NVIDIA GRID™
GPU Acceleration for Virtualization
AGENDA

GRID For VDI
GRID Enabled Solutions
User Profiles and Experiences
VDI
Circa 2011
GRID Powered VDI

A TRUE PC EXPERIENCE
Delivered to any device for the hundreds of millions of power users who want to bring their own devices to work.
Key Components of GRID

GRID VGX
Software

GRID GPUs

GRID VCA
Visual Computing Appliance
VDI
Powered by NVIDIA GRID

VIRTUAL MACHINE

- Windows 7
- Apps
- NVIDIA GRID Enabled Virtual Desktop
- NVIDIA Driver

NVIDIA GRID ENABLED Hypervisor

NVIDIA GRID GPU

VIRTUAL DESKTOPS
Key Components of GRID

GRID VGX
Software

GRID GPUs

GRID VCA
Visual Computing Appliance
Key Components of GRID

GRID
GPUs
NVIDIA Brands

GeForce®
Quadro®
Tesla®

Tegra®

NVIDIA GRID™
<table>
<thead>
<tr>
<th></th>
<th>NVIDIA GRID K1</th>
<th>NVIDIA GRID K2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GPU</strong></td>
<td>4 Kepler GPUs</td>
<td>2 High End Kepler GPUs</td>
</tr>
<tr>
<td><strong>CUDA cores</strong></td>
<td>768 (192 / GPU)</td>
<td>3072 (1536 / GPU)</td>
</tr>
<tr>
<td><strong>Memory Size</strong></td>
<td>16GB DDR3 (4GB / GPU)</td>
<td>8GB GDDR5</td>
</tr>
<tr>
<td><strong>Max Power</strong></td>
<td>130 W</td>
<td>225 W</td>
</tr>
<tr>
<td><strong>Form Factor</strong></td>
<td>Dual Slot ATX, 10.5”</td>
<td>Dual Slot ATX, 10.5”</td>
</tr>
<tr>
<td><strong>Display IO</strong></td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>Aux power requirement</strong></td>
<td>6-pin connector</td>
<td>8-pin connector</td>
</tr>
<tr>
<td><strong>PCIe</strong></td>
<td>x16</td>
<td>x16</td>
</tr>
<tr>
<td><strong>PCIe Generation</strong></td>
<td>Gen3 (Gen2 compatible)</td>
<td>Gen3 (Gen2 compatible)</td>
</tr>
<tr>
<td><strong>Cooling solution</strong></td>
<td>Passive</td>
<td>Passive</td>
</tr>
<tr>
<td><strong># users</strong></td>
<td>4 - 100¹</td>
<td>2 - 64¹</td>
</tr>
<tr>
<td><strong>Watts per user</strong></td>
<td>~ 1.5 W</td>
<td>~ 3.5 W</td>
</tr>
<tr>
<td><strong>OpenGL</strong></td>
<td>4.x</td>
<td>4.x</td>
</tr>
<tr>
<td><strong>Microsoft DirectX</strong></td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td><strong>GRID VGX Virtualization support</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

¹ Number of users depends on software solution, workload, and screen resolution
GRID Enabled OEM Platforms

Available Today:
- IBM iDataPlex DX360
  2 GRID K1 or 2 GRID K2
- Dell PowerEdge R720
  2 GRID K1 or 2 GRID K2

Available Q2 2013:
- HP ProLiant SL250
  2 GRID K2
- HP ProLiant SL270
  4+ GRID K2
- HP ProLiant WS460c Gen8
  1 GRID K1 or 1 GRID K2
- SuperMicro SYS-1027-TRF
  2 GRID K1 or 3 GRID K2
- SuperMicro SYS-2027-TRF
  2 GRID K1 or 4 GRID K2
Key Components of GRID

GRID VGX
Software

GRID GPUs

GRID VCA
Visual Computing Appliance
The PC

OS

CPU

Memory

Storage

Network

GPU

Software

HW Driver

HW Driver

HW Driver

HW Driver

NVIDIA Driver

Hardware

PC
The PC

OS

App

App

App

Win 7
Win 8
Linux

Software

Hardware

CPU

Memory

Storage

Network

GPU

HW Driver

HW Driver

HW Driver

HW Driver

NVIDIA Driver
The Virtualized Desktop

Synonymous terms
- VDI - Virtual Desktop Infrastructure
- HVD - Hosted Virtual Desktop
- Client Virtualization

Purpose
- Replace physical desktop / laptops with virtual desktops on servers

Benefits
- Move the compute resource closer to the large data in the data-center
- Security - Company IP stays in the data-center
- Manageability - OS image management
- User Flexibility - any device, anywhere, anytime
- Resource Utilization - keep shared resources busy for better ROI
The Virtualized Desktop

- **Virtual Driver**: For each virtualization layer
- **Virtual Machine**
  - vCPU
  - vMemory
  - vStorage
  - vNetwork
- **Hypervisor**
  - CPU
  - Memory
  - Storage
  - Network
- **Server**
- **Client**
The Virtualized Desktop

Virtual Machine

- vCPU
- vMemory
- vStorage
- vNetwork

Guest OS

Virtual Driver

- VDA

Hardware

- CPU
- Memory
- Storage
- Network

Virtualization

- Hypervisor

Software

- VDI
- VM

Client

- VMware ESX / vSphere
- Microsoft HyperV
- Redhat KVM
- Citrix XenServer
- Open Source...

ICA (Citrix)

PCoIP (VMware)

RDP (MSFT)

Citrix XenDesktop

VMware View

Microsoft RDP

HP RGS

NICE DCV

VNC

VMware Receiver

Citrix Receiver

VMware View

Microsoft RDP

HP RGS receiver

Microsoft RDP

Win 7

Win 8
GPUs in a Virtual Desktop

- **GPU pass-through**: 1:1 dedicated GPU to user
- **Shared GPU**: Software virtualization of the GPU
- **GRID VGX**: Hardware virtualization of the GPU through the NVIDIA GRID VGX technology
GPU Pass-Through

Accelerated Remoting
Citrix XenDesktop 5.6 FP1
VMware View 5.2

NVIDIA Pass-through
Citrix XenServer
VMware ESXi

GRID K1
GRID K2
Quadro 2000-6000
Quadro K2000-K5000
GPU Sharing

Also known as
- Software Virtualization
- API intercept
GPU Sharing

VIRTUAL MACHINE

VDA

GUEST OS

VIRTUAL GRAPHICS DRIVER

SOFTWARE

GPU SHARING

HYPERSERVER

SERVER

Cpu
Memory
Storage
Network
Gpu

CLIENT

GPU

NVIDIA DRIVER

VIRTUALIZATION

SOFTWARE

SOFTWARE

SOFTWARE

SOFTWARE
GPU Sharing

**Software**
- Virtual Driver
- Virtual Driver
- Virtual Driver
- Virtual Driver
- Virtual Graphics Driver

**Virtual Machine**
- vCPU
- vMemory
- vStorage
- vNetwork
- vGraphics

**Hypervisor**

**Server**
- CPU
- Memory
- Storage
- Network
- GPU

**Client**

**RemoteFX**
- Microsoft Server 2008 R2 - DX9
- Microsoft Server 2012 - DX9, 10, 11
- VMware vSGA - DX9, OGL2.1

**GRID K1, K2**
- Quadro 4000, 5000, 6000
- Tesla M2070Q
HW GPU Virtualization

Also known as

- NVIDIA GRID™ VGX technology
- VGX GPU Hypervisor
- vGPU
- Virtual GPU
- Hardware Virtualization

Coming
Mid-2013
HW GPU Virtualization

- **Virtual Machine**:
  - vCPU
  - vMemory
  - vStorage
  - vNetwork
  - vGPU

- **Guest OS**
  - NVIDIA Driver

- **Virtualization**
  - NVIDIA GRID VGX technology

- **Hypervisor**
  - Server
  - GPU

- **Hardware**:
  - CPU
  - Memory
  - Storage
  - Network

- **Software**
  - Virtual Driver
  - Virtual Driver
  - Virtual Driver
  - Virtual Driver
  - Virtual Driver

- **Client**
  - Client
  - Client

- **Graphic Commands**

- **Coming Mid-2013**
HW GPU Virtualization

HYPERVERSOR

VIRTUAL MACHINE

Client

CUDA

GRID VGX

VDA

Virtual Driver

vCPU

vMemory

vStorage

vNetwork

vGPU

Standard NVIDIA Driver

Citrix XenServer

NVIDIA GRID VGX software from NVIDIA

GRID K1, K2

Coming Mid-2013

Software

Virtualization

Hardware
USER EXAMPLES
<table>
<thead>
<tr>
<th></th>
<th>No GPU</th>
<th>Shared GPU</th>
<th>Pass-through</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DESIGNER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>POWER USER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>KNOWLEDGE WORKER</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User Type</td>
<td>No GPU</td>
<td>Shared GPU</td>
<td>Pass-through</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------</td>
<td>------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Designer</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Power User</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Knowledge Worker</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tbody>
</table>
One more thing...

XenApp - accelerated by GRID

Next...

- Delivering 3D Graphics from the Cloud with XenApp and XenDesktop VDI
  - Derek Thorslund (Director of Product Management, Citrix)
THANK YOU