WHAT’S NEW WITH NVIDIA VIRTUAL GPU

John Fanelli, Vice President of Product
Anne Hecht, Senior Director of Marketing
EVOLUTION OF GPU ACCELERATED VDI

2013
Designers, Architects, Engineers

2016
Business User

2017
Simulation, Photo Realism

2018
Live Migration

2019
RTX Ray-Tracing
VIRTUAL GPU MARCH 2019 (8.0)
For Every Workload

Windows 10 Migration Acceleration Program
T4 with NVIDIA GRID

RTX Server for Rendering
Quadro Virtual Data Center Workstations

RTX Server for Gaming
NVIDIA GRID vGaming

Quadro in the Cloud
Global CSP Adoption
NVIDIA GRID FOR THE MODERN DIGITAL WORKER
NVIDIA T4 FOR VIRTUAL WORKSTATIONS

Universal GPU for Everyone

- **Virtual PCs for the Knowledge Worker**
  - NEW Windows 10 Migration Acceleration Program

- Up to 33% improved performance compared to CPU-only VMs
CUSTOMER RESULTS

Increased Productivity - Lower Management Costs - User Satisfaction

- Where it used to take 8-10 seconds to open up the intranet, it only took 2-3 seconds with GPUs - SeyFarth Shaw

- 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

- Migrated to Windows 10 and NVIDIA GRID vPC and doubled the density at 2/3s the cost - The Polyclinic

- VDI that performs so well that they don’t hear from users - Häagen-Dazs Japan

- Same day dental implants - Touro Dental College
Inserting video: Insert/Video/Video from File.

Insert video by browsing your directory and selecting OK.

File types that work best in PowerPoint are mp4 or wmv.
WINDOWS 10
Highest Graphics Requirement of any Operating System to Date

Windows 10 Requires a 50% Increase in graphics requirements, compared to Windows 7

*Percent of time consuming GPU (DirectX or OpenGL), comparing Windows 7 to Windows 10 builds in 2018 (builds 1803 and 1709)
INCREASING DEMAND FOR GRAPHICS

Windows 10 was developed with hardware acceleration in mind and is fully accelerated using a GPU by default.

Certain features like Metro/Modern UI cannot be completely disabled.

Free Windows 10 upgrades for consumers drive expectations for the same quality of experience at work to be productive.

GRAPHICS USAGE OF WINDOWS ENVIRONMENTS

- **Digital Worker on Windows 10 in 2019**
- **Digital Worker on Windows 10 in 2018**
- **Digital Worker on Windows 10 in 2017**
  - 20% more graphics*
  - 30% more graphics*
  - 50% more graphics usage from Windows 7 to Windows 10 in 2018* (*Measured by the percent of time consuming GPU (DirectX or OpenGL). Windows 10 builds in 2017 include 1709, 1703 and 1607. Windows 10 builds in 2018 include 1803 and 1709*)

Windows 7
WINDOWS 10 BUILDS GET MORE MASSIVE

32% increase in graphics requirements from Win7

50% increase in graphics requirements from Win7

- More 3D features (Snipping Tool, Timeline)
- Set customized graphics performance by application
- Fluent design UI including new “acrylic” texturing
- Motion improvements bring super smooth animations to dropdown menus, opening a new tab and more

20% increase in graphics requirements in Windows 10 from 2017 to 2018

3X increase in graphics requirements from Office 2010 to 2016

*Windows 10 builds in 2017 is based on data from builds 1709, 1703 & 1607. Windows 10 builds in 2018 is based on data from builds 1803 and 1709
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 Graphics

Applications that require graphics has doubled since 2012

Over half of enterprise users access at least one graphics accelerated app

*Percent of time consuming GPU (DirectX or OpenGL). Windows 10 builds in 2017 is based on data from builds 1709, 1703 & 1607. Windows 10 builds in 2018 is based on data from builds 1803 and 1709
THE NEW DIGITAL WORKER
The Way We Work is Changing

Windows 10
50% increase in GPU requirement over Windows 7¹

Office 365/Office 2016
50-100% increase in GPU requirements over Windows 7¹

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 GPU²

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

¹ Percent of time consuming GPU (DirectX or OpenGL), comparing Windows 7 to Windows 10 builds in 2018 (builds 1803 and 1709)
NVIDIA GRID vPC FOR THE BEST WINDOWS 10 VDI USER EXPERIENCE

Tested by NVIDIA on knowledge worker workloads (Excel, Word, PowerPoint, Chrome, Media Player, PDF) running on a single HD-resolution display with NVIDIA GRID 7.1 and NVIDIA T4-1B
WINDOWS 10 MIGRATION ACCELERATION PROGRAM

SERVER + GPUS + SOFTWARE (90 day activation delay) + Support

Certified Bundles - Validated & Tested

**T4**
- Universal GPU high utilization
- GRID vPC (64 users) + Four T4
- GRID vPC (96 users) + Six T4

**M10**
- Lowest cost per user
- GRID vPC (64 users) + Two M10
- GRID vPC (96 users) + Three M10

GRID vPC Software
- 33% off on 3 year subscription (3 years for price of 2)
- 40% off on 5 year subscription (5 years for price of 3)
WINDOWS 10 MIGRATION ACCELERATION PROGRAM

Available

Broad Partner Adoption

Logos of Cisco, Dell EMC, Hewlett Packard Enterprise, Supermicro, Fujitsu, iDIS, NetApp, Lenovo, and CDW.
NVIDIA RTX SERVER WITH QUADRO vDWS
RTX SERVER
Accelerated GPU Rendering in the Data Center

RTX | OMNIVERSE | 5G GFN ALLIANCES
RTX SERVER - RENDERING
Accelerated GPU Rendering in the Data Center
EXPLOSION OF CONTENT

1993
- Jurassic Park
  - 63 VFX Shots

2018
- Avengers: Infinity War
  - 2,680 VFX Shots

Annual Spend on Original Content

- Apple
- Amazon
- Netflix

“That shot... took 400 hours a frame to render.”

Danielle Feinberg
Director of Photography, Lighting
Interactive Session
GPU Rendering

Desktop
User Workspace

Datacenter
Render Nodes
Storage

Batch Jobs
CPU Rendering

Total Install Base: >50M desktops

1.5M CPU-Based Servers
“We never expected to see results this dramatic. This will completely change how our artists work.”

Michele Sciolette
CTO, Cinesite

2 Shots a Day
7 Shots a Day
ON DEMAND, INTERACTIVE RENDERING
Extend Power of RTX to Quadro Virtual Workstations

On-demand, Interactive, Rendering

Batch Rendering
NEW Quadro virtual Data Center Workstation
(Release March 2019):

- RTX 6000 and RTX 8000
- Up to 1.4X graphics performance than P40
- RTX Server with Virtual Workstation

QUADRO VIRTUAL WORKSTATION
STREAMS FROM RTX SERVER
Interactive, Real Time Rendering on Any Device, Anywhere
QUADRO VIRTUAL WORKSTATION STREAMS FROM RTX SERVER

NEW Quadro Virtual Workstation - expands virtualization to Quadro RTX 6000 and 8000

• Provision, in minutes, multiple high-end Quadro Virtual Workstations or any combination of virtual workstations and dedicated render GPUs
• Flexible configuration maximizes ROI
• Extend power of RTX platform to designers, on any device, anywhere

“Any VFX firm that’s not using virtual workstations is underutilizing its workstations, leading to higher costs. Teradici Cloud Access Software is the best solution because Teradici understands VFX challenges and is committed to solving them.”

Graham Jack
Chief Technology Officer, DNEG
ACCELERATING CREATIVITY

Most Powerful Rendering Platform

Media & Entertainment
Photorealistic Rendering & Design

Manufacturing
Product Design

Architecture
Design and Rendering
# RTX SERVER - RENDERING

Accelerated GPU Rendering in the Data Center

## Improvement

<table>
<thead>
<tr>
<th></th>
<th>CPU Node (Dual Skylake)</th>
<th>RTX Server (4 x RTX 8000)</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Render time (1 frame)</td>
<td>40 min</td>
<td>6 min</td>
<td>7x</td>
</tr>
<tr>
<td>Total render time (120 frames)</td>
<td>80 hours</td>
<td>3 hours</td>
<td>27x</td>
</tr>
<tr>
<td># of nodes</td>
<td>27</td>
<td>1</td>
<td>27x</td>
</tr>
<tr>
<td>Power (kW)</td>
<td>14.3</td>
<td>1.9</td>
<td>8x</td>
</tr>
<tr>
<td>Acquisition cost</td>
<td>$203k</td>
<td>$28k</td>
<td>7x</td>
</tr>
<tr>
<td>Cost of power (5 yrs)</td>
<td>$74k</td>
<td>$10k</td>
<td>7x</td>
</tr>
<tr>
<td>Total cost</td>
<td>$276k</td>
<td>$38k</td>
<td>7x</td>
</tr>
</tbody>
</table>

NETFLIX Lost In Space scene: renders in a fraction of the time using RTX Server
- 7x faster for a single frame
- 27x faster for the entire shot

*note: RTX Server not used in actual Lost In Space production*
RTX SERVER ECOSYSTEM SUPPORT
Quadro Virtual Workstations and RTX Server
“The ray-tracing compute capabilities of NVIDIA’s RTX GPUs and RTX Server, now with virtual workstations, are helping artists push the boundaries of content creation,” said Chris Vienneau, senior director of Media & Entertainment Products at Autodesk. “The Arnold GPU beta is now available to all our customers and we are excited to see how our users will take advantage of the unprecedented rendering speeds and amazing efficiency thanks to the powerful RT Cores, Tensor Cores and CUDA cores.”

“NVIDIA RTX Server delivers a powerful virtual workstation experience for designers and content creators. With Quadro vDWS, artists can easily tackle complex designs and create photorealistic objects, characters and environments at high resolutions,” said David Smith, CEO at Teradici. “In collaboration with NVIDIA for this launch, we are pleased to announce that we have enhanced our PCoIP protocol to support Quadro vDWS GPU acceleration, so Teradici Cloud Access Software customers now have another efficient and powerful option to run their design applications and workflows virtually.”

“The Quadro RTX Server with virtual workstation access is a new standard for on-demand rendering in the data center,” said Teri Bruns, vice president of Global Partner Solutions at VMware. “Combined with VMware vSphere and Horizon, multiple users are able to access a single GPU through virtual workstations, dramatically increasing the density of the data center. End-users can also easily provision render notes and workstations based on their specific needs.”
GeForce NOW CLOUD SERVICE RUNS ON GRID

Play your favorite PC games on nearly any device anywhere you go like LAYERUNKNOWN’S BATTLEGROUNDS, Fortnite, and more from Steam, Uplay and other popular digital stores. Games load faster and are always up-to-date with the latest patches.
NVIDIA QUADRO IN THE CLOUD
PROVEN QUADRO EXPERIENCE, ANYWHERE
Accelerating Design and Engineering Applications

Quadro in Physical Workstations
Quadro in traditional desktop and mobile workstations

Quadro in the Data Center
Quadro workspaces virtualized from the data center with Quadro vDWS

Quadro in the Cloud
Quadro delivered from the cloud with Quadro Virtual Workstation (Quadro vWS)
A BREAKTHROUGH IN REAL-TIME SIMULATION EXPERIENCE

“With Quadro vWS from the Azure marketplace, design engineers can quickly and easily interact with simulations in real time and iterate design alternatives remotely, on any device, resulting in significant cost and time reductions in the development phase.”

Justin Hendrickson, director of product management at ANSYS
“When spikes in production demand occur, particularly around major broadcast events like the Olympics or the World Cup, time and budget to set up new temporary editors are a big problem. With Quadro Virtual Workstation on NVIDIA T4 GPUs in the GCP marketplace, I have access to the same Quadro experience on-demand and from anywhere. I can use critical applications like Adobe Premiere Pro, apply GPU-accelerated effects, reposition, scale and rotate clips with a native, workstation-like experience.”

Alvaro Calandra, Consultant and Adobe Certified Master Instructor, ElCanal.com
# CLOUD ECOSYSTEM

## THIN CLIENTS
- IGEL
- 10Zig
- LG

## SOFT CLIENTS
- Teradici
- VMware Horizon with Blast
- Citrix Virtual Desktop with HDX Protocol
- Microsoft
- NICE

## DaaS
- Amazon WorkSpaces
- Windows Virtual Desktop

## DaaS MANAGEMENT SERVICES
- Workspot
- FRAME
- Citrix Cloud
- VMware

## INFRASTRUCTURE PROVIDERS
- Microsoft Azure
- Google Cloud Platform
- AWS
- Alibaba Cloud
- IBM Cloud
- Tencent Cloud
- Huawei
- Nutanix
- Oracle Cloud
- DiDi
- Baidu Cloud
GPU-Accelerated cloud computing is transforming industries

**Architecture**
Collaborate in real-time on designs, with the flexibility to adjust consumption based on cyclical project life cycles.

**Manufacturing**
Leverage cloud-based workstations running CAD/CAE apps, with enhanced security of IP, and provision the right level of resources for each user.

**Media and Entertainment**
Major and independent studios can be more flexible and agile, and easily scale up and down for productions by managing on-demand resources.

**Oil and Gas**
Geologists, geophysicists, and engineers can leverage applications running complex 3D data visualizations from the cloud, on any device.
QUADRO VIRTUAL WORKSTATION
Cloud Adoption News at GTC 2019

• 1st Virtual GPU in the Cloud for improved efficiency
  • Alibaba’s VGN5i KVM-based virtual GPU computing instance

• Marketplace Adoption
  • Alibaba
  • Azure
  • More to come....

• T4 Adoption for RTX from the cloud
  • GCP
  • AWS
  • Alibaba
How to launch an NVIDIA Quadro Virtual Workstation instance from the Microsoft Azure marketplace
GPU VIRTUALIZATION AT GTC!
NVIDIA Virtualization Demos
Accelerated GPU Rendering in the Data Center

RTX Server with Quadro Virtual Data Center Workstation

Quadro Virtual Data Center Workstation on T4 for AI Enhanced Workloads
PARTNER DEMOS

- Cisco
- Dell EMC
- Google Cloud Platform
- Hewlett Packard Enterprise
- Teradici
- Supermicro
- NetApp
- Microsoft Azure
## GPU VIRTUALIZATION TRACK

### Hilton Hotel, Almaden 1 Room

<table>
<thead>
<tr>
<th>Tuesday, March 19</th>
<th>Wednesday, March 20</th>
<th>Thursday, March 21</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology Innovation</strong></td>
<td><strong>vGPU Customers</strong></td>
<td><strong>vGPU Partners</strong></td>
</tr>
<tr>
<td>10 am S9882-Supercharging Graphics &amp; Rendering with NVIDIA Quadro Virtual Workstations from CSP Marketplaces</td>
<td>9 am S9454-High-Performance Compute &amp; Visualization Platform for Oil &amp; Gas</td>
<td>9 am S9886-Deliver Extreme Graphics While Achieving Great TCO with HPE SimpliVity HCI &amp; NVIDIA GPUs</td>
</tr>
<tr>
<td>11 am S9815-Maximizing Utilization of NVIDIA Virtual GPUs in VMware vSphere for End-to-End Machine Learning</td>
<td>10 am S9219-Designing &amp; Implementing a VDI Project Powered with GPU Hardware</td>
<td>10 am S9881-Using Industry Standard Benchmark Tools to Size Graphics Accelerated Applications</td>
</tr>
<tr>
<td>1 pm S9883-Powering Intelligent Video Analytics with NVIDIA Virtual GPU</td>
<td>11 am S9162-Improving Healthcare with Horizon &amp; NVIDIA GPU</td>
<td>11 am S9231-Leveraging NVIDIA, Citrix and IGEL to Support Unified Communications in VDI</td>
</tr>
<tr>
<td>2 pm S9670-Virtual Desktops by Day, Computational Workloads by Night: An Example Infrastructure</td>
<td>1 pm S9741-Network Accelerated GPU Workloads: How 5G and Edge Networks Boost XR</td>
<td>3 pm S9886-Deliver Extreme Graphics While Achieving Great TCO with HPE SimpliVity HCI &amp; NVIDIA GPUs</td>
</tr>
<tr>
<td>3 pm S9888-Virtual GPU Powers AI and Deep Learning in Universities</td>
<td>2 pm S9889-From Passthrough to vGPU: PSA Group’s Walk through Next-Gen VDI</td>
<td>3 pm S9870-Expert Panel Discussion: See How NVIDIA Quadro Virtual Workstations are Transforming Industries</td>
</tr>
<tr>
<td>4 pm S9884-User Experience is Key to VDI Success, Color Accuracy is Key to User Experience</td>
<td>3 pm S9870-Expert Panel Discussion: See How NVIDIA Quadro Virtual Workstations are Transforming Industries</td>
<td>4 pm S9814-How GPU-Accelerated Virtual Workstations Enable Mobility &amp; Collaboration for Autodesk Applications</td>
</tr>
</tbody>
</table>

* Technologies Innovation: March 19, 2019, Hilton Hotel, Almaden 1 Room.
* vGPU Customers: March 20, 2019, Hilton Hotel, Almaden 1 Room.
* vGPU Partners: March 21, 2019, Hilton Hotel, Almaden 1 Room.
**CUSTOMERS**

- UNMC
- PSA GROUPE
- Veterans United
- Browning Day Mullins Dierdorf

**PARTNERS**

- Hewlett Packard Enterprise
- GeoComputing group
- Autodesk
- GeoComputing group
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- GeoComputing group
- Asus
- Dell
- Intel
- Red Hat
- VMware

**INNOVATION**

- What’s New with NVIDIA vGPU?
- Video Analytics - Deepstream
- Quadro Virtual Workstation in the Cloud
- User Experience is the Key to VDI Success
- Mixed Workloads with vGPU Technology
- Virtual Labs for Education
# CISCO VDI SOLUTION BUNDLES

## Base Experience

<table>
<thead>
<tr>
<th>UCS C240 M5</th>
<th>SKU: LW87648192M</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRID vPC licenses (64 users)</td>
<td>2 x M10</td>
</tr>
</tbody>
</table>

## Enhanced Experience (Rack)

<table>
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<th>UCS C240 M5</th>
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<tbody>
<tr>
<td>GRID vPC licenses (64 users)</td>
<td>4 x T4</td>
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<th>UCS C240 M5</th>
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<tr>
<td>GRID vPC licenses (96 users)</td>
<td>6 x T4</td>
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</table>

## Enhanced Experience (Blade)

<table>
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<th>UCS B200 M5</th>
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<tbody>
<tr>
<td>GRID vPC licenses (32 users)</td>
<td>2 x Tesla P6</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>8 x UCS B200 M5, 1 Chassis</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRID vPC licenses (256 users)</td>
</tr>
</tbody>
</table>

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1. Cisco C240 M5 bundle with 6 x NVIDIA T4 GPUs with GRID licenses for 96 users coming soon.
## DELL VDI COMPLETE ENHANCED BUNDLE TEMPLATES

### Graphics Enhanced
Powered by vSAN Ready Node

<table>
<thead>
<tr>
<th>PowerEdge R740XD</th>
<th>Hybrid Disk Storage</th>
<th>2 x Intel Xeon Gold 5120 (14C)</th>
<th>384 GB Memory</th>
<th>2U Server Platform x/2000W PSU</th>
</tr>
</thead>
</table>

GRID vPC licenses (64 users)
- 2 x M10

VMware Horizon 7 Advanced
- Preferred Endpoints
  - Wyse 3040 Thin Client, Wyse 5070 Thin Client, OptiPlex 3060

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### Graphics Enhanced
Powered by vSAN Ready Node

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GRID vPC licenses (64 users)
- 4 x T4

VMware Horizon 7 Advanced
- Preferred Endpoints
  - Wyse 3040 Thin Client, Wyse 5070 Thin Client, OptiPlex 3060
<table>
<thead>
<tr>
<th>Plan</th>
<th>M10 Services</th>
<th>T4 Services</th>
</tr>
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<tbody>
<tr>
<td><strong>64 USER M10</strong></td>
<td>DL380 Gen10</td>
<td></td>
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<td>DL380 Gen10</td>
</tr>
<tr>
<td>GRID vPC licenses (96 users)</td>
<td>3 x M10</td>
<td></td>
</tr>
<tr>
<td><strong>64 USER T4</strong></td>
<td>DL380 Gen10</td>
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NVIDIA T4 FOR VIRTUAL WORKSTATIONS
Universal GPU for Everyone

- **Quadro Workstation from the Cloud**
  - Alibaba
  - AWS
  - Google
  - Azure

- **Professional Workstation Performance on T4**
  - Up to 2X graphics performance versus M60
  - 5 Giga Rays per second for real-time, interactive rendering

- **Virtual PCs for the Knowledge Worker**
  - Up to 33% improved performance compared to CPU-only VMs
  - NEW Windows 10 Migration Acceleration Program
MIXED REALITY SOLUTIONS FOR RETAIL OPTIMIZATION AND SHOPPER ENGAGEMENT

Surveys to customers showing realistic virtual simulations powered by Frame and Microsoft Azure enable companies a risk-free and cost effective way on a pay-by-the-minute basis to get feedback and iterate on new concepts for their shop floor.