
TOMORROW starts here.
cisco
Cisco live!

Deploying Virtual Desktop Infrastructure (VDI) in the Enterprise Data Centre

BRKVIR-2002

Leon Czechowicz

Systems Engineer

Cisco live!

Abstract

As technology moves forward we see new capabilities and benefits solving different problems in different ways. Improvements relate to: data protection, disaster recovery, user mobility and workload agility, desktop migration support and simplification of bulk administration.

The recent trend towards VDI away from hardware desktops is due to a number of factors driven by operational capability. Conceptually remote desktops are certainly not new, but the advent of gigabit and greater bandwidth networks has led to appropriate bandwidth overhead to enable transparent, media feature rich, virtual experiences.

The desktop is no longer considered a piece of hardware rather it is an instance supported by numerous services. These can be spawned, controlled, monitored and maintained in a more effective manner when they are centralised in the Data Centre rather than in the traditional distributed hardware desktop manner or indeed bound to wired physical infrastructure.

The architecture of the entire system needs to be tailored to support virtual desktop (visual) flows rather than application level transactions. Visual data flows are large but less dynamic and they must be given appropriate support and operational visibility throughout the network so an optimised VDI experience is available. Because of the nature of the data flows, the security ramifications at each point in the network have changed and the overall architecture required to support VDI is different to that of traditional hardware desktop models.

This presentation explores and discusses the differences, changes, benefits, solutions and optimisations.

Agenda

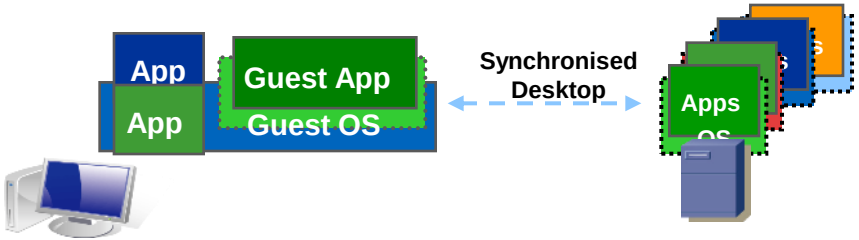
- Overview
- Software - Fundamentals and Major Players
- Collaboration – A Use Case for Problem Proofs
- Enterprise Networks – The Meat in the Sandwich
- Data Centre – Compute and Storage Considerations
- Strategy – Use Validated Architectures
- Plan Build Operate – Simplify, Automate, Orchestrate



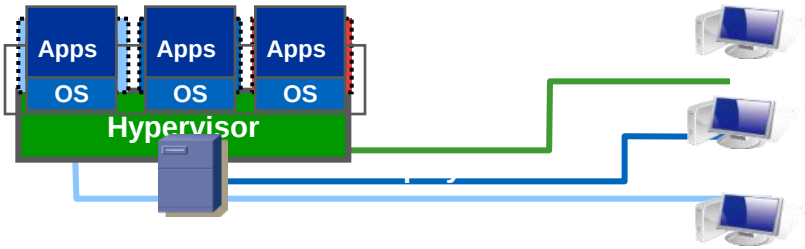

Overview

Virtual Desktop Models

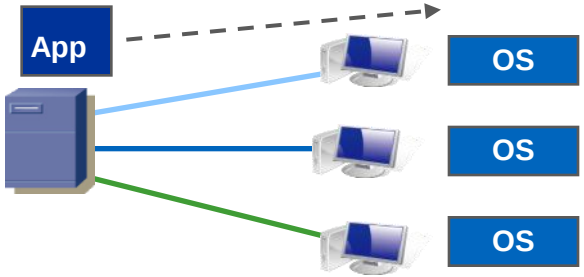
Virtual Desktop Streaming



Hosted Virtual Desktop

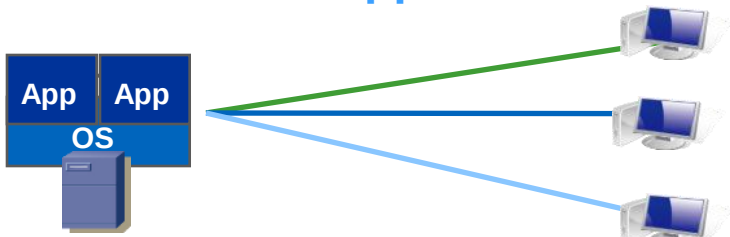


Application Streaming



Client Hosted Computing

Terminal Services or Published Applications



Server Hosted Computing

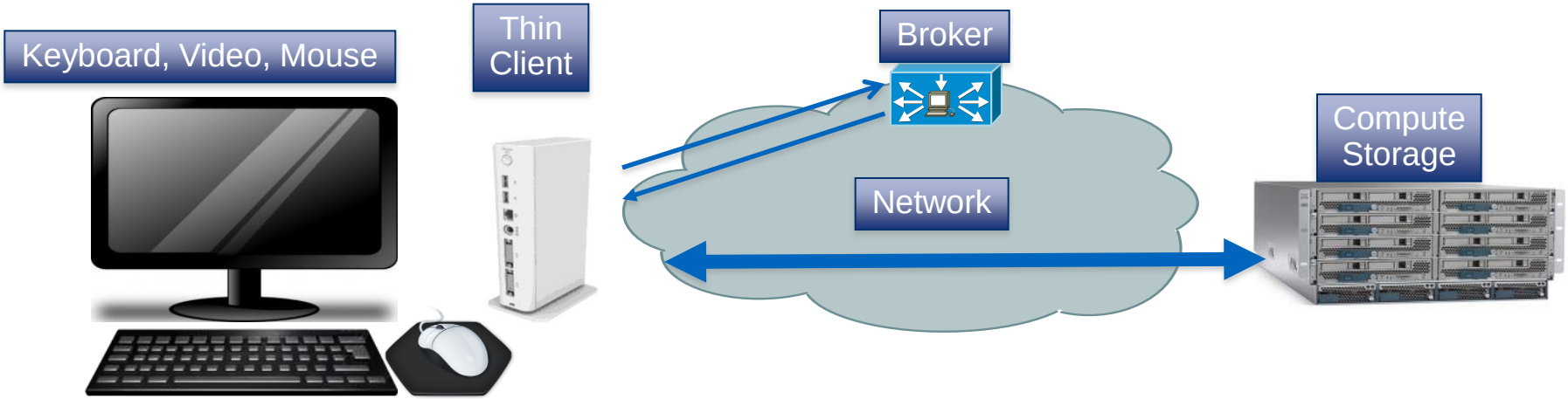
The Network is the Desktop

Keyboard, Video, Mouse

- Large OS
- Many local applications
- Vulnerable
- Constant patching
- Data backup
- Complex management
- Software distribution delivery challenges
- Skilled local support staff required

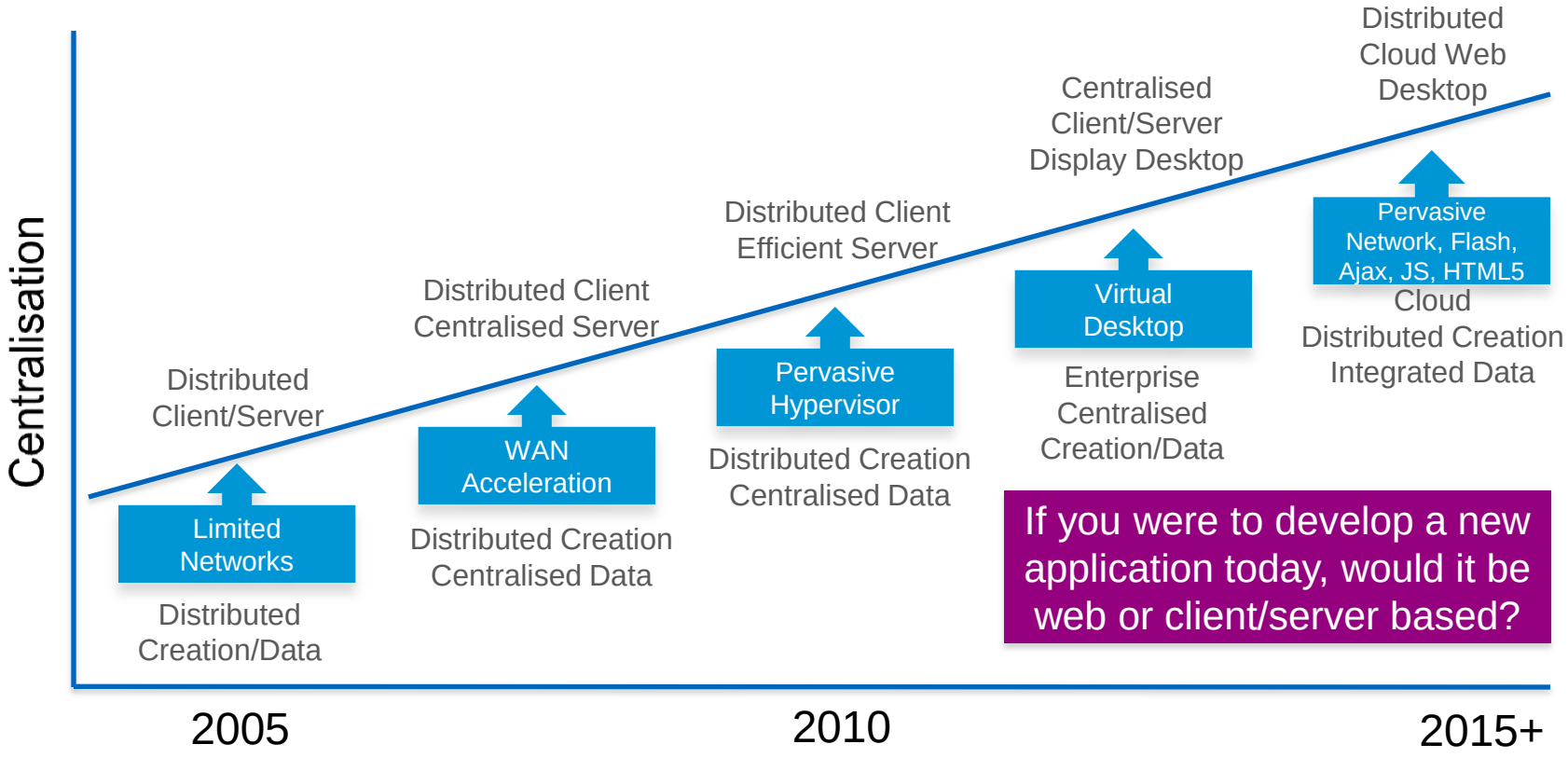
- Personal Computer is disaggregated
- Keyboard, Video, and Mouse stay with user
- Compute and storage move to the data centre
- Network availability is required for all application access
- Network performance is critical to user experience

The Network is the Desktop



- Personal Computer is disaggregated
- Keyboard, Video, and Mouse stay with user
- Compute and storage move to the data centre
- Network availability is required for all application access
- Network performance is critical to user experience

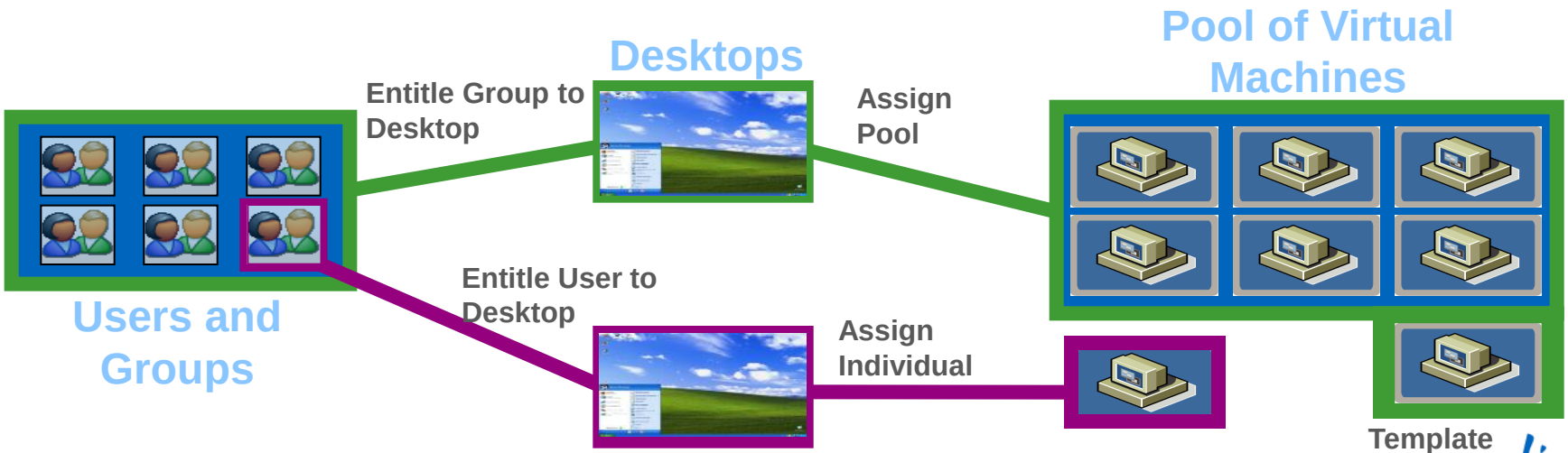
Moving Through VDI Rather Than to VDI



Software - Fundamentals and Major Players

Broker Desktop Entitlement

- **Non-Persistent or Pooled** - Generic virtual desktop assigned to users on a per session first come first server basis and then returned to the pool (possibly with profile removed) or destroyed
- **Persistent or Assigned** - Permanently assigned to a user statically or by first to connect
- **Personalised Non-persistent** – Abstracted persona applied to non-persistent desktops



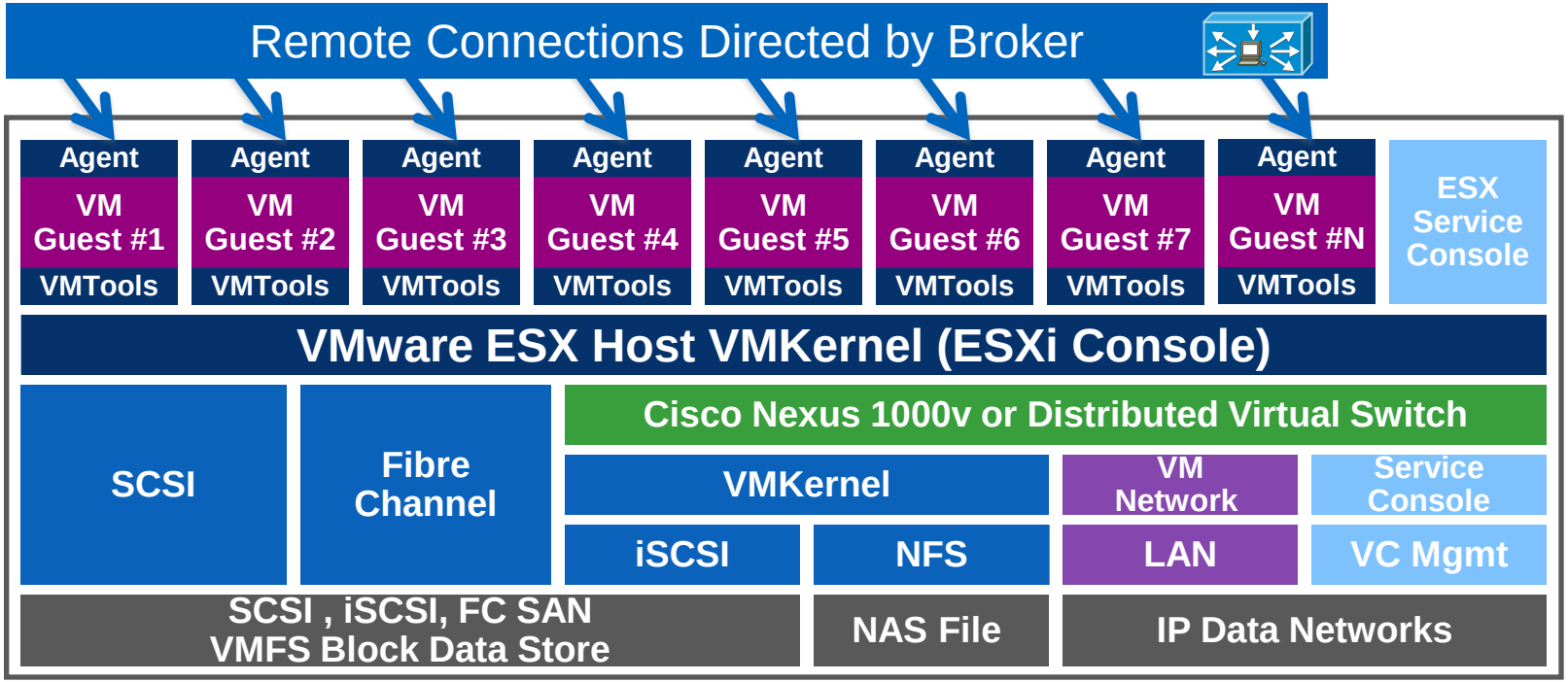
Software

VMware and Citrix Components

Function	VMware View	Citrix XenDesktop
Display Protocol Client	View Client	Citrix Receiver
Desktop Agent	View Agent contains PCoIP and RDP with Wyse TCX	Citrix Virtual Desktop Agent contains ICA and HDX Servers
Broker Provisioning	Composer / Thinapp	Citrix Provisioning Server
Broker Routing	Connection Server	Citrix Desktop Delivery Controller (DDC)
Broker Proxy	Security Server	Citrix Access Gateway
Portal	View Portal	Citrix Web Interface
Administration	View Administrator	Citrix Management Console
Personalisation	RTO Persona Management	Ringcube Personal vDisk
Hypervisor	VSphere ESX	XenServer
Orchestration	Virtual Centre	XenCentre

VMWare View Model

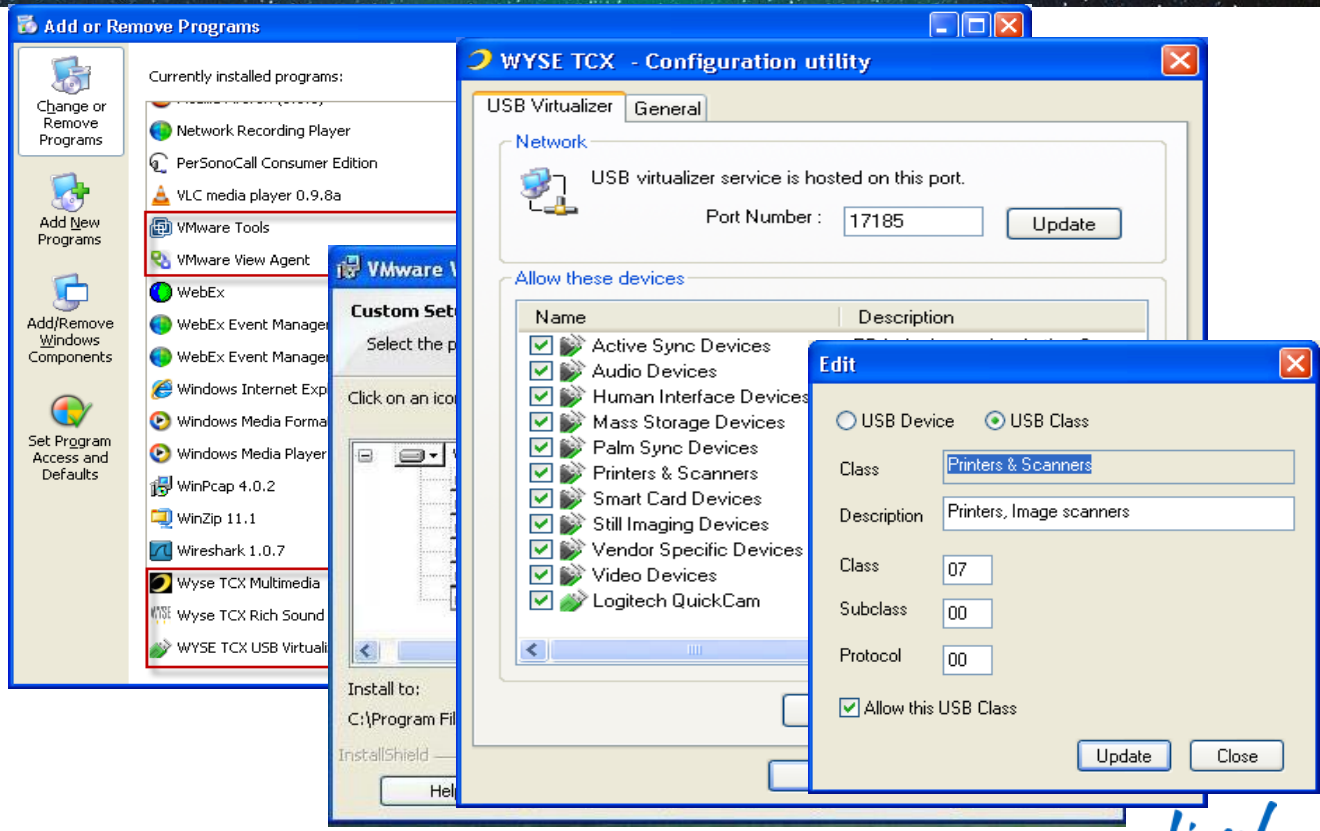
Desktop (OS) Virtualisation



- Virtual Machine (VM)
- Small Computer System Interface (SCSI)
- Storage Area Network (SAN)
- Virtual Machine File System (VMFS)
- Fibre Channel (FC)
- Network File System (NFS)
- Network Attached Storage (NAS)
- Virtual Centre (VC)

Display Protocol Server Components (Agent)

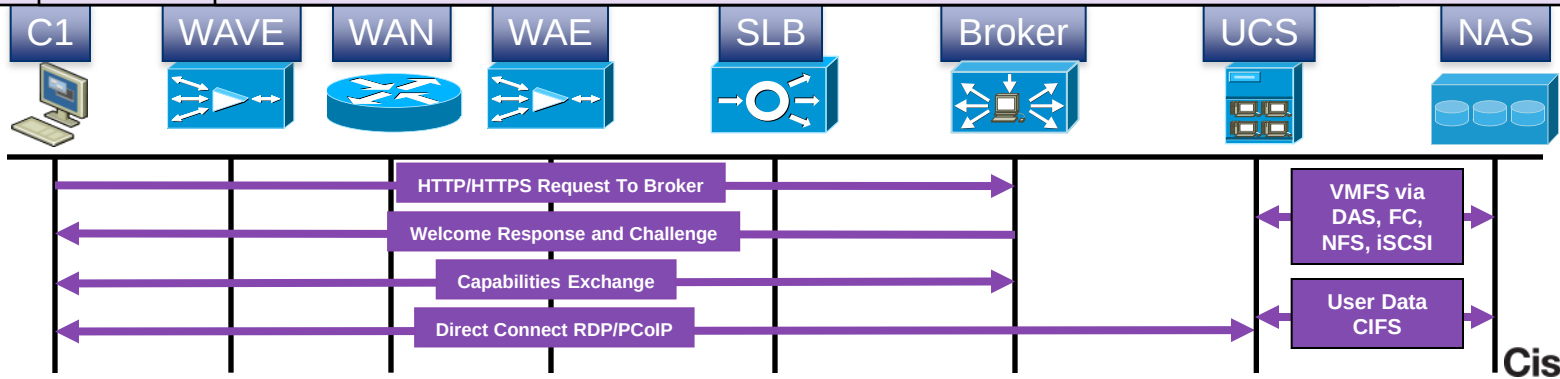
- VMware Tools
- Broker Agent
- Multimedia Redirector (Windows Media and Flash)
- Rich Sound Server (Analog Mic/Skr)
- USB Virtualisation Server



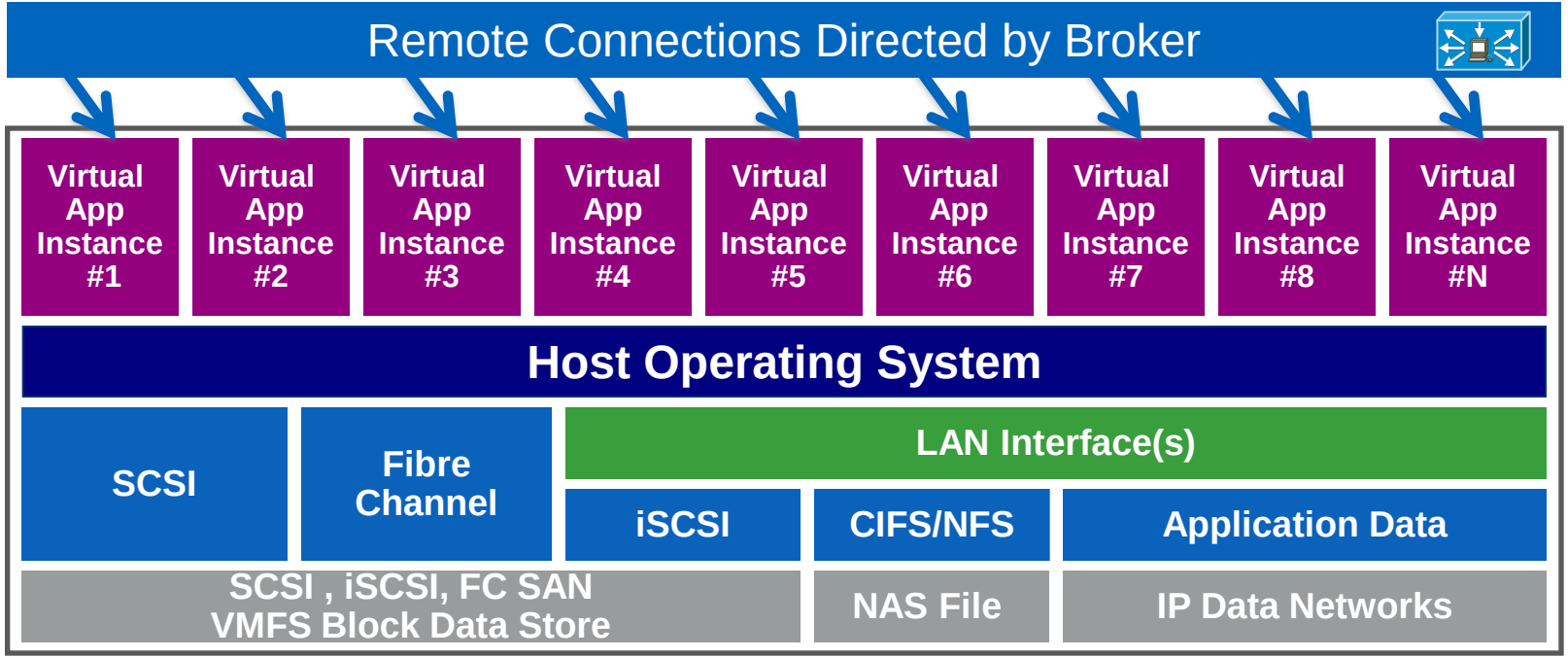
Software
Example Direct Mode Broker Exchange

```
<broker ve
 <id>CN=dc
 <name>dc1
 <type>sti
 <state>di
 <session-
id>COMPANY
@cn=XXXX,o
 <reset-al
 <reset-al
 <user-pre
 <preferen
 <preferen
 <preferen
 <preferen
 <preferen
 </user-pr
</broker>
```

```
<?xml version="1.0"?>
<broker version="3.0">
 <desktop-connection>
 <result>ok</result>
 <id>CN=dc1-p,OU=Applications,DC=vdi,DC=vmware,DC=int</id>
 <address>10.87.121.28</address>
 <port>3389</port>
 <additional-listeners>
 <additional-listener name="MMR">10.87.121.28:9427</additional-listener>
 </additional-listeners>
 <protocol>RDP</protocol>
 <user-name>jifrench</user-name>
 <password>YzZmNGFlMTMt</password>
 <domain-name>COMPANY</domain-name>
 <enable-usb>true</enable-usb>
 <enable-mmr>true</enable-mmr>
 </desktop-connection>
</broker>
```



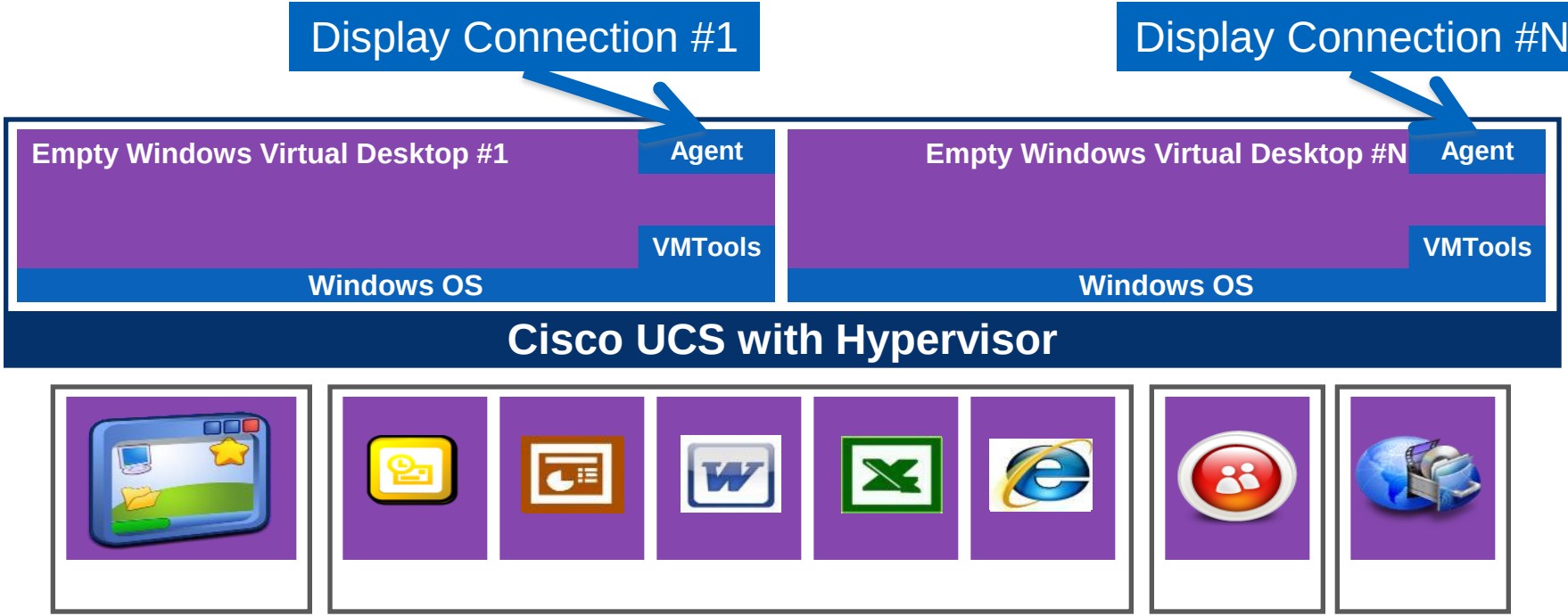
XenApp Model
Application Virtualisation (Terminal Services)



- No device or kernel drivers
- No Windows services
- No Windows class names or window name
- Installers cannot require a restart during install
- Support shared IP addresses
- No Inter-Process Communications
- No Distributed Component Object Model (DCOM)
- Registry/App Objects must link to USER32.DLL

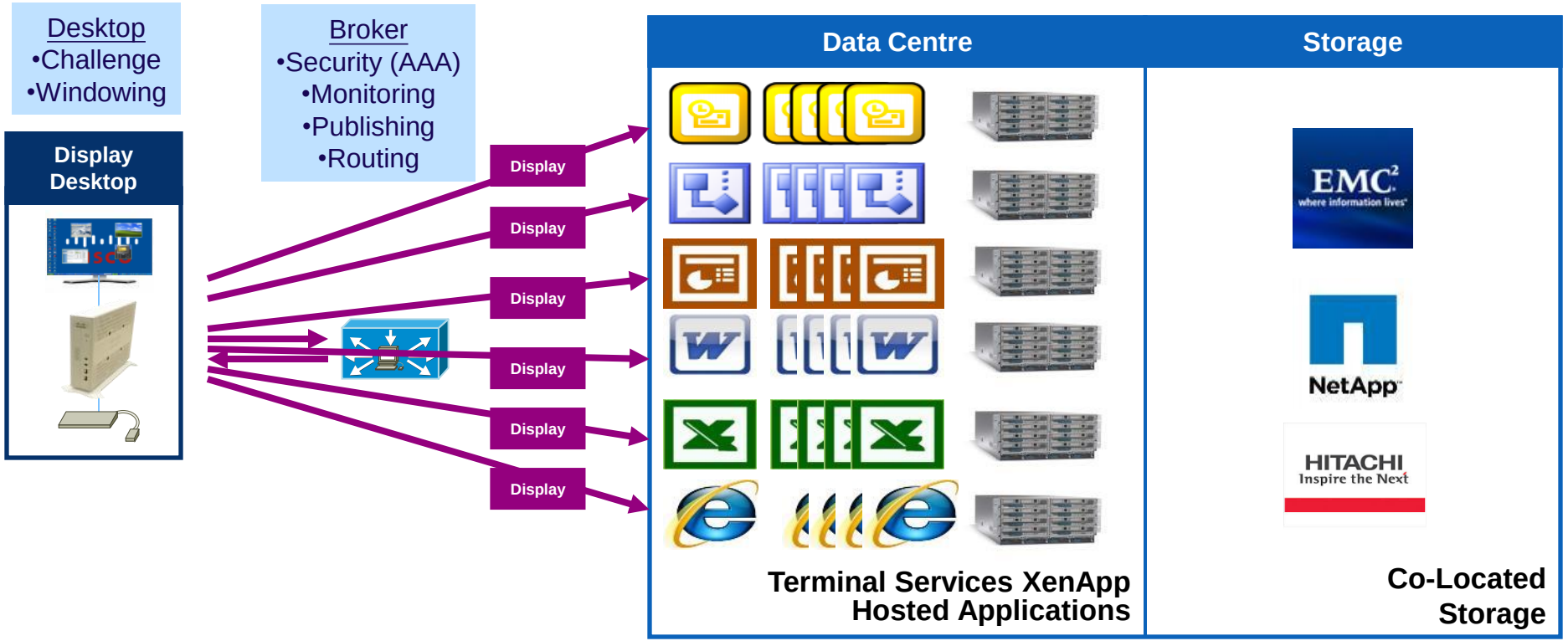
Stateful Desktop

Hosted Desktop with Streamed Virtual Application



- Profile decoupled from desktop OS using tools like AppSense
- Desktop provisioned with minimal or fixed set of applications installed
- Applications reside on File (VMware) or Streaming Server (Citrix)
- Administrator manages one master copy of an application that is streamed at run time

Software
Published Desktop

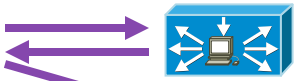


Software
MultiUser Hosted Shared Desktop (HSD)

Desktop
- Challenge
- Windowing

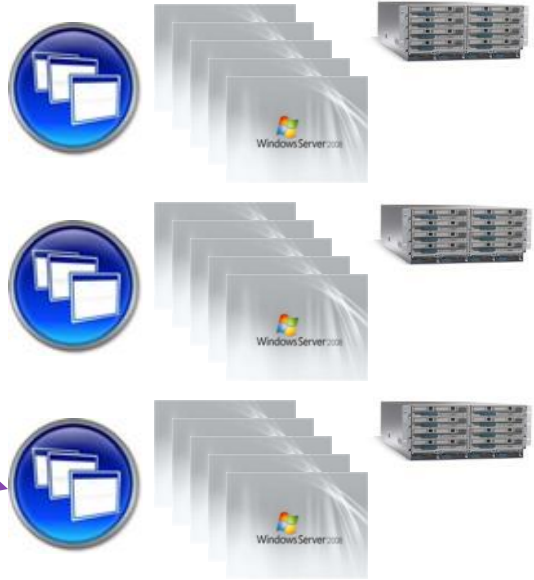
Broker
- Security (AAA)
- Monitoring
- Publishing
- Routing

Display Desktop



Display

Data Centre



Windows 2008 R2 Desktop Experience

Storage

EMC² where information lives

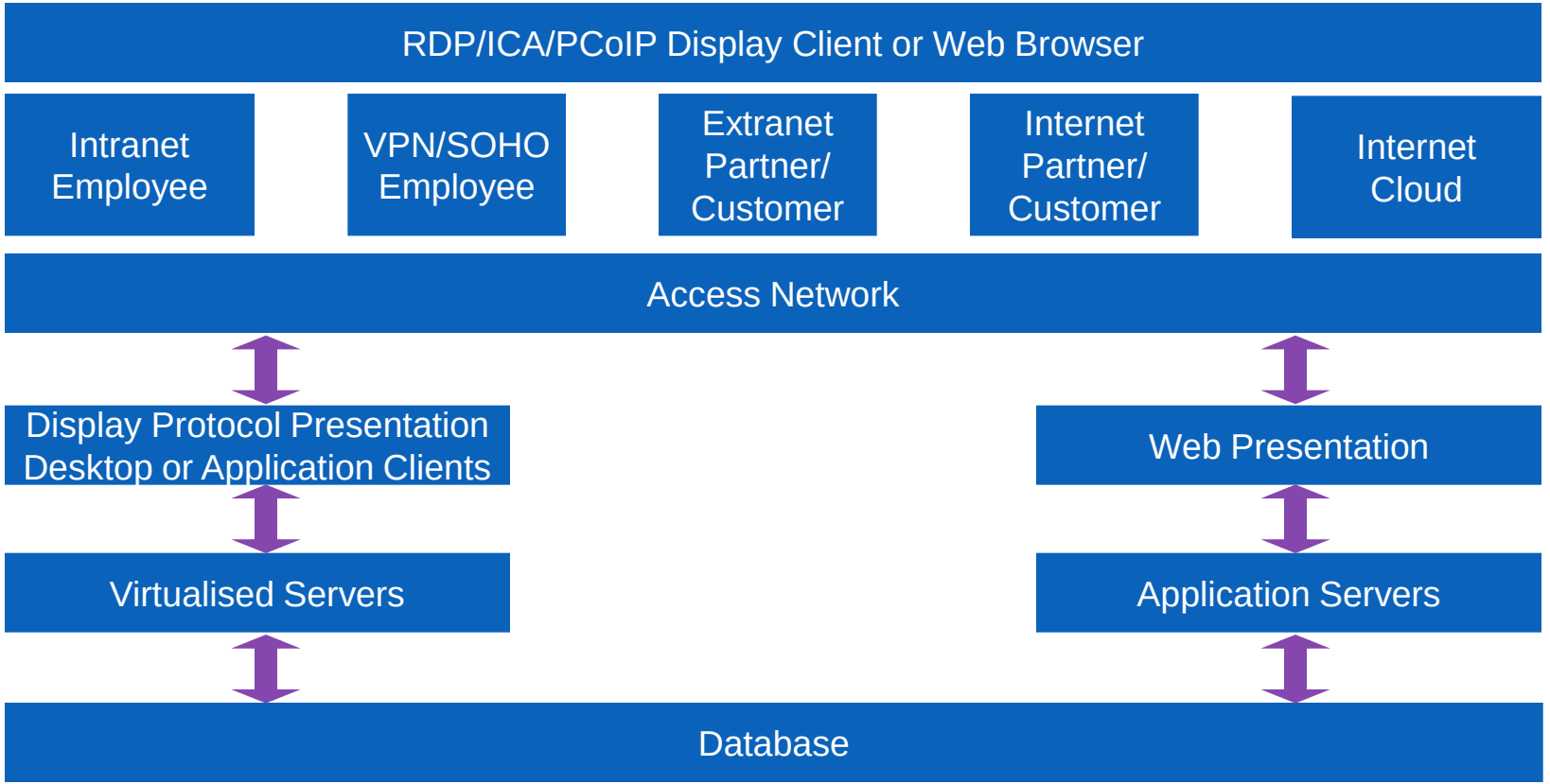
NetApp

HITACHI Inspire the Next

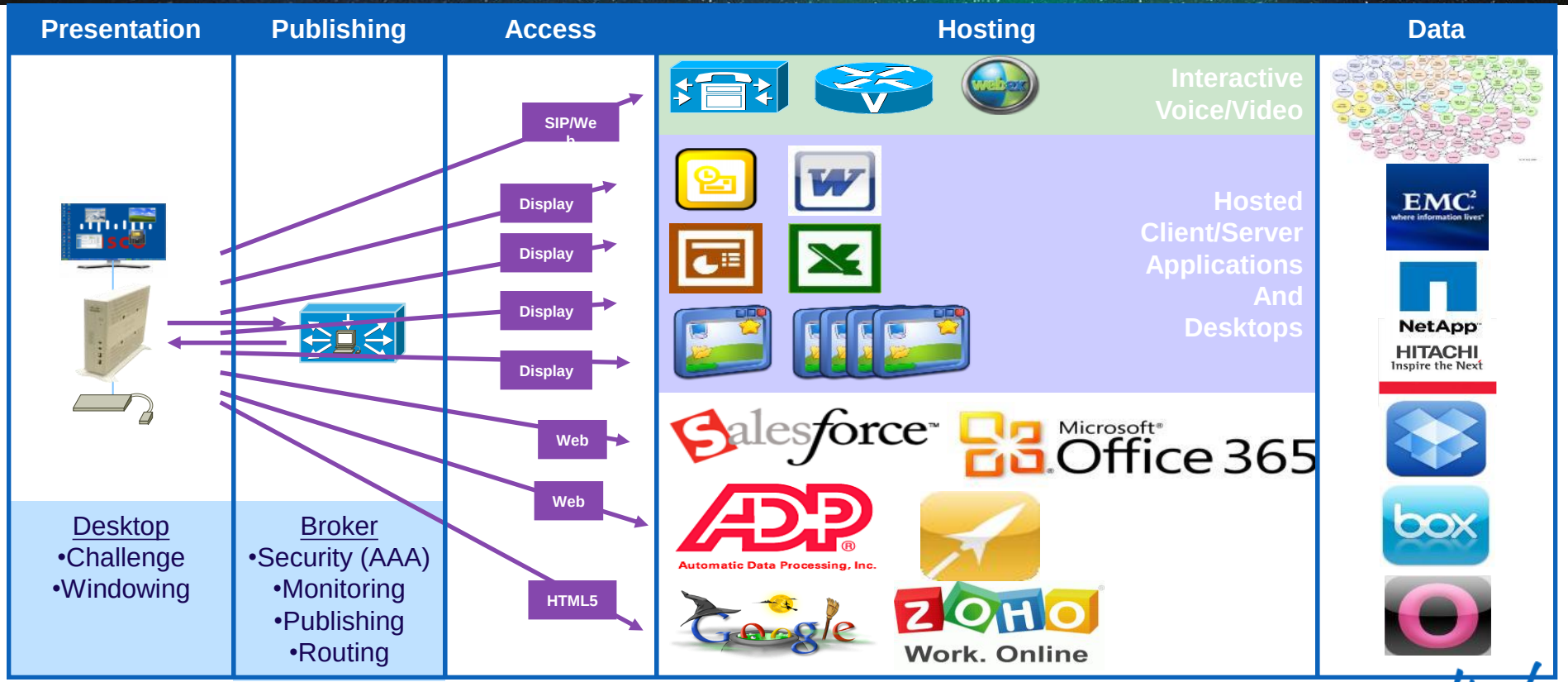
Co-Located Storage

Cisco live!

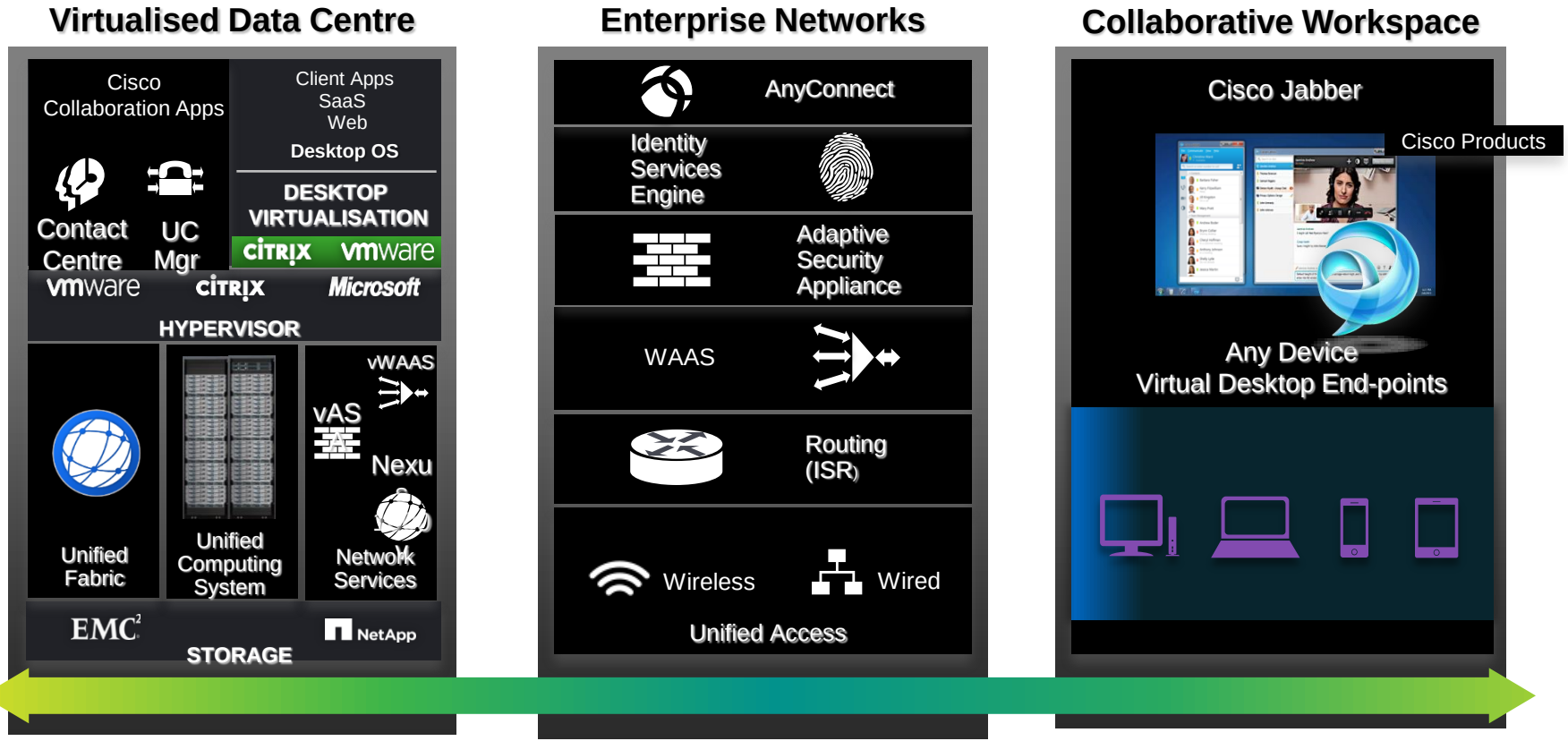
Software
Display versus Web Application Presentation



Software
Presentation Desktop



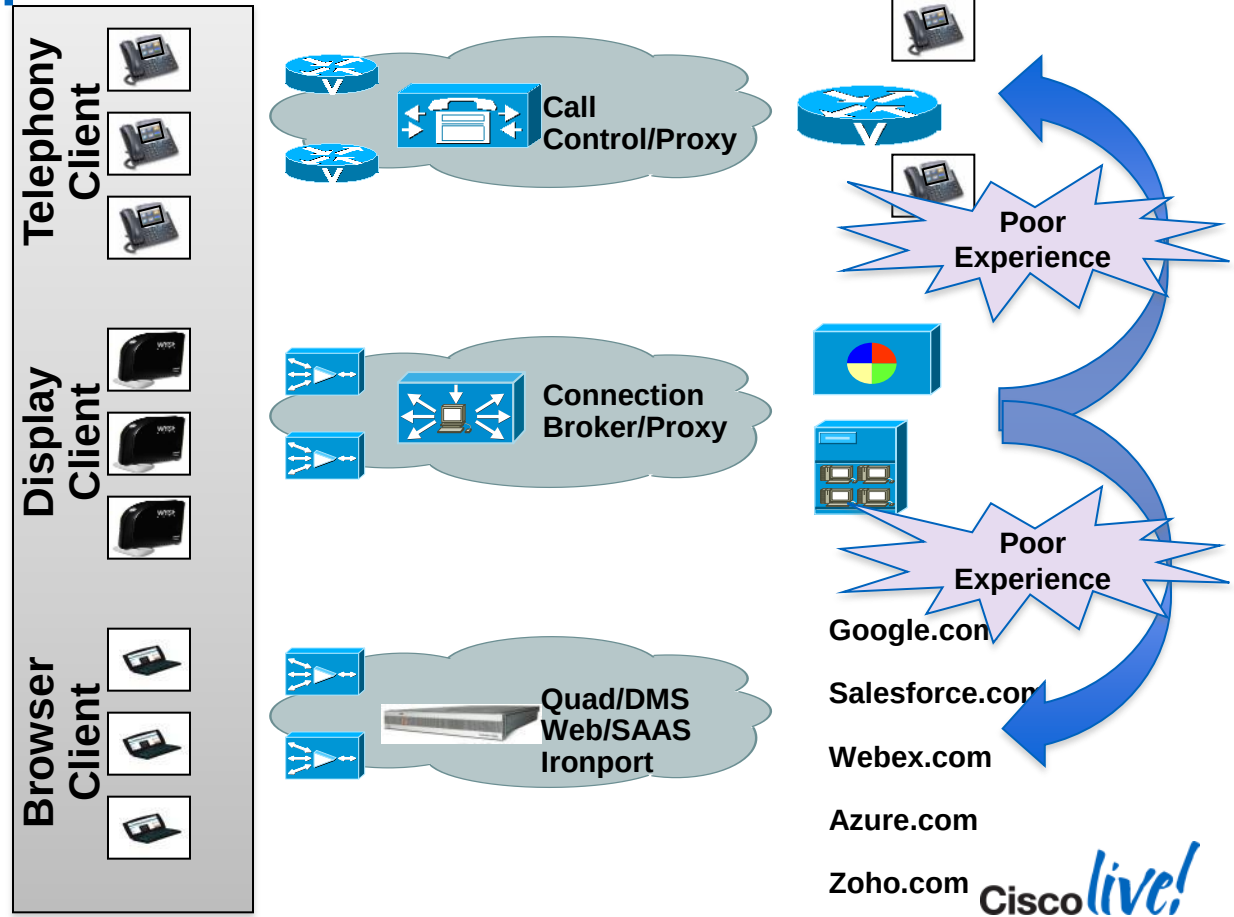
Cisco Virtual Workspace Smart Solution



Collaboration – A Use Case for Problem Proofs

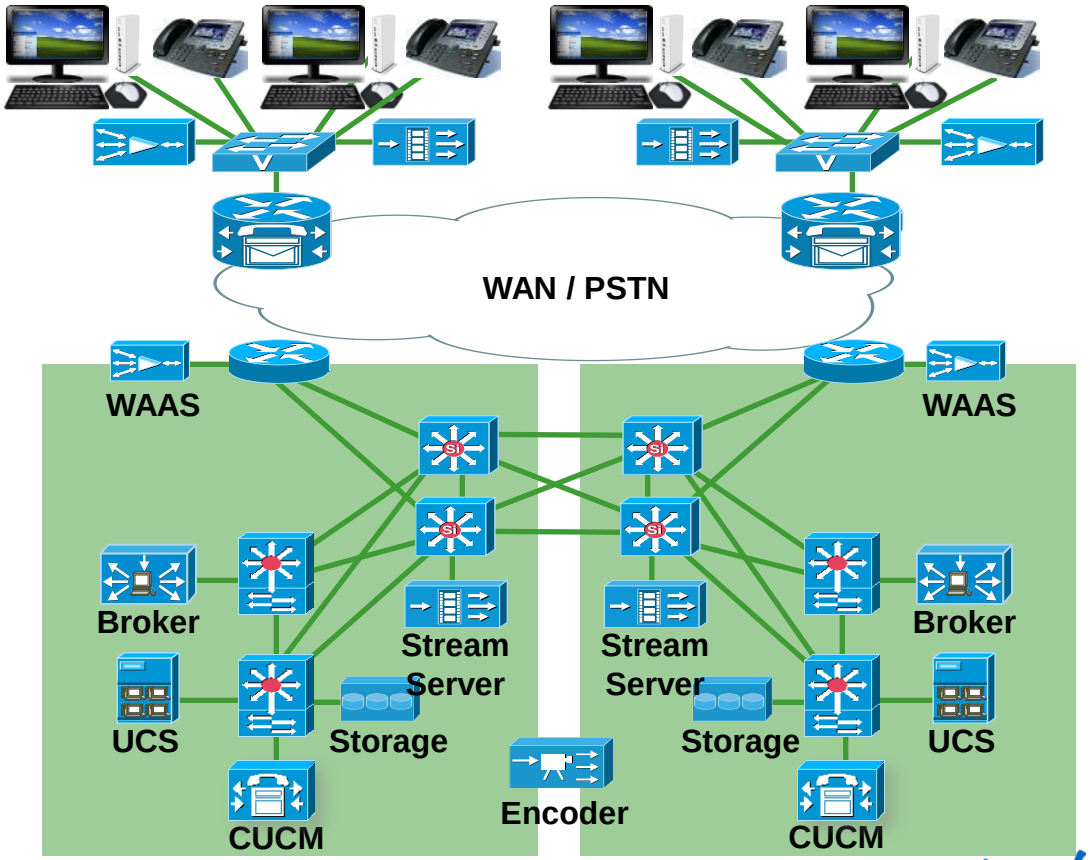
Collaboration
Forms of Hosted Applications

- Communications
  - Peer to peer
  - Real time experience
  - Call Admission Control
- Client/Server
  - Client to server
  - Mix of real time and bulk transfer
  - Allow all
- Web/Streaming/SAAS
  - Client to server
  - Network tolerant
  - Mostly bulk transfer



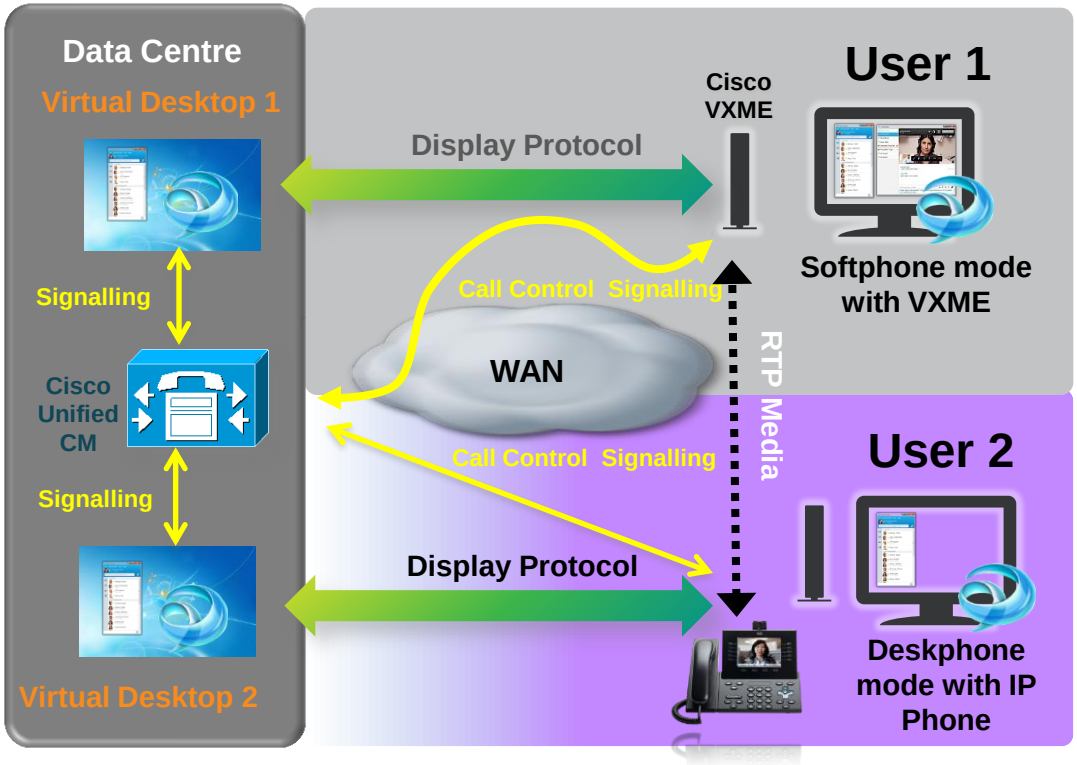
Collaboration
History of Network Services

- Unified Communications
  - Virtual Experience Client (VXC) – Zero Client
  - Cisco IP Hard Phone
  - Branch Call Control, Voice Gateway, and Voice Mail
- Enterprise Networks
  - Wireless
  - Wide Area Application Services (WAAS) for better performance and user density
  - Content Delivery System (CDS) for streaming video caching, splitting, and branch multicast
- Data Centre
  - Unified Compute System (UCS)
  - Centralised Call Control with Cisco Unified Communication Manager (CUCM) on UCS
  - Digital Media System (DMS)
- Partners
  - Broker
  - Storage



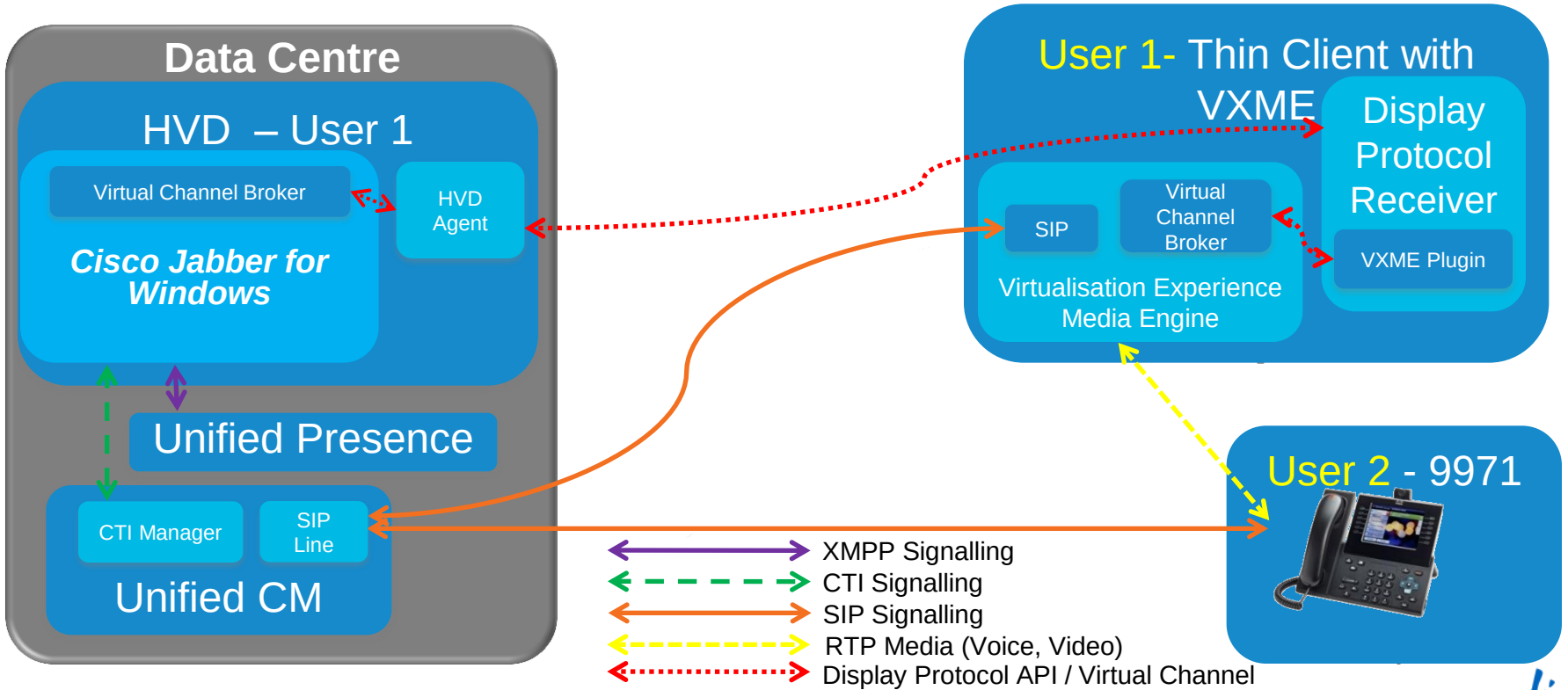
Collaboration

Cisco Jabber Two Deployment Modes for Voice/Video



- Cisco Jabber Windows on remote virtual desktop
  - Citrix XenDesktop, XenApp (published desktop) and Vmware View
- Softphone mode with VXME
  - UC voice/video offloaded to VXME on local thin client
  - Voice/video overlaid on remote virtual desktop for integrated experience
- Deskphone control mode (CTI) of Cisco IP Phone
  - UC voice/video offloaded to Cisco IP Phone
  - Voice/video displayed on Cisco IP Phone

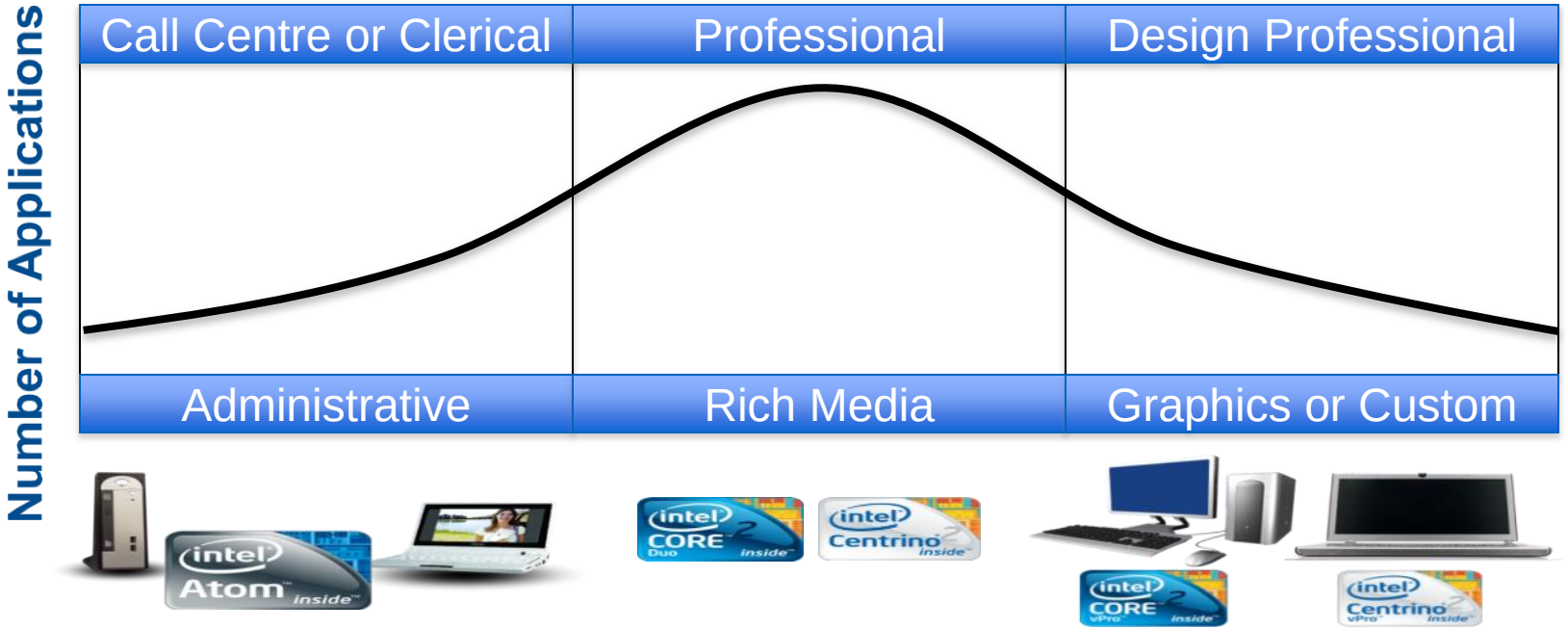
Collaboration
Virtualisation Experience Media Engine Interaction



Collaboration
Software Strategy for Virtual Environments

- Virtualisation Experience Media Engine (VXME)
  - Software that enables Jabber to run in virtualised environments
- Thin client and Windows PC
  - Dell Wyse Z50 with Linux VXME
  - Windows thin clients and PCs
- Enable the Jabber experience running on virtual desktop as available today on your PC
  - Presence & IM
  - High definition video & wideband audio
  - Conferencing

Collaboration
What Do End Users Need?



Collaboration
Client Strategy Depends On Hosted Applications

	User	Hardware	OS	Software	Execution	Storage	Security	Life (Yrs)
Zero	Task	Chip	Firmware	None	All remote	None	Low risk	7-10
Thin	Task/Knowledge	Limited	Hardened	Display	All remote	None	Low risk	5-7
Hybrid	Knowledge	Capable (possible media offload)	Hardened General (Linux or Windows Embedded)	Display Rich Media Web	Client/Server remote Rich media local	Transient Encrypted	Medium risk	5-7
Thick	Knowledge or Power	High End	Open General (Windows, Linux, Mac)	Unlimited	Mostly local Some remote	Persistent	High risk	3-5

1. Status-quo - Use whatever desktop/notebook/etc you already have
2. Recycle PC - Convert old PC hardware to a “homebrew” thin-client
3. New PC - buy new desktop/notebook hardware with HVD and application virtualisation rollout
4. New thin/zero clients

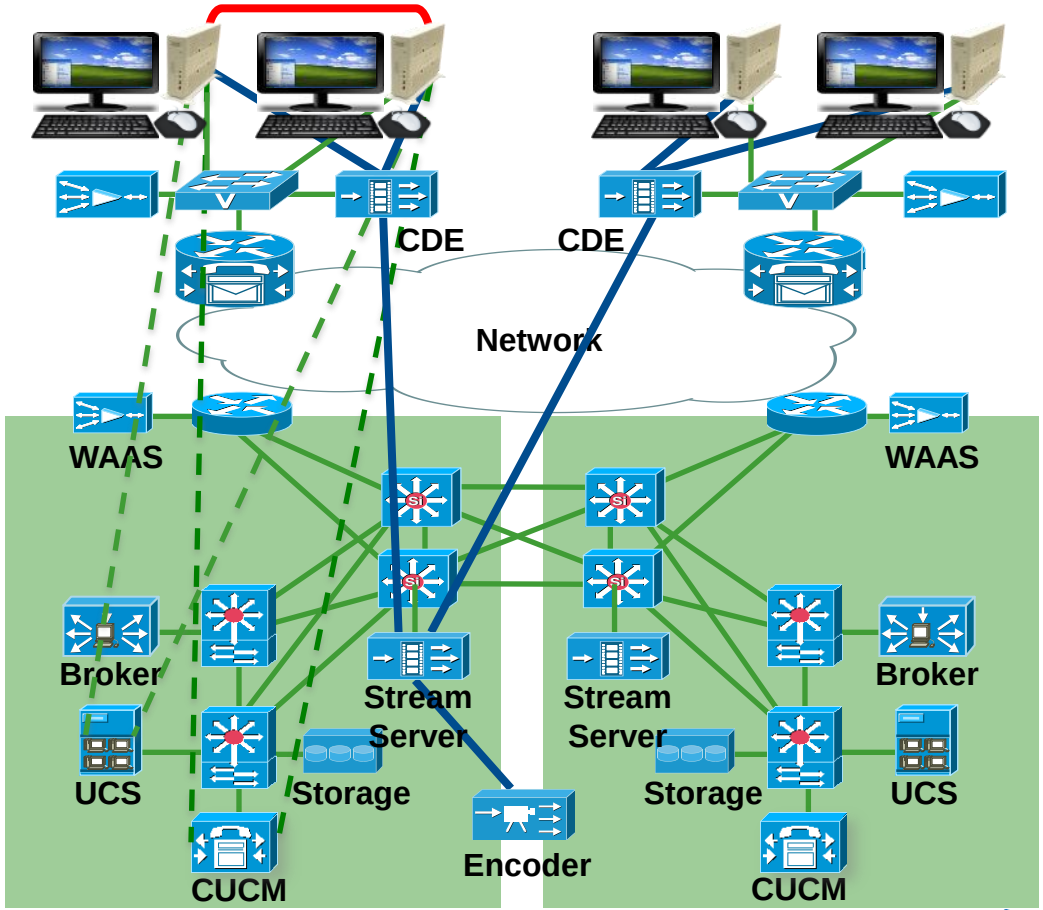
Collaboration

Cisco DX650 Android Based Desk Phone

VDI (Virtual Desktop Interface) allows users to access their remote virtualised desktops, apps, and docs from a DX650 device using client apps running on DX650

Traditional Network Services Work For All Clients

- Unified Communications
  - Softphone in VXI runs native locally
  - Supports Survivable Remote Site Telephony (SRST) supported
  - Use local services (gateways, call control, vmail, etc.)
  - No voice hairpinning
- Enterprise Networks
  - Use local internet access
  - Use CDS/ACNS/WAAS to cache, split, and/or multicast streaming media
  - Provide QoS for rich media
- Data Centre
  - Offload server CPU
  - Offload server bandwidth



Enterprise Networks – The Meat in the Sandwich (Borderless Networks)

Enterprise Networks

Universal Power Over Ethernet (uPoE) – 60 Watts

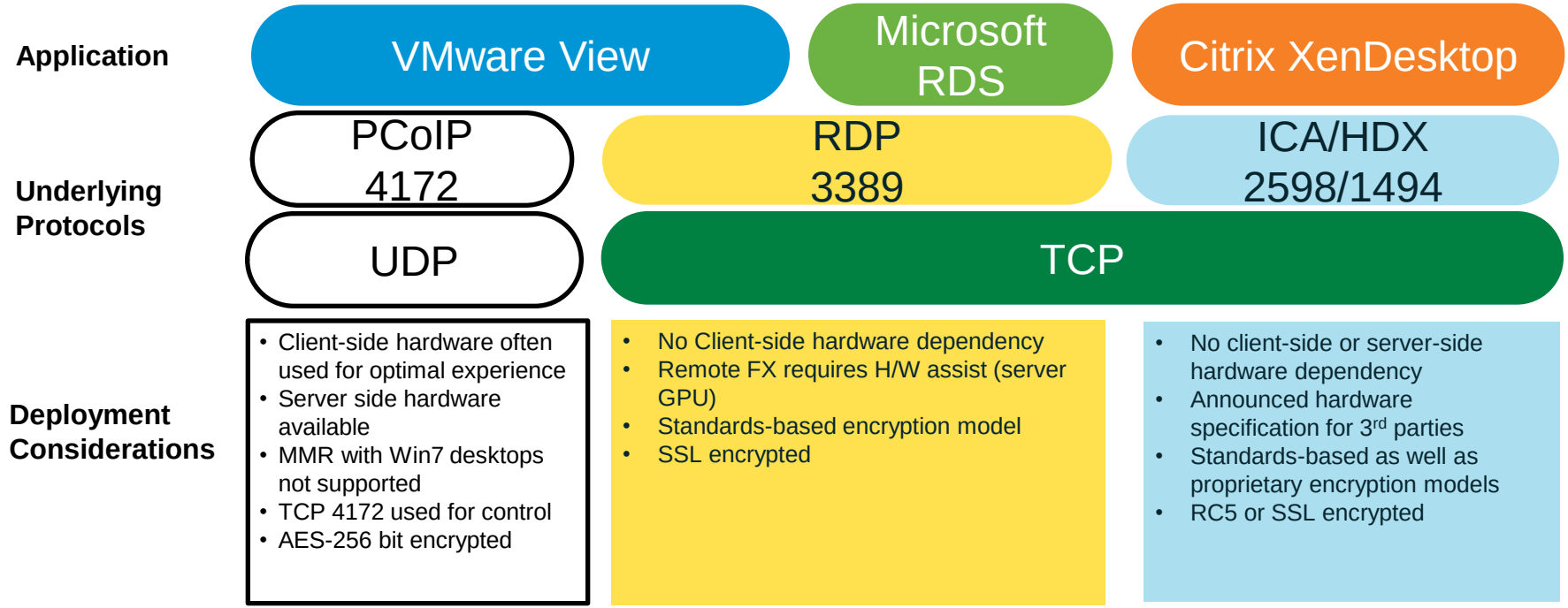
Global Common Power Cable

Country Specific Wall Plugs with UPS

Catalyst 4500

- OPEX
  - High efficiency bulk power supplies are more efficient than power cubes
  - Power regulation using EnergyWise
  - Increase business productivity through reduced downtime
- CAPEX
  - Lower cost devices without power bricks
  - Building construction savings
  - Minimal power routing
  - Lower maintenance for power cables

Enterprise Networks
Decoding the VDI Protocol Stack



Enterprise Networks
Display Protocol Considerations Checklist

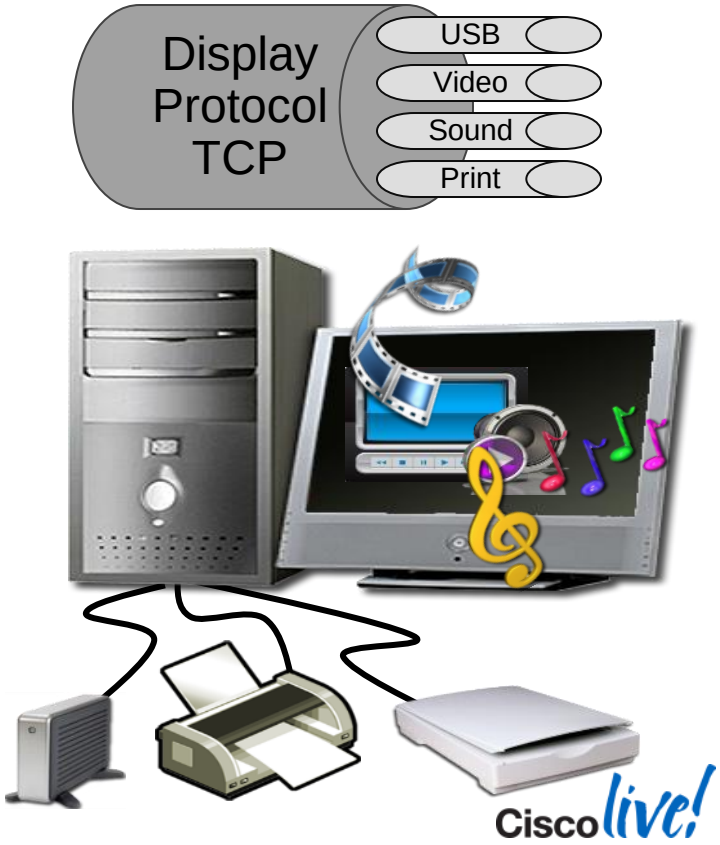
- Network
  - Transport – TCP, UDP, RTP
  - Behaviour - bandwidth, congestion, latency, drop
- Channels
  - Inband
  - Out of band
- Acceleration
  - Encryption
  - Compression
- USB
  - Headset
  - Print
  - Drive
  - Security
- Voice
  - USB headset
  - Analog microphone/speaker
- Graphics/Video
  - Quality– Lossy or lossless
  - Streaming - Windows Media, Adobe Flash, QuickTime, or SilverLight
  - Telephony – Jabber, Skype, Lync, Google, etc.
- Print
  - Print server
  - Printer location
  - User mobility

Enterprise Networks
Display Protocol Summary

Protocol	Vendor	Transport	Bandwidth without WAAS (Approx)	Bandwidth with WAAS (Approx)
Remote Desktop Protocol (RDP)	Microsoft	TCP 3389	384 Kbps	96 Kbps
Independent Computing Architecture (ICA)	Citrix	TCP 2598 CGP TCP 1494 ICA	120 Kbps	60 Kbps
PC over IP (PCoIP)	Teradici / VMware	Media – UDP 50002/4172 Control – TCP 50002/4172	192 Kbps	192 Kbps

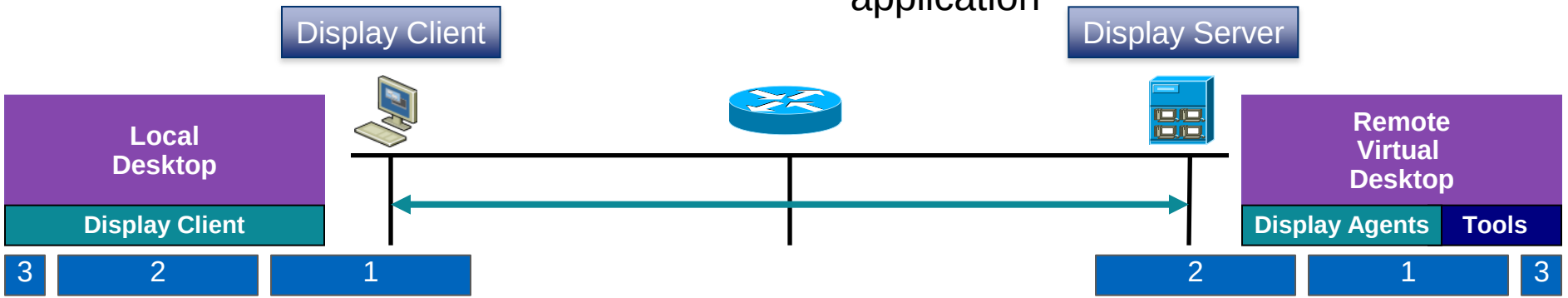
Enterprise Networks
Display Protocol Channels

- Display protocols operate at the session layer
- Display protocols were intended to remote applications and not desktops
- Desktop interactions require that some local client services be extended to the remote virtual desktop
- Channels provide a means to extend remote virtual desktop services
- Traditional channels cannot leverage network services like QoS, security, media bridging, stream splitting, or multicast



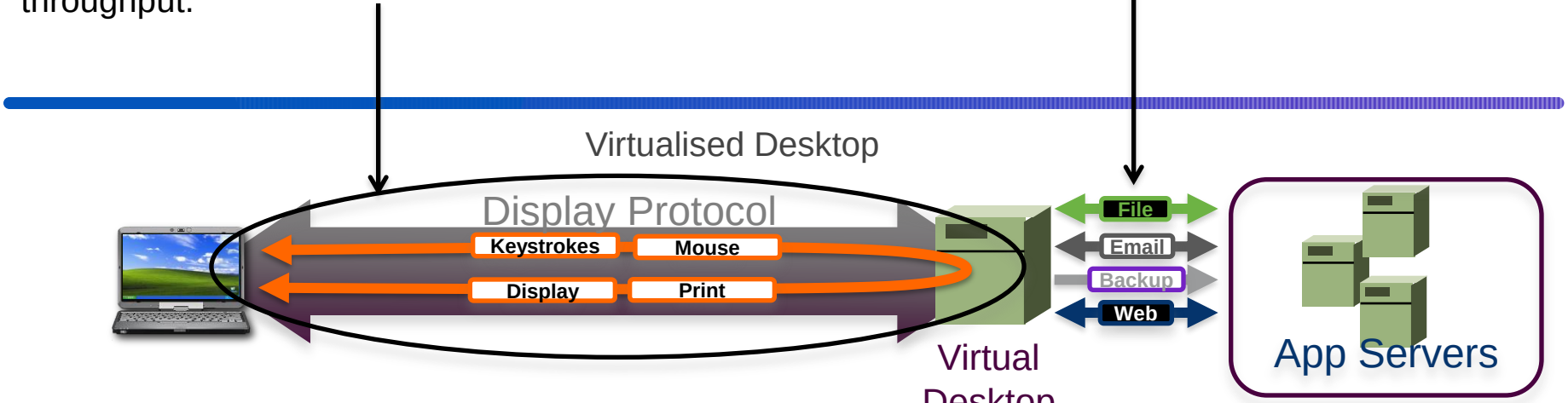
Enterprise Networks
Fundamental Problems with In-Band Channels

- Mixing interactive and bulk transfer traffic types in a single TCP connection
  - Client copies file from local USB with packets #1 and #2
  - Client clicks with packet #3
- If network could provide better service to packet #3, it would reach host before #1 and #2
- Destination host TCP stack will wait for the rest of the TCP window to send to the application



Enterprise Network
VDI User to Application Interactions

- The entire client display with all user interactions such as mouse movements and keystrokes is sent over the network. This requires not only bandwidth efficiency but fast throughput.
- With VDI, the same applications now transfer data between the Citrix server and the origin application server.

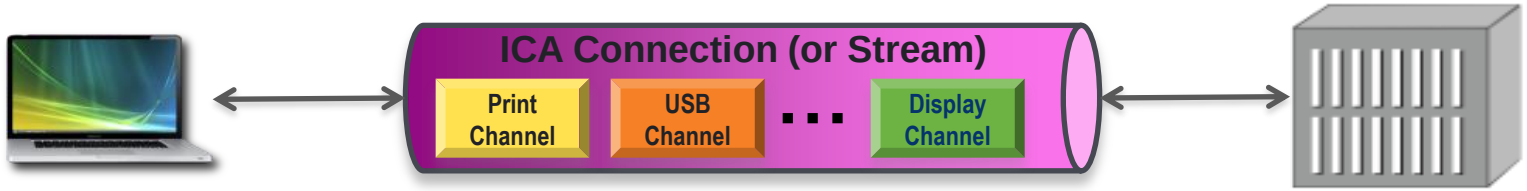


- **Increased WAN BW per user**
- **Keystrokes go across the WAN**
- **Limitations on local services (i.e. print)**

+ **Centralised Applications**
+ **Centralised Desktop Image Administration**

Enterprise Network
Citrix ICA Enhances VDI

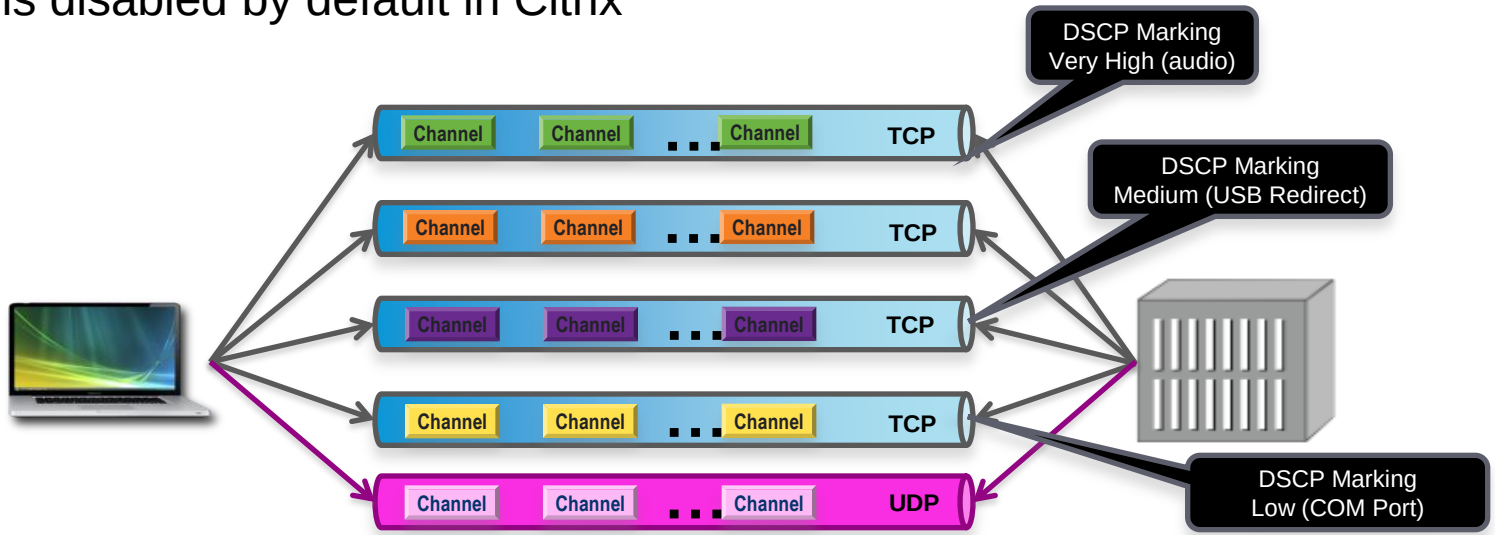
- Wide Area Application Services (WAAS) optimises all channels within the ICA stream



- Single TCP connection (Stream) per ICA Client
- Citrix Proprietary Encryption
- All ICA virtual channels inside the single stream
- Network based QoS cannot be applied to individual ICA virtual channels

Enterprise Network
Multi-stream ICA (MSI) Splits a User into 5 Streams

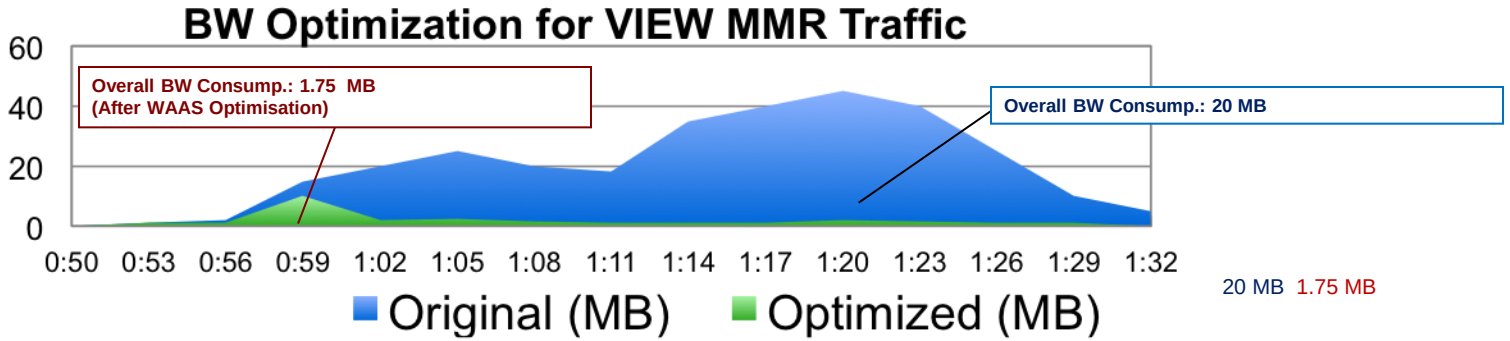
- MSI is disabled by default in Citrix



- Enabling Multi-Stream ICA on WAAS automatically enables it through Citrix.
- WAAS automatically discovers/optimises channels which use separate TCP connections.
- WAAS can dynamically apply DSCP markings to match Citrix priorities.

Enterprise Networks
WAAS Reduces MMR Bandwidth up to 99%

- Rich Media Streaming w/ MMR (Direct Connect)



20 MB 1.75 MB

PCoIP Session

RDP Session

	Source IP:Port	Dest IP:Port	Peer Id	Applied Policy	Open Duration	Org Bytes	Opt Bytes	% Comp	Classifier Name
	10.10.3.111:1719	10.10.1.53:32111	Core-WAE		0:4:9	6.376 KB	3.167 KB	50%	USBRedirect
	10.10.3.111:1721	10.10.1.53:9427	Core-WAE		0:2:27	4.7251 MB	52.3486 KB	99%	MMR
	10.10.3.110:1296	10.10.1.54:32111	Core-WAE		0:0:59	6.2959 KB	2.8584 KB	55%	USBRedirect
	10.10.3.110:1299	10.10.1.54:9427	Core-WAE		0:0:3	1.3522 MB	18.376 KB	99%	MMR

Solutions Setup

2 Concurrent View Clients
Display Protocol: RDP and PCoIP
View Deployment Mode: Direct Connection
BW/Latency: T1/80 ms
Play Time: 5-6 Minutes of Repeat Tracks

Audio: Format: MP3
Bitrate/Size: 192 Kbps/8.3 MB
Video: Format: WMV v.9
Bitrate: 1527 Kbps and 1772 Kbps
Size: 18.8 MB and 62.4 MB

WAAS Applied Policies: TFO, DRE, LZ
WAAS Classification Map:
- MMR – TCP Port 9427
- USB – TCP Port 32111
Overall Compression: 79.8%

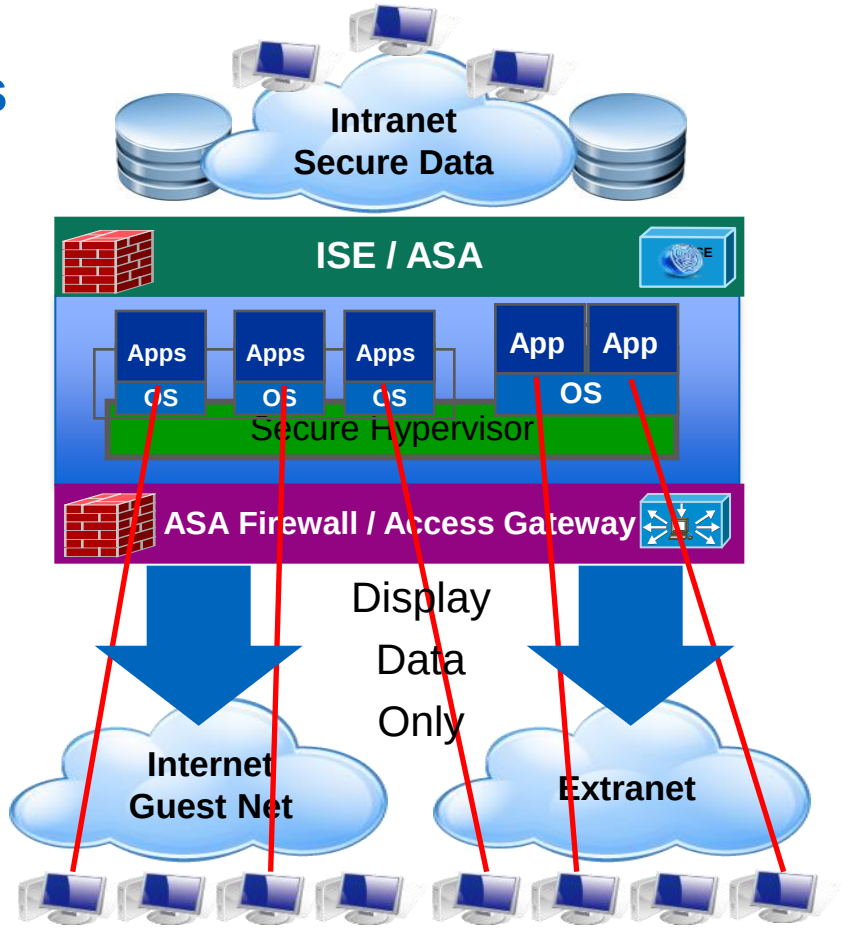
Enterprise Networks
Bring Your Own Device (BYOD)

Use Case Requirements			Design Requirements		
Telephony	**Client/Server**	**Local Apps/Data**	**VDI**	**VPN**	**MDM**
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	No	Yes	No	No
Yes	No	Yes	No	Yes	Yes
No	Yes	Yes	Yes	Yes	Yes
No	No	Yes	No	Yes	Yes
No	Yes	No	Yes	No	No

- BYOD or Not – Who cares who bought it?
  - Company buys
  - Employee buys
  - Gift if you're lucky…
- VDI or Not
  - Offers access to legacy hosted client/server apps
  - Allow display only access to client/server with no local data
  - VPN generally not required
- Mobile Device Management (MDM) or Not
  - Often coupled with local device apps/data and VPN
- VPN or Not
  - Often used with local device apps/data beyond mobile mail and display client
- Cisco Communications or Not
  - Local communications software commonly using VPN (future embedded VPN)

Enterprise Networks
VDI Firewalls For Remote Access

- Non-Persistent desktops
- No direct network to network VPN
- Reduce data leakage risk
- Control access of consultants, contractors, developers, extranets connections, BYOD users, etc.
- ASA provides access gateway
- Identity Services Engine (ISE) provides user based access control policies
- ISE may also provide access client user identity, location, and device access controls

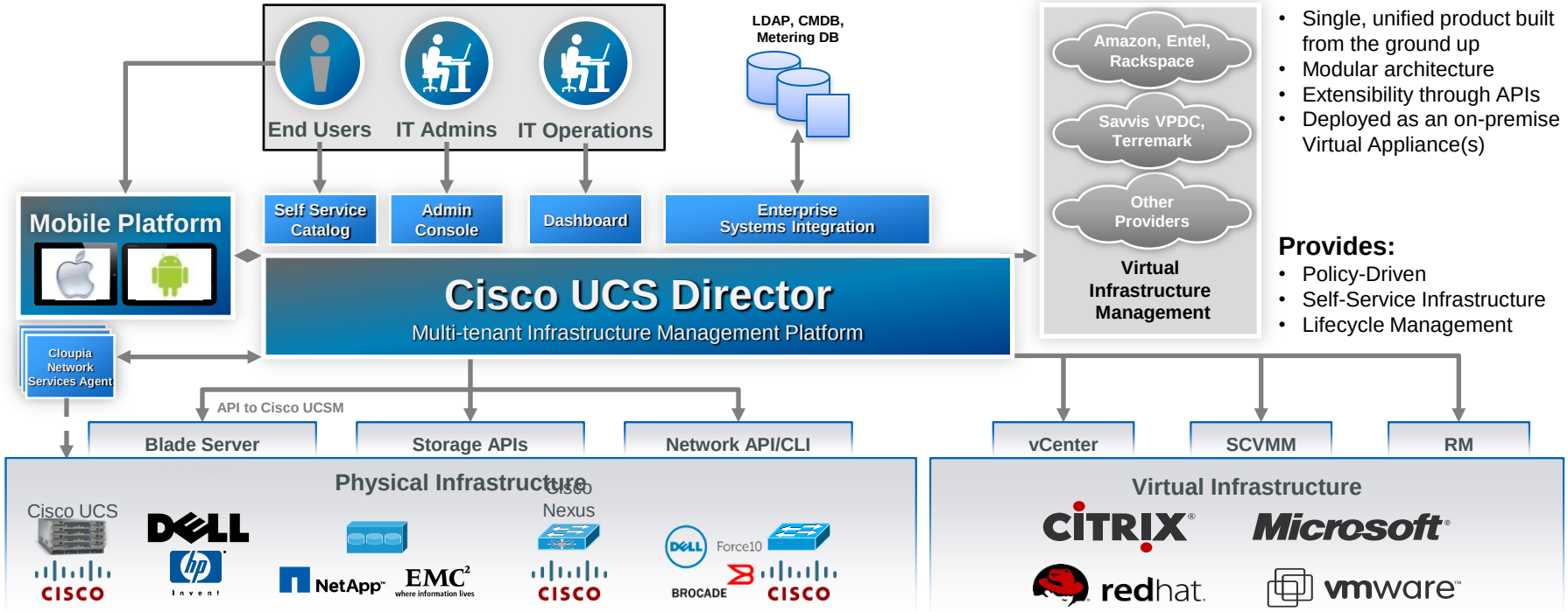


Data Centre - Compute Considerations

Data Centre
Considerations

- Compute
  - Scale
  - Cost
  - Performance
  - Power/Cooling
  - Space
  - Cabling
- Storage Scale
  - Scale capacity (Linked and Flex Clones)
  - Scale IOPS
- Client Network Services
  - Security
  - Monitoring
  - IP address management
- Automation/Orchestration
  - Inter DC
  - Intra DC
  - InterCloud
  - Policy development
  - Enforcement/Error reduction
  - Profiles

Data Centre
UCS Director



- Single, unified product built from the ground up
- Modular architecture
- Extensibility through APIs
- Deployed as an on-premise Virtual Appliance(s)

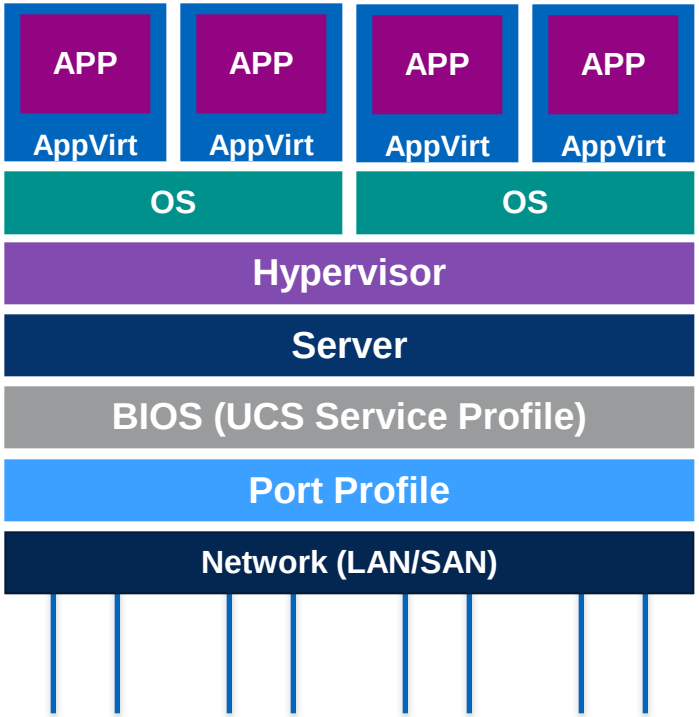
Provides:

- Policy-Driven
- Self-Service Infrastructure
- Lifecycle Management

UCS Director Provides Unified, Centralised Management of Physical and Virtualisation Infrastructure in Private and Hybrid Clouds

Data Centre - Compute
Statelessness For Automation & Efficiency

- Application virtualisation decouples application from OS (i.e. ThinApp, AppV, Provisioning Server, etc.)
- Hypervisor decouples OS from compute hardware
- UCS Service Profile decouple server from BIOS
- Nexus Port Profile decouples cabling from server



Data Centre - Compute
UCS Blade Servers

FOR REFERENCE

	B22 M3	B200 M3	B230 M2	B420 M3	B440 M2	B260 M4	B460 M4
Processors	2	2	2	4	4	2	4
CPU	E5-2400	E5-2600 /v2	E7-2800 / 8800	E5-4600	E7-4800 / 8800	E7 v2	E7 v2
Cores	16	16	20	32	40	30	60
Max RAM	384GB (12 DIMMs)	768GB (24 DIMMs)	512GB (32 DIMMs)	1.5TB (48 DIMMs)	1TB (32 DIMMs)	3TB (48 DIMMs)	6TB (96 DIMMs)
Disk	2 x 2.5” (2TB)	2 x 2.5” (2TB)	2 SSD (600GB)	4 x 2.5” (4TB)	4 x 2.5” (3.6TB)	2 x 2.5” (2TB)	4 x 2.5” (4TB)
Raid	0/1	0/1	0/1	0/1/5/10	0/1/5/10	0/1	0/1
Max I/O	80Gbps	80Gbps	20Gps	160Gbps	40Gbps	160Gbps	320Gbps
Mezzanine	2	2	1	3*	2	2	4

* Using port expander technology VIC1240/1240/1280 combination

Data Centre - Compute
UCS Rack Servers

FOR REFERENCE

	C22 M3	C24 M3	C220 M3	C420 M3	C260 M2	C460 M2
Processors	2	2	2	4	2	4
CPU	E5-2400 /v2	E5-2400 /v2	E5-2600 v2	E5-4600	E7-2800	E7-4800
Cores	16	16	16	32	20	40
Max RAM	384GB (12 DIMMs)	384GB (12 DIMMs)	512GB (16 DIMMs)	1.5TB (48 DIMMs)	1TB (64 DIMMs)	2TB (64 DIMMs)
Disk*	8xSFF/4xLFF	24xSFF/12xLFF	8xSFF/4xLFF	16xSFF	16xSFF	12xSFF
I/O	2 x 1Gb + 10Gbps Unified fabric option	2 x 1Gb + 10Gbps Unified fabric option	2 x 1Gb + 10Gbps Unified fabric option	4 x 1Gb + 10Gbps Unified fabric option	2 GE (LOM)** ports Two 10 Gbps ports	2 GE (LOM)** ports Two 10 Gbps ports

* RAID optional - 0, 1, 5, 6, 10, 50, 60

** LOM = LAN on motherboard

Data Centre
UCS Virtual Desktop Densities

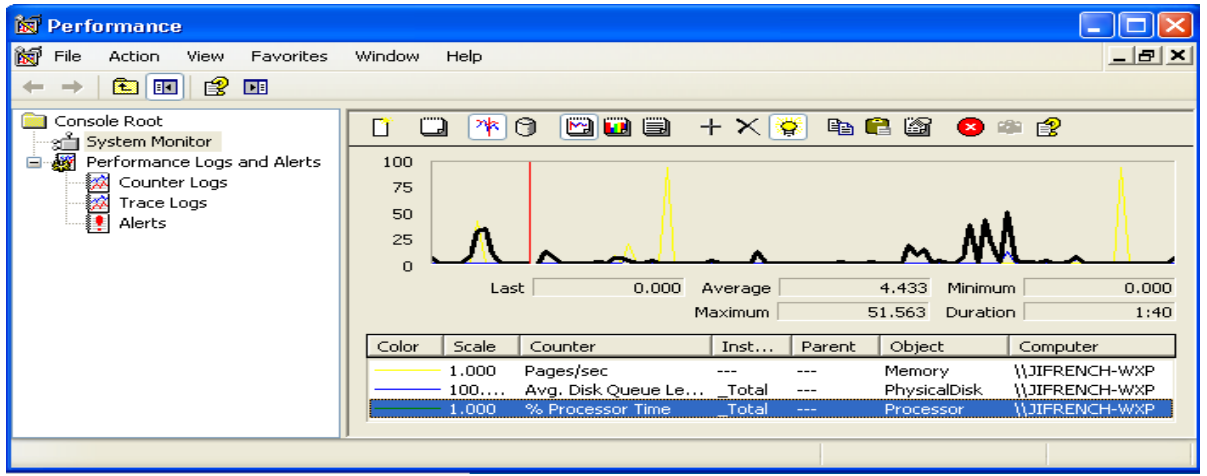
Blade	Server CPU	Server Memory	Desktop Configuration	Per Blade	Per Chassis	Per Domain 20 Chassis
B200-M1	Xeon5570 2.93 GHz	48 GB	WinXP 512 MB	128	1,024	20,480
B200-M1	Xeon5570 2.93 GHz	96 GB	WinXP 512 MB	160	1,280	25,600
B200-M1	Xeon5570 2.93 GHz	192 GB	WinXP 1024 MB	150	1,200	24,000
B250-M1	Xeon5570 2.93 GHz	384 GB	WinXP 1024 MB	332	1,328	26,560
B250-M2	Xeon5600 3.33 GHz	192 GB	Win7-32 1.5 GB	110	440	8,800
B230-M2	Xeon2870 2.40 GHz	512 GB	Win7-64 2.0 GB	175	1,400	28,000
B200-M3	Dual E5-2690 / 8 Core	384 GB	Win7-64 2.0 GB	184	1,472	29,440
B240-M3	Dual E5-2690 / 8 Core	384 GB	Win7-64 2.0 GB	186	1,488	29,760

Hosted Virtual Desktop model

Data Centre
CPU Considerations for Virtual Machine

- CPU class
  - CPU class is affected by number of cores, CPU clock speed, amount of cache memory and CPU virtualisation technology
- CPU core count
  - CPU core count affects virtual machine scalability and performance
- CPU over commitment
  - CPU over commitment occurs when the number of virtual CPUs assigned to the virtual machines exceeds the number of physical CPUs available to the host
- Virtual machine role priority
  - Virtual machine role priority determines how CPU resources are distributed across virtual machines

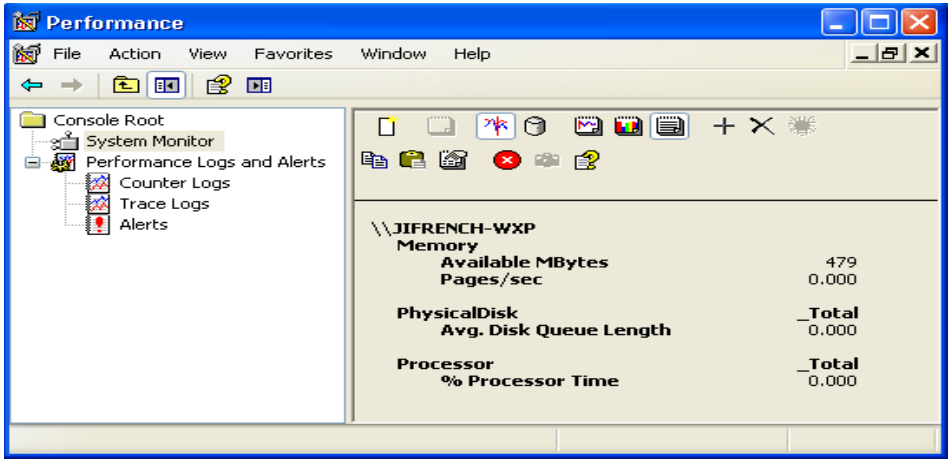
Data Centre - Compute
Example CPU Capacity Planning



- Win XP % Processor Time average 5% on 2 GHz core
- Requires 100 MHz per desktop (0.05 * 2 GHz)
- 100 desktops require 10 GHz processing (100 * 100 MHz)
- Add 10% to 25% overhead for virtualisation, display protocol, and buffer for spike
- 100 desktops achieved with 12.5 Ghz via 4 cores at >=3.125 GHz per core

- Planning
  - Windows XP 150-250 MHz
  - Windows 7 400-600 MHz

Data Centre - Compute
Example Memory Capacity Planning



- Vmware ESX Transparent Page Sharing to share master copy of memory pages among virtual machines
  - Windows XP - 4 KB page sharing
  - Windows 7 - 1 MB page sharing
- Planning Without Memory Oversubscription
  - Windows XP - 512-1024 MB
  - Windows 7-32 bit - 1-1.5 GB
  - Windows 7-64 bit - 2-3 GB

Data Centre - Compute
Forms of Hosted Desktops

Characteristic	Hosted Virtual	Hosted Shared	Published	Web
CPU Use	High	Medium	Low	Low
Memory Use	High	Medium	Low	Low
Storage IOPS	High	Medium	Low	Low
Personalisation	High	Medium	Low	Low
Cost	High	Medium	Low	Low

- Hosted Virtual Desktop (HVD) – One user per VM
- Hosted Shared Desktop (HSD) – Many users per VM
- Published Desktop – Many instances of one application per VM
- Web Desktop – Many clouds per user

Data Centre - Compute

GPU Requirement for VDI User Profile

DESIGNER

Graphics & Media Professionals, Design Engineers

CATIA, CS6, Inventor

POWER USER

Financial Analysts, Traders, Design Reviewers

PLM, Solidworks, Adobe Dreamweaver, Medical Imaging Showcase

KNOWLEDGE WORKER

Office workers, productivity & line-of-business workers

MS Office, Photoshop

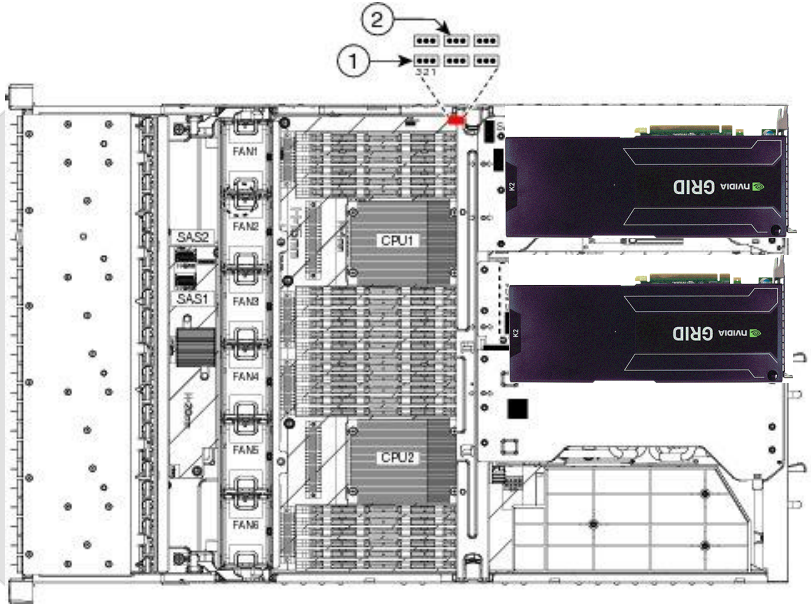
Data Centre - Compute
nVidia Graphics Processing Units (GPU)

	nVidia GRID K1 	nVidia GRID K2 
GPU	4 Kepler GPUs	2 High End Kepler GPUs
CUDA cores	768 (192 / GPU)	3072 (1536 / GPU)
Memory Size	16GB DDR3 (4GB / GPU)	8GB GDDR5
Max Power	130 W	225 W
Form Factor	Dual Slot ATX, 10.5”	Dual Slot ATX, 10.5”
Aux power requirement	6-pin connector	8-pin connector
PCIe	x16	x16
PCIe Generation	Gen3 (Gen2 compatible)	Gen3 (Gen2 compatible)
# users	4 - 100[1]	2 – 64[1]
Watts per user	~ 1.5 W	~ 3.5 W
OpenGL	4.x	4.x
Microsoft DirectX	11	11
VGX Hypervisor support	Yes	Yes

[1] Number of users depends on software solution, workload, and screen resolution

Compute
Cisco UCS C240 M3 GRID Card Support

Cisco VDI



- UCS C240 M3 Rack Server is 2U, 2-socket server
- Supports up to 186 Virtual Desktops*

Status	System	GRID K1			GRID K2		
		FCS	#	OEM Part #	FCS	#	OEM Part #
Available	Cisco UCS c240	Now	2	**74-12102-01**	Now	2	**74-12103-01**

Data Centre - Compute

C240 M3 Graphic Processing Unit (GPU) Support

- NVIDIA GVX K1
  - 4x Entry Level Kepler GPUs
  - 768 NVIDIA CUDA cores
  - 130W
  - 6pin aux power connector

- NVIDIA GVX K2
  - 2x High-end Kepler GPUs
  - 3072 NVIDIA CUDA cores
  - 225W
  - 8pin aux power connector

- C240 M3 Slot Support
  - Slot 2
  - Slot 5
- OS Support
  - XenServer 6.0.2, 6.1
  - Windows Server 2012
  - ESX 5.1 / VMWare View 5.2 (Q1'2013)
- Hypervisor Support
  - Citrix – Pass Through
  - Windows – Shared
  - VMware – Pass Through and Shared

Data Centre - Compute
GPUs in a Virtual Desktop

- GPU Pass-through
  - 1:1 dedicated GPU to user
  - Driver in VIRTUAL MACHINE
- GPU Sharing
  - Software virtualisation of the GPU or API Intercept
  - Driver in Hypervisor
- VGX
  - Hardware virtualisation of the GPU through the NVIDIA VGX Hypervisor
  - Driver in VM

Data Centre
GPU support for VDI Profile

FOR REFERENCE

Vendor	GPU Pass-Through	GPU Sharing	VGX
CITRIX	✔	XenApp only	✔ *(Future)
vmware	✔ (vDGA)	✔ (vSGA)	✗
Microsoft	✔	✔	✗

Data Centre
GPU Recommended Mode

FOR REFERENCE

User	No-GPU	GPU Sharing	GPU Pass-through
 Designer	✗	✗	✔
 Power User	✗	✗ / ✔	✔
 Knowledge Worker User	✔	✔	✔

GRID Reference Architecture

User	NVIDIA GRID	Hypervisor	Virtual Desktop Agent	Recommended Configuration
 Designer	K2	XenServer 6.1	XenDesktop 5.6 FP1 (with HDX 3D Pro)	4 Users 2 GRID K2 boards
		or		
		ESXi 5.1 with vDGA	View 5.X or XenDesktop 5.6 FP1 (with HDX 3D Pro)	Dual socket server 64 GB system memory
 Power User	K1	XenServer 6.1	XenDesktop 5.6 FP1 (with HDX 3D Pro)	8 Users 2 GRID K1 boards
		or		
		ESXi 5.1 with vDGA	View 5.X or XenDesktop 5.6 FP1 (with HDX 3D Pro)	Dual socket server 96 GB system memory
 Knowledge Worker	K1	XenServer 6.1	XenDesktop 5.6 FP1 (with HDX 3D Pro)	8-32+ Users 2 GRID K1 boards
		or		
		ESXi 5.1 with vSGA	View 5.X	Dual socket server Minimum 128 GB system memory
		or		
		Windows Server 2012 With Hyper-V	Remote FX	

Data Centre - Storage Considerations

Data Centre - Storage
Overview

- Type
  - Virtual machine
  - User data
  - Profile
  - Virtual applications
- Storage
  - Storage Area Network (SAN)
  - Network Attached Storage (NAS)
  - Direct Attached Storage (DAS)
- File System
  - NT File System (NTFS)
  - File Allocation Table (FAT)
  - Extended File System (ext3)
  - Virtual Machine File System (VMFS)
  - Raw Device Mapping (RDM)
- File Access
  - Common Internet File System (CIFS) / Server Message Block (SMB)
  - Network File System (NFS)
- Block Transport
  - Small Computer System Interface (SCSI)
  - Internet SCSI (iSCSI)
  - Fibre Channel (FC)
  - FC over Ethernet (FCoE)
  - SCSI over FC over IP (FCIP)
- Data Deduplication
  - NetApp File Level Flex Clone
  - VMware Linked Clone
  - Atlantis Computing iLio
  - Citrix Intellicache
  - VMware Storage Accelerator
  - Cisco WAAS Transport

Data Centre - Storage
Business Objectives

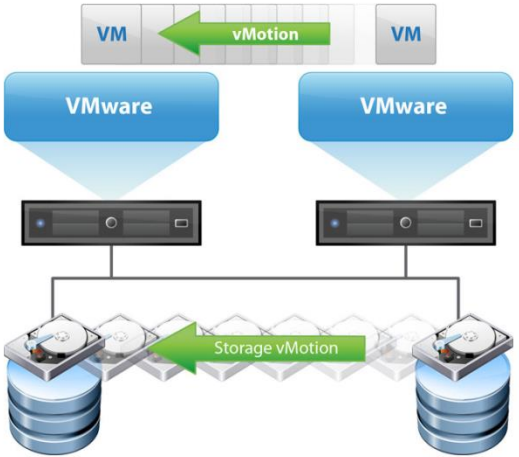
Workload Acceleration
- Fast I/O
- High Bandwidth
- Low Latency

Data Reduction
- Eliminate Redundant Data
- Efficient Storage Utilisation

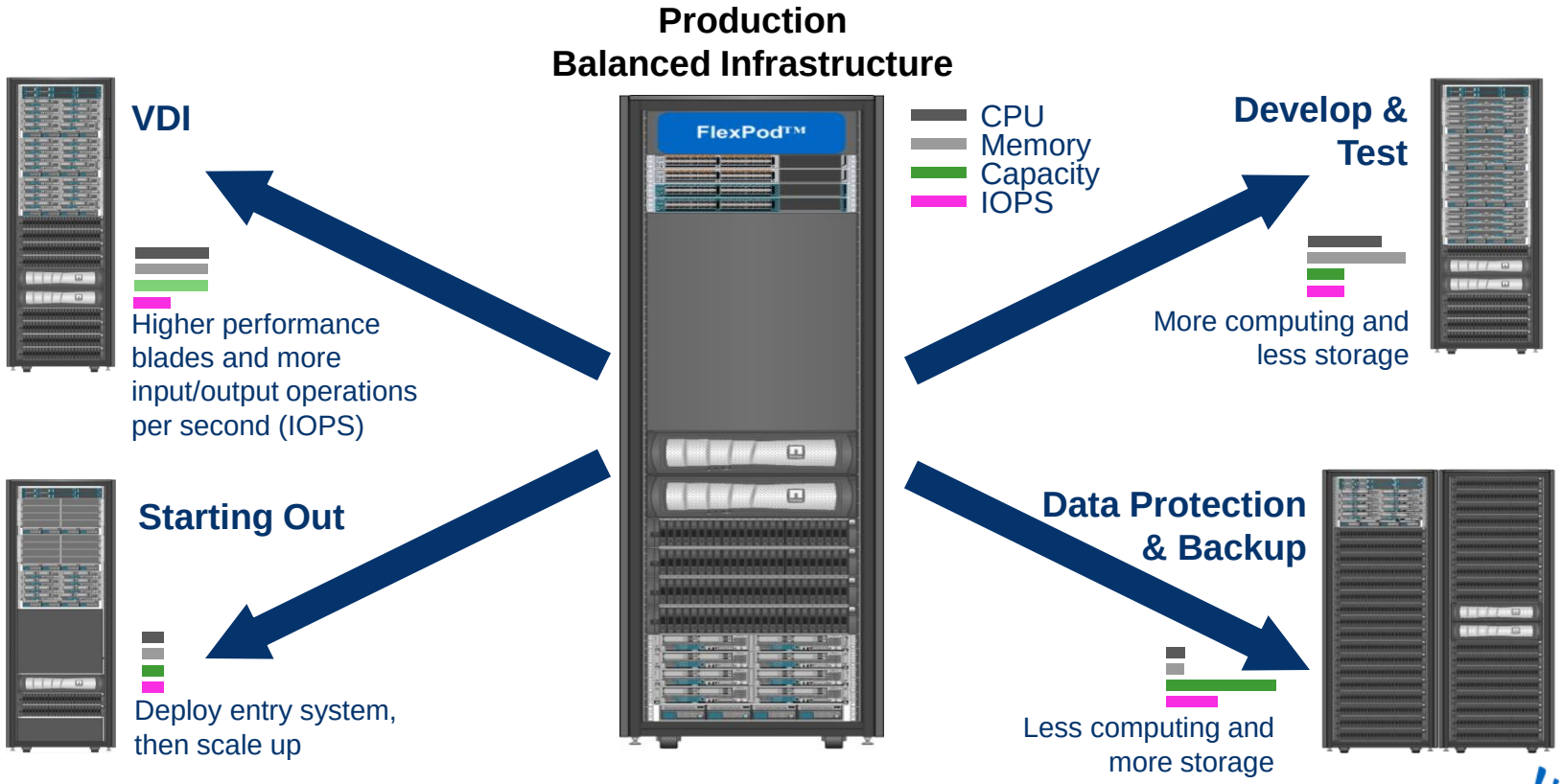
Data Centre Efficiency
- Reduce Energy Consumption
- Reduce Floor Space Consumption
- Reduce Management Overhead

Data Centre - Storage
Implementation Top Challenges

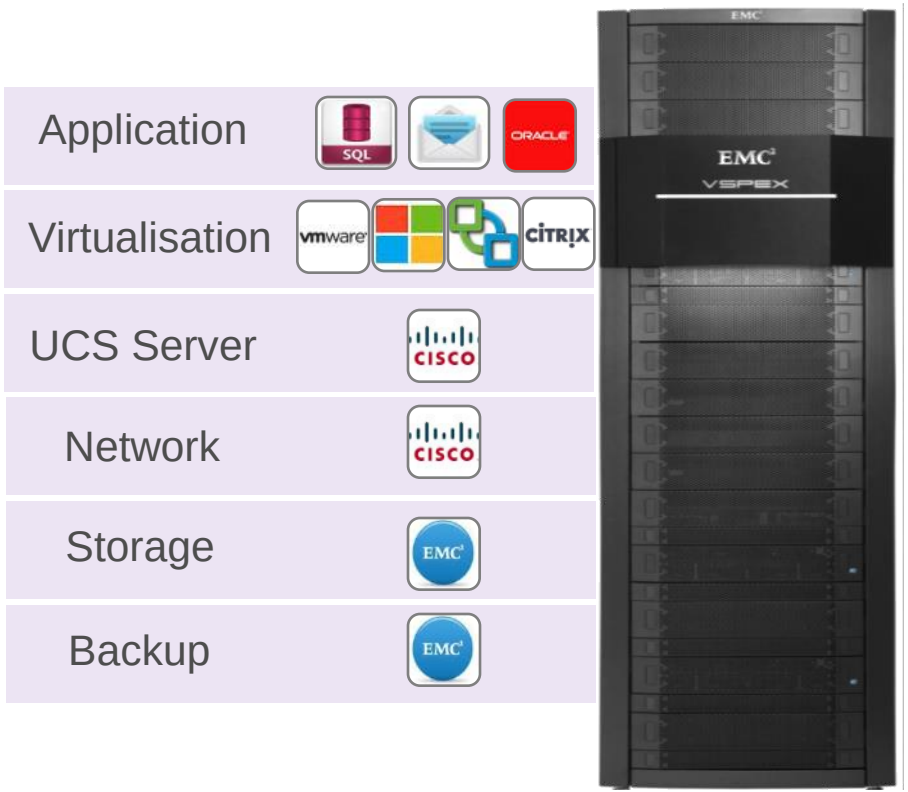
- Boot Storms
- vMotion
- DCI connectivity
- Provisioning/location/cache
- Right storage technology for the right job
- Reduction of Latency



Data Centre - Storage
Flexpod - Netapp



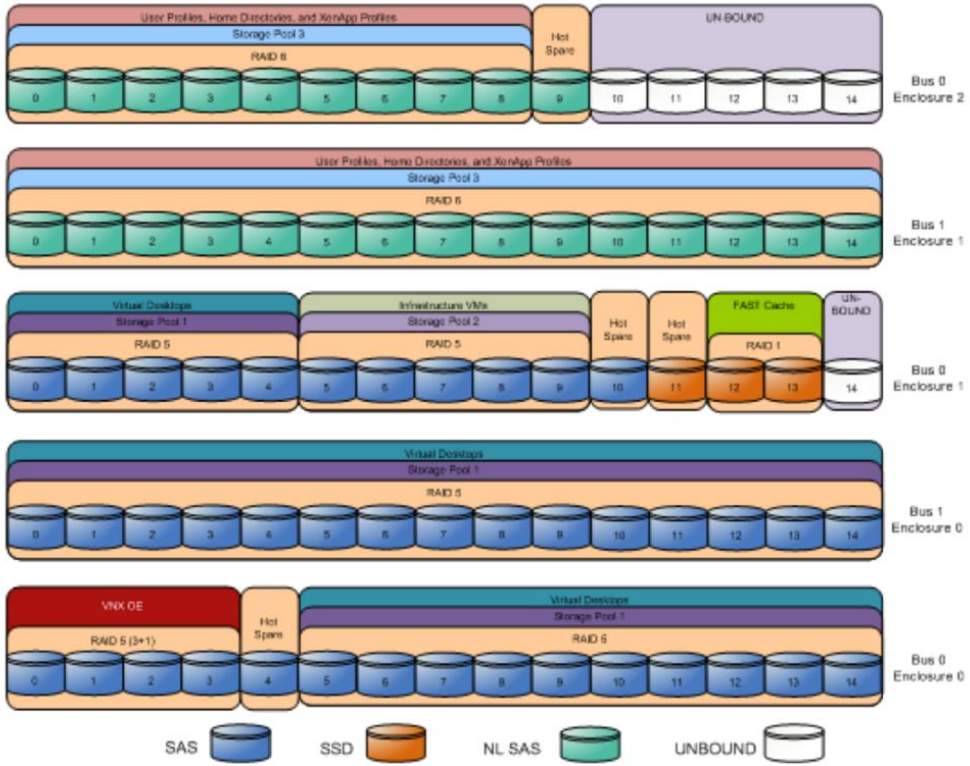
Data Centre – Storage
EMC VSPEX



- Applications
  - Citrix VDI
  - VMware View
  - SharePoint
- Private Cloud
  - VMware vSphere
  - MSFT Hyper-V 2012
- Storage Back and Recovery
  - Avamar
  - NetWorker
  - DataDomain

Data Centre - Storage

Rewrite the rules – Compromise is costly

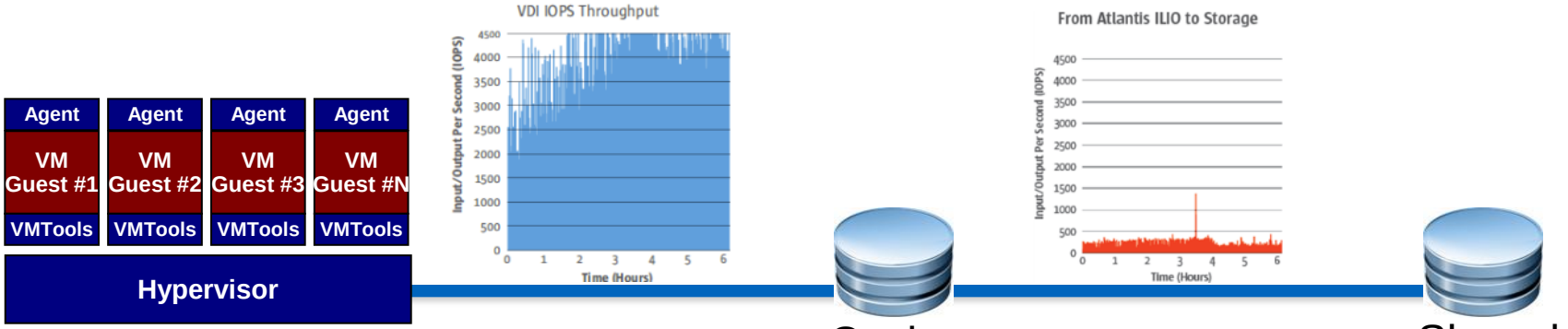


LUN Diagram for 1000 Desktops

Drives	Media	Size	IOPS	Capacity
41	HDD 15K	300GB	8,200	12.3TB
25	HDD 7.2K	2TB	1,750	50TB
3	Flash	300GB	105,000	900 GB
69	Mixed	.8 TB	114,950	141TB

1000 Persistent Desktops will require <10TB of capacity will demand ~80K backend IOPS

Data Centre - Storage
Acceleration

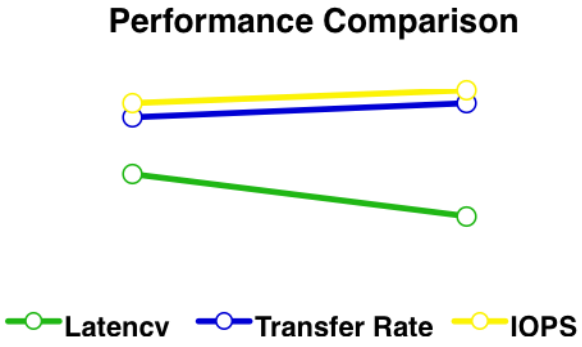


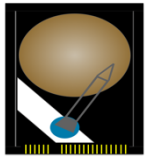
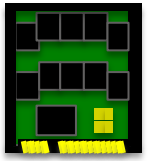
- Atlantis Computing ILIO – Read/Write acceleration (RAM option)
- Citrix Intellicache – Accelerated read with local write
- VMware Storage Accelerator (VSA) – Accelerated read

- Forms of optimisation (~90%)
  - Caching
  - Deduplication
  - Compression
  - Coalescing
  - Content-Awareness

Data Centre - Storage

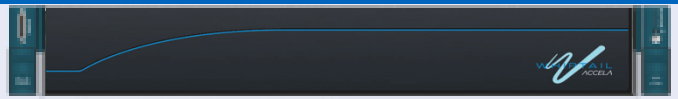
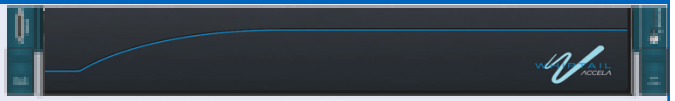
Flash Delivers High Performance & Low Operating Costs



		Low Performance	High Performance
		Est 1956	Est 1980
			
		Hard Disk Drive	Flash Drive
Speed	Latency in Seconds	0.001 (milliseconds)	0.000001 (microseconds)
	Transfer rate(s) MB/s	10s	100s
	Write / Read operations per Second (IOPS)	100s	1000s
Design		Mechanical	Silicon
		Motors & Spindles	Integrated Circuit
		High Energy consumption	Low Energy Consumption

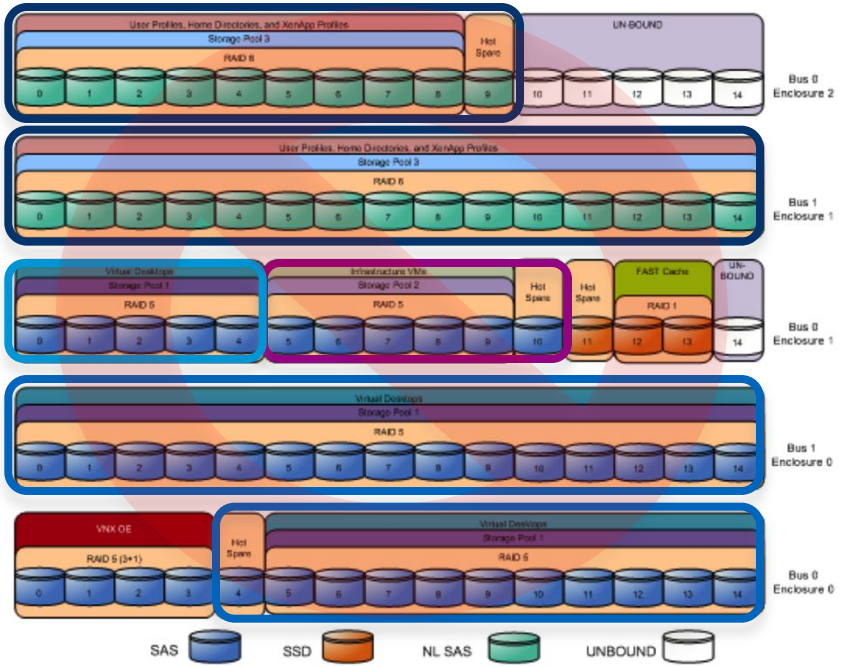
Data Centre - Storage

Building Blocks To Accelerate & Optimise Data

	Workload Acceleration		Data Reduction	
				
	Appliance	Silicon Node	Appliance	Silicon Node
Bandwidth (GB/s)	1.9	1.5	1.5	1.2
IOPS	250,000	200,000	200,000	165,000
Latency (Microseconds)	<100	<200	<100	<200
Size	2 RU		2 RU	
Max Capacity (TB)	24		64*	

* Effective Capacity

Data Centre - Storage
Data Reduction Storage Nodes



114,950 IOPS 141TB

825,000 IOPS 150 TB

Data Centre - Storage
Planning

- Storage Requirements
  - Total number of desktops
  - Type of desktops (persistent, non-persistent)
  - Size per desktop
  - OS for desktop
  - Worker workload profile
  - Storage growth horizon
  - Disaster recovery, backup, and data protection requirements
  - Size of NAS (CIFS) home directories
  - Roaming profiles
- Transport De-duplication
  - Transport workload mobility solutions
  - Shared storage replication acceleration (SRDF, SnapMirror, etc.)
  - Workload mobility acceleration (Clone, VMDK access, etc.)

- Planning
  - Consider DAS for Non-Persistent Desktops
  - Use shared storage with RAID and replication for persistent desktops and user data
  - Use Linked Clones or File Level Flex Clones for storage capacity
  - IOPS (4096 Bytes/IOP)
    - WinXP 5-10
    - Win7 10-20
    - 15K RPM drive – 200 IOPS
    - SSD drive – 10,000s IOPS
    - Reads versus writes
    - storage attachment cache/SSD/scaled
  - Consider impact of antivirus
  - Use storage caching to scale
    - Consider data redundancy levels

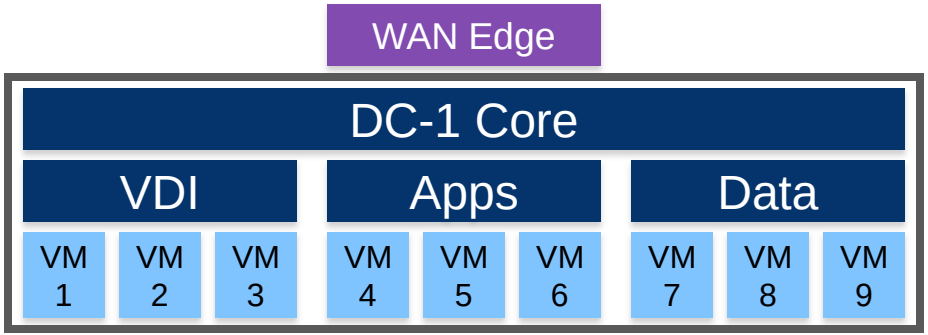
Data Centre - Network and Security Considerations

Data Centre - Network
Security Options

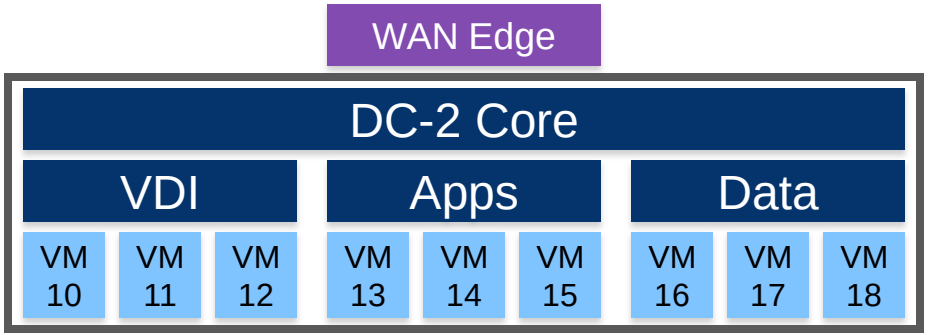
- Infrastructure placement
- Zoning by user/group, application, desktop, data
- Campus network security features
- Patching
  - Persistent desktop versus non-persistent desktop
- Virus scanning
  - Virtual machine virus scanning
  - VMSafe service in vSphere
  - NAS (file server) based virus scanning
  - Network or proxy based virus scanning (Scansafe/Ironport)

- Virtual desktop access
  - Direct internally or proxied externally

Data Centre - Network
Deployment Considerations



- Separate VDI from application environments
- Modular physical, network and compute infrastructure
- Predictable and repeatable scalability
- Campus security best practice
- IP address management

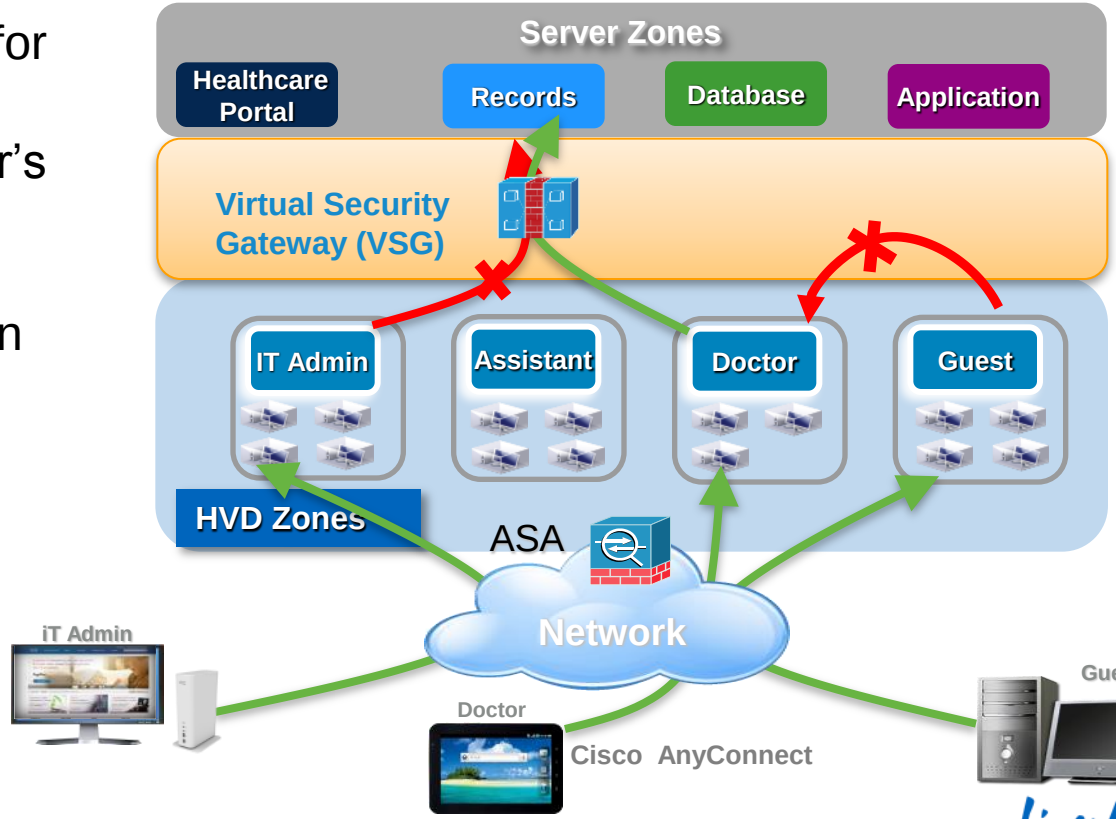


- Hosted virtual desktops in the server farm access considered east/west
- Hosted virtual desktops considered as a campus are north/south
- WAN edge in the access block is east/west?
- Data centre core is becoming an any to any transport
- It's all relative…

Data Centre - Network

Securing VDI with Cisco Virtual Security Gateway (VSG)

- Persistent virtual workspace for the doctor
- Flexible workspace for Doctor's assistant
- Maintain compliance while supporting IT consumerisation
- Security Enforcement
  - ACLs with logging
  - Port Profile Port Security
  - DHCP Snooping
  - Dynamic Arp inspection
  - IP Source Guard



Data Centre
Anti-Virus

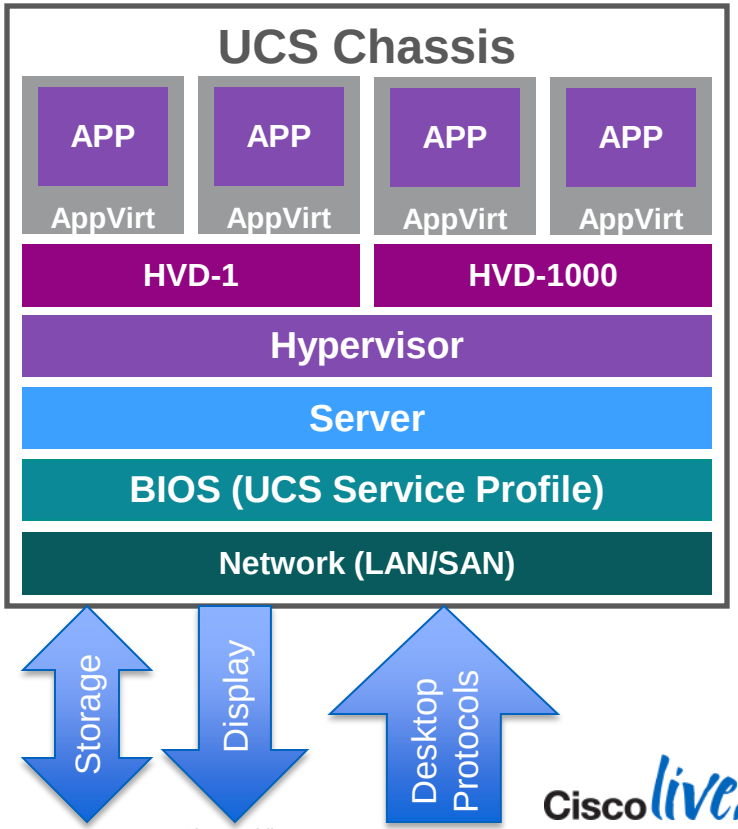
- Virus scan is an essential component of the Virtual Workspace
- Traditional AV software impacts HVD densities and hence the TCO
- Storage IOPS requirements and Login/Boot/AV Storms should be considered in the design apart from HVD density impact

18% impact on HVD Density
XenDesktop 5/ ESXi 4.1 , Win 7 32b/1.5G/20G

Workload Profile	AV Scan Policy	HVD Density
Knowledge Worker (KW) only	N/A	110/110
KW with MoveAV 1.5	Default	90/90

Data Centre – Storage
Sample Bandwidth Planning

- Storage (in and outbound)
  - 20 IOPS per desktop at 4K Bytes EA
  - 671 Kbps EA (assume 1 Mbps)
  - 1 Gbps for 1000 HVDs in UCS blade chassis
  - Assume 1 Mbps per HVD
- Network Display (mostly outbound)
  - Assume 1 Mbps per desktop
  - 1 Gbps for 1000 HVDs in UCS blade chassis
- Desktop Protocols (mostly inbound)
  - Estimate 8 Mbps which opens 25MB in 25 seconds and handles streaming and interactive video
  - 8 Gbps for 1000 HVDs in UCS blade chassis
- Total
  - 10 Mbps per HVD for storage, display, and desktop protocols
  - 10 Gbps for 1000 HVDs in UCS blade chassis



Strategy – Use Validated Architectures

Strategy
Approach

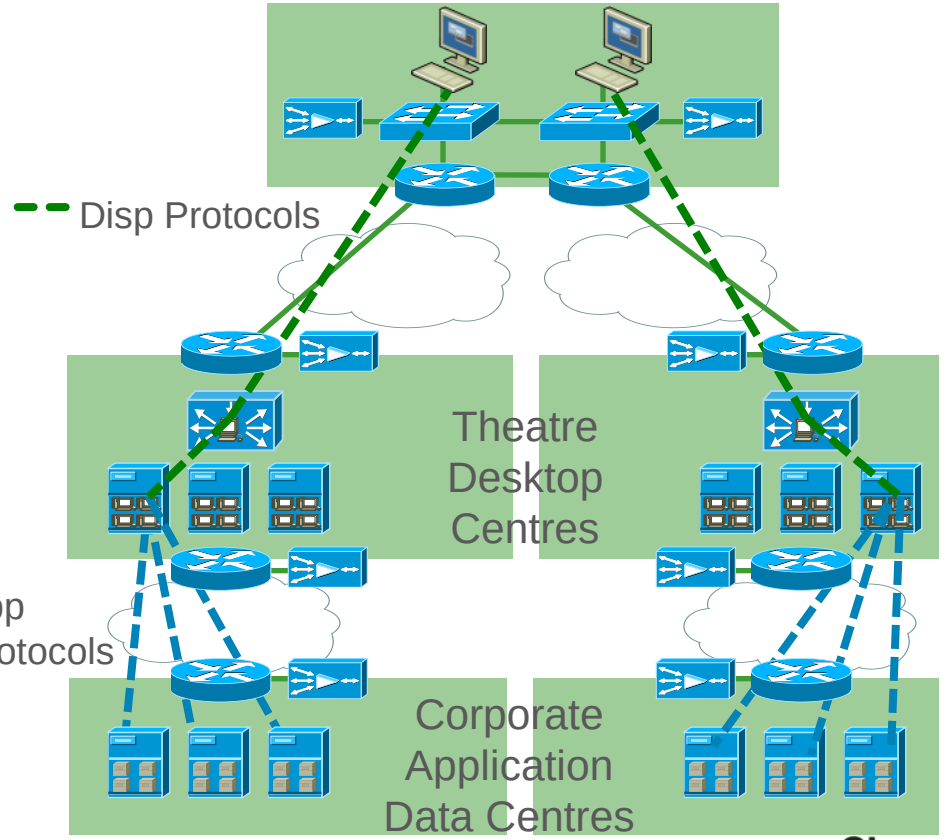
- Centralised when you can
  - Communications – Email
  - Productivity – Office, Wiki
  - Information Management – File, Sharepoint, iDisk, etc.
  - Business applications – Client/Server
  - Business intranet web
- Local when you must
  - Communications
    - IP Telephony (interactive softphone)
    - Video on demand (native encoding with local caching and prepositioning)
    - Video streaming (broadcast)
  - Rich media web
    - Experience
    - Branch split VPN with local web access
  - Print

Strategy
Considerations

- Business
  - Identify worker types (i.e. Task, Knowledge, Power, etc.)
  - Pursue when it makes business sense
  - Address security and compliance requirements
  - Consider the workspace (not just a desktop)
  - Consider the employ onboarding and off-boarding workflow
- Design
  - Fault domains
  - Disaster recovery
  - Shared storage scalability
  - Application concurrency
  - Per application requirements (One bad app ruins a bushel!)
  - Rich media or graphic intensive applications have many caveats
  - Stateless desktop is the goal

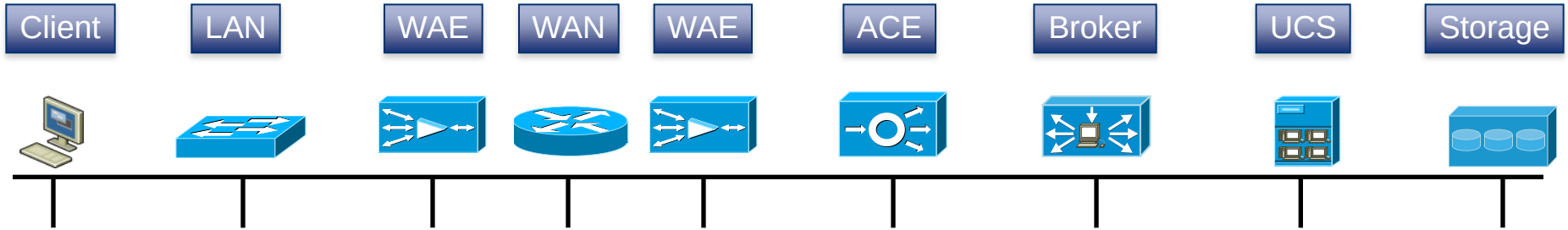
Architecture
Large Scale Virtual Desktop Architecture

- Branch
  - Thin Clients or display protocol clients
  - WAN Acceleration (1 connection per HVD/HVA)
- Desktop Data Centre
  - WAN Acceleration From Thin Client (1 connection per HVD/HVA)
  - Broker
  - Virtual Desktops
  - Limited applications
  - WAN Acceleration to Application (10 connections per HVD)
- Application Data Centre
  - WAN Acceleration From HVD
  - Centralised applications



Architecture
Fault Domains

- Client – 1 user
- Branch Switch – Up to 250
- Building or WAN – 2 to 1,000
- SLB – 2,000 to 20,000
- Broker – Up to 1000
- UCS Blade – Up to 332
- UCS Chassis – Up to 1,328
- Storage – 1 to 10,000



Plan Build Operate – Simplify, Automate, Orchestrate

Plan, Build, Operate
Cisco VDI

- **Unified Management**
  - UCS Director
  - UCS Manager
  - UCS Central
  - Treat Blades an Rack mount the same
  - Profile based management
- **Unified Compute**
  - Converged Network (including FCoE)
  - Wire once
  - Bandwidth scalability
  - Invicta Integration (IOPS)
  - Cache Technologies
  - GPU Capacity
- **Unified Fabric**
  - Fabric based Architecture
  - Dynamic Fabric Automation
  - ACI Futures (policy End Point Groups)
  - Nexus 1000V
    - Citrix Netscaler
    - ASA
    - VSG
  - DCI Options:
    - Optical
    - MPLS
    - OTV
    - Fabricpath
    - InterCloud

Cisco Validated Designs: http://www.cisco.com/go/designzone

Desktop Virtualisation with Citrix:

http://www.cisco.com/en/US/solutions/ns340/ns414/ns742/ns743/ns993/landing_vdi_citrix.html

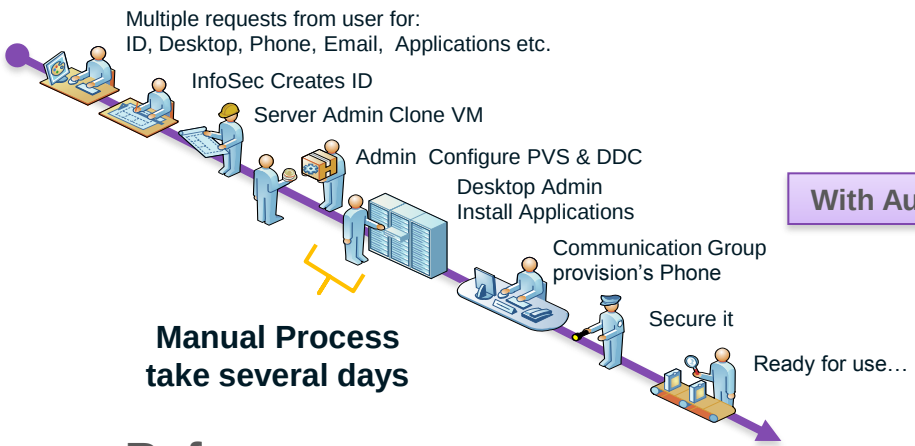
Desktop Virtualisation with VMWare

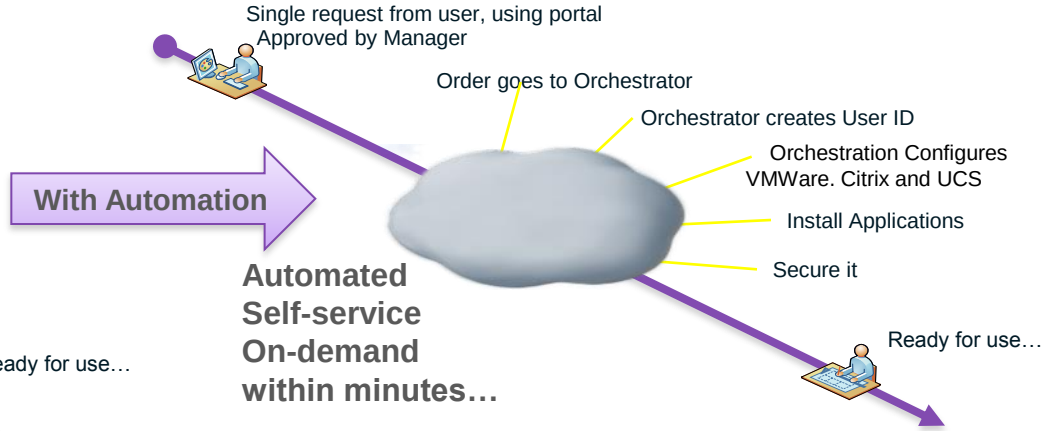
http://www.cisco.com/en/US/solutions/ns340/ns414/ns742/ns743/ns993/landing_vdi_view.html

Cisco Desktop as a Service:

http://www.cisco.com/en/US/solutions/ns340/ns414/ns742/ns743/ns1050/desktop_services.html

Plan, Build, Operate
Example Employee Onboarding Futures





Before:

Conventional VDI
- Manual provisioning
- Hard to control utilisation
- High provisioning & ops cost
- Extended provisioning time
- Configuration risk

After:

Automated VDI Solution
- Self-service; automated provisioning
- Elasticity (capacity-on-demand)
- Optimised provisioning & ops cost
- Rapid provisioning
- Increased Resiliency and Availability




Q & A

Complete Your Online Session Evaluation

Give us your feedback and receive a Cisco Live 2014 Polo Shirt!

Complete your Overall Event Survey and 5 Session Evaluations.

- Directly from your mobile device on the Cisco Live Mobile App
- By visiting the Cisco Live Mobile Site www.ciscoliveaustralia.com/mobile
- Visit any Cisco Live Internet Station located throughout the venue

Polo Shirts can be collected in the World of Solutions on Friday 21 March 12:00pm - 2:00pm

Learn online with Cisco Live!

Visit us online after the conference for full access to session videos and presentations.
www.CiscoLiveAPAC.com


CISCO
TM




Appendix

Enterprise Networks
Quality of Service in a Cisco VXI Network

Protocol	TCP/UDP Port	DSCP /CoS Value
Desktop Virtualisation Protocols		
RDP7	TCP 3389	DSCP af21/CoS 2
PCoIP*	TCP & UDP 50002 TCP & UDP 4172	DSCP af21/CoS 2 DSCP af21/CoS 2
ICA/HDX		
Session	TCP 1494	DSCP af21/CoS 2
Session Reliability	TCP 2598	DSCP af21/CoS 2
Web Services	TCP 80	DSCP af21/CoS 2
USB Redirection (PCoIP)	TCP 32111	DSCP af11/CoS 1
MMR	TCP 9427	DSCP af31/CoS 4
Other Protocols found within Cisco VXI		
Network-based Printing (CIFS)	TCP 445	DSCP af11/CoS 1
UC Signalling (SCCP)	TCP 2000	DSCP cs3/CoS 3
UC Signalling (SIP)	TCP 5060	DSCP cs3 /CoS 3
UC Signalling (CTI)	TCP 2748	DSCP cs3/CoS 3
UC Media (RTP, sRTP)	UDP 16384 - 32767	DSCP ef/CoS 5

- Display protocols obscure multiple traffic types in a single TCP connection

Ports Used During Classification for QoS

```
ip access-list RDP
 permit tcp any eq 3389 any
ip access-list PCoIP-UDP
 permit udp any eq 50002 any
ip access-list PCoIP-TCP
 permit tcp any eq 50002 any
ip access-list PCoIP-UDP-new
 permit udp any eq 4172 any
ip access-list PCoIP-TCP-new
 permit tcp any eq 4172 any
ip access-list ICA
 permit tcp any eq 1494 any
!
ip access-list View-USB
 permit tcp any eq 32111 any
```

```
ip access-list MMR
 permit tcp any eq 9427 any
!
ip access-list NetworkPrinter
 permit ip any host 10.1.128.10
 permit ip any host 10.1.2.201
!
ip access-list CUPCDesktopControl
 permit tcp any host 10.0.128.125 eq 2748
 permit tcp any host 10.0.128.123 eq 2748
```

Cisco's Nexus 1000v deployed with its ability to safeguard against DHCP snooping, dynamic ARP inspection and IP source guard

In testing, the markings were done on the Nexus 1000v whenever possible

- These example provides a guideline for deploying QoS in a Cisco VXI Network

Class-maps

```
class-map type qos match-any CALL-SIGNALING
 match access-group name  CUPCDesktopControl

class-map type qos match-any MMR-STREAMING
 match access-group name MMR

class-map type qos match-any TRANS-DATA
 match access-group name RDP
 match access-group name PCoIP-UDP
 match access-group name PCoIP-TCP
 match access-group name PCoIP-UDP-new
 match access-group name PCoIP-TCP-new

class-map type qos  match-any BULK-DATA
 match access-group name View-USB
 match access-group name NetworkPrinter
```

Policy-map

```
policy-map type qos pmap-HVDPort
 class CALL-SIGNALING
    set cos 3
    set dscp cs3
     ! dscp = 24
 class MMR-STREAMING
    set cos 4
    set dscp af31
     ! dscp = 26
class TRANS-DATA
    set cos 2
    set dscp af21
     ! dscp = 18
class BULK-DATA
    set cos 1
    set dscp af11
     ! dscp = 10
```

Enterprise Networks
Quality of Service Validation with MMR

- Viewing QoS Policy Statistics

```
DC-WAN#show policy-map interface

GigabitEthernet0/0
Service-policy input: HQ-LAN-EDGE-IN

Class-map: MMR-STREAMING (match-any)
3532 packets, 5249960 bytes
30 second offered rate 9000 bps, drop rate 0
Match: dscp af31 (26) af32 (28) af33 (30)
0 packets, 0 bytes
30 second rate 0 bps
Match: access-group name MMR
3532 packets, 5249960 bytes
30 second rate 9000 bps
QoS Set
dscp af31
Packets marked 3532

Serial0/0/0:0
Service-policy output: WAN-EDGE

Class-map: MMR-STREAMING (match-any)
5456 packets, 8052828 bytes
30 second offered rate 393000 bps, drop
Match: dscp af31 (26) af32 (28) af33 (30)
5456 packets, 8052828 bytes
30 second rate 393000 bps
Match: access-group name MMR
0 packets, 0 bytes
30 second rate 0 bps
Queueing
queue limit 64 packets
(queue depth/total drops/no-buffer drops) 0/0/0
(pkts output/bytes output) 5456/8052828
bandwidth 5% (76 kbps)
Exp-weight-constant: 9 (1/512)
Mean queue depth: 25 packets
```

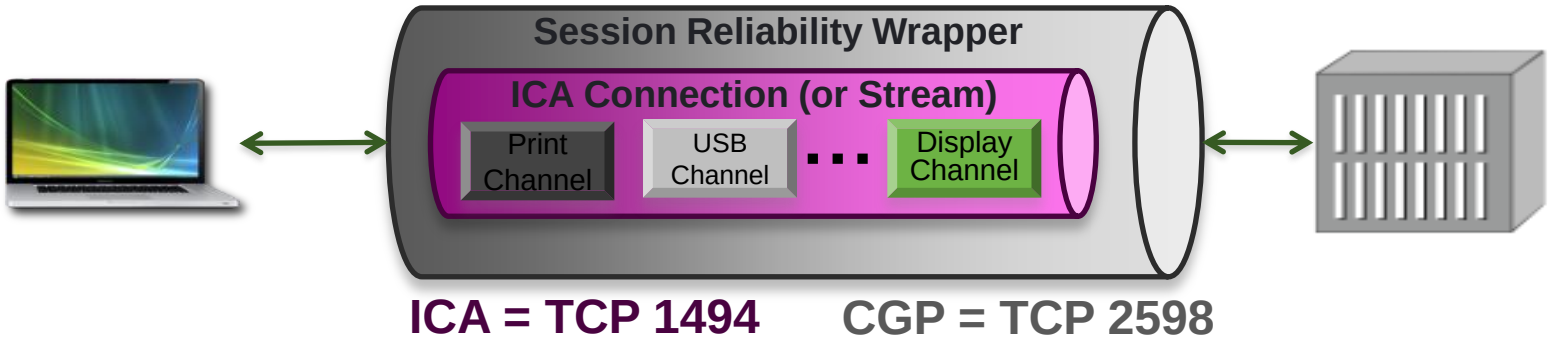
Enterprise Networks
Citrix ICA QoS

- Branch Considerations
  - Network QoS implications
  - Display Protocol Adaptiveness
  - HDX enhancements in XD5.6
    - Streaming video handling – client or server fetch, client or server rendering
    - Dynamic Adjustments based on BW Available
  - Multistream-ICA that allows for 4 TCP stream ports and 1 UDP stream - visibility into the desktop protocol allows for appropriate QoS handling
- Network QoS implications of Display Protocol

Type of Traffic (multi-stream ICA Priority)	Ports	Suggested QoS (DiffServ Classes) on Network
UDP	16500 -16509	EF
TCP: Realtime (priority very high)	Custom	AF4x
TCP: Interactive (priority high)	2598 (original)	AF4x
TCP: Bulk (priority medium)	Custom	AF21
TCP: background (priority low)	Custom	BE

Enterprise Network
Session Reliability via Common Gateway Protocol (CGP)

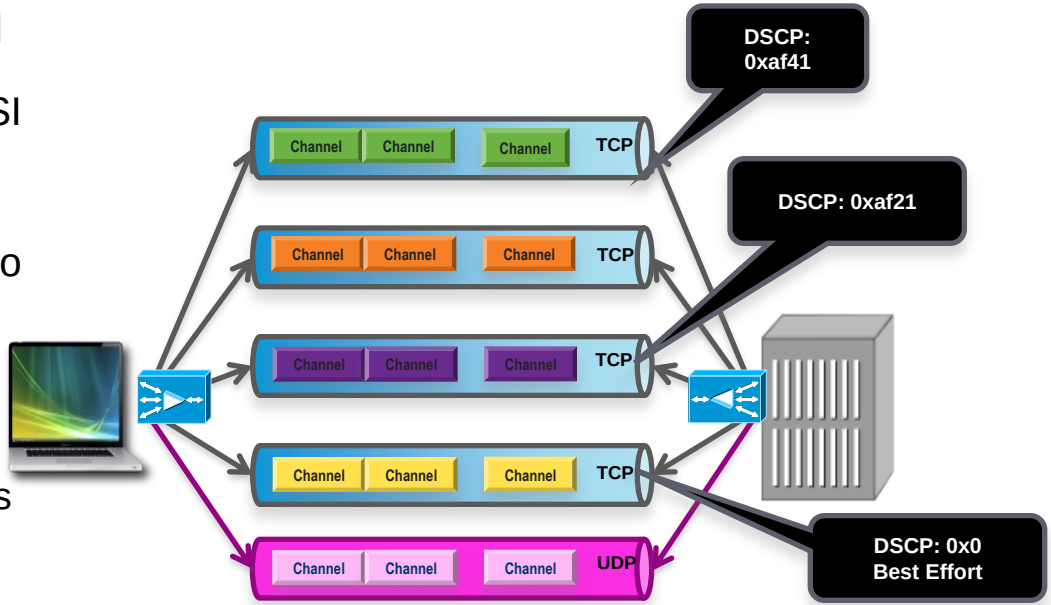
- CGP improves session persistence over the WAN



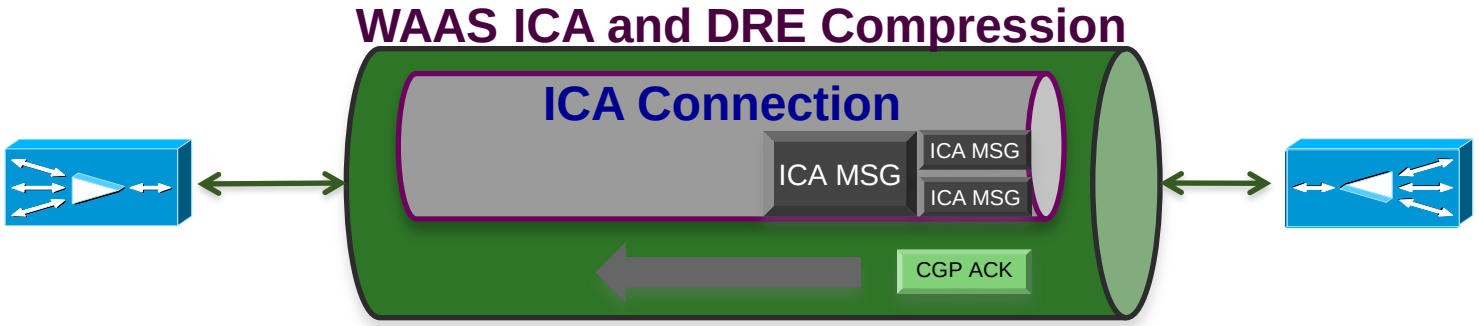
- Session Reliability encapsulates ICA inside another Citrix protocol called CGP
- This is a “Default” Citrix setting required for Multi-Stream ICA
- WAAS improves CGP over the WAN.

Enterprise Network
QoS Support for MSI and non-MSI streams

- WAAS can be enabled to implement Differentiated Service Code Point (DSCP) tagging of both MSI and non-MSI ICA and CGP traffic
- Once enabled, WAAS will interpret the MSI stream type for the TCP connection and enable the appropriate DSCP value
- The user will be able to enable or disable tagging MSI or non-MSI traffic as well as to define different values for the MSI and non-MSI traffic
- DSCP Defaults
  - Very High Priority - used for real-time channels such as audio (af41)
  - High Priority - used for interactive channels such as graphics, keyboard, and mouse (DSCP af41)
  - Medium Priority - used for bulk virtual channels such as drive mapping, scanners, etc. (DSCP af21)
  - Low Priority - used for background virtual channels such as printing (DSCP 0)



Enterprise Network
Enhanced Compression and Stream Throughput



- WAAS provides many new enhancements for better compression, throughput and capacity for small message sizes, header reduction, & buffer management.
- WAAS further accelerates performance by better processing of CGP ACKs

Enterprise Networks

WAAS Citrix XenDesktop Feature Expectations

Feature	Function	Impact to WAAS 4.5
Common Gateway Protocol (CGP)	Session reliability	ADDRESSED in WAAS 5.2.
Citrix Receiver client cache	Receiver caches a substantial history	Minimises WAAS DRE to near 0 in a single user environment. Test in a multiuser environment.
No MMR	Flash request made my hosted virtual desktop (HVD), media rendered in the HVD, and sent through ICA as bitmaps	Increases bandwidth AND minimises WAAS reduction to about 30%
Flash MMR server side fetch	Flash request made by hosted virtual desktop, media passes in ICA channel, and stream is decoded on the client	>95% DRE hit between successive on demand video views but stream still be delivered through the desktop server farm.
Flash MMR client side fetch URL redirect	URL is redirected to the client which then directly makes the video request bypassing the hosted virtual desktop	>95% DRE hit between successive on demand video views and stream does not pass through the hosted desktop
Intelligent USB redirect	Apply intelligent compressions on USB extension based on the device type	WAAS not effective for real time media over USB but is effective for data transfer over USB

Enterprise Networks
WAAS Citrix XenDesktop Situation Expectations

Variable	Implication	Impact to WAAS 4.5
Print – USB attached printer	USB redirection used to delivery print job	>80% BW reduction and latency mitigation
Print – local print server	CIFS/MSRPC accelerated from hosted desktop to branch print server	>80% BW reduction and latency mitigation
Print – hosted print server	PS/PCL file delivery from data centre to branch printer	>80% BW reduction and latency mitigation
Print – direct print from hosted desktop to branch printer	CIFS/MSRPC accelerated from hosted desktop to branch printer	>80% BW reduction and latency mitigation
3rd party print redirection		
Powerpoint presentation mode	Bitmap graphics	~30% overall but WAAS DRE is zero

Enterprise Networks
WAAS Citrix XenDesktop Experience Expectations

Variable	Implication	Impact to WAAS 4.5
TCP flow control	Client/Server operating system dependent	Recent release client/server operating systems support more aggressive TCP stacks resulting in limited WAAS TFO latency benefits.
High latency with recent OS	Compression reduces data amount	Interactivity improved by passing less data

Architecture
Remote NAS WAAS NFS Storage Acceleration

- Display protocols are challenged by rich media
- Mitigate display protocol challenges by placing compute close to user
- Achieve data protection by placing vmdk in data centre
- Minimise network impact with WAAS

WinXP Action	NFS Origin	NFS Optimised	Percent Optimised
Boot	204	2.922	98.61%
Login	91.781	1.938	97.89%
Office	201	3.584	98.26%
Web 5X	21.5	0.433	98%
On demand Flash	3.333	0.062	98.18%

Citrix Receiver Feature Matrix

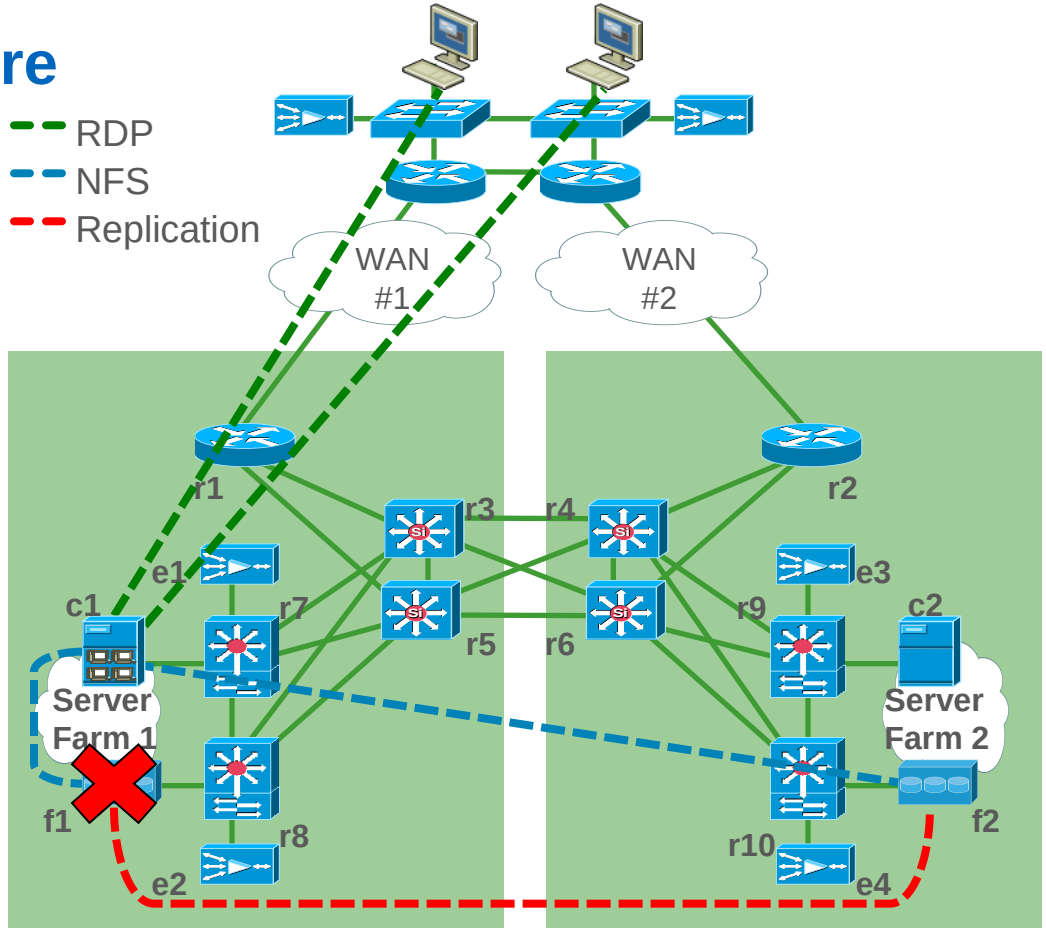
	Android (2.2 +)	VXC 6215	DX 650
Content			
XenApp Applications	✔	✔	✔
XenDesktop Desktops	✔	✔	✔
SaaS Applications Access	✔		✔
ShareFile Follow Me Data	✔		✔
Follow Me Apps / Subscriptions	✔		✔
Mobile Apps	✔		✔
Offline Apps (Citrix and App V)			
Mobility Pack	✔		✔
Follow Me Sessions (Work Space Control)		✔	
HDX			
Bidirectional Audio (VoIP)		✔	
Web Cam (Video Chat)		✔	
Video Playback	✔	✔	✔*
Flash Redirection		✔	
Cisco/Lync UC Optimisation		✔	
Multimedia Redirection		✔	
Local Printing		✔	
3DPro Graphics		✔	
Remote FX			
Location Based Services	✔		
USB Drive Mapping	Roadmap	✔	Roadmap
Branch Repeater Acceleration Plug-in			

Citrix Receiver Feature Matrix

	Android (2.2 +)	VXC 6215	DX 650
Security			
Receiver for Web Access	✔	✔	✔
Remote Access via AGEE	✔	✔	✔
RSA Soft Token	✔		✔
Client Cert Authentication			
Smart Card (CAC,PIV Etc.)		✔	
Proximity/Contactless Card (Fast Connect)			
Pass Thru Authentication			
SAN Cert		✔	
SSLv3/TLS1.0	✔	✔	✔
FIPS 140/SHA2			
AES & 3DES Encryption	✔	✔	✔
Smart Access			
Updates			
Auto Discovery/Configuration	✔		✔
Citrix/App Store	✔		✔
Merchandising Server			

Availability and Mobility
Virtual Desktop Architecture

- Normal Conditions
  - Desktops provisioned to use local NFS Filer
  - SnapMirror Replicates VMDK files through WAAS
- Event
  - NAS fails over to replicated NAS using L2 extension or Route Health Injection (RHI)
  - WAAS enables desktops to run from NAS in remote data centre
  - View Clients maintain display protocol connection with stationary compute VM

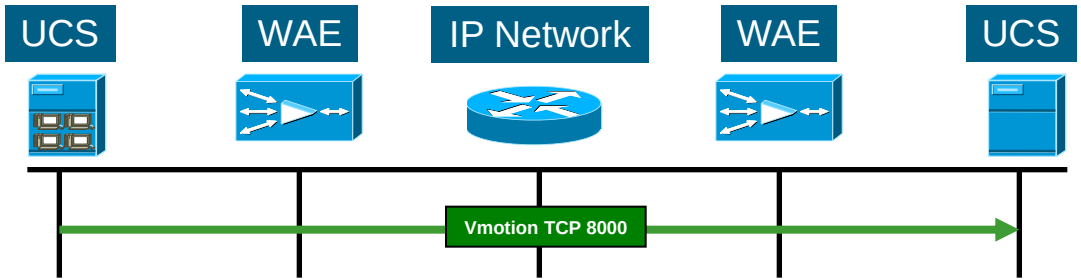


Availability and Mobility
VMotion Acceleration

- WAAS reduces 512 MB transfer to just 31 MB if warmed with similar WinXP desktop
- WAAS enables bulk VMotion between data centres in the event storage moves
- WAAS enables efficient VMotion from/to private to/from public clouds

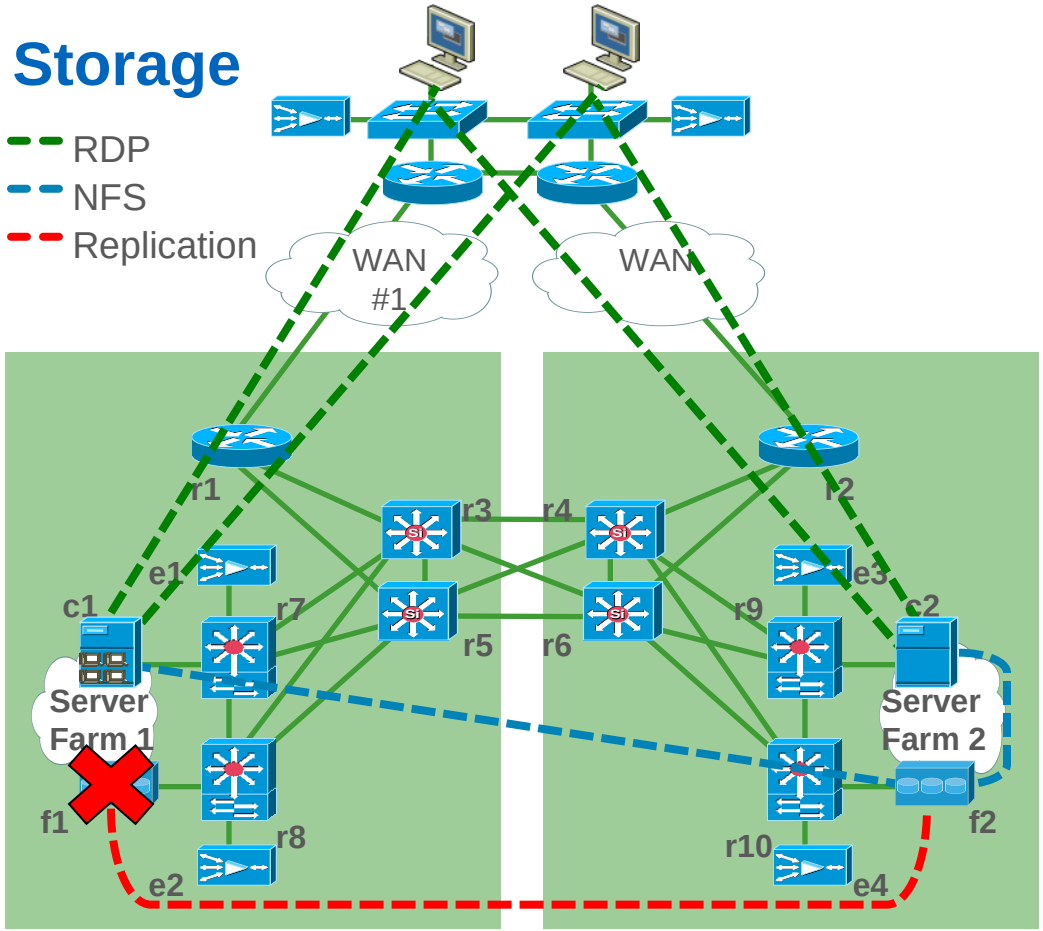
- VMotion uses TCP to reliably migrate the contents of memory from one compute to another
- Source host initiates a TCP 8000 connection to the destination host
- WAAS can be in the path using inline card or WCCP

	Source IP:Port	Dest IP:Port	Peer Id	Applied Policy	Open Duration	Org Bytes	Opt Bytes	% Comp	Classifie Name
	10.87.121.4:49157	192.168.203.201:8000	dc1-wae2		0:1:24	513.254 MB	31.5101 MB	94%	HTTP
	192.168.203.201:49157	10.87.121.4:8000	dc1-wae2		0:1:24	136 Bytes	300 Bytes	-	HTTP



Availability and Mobility
VMotion Compute Follows Storage

- Normal Conditions
  - Desktops provisioned to use local NFS Filer
  - SnapMirror Replicates VMDK files through WAAS
  - Netapp Flex Clones to reduce storage
- Event
  - NAS fails over to replicated NAS using L2 Extension or Route Health Injection (RHI)
  - WAAS efficiently migrates desktop VMs to backup compute following storage
  - Client VMs can preserve IP with RHI, L2MP, or request new IP through DDNS

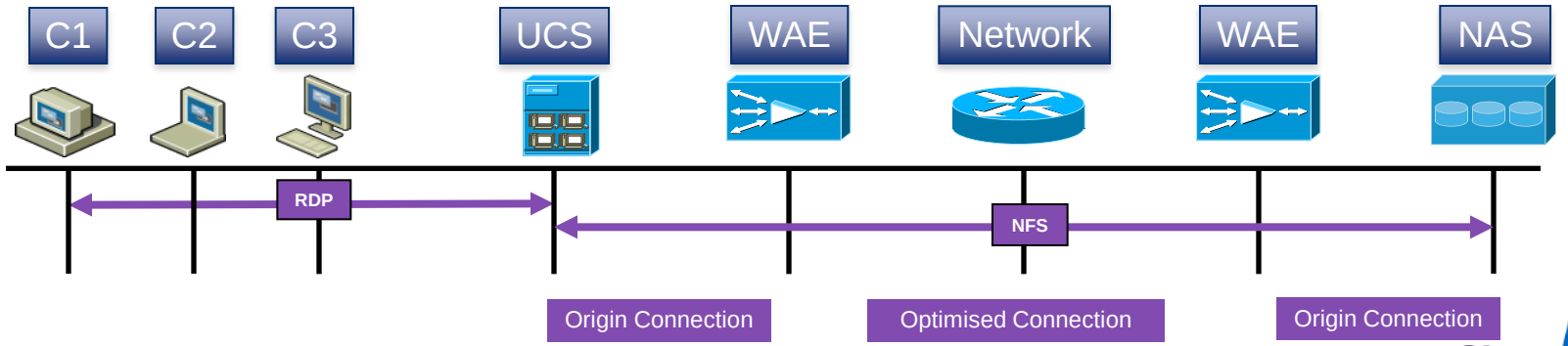


Architecture
WAAS NFS Transport DeDuplication

- Storage
  - NFS from ESX to NAS
  - WAAS between ESX and NAS
  - 99.6% compression (10 GB reduced to <100 MB)

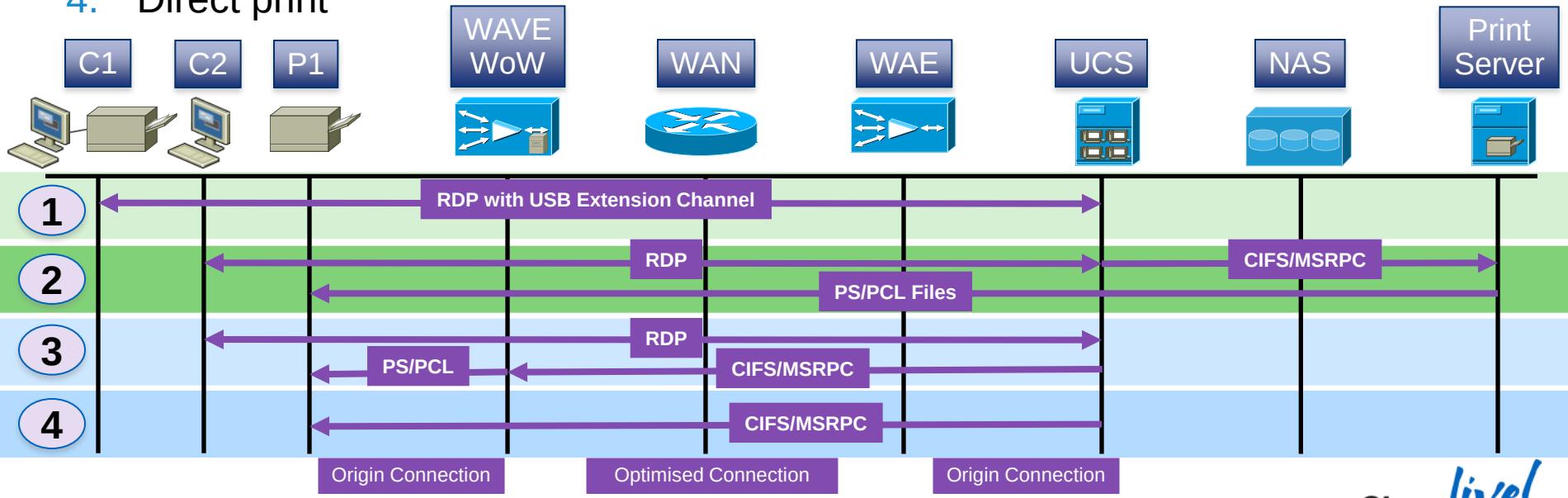
- Client LAN attached terminal
- Native protocols over WAN
- Centralised VMDK and user data

Source IP:Port	Dest IP:Port	Peer Id	Applied Policy	Open Duration	Org Bytes	Opt Bytes	% Comp
192.168.203.200:693	192.168.101.100:2049	dc1-wae2		0:45:48	10.0108 GB	67.5429 MB	99%
192.168.203.200:694	192.168.101.100:2049	dc1-wae2		0:27:48	166.7422 KB	26.8691 KB	84%
192.168.203.201:807	192.168.101.100:2049	dc1-wae2		796:9:51	19.9475 GB	1.5759 GB	92%
192.168.203.201:808	192.168.101.100:2049	dc1-wae2		796:9:51	930.2551 MB	131.4365 MB	86%



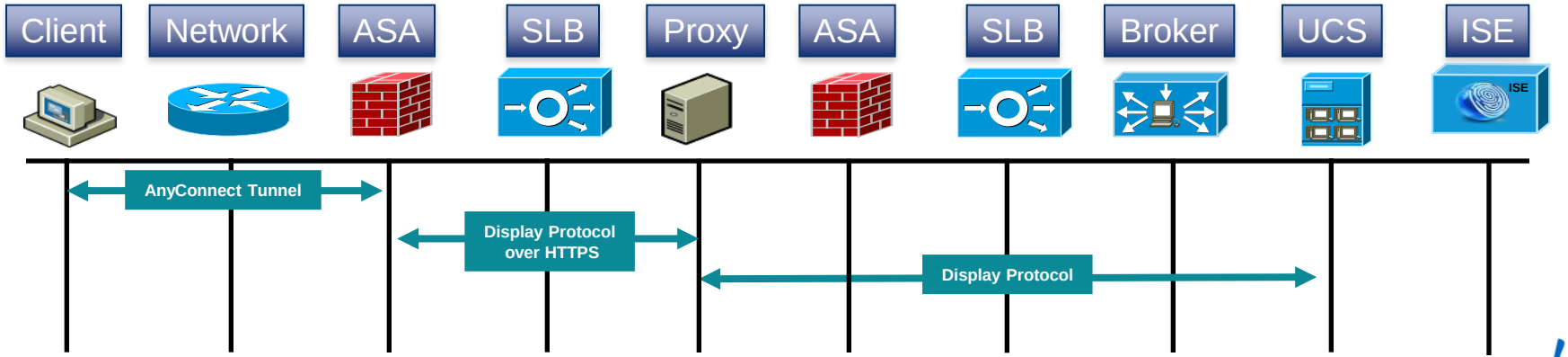
Enterprise Networks
Virtual Desktop Print Options

1. USB attached printer via display protocol USB extension
2. Centralised print server
3. Branch print server (physical machine or Windows on WAAS)
4. Direct print



Enterprise Networks
DMZ Deployments

- AnyConnect aggregates enterprise display, telephony, and web
- DMZ secured with a firewall (ASA)
- SLB balances and offloads display protocol proxy/gateway
- SLB provides backend broker availability and scale
- Identity Services Engine (ISE) provides user/group policy enforcement




CISCO
TM