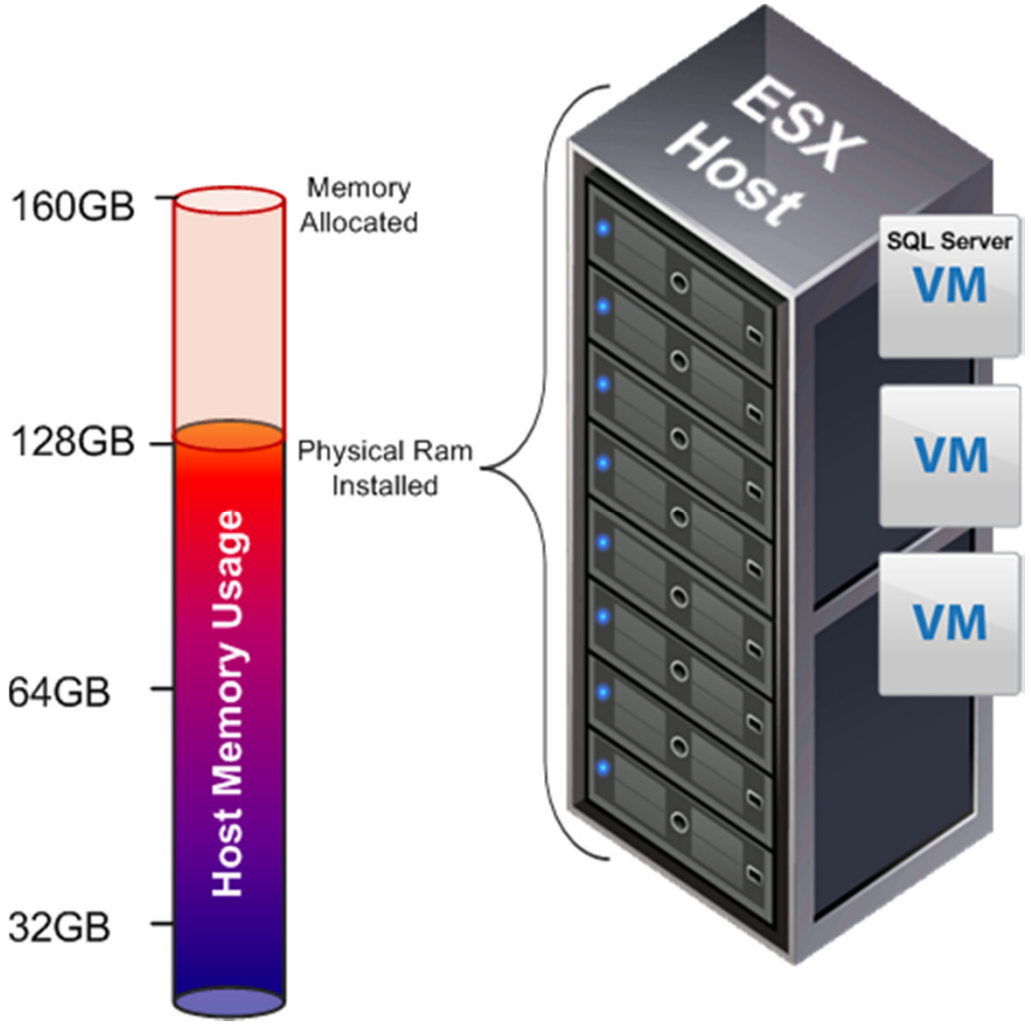
Installing a SQL Server Instance

- Object separation can optimize:
  - Performance
  - Disaster recovery
  - Backup
  - Licensing



Configuring a SQL Server Instance

- Enable Lock Pages in Memory
- Enable Instant File Init
- Use Large Pages – Trace Flag 834
- VM RAM Reservation
  - Memory Provisioned
  - SQL Server memory + OS + VM overhead
- Set "Max Server Memory" and "Min Server Memory"
- Enable Optimize for Ad-hoc Workloads



Monitoring Performance

- Perfmon / IOMeter / SQLIO / DVDStore
- vCenter Statistics
- SQL Server health checks
  - sqlserverperformance.wordpress.com
  - brentozar.com/blitz
  - bradmcgehee.com/healthcheck.zip
- Benchmark and compare to baselines (physical and virtual)
- Remember to update your baselines when the configuration changes!

MSFC Clustering vs. VMware HA

- Four MSFC evaluation criteria:
  - Less than four minute SLA?

    then

  - Rolling maintenance utilized
  - Cluster-aware middle tier?
  - Does technical expertise exist to support clustering?

Criteria answers = "Yes"

- Consider clustered SQL Server on VMware HA

Otherwise

- Other options exist

SQL Server 2012

- AlwaysOn + VMware = Complementary technologies
- Blurs line between HA and DR
- Best of MSFC and Mirroring
- Current best practices directly apply to 2012
- Watch your licensing

SQL Server on VMware Boot Camp

More information at http://bit.ly/PIne7f. Register at http://bit.ly/PUKkbO.

Questions

SQL Server Virtualization

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