Delivering 3D Professional Graphics from the Cloud
with Citrix XenDesktop

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Citrix Systems

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Desktops & Apps as a Service
#1

XenDesktop

• #1 in the VDI market with 10M+ licenses
• 100+ customers with over 10K seats
• 300+ customers with 5,000+ licenses in production
• 1,600+ customers with more than 1,000 licenses in production
High Definition Experience

HDX Broadcast
ICA and RDP protocol support for access from any device, anywhere

HDX MediaStream
Video and audio playback, any format, on any device

HDX RealTime
Voice and video for real-time collaboration / unified communications

HDX SmartAccess
Simplified secure access

HDX Plug-n-Play
Access to local resources and peripherals such as printers, monitors and USB devices

HDX RichGraphics
2D and 3D graphics incl. Adaptive Display, HDX 3D, HDX 3D Pro and RemoteFX

HDX WAN Optimization
Performance and bandwidth optimizations via Citrix Branch Repeater

HDX Adaptive Orchestration
Best user experience based on server, network connection and user device
3D graphics acceleration options from Citrix

Rendering performance

1 GPU/user, DX & OpenGL

Shared GPUs, DX only

XenDesktop w/ RemoteFX

XenApp HDX 3D h/w acceleration for DirectX

XenDesktop HDX 3D Pro

High-end 3D professional graphics

Bandwidth efficiency at 1024 x 768

Est. 7-10 Mbps

~3 Mbps

~1.5 Mbps
Autodesk Citrix Portfolio

- AutoCAD® 2012
- AutoCAD® Architecture 2012
- AutoCAD® MEP 2012
- AutoCAD® Mechanical 2012
- AutoCAD® Map 3D 2012
- AutoCAD® Map 3D Enterprise
- AutoCAD® Raster Design 2012
- Autodesk® Revit® Architecture 2012
- Autodesk® Revit® Structure 2012
- Autodesk® Revit® MEP 2012

(See http://autodeskandcitrix.com)
### GPU-accelerated graphics: XenApp or XenDesktop?

<table>
<thead>
<tr>
<th>XenApp HDX 3D</th>
<th>XenDesktop HDX 3D Pro</th>
</tr>
</thead>
<tbody>
<tr>
<td>• GPU acceleration of DirectX (OpenGL is CPU-rendered)</td>
<td>• GPU acceleration of DirectX <em>and</em> OpenGL</td>
</tr>
<tr>
<td>• Each GPU can be shared by multiple users</td>
<td>• One user per GPU</td>
</tr>
<tr>
<td>• Apps must be compatible with RDS (Terminal Services)</td>
<td>• Deep compression</td>
</tr>
<tr>
<td></td>
<td>• 3D SpaceMouse support</td>
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XenDesktop HDX 3D Pro

• XenDesktop feature for high-end 3D professional graphics

• **GPU acceleration** for hardware rendering of large 3D models

• Multiple compression options including **deep compression** codec for access over WAN links
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

HDX

Citrix CloudGateway

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HDX 3D Pro Architecture

XenDesktop Controller

Citrix Receiver

App Streaming

Access Gateway

User Profiles

Host Workstation
(e.g. blade or rack)
1 GPU per user

Desktop Provisioning

Apps

User Settings

OS

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Intellectual property: Do you recognize this car?
HDX 3D Pro: Centralize and secure design IP

All engineering data and intellectual property is centrally stored and secured:

- Engineering drawings
- Bills of Materials
- Cost Info
- Lifecycle Data
HDX 3D Pro: Leverage worldwide talent pool
HDX 3D Pro is not application-dependent 😊

Examples of applications tested with HDX 3D Pro:

**CAD**
- CATIA V5R19
- Autodesk Inventor 2010
- Autodesk Revit 2010
- Autodesk MAYA 2010
- AutoCAD 2010
- Bentley
- 3D XML Player
- JT2Go
- SolidWorks
- Blender
- FurnPlan
- Adobe 3D

**GIS**
- Google Earth
- ISRO – Bhuvan
- ArcGIS Explorer

**Medical**
- Fiat Lux

**Multimedia**
- HD Videos in YouTube
- Windows Media Player
- VLC Media Player etc.

**Benchmark and Demo**
- Realtime HDR
- Turbine Demo
- SpecViewPerf
- CineBench

**Test Applications**
- NEHE Apps for OpenGL
- DirectX SDK
- CUDA SDK
- GLView

**Office Apps and Win 7 Gadgets**
- Mix Me
- Photo Shuru
- Visual 3D
Case study and customer reference
Global CAD accesss with HDX 3D Pro
Engineers in India need to be able to work as if they were sitting in Switzerland.
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
Implementation at ABB
Citrix XenDesktop HDX 3D Pro
Learnings

*Service quality is a subjective matter*

Using Dassault SolidWorks, 5-6 hours per day. Designers can work from India as if in Switzerland!

Latency effect
(subjective scores)

China, Beijing
India, Bangalore
Canada, Montreal
Poland, Cracow
Switzerland, Turgi

<table>
<thead>
<tr>
<th>Latency [ms]</th>
<th>System Quality [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>75%</td>
</tr>
<tr>
<td>50%</td>
<td>80%</td>
</tr>
<tr>
<td>50%</td>
<td>90%</td>
</tr>
</tbody>
</table>

(These results *without* Branch Repeater)
Power and productivity for a better world™
HDX 3D Pro case study
Major European heavy vehicle manufacturer

- Access from Japan, Australia, India, U.S. and Brazil to 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 SpaceMouse
HDX 3D Pro case study
Aerospace and rail transportation manufacturer

- Dassault CATIA R18 access from India, Ireland, USA and Mexico to data center in Canada
- Dell workstations with NVIDIA Quadro GPUs
HDX 3D Pro case study
Wind turbine manufacturer

- PTC Pro/E and Dassault SolidWorks from Europe to other continents
- 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

Large engineering, design and consultancy company

• 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!”

• “We reduced the number of PCs per user from 1.6 to 1.05”
HDX 3D Pro

- Feature of XenDesktop Enterprise and Platinum editions
- Broad app compatibility
  - OpenGL, DirectX (incl. WPF)
- Blade/rack workstations are ideal, but any form factor can be used for the host
  - Multiple users per workstation using XenServer 6 GPU Passthrough
- User device can be standard PC running Windows or Linux
  - Min. 2 GHz single core CPU at 1920x1200 resolution; 3 GHz for top performance
  - Min. 2 GHz dual core CPU for dual monitor support
HDX 3D Pro
Additional Features

- 64-bit OS support on VDA (WinXP & Win7)
  - Note: XenServer, however, does not support Windows XP 64-bit

- Windows 7 on host (32-bit & 64-bit)
  - Aero support available if required (consumes one CPU core)

- English-on-German/French/Spanish/Japanese/etc.

- Pixel-perfect lossless compression for medical imaging
  - Can combine with lossy compression during motion, for responsive remote access

- Seamless app delivery (see next slide)
Seamless Application Delivery

- Apps are merged seamlessly into the user’s local desktop
- Leverages the same architecture as desktop delivery
HDX 3D Pro
Desktop Virtualization for High-end Graphics Users

Compression options

1. 2D/fine drawing
   • Best image quality for fine detail
   • 3 Mbps bandwidth recommended
2. Deep compression
   • 1.5 Mbps bandwidth recommended
3. Lossless (e.g. for medical imaging)
4. Standard ICA codec
   • For access from Mac, iPad 2, Android devices

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User Control

• User can adjust image quality settings via HDX Config Tool
  • Image quality setting controls image sharpness while in motion
  • Decreasing image quality increases responsiveness over low bandwidth
  • Admin control (e.g. disable Lossless, define quality range)
Lossless Compression (pixel-perfect)

Lossless Systray icon

Text displayed on hovering the mouse over the icon

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HDX 3D Pro
Desktop Virtualization for High-end Graphics Users

GPU options

• Any graphics card recommended by the app vendor
  • But highest frame rate with NVIDIA cards thanks to proprietary VGX™ API
• GPU-based Deep Compression (alternative to CPU-based Deep Compression) requirements:
  • Single monitor: 128 CUDA cores recommended (96 minimum)
    Dual monitor: 256 CUDA cores recommended (192 minimum)
HDX 3D Pro
Desktop Virtualization for High-end Graphics Users

Client options

Optimized with special codecs:

Std. ICA codec:

iPad 2
(Citrix iPad Receiver 5.0)

Android Receiver 3.0
HDX 3D Pro on a tablet

“Performance is great! Nearly like my Windows 7 PC!”
XenDesktop 5.5. HDX 3D Pro

• Multi-monitor support
  ◦ Up to the maximum number of monitors supported by the graphics card
  ◦ Citrix Receiver for Windows or Linux
  ◦ Efficient use of bandwidth
  ◦ Host must be configured with at least as many virtual monitors as the user device
3D mouse support

- USB redirection for 3D Space Mouse and similar devices
- Virtual Channel can be prioritized to maximize responsiveness
Citrix Branch Repeater
Ideal for low bandwidth and high latency connections

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

• Further reduces bandwidth consumption due to local caching, enabling more users to share a given size of pipe (e.g. ABB sees 3:1 compression at 5 users)
Multi-GPU Passthrough in XenServer 6

Reduced cost per user

- XenDesktop HDX 3D Pro and XenApp HDX 3D
- Windows 7 (32/64-bit), Windows XP (32-bit), Windows Server 2008 R2 (64-bit)
- Multiple GPUs per host (initially up to 4)
  - One graphics-accelerated VM per GPU
  - Depending on CPU power, same host may also support non-graphics-accelerated users (i.e. regular office workers)
- Leverages NVIDIA high-performance Fermi GPUs
  - e.g. Quadro 1000M/2000/3000M/4000/5000/6000, Tesla M2070Q
  - Use latest NVIDIA Quadro driver (min. 276.14)
XenServer GPU Passthrough

XenDesktop

Windows VMs

- non-3D VM
- 3D Pro VM
- non-3D VM
- 3D Pro VM
- non-3D VM
- 3D Pro VM
- non-3D VM
- 3D Pro VM
- non-3D VM
- non-3D VM

XenServer hypervisor

Hardware platform

GPU

GPU

GPU

GPU
### Multi-GPU Hardware Platforms for XenServer

Ever-growing list of tested multi-GPU solutions

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Platform</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HP</strong></td>
<td>ws460c G6 blade</td>
<td>(2x Q4000 or 1x Q5000/Q6000) (6x Q1000M/Q3000M in beta)</td>
</tr>
<tr>
<td><strong>DELL</strong></td>
<td>R5500 rack workstation</td>
<td>(3x Q4000 or 4x Q2000)</td>
</tr>
<tr>
<td><strong>DELL</strong></td>
<td>PowerEdge M610x with M2070Q plus C410x PCIe expansion chassis (XenApp only)</td>
<td>(4 GPU devices per server, 16 total GPUs per chassis)</td>
</tr>
<tr>
<td><strong>IBM</strong></td>
<td>HS22 with GPU expansion blade</td>
<td>(4x M2070Q)</td>
</tr>
<tr>
<td><strong>IBM</strong></td>
<td>System x iDataPlex dx360 M3</td>
<td>(2x Q4000/Q5000/M2070Q)</td>
</tr>
<tr>
<td><strong>IBM</strong></td>
<td>System x3650 M3</td>
<td>(2x Q2000)</td>
</tr>
</tbody>
</table>
Looking ahead…

Hardware vGPU

Here at the 2012 GPU Technology Conference, NVIDIA and Citrix announced our collaboration on GPU Hardware Virtualization

• VGX will extend Citrix’s GPU sharing capability from RDS to VDI, and from DirectX-only to DirectX, OpenGL and CUDA
• High performance with large models, unlike API Intercept method
• Ideal for second tier users of 3D professional graphics, driving down the total cost per user to under $1,000
• Beta trials expected to begin towards year-end 2012
GPU Virtualization

XenDesktop Windows VMs

1
3D Pro VM

2
3D Pro VM

3
3D Pro VM

4
3D Pro VM

... 100
3D Pro VM

XenServer hypervisor

vGPU

Hardware platform

GPU

...
HDX 3D Pro Summary

• Best WAN performance on the market
• First to market with NVIDIA VGX API support
• Lowest cost per user
• Any device
Work better. Live better.