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S8199: GPU-Enabled VDI Made the Grade at USC Viterbi School of Engineering

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Quick Poll
Current state of your VDI implementation

• Not yet; in discovery phase
• Not yet; in POC/pilot phase
• Already has VDI; looking to add GPU
• Already has GPU-enabled VDI
Session Objectives

• Why GPU-Enabled VDI @ USC Viterbi
• Strategies and Path USC Viterbi took
• Lessons Learned
• Next Steps
USC Viterbi at a Glance

- Founded 1905
- 8 Academic Departments
- Academic Programs: 27 BS, 58 MS, and 13 PhD
- Students: 2600 UGs, 5700 Gs
- Full Time Faculty: 310 (190 TT)
- ~5% annual growth in MS students over past 7 years
Instructional Computing @ Viterbi

- 27 30-computer classrooms
- 800+ desktops/laptops
- 220+ software titles
- 1350+ class sections per semester
- 20 FTEs, 80 student workers
Challenges

• Incoming students are digital natives
• Strategic move to accelerate education everywhere and to improve school ranking
  – Increase in class enrollment
  – More classes are teaching with graphics intensive apps
  – Applications require ever-increasing processing power to run with acceptable user experience
• Simplified IT management to reduce costs and complexity
Solution
GPU-enabled Virtual Desktop Infrastructure
VDI Benefits to Students

Enhances student academic success

• Increases mobility
• Enables device independence
• Gains flexible computing
• Realizes enhanced performance, productivity, and collaboration
• Improves security of user data via regular central data backup
VDI Benefits to Faculty

Puts faculty and students ahead of the curve

- Affords faculty with the same flexibility and mobility
- Enables faculty to focus on academics, not technology
- Enables classrooms to transform to customizable learning spaces
- Empowers faculty to experiment with innovative teaching methods
VDI Benefits to Administration

Reduces costs and increases revenues

- Relieves space constraints; eases classroom scheduling
- Facilitates online classes to include graphics-intensive applications
- Facilitates innovative teaching methodologies
VDI Benefits to IT

Reduces desktop support, management, and security costs.

- Eases system maintenance
- Offers more secure computing environment
- Affords agile and flexible computing
- Affords rapid deployment of applications
- Reduces break/fix issues at users’ devices
- Focuses on more strategic projects
Strategies
Successful GPU-enabled VDI implementation

• Build a compelling value proposition
• Understand your users and use cases
• Get the right people involved
• Conduct a pilot that is true to scale
• Optimize at every level and scale for growth
• Understand software licensing / behavior
• Focus on the user experience
Our Journey
Staged rollout

Proof of Concept
- IT infrastructure
- Identity & Access Management
- Network/security architecting
- Software compatibility

Phase I
- NVIDIA GRID K2 GPUs
- Soft launch; served 50 class sections

Phase II
- NVIDIA GRID K2 & Tesla M60 GPUs
- Went production; served 200 class sections

Next Steps
- Force multiplier
- Optimization

Pilot
- NVIDIA GRID K1 & K2 GPUs
- Engaged faculty/students
- Assessed work loads
- VM sizing

Q4/2013 – Q2/2014
Q3/2014 – Q2/2015
Q3/2016 – Q2/2017
Q3/2017 – onward

Q3/2015 – Q2/2016
Technical Specs – Hardware

Hardware components of USC Viterbi VDI system

- **Dell SonicWall** firewalls
- **Dell Force10 (10GbE)** network switches
- **Dell EqualLogic iSCSI SAN** storage arrays
- **Dell PowerEdge R730/R720** servers
- **NVIDIA Tesla M60** GPU cards
- **NVIDIA GRID K2** GPU cards
- **Teradici APEX 2800** PCoIP offload cards for R720 servers equipped with GRID K2
Technical Specs – Software

Software components of USC Viterbi VDI system

- **vSphere** - Cloud computing virtualization system includes ESXi (hypervisor)
- **Horizon** - Desktop virtualization system
- **UX** - User experience monitoring
- **Hive IO USX** - software-based storage acceleration solution
- **TrendMicro Deep Security** anti-malware
## USC Viterbi VDI Pools

<table>
<thead>
<tr>
<th>VDI Pool</th>
<th>Virtual GPU Profile</th>
<th>Server</th>
<th>Remote Display Protocol</th>
<th>Virtual Display Heads</th>
<th>Max Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced Desktop</td>
<td>M60-4Q</td>
<td>Dell PowerEdge R730: 2x Intel Xeon E5-2698v4 CPUs 2x NVIDIA Tesla M60 GPUs 768GB RAM 6x 10Gb BT network ports</td>
<td>Blast Extreme</td>
<td>2</td>
<td>2560x1600</td>
</tr>
<tr>
<td>General Desktop</td>
<td>K240Q</td>
<td>Dell PowerEdge R720: 2x Intel Xeon E5-2695v2 CPUs 2x NVIDIA GRID K2 GPUs 384GB RAM 2x 800GB SSD SLC RAID 0 6x 10Gb BT network ports</td>
<td>PCoIP</td>
<td>2</td>
<td>2560x1600</td>
</tr>
</tbody>
</table>

**GRID K2**: each GPU has 4GB of video frame buffer memory  
**Tesla M60**: each GPU has 8GB of video frame buffer memory
# Virtual Desktop Configurations

<table>
<thead>
<tr>
<th>Virtual GPU</th>
<th>Video Frame Buffer</th>
<th>vCPUs</th>
<th>RAM</th>
<th>VMs/server</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>M60-4Q</td>
<td>4 GB</td>
<td>4</td>
<td>32 GB</td>
<td>8</td>
<td>Adobe CC, ArcGIS, Arena, Autodesk AutoCAD/Maya/Revit, Bentley MicroStation/InRoads, Citilabs Cube, DS Abaqus, DS SolidWorks, Siemens NX/STAR-CCM+, etc.</td>
</tr>
<tr>
<td>K240Q</td>
<td>1 GB</td>
<td>2</td>
<td>16 GB</td>
<td>16</td>
<td>COMSOL, Erwin, Mathematica, MATLAB, Minitab, MS Office/Project/Visio/Visual Studio, PRO II, Python, Questa Sim, R, SAS, Xilinx ISE, etc.</td>
</tr>
</tbody>
</table>

Virtual Desktop runs Windows 10 x64 Enterprise LT SB.
USC-Specific User Experience

Some extras to enhance user experience

• **Simplified identity management** – students use same USC NetID account login credentials to access the USC Viterbi VDI system

• **Granular user entitlement management** – users are authorized/prioritized access to VDI based on class enrollment, class schedule, and where the client is connecting from

• **Unified desktop experience of data storage** across physical and virtual computing environments
Lessons Learned

Common pitfalls to avoid

• Buy only what you need; leverage existing infrastructure, if feasible
• VDI gives flexibility, but implementation is complex
  – Consider professional service, HCI, DaaS
• Virtualization has needs and considerations
• Changed cost structures - costs shifted from edge to data center
• Growth mindset
Next Steps
Where will we go from here

• Force multiplier... expand VDI capacity; capitalize on new gen GPU and GRID technology
• Convert workstations in computer classrooms to thin clients
• Optimize VDI management
• Enhance disaster recovery capabilities
Your Opportunity

Great rewards often require bold risk – stepping up to face your giants & stepping into the unknown.
Resources to Get Started

Useful NVIDIA virtual GPU resources

- NVIDIA Virtual GPU: http://www.nvidia.com/virtualgpu
- Virtual GPU Test Drive: http://www.nvidia.com/trygrid
- GRID YouTube Channel: http://tinyurl.com/gridvideos
- GRID Forums: https://gridforums.nvidia.com

Source: NVIDIA
Questions and Comments