GPU Accelerated XenDesktop – 3D Graphics beyond Designers and Engineers
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History of Virtualized Graphics

Business Drivers Leading to Virtualization

Citrix Solutions for Application & Desktop Virtualization

Customer Examples

New Technologies in Virtualization
- XenDesktop 7
- NVIDIA GRID vGPU

Q & A
Citrix Synergy keynote – May 2013
Citrix/NVIDIA collaboration
GPU Milestones in 3D graphics remoting

- **2006**: Project K2 delivers CATIA to Boeing Dreamliner designers
- **2009**: GA of XenDesktop HDX 3D Pro with Deep Compression
- **2011**: XenServer 6.0 hypervisor introduces GPU Passthrough
- **2012**: Higher fps via NVIDIA GRID™ API plus improved compression
- **2013**: XenDesktop 7 GPU Sharing with high density GRID™ K1/K2 cards
Industries that use 2D/3D professional graphics

- Aerospace
- Automotive
- Construction
- Energy
- Broadcast and Film
- Engineering Services
- Hi Tech - Electronics
- Industrial Equipment
- Medical Equipment
- Oil & Gas Exploration
Time to satisfy the “end users” & IT

Why can’t I work from home with my Mac?

How can I keep cost down and deliver IT more efficiently?

I wish I could access the engineering data on my phone.

I wish I could access my data from anywhere.
Business Drivers for virtualizing 2D/3D graphics apps & workstations

- Global talent base
- Secure IP
- Work-from-home
- Disaster recovery
- Mobile device access
- Collaborate share content and video
- Improve time-to-market
- Cost efficiency
Global product development teams – real example
Global development effort – Real Example

- 30,000 CAD files or 70 GB of data to be synchronized every day
- Across 26 design centers
  (30,000+ users)
- Across 16 countries
- It took 2 weekends to sync all code updates!
- More challenging for 4,000+ suppliers and partners
Enhances IP control, collaboration and global agility

Data stays in data center
Access via LAN or WAN
Citrix remote graphics solutions today

- Citrix XenServer – GPU Pass-through to virtual machines
  coming soon vGPU

- Citrix XenDesktop – Access to dedicated physical/virtual machine to any device
  coming soon vGPU ** supported only with XenServer

- Citrix XenApp – Access to shared physical/virtual machine to any device
  New!! OpenGL + coming soon deep compression codec

- Citrix RemotePC – Access to existing physical machine to any device
Virtual Desktop vs. Virtual Application

**Virtual Desktop**
- A full desktop OS (i.e. Win 7) per user, run on a data-center based server

**Virtual Application**
- Each application spawns a server hosted version of that app, running in Windows Terminal Services (Window Server OS)
Virtual Desktop vs. Virtual Application
Citrix XenDesktop HDX 3D Pro case study

- Below customers are pioneers implementing remote graphics solution
- Business challenges
- Solutions build w. remote graphics from Citrix/NVIDIA and benefits gained
Challenges

• Of course there were more than one...

3D CAD data is large
  ▪ Transferring our largest assemblies took 2.5 hours!

ABB’s corporate network
  ▪ Latency
  ▪ Bandwidth
Learnings

Service quality is a subjective matter

Using Dassault SolidWorks, 5-6 hours per day; Designers can work from India as if in Switzerland!
HDX 3D Pro case study

- Wind turbine manufacturer
  - Delivering PTC Pro/E and Dassault SolidWorks from Europe to other continents since 2008 (2,000 remote users)
- HDX 3D Pro protects Vestas’ intellectual property, supports workforce globalization, eliminates inconsistencies in engineering design versioning and overcomes regulatory challenges
- Reduced cost per running hour by 30% from €416 (traditional CAD workstations) to €291 (data center blade workstations) via follow-the-sun utilization (Denmark, UK, US, India, China)
HDX 3D Pro case study

- Major European heavy vehicle manufacturer

- Access from Germany, Mexico and Brazil to Dassault CATIA apps hosted in Sweden

- At 220ms roundtrip latency, good performance working on models with 1500+ parts; bandwidth usage rarely reaches 2.5 Mbps

- Using 3D Space Mouse
HDX 3D Pro case study

- Large engineering, design and consultancy company in 24 countries

- Bentley, Navisworks, Revit, AutoCAD, and more

- “It’s faster than local!” (large 3D models no longer have to be transferred across the network)

- “It even works on 3G!” (800 Kbps)

- “We reduced the number of PCs per user from 1.6 to 1.05”

- Virtual machines are used now 90% all the time 24-7

- 200% Return-on-Investment
Customer Case

• RaySearch Laboratories

World leader in radiation therapy
Raysearch advanced software solutions for radiation therapy are used successfully in more than 2000 clinics

• Access to global talent
• Clinic had a large central datacenter located 25kms from the main facility.
• Customer didn’t want to put the machines with RayStation on multiple desks, where the people who would access the system would never be more than the 10 licenses purchased (20 users with 10 licenses).
• This reduced the need for purchase and maintenance of 20 machines even though only 10 could be in use at any one time.
• Users already had PCs for operations on other applications – PC is used as end point device.
• The application is published seamlessly so settings on the host machine are preserved and local host disk access is restricted – meaning users have to use shared storage accessible from the hosts.
• Data is massive – overall average today 1GB per patient. In the future with 4D scans this will increase.
• Connectivity to the databases is important for open and save operations – with Citrix this...
Citrix XenApp GPU sharing + GRID K2
POC case study
• Oil & Gas company
Business Challenges

- Collaboration room with thin clients connects up to multiple big screens, where the 2D/3D application needs to be shared to multiple users in a live video feed with CISCO UC/Tandberg systems.
- Work from any device, work from home, work remotely.

The Solution for the POC

Dell R720 server with 2x NVIDIA GRID K2
Virtualization of hardware with Citrix XenServer
Offer 2 VM with Citrix XenApp HDX 3D with GPU pass-through to a GRID K2 board, able to share the resources to multiple users on each VM.
End devices Dell Wyse R90D7 with 2x24” displays
Workstations with Cisco UC client + Citrix Receiver
Ipad with Citrix Receiver
Petrel software + Autodesk + Bentley + Google Earth is offered remotely on any device even with CISCO UC
Technolog benefits

- Centralise data
- No data deduplication to multiple sites
- Share 2D/3D applications in collaboration rooms
- The users can log on any place and their 2D/3D workplace follows them
- Better user density (reduce amount of machines, centrally management)
- Reduce bandwidth
- Deliver any app to any device any where
Remote graphics enable new workstyle
Segmenting the user population

Tier 1  (e.g. design engineers)
- Top rendering performance (dedicated GPU)
- Deep compression on WAN links
- 3D SpaceMouse

Tier 2  (viewing/editing of large 3D drawings)
- GPU sharing

Tier 3  (typical knowledge workers)
- Software rasterizer or highly shared GPU
Classification of 3D professional graphics users

- **XenDesktop**
  - VDI
  - Create & manipulate large 3D models
  - Dedicated GPU

- **XenDesktop**
  - Hosted-shared (RDS)
  - View & edit 3D data
  - Shared GPU

- **Knowledge & Task users**
  - Business graphics apps
  - Shared GPU
XenDesktop 7

Mobile

Simple

Secure
XenDesktop: Powerful and flexible infrastructure

Universal client

High-Definition User Experience

Enterprise app store

Flexible Desktop and App delivery

PC
Mac
tablet
smartphone
thin client

Citrix Receiver

NetScaler Gateway

XenDesktop

HDX

FlexCast
DELIVERY TECHNOLOGY
• Tier 1: HDX 3D Pro on VDI
  • GPU acceleration of Direct3D, OpenGL, CUDA, OpenCL
  • H.264-based Deep Compression
  • One user per GPU (but ready for use with VGX™ hardware vGPU)
  • 3D SpaceMouse support

**TOP PERFORMANCE SOLUTION**

• Tier 2: HDX 3D Pro on RDS
  • GPU acceleration of Direct3D, OpenGL, CUDA, OpenCL
  • H.264-based Deep Compression
  • High performance GPU sharing
  • Lower cost Microsoft licensing
  • Apps must be RDS compatible

**MOST COST-EFFECTIVE SOLUTION**
XenDesktop architecture
Windows Apps and Desktops as Mobile Services
HDX 3D Pro license

- Feature of Citrix XenDesktop App/Enterprise/Platinum license and Citrix XenApp Enterprise/Platinum license

### HDX high-definition, mobile user experience

<table>
<thead>
<tr>
<th>Feature</th>
<th>XenDesktop Editions</th>
<th>XenApp Editions</th>
</tr>
</thead>
<tbody>
<tr>
<td>App Mobilization SDK (HDX Touch SDK)</td>
<td>VDI</td>
<td>Enterprise</td>
</tr>
<tr>
<td>Multimedia support</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Point to Point Unified Communications support</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lync 2010, 2013 Optimization</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Client-side hardware acceleration</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Multicast Video Support</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Client Drive Mapping</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Multi-monitor support</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Application Multi-Tasking</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td><strong>3D Graphics Business Apps Support (HDX 3D Pro)</strong></td>
<td>✓</td>
<td>✓</td>
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<tr>
<td><strong>3D Graphics Professional Applications Support (HDX 3D Pro)</strong></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
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Deep Compression codec technology

- Customer-reported bandwidth utilization on long-haul connections

- First user requires **1.5 to 2 Mbps minimum**

- Heavy equipment manufacturer:
  Branch with 12 concurrent users requires **700-800 Kbps per user**

- Control valves manufacturer:
  20 Mbps WAN link serves branch with 17 users, i.e. **1.2 Mbps/user**

- Bandwidth requirement does not scale linearly 😊
3D graphics acceleration options from Citrix

- High-end 3D professional graphics (OpenGL and DirectX)
- XenDesktop HDX 3D Pro
- XenApp 7 HDX 3D Pro
- XenApp 6.x HDX 3D

Rendering performance:

- 1 GPU/user: 3-10 Mbps
- Shared GPUs: ~3 Mbps (~1.5 Mbps at 1024 x 768)

Bandwidth efficiency at 1024 x 768:

- ~3 Mbps
- ~1.5 Mbps
Supports up to 4 monitors

- Citrix Receiver for Windows or Linux
- Efficient use of bandwidth
3D mouse support available on VDI

USB redirection for 3D Space Mouse and similar devices
Virtual Channel can be prioritized to maximize responsiveness
Citrix CloudBridge for WAN optimization

• Ideal for low bandwidth and high latency connections

• Improves responsiveness of apps delivered via HDX 3D Pro over high latency connections

• Reduces bandwidth consumption, enabling more users to share a given size of pipe (e.g. ABB reports 3:1 improvement at just 5 users)
XenApp GPU sharing scalability

- With two NVIDIA Quadro 4000 cards we ran **9 users per GPU** using a test app that works with ESRI ArcGIS, and we still had space for more

- Running Dassault SolidWorks, Ansys Workbench and Fluent, scalability was **6 to 10 users** per Quadro 4000

- The Quadro 6000 was able to support **30 users** running Dassault 3DVIA Composer Player with only minor slowdown; and this test was harder on the graphics card than the real world is!

- We are getting **30 users** of SAP Right Hemisphere 3D on a physical XenApp 6.5 server with a Quadro 2000 card

New NVIDIA GRID K1 & K2 introduces even higher user densities!
Client options for Citrix XenApp HDX 3D and XenDesktop HDX 3D Pro

Any Device – Business or Personal
Universal Access to Desktops, Apps and Data From Any Device

VDI
Citrix XenDesktop
1-1

Shared
Citrix XenApp
1- many
Future proven GPU options for remote graphics

Citrix XenApp, XenDesktop, XenServer

- GRID K2: 16GB
- GRID K1: 8GB

GPU Memory

GRID K2
GRID K1
Virtualized Desktops
The Virtualized Desktop

- **Hardware**: CPU, Memory, Storage, Network
- **Virtualization**: Hypervisor
- **Software**: Guest OS, Virtual Driver, Virtual Machine, vCPU, vMemory, vStorage, vNetwork
- **App**: VDA
- **Client**: Connection to the virtual desktop

Diagram highlights the components and their interactions within a virtualized desktop environment.
The Virtualized Desktop

Hardware

Software

Virtualization

Virtual Machine

Guest OS

vCPU
vMemory
vStorage
vNetwork

HYPERVISOR

CPU
Memory
Storage
Network

Server

Client

ICA (Citrix)

Citrix XenServer

VMware vSphere

Citrix XenDesktop

Citrix Receiver

Win XP
Win 7
Win 8

App

Virtual Driver

VDA

Virtualization

Virtual Machine

Guest OS

Virtual Driver
GPUs in a Virtual Desktop

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

Guest OS

CPU

GPU Pass-Through

Through Hardware

Memory

Storage

Network

Software

Virtual Driver

Virtual Driver

Virtual Driver

Virtual Driver

NVIDIA Driver

VIRTUAL MACHINE

vCPU

vMemory

vStorage

vNetwork

GPU

HYPervisor

Server

CPU

Memory

Storage

Network

GPU

Client

NVIDIA Driver

VDA
GPU Pass-Through

Guest OS

Server

CPU

GPU Pass-
Through

Hardware

Virtualization

Software

Accelerated Remoting
Citrix XenDesktop 5.6 FP1
Citrix XenDesktop 7

NVIDIA Pass-through
Citrix XenServer (vGPU)
VMware ESXi

VDA

VIRTUAL MACHINE

VIRTUAL DRIVER

vCPU

vMemory

vStorage

vNetwork

GPU

NVIDIA Driver

HYPERSERVER

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

App

App

App

NVIDIA Driver

NVIDIA GRID

GPU

Accelerated Remoting
Citrix XenDesktop 5.6 FP1
Citrix XenDesktop 7

NVIDIA Pass-through
Citrix XenServer (vGPU)
VMware ESXi

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

GPU

Accelerated Remoting
Citrix XenDesktop 5.6 FP1
Citrix XenDesktop 7

NVIDIA Pass-through
Citrix XenServer (vGPU)
VMware ESXi

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

GPU

Accelerated Remoting
Citrix XenDesktop 5.6 FP1
Citrix XenDesktop 7

NVIDIA Pass-through
Citrix XenServer (vGPU)
VMware ESXi

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

GPU
Virtualization GPU (vGPU)

Guest OS

VIRTUAL MACHINE

vCPU vMemory vStorage vNetwork vGPU

NVIDIA Driver

HYPERVISOR

vCPU vMemory vStorage vNetwork vGPU

NVIDIA Driver

GRID Software

Server

CPU Memory Storage Network GPU

Client

GPU

NVIDIA Pass-through
Citrix XenServer 6.2 (vGPU)

Accelerated Remoting
Citrix XenDesktop 7

Virtualization Software

Virtual Driver Virtual Driver Virtual Driver Virtual Driver

App App App App

App App App App

VDA

App App App App

Coming Mid-2013
Virtualized Applications
XenApp on Bare Metal

Windows Server OS

- App
- XenApp
- Terminal Session
- HW Driver
- NVIDIA Driver

Software

- Citrix XenApp 6.5
  - DX 9
  - OGL 4.3

- Citrix XenApp 6.5 FP2
  - DX 11, OGL 4.3

- Citrix XenApp 7
  - DX 11, OGL 4.3

Hardware

- CPU
- Memory
- Storage
- Network
- GPU

Server

Windows Server 2008 R2
Windows Server 2012 (R2)
XenApp in a Virtual Machine
GRID Enabled OEM Platforms

Available Today

IBM iDataPlex dx360 M4
2 GRID K1 or 2 GRID K2

Dell PowerEdge R720
2 GRID K1 or 2 GRID K2

Cisco UCS C240 M3
2 GRID K1 or 2 GRID K2

SuperMicro SYS-1027 TRF
2 GRID K1 or 3 GRID K2

SuperMicro SYS-2027 TRF
2 GRID K1 or 3 GRID K2

Asus ESC 4000 G2
3 GRID K1 or 4 GRID K2

Available Q2 2013

HP ProLiant SL270
4+ GRID K2

HP ProLiant SL250 Gen8
2 GRID K2

HP ProLiant SL270
1 GRID K1 or 1 GRID K2

HP ProLiant WS480c Gen8
1 GRID K1 or 1 GRID K2
Citrix XenDesktop/XenApp HDX 3D Pro & XenServer w. NVIDIA GRID

Best WAN performance on the market
First SBC/VDI solution with direct hardware GPU acceleration
First SBC solution with GPU sharing
First to market with Nvidia VGX API support
First Hypervisor to market with Nvidia vGPU sharing with GRID
Lowest cost per user
Any device
Q&A

GPU TECHNOLOGY CONFERENCE

WHO
WHAT
WHERE
WHEN
WHY
HOW
QUESTIONS
ANSWERS
Need help
http://www.poppelgaard.com/professional_services

Validate
Training
Review
Advise
Consulting
POC

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Upcoming GTC Express Webinars

July 9 - NVIDIA GRID VCA: A Turnkey Appliance for Design and Engineering Applications

*Presented by Ankit Patel, Sr. Product Manager, NVIDIA*

July 17 - Delivering 3D Graphics from the Private or Public Cloud with XenDesktop and GRID

*Presented by Derek Thorslund, Director, Product Management, Citrix*

Register at www.gputechconf.com/gtcexpress