VMware Horizon View 3D Graphics

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Disclaimer

- This session may contain product features that are currently under development.
- This session/overview of the new technology represents no commitment from VMware to deliver these features in any generally available product.
- Features are subject to change, and must not be included in contracts, purchase orders, or sales agreements of any kind.
- Technical feasibility and market demand will affect final delivery.
- Pricing and packaging for any new technologies or features discussed or presented have not been determined.

Agenda

- Trends, Graphics & Desktop Virtualization
- Horizon View Graphics Overview
- Graphics Use Cases and Case Studies
- Using GPUs with VMware Horizon View
- Q&A

The pace and rate of technology change is faster than ever

Devices

66% use 2+ devices for work

1/2 of all non-PC devices will be BYO by 2016

2014 Android shipments will outstrip iOS

Y/Y steady PC shipment forecasts

Apps

300B app downloads by 2016

80% of LOB apps are SaaS

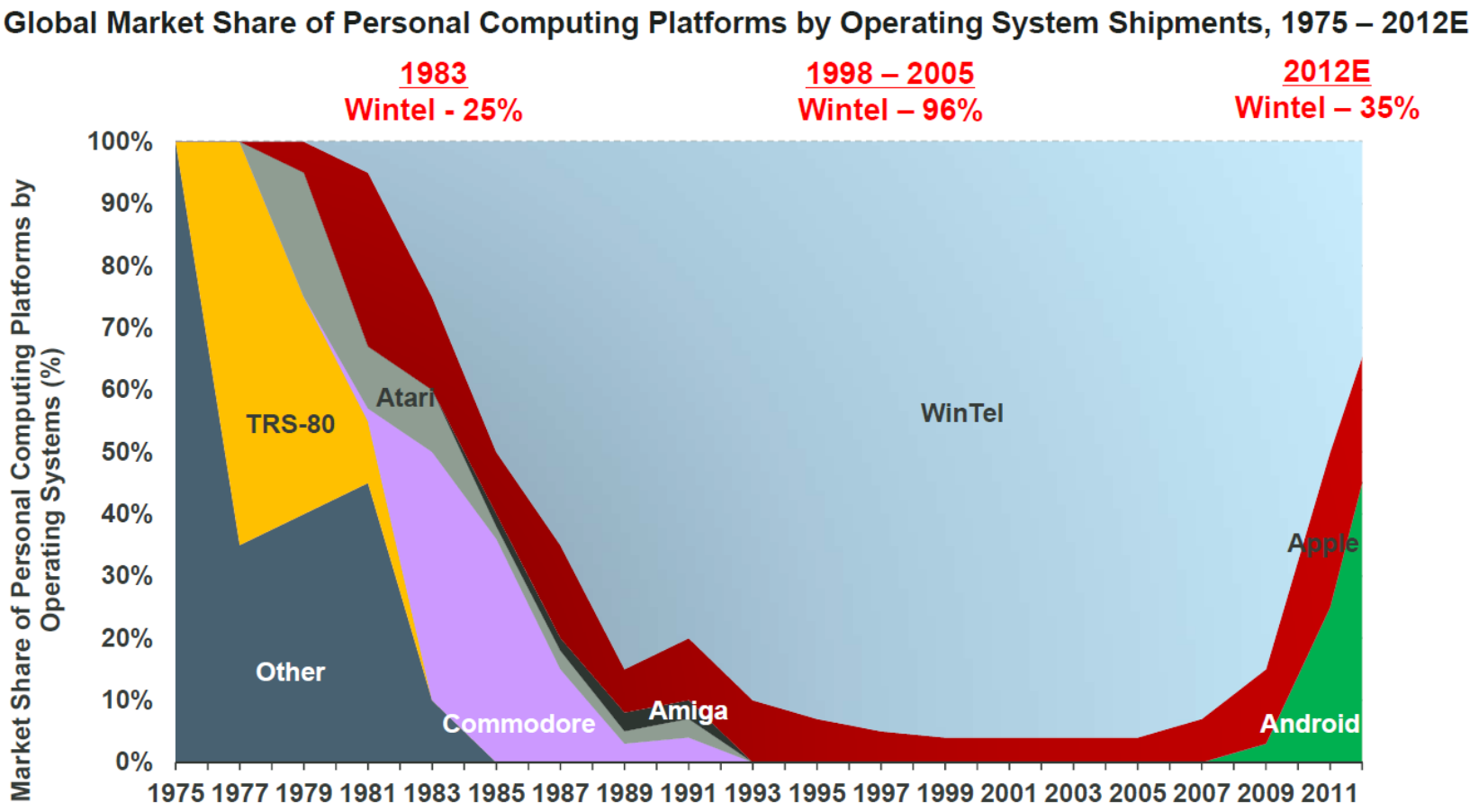
Access

52% of companies support mobile/remote employees

>30% of the worldwide workforce is mobile

Sources: IDC 2012, Morgan Stanley 2011, Gartner 2012, Forrester 2012, Pew 2011

Changing Platforms



KPCB

Source: Asymco.com (as of 2011), Public Filings, Morgan Stanley Research, Gartner for 2012E data. 2012E data as of Q3:12.

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Graphics Intensive Apps Are Required by More Users

DESIGNER
(AutoCAD, CATIA, CS6, Inventor, etc.)

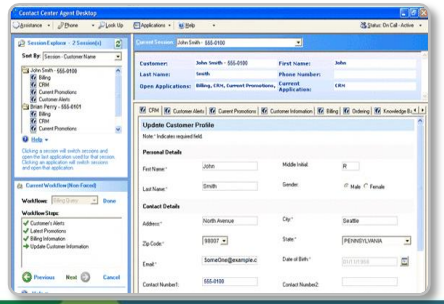
25 M

POWER USER
(Photoshop, 3D Viewers, PLM, Medical, Showcase, etc.)

200 M

KNOWLEDGE WORKER
(MS Office, Google Earth, etc.)

400 M



TASK WORKER
(Windows Aero, Call Center Apps)

100 M

Source: Gartner & NVIDIA 2012 Research

Additional Workplace Challenges

More distributed than ever

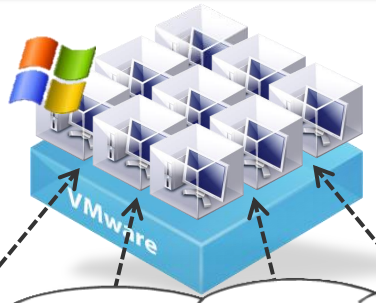
Large datasets are harder to share

Contractors need revocable access

Data leakage & corporate security

Horizon View Desktop Virtualization Enables The New Workforce

IT manages centralized virtual desktops

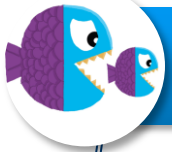


Highly efficient remote protocol

Users remotely access from various devices

Security & Compliance

Anywhere Access

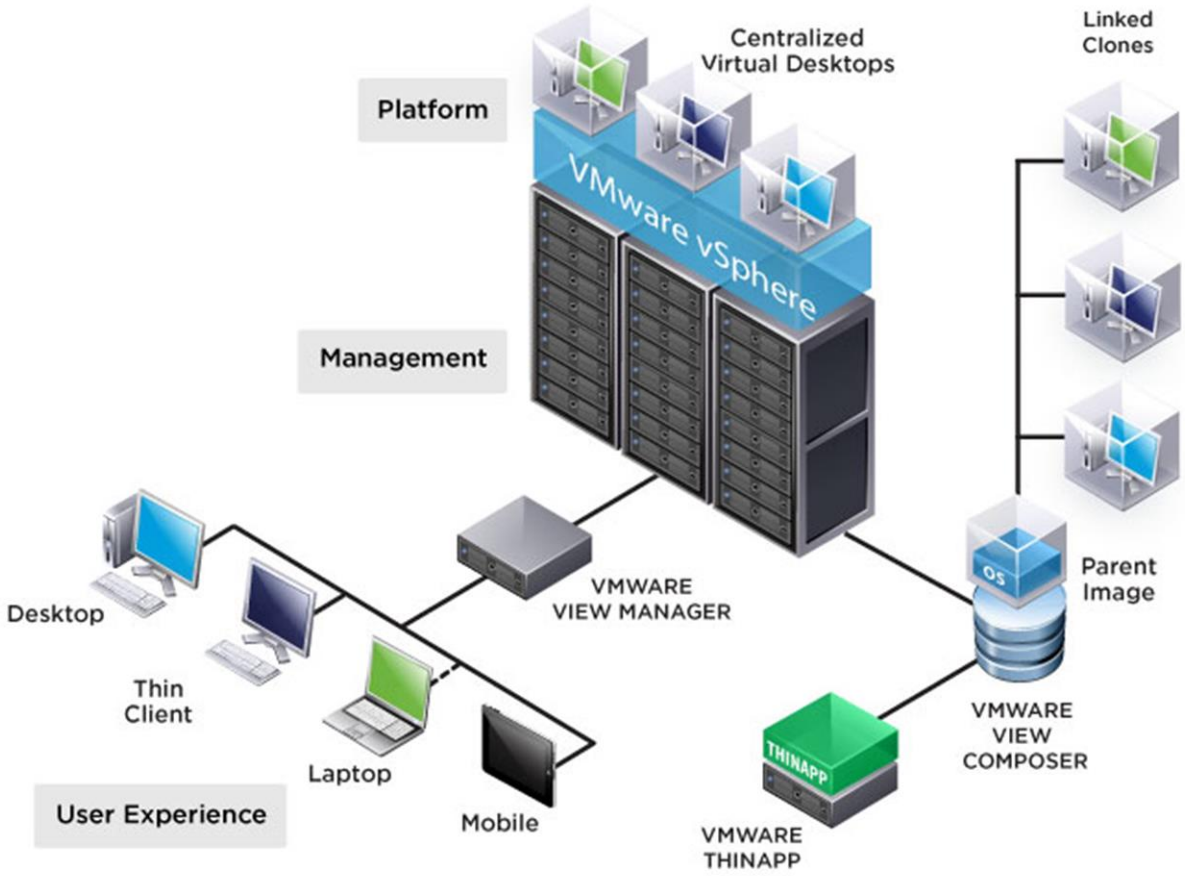


Business Agility

Mobile & BYOD Access

OPEX Savings

What is VMware View



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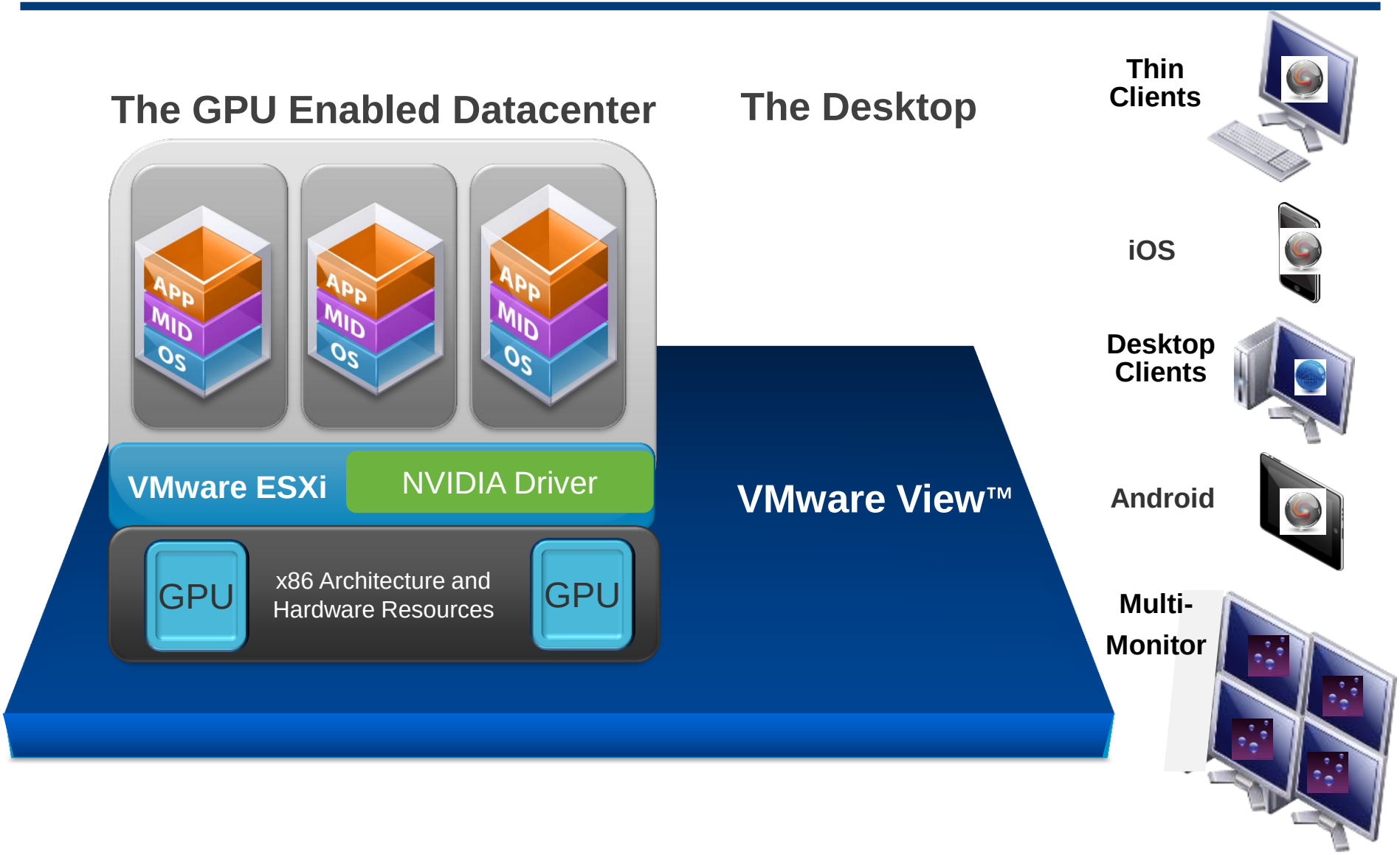
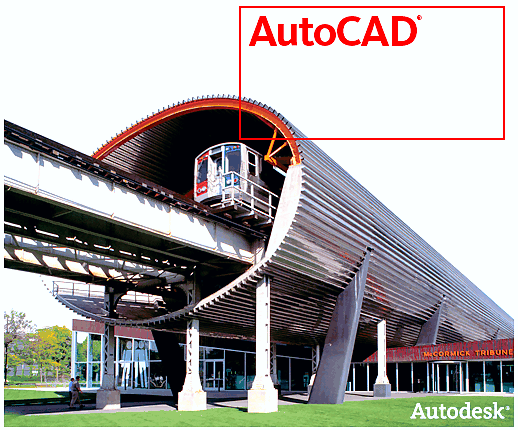
Horizon View Graphics Overview

Virtualization of Desktop 3D Workloads



VMware Graphics Virtualization Goals

- Most flexible platform for all graphics needs
- Broadest coverage of all use cases
- Highest scalability across use cases
- Full application compatibility

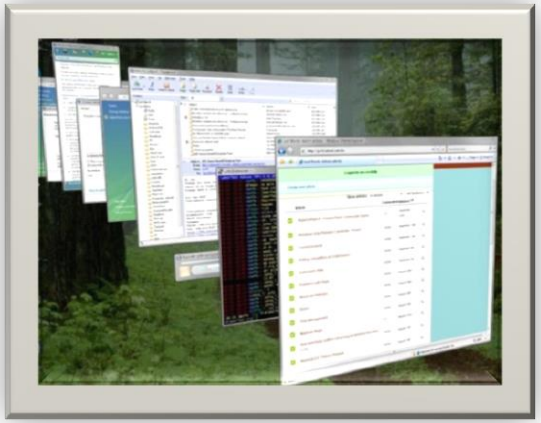


Soft 3D – Basic 3D without Graphics Card

Software renderer provides 3D to productivity apps

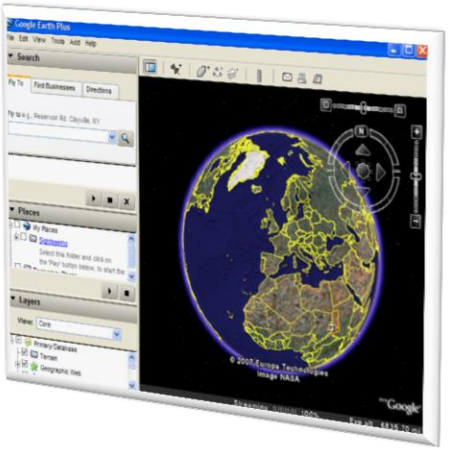
Overview

- Basic 3D graphics capabilities for productivity workers
- Targeted at Task and Knowledge Workers who need AERO or applications that require 3D graphics
- Requires additional CPU and reduces consolidation, but enables 3D for light use cases.



Benefits

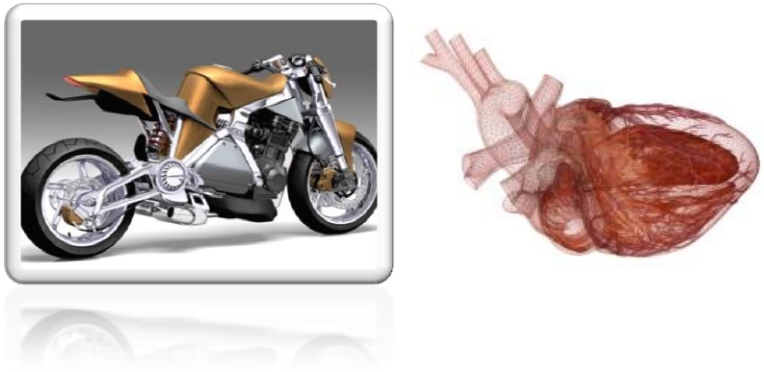
- Enables DirectX 9 and OpenGL 2.1 apps
- No physical graphics card required
- Lower initial VDI CAPEX
- No Windows client side dependencies
- Full compatibility with vMotion, DRS, HA



vSGA – Shared 3D Graphics With Multiple Virtual Machines

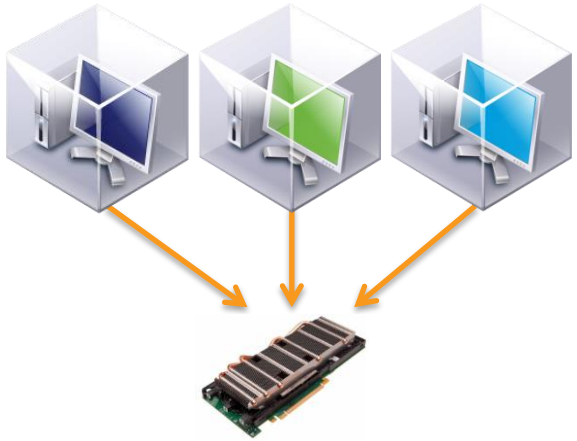
Overview

- Supports select NVIDIA Graphics Cards
- Share single 3D graphics card with multiple virtual machines for high performance 3D workloads
- Desktops see abstracted VMware SVGA device for maximum virtual machine compatibility & portability.



Benefits

- Enables high performance for DirectX 9 SM 3 and OpenGL 2.1 apps
- Cost effective with multiple VMs sharing single 3D graphics card
- Full compatibility with vMotion, DRS for hosts lacking physical 3D graphics cards



vDGA – Deliver Workstation Class 3D Graphics for VDI Desktops

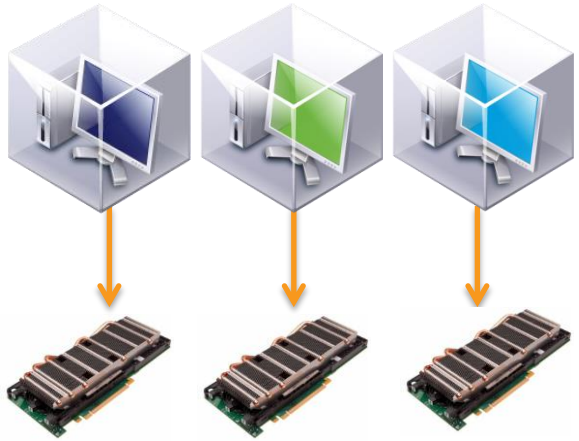
Full workstation class user experience with dedicated NVIDIA graphics card

Overview

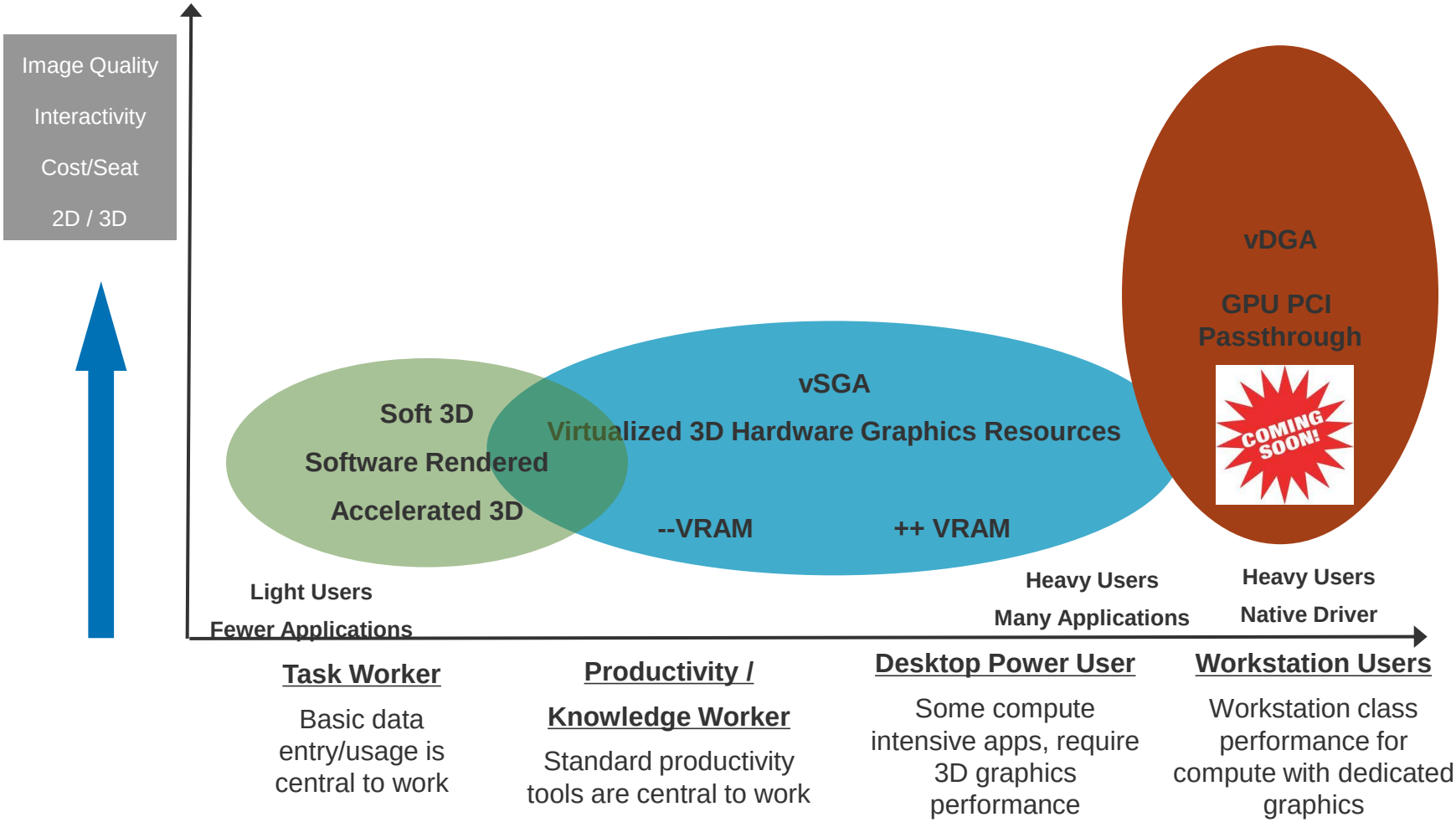
- Enables dedicated access to physical GPU hardware for 3D and high performance compute workloads.
- Uses native NVIDIA drivers
- CUDA and OpenCL compute APIs supported
- Best for super high performance needs like design, manufacturing, oil & gas

Benefits

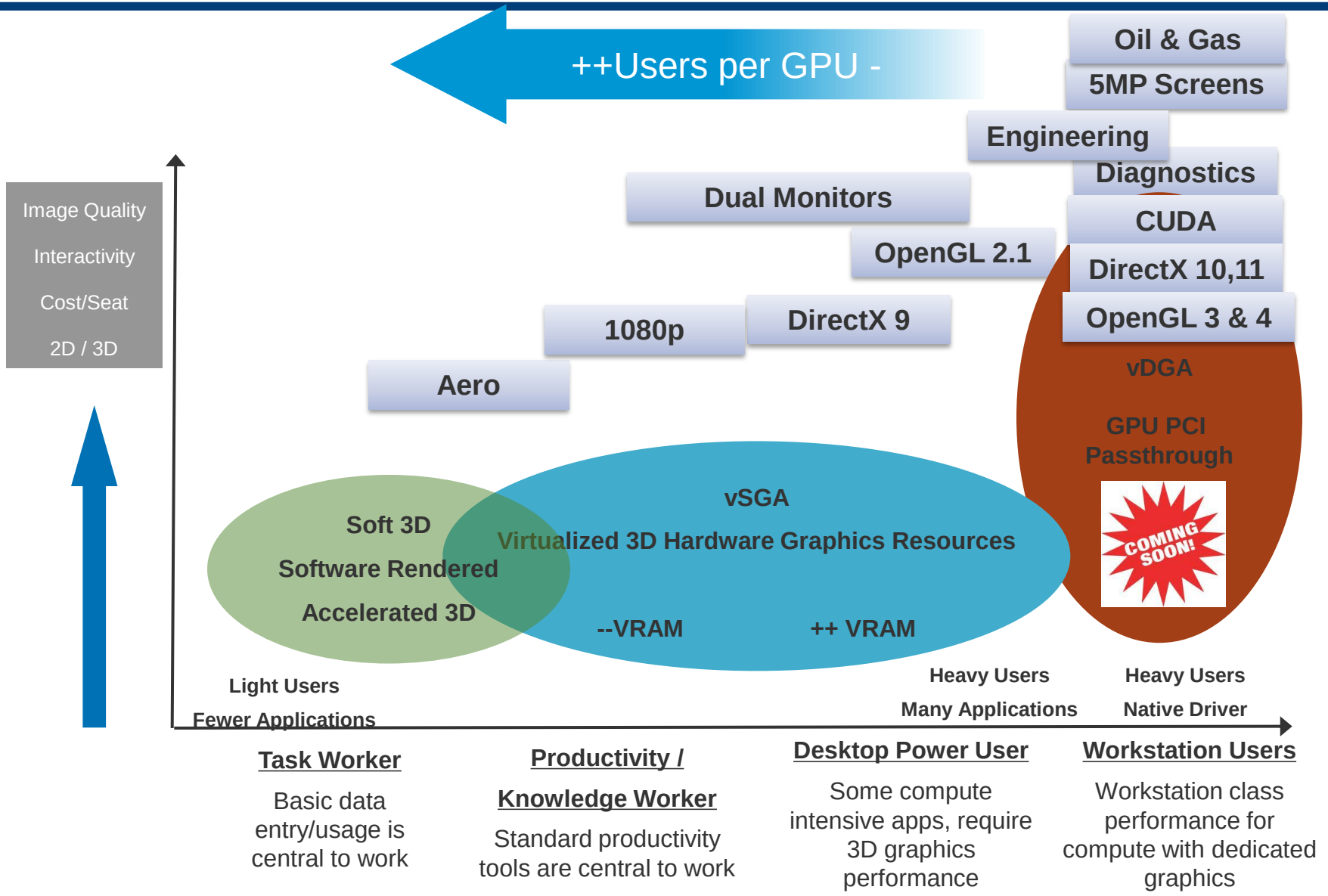
- Compliments vSGA cost/performance
- True workstation replacement option
- Full capabilities of physical NVIDIA GPUs
- High performance compute GPU option



Virtual Desktop 3D Graphics Segmentation



Virtual Desktop 3D Graphics Segmentation



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vSGA / vDGA Benefits and Comparison

vSGA

- GPUs shared between users
- High consolidation ratio
- Good performance for many apps
- Broad 3D application compatibility for productivity apps and many 3D apps
- DirectX 9.0 SM3
- OpenGL 2.1
- Software video playback
- vMotion / HA / DRS compatible
- Automatically fall back to software renderer as needed

vDGA

- GPU dedicated to individual user
- Workstation level performance
- Maximum Performance
- Maximum compatibility with all 3D and GPU computation applications
- DirectX 9, 10 ,11
- OpenGL 2.1, 3.x, 4.x
- Hardware accelerated video playback
- Not compatible with vMotion / HA
- Compute with CUDA, OpenCL

Access 3D Desktops from Wide Variety of Clients

Laptops

Modern Browsers

Tablets/Phones

Zero Clients

Desktops

Thin Clients

Customer Case Study

SSOE Group Case Study – Background Information

- **Company size**
  - Employees – 1,200
  - Revenue – $188 Million
  - Offices – 29 offices in 7 countries

- **Business**
  - 11th largest engineering, architectural, and construction management firm (Building Design + Construction)
  - One of Inc. magazine's fastest growing firms (2012)
  - One of the "Best AEC Firms to Work For" (Building Design + Construction)
  - Deliver Great Client Service to clients through a full range of EPCM services.
  - Makes clients successful by saving them time, trouble, and money.

SSOE Group Case Study – Challenges

29 Offices in 7 Countries

Sharing Large Data Between Sites Slow

Third Party Partner Secure Access

Protect Customer IP Leakage

SSOE Group Case Study – Use Case

- **Remote 2D/3D Uses**
  - Domestic – 2D drafting and 3D modeling
    - Locations (partial list)
      - Birmingham, AL
      - Toledo, OH
      - Troy, MI
      - Hillsboro, OR
      - Brentwood, TN

  - International – 2D drafting and starting 3D (Revit)
    - Locations
      - Sao Paulo, Brazil
      - Ontario, Canada
      - Shanghai, China
      - Mumbai, India
      - Penang, Malaysia
      - Singapore

SSOE Group Case Study – Applications In Use

- **Software In Environment**
  - Antivirus
    - Microsoft Forefront Endpoint Protection
  - Applications
    - Deltek Vision (ERP)
    - Microsoft Lync
    - PeopleSoft
    - Cisco UC/Microsoft Office
  - Design and Graphics Applications
    - Autodesk Revit
    - Bentley PlantSpace
    - Autodesk AutoCAD
    - Bentley MicroStation (and verticals)
    - Autodesk Plant3D
    - Autodesk Navisworks
    - Autodesk Inventor
    - Dassault Systèmes SolidWorks
    - Bentley ProjectWise
    - Autodesk Revit Server
    - Autodesk Vault

SSOE Group Case Study – Horizon View Architecture

- **VMware Horizon View Infrastructure**
  - Hardware
    - Servers
      - Cisco B200's w/ software GPU
      - Cisco C260's w/ software GPU
      - Cisco C240's w/ NVIDIA GRID cards
    - Network
      - Cisco Nexus 7010 dual core
      - Cisco UCS 6248UP Fabric Interconnect cluster
    - Storage
      - EqualLogic SATA & SAS/SSD Hybrid arrays (legacy)
      - Nexgen N5 Fusion-IO powered arrays (two)
    - Endpoints
      - Dell & Lenovo workstations & laptops
      - Tablets (iPad)
      - Zero clients (Wyse P20, P45)

SSOE Group Case Study – Lessons Learned

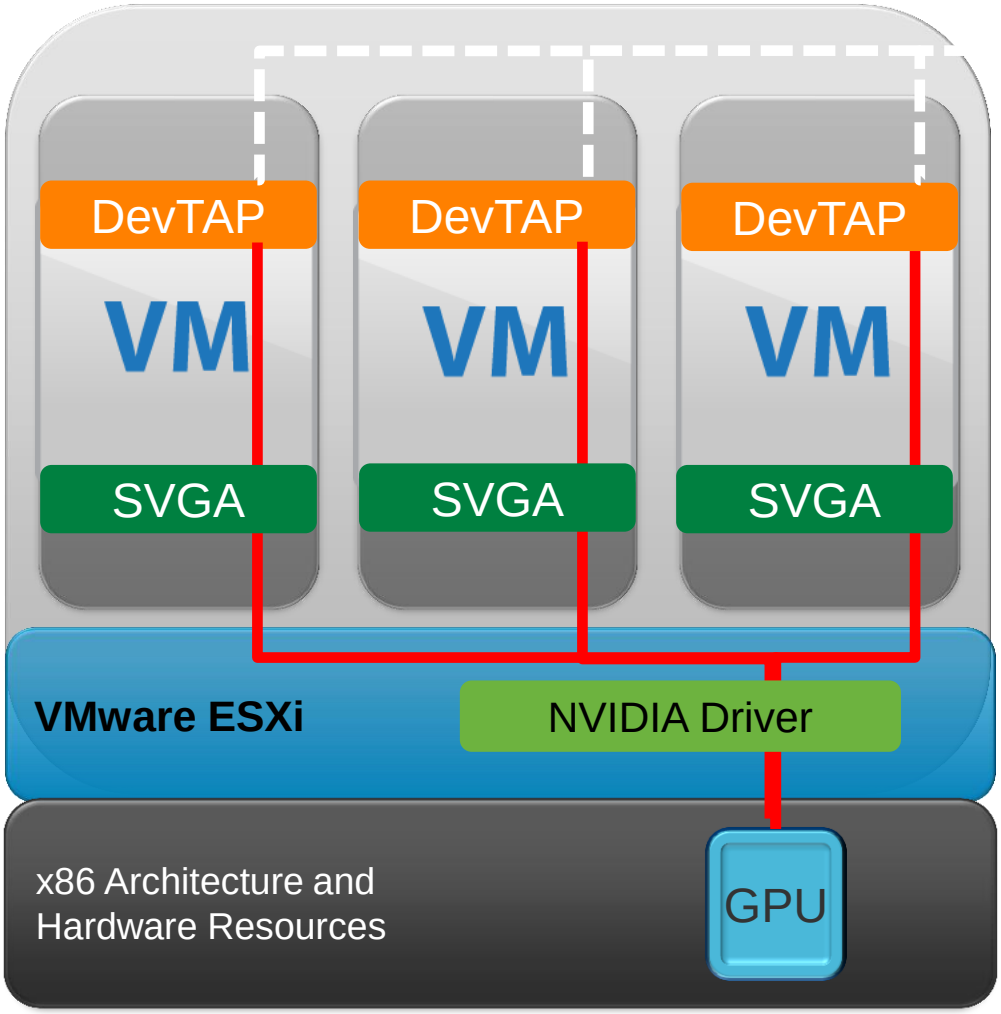
- **Benefits**
  - Management
    - Control desktop configuration for remote or non-employee users
  - Security
    - Increase intellectual property security
  - Availability
    - Use of VMware vSphere HA to recover from hardware failure
    - Across multiple sites when programs are not multi site enabled
  - Scalability
    - Rapid deployment of additional guests to fit unexpected situations.
- **Costs**
  - Additional application licensing needed ‘in country’ for certain applications
  - POC grew faster than expected; had to purchase additional hardware sooner

Using GPUs with VMware View

Resources to Maximize Success with 3D Graphics & View

- VMware Horizon View Graphics Acceleration Deployment Guide
- http://www.vmware.com/files/pdf/techpaper/vmware-horizon-view-graphics-acceleration-deployment.pdf
- VMware Horizon View 5.2 Hardware Accelerated 3D Graphics: Performance Data & Best Practices
- http://www.vmware.com/files/pdf/view/vmware-horizon-view-hardware-accelerated-3Dgraphics-performance-study.pdf
- VMware vSGA 3D Hardware Compatibility List
- http://www.vmware.com/resources/compatibility/vcl/vsga.php

vSGA (Shared) with NVIDIA Technical Overview



Remote Protocol

View Client

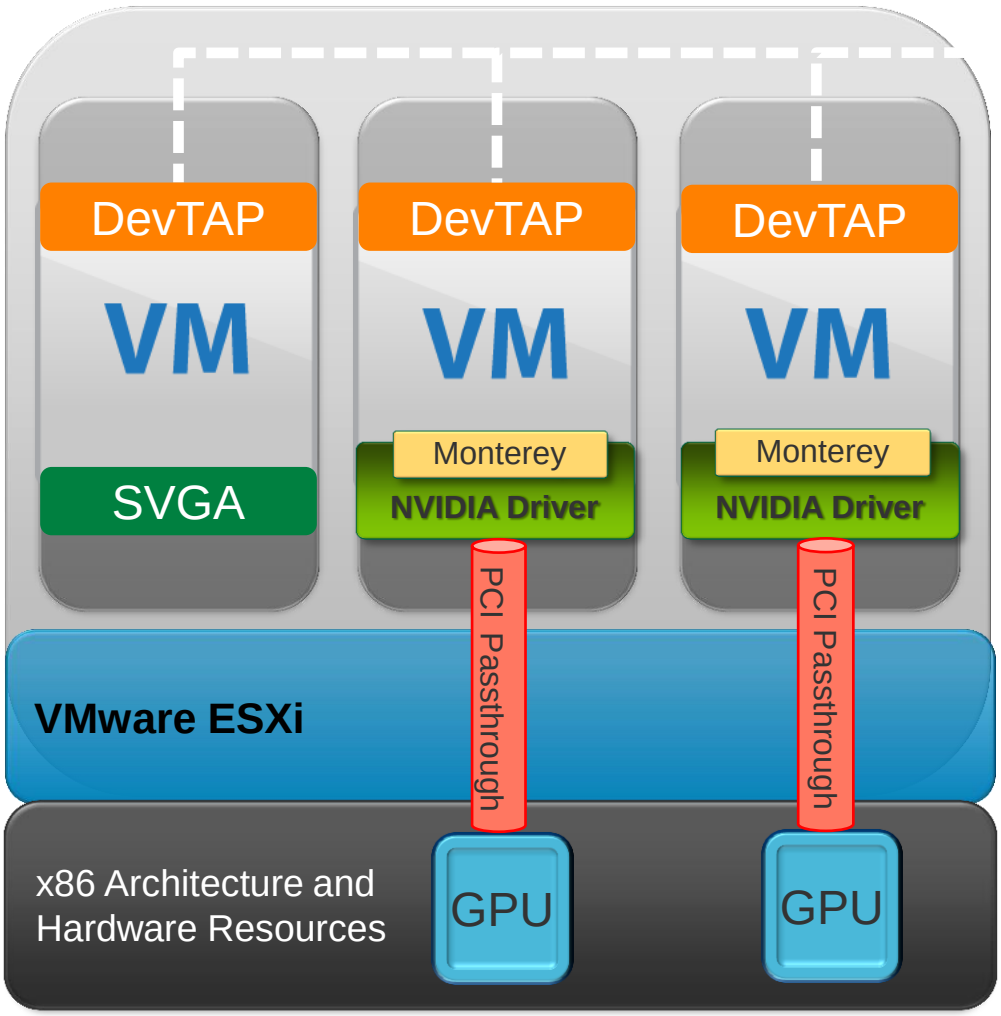
DevTAP
Bridges graphics pipeline and remoting protocol

VMware SVGA Driver
VMware Tools Driver

VMware ESXi
Resource Management

GPUs (see HCL for specifics)
NVIDIA Quadro / GRID GPUs

vDGA (Passthrough) with NVIDIA Technical Overview



Remote Protocol

View Clients

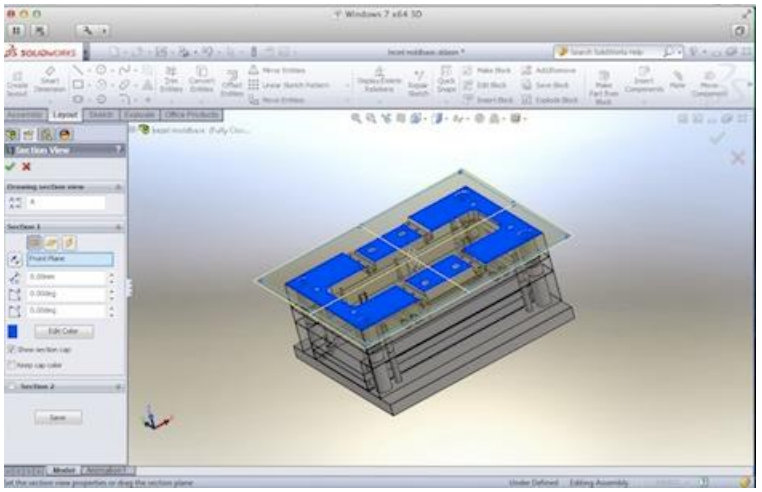
DevTAP
Bridges graphics pipeline and remoting protocol

NVIDIA Monterey API / Driver
Provides low latency frame buffer read back.

Direct-IO
Presents GPU to VM

GPUs (see HCL for specifics)
NVIDIA Quadro / GRID GPUs

Example vSGA (Shared) Scalability with Two NVIDIA Tesla GPUs

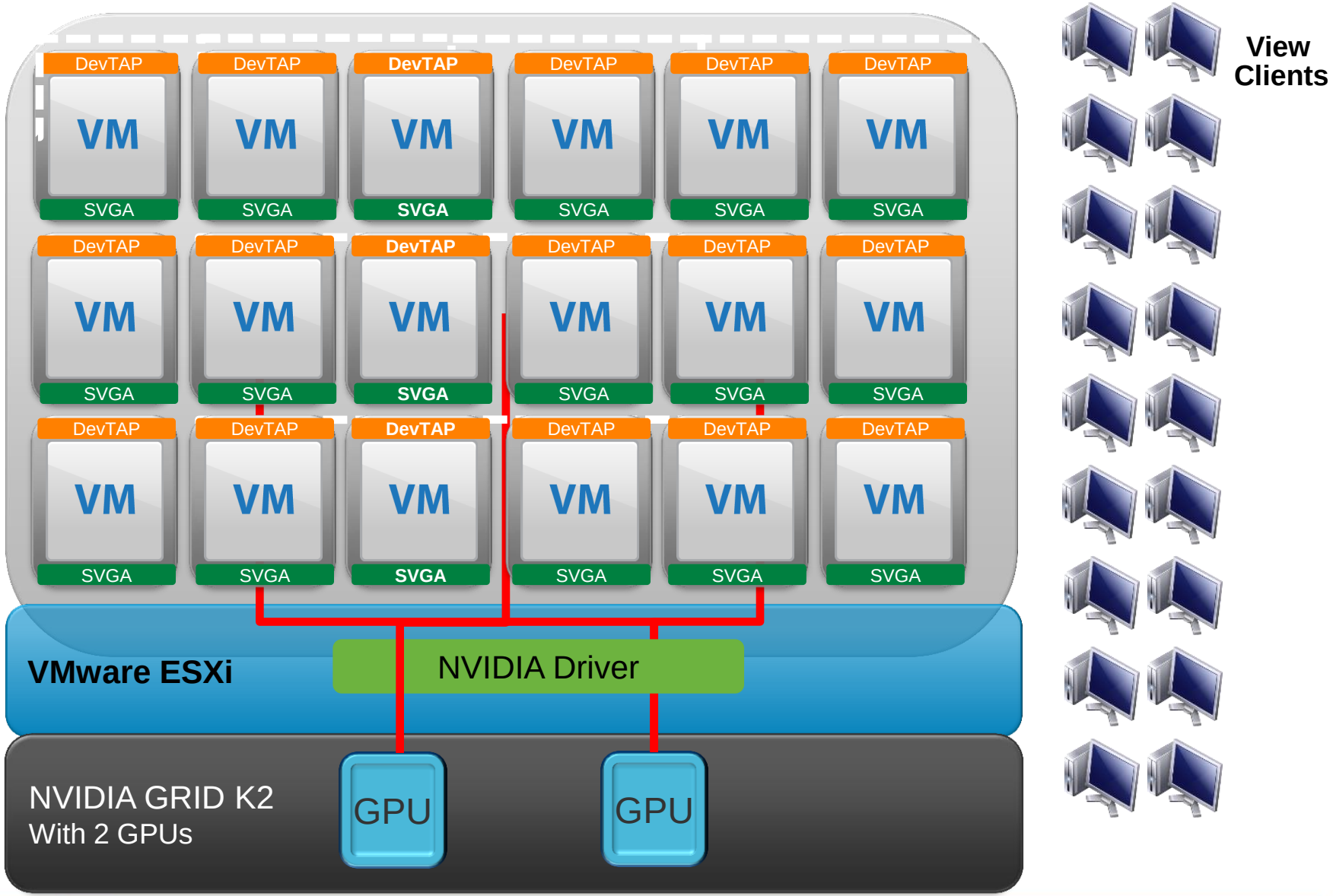


- **Using a Dell 720 2-socket x86 server with two NVIDIA Tesla GPUs**
- **Over 100 users running typical office applications on 3D desktops**
- **Up to 32 users running CAD apps like SolidWorks & Solid Edge**

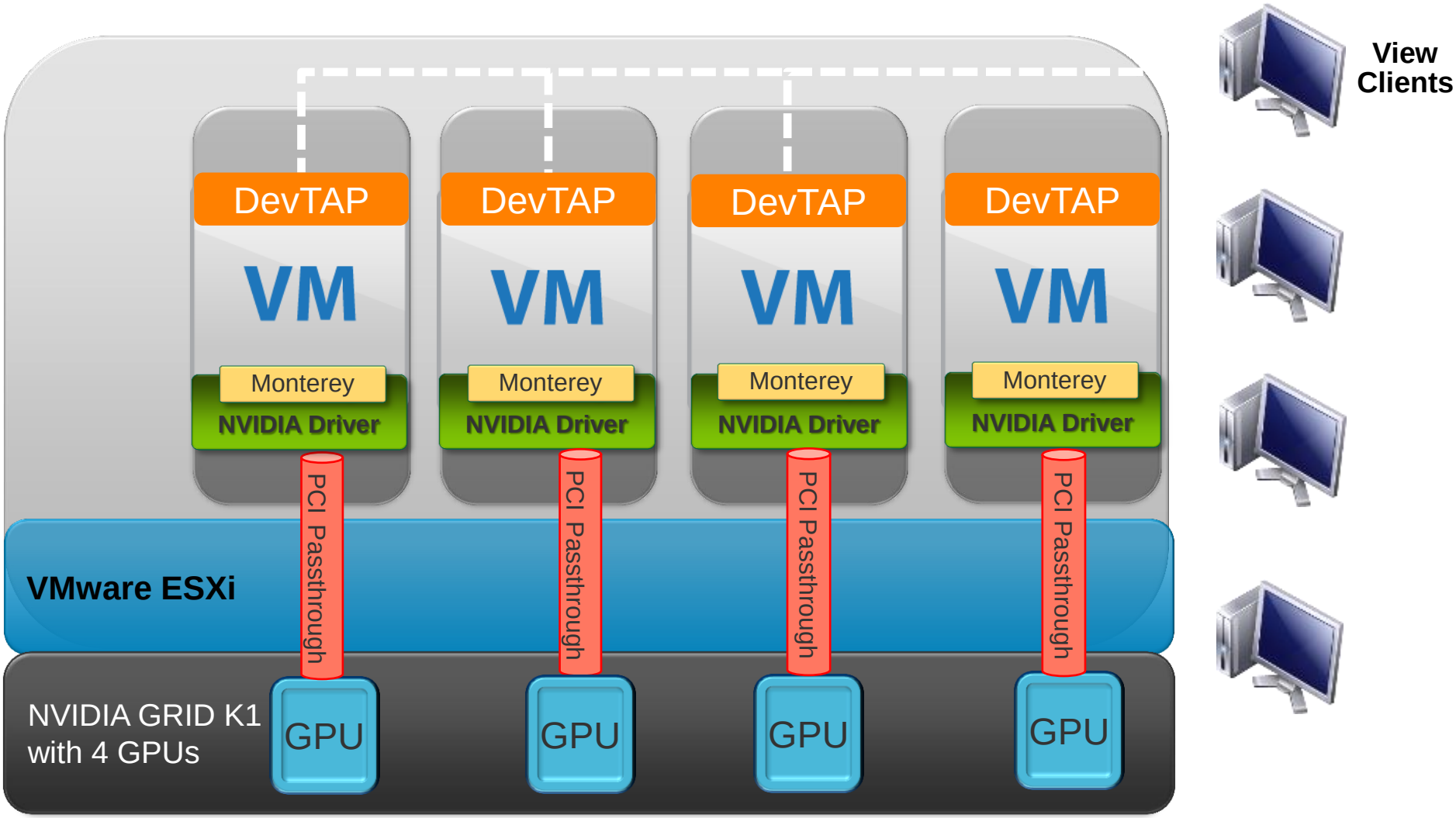
For more details, refer to the Horizon View 3D Performance Study

http://www.vmware.com/files/pdf/view/vmware-horizon-view-hardware-accelerated-3Dgraphics-performance-study.pdf

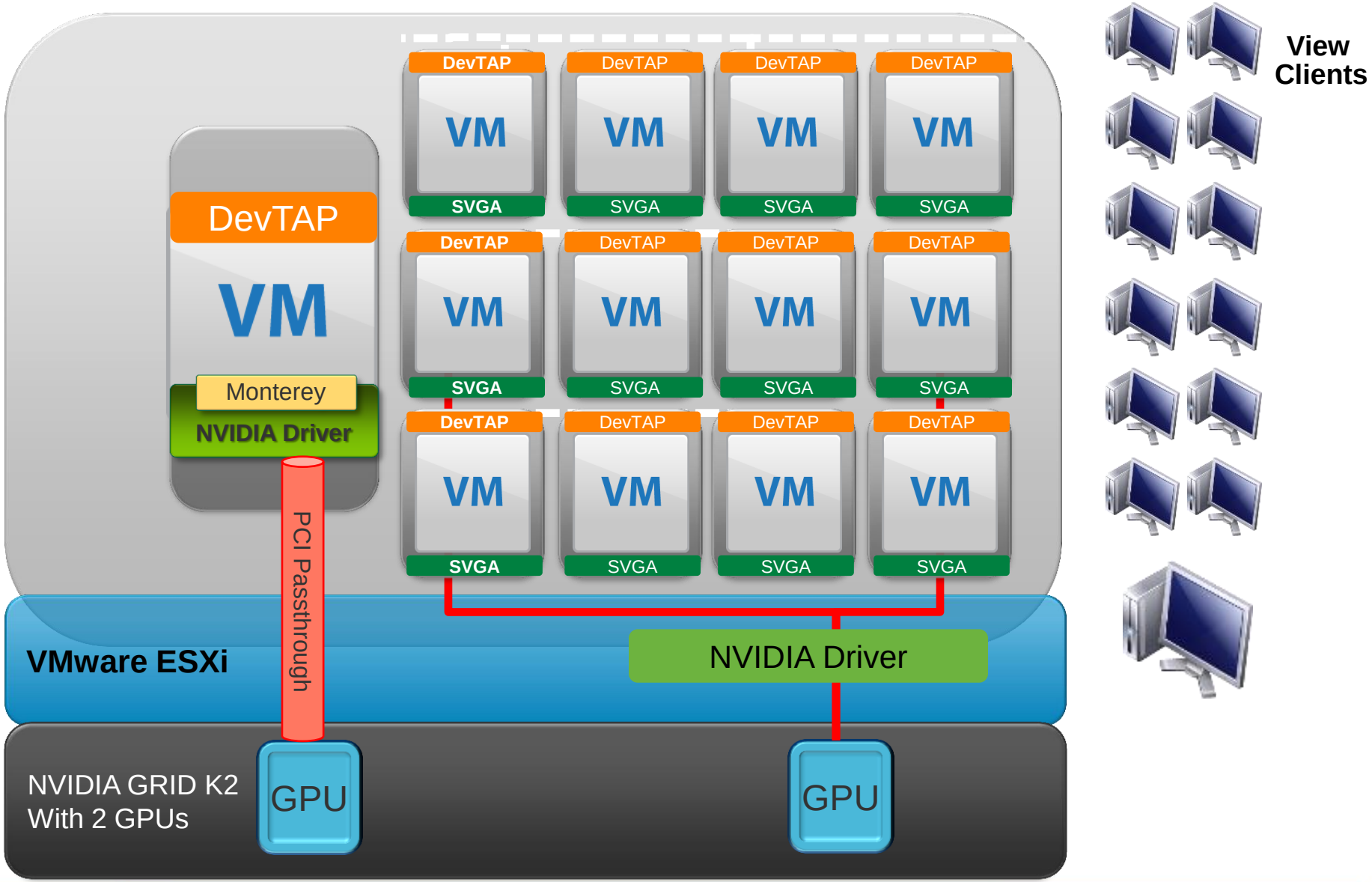
Example vSGA (Shared) with NVIDIA GRID K2



Example vDGA (Passthrough) with NVIDIA GRID K1



Example vSGA & vDGA with NVIDIA GRID K2



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Key Takeaways

- **VMware Horizon View meets widest range of 3D solutions from task workers up to high end workstation users**
- **Soft 3D maybe be “good enouogh” for task & knowledge workers using Microsoft Office and Windows Aero**
- **vSGA (Shared Graphics) is ideal for providing 3D graphics to knowledge workers for high end productivity apps, 3D viewers and light 3D design app usage for power users**
- **Coming later this year, vDGA (Dedicated Graphics) with NVIDIA is for ideal for high performance 3D design, engineering, and video design applications for engineers and designers.**
  - It is also ideal for oil & gas and scientific use cases requiring programmable GPUs features including CUDA or OpenCL


Thank You! Questions?
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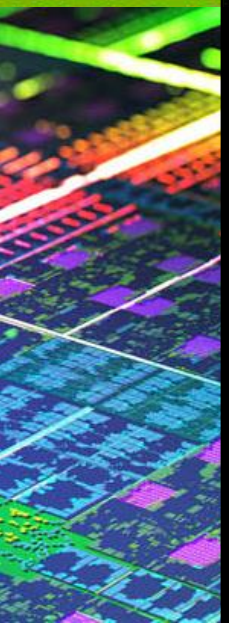

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September 17 - ArrayFire: A Productive GPU Software Library for Defense and Intelligence Applications

September 19 - Learn How to Debug OpenGL 4.2 with NVIDIA® Nsight™ Visual Studio Edition 3.1

September 25 - An Introduction to GPU Programming

September 26 - Learn How to Profile OpenGL 4.2 with NVIDIA® Nsight™ Visual Studio Edition 3.1

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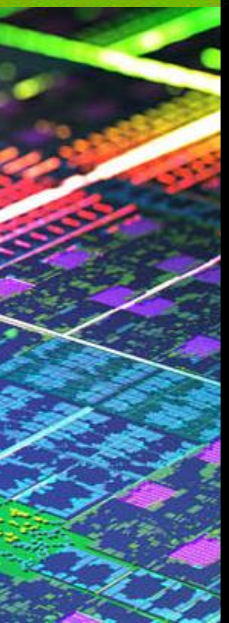
GPU TECHNOLOGY CONFERENCE



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