VIRTUAL CLIENT COMPUTING CHALLENGES
User Experience is the Most Important Factor for VDI & DaaS

Mobility
1 in 3 workers are remote or multilocation today

Security
Loss of IP & data from cyber attacks, natural disaster, human error

Cost
Achieve highest user density while maintaining performance

Pro 3D Apps
Deliver a full Quadro experience from data center or cloud

Modern Apps
82% of Global IP traffic will be video by 2021

Sources: Gartner, Lakeside, Cisco Visual Networking Forecast
PERFORMANCE FROM THE DATA CENTER

NVIDIA Virtual GPU technology delivers graphics accelerated virtual desktops and applications

All devices have graphics

Virtual machines also need a GPU
GPU Accelerated Experience to every Virtual Desktop with NVIDIA HW and SW

With NVIDIA Virtual GPU

- Apps and VMs
- NVIDIA Graphics Drivers
- NVIDIA Virtual GPU
- NVIDIA virtualization software
- Hypervisor
- NVIDIA Tesla GPU
- Server

CPU Only VDI

- Apps and VMs
- Hypervisor
- Server
IMMERSIVE VIRTUAL WORKSPACES

Knowledge/Business Worker

NVIDIA GRID Virtual PC
NVIDIA GRID Virtual Apps

Creative/Technical Professional

NVIDIA Quadro Virtual
Data Center Workstation
## NVIDIA VIRTUAL GPU SOLUTIONS

<table>
<thead>
<tr>
<th>Type of User</th>
<th>Virtual GPU Software Edition</th>
<th>GPU Hardware Recommendation</th>
<th>Knowledge Worker</th>
<th>Creative &amp; Technical Professional</th>
</tr>
</thead>
</table>
| Virtual G... | GRID Virtual PC/Virtual Ap... | Tesla M10                  | Quadro Virtual Data Center Workstation | Tesla P4
| Edition      | Applications                  | Tesla P6 for blade form factor |                  | Tesla M60, P40, P100, V100 Tesla P6 for blade form factor |
ACCELERATE PRODUCTIVITY
For Every User, Any App

Knowledge Worker

Providing business users the highest level of experience for all their apps on any device

Creative & Technical Professional

Uncompromised experience for professional graphics users allowing them to design on the go

Scalability

Performance

Office, Ai, Ps, Id

AUTOCAD, SOLIDWORKS, Petrel, CATIA, REVIT, ArcGIS, Siemens NX, Autodesk Maya, 3DEXCITE

nvidia
Employee Productivity

- From 12 hours for a developer to download code to downloading in minutes - Autodesk
- Where it used to take 8-10 seconds to open up the intranet, it only took 2-3 seconds with GPUs - Seyfarth Shaw
- Delivered 2X performance improvement on 3D CAD/CAE apps - Honda
- During a series of snowstorms, employees were able to log into work remotely, with no decline in user experience - WBCM
- People from multiple offices can work together in the same files at the same time - CannonDesign
IT Staff Productivity

- Stand up a new virtual workstation in as little as ten minutes - CannonDesign
- Achieved 75% leaner IT with simplified management, compared to a city with the same population - City of Davenport
- 500:1 IT to employee ratio - DigitalGlobe
- 700+ employees across the globe with a team of 10 in the Netherlands and no local IT - AWL
- Agility to respond to new business requirements and add new users on the fly, with a VM sized perfectly for them - CannonDesign
Revenue and Customer Satisfaction

• Employees’ fully capable 3D workstations “follow” them wherever they go, including when working at a client’s office - WBCM
• Same day dental implants - Touro Dental College
• Sales technicians give customer demonstrations on tablets with significantly better graphics experience than expensive, heavy laptops used in the past - Autodesk
• VDI that performs so well that they don’t hear from users - Häagen-Dazs Japan
Cost Reduction

- Migrated to Windows 10 and NVIDIA GRID vPC and doubled the density at 2/3s the cost - The Polyclinic
- Reduced physical lab space with 90% of labs virtualized - University of Arkansas
- Delivered virtual workstations that quadrupled VDI usage - DENSO
- Virtual workstation experience that’s ‘almost as good as a $10,000 workstation’ - UMass Lowell
- VDI environment with GPU saw 70% improvement in CPU utilization - Holstebro
NVIDIA GRID vPC and vApps
Excellent User Experience at Scale
Windows 10 Requires a 30% Increase in CPU Consumption, compared to Windows 7
As new updates to Windows 10 aim to bring more and more 3D and 4D capabilities to base OSs, as well as everyday business applications such as Microsoft PowerPoint, the need for IT organizations to leverage virtual client computing with support for GPUs to deliver a superior virtual graphics experience to any device, anytime, anywhere will continue to grow exponentially.

MODERN APPS IN THE DIGITAL WORKPLACE
Demands more GPU

Applications that require graphics has doubled since 2012

Over half of enterprise users access at least one graphics accelerated app
THE NEW DIGITAL WORKER
They way we work is changing

Windows 10
32% increase in CPU requirement over Windows 7

Office 365/Office 2016
50-85% increase in CPU requirements over Windows 7

Web Browsers
Modern browsers are hardware accelerated by default

Latest Web Standards
Flash, HTML5, and WebGL are all very taxing to the CPU

PDF Viewers
Adobe® Acrobat® and Microsoft Edge are hardware accelerated by default

Collaboration and Video
Skype and YouTube are now prevalent across the enterprise

Digital Imaging & Design
Some features in Adobe® Photoshop® won’t work without a GPU

Multi-, High Res Monitors
Multi-monitors is the new normal and 4K is becoming mainstream

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New NVIDIA GRID Features

- 2 GB profile to support “new normal” for knowledge workers
- Linux VDI for developers
- Multiple Monitors: up two 4K monitors or four HD monitors
NVIDIA GRID vPC FOR THE BEST WINDOWS 10 VDI USER EXPERIENCE

3X Improved End User Latency

2X Improved Consistency

1.5X More Remoted Frames

19% Average Resource Savings

Tested by NVIDIA on knowledge worker workloads (Excel, Word, PowerPoint, Chrome, Media Player, PDF) running on single 4K resolution monitor on VMware ESXi 6.5 on Horizon 7.4 with NVIDIA Tesla M10-2B and NVIDIA virtual GPU March 2018 Release (a.k.a. GRID 6.0)
SAFEGUARD ADOPTION WITH NVIDIA GRID

With NVIDIA GRID, police officers can use Google Earth and write reports from a virtual session, from anywhere. Simplified management enabled IT to expand VDI to knowledge workers and city planning engineers with 75% leaner IT compared to a city with the same population.
ACCELERATING INNOVATION

Quadro vDWS accelerates & streamlines professional workflows anywhere

Manufacturing  Architecture  Medical Imaging  Energy

Video Editing  Photorealism  Mapping & Analytics  Simulated Training
THE WORLD’S MOST POWERFUL VIRTUAL WORKSTATION

- Ultra High-End Workflows on Quadro Virtual Data Center Workstation powered by Tesla V100
- Faster, more fluid visual interactivity throughout the design process
“98-99% of our users can use the virtual environment just like a physical machine sitting in front of them. Users are actually reporting back that it performs exactly the same as a physical machine.”

Wesley Struble, CAD system admin, DENSO International America
NVIDIA vGPU
OCTOBER 2018
VIRTUAL GPU OCTOBER 2018 (vGPU 7)

Unprecedented Performance & Manageability

Multi-vGPU Support

vMotion Support for vGPU

NGC with vGPU

Tesla T4 GPU Support*

* Tesla T4 support coming with vGPU software 7.1 release
WHAT IS MULTI-vGPU?
Delivering a More Powerful Virtual Workstation

Multiple VM’s Sharing a GPU with NVIDIA Quadro vDWS

A Single VM Accessing Multiple Tesla GPUs with NVIDIA Quadro vDWS (7.0)
QUADRO vDWS MULTI-vGPU
Enabling New Virtual Workstation Workflows

Oil & Gas
Seismic interpretation, simulation

Manufacturing
Simulation, modeling & design

Government
Simulation & training

Media & Entertainment
Rendering
SPEED RENDER TIME BY UP TO 4.3X

Blender Cycles (CUDA) Render Time

Render scenes up to 4.3X faster than CPU only with three Tesla V100-32Q GPUs assigned to a VM with NVIDIA Quadro vDWS.

Tests were run on a server with 2x Intel Xeon Gold (6154 3.0 GHz) CPUs, 512GB RAM, RHEL 7.5, NVIDIA Quadro vDWS software, Tesla V100-32Q, Driver - 410.39, 256 GB RAM, Windows 10 x64 RS3.
“The flexibility of the new multi-GPU feature available with NVIDIA Quadro vDWS opens up powerful new rendering workflows to SOLIDWORKS Visualize users. The near linear performance scaling means they can iterate on their designs at lightning speed on professional virtual workstations, allowing our customers to arrive at their best design in the shortest amount of time.” - Brian Hillner, SOLIDWORKS Product Portfolio Manager

Tests were run on a server with 2x Intel Xeon Gold (6154 3.0 GHz) CPUs, 512GB RAM, RHEL 7.5, NVIDIA Quadro vDWS software, Tesla V100-32Q, Driver - 410.39, 256 GB RAM, Windows 10 x64 RS3
UP TO 6.8X FASTER SIMULATIONS
Ansys Fluent Computational Fluid Dynamics (CFD)

Internal Flow of a Cooling Water Jacket Model - 5.4 million cells
Ansys Fluent 19.1 with NVIDIA Quadro vDWS & Tesla V100-32Q

Tests were run on a server with 2x Intel Xeon Skylake (6148 2.4 GHz Turbo - 3.6 GHz), NVIDIA Quadro vDWS software, Tesla V100 GPUs with 32Q profile, Driver - 410.53, 256 GB RAM, Cent OS 7.4 64-bit. Benchmark Model: Water Jacket Model, Unsteady RANS, Internal Flow, Fluid- Water, size 4, 20 time steps
UP TO 4.95X FASTER THAN CPU-ONLY

Abaqus/Standard 2018 Elastomeric Bearing Model

Tests run on a sever with 2x Intel Xeon Skylake CPUs (Xeon 6148 2.4 GHz 32-core), NVIDIA Quadro vDWS software, Tesla V100 GPUs with 32Q profile, Driver - 410.53, 256 GB vRAM, Cent OS 7.4 64-bit. Benchmark Model: ~450-550 TFLOPs, 5.9M DOF, Highly Nonlinear Static, Axisymmetric model with non-axisymmetric loading and twist, Direct Sparse Solver (Model courtesy: SIMULIA)
vMOTION SUPPORT FOR vGPU
Delivering the Modern, Agile Data Center

Keep Servers Healthy
Run patches and upgrades at your own time, and easily perform workload balancing, without end user disruption or data loss.

Maximize Infrastructure ROI
Run mixed workloads using the same infrastructure by repurposing hosts that run VDI during the day to run HPC and other compute workloads at night.

vMotion supported on vSphere 6.7.1 and NVIDIA virtual GPU release 7.0
XenMotion support on Citrix XenServer 7.4 and NVIDIA virtual GPU release 6.0
ENABLING THE AGILE DATA CENTER

Ensure High Availability
Live migrate GPUs with support for vMotion & XenMotion

Lower IT Tickets
End-to-end monitoring with vROps integration

Maximize Infrastructure Utilization
Virtualize any workload and run VDI by day, HPC by night
NVIDIA TESLA T4 FOR VIRTUALIZATION
Powering 3D Professional Virtual Workstations

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPU Architecture</td>
<td>Turing</td>
</tr>
<tr>
<td>CUDA Cores</td>
<td>2,560</td>
</tr>
<tr>
<td>Tensor Cores</td>
<td>320</td>
</tr>
<tr>
<td>Memory Size</td>
<td>16 GB</td>
</tr>
<tr>
<td>vGPU Profiles</td>
<td>1 GB, 2 GB, 4 GB, 8 GB, 16 GB</td>
</tr>
<tr>
<td>Form Factor</td>
<td>PCIe 3.0 single slot</td>
</tr>
<tr>
<td>Power</td>
<td>70 W</td>
</tr>
<tr>
<td>Thermal</td>
<td>Passive</td>
</tr>
</tbody>
</table>
vGPU 7.0 MULTI-GPU DEMO

Get Faster Rendering & Simulation Results with Quadro vDWS

See how NVIDIA multi-vGPU support enables faster simulations in Ansys Discovery Live

Learn about how users can render faster in SOLIDWORKS Visualize by assigning more than one GPU to a virtual machine

Leverage more compute resources to do both graphics and compute

Run multiple apps in a single VM
vGPU SESSIONS AT GTC

Learn How the New NVIDIA vGPU Software Helps Deliver the Agile Data Center
Wednesday, Oct 10 at 14:30 in Room 22 - John Fanelli, Anne Hecht

Thursday, October 11\textsuperscript{th} in Room 13b

- BIM Cloud Workspace on Azure, Citrix and NVIDIA GRID
- Citrix XenApp/Microsoft RDSH - How to Get the Best User Experience and Performance with NVIDIA vGPU Technology
- Digital Disruption: Enabling BIM Agility in Construction Using NVIDIA Quadro vDWS
- How to Choose a GPU for your Environment with the Game Skyrim
- Maximize Data Center Resources: How to run VDI, HPC and AI Workloads on Common Infrastructure
- Optimizing NVIDIA Virtual GPU for the Best User Experience

Digital Disruption: Enabling BIM Agility in Construction Using NVIDIA Quadro vDWS
Learn more about NVIDIA virtual GPU technology
www.nvidia.com/vgpu

Test Drive NVIDIA virtual GPU today!
http://www.nvidia.com/testdrive