LEWAN TECHNOLOGY
A Xerox Company

S4783: Virtual is Better than Physical

Delivering a Delightful User Experience from a Virtual Desktop

About the speaker

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Solutions Architect – Lewan Technology

Focus on Application, Desktop, Datacenter Virtualization

VMware Premier, Citrix Platinum, Microsoft Gold

Liquidware, AppSense, Atlantis Computing

Dell, HP, Cisco, NetApp, Nimble

Delivering a desktop

Planning for desktop virtualization

Design choices and how they impact user experience

About the Any's (Any Device, Anytime, Anywhere)

“Those who fail to plan, plan to fail”

-Michael Baisden

Planning

Who are your user groups?

What applications do they (really) use?

How and When do they work?

How will they use a virtual desktop (or applications)?

How will you deliver applications (or desktops) to them?

What are the user's current expectations?

Planning

Why are we talking about virtualization?

What are we trying to accomplish?

What is our plan to get from here to there?

How will we know when we get there?

You need to be able to articulate the answers!

“One size does not fit all.”

-Frank Zappa

Planning

Break users down into homogenous groups

- Similar application needs
- Similar performance needs
- Similar usage patterns
- Similar expectations

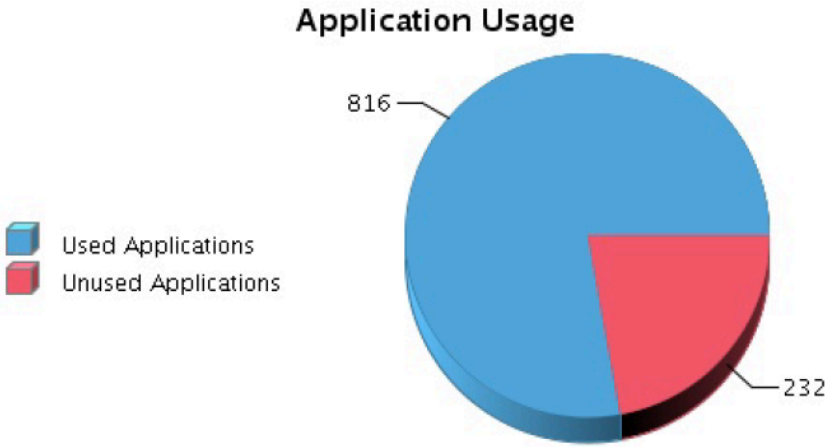
Then design a solution around each group

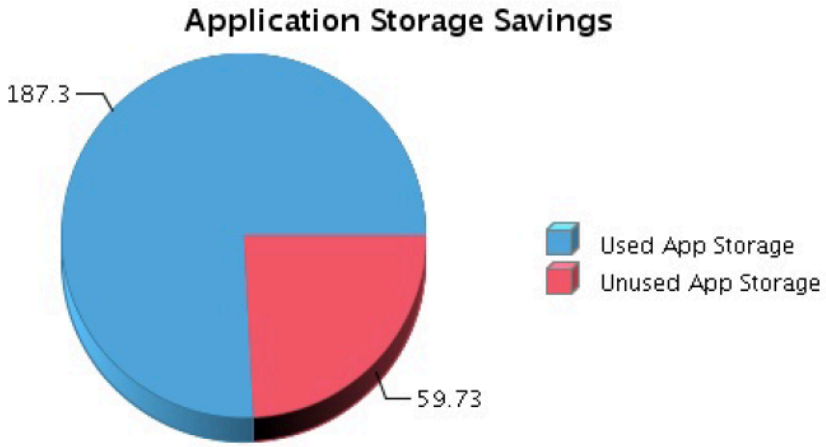
Planning

Consider a formal assessment

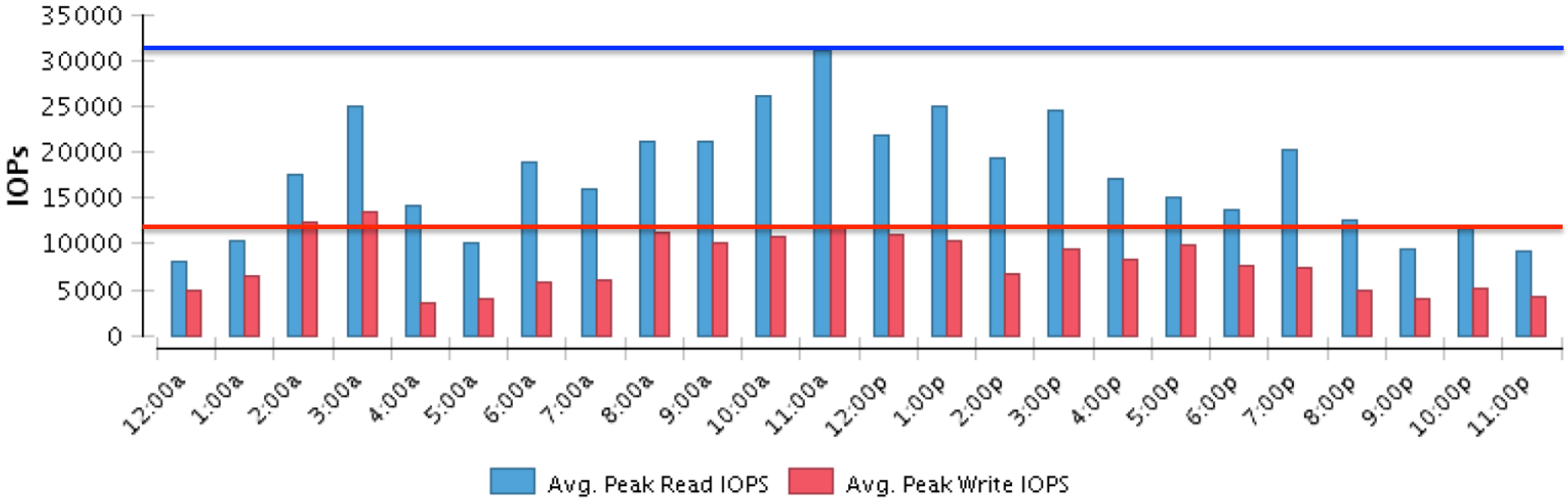
- Discover application usage
- Discover resource usage
- Discover user login/logoff patterns

…and lots more you probably didn’t know…

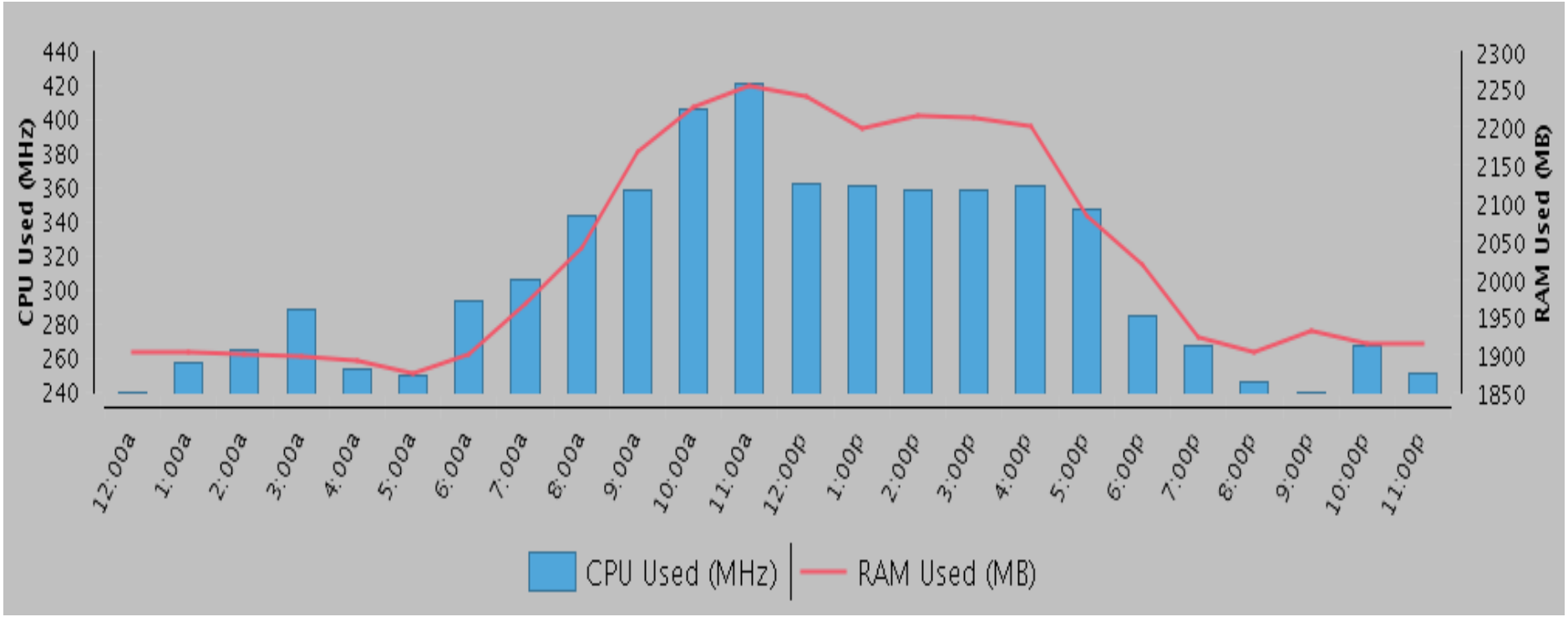

Application Usage
816
232
Used Applications
Unused Applications


Application Storage Savings
187.3
59.73
Used App Storage
Unused App Storage

Application Name	Machine Install Count	Machine Used Count	Approx. Launches Per User	Avg. Launch Delay	CPU Time Used	ANR per Sec	Peak Avg. Mem Used	Peak Avg. IOPs	Total Install Size
Microsoft .NET Framework 4 Extended (v4.0.30319)	23	1	2	00:00:04.547s	00:00:00.1s	3030.3	17 MB	0	33 GB
ShoreTel Communicator (v16.43.1410)	23	20	18	00:00:11.881s	00:00:07.364s	1011.6	30 MB	3.03	2 GB
Google Earth (v7.1.2)	21	3	3	00:00:01.614s	00:00:01.641s	78.6	660 MB	9.07	4 GB
persistence Module (v8.15.10)	20	19	6	00:00:00.33s	00:00:00.000s	12610000.0	3 MB	0	8 MB
hkcmd Module (v8.15.10)	19	19	5	00:00:00.29s	00:00:00.000s	0.0	2 MB	0	7 MB
Internet Explorer (v11.00.9600)	19	16	33	00:00:00.73s	00:00:43.825s	42.9	82 MB	5.02	15 MB
Java(TM) Platform SE binary (v6.0.220)	18	17	8	00:00:23.770s	00:00:31.407s	73.4	124 MB	1.02	2 MB
Google Chrome (v32.0.1700)	17	17	58	00:00:40.415s	00:02:52.272s	49.5	58 MB	90.26	14 MB
Microsoft Office Single Image 2010 (v14.0.7015)	17	17	25	00:00:01.418s	00:00:49.843s	100.3	67 MB	11.28	35 GB
Roxio Burn (v1.8)	15	13	4	n/a	00:00:00.000s	3533333.3	5 MB	0	484 MB
Trusted Drive Manager (v4.1.1)	13	13	6	00:00:00.29s	00:00:00.000s	0.0	2 MB	0	363 MB
FF_Protection MFC Application (v1, 0, 0, 0)	11	10	5	00:00:00.31s	00:00:00.000s	14158333.3	2 MB	0	7 MB
Microsoft .NET Framework 4.5.1 (v4.5.50938)	11	1	2	00:00:01.193s	00:00:00.000s	0.0	2 MB	0	2 GB
Intel(R) Management and Security Status (v7.1.20)	10	10	7	00:00:00.408s	00:00:00.13s	141136.4	13 MB	0.01	18 MB
Microsoft Office Professional Plus 2010 (v14.0.7015)	10	9	24	00:00:01.788s	00:00:11.905s	295.6	24 MB	2.82	16 GB


IOPs
35000
30000
25000
20000
15000
10000
5000
0
12:00a
1:00a
2:00a
3:00a
4:00a
5:00a
6:00a
7:00a
8:00a
9:00a
10:00a
11:00a
12:00p
1:00p
2:00p
3:00p
4:00p
5:00p
6:00p
7:00p
8:00p
9:00p
10:00p
11:00p
Avg. Peak Read IOPS
Avg. Peak Write IOPS

Hour of Day	User Count	Machine Count	Total Avg. IOPS	Total Avg. Peak IOPS	Total Avg. Peak Reads	Total Avg. Peak Writes	Total Avg. Peak Read Percent
9:00a	267	331	7962.39 IOPs	31222.57 IOPs	21162.34 IOPs	10076.51 IOPs	68.04 %
10:00a	268	332	8898.85 IOPs	36900.53 IOPs	26074.88 IOPs	10850.64 IOPs	70.66 %
11:00a	267	331	9811.15 IOPs	42893.44 IOPs	31052.31 IOPs	11891.73 IOPs	72.33 %
12:00p	264	329	8014.73 IOPs	32616.65 IOPs	21842.03 IOPs	10879.89 IOPs	66.92 %
1:00p	264	330	8007.05 IOPs	35309.77 IOPs	25063.33 IOPs	10371.71 IOPs	70.75 %
2:00p	264	330	6376 IOPs	25896.63 IOPs	19216.9 IOPs	6700.74 IOPs	74.42 %
3:00p	265	331	7770.43 IOPs	33773.63 IOPs	24596.59 IOPs	9442.38 IOPs	72.41 %
4:00p	260	329	6047.71 IOPs	25194.77 IOPs	16996.11 IOPs	8223.83 IOPs	67.42 %
5:00p	245	323	6474.03 IOPs	25046.35 IOPs	15105.41 IOPs	9947.83 IOPs	60.36 %


CPU Used (MHz)
440
420
400
380
360
340
320
300
280
260
240
RAM Used (MB)
2300
2250
2200
2150
2100
2050
2000
1950
1900
1850
12:00a
1:00a
2:00a
3:00a
4:00a
5:00a
6:00a
7:00a
8:00a
9:00a
10:00a
11:00a
12:00p
1:00p
2:00p
3:00p
4:00p
5:00p
6:00p
7:00p
8:00p
9:00p
10:00p
11:00p
CPU Used (MHz)
RAM Used (MB)

Metrics	Allocated	Average Used	Peak Average Used	Peak Used
CPU MHz	1458.75 GHz	88.47 GHz	196.64 GHz	599.9 GHz
RAM	1013.81 GB	532.93 GB	573.12 GB	727.79 GB
Page/Swap File	1.23 TB	128.6 GB	136.45 GB	236.5 GB
Storage Capacity	68.78 TB	13.74 TB	13.75 TB	16.66 TB
Read IOPs		3270.51 IOPs	15572.53 IOPs	89330.2 IOPs
Write IOPs		2384.91 IOPs	7391.52 IOPs	84254.97 IOPs
Read Rate		14.39 GBps	34.76 GBps	253.9 GBps
Write Rate		13.29 GBps	30.65 GBps	164.06 GBps
Network B/w Capacity	52.62 GB/s	634.97 MB/s		2.18 GB/s
Network Send Rate		17.69 MB/s	48.14 MB/s	318.38 MB/s
Network Receive Rate		19.99 MB/s	54.79 MB/s	363.51 MB/s

“It’s the art of design”

- anonymous

Design

Know that industry averages are … average…

Best practices and reference architectures are …stuff that works well most of the time…

As you begin your design, know if you are average, and if best practices apply to your specific situation!

Design

CPU - vCpu/Core User Group	vCPU old	vCPU Dual/2S	vCPU Quad/4S	vCPU/PVD Dual/2S	vCPU/PVD Quad/4S
Light	8-10	13	11	11	9
Normal	6-8	10	8	8	6
Heavy	2-4	5	4	4	3

RAM - GB/VM User Group	Old	Pooled	PVD
Light	1-1.5	1	1
Normal	1.5-2	2	2
Heavy	4	4	4

IOPS - IOPS/VM User Group	Old	MCS	PVS	MCS/PVD	PVS/PVD
Light	4-6	8	5	7	4
Normal	8-12	16	10	14	9
Heavy	25-50	32+	20+	29+	18+

Guidelines updated from http://virtualfeller.com/2013/05/02/virtual-desktop-resources-then-and-now/ - by Daniel Feller, Lead Architect

"old" guidelines from 2011, new guidelines updated 2013. Principal change - Faster processors

Design

Consider the customer assessment shared earlier:

- 268 users
- Peak 600Ghz of CPU, 728GB of RAM, 90,000 IOPS
- Peak Averages of 197Ghz, 574GB RAM, 23,000 IOPS

Observed:	vs.	Guideline (Normal-Heavy):
0.73-2.3Ghz per user		0.31-0.63Ghz per user
2.14GB-2.71GB RAM/user		2-4 GB RAM per user
86-335 IOPS per user		16-32+ IOPS per user

KNOW YOUR ENVIRONMENT!

VDI vs. SBC

Design

VDI – Windows Desktop OS running in a VM – 1:1

SBC – Windows Server OS running RDS – 1:n

VDI – Virtual Desktop Infrastructure

SBC – Server Based Computing

a.k.a. Terminal Services

Design

VDI Advantages

- Every user is in their own VM, providing per user isolation
- Users can be granted admin rights within their session
- Software is running on a desktop OS
- Device Pass-through is more robust
- GPU shared at the virtual hardware level

Design

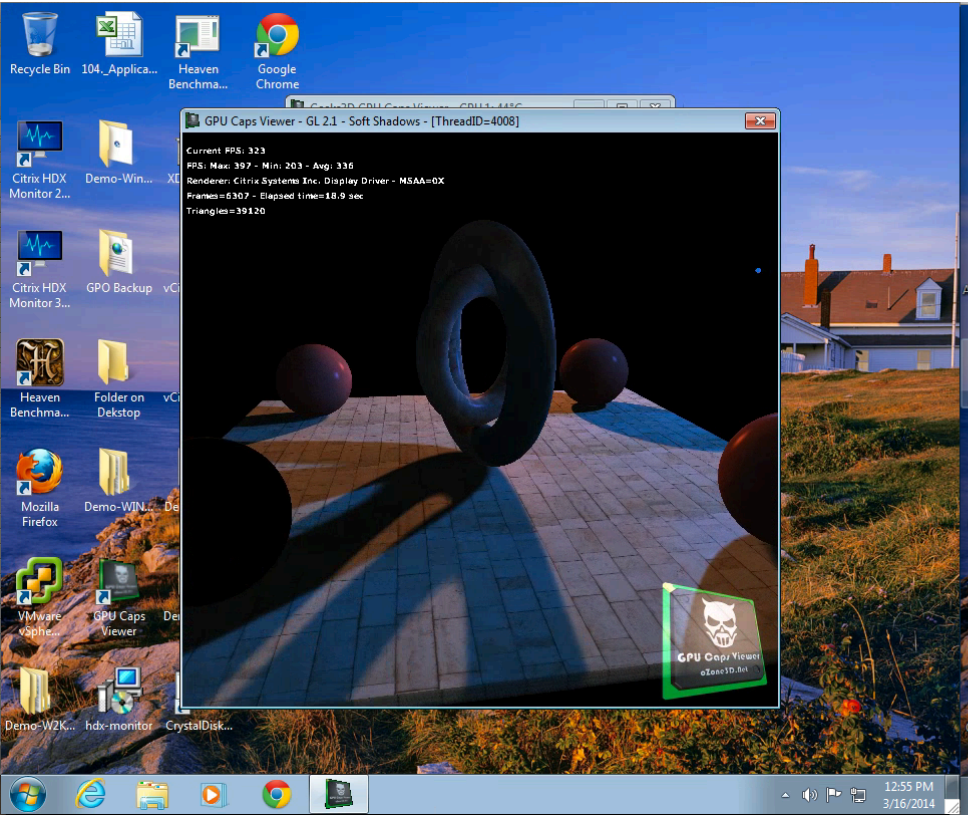
SBC Advantages

- Lower resource requirements since a single instance supports multiple users
- Lower per-user license costs (MS RDS CAL vs. VDA subscription)
- Fewer instances required to support a total number of users
- GPU can be shared at the OS level

Design

SBC and VDI Disadvantages

- Some software requires admin privs - VDI
- Some software requires desktop OS – VDI
- More protocol options for VDI – VDI
- VDI resources can be 10x SBC – SBC
- MS VDA is $100/year, RDS CAL is $92. – SBC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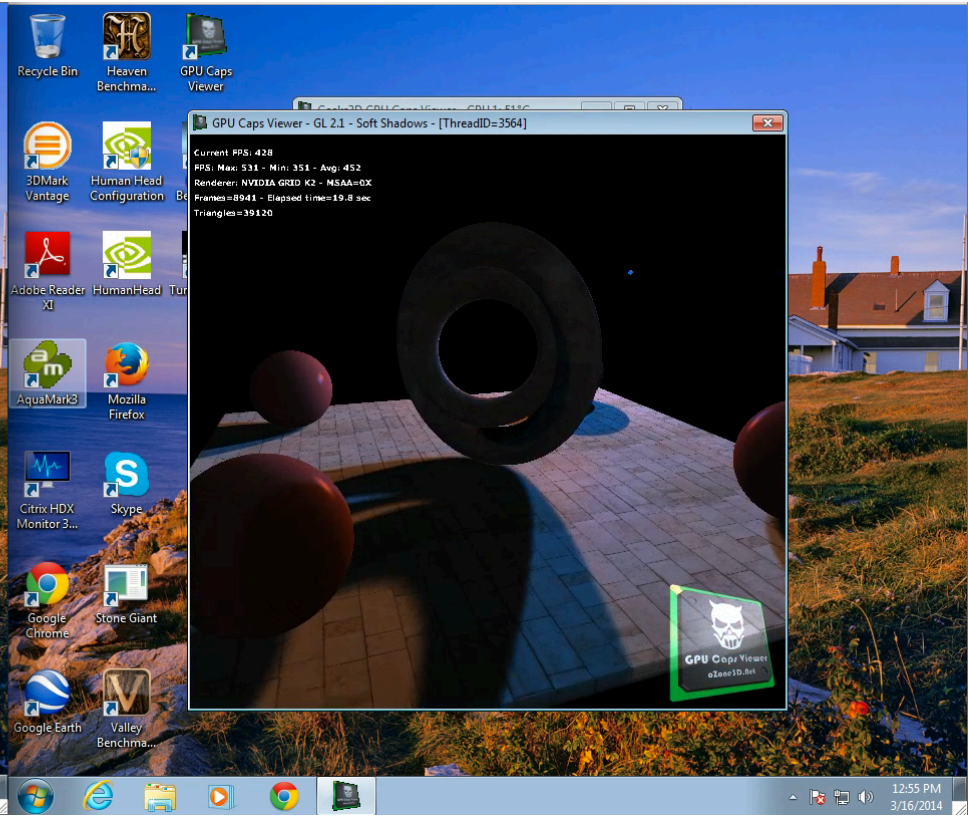
Current FPS: 323
FPS: Max: 397 - Min: 203 - Avg: 336
Renderer: Citrix Systems Inc. Display Driver - MSAA=0X
Frames=6307 - Elapsed time=18.9 sec
Triangles=39120
Recycle Bin
104._Applica...
Heaven Benchma...
Google Chrome
Citrix HDX Monitor 2...
Demo-Win...
Citrix HDX Monitor 3...
GPO Backup
Heaven Benchma...
Folder on Dekstop
Mozilla Firefox
Demo-WIN...
VMware vSphe...
GPU Caps Viewer
Demo-W2K...
hdx-monitor
CrystalDisk...
12:55 PM
3/16/2014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Current FPS: 428
FPS: Max: 531 - Min: 351 - Avg: 452
Renderer: NVIDIA GRID K2 - MSAA=0X
Frames=8941 - Elapsed time=19.8 sec
Triangles=39120
Recycle Bin
Heaven Benchma...
GPU Caps Viewer
3DMark Vantage
Human Head Configuration
Adobe Reader XI
HumanHead
AquaMark3
Mozilla Firefox
Citrix HDX Monitor 3...
Skype
Google Chrome
Stone Giant
Google Earth
Valley Benchma...
12:55 PM
3/16/2014

Design

SBC vs VDI Conclusion

- If cost is of greater concern - SBC
- If flexibility is of greater concern – VDI

Mix and Match in the same environment

- XenApp + XenDesktop!
- View + MS RDS!
- MS RDS supports both!

Persistent vs. Non-persistent

Design

Non-Persistent – VDI or SBC where changes/ customization are lost after a reboot

Persistent – VDI or SBC where changes are preserved and users are assigned to specific instances

Design

Persistent Advantages

- Physical desktops are inherently persistent
- Do what you've always done

Why change what works?

Design

Persistent Considerations

- Backups
- Availability
- Users must be returned to the same instance
- Management infrastructure (patches, software dist)
- Provisioning
- Cost

Design

Non-Persistent Advantages

- Gold Image based
- User connects to first available instance
- Potential lower total resource needs
- Cost (instance count = max concurrent users)
- Always new
- Inherent backup/availability solution

Design

Non-Persistent Advantages (cont.)

- Option for local storage (vs shared)
- User changes can be intentionally lost - lab/demo/ kiosk
- Simplified update process – no SCCM, LANDesk, etc.

but I need something in the middle…

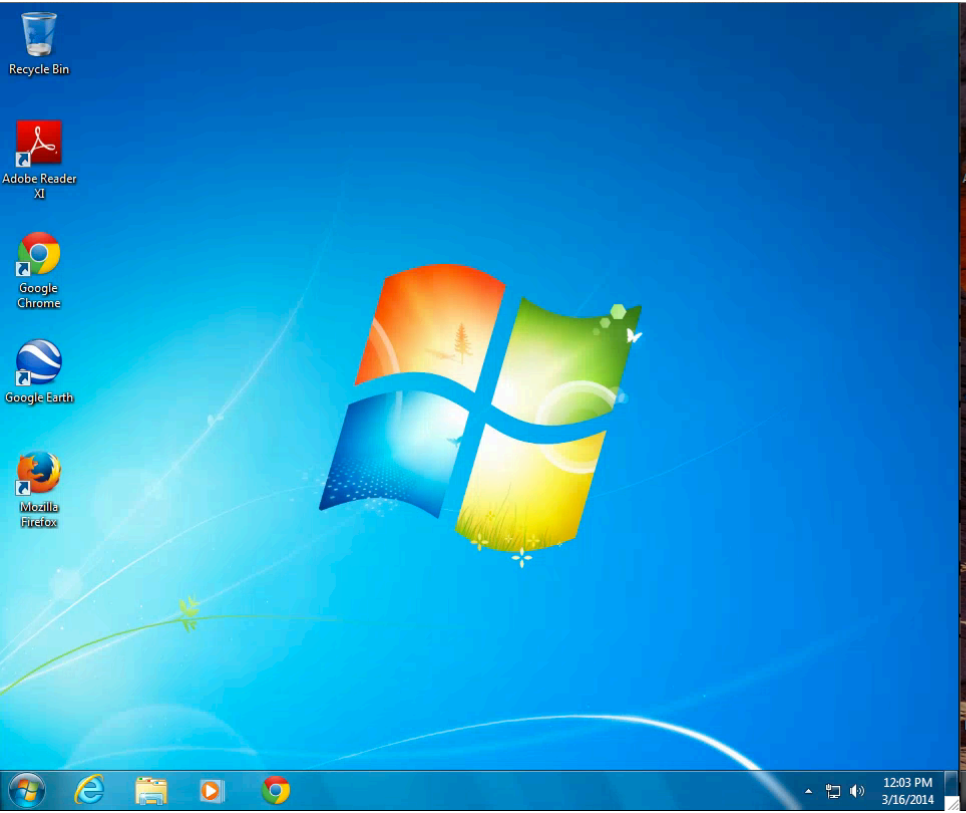
Design

Persistent – Non-Persistent Hybrid options

- Roaming Profiles, Profile managers, UEV
- Folder Redirection
- Layering – PVD, Mirage, Liquidware

Adds some complexity; rules; adds some flexibility

Looking to merge benefits of both NP and P desktops


Recycle Bin
Adobe Reader XI
Google Chrome
Google Earth
Mozilla Firefox
12:03 PM
3/16/2014


Recycle Bin
Demo-W20...
CrystalDisk...
XD710ICA...
Adobe Reader XI
Demo-Win...
Google Chrome
XD710ICA...
Google Chrome
Demo-Win...
GPU Caps Viewer
Google Earth
Demo-WIN...
hdx-monitor
Mozilla Firefox
Folder on Dekstop
Heaven Benchmark
Skype
GPO Backup
vCitrixNS10...
Demo-W2K...
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vCitrixNS10...
12:03 PM
3/16/2014

Design

Folder Redirection

Take the common folders from the desktop – Desktop, Documents, Downloads, etc. and redirect them from the user profile to a network location

This alone will make the contents of the folders persist and float between desktops

Design

Profile Managers and Roaming Profiles

Take the user profile (c:\users\username) and copy it to a network location at logoff, copy it back at logon

Provides persistence for the contents of the profile which includes most user preferences and data

Design

MS Roaming profiles are built into the OS

Citrix and VMware provide profile managers with additional capabilities (deeper control, policy)

3rd parties such as Liquidware Labs Profile Unity provide yet more control and the ability to map settings between v1 and v2 profiles, which is useful to mix XP, Win7, Win8 or support migration

Design

User Environment Virtualization (UEV)

- More sophisticated approach than typical profile management.
- Wrap a bubble around the user environment and track changes made, then replay those changes to a new session on upon application launch
- Can get very granular about what is persisted

Design

Also introduce a significant policy engine to allow for managing the user environment

- Map printers
- Map drives
- Logon and logoff scripts
- Policy actions within the environment

Design

Layering

- Break the desktop into “layers” for OS, Applications, and user data
- User desktop is constructed by assembling the layers into a composite image
- Layers can then be updated/removed/added independently of each other

Design

Citrix Personal vDisk (PVD) and VMware user data disk (UDD) provide a “user layer” on top of the system image. This allows the system image to be updated without impacting data in the user layer.

These technologies are included with their respective products and provide persistence while allowing administrators to utilize image based management

Design

VMware Mirage provides a more sophisticated layering technology which can be used with VDI and Physical desktops

Liquidware Labs Profile Unity supports a user layer attached dynamically to non-persistent desktops and also supports admin assigned departmental layers

Design

Persistent vs Non-Persistent

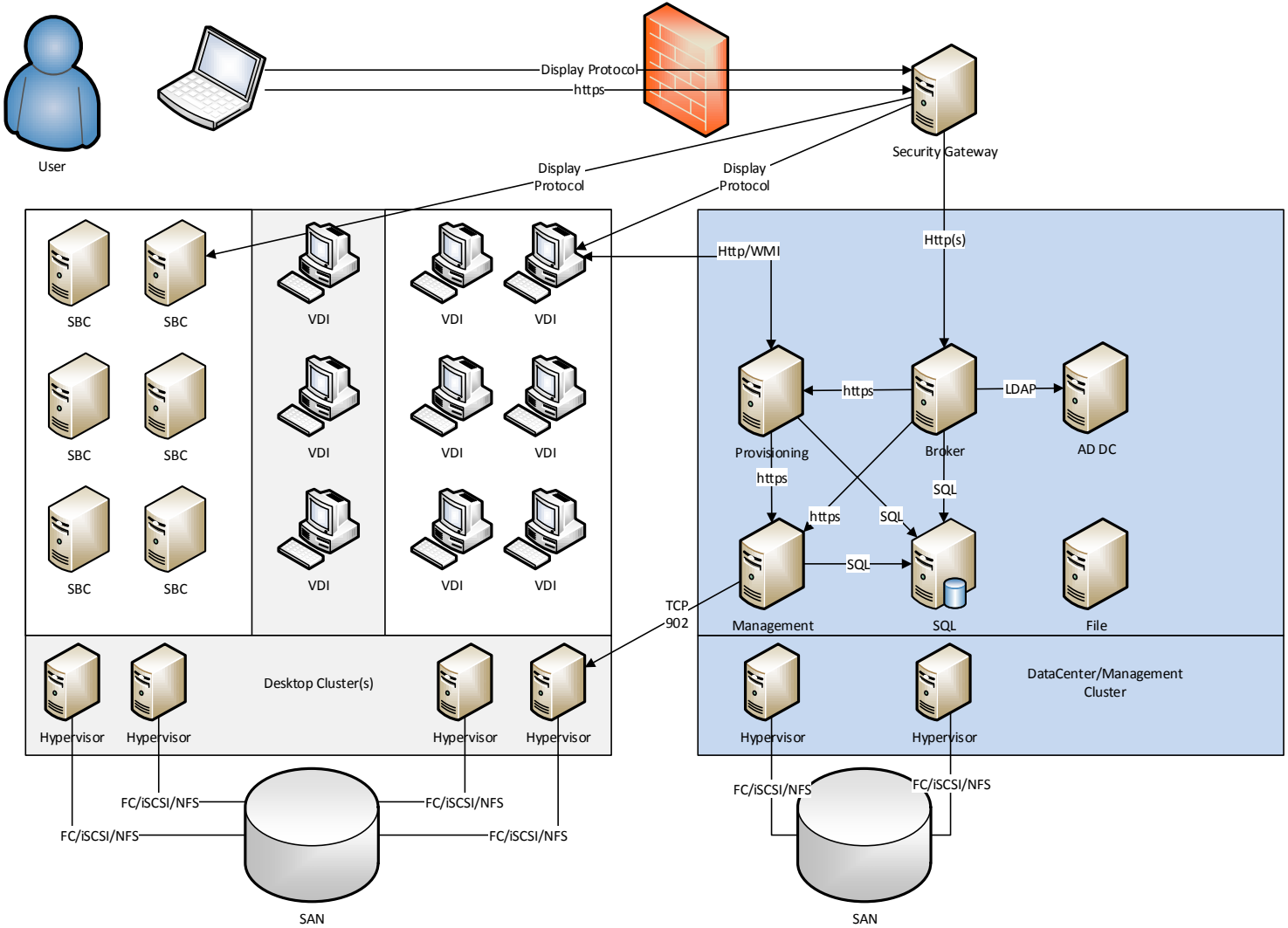
Computer Labs, Training Rooms – NP

Application Developers – P

Everybody else … It depends

Most customers end up with a mix of Persistent, Hybrid, and Non-Persistent with the mix changing over time.

“And now here’s something we hope you’ll really like”
-Rocky the Flying Squirrel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Security Gateway
Display Protocol
Display Protocol
Http/WMI
Http(s)
SBC
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VDI
VDI
VDI
VDI
VDI
VDI
VDI
Provisioning
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Broker
LDAP
AD DC
https
SQL
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Desktop Cluster(s)
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Hypervisor
Hypervisor
DataCenter/Management Cluster
FC/iSCSI/NFS
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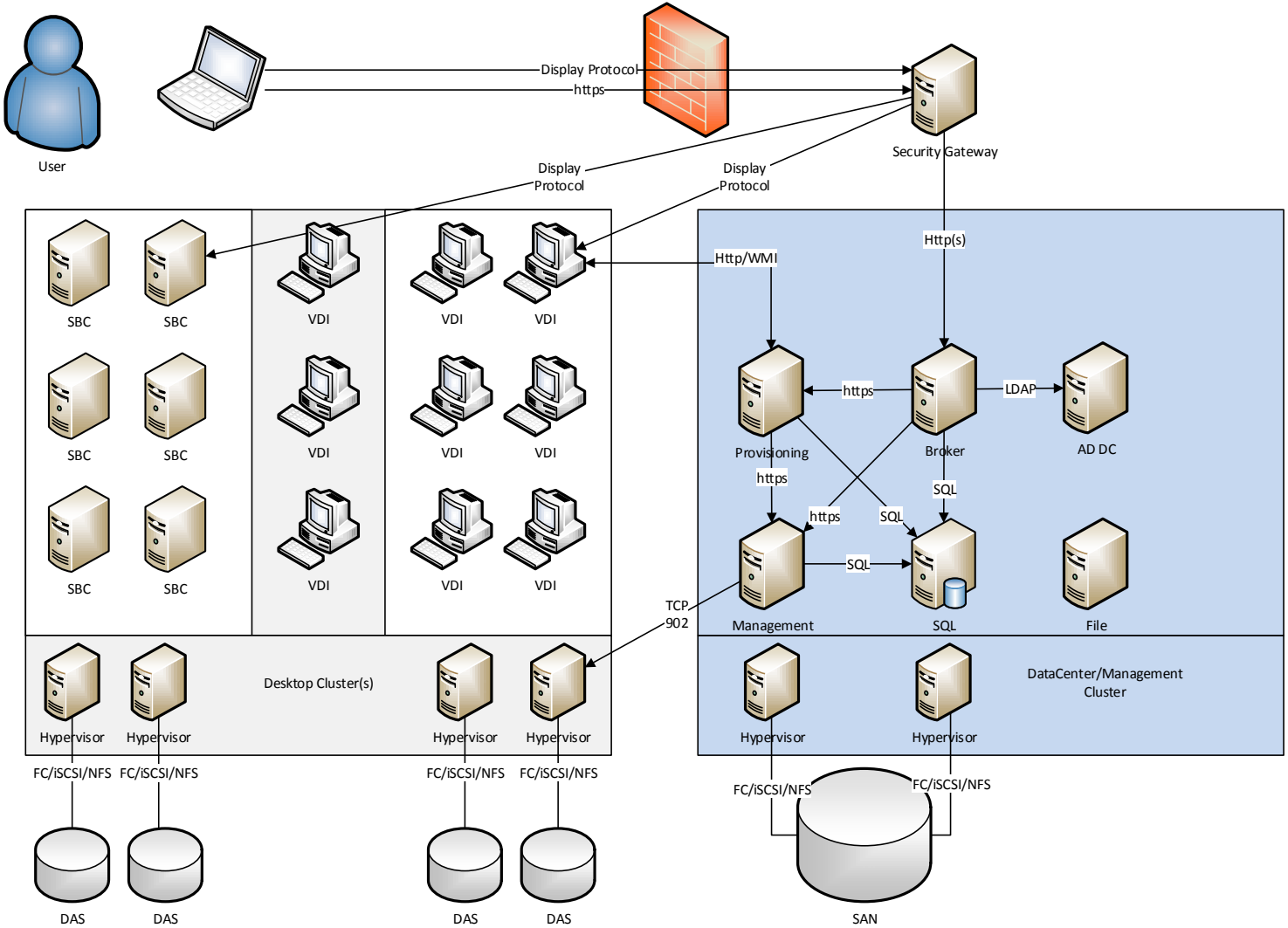
SAN
SAN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Provisioning
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Broker
LDAP
AD DC
https
SQL
https
SQL
SQL
Management
SQL
File
TCP 902
Hypervisor
Hypervisor
Desktop Cluster(s)
Hypervisor
Hypervisor
Hypervisor
Hypervisor
DataCenter/Management Cluster
FC/iSCSI/NFS
FC/iSCSI/NFS
FC/iSCSI/NFS
FC/iSCSI/NFS
FC/iSCSI/NFS
FC/iSCSI/NFS
DAS
DAS
DAS
DAS
SAN

Design

CPU

Memory

Disk

Network

Graphics

Design

Desktop virtualization is a high demand workload

Don’t mix desktop workloads with server workloads; when resources are in contention desktops win or UX suffers

Do not build your desktop virtualization project on last-year’s hardware or the castoffs from the server folks

If your servers are 5ms slower, users won’t care

If their desktops are 5ms slower they will notice

Design

Windows Experience Index

- Benchmark built into Windows OS in Windows Vista, Windows 7 and Windows 8 (removed in 8.1)
- Requires at least some 3D support to run
- Rates subsystems separately and the lowest overall score determines the system's score
- Useful for comparing a systems overall ability to deliver a user experience

« All Control Panel Items ▸ Performance Information and Tools

Search Control Panel

Control Panel Home

Adjust visual effects

Adjust indexing options

Adjust power settings

Open disk cleanup

Advanced tools

Rate and improve your computer's performance

The Windows Experience Index assesses key system components on a scale of 1.0 to 7.9.

New hardware detected
Your Windows Experience Index needs to be refreshed

Refresh Now

Component	What is rated	Subscore	Base score
Processor:	Calculations per second	6.6	4.4
Memory (RAM):	Memory operations per second	5.9	
Graphics:	Desktop performance for Windows Aero	4.4	
Gaming graphics:	3D business and gaming graphics performance	5.1	
Primary hard disk:	Disk data transfer rate	5.7	

What do these numbers mean?

View and print detailed performance and system information

Tips for improving your computer's performance.

Learn more about scores and software online

Last update: 8/14/2012 5:28:33 PM

Re-run the assessment

See also

Action Center

Control Panel ▸ All Control Panel Items ▸ Performance Information and Tools

Search Control Panel

Control Panel Home

Adjust visual effects

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Adjust power settings

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Advanced tools

Rate and improve your computer's performance

The Windows Experience Index assesses key system components on a scale of 1.0 to 7.9.

Component	What is rated	Subscore	Base score
Processor:	Calculations per second	6.1	5.9 Determined by lowest subscore
Memory (RAM):	Memory operations per second	6.1	
Graphics:	Desktop performance for Windows Aero	5.9	
Gaming graphics:	3D business and gaming graphics performance	6.3	
Primary hard disk:	Disk data transfer rate	5.9	

What do these numbers mean?

Tips for improving your computer's performance.

View and print detailed performance and system information

Learn more about scores and software online

Your scores are current
Last update: 9/23/2012 10:18:45 PM

Re-run the assessment

See also

Action Center

Design

Typical Laptop – 4.4-6.0 base score

- Processor – 5.6-7.8
- Memory – 5.9-7.9
- Business Graphics – 4.6-6.2
- Gaming Graphics – 6.1-6.6
- Disk – 5.6-6.3

So we want our virtual desktop in these ranges

More info - http://bit.ly/PZgGau

Control Panel ▸ All Control Panel Items ▸ Performance Information and Tools

Control Panel Home

Adjust visual effects

Adjust power settings

Open disk cleanup

Advanced tools

Rate and improve your computer's performance

The Windows Experience Index assesses key system components on a scale of 1.0 to 7.9.

Component	What is rated	Subscore	Base score
Processor:	Calculations per second	5.6	5.6 Determined by lowest subscore
Memory (RAM):	Memory operations per second	7.9	
Graphics:	Desktop performance for Windows Aero	5.9	
Gaming graphics:	3D business and gaming graphics performance	5.8	
Primary hard disk:	Disk data transfer rate	6.1	

What do these numbers mean?

Tips for improving your computer's performance.

View and print detailed performance and system information

Learn more about scores and software online

Your scores are current
Last update: 10/12/2013 10:54:31 AM

Re-run the assessment

See also

Action Center

Control Panel ▸ All Control Panel Items ▸ Performance Information and Tools

Control Panel Home

Adjust visual effects

Adjust power settings

Open disk cleanup

Advanced tools

Rate and improve your computer's performance

The Windows Experience Index assesses key system components on a scale of 1.0 to 7.9.

Component	What is rated	Subscore	Base score
Processor:	Calculations per second	7.2	7.2 Determined by lowest subscore
Memory (RAM):	Memory operations per second	7.9	
Graphics:	Desktop performance for Windows Aero	7.9	
Gaming graphics:	3D business and gaming graphics performance	7.9	
Primary hard disk:	Disk data transfer rate	7.4	

What do these numbers mean?

Tips for improving your computer's performance.

View and print detailed performance and system information

Learn more about scores and software online

Your scores are current
Last update: 10/14/2013 9:13:55 PM

Re-run the assessment

See also

Action Center

Compute

Design

CPU is virtualized on a time-slicing basis with a scheduler and priority mechanism to address contention

Not enough and user sessions run slow, hang, disconnect

Generally VDI configs are memory bound rather than CPU. SBC configs are more likely to be CPU bound

Generally faster is better, yielding more responsive desktops

Design

CPU - AMD vs INTEL

- Generally AMD offers more cores, but Intel offers faster cores.
- Benchmarks and load testing favor Intel systems hosting greater densities (>60%), but at a higher price tag per host.
- Generally Intel's density offsets the higher cost
- Generally Intel's faster core gives a better UX

Design

CPU –

- 12 cores at 2.5 Ghz = 30Ghz
- 0.3Ghz/desktop means 100 desktops
- 0.6Ghz/desktop means 50 desktops
- 2.5Ghz/desktop means 12 desktops

Plan CPU capacity according to user workloads, allowing for peak demands to be met

Design

CPU – Hyperthreading

- Can provide some additional logical capacity however it's very dependent upon the workloads being executed
- If workloads are largely homogenous the benefit decreases
- Plan environment based on physical core capacity
- Know that HT will provide some additional headroom

Design

Multiple virtual CPUs (vCPUs)

- General guidance is to only use what's needed, but
- User experience generally improves with 2 or more
- Moving from 1 vCPU to 2 will directly reduce VM density

Memory

Design

Memory

- Swapping degrades UX rapidly
- Physical memory bus is a shared resource
- 100 2GB VM’s means 200GB of real memory
- Hypervisor will use some RAM itself

Design

Hyper-v and XenServer allow variable memory assignments (1-3GB for instance)

vSphere requires a hard assignment (2GB) but allows memory overcommit and will swap at the hypervisor if needed … but swapping remains bad for UX

Because of the per-VM swap, vSphere creates a swap file for each VM on storage when the VM powers on

This swapping (and the file) can be disabled via memory reservations

Storage

Design

- The number one performance issue encountered with desktop virtualization is undersized storage performance
- Storage performance and capacity are independent
- There is more than one way to skin this cat
- Remember to think about UX when making storage decisions

Design

IOPS – IO Operations Per Second

Local Storage, DAS – Storage internal or connected to a single physical host

Shared, SAN – Storage physically connected to multiple hosts such that all have equal access

IO Latency – Measure of how long a drive takes to respond to a command (perform an IO operation) generally measured in milliseconds (ms)

Design

- 7,200 RPM drives generally perform 80 IOPS
- 10,000 RPM drives generally perform 120 IOPS
- 15,000 RPM drives generally perform 180 IOPS
- SSD drives generally perform 2000+ IOPS

Design

SAN Advantages

- Conventional approach for most datacenters
- Provides high availability
- Provides high performance
- Relatively easy to manage
- Facilitates VM mobility between hosts
- Simplified DR through SAN replication
- Good choice for persistent deployments

Design

SAN Downsides

- Relatively high cost
- Stair-step scalability

Design

Local Advantages

- Low cost
- Simple
- Easy to scale
- Easy to configure
- Good choice for non-persistent

Design

Local downsides

- Complicates live migration and HA
- Complicates provisioning
- Complicates persistent scenarios

Design

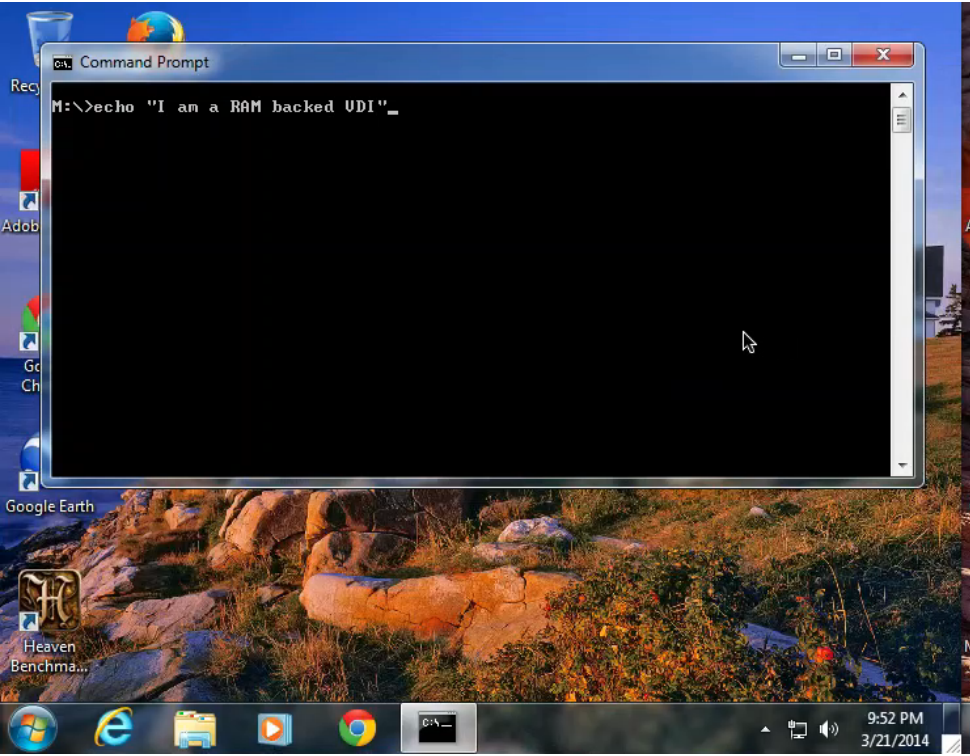
Local vs SAN

- Non-Persistent desktops – Local storage
- Persistent desktops without HA – Local storage
- Persistent desktops requiring HA – SAN storage

Design

RAM based IO accelerators

- Virtual machine using RAM to either optimize or eliminate physical disk IO
- Products from Atlantis Computing support both persistent and non-persistent desktops
- Basic concept – 256GB of RAM costs $3900 and 200GB enterprise SSD costs $5900
- IO Accelerator can eliminate the need for high performance disk


Command Prompt
M:\>echo "I am a RAM backed VDI"_
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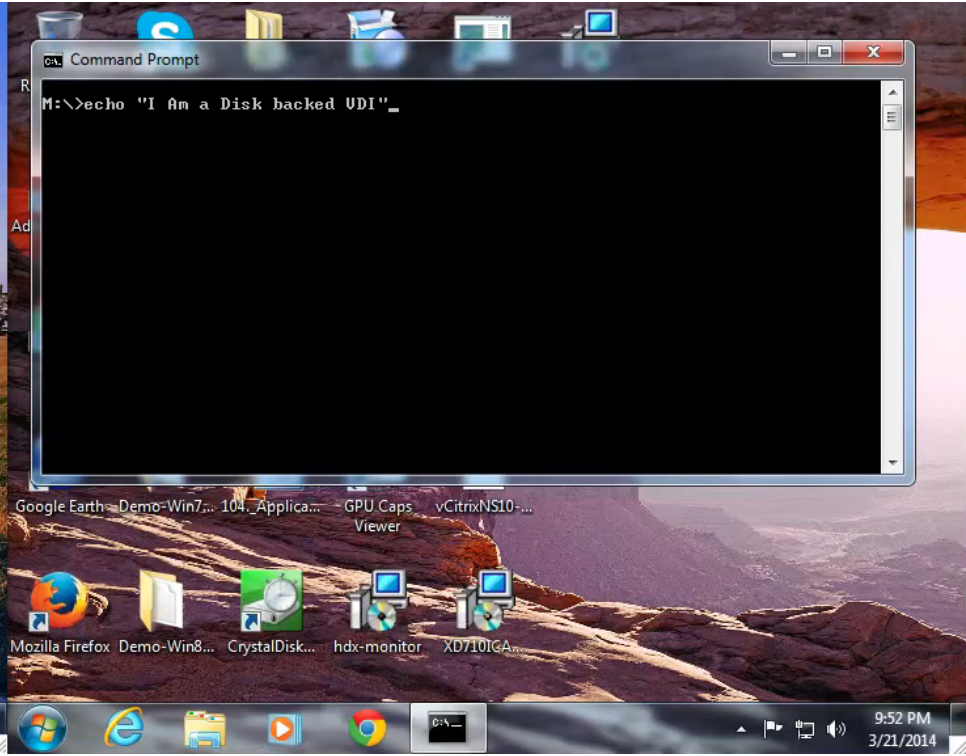
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Mozilla Firefox
Demo-Win8...
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hdx-monitor
XD710IGA...
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Design

- Accelerator uses RAM from host – usually 20-64GB to optimize and compress VM IO.
- Only optimized writes go to physical disk
- Can result in a 100x reduction in physical disk IO
- For non-persistent solutions physical disk IO can be completely eliminated
- IO from RAM measured in nano-seconds as compared to disk IO measured in milli-seconds

Design

- Accelerator performance scales as additional hosts are added
- End result is a lower cost solution for providing very fast IO to virtual desktops
- HA is handled at the accelerator appliance level – the appliance and dependent desktops must migrate together
- Compatible with all existing storage – local and SAN

Design

Storage Sizing – Capacity – Full Clones/Persistent

- (size of the image+size of RAM)*number of images
- (40GB Image+2GB RAM)*200 desktops = 8,400 GB

Storage deduplication can reduce this footprint significantly by only tracking unique blocks for each VM

Design

Storage Sizing – Capacity – Linked Clones Non-P

- Varies with placement of replica files, number of pools and technology.
- VMware Composer allows placement of replicas on separate storage from the VM's themselves
- Size of Image + (VM Delta + RAM)*VMs
- 40GB + (5GB+2GB)*200 = 1800GB

Design

- Citrix Machine Creation Services (MCS) requires placement of replicas on the storage with the VM's themselves; with max of about 64 VM's in a group
- With 200 VM's you'd have 4 groups of 50 each
- 4*(size of image+(size of RAM+VM Delta)*50)
- 4*(40GB+(2GB+5GB)*50) = 1560GB

Design

- Citrix Provisioning Services (PVS) requires placement of images on the PVS server
- PVS Server Disk Size = Size of Image(s)
- Number of VMs*(Size of RAM + VM Delta)
- 200*(2GB+5GB) = 1400GB

Note that the “size of RAM” figure is vSphere specific and is zero for Hyper-v and XenServer.

Design

Storage Sizing – Performance

- Understand the IO profile of the desktops – how many IOPS to size for and the read/write mix
- RAID5 requires 4 IOPS for every write IO
- RAID1 and RAID10 require 2 IOPS for every write IO

These are referred to as the “raid penalty” associated with performing writes in a RAID configuration

Design

General VDI IO mix is accepted as being 80-90% writes

If we assume 200 desktops @ 20 IOPS each, (4000 raw IOPS) and 90% writes…

- RAID10 effective IOPS are 7,600 IOPS
- RAID5 effective IOPS are 18,400 IOPS

Design

Physical disks to support this IO load would be

- RAID10 – 96 7.2K, 64 10K, 44 15K, or 4 SSD's
- RAID5 – 230 7.2K, 154 10K, 103 15K, or 8 SSD's

Citrix PVS and VMware Composer would allow you to size separate disk solutions for reads and writes

Design

Size performance first, *then* capacity

Example we need 4000 IOPS @ 90% write and 1400GB usable capacity

Solutions then are:

- RAID10 – 96 29GB 7.2K, 64 44GB 10K, 44 64GB 15K, 4 700GB SSD
- RAID5 – 230 6GB 7.2K, 154 9GB 10K, 103 14GB 15K, 8 200GB SSD
- RAM Accelerators + 1400GB of slow-medium speed disk

Design

- Use drive sizes and quantities to price out storage options
- All Flash arrays will often include 8-16 SSD drives in a single chassis
- Enterprise arrays from major vendors can incorporate SSD drives into their configurations
- IO Accelerators will reduce or eliminate disk performance requirements

Design

SSD drive use flash memory to store data. The physical nature of flash memory is such that repeated overwrites of the same memory cell eventually wear out the cell.

For this reason use of SSD to store data which is frequently overwritten may result in premature failure of the SSD device

Design

Technologies such as TRIM and “wear leveling” attempt to minimize these failures but do not eliminate the issue

For this reason it is very important to understand how vendors use and warranty SSD storage

Design

Perspective – SAN costs for 2000 IOPS (persistent)

- Ram costs $3900 for 256GB + disk backing (~ $2500)
- Enterprise SSD costs – $11,800 (per 200GB usable)
- Enterprise 15K costs - $21,450
- Enterprise 10K costs - $40,640
- Enterprise 7.2K costs - $46,752

Design

Perspective – Local costs 16-disks – Non-persistent

- Ram costs $3900 for 256GB @ 20,000 IOPS
- Local SLC SSD costs - $2760 @ 2400 IOPS – 200GB Usable
- Local 15K costs -$6192 @ 1400 IOPS – 2.4TB Usable
- Local 10K costs - $6192 @ 900 IOPS – 4.8TB Usable
- Local 7.2K costs - $3920 @ 600 IOPS – 4.0 TB Usable

Its all about user density and UX here

Design

Perspective – RAM IO Accelerators

- RAM is inherently faster than disk
- Persistent RAM accelerators will greatly reduce costs for SAN configs
- Non-persistent SAN represents an expensive option, but less so with RAM accelerators
- Non-persistent RAM accelerators will reduce cost or be cost neutral but will improve performance in local configs

Network

Design

How much network bandwidth do I need?

It depends on a number of factors; what is the user actually doing? What display protocol is in use? and how much compression is happening.

Office applications can be as little as 384Kb/s/user, but video, animation, and graphics can be 10Mb/s or higher.

Design

Network bandwidth is not constant. It will vary from mouse click to mouse click

Display protocol choice (RDP, HDX, PCoIP) will also impact the bandwidth use; as can the tuning of these protocols

Easiest to evaluate actual bandwidth during a pilot

Design

Insufficient bandwidth will result in slow screen paints as data trickles in; and may even result in dropped or hung sessions

Excessive network latency can give the impression that the session is running slow and even render it unusable, and can cause dropped sessions

Design

- Can generally tolerate network latency up to 120-150ms
- Some cases can be usable up to 300ms
- Tuning can reduce bandwidth requirements

It is important to understand the network conditions you expect to deliver desktops over

Graphics

Design

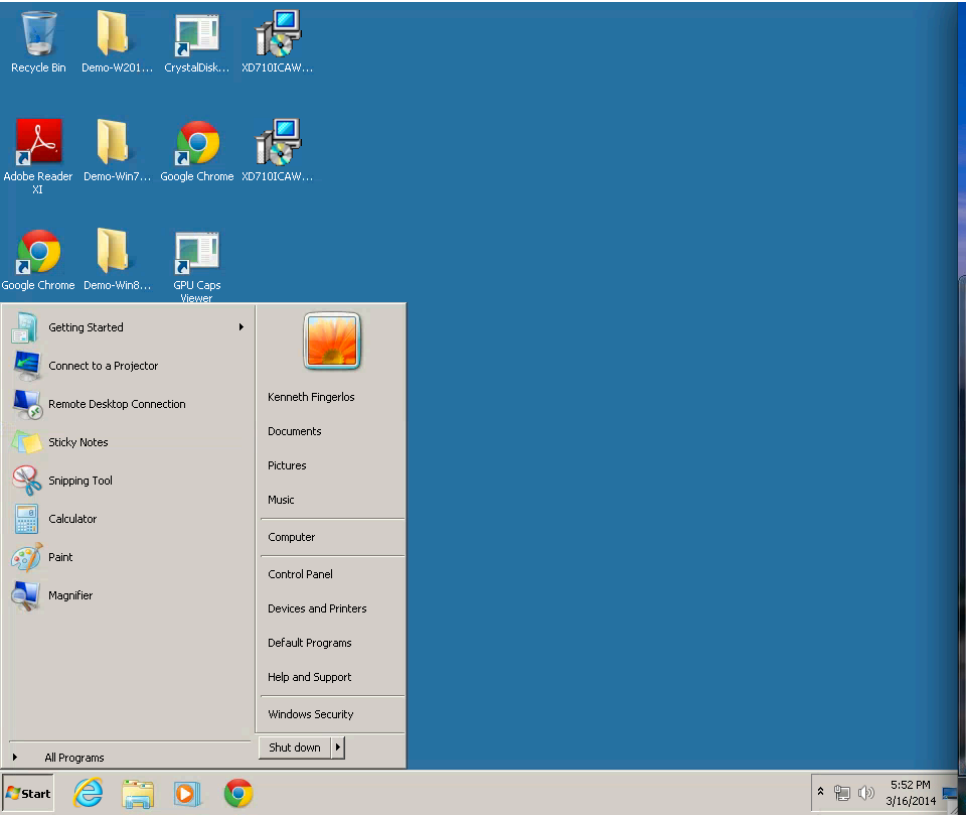
Consider that

- nearly every PC (or computer) shipped in the last 20 years has had some form of hardware graphics accelerator
- Applications are becoming increasingly graphics intensive
- Traditional virtual machine have no graphics hardware at all

Design

- Traditional virtual desktops render all of their 2D graphics on the system CPU
- Traditional virtual desktops have limited (if any) 3D rendering capability
- Traditional virtual desktops are therefore heavily optimized to minimize graphic content

But this creates problems…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Getting Started
Connect to a Projector
Remote Desktop Connection
Sticky Notes
Snipping Tool
Calculator
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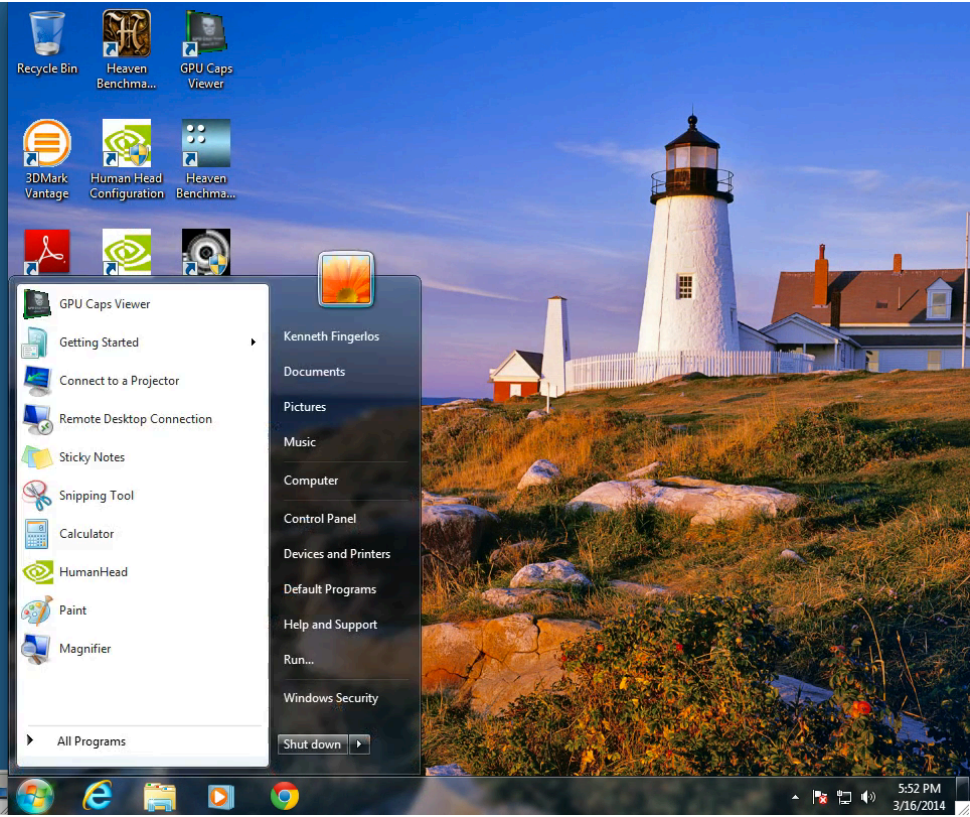
Recycle Bin
Heaven Benchma...
GPU Caps Viewer
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GPU Caps Viewer
Getting Started
Connect to a Projector
Remote Desktop Connection
Sticky Notes
Snipping Tool
Calculator
HumanHead
Paint
Magnifier
All Programs
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Documents
Pictures
Music
Computer
Control Panel
Devices and Printers
Default Programs
Help and Support
Run...
Windows Security
Shut down
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Design

Also consider that

- Windows 7 is optimized for graphics hardware
- Users expect a rich graphical experience
- Applications expect to be able to render 3D graphics via OpenGL and DirectX

How do we solve this?

Design

Software Rendering

- Provides basic 3D rendering support using CPU
- Suitable for basic applications and static images
- Compatible with virtually any hardware

- Slow and resource intensive
- Limited capability for recent DirectX and OpenGL versions

Control Panel ▸ All Control Panel Items ▸ Performance Information and Tools

Control Panel Home

Adjust visual effects

Adjust power settings

Open disk cleanup

Advanced tools

Rate and improve your computer's performance

The Windows Experience Index assesses key system components on a scale of 1.0 to 7.9.

Component	What is rated	Subscore	Base score
Processor:	Calculations per second	5.5	2.5 Determined by lowest subscore
Memory (RAM):	Memory operations per second	5.5	
Graphics:	Desktop performance for Windows Aero	5.0	
Gaming graphics:	3D business and gaming graphics performance	2.5	
Primary hard disk:	Disk data transfer rate	7.9	

What do these numbers mean?

Tips for improving your computer's performance.

View and print detailed performance and system information

Learn more about scores and software online

Your scores are current
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Re-run the assessment

See also

Action Center

Design

GPU Pass-Through

- Physical pass-through of a GPU to a virtual machine
- Virtual machine runs the GPU's native drivers
- Provides full support of latest OpenGL and DirectX
- Provides full performance of the GPU
- Suitable for Professional Graphics needs

- Limited to 1 VM per GPU

Control Panel ▸ All Control Panel Items ▸ Performance Information and Tools

Control Panel Home

Adjust visual effects

Adjust power settings

Open disk cleanup

Advanced tools

Rate and improve your computer's performance

The Windows Experience Index assesses key system components on a scale of 1.0 to 7.9.

Component	What is rated	Subscore	Base score
Processor:	Calculations per second	7.2	7.2 Determined by lowest subscore
Memory (RAM):	Memory operations per second	7.9	
Graphics:	Desktop performance for Windows Aero	7.9	
Gaming graphics:	3D business and gaming graphics performance	7.9	
Primary hard disk:	Disk data transfer rate	7.4	

What do these numbers mean?

Tips for improving your computer's performance.

View and print detailed performance and system information

Learn more about scores and software online

Your scores are current
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Re-run the assessment

See also

Action Center

Design

GPU Virtualization – VMware vSGA

- API intercept and GPU virtualization using VMware SVGA driver
- Leverages GPU for faster graphics rendering
- Allows fall-back to software rendering

- Limited OpenGL and DirectX version support
- Variable performance based on system load

Control Panel ▸ All Control Panel Items ▸ Performance Information and Tools

Control Panel Home

Adjust visual effects

Adjust power settings

Open disk cleanup

Advanced tools

Rate and improve your computer's performance

The Windows Experience Index assesses key system components on a scale of 1.0 to 7.9.

Component	What is rated	Subscore	Base score
Processor:	Calculations per second	5.8	5.5 Determined by lowest subscore
Memory (RAM):	Memory operations per second	5.5	
Graphics:	Desktop performance for Windows Aero	5.9	
Gaming graphics:	3D business and gaming graphics performance	5.8	
Primary hard disk:	Disk data transfer rate	7.9	

What do these numbers mean?

View and print detailed performance and system information

Tips for improving your computer's performance.

Learn more about scores and software online

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Re-run the assessment

See also

Action Center

Design

GPU Virtualization – NVIDIA vGPU

- Allocate a subset of a GPU's physical resources
- Virtual machine runs the GPU's native drivers
- Supports latest OpenGL and DirectX
- Performance based on allocated resources

- XenServer only
- Max users dependent on resource allocation

Control Panel ▸ All Control Panel Items ▸ Performance Information and Tools

Search Control Panel

Control Panel Home

Adjust visual effects

Adjust indexing options

Adjust power settings

Open disk cleanup

Advanced tools

Rate and improve your computer's performance

The Windows Experience Index assesses key system components on a scale of 1.0 to 7.9.

Component	What is rated	Subscore	Base score
Processor:	Calculations per second	6.5	6.5 Determined by lowest subscore
Memory (RAM):	Memory operations per second	7.2	
Graphics:	Desktop performance for Windows Aero	7.1	
Gaming graphics:	3D business and gaming graphics performance	7.1	
Primary hard disk:	Disk data transfer rate	6.6	

What do these numbers mean?

Tips for improving your computer's performance.

View and print detailed performance and system information

Learn more about scores and software online

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Re-run the assessment

See also

Action Center

Design

GPU Sharing – SBC

- Pass-Through GPU to a SBC desktop
- SBC runs native GPU Drivers
- Supports latest OpenGL and DirectX
- High performance based on allocated resources
- Allows GPU to be shared by multiple sessions on the VM
- Performance varies with user load

Design

Graphics Performance (best to worst)

- GPU Pass-Through/GPU Sharing
- NVIDIA vGPU
- VMware vSGA
- Software Rendering
- Traditional VDI (no 3D)

Balance cost and performance with need

Endpoints Matter

Endpoints

The users endpoint is the device charged with presenting the desktop experience to the user

The endpoint can't improve (much) on what the datacenter does, but it can certainly detract from it

Rendering 60FPS of HD video in the desktop is useless if the endpoint can only render 5fps

Endpoints

Thin Client types –

- Zero Clients – firmware only devices, often have hardware assists to decode display protocols
- Linux Embedded – customized Linux distribution and client software
- Windows Embedded – Windows XP/7/8 and client software

Endpoints

Client software does matter.

CPU in the endpoint does matter, as do hardware decoding capabilities.

A thin client which drives a 17” or 19” monitor ok, may not be able to handle the additional CPU load of a 20” or 24” display.

You get what you pay for; an inexpensive thin client may be fine for a task worker, but be insufficient for professional graphics.

The Any’s

Anytime, Anywhere, Anything

Anytime, Anywhere, Anything

Endpoints Matter!

Networking Matters!

Time of day?

- Yes! Backups, Maintenance, After-School Surfing!

Virtual is better than Physical

Delivering a delightful experience

Virtual is Better

Consider Windows Experience Scores (7.9 max)

- Typical laptop provides a maximum of a 5.9; limited by disk IO
- Typical laptop scores 4.6-6.2 for business graphics
- Using IO Accelerators and GPU Pass-Through you can build a VDI desktop scoring 7.9 (maximum)
- Using IO Accelerators and vSGA you can build a desktop scoring 6.0 graphics and 7.9 on disk.

Virtual is Better

And you get the benefits of being virtual

- Access from your iPad
- Access from home
- Access from Starbucks
- Security
- Control
- Flexibility
- …and so many more

@KFingerlos #GTC14

S4783 Virtual is Better than Physical