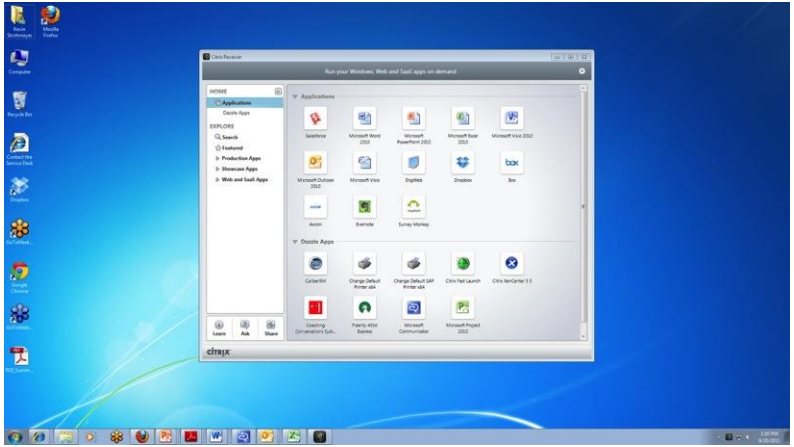
Delivering 3D Graphics from the Cloud with XenApp and XenDesktop

Derek Thorslund, Director of Product Management
Citrix Systems

March 2013



Rich Apps as a Service

HDX 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

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Milestones in 3D graphics remoting

2006
Project K2 delivers CATIA to Boeing Dreamliner designers

2009
GA of XenDesktop HDX 3D Pro with Deep Compression

2010
XenApp 6.0 high performance GPU Sharing for DirectX

2011
XenServer 6.0 hypervisor introduces GPU Passthrough

2012
Higher fps via NVIDIA VGX™ API plus improved compression

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Business Drivers

for virtualizing 3D graphics apps & workstations

Global talent base

Secure IP

Work-from-home

Disaster recovery

Mobile device access

Improve time-to-market

Cost efficiency

CITRIX®

Leverage worldwide talent pool

Centralize and secure design IP

Engineering drawings

Bills of Materials

Cost info

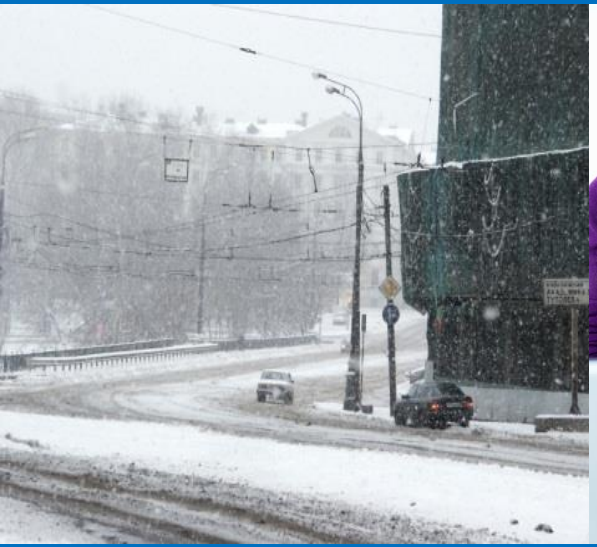
Supplier info

Customer info

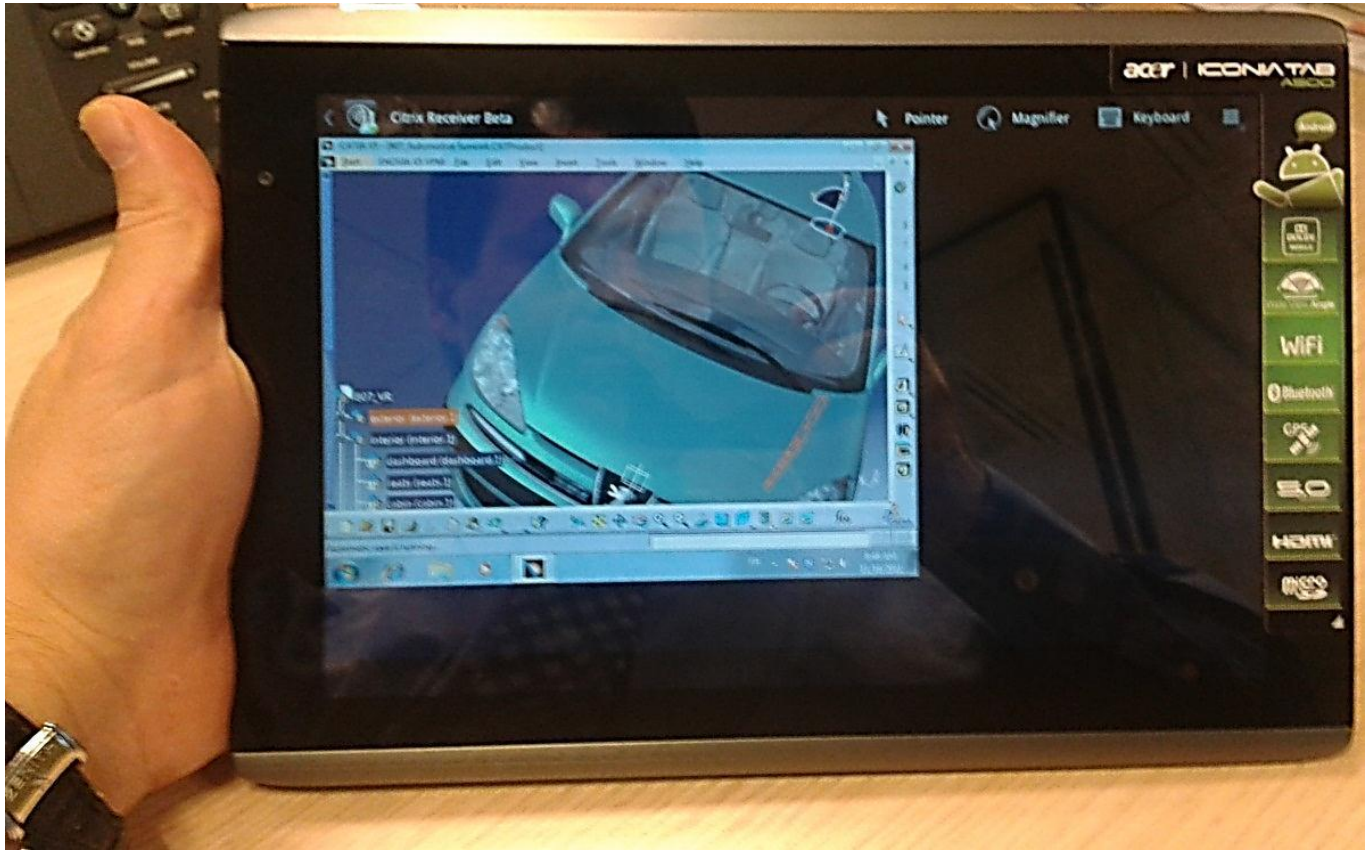
Lifecycle data

Product design decisions

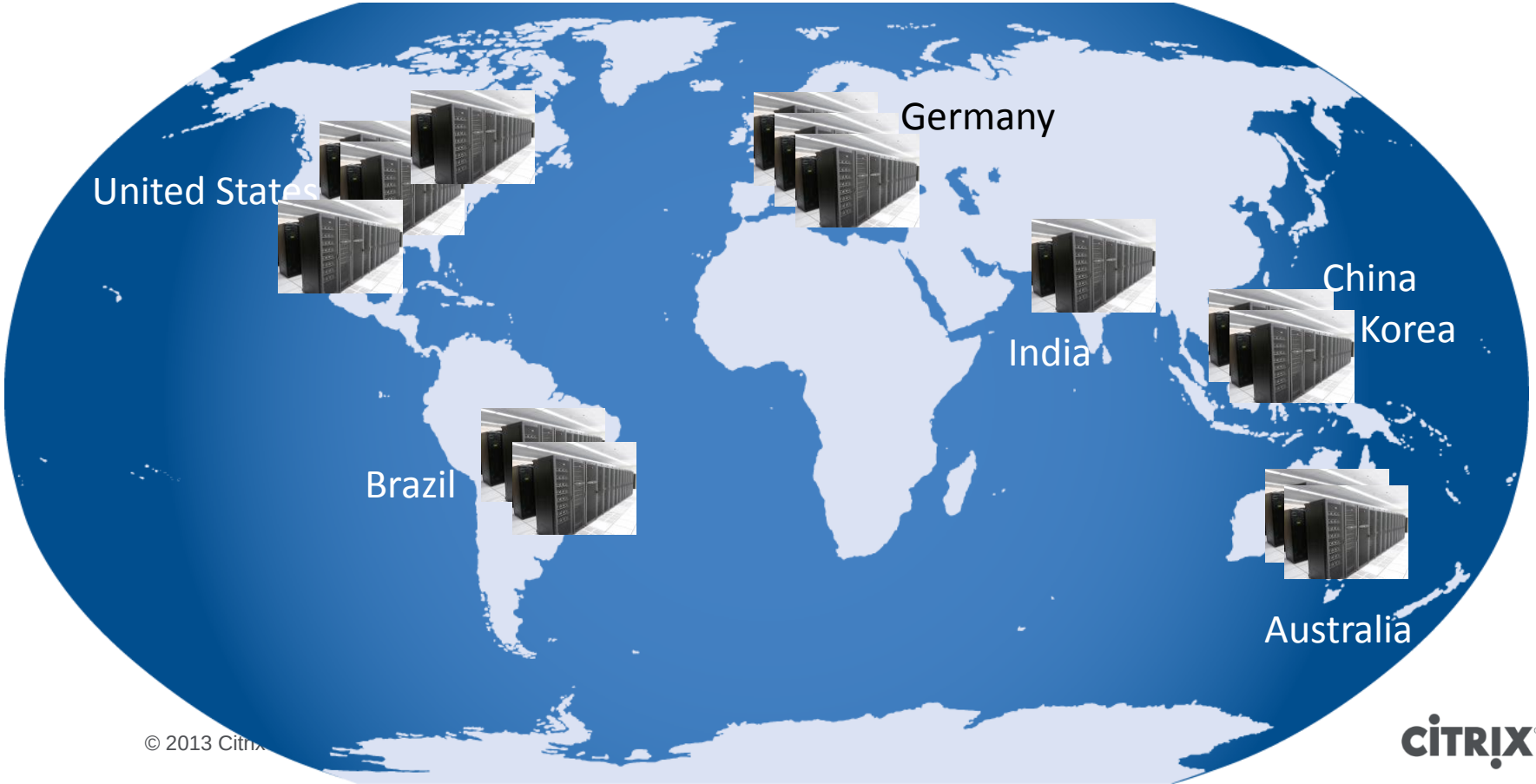
Work-from-home & Disaster recovery



Leverage mobile devices

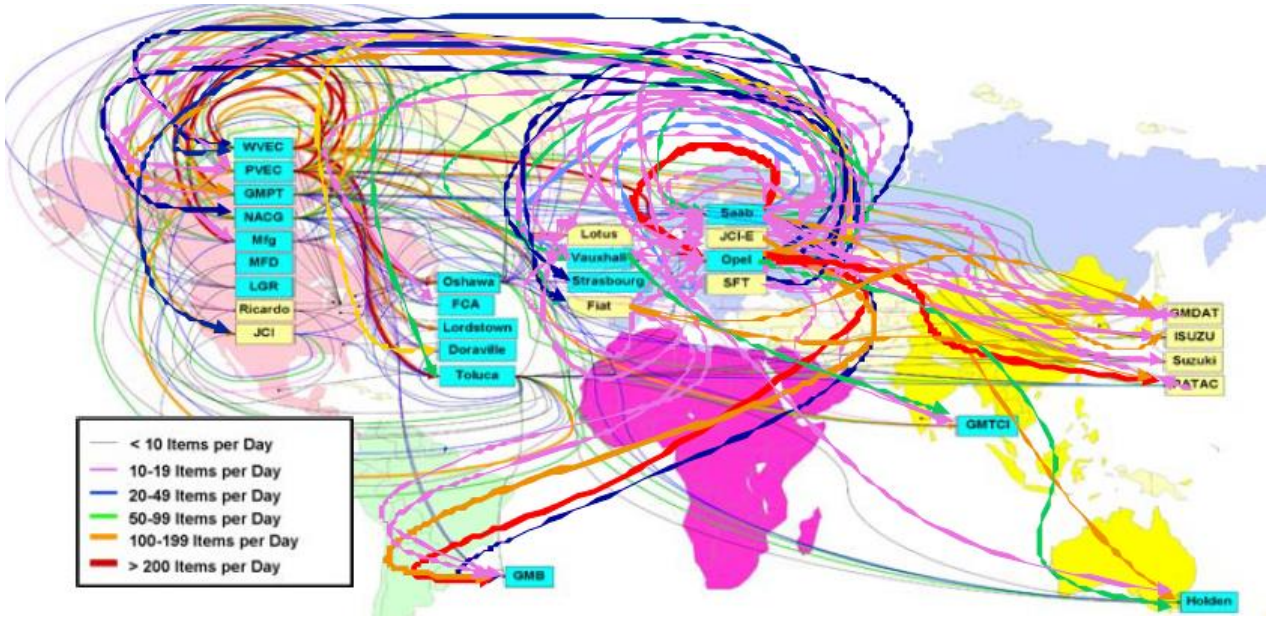


Global Product Development Teams - Real Example

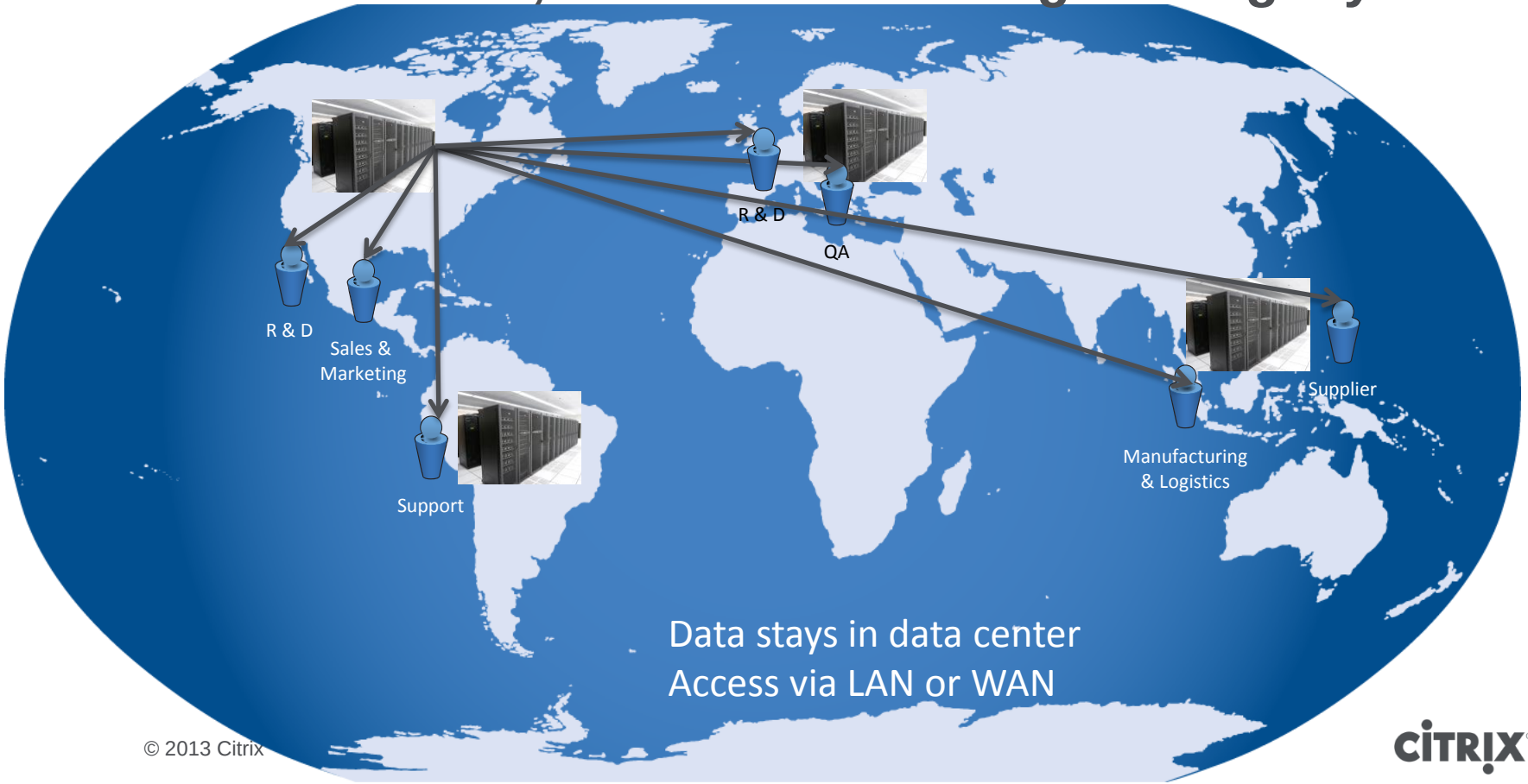


Global Development Effort – Real Example

- 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



Case studies

Manuel Killer, Project Manager CAx Technologies **ABB Switzerland Ltd – Power Electronics & MV Drives**

Case study and customer reference

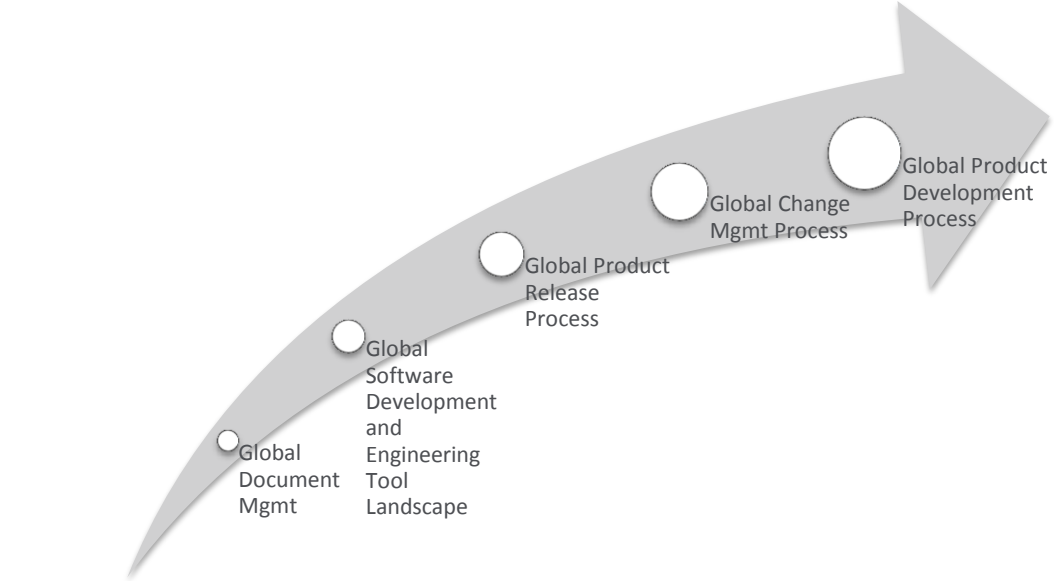
Global CAD accesss with HDX 3D Pro

October 2011

Power and productivity
for a better world™

Requirements from Business to IS

Extended Engineering Workbench in India



Global Development
Global Engineering
Global Production

Turgi

Engineers in India need to be able to work as if they were sitting in Switzerland

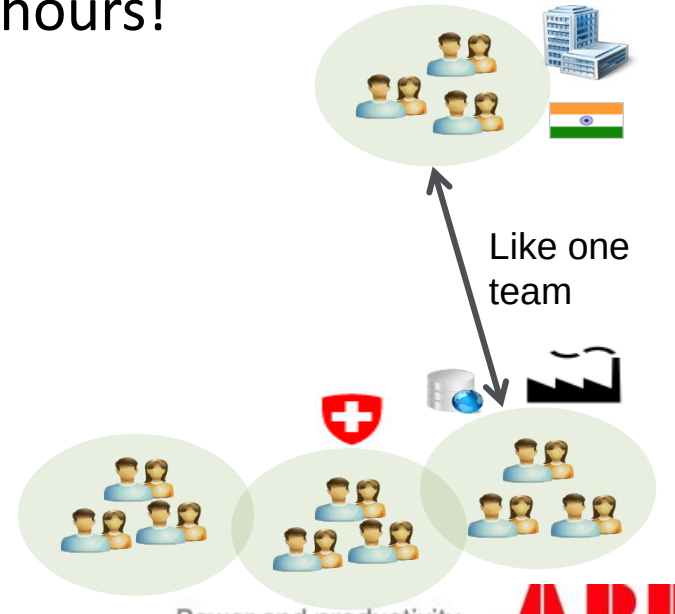
Challenges
Of course there were more than one…

3D CAD data is large

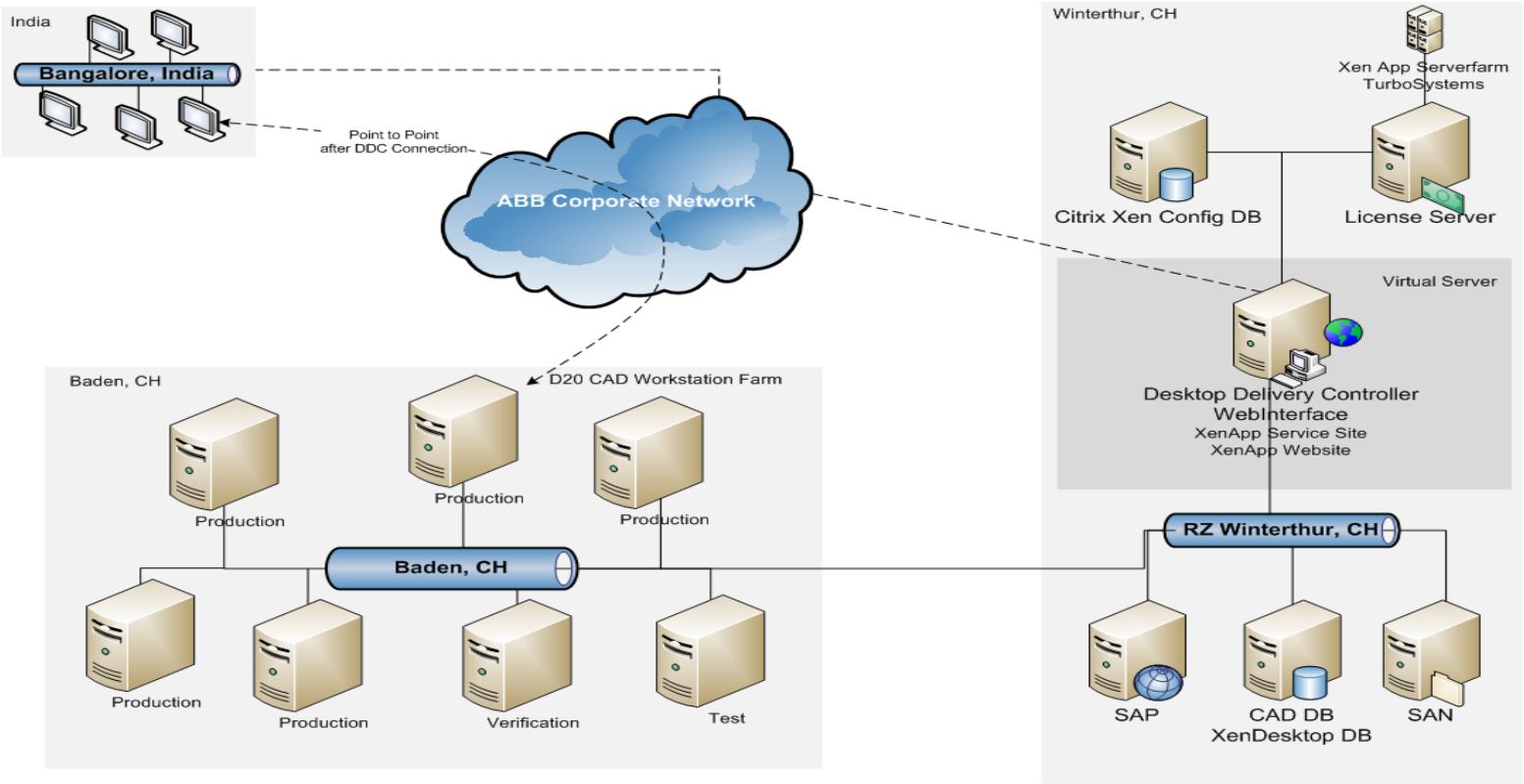
- Transferring our largest assemblies took 2.5 hours!

ABB's corporate network

- Latency
- Bandwidth



Implementation at ABB
Citrix XenDesktop HDX 3D Pro



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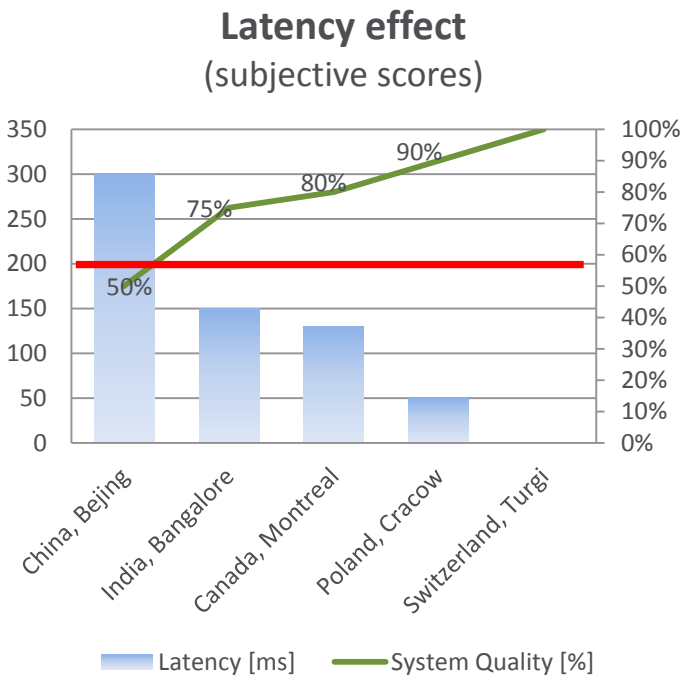
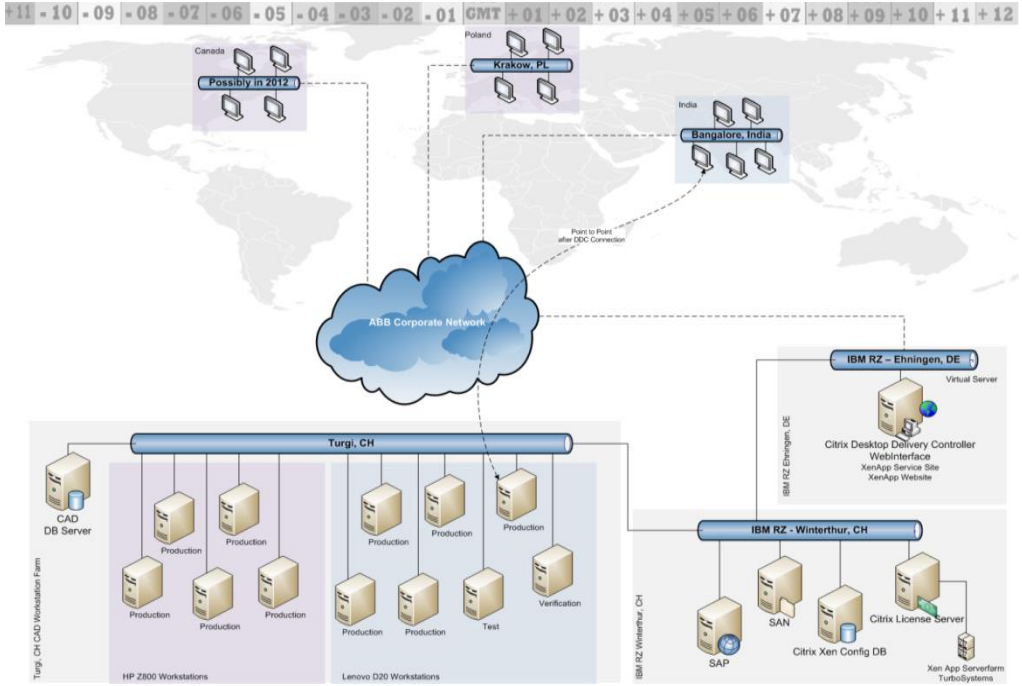
Learnings

Service quality is a subjective matter



(these scores not incl. Repeater benefits)

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



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Power and productivity
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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

Daimler Digital Factory

DAIMLER

- The Daimler Digitale Fabrik (Digital Factory) team can simulate an entire manufacturing plant in software
- HDX 3D Pro serves users across various Daimler plants and offices
- Siemens NX applications
- HP ws460c data center blade workstations
- NVIDIA Quadro Fermi Q2000 cards

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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

John Deere

- In production since 2011
- IP security was a key requirement
- PTC Pro/E is primary application
- Follow-the-sun utilization
- NetScaler used to connect user to nearest data center
- HP WS460c workstation blades with NVIDIA Q2000M graphics cards

HDX 3D Pro case study

BOMBARDIER

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

CITRIX

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"*

Product Overview

XenDesktop HDX 3D Pro and XenApp HDX 3D

CITRIX®

XenDesktop®

HDX 3D Pro
and XenServer®

- Heavy 3D graphics app usage
- Exceptional graphics performance and response optimizations
- Multiple users per workstation
- Best WAN performance
- OpenGL and DirectX acceleration

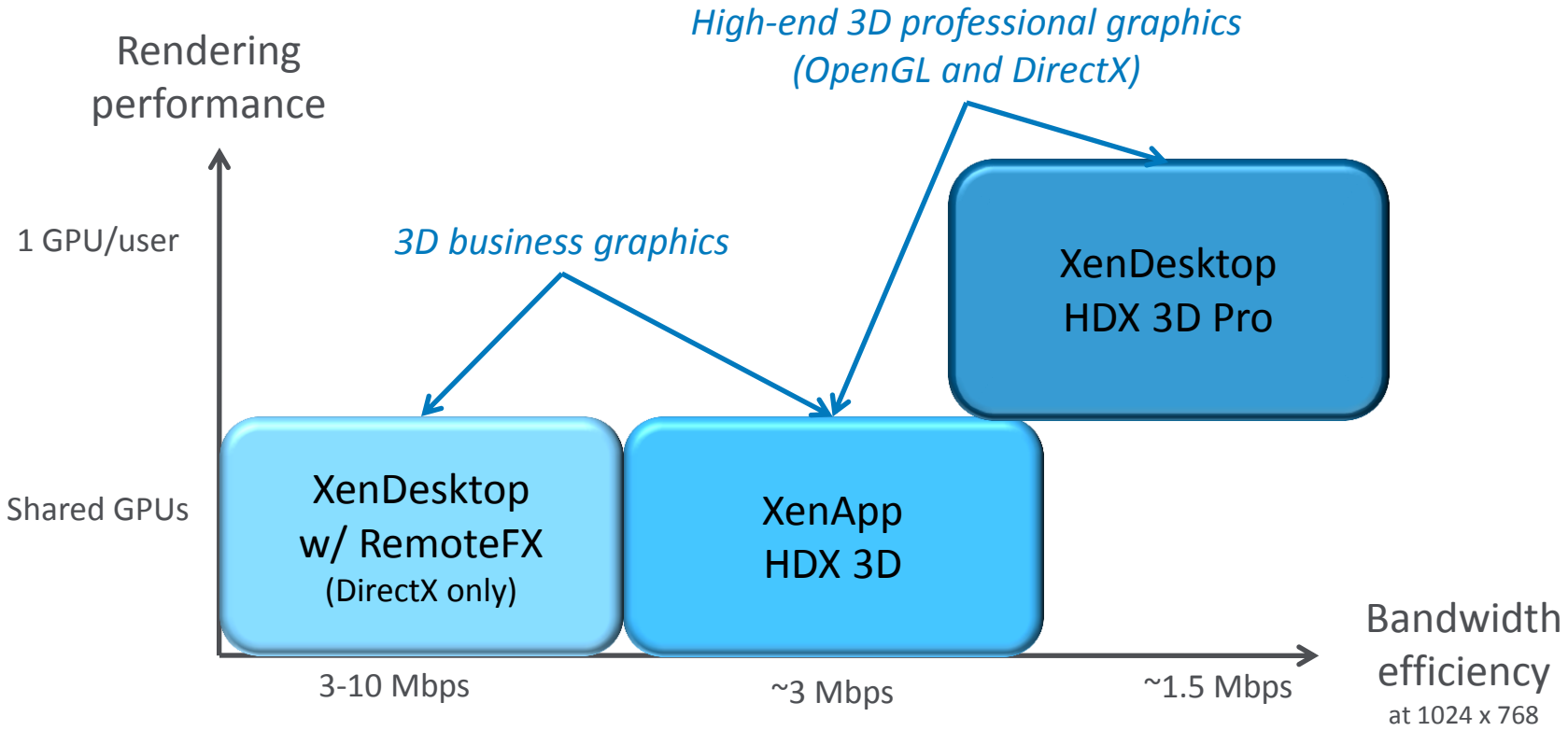
CITRIX®

XenApp®

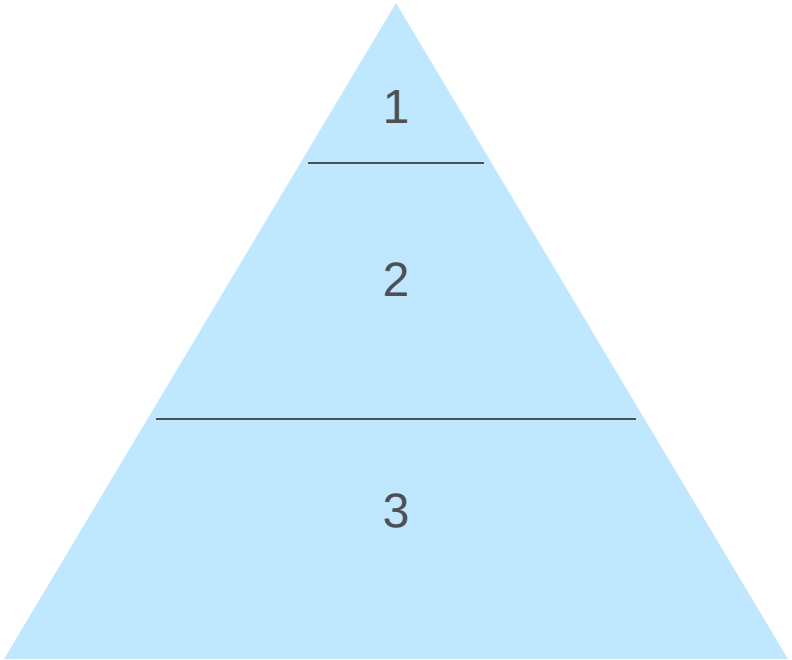
and XenServer®

- Many users per server
- Works well over WAN at 3 Mbps
- Graphics performance and response optimizations
- DirectX and OpenGL acceleration

3D graphics acceleration options from Citrix



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

Tier 1 and Tier 2 solutions for GPU-accelerated graphics

XenDesktop HDX 3D Pro

- GPU acceleration of DirectX and OpenGL
- One user per GPU (can also be used with GPU virtualization)
- H.264-based Deep Compression
- 3D SpaceMouse support

TOP PERFORMANCE SOLUTION

XenApp HDX 3D

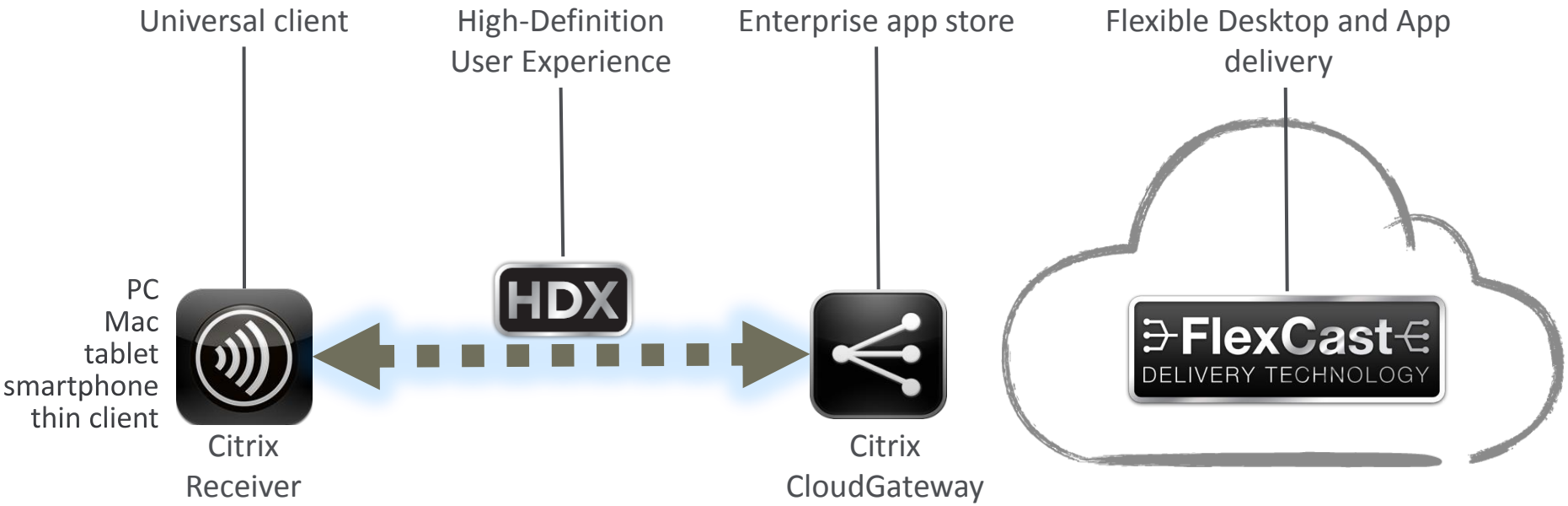
- GPU acceleration of DirectX and OpenGL
- High performance GPU sharing
- Lower cost Microsoft licensing
- Apps must be compatible with RDSH (Terminal Services)

MOST COST-EFFECTIVE SOLUTION

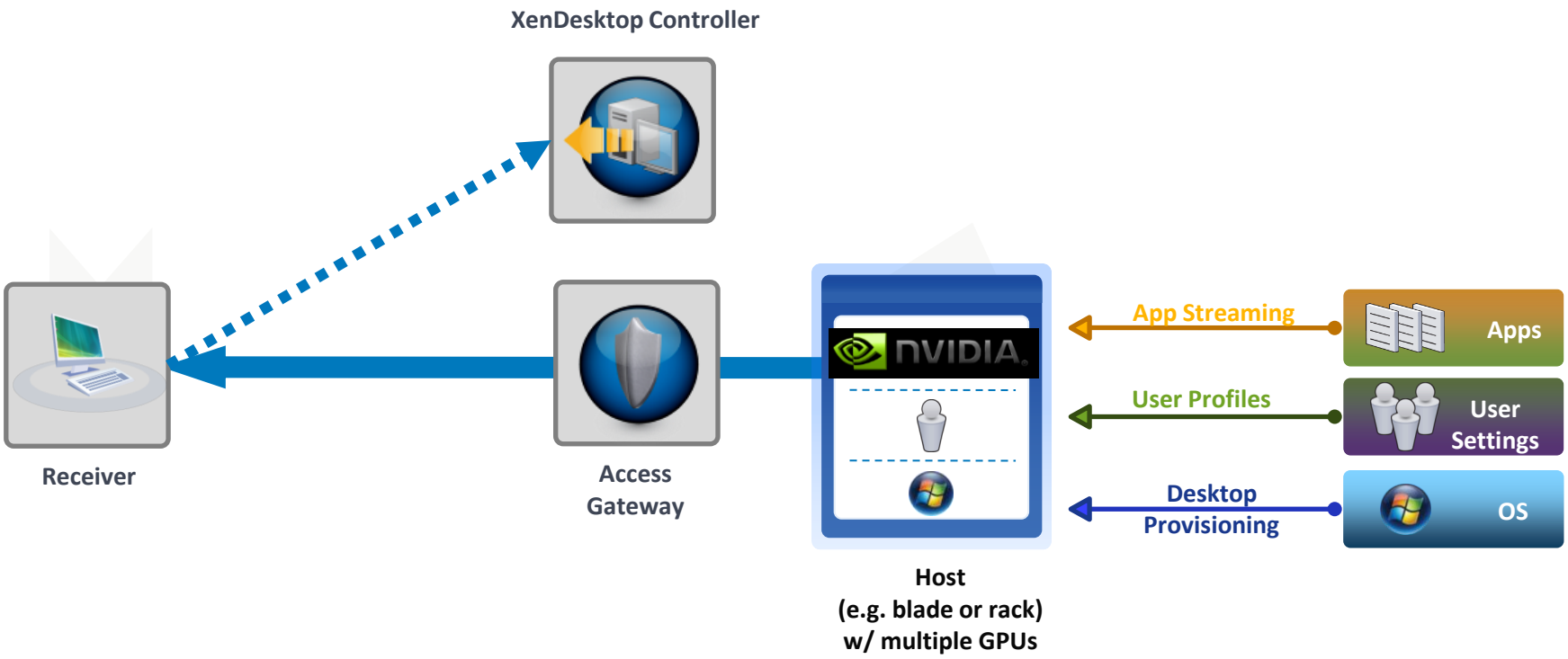
XenDesktop HDX 3D Pro

- 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 narrow WAN links

XenDesktop: Powerful and flexible infrastructure



HDX 3D Pro Architecture



HDX 3D Pro

- Feature of XenDesktop Enterprise and Platinum editions
- Broad app compatibility
  - OpenGL, DirectX (incl. WPF etc.)
- Blade/rack workstations are ideal, but any form factor can be used for the host
  - Multiple users per workstation using GPU Passthrough
- User device can be PC, Mac, tablet or thin client

HDX 3D Pro is <u>not application-dependent</u> ☺

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

Test Applications

- NEHE Apps for OpenGL
- DirectX SDK
- CUDA SDK
- GLView

Office Apps and Win 7 Gadgets

Multimedia

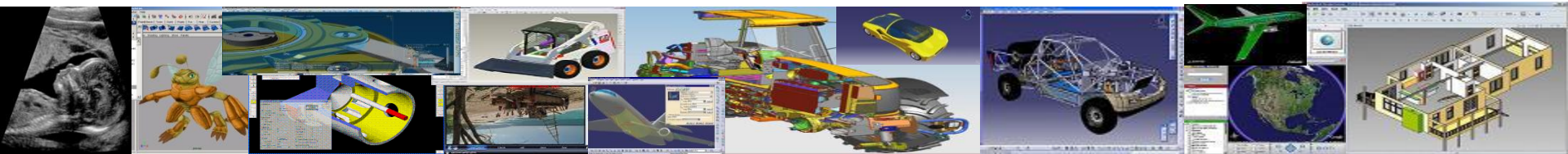
- HD Videos in YouTube
- Windows Media Player
- VLC Media Player etc.

Benchmark and Demo

- Realtime HDR
- Turbine Demo
- SpecViewPerf
- CineBench

WPF Applications

- Mix Me
- Photo Shuru
- Visual 3D



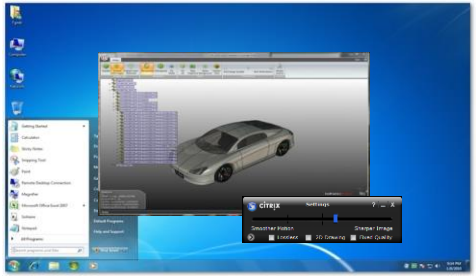
HDX 3D Pro

Additional Features

- Host OS support: WinXP & Win7, 32-bit & 64-bit
  - Note: XenServer, however, does not support Windows XP 64-bit
- English-on-German/French/Spanish/Japanese/etc.
- Pixel-perfect lossless compression (e.g. 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



Citrix Receiver

ICA

HDX 3D Pro

XenDesktop VDA

Host

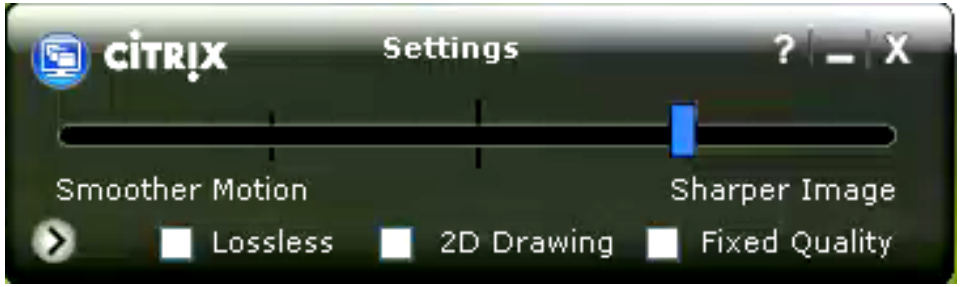
End Point

Deep Compression codec technology

Customer-reported bandwidth utilization on long-haul connections

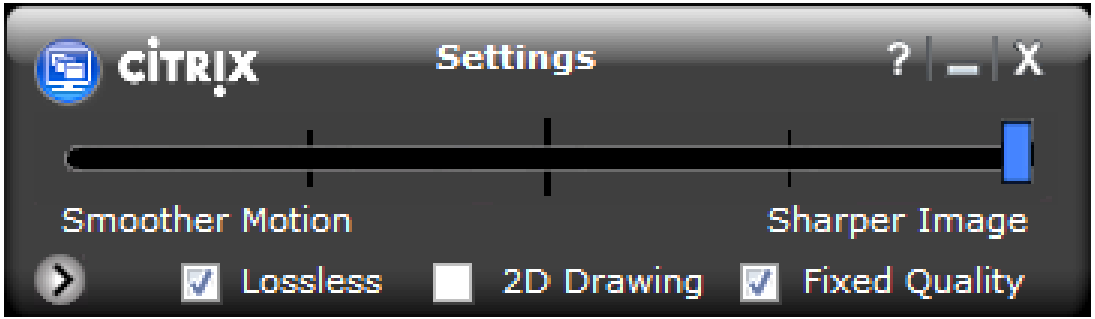
- First user requires 1.5 to 2 Mbps minimum
- Navistar:
  Branch with 12 concurrent users requires 700-800 Kbps per user
- CCI Valves:
  20 Mbps WAN link serves branch with 17 users (1.2 Mbps/user)
- Bandwidth requirement does not scale linearly ☺

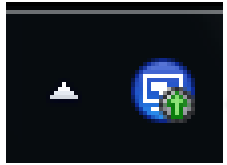
User control… and Admin control



Adjust image quality settings with HDX image quality configuration tool

Lossless Compression (pixel-perfect)





Lossless Systray icon

Text displayed on hovering the mouse over the icon

GPU Options

- NVIDIA cards deliver highest frame rate with VGX™ API (“Monterey”) and support full-screen applications
- CPU-based deep compression is default, but if server CPU is limited then deep compression can be offloaded to the NVIDIA GPU

HDX 3D Pro

Desktop Virtualization for High-end Graphics Users

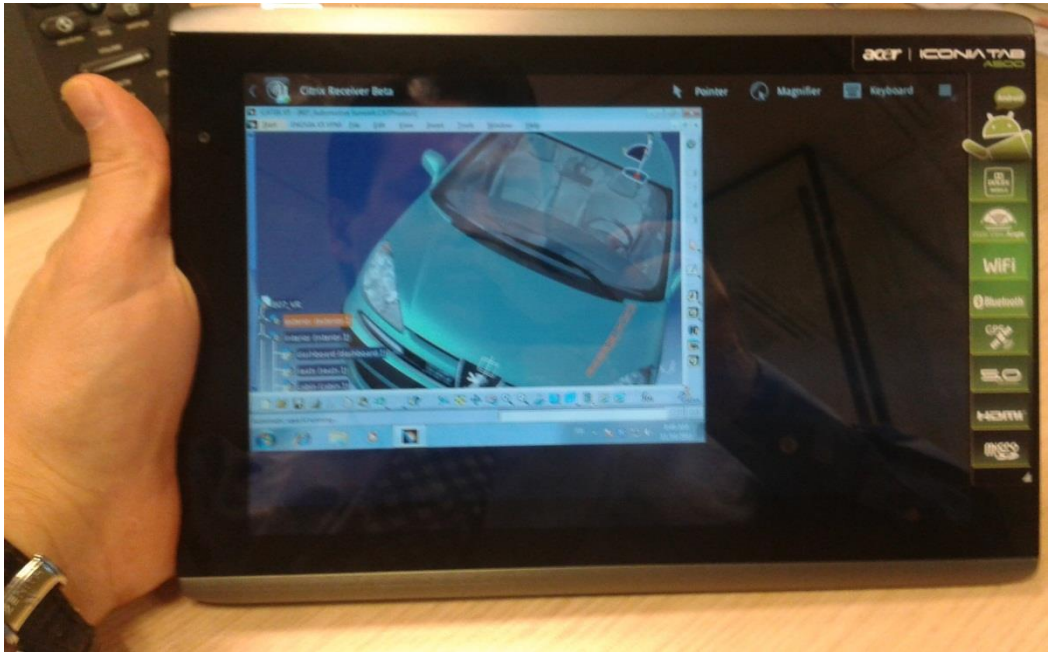
Client options

Optimized with special codecs:

Std. ICA codec:

HDX 3D Pro on a tablet

“Performance is great! Nearly like my Windows 7 PC!”



HDX 3D Pro on thin clients

- HDX Ready Premium thin clients supporting Deep Compression decoding
- More to come, including lower cost HDX SoC devices

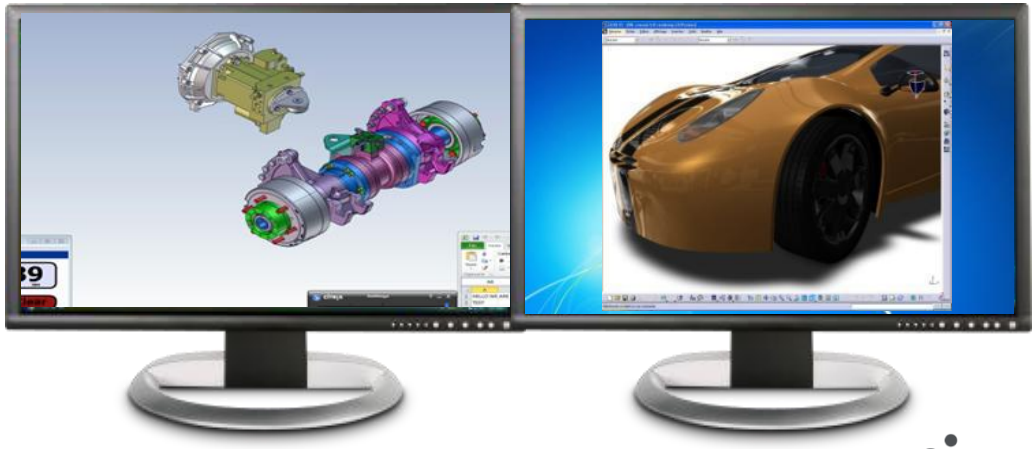
Photos not to scale

Host requirements

- Windows 7 (32/64-bit), Windows XP (32/64-bit)
- XenServer 6.x or vSphere 5.1 or physical machine
- Quad core CPU at 2.3 GHz or higher, or four vCPUs
- 4 GB of RAM minimum
- XenDesktop 5.6 Feature Pack 1 (select “HDX 3D Pro” during installation)
- GPU card supported by ISV (recommend NVIDIA Quadro or GRID)

Dual monitor support

- Citrix Receiver for Windows or Linux
- Efficient use of bandwidth



3D mouse support

USB redirection for 3D Space Mouse and similar devices

Virtual Channel can be prioritized to maximize responsiveness

Citrix CloudBridge™ 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 reports 3:1 compression at just 5 users)

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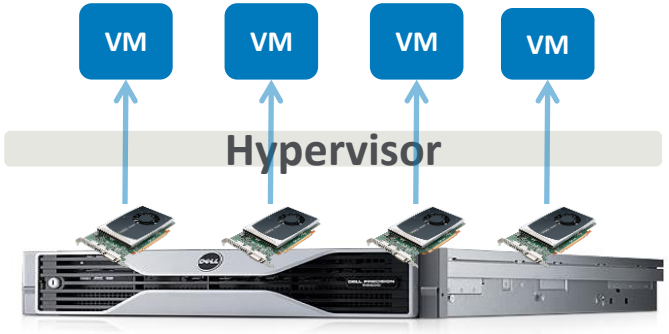
GPU Passthrough introduced in XenServer 6

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
  - Servers with 4 GPUs currently on HCL; testing underway with 8
  - One graphics-accelerated VM (single-user or multi-user) 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/Kepler GPUs
  - e.g. Quadro 1000M/2000/3000M/4000/5000/6000, Tesla M2070Q, GRID K1/K2

XenDesktop HDX 3D Pro

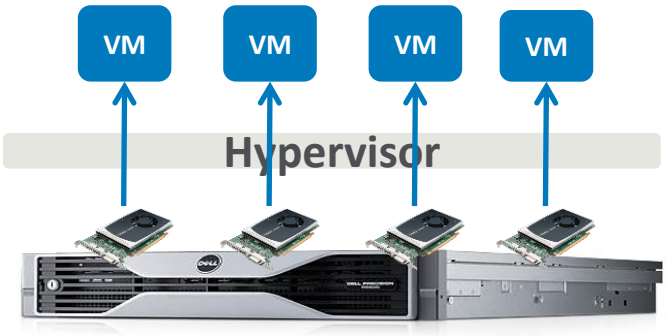
Option 1:

1 Server : 1 GPU : 1 User

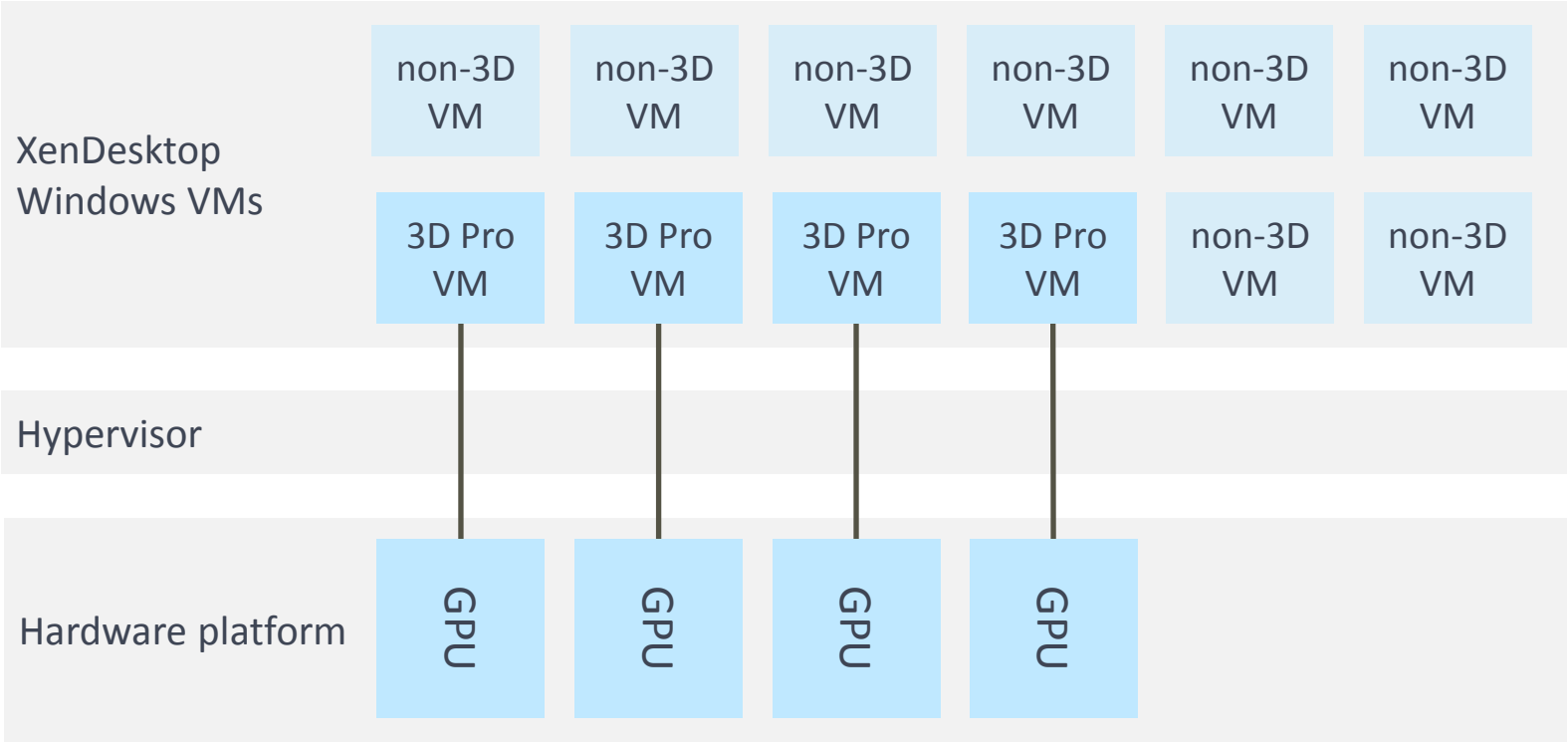
Option 2 (GPU Passthrough):

1 Server : 4 GPU: 4 Users

1 Server : 2 GPU : 2 Users



GPU Passthrough



XenApp HDX 3D: GPU sharing on Windows Server

Up to 4x more users

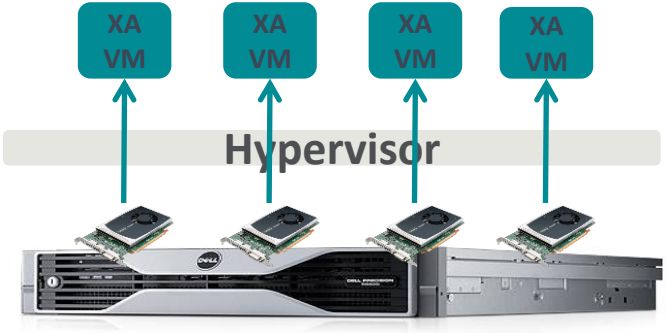
Option 1:

- 1 Server : 1 GPU : ~10 Users

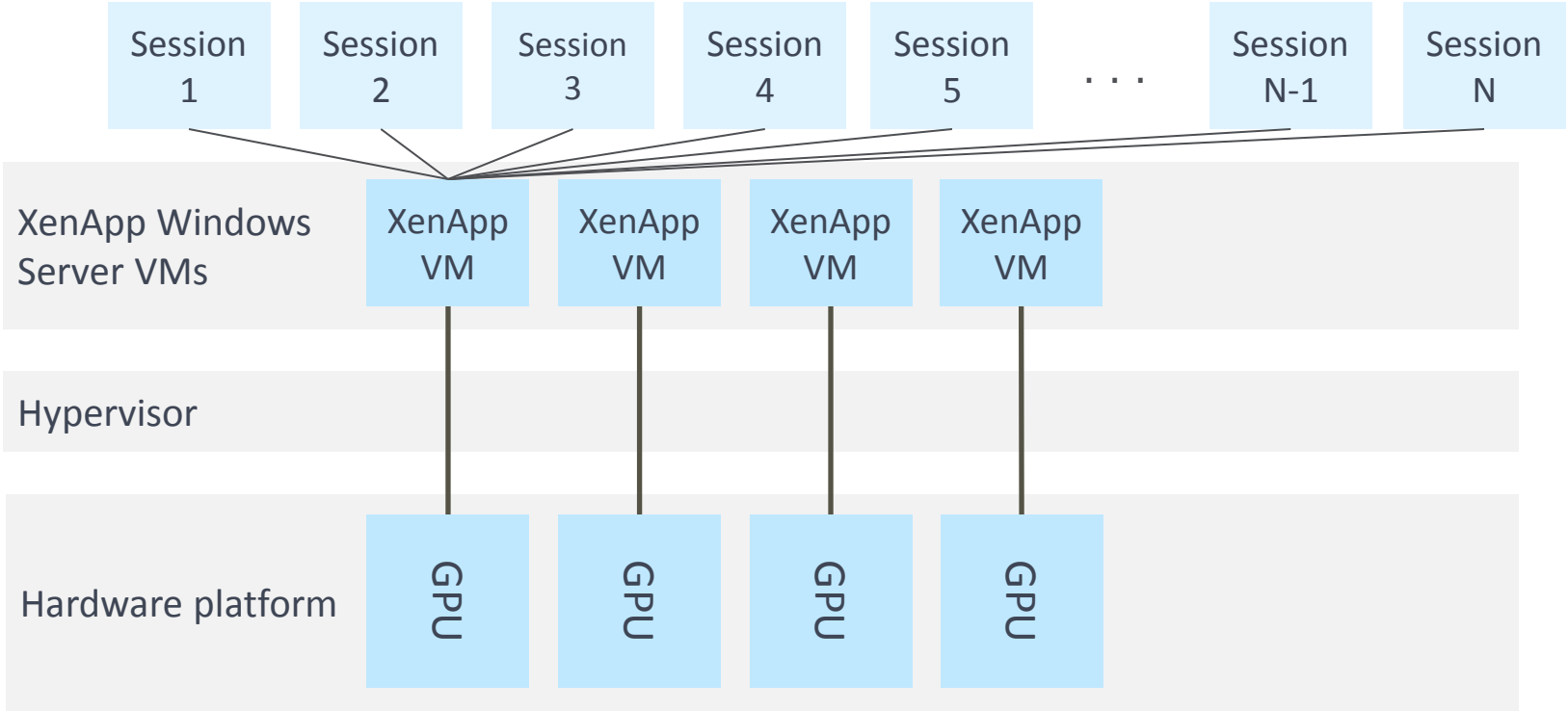
Option 2 (GPU Passthrough):

- 1 Server : 4 GPU* : ~40 Users
- 1 Server : 2 GPU* : ~20 Users

Note - * Server & GPU dependent



XenServer GPU Passthrough with XenApp



GPU sharing scalability

Reports from the field

- *With two NVIDIA Quadro 4000 cards we ran 18 users 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!*

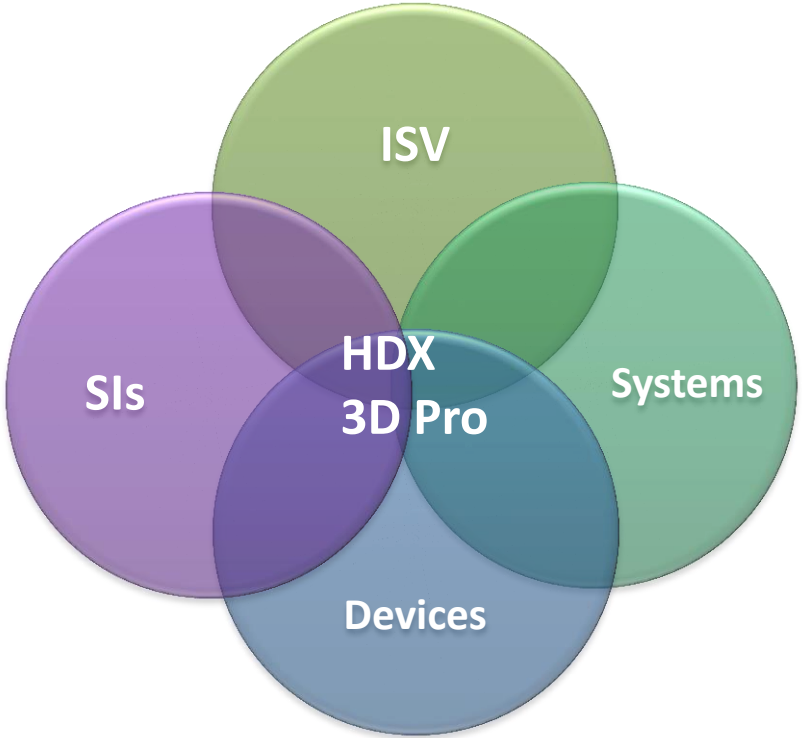
New NVIDIA GRID K2 promises even higher user densities!

Multi-GPU Hardware Platforms

	ws460c G6 blade (Q4000/5000/6000) ← XenServer certified
	Servers: DL980 G7, DL370 G6, SL390S G7 and others
	R720 rack workstation (two dual-slot cards, e.g. M2070Q or GRID) ← tested R5500 rack workstation (3x Q4000 or 4x Q2000) ← XenServer certified R5400 rack workstation (2 PCIe x16 GPUs, e.g. Q4000)
	PowerEdge T620 (4x Q2000)
	PowerEdge M610x with M2070Q plus C410x PCIe expansion chassis (4 GPU devices per server, 16 total GPUs per chassis) ← tested w/ XenApp
	HS22 with GPU expansion blade ← tested with 2x M2070Q
	System x iDataPlex dx360 M3/M4 (supports Q4000/Q5000/M2070Q) ← tested
	System x iDataPlex x3650 M3/M4 (2 dual-slot cards, e.g. GRID) ← certified
Others	Cisco C240 M3; Fujitsu TX300; SGI Asterism ID112 ← XenServer certified

Designer Engineer Virtual Workstation solution

Citrix ready design engineer ecosystem around HDX 3D Pro



GPU Sharing on XenApp

Multiple concurrent users per GPU

- XenApp HDX 3D GPU Sharing has been available since XenApp 6.0
- *New*: XenApp 6.5 OpenGL GPU Sharing – *NOW AVAILABLE* on citrix.com
- Lots of great comments from our Tech Preview participants: http://blogs.citrix.com/2013/02/22/how-many-users-can-share-a-gpu/
- Works with Fermi-generation NVIDIA Quadro cards and with the latest Kepler-architecture GRID K2 (higher user density)
- Directly leverages the GPU video driver (unlike API Intercept vGPU)
- Supports all versions of DirectX and OpenGL
- Ideal for second tier users of 3D professional graphics

XenDesktop/XenApp on vSphere 5.1

GPU passthrough and GPU sharing on vSphere 5.1

- XenDesktop/XenApp is hypervisor agnostic
- vSphere 5.1 has introduced “virtual Direct Graphics Acceleration” (vDGA) and “virtual Shared Graphics Acceleration” (vSGA)
- Testing for XenDesktop HDX 3D Pro compatibility with vDGA has been successfully completed (http://support.citrix.com/article/CTX136291)
- Testing with vSGA successful (single monitor) for “tier 3” use cases
- vSGA uses API Intercept method of sharing the GPU so performance may be an issue with large 3D models, and graphics API compatibility is limited to DirectX 9c and OpenGL 2.1

Looking ahead…

3D graphics enhancements in Excalibur (first release from project Avalon)

XenDesktop HDX 3D Pro

- Multi-monitor support (i.e. more than two)
- Dynamic resizing without disconnect
- Auto-config / auto-adapt (no config tool / user intervention required)

XenApp HDX 3D becomes XenApp “HDX 3D Pro”

- Deep Compression

Citrix Receiver (enhancements targeted for Excalibur timeframe)

- Deep Compression support on Mac, iPad, Android
- HDX SoC support for Deep Compression decoding on low-cost Linux thin clients

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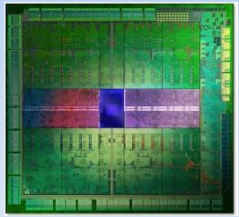
Looking ahead…

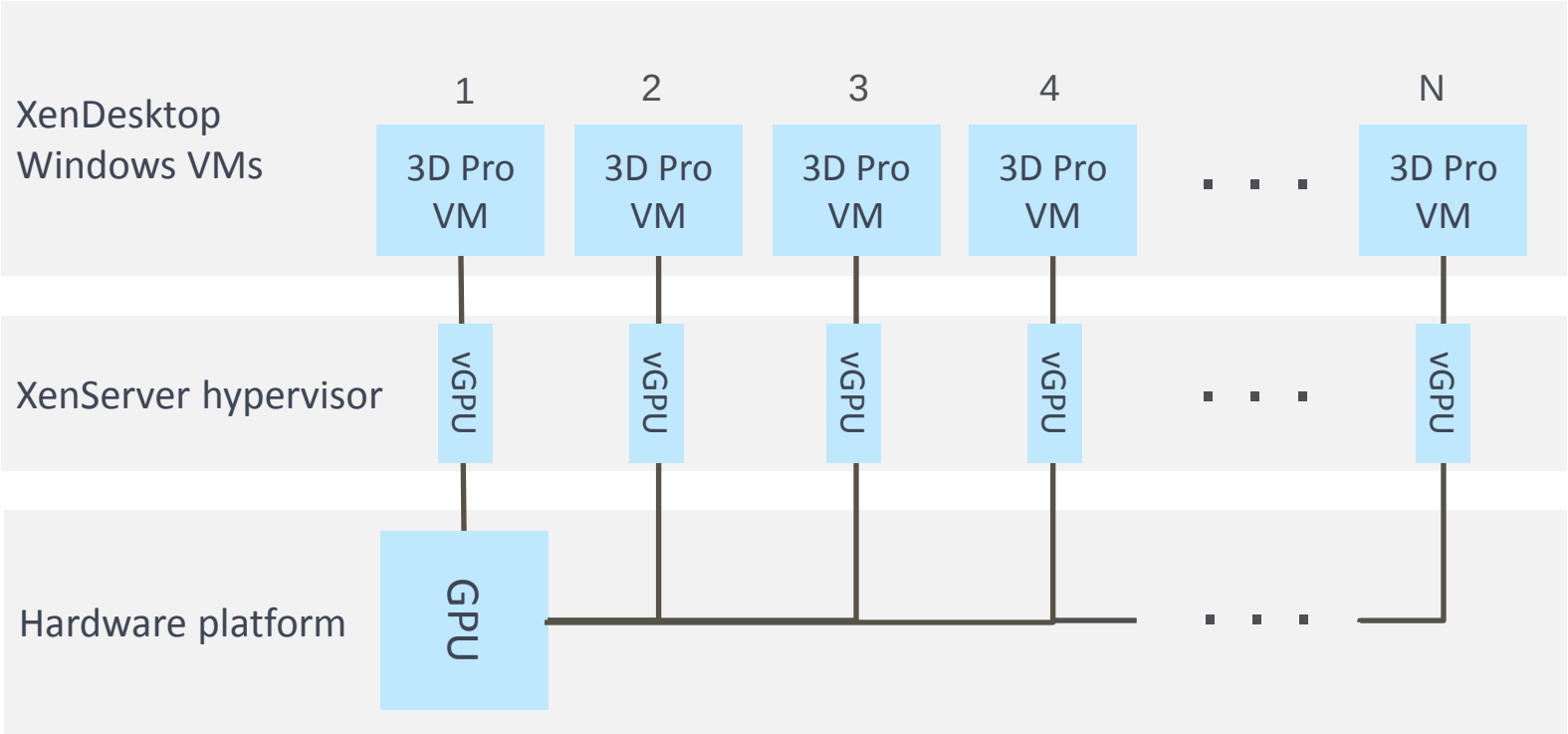
Hardware vGPU



At the 2012 GPU Technology Conference, NVIDIA and Citrix announced our collaboration on **GPU Hardware Virtualization**

- Enhancements to the VGX™ API and XenServer along with new GRID graphics cards will extend Citrix's high performance GPU sharing capability from Windows Server RDSH to Windows XP/7/8 VDI
- Higher performance with large 3D models compared to API Intercept method used by VMware vSphere/ESX and Microsoft Hyper-V
- Ideal for second tier users of 3D professional graphics
- Beta trials with selected partners starting Q2 2013 (see demo in Exhibit Hall)

GPU Virtualization



Summary: Citrix solution for 3D graphics

- *Best WAN performance on the market*
- *First to market with NVIDIA VGX API support*
- *Lowest cost per user*
- *Any device*

And don’t miss…

Citrix booth in the Exhibit Hall

- XenApp high-performance GPU sharing (OpenGL and DirectX)
- GPU sharing on XenDesktop
  (pre-beta of GRID VGX Software for GPU hardware virtualization)

Thomas Poppelgaard’s seminar S3540

- *Successfully Delivering 3D Graphics Solutions for Your Business*
- Best practices from real-world implementations, plus cool videos!
- Wednesday at 9:30am, room 230C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