

# VDI Smackdown

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The logo for PQR, consisting of the letters 'PQR' in a white serif font on a dark blue square background.

Eenvoud in ICT

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## DOCUMENT OVERVIEW

### HISTORY

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<b>1.0</b>	June 2010	Ruben Spruijt	Release 'the Matrix'
<b>1.1</b>	February 2011	Ruben Spruijt	Release 'the Matrix reloaded'
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1.3	February 2012	Ruben Spruijt	
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### REVIEWER

Version	Date	Reviewer	Remarks
2.2	August 2013	Erik van Veenendaal	
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# 1. INTRODUCTION

Are you looking for an independent overview of desktop virtualization solutions and curious about the different strategy questions? Do you want detailed information about the features and functions each desktop virtualization vendor is offering!? If so this is the whitepaper you definitely must read!

In the current market there is an increasing demand for unbiased information about desktop virtualization solutions. This white paper is focused on solutions that are anticipated to have an important role in desktop virtualization deployments. An overview of available features of each solution has been created to allow an understanding and comparison of capabilities.

## 1.1 OBJECTIVES

The goals of this whitepaper are to:

- Provide an **application and desktop delivery solutions overview**
- **Explain** the different desktop virtualization **concepts**
- Explain the **pros and cons of desktop virtualization**
- Highlight **why application virtualization and VDI are a perfect fit**
- **Describe the different desktop virtualization vendors and solutions**
- **Compare the features** of the various desktop virtualization solutions

## 1.2 INTENDED AUDIENCE

This document is intended for IT Managers, architects, analysts, system administrators and IT-Pros in general who are responsible for and/or interested in designing, implementing and maintaining desktop virtualization Infrastructures.

## 1.3 VENDOR INVOLVEMENT

All major vendors whose products are covered such as Citrix, Microsoft, Dell/Quest, Virtual Bridges, RedHat and VMware have been approached in advance to create awareness of this whitepaper and discuss their solutions functionality and features.

## 1.4 FEEDBACK

We try to provide accurate, clear, complete and usable information. We appreciate your feedback. If you have any comments, corrections or suggestions for improvements of this document we want to hear from you! Please send an e-mail to Ruben Spruijt ([rsp@pqr.nl](mailto:rsp@pqr.nl)) Include the product name, version number and the title of the document in your message.

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## 2. ABOUT

### 2.1 ABOUT PQR

PQR is a professional ICT infrastructure company focusing on the availability of data, applications and work spaces with optimized user experience in a secure and manageable way.

PQR provides its customers innovative ICT solutions, from on-premises to cloud management, without processes getting complex. Simplicity in ICT, that's what PQR stands for.

PQR has traceable references and a wide range of expertise in the field, proven by many of our high partner statuses and certifications. PQR is a Citrix Platinum Solution Advisor, HDS Tier 1 Platinum Partner, HP GOLD Preferred Partner, Microsoft Gold Partner, NetApp Star Partner, RES Platinum Reseller, VMware Premier Partner en VMware Gold Authorized Consultant Partner.

PQR's approach is based on four main pillars:

- Data & System Availability
- Application & Desktop Delivery
- Secure Access & Secure Networking
- Advanced IT Infrastructure & (Cloud) Management

PQR, founded in 1990, is headquartered in De Meern and has over 107 employees. In fiscal year 2011/2012 posted sales of € 94.9 million and a net after tax profit of € 4.6 million have been recorded.

### 2.2 ACKNOWLEDGMENTS

#### **Ruben Spruijt**, CTO @ PQR

Ruben Spruijt (1975) is CTO and focuses primarily on Enterprise Mobility, Virtualization and Cloud Management. He is actively involved in determining PQR's vision and strategy. Ruben is a Microsoft Most Valuable Professional ([MVP](#)), Citrix Technology Professional ([CTP](#)) and VMware [vExpert](#) and is the only European with these three virtualization awards. He gives customers advice and has them benefit from his expertise; he motivates his colleagues and writes blogs, articles and opinion pieces on a regular basis. During presentations in several national and international congresses, Ruben shares his thoughts and knowledge on application and desktop delivery, and on virtualization solutions. To contact Ruben directly send an email to [rsp@pqr.nl](mailto:rsp@pqr.nl). Follow Ruben on [twitter: @rspruijt](#)





**A-Team** - it's only through the effort and persistence of the 'VDI Smackdown' team that we achieved the goals, a big thanks to them!

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### Special thanks

A special thanks to **Chris Wolf** of Gartner for his insights, ideas and opinions with regards to Server-Hosted Virtual Desktops and this whitepaper. Gartner created different documents around Server-Hosted Virtual Desktops which are really worth reading. Follow Chris on [twitter](#).

A special thanks to **Alistair Gillespie** for reviewing the document and provide great feedback. He is based in the UK and works in the End User Computing" space covering Client Virtualization, Application Virtualization and Enterprise Mobility. To contact Alistair directly [email](#) or follow Alistair on [twitter](#)

**Community effort:** A **BIG** thanks to the desktop virtualization community members, especially [Kevin Buenerkemper](#) and [Thomas Poppelgaard](#).

## 2.3 QUOTE'S

### **Brian Madden, blogger, analyst, geek and thought leader**

"The VDI Smackdown is really more like a book about desktop virtualization that explains all the different options. It's more than VDI, covering RDSH, client hypervisors, streaming.. everything! The list of products is extensive. PQR created an overview of every vendor and every product, including features, architecture, licensing models, and what makes each vendor unique."

"I also love the huge 'matrix' of features, where they literally go through several hundred product features with checkmarks to show which products support them! It would literally take hundreds of hours to compile everything that Ruben and his team put into this document. For me it's 'required reading' for anyone who's about to make a buying decision around VDI or desktop virtualization."

### **Vishal Ganeriwala, Director Technical Marketing, Citrix Systems Inc.**

"For customers looking to quickly come up-to-speed on the desktop virtualization landscape, the VDI Smackdown is a valuable resource that delivers a detailed side-by-side vendor-independent analysis of the different product offerings."

### **Dave Callahan, Director of Product Management, Dell Software**

"PQR's VDI Smackdown is a must read for anyone looking at implementing desktop virtualization within their organization. It is the most detailed feature analysis of the major desktop virtualization software providers available from an independent party that I am aware of. We frequently recommend it to our customers who are looking for an unbiased breakdown of features."

### **Scott H. Davis, CTO End User Computing, VMware**

"PQR's VDI Smackdown is a thorough, independent and well-researched technical deep dive into the features comprising various commercial Virtual Desktop offerings. It can be a valuable source of information for CIO's and technical architects looking to evaluate their needs in a VDI solution."

## 3. APPLICATION AND DESKTOP DELIVERY

### 3.1 STRATEGY

Enterprise Mobility, BYO, Consumerization of IT, BigData, Cloud Computing, Cloud Management Solutions, Dynamic Datacenter and Software Defined Datacenter are the main trends in the IT industry. Virtualization is incorporated in several of these trends.

Virtualization is nothing more than the decoupling of IT resources. The forms of virtualization that are most frequently applied include network, storage, hardware/server, application and desktop virtualization.

Application and Desktop Delivery is a process which has the goal of offering applications independent of location and device, so users can work onsite, online, offsite, offline, anywhere, with any (own) device and at any time. The dynamic delivery of applications is an essential functionality and part of a broader strategy of an optimized Desktop.

When studying and determining which **Application and Desktop Delivery** solution suits with the users and your organization, it is essential to ask three questions:

1. What is the **execution platform** for the applications?

Within the execution platform, system resources such as the CPU, memory, disk and network are used in order to execute the windows, web-architected, rich mobile and mobile web-applications. The most frequently used execution platforms include the following: Desktop, Laptop, Tablet, Smartphone, Virtual Desktop Infrastructure and Server Based Computing (also known as Session Virtualization). The choice of an execution platform is the most fundamental decision made! Applications are either executed locally on a device or centrally in a datacenter. Each execution platform has its own characteristics. In practice, every organization possesses a mixture of device access scenarios. The theories: "Less is more", "Cut out the exceptions" and "Manage diversity" should always be in mind!

2. How will **applications** be made available **on the execution platform**?

An execution platform is great; but if there are no applications available on the platform, the platform is of no real value to the end-user. The second question is this: How will applications get onto the execution platform?! A number of solutions exist for making Windows, web-architected, rich internet and mobile web applications available on the platform. The forms most frequently used with windows applications include **installation** or **application virtualization**, and more recently, **layering**.

With installation, applications are delivered to a windows machine and (typically) "installed" in an unattended manner. The execution platform is altered (e.g. writes to the file system / registry) as a result of the install. Installing applications as "core" components in a base image is also one of the possibilities available.

When applications are made available by means of application virtualization, they are available 'on demand' on the execution platform. No adjustments are made to the platform, the applications are 'isolated' from the core operating system.

Layering is a newer approach that combines the benefits of standard installation and application virtualization. Like application virtualization, layered applications are packaged once, separate from the operating system. They can then be assigned in a modular way to one or more desktops without having to rerun the installation. But unlike application virtualization, layered applications are not isolated – they appear to Windows and each other as if they are natively installed. As a result, layered applications don't have the interoperability limitations and packaging complexities of application virtualization.

3. How are the **execution platform** and the **applications managed** from an **IT-Pro** and from an **end-user** perspective?

An execution platform with a variety of windows, web and mobile applications can be created but how do you manage and maintain this environment?

**Important points to keep in mind!**

- Do you need to manage the environment and/or devices?
- In a Bring Your Own Device (BYOD) scenario where does managing the environment start and where does it ends?
- How is the desktop composed from a user perspective?
- What are the different access scenarios?

These and more questions fit in this third question:

- How do we control, maintain and support the workspace as a concept and as an endpoint device from an IT Pro and end-user perspective?

**“Enterprise Mobile Management”, “Workspace Aggregation”, “Client Device Management”** and **“User Environment Management”** solutions fit in this category.

## 3.2 THE ESSENCE OF APPLICATION AND DESKTOP DELIVERY

Empowering the end-user by giving access to Windows, Web and Mobile applications so he can access data and information systems from both private and public datacenters regardless of the device or location is the ultimate strategic objective.

The **delivery** of the classic (Windows) **desktop** interface can be divided in two segments:

- the **classic desktop** and laptop, running Windows, Linux or Mac OS X;
- the **virtual desktop** running in the datacenter or local on the classic workstation.

In essence **“desktop virtualization”** is the de-coupling of the desktop, operating system and the applications from the underlying endpoint or device. This kind of virtualization can be subdivided into two types:

- With the first type **applications are executed remotely**, server hosted, **and presented at the endpoint via a remote display protocol**.
- With the second type **applications are executed at the endpoint**, client-side and **presented locally**.

The above description outlines the first question: **“What is the execution platform for the applications?”**

In most enterprise infrastructures the majority of applications are either **web-architected** or Windows-based. The ratio of Web vs. Windows applications depends on the vertical, customer, history, legacy, innovation and control of application development. Windows applications are either installed (manually, automatically or integrated in to the base-image) or **virtualized** (using application virtualization or virtual disk layering solutions)

### **Enterprise Mobility Management Smackdown**

The term “Enterprise Mobility Management” (EMM) is used to describe solutions to securely manage devices, applications and data. There are numerous products / solutions available, each using a slightly different approach to support mobility. EMM consists at least of the following key concepts:

- Mobile Device Management;
- Mobile Application Management;

- Mobile Information Management;
- Mobile Expense Management;
- Secure e-mail;
- Secure Data;
- Secure Web browsers.

Read the [Enterprise Mobility Management Smackdown](#) to get a good understanding of what EMM is, what it means to define a Mobile IT strategy, and to learn about some of the available solutions and a feature comparison.

### 3.3 OVERVIEW OF APPLICATION AND DESKTOP DELIVERY SOLUTIONS

Before doing a 'deep dive' into virtual desktop infrastructures, it's important to have an overview of all the 'Application and Desktop Delivery' solutions.

PQR created the "**Application & Desktop Delivery Solutions Overview**" to provide an at-a-glance outline of the various [application and desktop delivery solutions](#). Reading this chapter will give you a complete outline of the diagram and all the application and desktop solutions that are included within it. This paragraph does not aim to describe all application scenarios or their technical advantages and disadvantages, but to give a general idea of the state of union in the application and desktop delivery segment, independent of vendors.

#### Application & Desktop Delivery

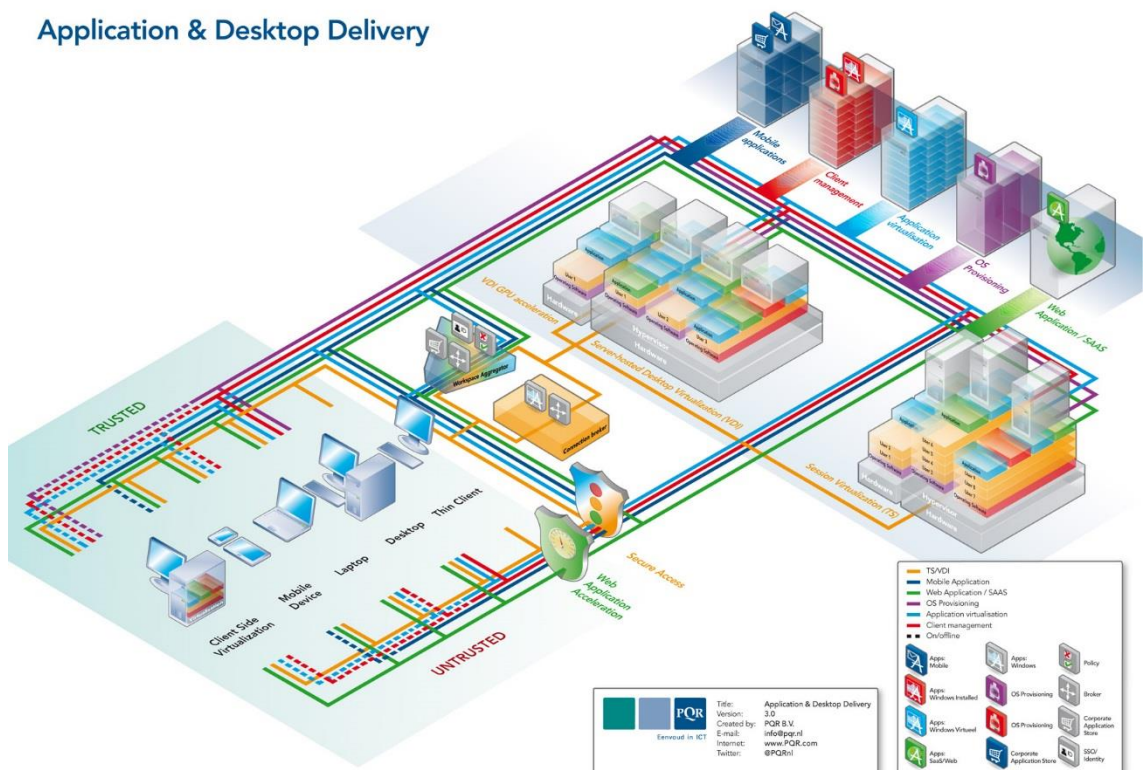


Figure 1, Application and Desktop Delivery Solutions Overview

### 3.4 TRUSTED AND UNTRUSTED WORK PLACE SCENARIOS

Trusted work places are devices that are connected to the existing IT backend infrastructure via wired or wireless network. Untrusted work places are devices that do not have a secure wired or wireless network connection to the existing IT backend infrastructure or devices which aren't centrally managed by the IT department. This is, for example, equipment that is connected to a

separate network segment for security reasons or because it is used from home or at a work experience location.

Each organization has different work place and application delivery scenarios, especially with Bring Your Own Device (BYOD) and Enterprise Mobility the amount of scenario's will increase rapidly. For the IT department, it is important to have a good overview of the various work place and application delivery scenarios, we call this persona or access scenario's, since this indicates how the various users work with the applications and what their requirements are. In the work place scenario's we see 'Client Side Virtualization', Mobile Devices such as smartphones and tablets, Laptops and (Hybrid) Ultrabooks, Desktops and ThinClients being used.

### 3.5 SECURE ACCESS

Secure Access solutions provide secure access for (untrusted) devices to corporate IT. A Secure Access solution could be a full (SSL) VPN solution or a Gateway Services which is targeted for Server Hosted Desktops. Solutions that can be used to realize secure access scenarios include Cisco ASA, Citrix Netscaler Gateway, Juniper SSL VPN, Microsoft Unified Access Gateway (UAG) and VMware View Security Server. A complete overview of Secure Access and Secure Networking solutions has been created and can be downloaded [here](#). A nice Gartner magic quadrant of SSL VPNs can be found [here](#). Functions of Secure Access are:



- Secure Network access, the shield symbol.
- Access to corporate resources, the traffic light. Access can also be fine-grained.

### 3.6 MOBILE APPLICATION DELIVERY

Rich Mobile applications running natively on Apple iOS, Google Android, Blackberry, Windows Phone and Modern Apps on RT or Windows 8.x are delivered by the Mobile Application delivery solution. In enterprise customer scenario's this function is incorporated in most of the Enterprise Mobility Management solutions but it can be a more consumer focused application store as well. Functions of mobile application delivery are:



- Store, an user interface for application access, delivery and reporting functionality.
- Delivery of Rich Mobile Application to a variety of mobile devices.

### 3.7 WEB APPLICATION ACCELERATION

Web Application Acceleration appliances, or application delivery controllers accelerate and secure web-architected applications. We are all confronted with these solutions nowadays: Public facing internet applications such as Google, MSN and eBay all use them. Web Application Acceleration solutions are not just useful for large public organizations, you can also use them for your own web applications. Solutions that facilitate web application acceleration and security include packages such as Citrix Netscaler and F5 BigIP. A nice Gartner magic quadrant of application delivery controllers can be found [here](#).



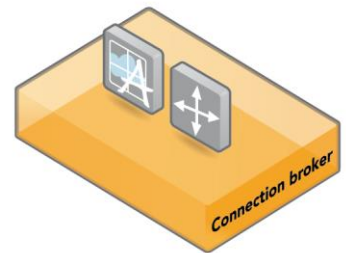
Functions of Web Application acceleration are:

- Secure access to SaaS and Web resources, the shield symbol.
- Fast and optimized access to web applications, the accelerator symbol.



### 3.8 CONNECTION BROKER

A connection broker determines which server-hosted remote applications and desktop will be available to a user. When using a server-hosted virtual desktop infrastructure for this, it is possible to either designate dedicated desktops or a pool of remote desktops. The desktop broker can automatically create, remove or pause remote desktops. There are a number of connection broker suppliers. Citrix - "XenDesktop", Microsoft - "Remote Desktop Services", Dell/Quest - "vWorkspace" and VMware - "View" are the best-known VDI solutions. Depending on the supplier, the connection broker may have additional functions, such as a web interface that can create secure (SSL) connections to remote desktops, Directory Services integration, Full USB support, support for various display protocols and integration with Remote Desktop Services Session Host (formerly RDSH). Depending on the rules, it is possible to execute applications centrally on a server-hosted VDI or on a terminal server.



Functions of this object are:

- Server Hosted Applications and desktops, the grey window with A-application logo.
- The 'compass', who determines which user will get access to which applications or desktops, both persistent and non-persistent.

### 3.9 APPLICATION VIRTUALIZATION

Through application virtualization, Microsoft Windows applications can be used without changing the local operating system or installing the application software at a particular work place. In other words; the application can be executed as if it had been installed locally and can save data and print without the need of any modifications to the local client. Resources such as the CPU, memory, hard disk and network card take care of the execution of these applications.

Application streaming and virtualization can make applications available to desktops, laptops, server-hosted VDIs and Remote Desktop Services Session Host (TS) platforms. The applications are executed on a "client" platform, without needing to modify the platform.

The advantages of application virtualization include: installation, upgrade, roll-back, delivery speed and the ease of application support and management). Installation of applications is no longer necessary, eliminating the possibility of conflicts. The result is a dynamic application delivery infrastructure. Application streaming and virtualization solutions include: Cameyo, Citrix (XenApp) application streaming, Microsoft App-V, Symantec Workspace Virtualization, Spoon and VMware ThinApp. More unique information about application virtualization can be found [here](#).



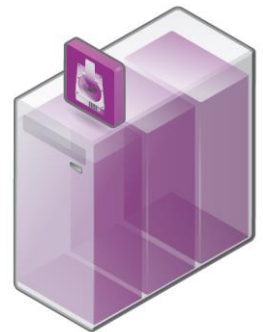
### 3.10 APPLICATION LAYERING

Application layering has recently emerged as an alternative way to package and deliver applications separate from the operating system, without having to reinstall them on every desktop. Applications can be layered by running a standard setup procedure. The changes in files, directories, and Registry keys made by the installation procedure are captured as a

“layer.” When the layer is assigned to one or more desktops, its files and Registry keys are merged with the Windows operating system layer and all other application layers. Layered applications appear in Windows Add/Remove programs, and look as if they are natively installed to Windows and all other applications. The advantages of application layering include: simple installation, upgrade, and roll-back; ease and speed of application packaging; support for Boot 0 applications, device drivers, and other complex applications that cannot be virtualized with traditional application virtualization; and interoperability with all other applications and Windows itself. Application layering solutions include Unidesk and VMware Mirage.

### **3.11 OS PROVISIONING**

OS Provisioning, or Machine Based Imaging, allows workstations to boot up and run from a central image. A single image can be used simultaneously by multiple workstations. The advantage of this is that complete operating systems, including applications and agents, can be made available quickly and securely. It is possible to make a single image available to multiple VDIs, RDS, Client Side Virtualization and physical desktop environments without causing conflicts. As a result, it is possible to upgrade or roll-back an OS quickly, simply, and without significant risks. When virtual desktops use OS streaming, (valuable) storage is saved and the management of virtual desktops becomes relatively simple. This means that virtual or physical machines using OS Provisioning can become - stateless devices. Citrix Provisioning Services and Machine Creation Services, part of the XenDesktop family, Doubletake Flex, VMware Mirage, Dell/Wyse Streaming Manager (WSM), Unidesk and the VMware View Composer are solutions that facilitate OS Provisioning.



### **3.12 SERVER-HOSTED DESKTOP VIRTUALIZATION (VDI)**

A Server-Hosted Virtual Desktop Infrastructure (VDI) is a dedicated remote desktop solution providing remote access to Windows XP/Vista/Win7/Win8/server2008/Server2012 or Linux desktops. The virtual machines are running from within the data center. The virtual infrastructure increases the system's independence, availability and manageability. The implementation of Server-Hosted VDIs means that desktops are no longer bound to a location or end-user appliance. Each user can have their own unique, personalized, fully independent work place. Programs run and data is processed and stored on a centralized personal desktop. The information is sent to the client screen via a remote display protocol such as Microsoft RDP/RemoteFX, Citrix ICA/HDX, Teradici/VMware “PC-over-IP”, SPICE or VNC. The protocol used for displaying the correct information depends on the operating system, bandwidth, the type of application, and the technical facilities. As with other desktop delivery solutions, VDI consists of various infrastructure components that facilitate management, provisioning, application delivery, personalization, load balancing, session control and secure access to virtual machines. Microsoft, Citrix, Dell/Quest, Oracle, Unidesk, Virtual Bridges, RedHat and VMware are all important suppliers within the server-hosted VDI segment.

### **3.13 VDI WITH GPU ACCELERATION**

“Graphical Processor Unit (GPU) acceleration” functionality can be added to the server-hosted VDI solution. It provides each (virtual) machine with graphic performance to run multimedia, 2D/3D, NextGen and CAD/CAM applications.



Display data is presented to the client device via an optimized remote display protocol. To ensure that the end-users experience the best possible performance, the bandwidth, latency, or local (software) components have to meet extra requirements.

### 3.14 SESSION VIRTUALIZATION (TS)

With session virtualization every user has his or her unique terminal server *session*. Session Virtualization, also known as Terminal Services, is a solution for the remote access to desktops and applications that are run on a terminal server in a data center. Access to the desktop or application is not tied to a location or end-user machine, and programs are executed centrally on the terminal server.

The data appears on the client screen through a remote display protocol such as Microsoft RDP/RemoteFX or Citrix ICA/HDX. Remote Desktop Services consists of various infrastructure components for management, load balancing, session control and support. It has the advantage that applications are made available quickly and securely, the TCO is low, and applications can be accessed irrespective of location or work place. Suppliers of Remote Desktop Services Session Host (TS) include Citrix, Ericom, Microsoft and Dell/Quest.

### 3.15 CLIENT-SIDE VIRTUALIZATION

Client-side Virtualization is a dedicated local desktop where the virtual machines run locally on the client device. The hypervisor ensures that each virtual machine is hardware-independent, and makes it possible to simultaneously use a number of virtual machines at the same workstation. The hypervisor plays an essential part in client-side VDI solutions while the management portion handles synchronization, policy, enforcement and management insights. The two types of Client-side Desktop Virtualization solution are:

- **Type 2 - 'client hosted' hypervisor** is installed and runs as an application on the operating system (be that Windows, Mac OS X or Linux) of the end device. (Examples are: Citrix DesktopPlayer for Mac, Microsoft Virtual PC, MED-V, MokaFive, Parallels Desktop, Oracle VirtualBox, VMware Fusion/Workstation and VMware View Client with Local Mode)
- **Type 1 - 'bare-metal' client hypervisor** acts as the device's base operating system and must be installed before other operating systems. (Examples are: Citrix XenClient, Citrix XenClient Enterprise - formerly Virtual Computer NxTop - and Windows 8 HyperV)

The main differences between type#1 and type#2 hypervisors are hardware support, performance, manageability and end-user experience.

### 3.16 WORKSPACE AGGREGATION

The term Workspace Aggregator is used to describe software that unifies the delivery of multiple application or desktop types such as:

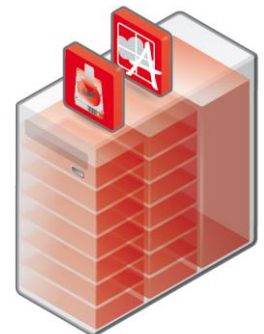
- Native mobile applications;
- Software as a Service (SaaS) applications;
- Mobile web applications;
- Windows Applications via application virtualization or installation;
- Desktops, local, server Hosted Virtual Desktops (VDI) or published Desktops in SBC.



A workspace aggregator also evaluates the user’s device to determine which applications are available for this user on this particular device and at this particular time (context-aware access). Next to application delivery, workspace aggregators provide secure file data access from a broad range of devices. A workspace aggregator simplifies the deployment and life cycle management of applications. As the single point of access, (de)provisioning, auditing and monitoring is easily accomplished through security rules and policy enforcement. Workspace aggregators that are available at the market today also provide Single Sign On capabilities to applications. ‘Workspace aggregation’ is a strategic function in the future’s workspace which is independent from hardware and is OS and browser neutral. Workspace aggregators will mature and become more and more complete over the next time.

### 3.17 CLIENT MANAGEMENT

Any self-respecting professional IT organization is bound to use a Client Management solution, as it is needed to facilitate things such as OS deployment, patch management, application and client deployment, asset management, service desk integration, and remote control. Example of client management systems are Altiris/Symantec Client Management, IBM BigFix, LANdesk Client Management , Microsoft System Center Configuration Manager (ConfigMgr/SCCM) and Novell ZENworks Configuration Management (ZCM). A nice Gartner Magic Quadrant of “Client Management tools” can be downloaded [here](#).



Functions of Client Management (in the context of Application and Desktop Delivery) are:

- Deliver and manage Windows applications
- Deliver and manage Windows Operating systems

### 3.18 VENDOR MATRIX, WHO DELIVERS WHAT

In this whitepaper various vendors are mentioned. A vendor overview is provided in this matrix.

Vendor	Product	Solution
Citrix	XenDesktop	VDI
Citrix	VDI-in-a-Box	VDI
Ericom	PowerTerm WebConnect	VDI
Microsoft	VDI with RemoteFX	VDI
RedHat	Enterprise Desktop Virtualization	VDI
Dell	vWorkspace	VDI
Virtual Bridges	VERDE	VDI
VMware	View	VDI
Ericom	RDP/Blaze	Remote Display Protocol
Citrix	HDX-ICA	Remote Display Protocol
HP	RGS	Remote Display Protocol
Microsoft	RemoteFX/RDP	Remote Display Protocol
Dell/Quest	EOP/RDP	Remote Display Protocol
Oracle	ALP	Remote Display Protocol
Virtual Bridges	SPICE	Remote Display Protocol
VMware/Teradici	PCoverIP	Remote Display Protocol
Teradici	PC over IP	SH- Physical Desktops
Ericom	PowerTerm WebConnect	SH- Physical Desktops
HP	Remote Graphics Software	SH- Physical Desktops
Citrix	XenDesktop HDX3D Pro	SH- Physical Desktops
VMware	View	SH- Physical Desktops
Citrix	XenClient	CSV, baremetal
Citrix	XenClient Enterprise	CSV, baremetal
Microsoft	Windows 8 Client Hyper-V	CSV, baremetal
Virtual Bridges	LEAF	CSV, baremetal
Citrix	DesktopPlayer for Mac	CSV
Microsoft	MED-V (MDOP)	CSV
VMware	Player/Fusion/Workstation/View	CSV
Bromium	vSentry	CSV, Security
Double Take	Flex	OS Provisioning
Citrix	Provisioning Services / MCS	OS Provisioning
Citrix	Personal vDisk (former RingCube)	OS Provisioning++
Quest/Dell	HyperDeploy	OS Provisioning
VMware	View Composer	OS Provisioning
VMware	Mirage	OS Provisioning++
Unidesk	Unidesk	OS Provisioning++
Virtual Bridges	Dynamic Gold Imaging	OS Provisioning
Dell/Wyse	Streaming Manager (WSM)	OS Provisioning
Microsoft	Windows Server 2008R2/2012	Session Virtualization
Citrix	XenApp	Session Virtualization
Dell/Quest	vWorkspace	Session Virtualization
Cisco	ASA	Secure Access
Citrix	Netscaler Gateway	Secure Access
Ericom	Ericom Secure Gateway	Secure Access

Vendor	Product	Solution
Microsoft	Unified Access Gateway	Secure Access
Juniper	SA	Secure Access
VMware	View	Secure Access
Citrix	Application Streaming	Application virtualization
Cameyo		Application virtualization
Microsoft	App-V	Application virtualization
Symantec	Workspace Virtualization	Application virtualization
Spoon	Spoon	Application virtualization
VMware	ThinApp	Application virtualization
VMware	Mirage	Application layering
Unidesk	Unidesk	Application layering
IBM	BigFix	Client Management
LANDesk	Client Management Suite	Client Management
Microsoft	System Center Config Manager	Client Management
Novell	ZenWorks Configuration Mgr	Client Management
Symantec	Client Management Suite	Client Management
RES	Automation Manager	RunBook Automation
Citrix	Cloud Gateway	Workspace Aggregator
VMware	Horizon Suite	Workspace Aggregator
Centrix	Workspace Universal	Workspace Aggregator
Framehawk	Framehawk	Workspace Aggregator
Airwatch	Enterprise Mobility Mgmt Suite	Mobile Application
Appsense	MobileNow	Mobile Application
Cisco	Meraki	Mobile Application
Citrix	XenMobile	Mobile Application
Good	For Enterprise	Mobile Application
Microsoft	Windows Intune	Mobile Application
MobileIron		Mobile Application
Symantec	Mobile Management Suite	Mobile Application
VMware	Horizon Mobile	Mobile Application

Table 1, Application and Desktop Delivery overview of solution area, products and vendors.

## 4. DESKTOP VIRTUALIZATION

The previous chapter gave an overview of 'Application and Desktop Delivery' solutions. This chapter describes 'desktop virtualization' in more detail.

### 4.1 INTRODUCTION

Virtualization is the act of isolating or unbinding one computing resource from others. Or - put another way - the process of decoupling layers of IT functions so that configurations of the layers become more independent of each other. As a result, virtualization masks the specific nature of IT resources from users. A user sees the function not the resource that delivers the function.

Making Windows, Web and Mobile applications available to the end-user, regardless of the technology being used, is an important strategic objective of an advanced IT infrastructure. The Virtual Desktop (vDesktop) is an essential component in the range of Application and Desktop delivery solutions and in essence, it provides the following functions:

- **Flexibility:** Detach the vDesktop from the endpoint; Several vDesktops can be used next to one another
- **BYO:** enables delivery of applications and desktops for BYO scenario's;
- **Access:** vDesktop works independently of location, endpoint and network;
- **Security:** Server Hosted – VDI; data in the computing center;
- **Freedom:** Every user can have his own desktop with administrator privileges when needed;
- **Management:** Centrally managed and hardware independent;
- **Legacy:** It is simple to offer legacy applications on a state-of-the-art platform;
- **Sustainability:** Power Management, handling the necessary resources in an efficient manner

### 4.2 USER CENTRIC COMPUTING

Users want applications and data to be available from a mix of devices (phone, tablet, desktop, laptop etc.) Some devices are "managed", others are "unmanaged". A variety of technology solutions are often used to provide applications to users depending on the scenario.

More and more people are designing, building and maintaining a hybrid-style, flexible application and desktop delivery solutions. Delivery of applications and data to the user needs to be transparent. Transparent means that applications, desktop delivery, user environment management "personal, user-centric" and based on "Access Scenarios". These scenarios should contain:

- User/Role/Persona
- Applications/Services
- Devices
- Location
- Context Awareness

The goal of "User Environment Management" is to deliver and maintain a User Workspace in a clear, visible and predictable way independent of the Application and Desktop Delivery concept and understand the context of the user Access Scenario. Having a clear view of the access scenarios, also known as personas, is essential and crucial for a complete Application and Desktop Delivery strategy. The focus is on the user context:

**Who:** Users; groups

**Which:** Device; capabilities managed and un-managed

**Where:** Location; Online, Offline, offsite and onsite

**What:** Applications, IT and end-user driven; services, resources, data content

**When:** 24x7, specific times

With Enterprise Mobility and "Consumerization of IT" a well-defined strategy around Enterprise Mobile Management (EMM) is also key.

At the end of the day, customers will have a **hybrid** Application and Desktop Delivery infrastructure. For the end-user, the business consumer, application access needs to be **transparent**.

Access scenarios need to be clear and profound and be part of the overall Application and Desktop Delivery Design process.

### 4.3 DESKTOP VIRTUALIZATION TYPES

Desktop Virtualization is the detachment of the desktop, the operating system and the end-user applications from the underlying endpoint or device. This kind of virtualization can be subdivided into two main categories:

**Server Hosted** - is where end-user applications are executed remotely and presented at the endpoint via a remote display protocol. Within this there are 3 types:

- Shared desktop (RDSH) – session virtualization
- Personal virtual desktop (VDI) – Virtual Desktop Infrastructure
- Personal physical desktop - (BladePC)

**Client Side** - is where applications are executed at the endpoint and presented locally on this workstation.

Within this category there are 2 types:

- Bare-metal (type #1) client hypervisor
- Client-hosted (type #2) hypervisor

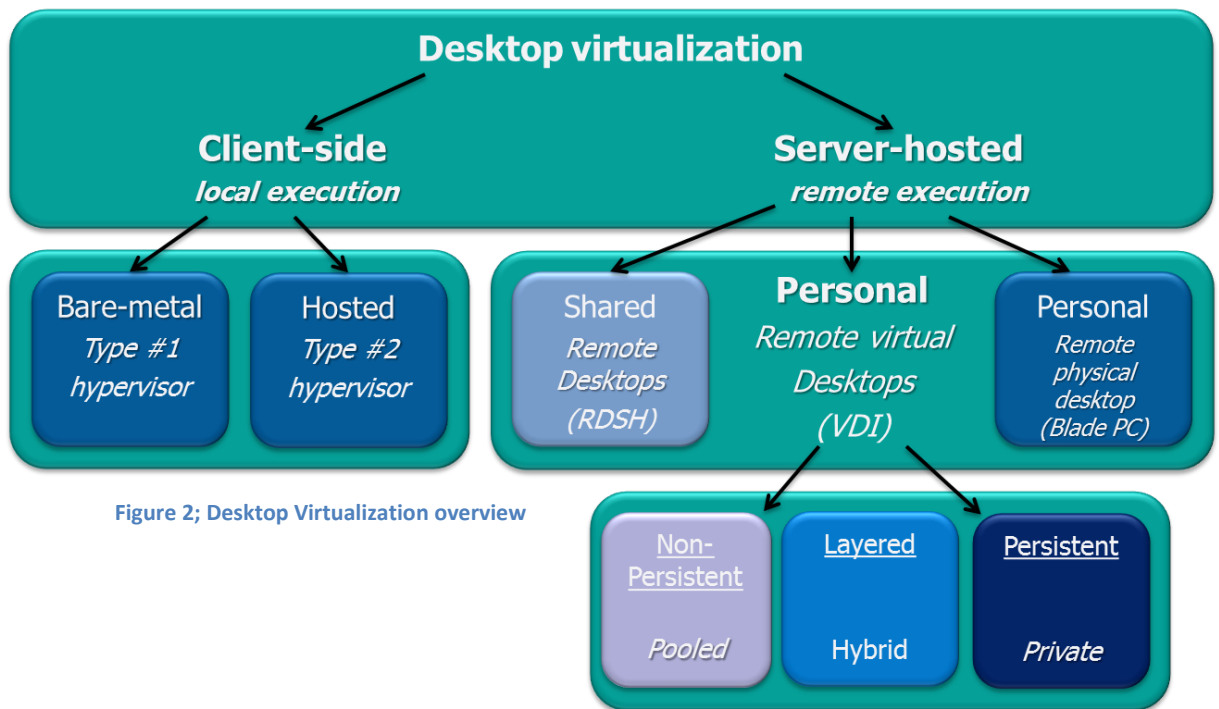


Figure 2; Desktop Virtualization overview

## 4.4 SERVER HOSTED DESKTOP VIRTUALIZATION DIRECTIONS

The different desktop virtualization solutions are outlined in the following paragraphs.

### 4.4.1 Server Hosted Virtual Desktop (VDI)

Server hosted Virtual Desktops (SH-VDI) is a solution for accessing Windows 7/8 or legacy Windows XP desktops that are executed remotely on a virtual machine in the datacenter. The Virtual Infrastructure ensures availability and manageability. Other frequently used terms for this type of desktop virtualization include: Virtual Desktop Infrastructure (VDI), Remote Desktop Services Virtualization Host.

### 4.4.2 Non-persistent, persistent and layered virtual desktops

Typically, server-hosted Virtual Desktops have come in 2 flavors: **non-persistent** desktops, in which users are given a fresh / new virtual machine every time they login, and **persistent desktops**, in which users are assigned a dedicated virtual machines that remains the same every time they login. Non-persistent desktops are often called stateless desktops because they will always revert back to their original state. Persistent desktops are often called stateful desktops because they give users the freedom to install software and make workspace-related adjustments by saving changes i.e. the state of the workspace, between sessions.

#### Stateless Desktops

The advantages of non-persistent (stateless) desktops are:

- simple roll-out and update of basic images
- A virtual desktop is guaranteed to be 100% identical
- The user always has a clean desktop
- Less effort is required by the management team due to the standardization of images
- Less storage is required because a single base operating system image can be shared across many desktops.

The major disadvantage of non-persistent desktops is that any customizations made by users and any applications that are delivered outside of the base image by IT are lost after each desktop reboot. In an effort to make stateless, non-persistent desktops act more like persistent desktops, VDI vendors have recommended profile management tools to restore user customizations each time users log in to their new virtual machines, and application virtualization tools to deliver different applications outside of the base gold image. User-installed applications and deep OS and application security settings that live outside of profiles cannot be captured and restored by profile management tools.

### **Stateful Desktops**

The advantages of persistent (stateful) desktops are:

- Freedom to install software within the desktop;
- Maintaining all changes to the operating system between reboots.

The major disadvantage of persistent desktops is the high cost. Most enterprises cannot afford the high costs of SAN storage required to implement full-sized, thick-provisioned virtual machines for every user. Persistent desktops also offer little operational cost savings, since they are managed one at a time like physical PCs, using the same agent-based PC management tools.

### **Layered Desktops**

A new technology has recently emerged that gives administrators a new virtual desktop provisioning and management option for VDI: "layering." Layering combines the benefits of stateful and stateless desktops in one solution. With layering, a persistent virtual machine is assigned to every user, guaranteeing that all customizations will be remembered through reboots and base image updates. User-installed applications, applications that IT installs directly on behalf of an end user (often required to satisfy "one-off" or ad hoc application requests), on the end-user's desktop, display settings, application customizations, and all other changes are sustained in each persistent desktop's Personalization layer, just as they would on a physical PC. This makes the layered virtual desktops stateful.

However, the persistent virtual machines are dynamically constructed from a shared, reusable set of stateless Operating System and Application layers that can only be created and assigned by IT. The advantages of layered desktops are:

- Freedom to install software within the desktop
- Maintaining all changes to the operating system between reboots
- The simple roll-out and update of basic images
- A virtual desktop is guaranteed to be 100% identical at the OS and App levels
- The user can always be reverted back to a clean desktop
- Less effort is required by the management team due to the standardization of images, simpler application packaging and ability to rollback or "undo" OS and application patches
- Less storage capacity is required because a single base operating system image and single image of common applications can be shared across many desktops.

A disadvantage of layering is that some of the vendors offer a solution supported in Server Hosted VDI environments only. However, the fact that there are now hundreds of real world customer implementations of layered desktops, many with over 1,000 users in production, indicates that VDI-only layering solutions are being generally accepted by the market.



### Use stateless, stateful, or layered!?

So, which is better, stateless, stateful?, or layered??! The answer to this question depends on the functionality that the end-users require and the impact of this functionality on the ICT department.

#### 4.4.3 Server-Hosted (virtual) Desktop with GPU Acceleration

An optimum experience has not yet been gained by the end-user with Terminal Services and Server Hosted VDI when using graphic intensive 2D/3D and NextGen (WPF/DirectX) applications. A significant reason for this is the fact that the presence of graphic processor unit (GPU) is lacking in the (current) virtual desktop. There are three ways to deliver GPU functionality on a Server Hosted (virtual) Desktop:

1. **GPU Passthrough;** A physical GPU can be used by a Virtual Machine when the Hypervisor (such as Citrix XenServer) is able to deliver full GPU (pass-through) support to a Virtual Machine. In this scenario the GPU isn't shared and has a 1:1 relation with the Virtual Machine. Multiple GPUs can be inserted. This scenario delivers all GPU functionality such as DirectX and OpenGL to the Virtual Machine which is important to resource intensive applications such as CAD, 2D and 3D. Citrix XenDesktop in combination with XenServer delivers this with Citrix XenDesktop HDX 3DPro and XenApp HDX 3D and is able to use the GPU to compress the HDX display protocol which increases User Experience and lowers the bandwidth for WAN scenarios.
2. **GPU Sharing** or Virtualization; a physical GPU can be used by multiple Virtual Machines if the Hypervisor such as Microsoft Hyper-V is able to deliver a Virtualized GPU to the Virtual Machine. This approach can have some limitations (e.g. level of support for OpenGL or DirectX). Microsoft Hyper-V in combination with RemoteFX supports GPU sharing. Nvidia has done a lot of work in this area with Grid (formerly VGX) graphics cards. "VGX is the name of the upcoming Hypervisor from NVIDIA", the NVIDIA Grid GPU's will be the first GPU's from NVIDIA that will support the upcoming VGX hypervisor that will work with Citrix XenServer and VMware vSphere.
3. **Dedicated GPU:** A physical desktop (typically a "workstation blade" running in a datacenter is another way to deliver resource intensive applications to remote clients. This scenario is most applicable for very high end workloads where maximum GPU resources / functionality are needed for applications such as CAD, 2D and 3D. Citrix XenDesktop, XenApp and VMware View with Teradici host cards can be used in this scenario. Citrix XenDesktop HDX 3DPro and XenApp HDX 3D are able to use the GPU to encode/decode and compress the HDX display protocol which increases User Experience and lowers the bandwidth for WAN scenarios..

## 4.5 VDI STRATEGY

The transition to a dynamic and optimized desktop is causing many IT organizations to reevaluate traditional IT operations, deployment, delivery, packaging, support, and management methods.

Desktop virtualization is a key component in the optimized desktop. It's important to have a **Vision** and **Strategy** around application and desktop delivery and enterprise mobility. Designing, building, managing and maintaining the desktop virtualization infrastructure using the right **Technologies**, corresponding vendors and products is an important step.

We see a lot organizations primarily focusing on **products** and **vendors** and lacking a clear and profound vision and strategy. This approach is fine for a point solutions but a proper vision and strategy is crucial for a vNext optimized desktop. How can the vision and strategy be successful? **Success = Vision x Execution x Adoption!**

The following *discussions* and corresponding *topics* should be part of the optimized desktop strategy:

- What are the **use-cases**? Does the use-case require Desktop Virtualization?
- **VD-why**, what do you want to **achieve**, a **business enabler**, overall cost of ownership (**TCO**) and **cost reducer**?
- What is the **business-case**? What do you expect as a ROI?
- Are you investigating a **tactical** (point)-or **strategic** solution? What do you want to solve?
- Is **work shifting** a key driver for the optimized virtual desktop? How are the **roaming/flexible** and mobile users within the organization facilitated? How do you take care of application and desktop delivery when the user has different **access scenarios**?
- How do you deliver applications to users in a **Bring Your Own** (BYO) or Choose Your Own (CYO) scenario?
- What's your desktop delivery and **migration** strategy for **Windows 7/Windows 8**?
- What is your application and desktop delivery model? Is delivery of applications/desktop focused on **SaaS, Enterprise, SMB** or the **Consumer** space?
- Is the VDI deployment targeted for small, medium or enterprise environment? Is the solution **easy to deploy** and easy to **maintain**?
- What's the **user experience** using Multimedia, Video/Voice, 2D/3D applications?
- Is **Unified Communications** and **VoIP** functionality within VDI needed? Is it supported by the VDI and UC-vendor?
- What are the user **expectations** of the vDesktop? Are **users involved** in a proof of concept and pilot? What are their acceptance criteria?
- What **endpoints** do we support and facilitate and what is the role of these devices in the end-user experience? Are the **endpoints managed** by the IT organization?
- Do you want to **deliver** windows and web **applications** to mobile devices such as **tablets and smartphones** via VDI? What does the user wants? What is your enterprise mobility strategy?
- **Secure Access and Secure networking**; [SASN](#) how do users, with a variety of endpoints (rich, thin or zero clients and mobile devices) connect to the vDesktop?!
- What is the **impact** of [Secure Access and Secure Networking](#) solutions on mobile devices while connecting to the vDesktop? What is the **user experience** with these secure access solutions?
- Does the VDI solution needs a client/**agent** component on the **endpoint**? Is there a supported agent for the OS/endpoint? What is the **User Experience** with this agent? What is the feature and future roadmap of these agents? Is agentless via **HTML(5)** included and important?
- Is **image deployment** and **management** part of the (virtual) Desktop Strategy?
- How do you design and build the **user's profile** and his '**workspace**'? Does Application virtualization fit into this strategy? The '[User Environment Management](#)' Smackdown can be helpful.
- Do we need a **vMachine based image management** solution?
- How do we design, build and maintain the (golden) Image(s)?
- Do you need **context awareness**? Based on user/role, device, location and various settings is access to application resources controlled and enforced when needed?
- What is your application **readiness assessment** strategy? Are Windows 7, Windows 8, VDI, application virtualization and x64 included?

- How are Windows applications delivered within the vDesktop? Unattended or manual installation, **application virtualization** or the applications are part of the (golden) image? What is the strategy?
- Do you want to **integrate** and run **local applications** in the centralized desktop environment and present centralized and local applications in one single interface to the end-users?
- Does the end-user needs the ability to install and update applications? Is **User Installed Applications** functionality needed? Does the user have the correct privileges to install or update software?
- What is the performance and storage impact of **application virtualization in combination with VDI**? Is this important from a business-case or technology perspective?
- Do you need **local** or **centralized** storage? What storage optimization (IOPS/latency) technology is being used?
- What is the **impact** on **storage** (<http://bit.ly/5HTajV>) and how does it affect the business case?
- Do we focus on **stateless** (non-persistent) and/or **stateful** (hybrid/persistent) **images**? What is, for example, the impact on storage, manageability, security, legal and business-case?
- What is the **impact** of **client management** solutions in a **stateless** VDI scenario? Is it supported?
- **Windows 8** or Windows 7 as core guest **OS** platform? x64 or x86?
- How does the solution scale? What do we need from a **scalability** point of view?
- Is there a validated design?
- How do we **size** the vDesktop and corresponding infrastructure and what are the [best-practices](#) for **optimizing** the vDesktop?
- What is the performance and bandwidth **impact** on the **network infrastructure**; LAN, WAN, WLAN, Mobile;
- **Licensing**; VDI solution, guest and client operating system, Client Access Licenses and (Business) Applications.
- What is the (business) applications **vendor support** policy for virtualized desktops?
- Do we need to **backup** (and restore) the vDesktops?
- Is **Antivirus** needed? Inside the VM or as layer on the Hypervisor? What is the real performance impact of Antivirus?
- What is your **site topology**? Multi-site, multiple datacenters?
- Is the VDI solution as a whole **highly available**? Is that built-in or are additional planning and solutions needed to get high availability? Is a highly available vDesktop needed?
- Is the IT department able to **adopt** the technology with right **knowledge** and **skills**? What subject matter experts are needed to get and keep the VDI solution up and running in production environment? Is this **expertise** available? Who has **overview** of the complete VDI solution stack?
- Is the VDI vendor a **financially healthy** organization? Is this important in evaluation of the vendor and the solution?
- Is there a huge **ecosystem** with **partners, consultancy, training and education** around the VDI solution? Is this important for you?
- Is **separation** of Operating System - Application - and User Preferences inside and outside the vDesktop part of the overall strategy?
- How does the desktop virtualization solution fit into existing deployment and management tools?
- **Bottom Line: What's your current Enterprise Mobility strategy?!**

## 4.6 MICROSOFT LICENSING FOR VDI SOLUTIONS

The [Microsoft VDI and Windows VDA Frequently Asked Questions](#) publication describes that Microsoft offers two options for licensing access to the virtual desktops.

### 1. Remote Desktop Services CAL (RDS-CAL):

A Remote Desktop Services CAL (RDS-CAL) license can be used for the Microsoft VDI infrastructure, irrespective of whether VMs or sessions are deployed. The RDS-CAL includes the possibility to virtualize applications using App-V.

It is optional to include the Microsoft Desktop Optimization Package to add application virtualization capabilities of App-V to the VDI environment. And because System Center Virtual Machine Manager (SCVMM) use rights are now part of System Center Configuration Manager (SCCM) Client Management License (CML) with active SA, you can use SCVMM when SCCM CML are available or acquired.

### 2. The VDI Suite

The VDI Suite license includes a RDS-CAL that is restricted to deploying VMs only (no session virtualization), as well as a Client Management License (CML) for Configuration Manager that's restricted to Virtual Machine Manager only. The VDI Suite licenses can be purchased with the option to include MDOP or not.

Both options require Windows Software Assurance (SA) or Windows Virtual Desktop Access (VDA) rights for the client endpoint devices. SA and VDA are device-based annual subscription licenses. Thin clients and mobile devices accessing the virtual desktop also need a VDA subscription license.

The VDI Suite is only available in the device subscription license model.

Feature	RDS CAL	VDI Suite
RDS session virtualization	✓	✗
RDS virtual desktops	✓	✓
SCVMM	✗	✓
MDOP (included App-V / MED-V)	✗	✗
App-V for RDS	✓	✗
RDS brokering for published apps (RemoteApp)	✓	✓

Table 2, Microsoft licensing for VDI solutions

### ROAMING USE RIGHTS AND COMPANION SUBSCRIPTION LICENSE

Both the SA and VDA subscription licenses are applicable to roaming use rights. This means that a user with SA or VDA on its primary device in the office, also can access the virtual desktop from a device off-premises (at home or elsewhere). However, accessing the virtual desktop when on-premises using a different device (e.g. from home) means that device needs a VDA subscription on its own.

As of Windows 8, a Companion Subscription License (CSL) has been introduced to enable bring your own device (BYOD) scenarios. The Windows CSL is an optional subscription add-on which

grants the primary user of a licensed device the rights to access a corporate desktop through either a VDI or Windows To Go on up to four devices capable of leveraging these technologies. This applies to on-premises and off-premises scenarios. Devices eligible for licensed use include any type of personally owned device as well as corporate owned non-x86 devices. A Windows RT tablet owned by the company includes Companion VDA right, which means no extra subscription licenses are needed.

#### **FREQUENTLY ASKED QUESTIONS**

##### **1. How does Microsoft Office licensing work in VDI environments?**

To be allowed to use Microsoft Office in the virtual desktop, you need to have a Volume License and Software Assurance for Microsoft Office on the user's primary desktop. This also provides Office Roaming Use Rights for that primary user, enabling access from third-party devices such as a home PC or Internet kiosk. There isn't a Companion Subscription License for Microsoft Office as there is with Windows 8. However the primary user of a device licensed with Microsoft Office and Software Assurance is allowed access to Microsoft Office through a VDI desktop on one personally owned device (BYOD) on-premises.

##### **2. What's the difference between CSL and CDL?**

Nothing. CSL as mentioned in this document stands for Companion Subscription License. CDL is short for Companion Device License. The two terms are used both by Microsoft. CSL however tends to get in all official published articles.

##### **3. How to license Windows 7/8 Desktop as a Service (DaaS) scenarios?**

Microsoft only provides a Service Provider License Agreement (SPLA) for Windows Server. This SPLA cannot be used for Windows 7 and Windows 8 as these are Windows Desktop Operating Systems. For a service provider to provide dedicated outsourcing to customers, the licenses for Windows 7/8 need to be bought by the DaaS customer. The licenses needed are thus the same as when hosting the VDI infrastructure in house. This applies to the Windows Desktop Operating System with Software Assurance (or the Virtual Desktop Access (VDA) Subscription license) and required Client Access Licenses (CALs).

As the [Providing Desktops as a Service licensing guide](#) states, the service provider also has a BIG restriction to comply with. The service provider needs to have a fully dedicated physical server environment in place per customer.

# Licensing Windows SA, VDA, and CSL

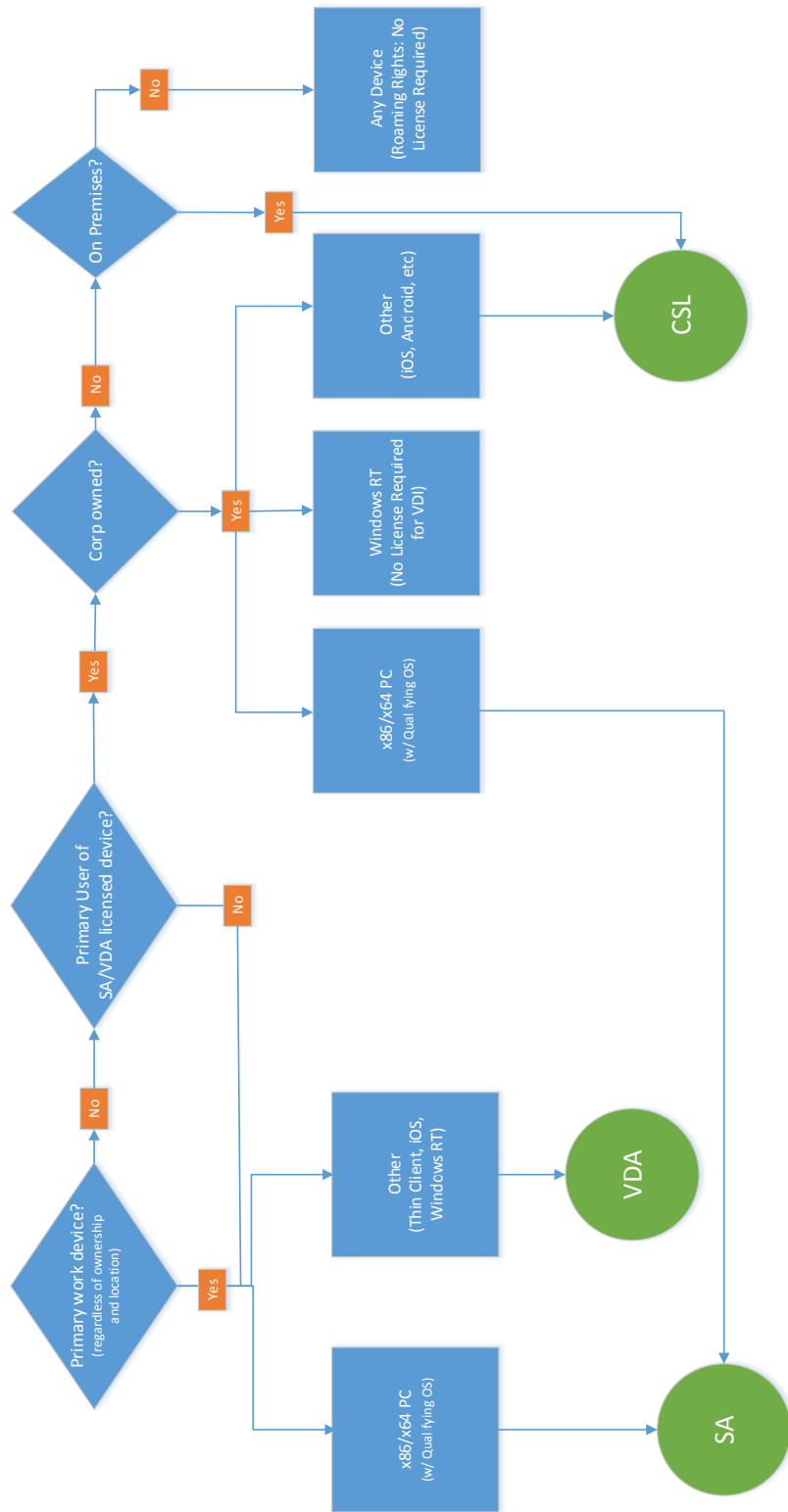


Figure 3, Licensing Windows SA, VDA, CSL

## 4.7 HTML5

More and more vendors are delivering an HTML5 remote access client for VDI.

### Pros

- Ease of deployment – no need to install anything (no need for client, flash, java, ActiveX)
- Useful for situations where a client cannot be installed (locked down machine / kiosk)

Most of the HTML5 remote access solutions delivers basic features such as publish desktop or applications and not the advanced features such as printing, USB redirection, HQ and High-speed audio/video. An interesting list of features can be found [here](#).

### Cons

- Needs HTML 5 capable browser with support for Canvas and Websocket
- Knowing it will work across a range of browsers could be “hit and miss”
- Less functionality
- Perceived performance and User Experience with HTML5 compared to native
- Performance impact on end-point

### Vendors

- [Ericom with AccessNow](#)
- Citrix XenDesktop and XenApp with [Receiver for Web](#)
- [VMware with Horizon with View 5.2 and Workspace](#)
- [RemoteSpark](#)
- [Cybele Software - ThinRDP](#)

Do you want to know how HTML5 remote desktop clients work? Read Gabe’s great blog [here](#).

## 4.8 WORKSPACE AGGREGATION

The term Workspace Aggregator is used to describe software that unifies the delivery of multiple application or desktop types such as:

- Native mobile applications
- Software as a Service (SaaS) applications
- Mobile web applications
- Windows Applications via application virtualization or installation
- Desktops, local, server Hosted Virtual Desktops (VDI) or published Desktops in SBC

A workspace aggregator also evaluates the user’s device to determine which applications are available for this user on this particular device and at this particular time (context-aware access). Next to application delivery, workspace aggregators provide secure file data access from a broad range of devices. A workspace aggregator simplifies the deployment and life cycle management of applications. As the single point of access, (de)provisioning, auditing and monitoring is easily accomplished through security rules and policy enforcement. Workspace aggregators that are available at the market today also provide Single Sign On capabilities to applications. The main vendors who deliver workspace aggregation functionality today are:

- [Centrix Workspace Universal, Citrix, Cloud Gateway, FrameHawk, VMware Horizon Suite](#)

“Workspace aggregation” is a strategic function in the future’s workspace which is independent from hardware and is OS and browser neutral. Workspace aggregators will mature and become more and more complete over the next time.



## 5. VENDORS AND THEIR SOLUTIONS

### 5.1 INTRODUCTION

To get an overview of the major players in the Virtual Desktop Infrastructure (VDI) space, a number of solutions are explained in this chapter (sorted alphabetically by vendor). The goal of this chapter is to enable a better understanding of the options in this space from a vendor perspective.

### 5.2 ERICOM POWERTERM WEBCONNECT

#### INTRODUCTION

Ericom provides organizations of all sizes and industries with access to applications, desktops and data running on Microsoft RDS / Terminal Services, VDI, Cloud platforms, and other systems, from a broad range of end user computers and mobile devices. Ericom Software provides several product lines, offering secure access to physical and hosted resources running in the data center. These products are available both as individual building blocks, as well as part of **PowerTerm WebConnect** - a comprehensive access solution. PowerTerm WebConnect provides secure, centrally managed access to applications, virtual / physical desktops and data, running on Microsoft RDS / Terminal Services, VDI (Hypervisor-agnostic), Cloud platforms, from a broad range of end user devices, including mobile and Chrome-based client platforms.

Ericom's goal with PowerTerm WebConnect is to provide organizations of all sizes and industries with a full-featured connection broker that is secure, cost-effective, and simple to deploy and operate. PowerTerm WebConnect enables users to connect to remote applications and desktops from any device (using Ericom's **AccessNow HTML5** or **AccessToGo Mobile** remote access RDP clients). Leveraging **Ericom Blaze RDP** acceleration technology, PowerTerm WebConnect also provides fast RDP communications and an accelerated user experience to users connecting over slow and low bandwidth connections.

For more details see <http://www.ericom.com/powerterm-webconnect-products>

**AccessNow** – Ericom's clientless HTML5 RDP client is a BYOD access solution catering for the wide variety of devices that IT staff must manage. It provides browser-based access to Windows desktops and applications, physical or hosted in VDI and Terminal Services (RDS) environments, from any device supporting an HTML5-compliant browser. AccessNow enables using RDP on any device or OS: PC, Mac, smartphone, tablet, Google Chromebook or locked down workstation with no software to install on the end-user device, minimizing support requirements and help desk workload. For more details see <http://www.ericom.com/rdp-clients>

**AccessToGo** – Ericom's Native Mobile RDP clients for Mobiles / Chrome (free or accelerated) offers the fastest remote desktop access to physical and virtual Windows desktops and hosted applications from the leading smartphones and tablets, as well as Chromebooks and other devices running Chrome OS. AccessToGo mobile RDP clients are available in two modes: standard RDP (Free) and accelerated, and can be used in unmanaged and centrally managed environments. For more details see <http://www.ericom.com/rdp-clients>

Extending Windows apps / desktops to tablet and smartphone form factors, PowerTerm WebConnect with AccessToGo and AccessNow RDP clients provides the flexibility and performance needed to support apps on-demand and BYOD policies, supporting all users who need to roam between device types, locations and networks with a consistent work



environment that is easy to use, centrally managed and secure.

For more details see <http://www.ericom.com/rdp-clients>

**Blaze** – Ericom's Accelerated RDP technology provides the fastest RDP user experience. Slow & choppy RDP experiences make it hard to work productively with graphics-rich applications & content such as PDFs, PPT, 2-D applications, Flash and streaming video, in Terminal Services (RDS) and VDI environments. With Ericom Blaze, IT Admins can transform the PC, Mac, Linux and mobile devices into fast RDP clients that deliver up to 10x faster display performance than regular RDP, providing users with super quick access to applications with high graphic content over WiFi, ADSL, 3G, 4G and GPRS networks, enhancing user experience and productivity.

For more details see <http://www.ericom.com/rdp-clients>

**Ericom Secure Gateway** - Ericom's scalable, high performance SSL Gateway secures the access to internal resources running on RDP hosts (virtual desktops, Terminal Servers, etc.) from unsecured locations outside the firewall without requiring an SSL / IPsec VPN. Ericom Secure Gateway can be used free of charge with the Ericom remote access products mentioned above. For more details see <http://www.ericom.com/securegateway>

#### **ARCHITECTURE**

Ericom PowerTerm WebConnect brokers connections to published desktops and applications from virtual desktops (VDI), Session Hosts (Terminal Services), and remote PCs. The VDI connection broker component is called DeskView Server, and is a service installed as part of the PowerTerm WebConnect server installation. PowerTerm WebConnect interfaces with directory services such as Microsoft Active Directory (AD) and Novell eDirectory, and also with RADIUS servers and RSA SecurID.

Ericom Secure Gateway is a software-only access gateway for secure, remote access. It can be installed separately in the DMZ. Additional components include a web interface (AccessPortal), and a Load Balancing server. Small agents need to be installed in the VMs (VMAgent) and the Session Hosts (TSAgent).

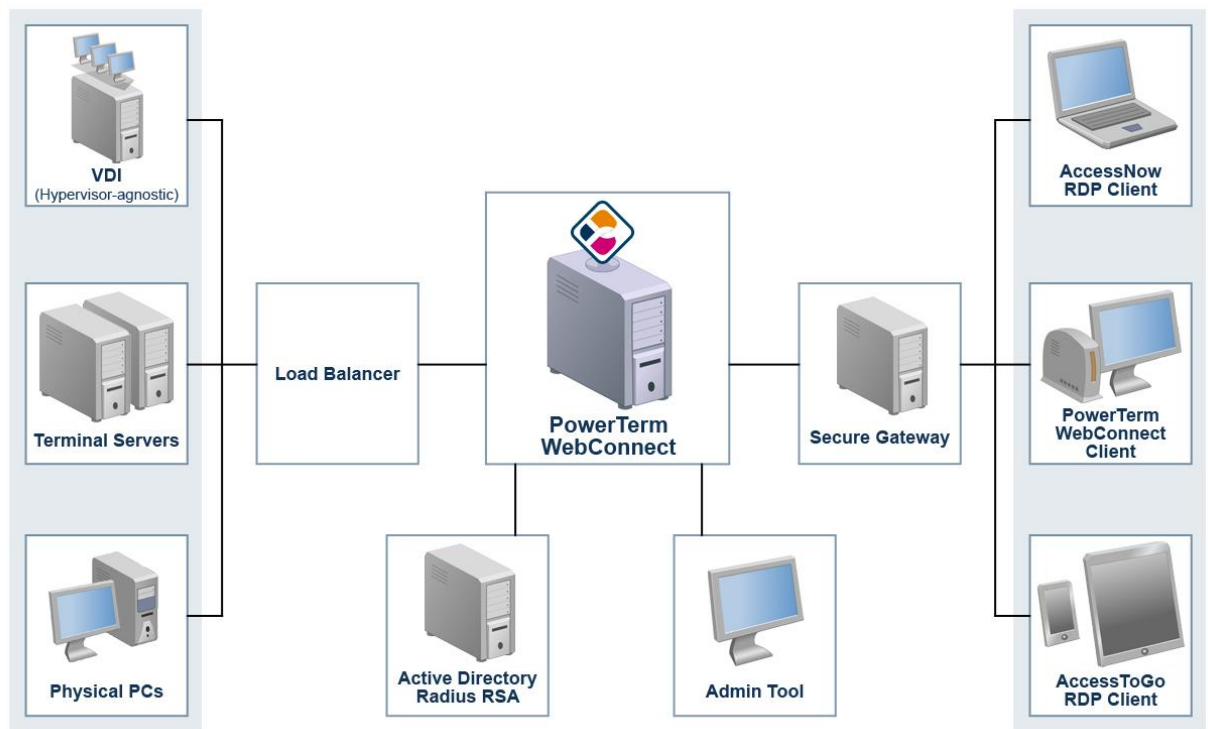


Figure 4, Ericom PowerTerm WebConnect architecture

Ericom PowerTerm WebConnect supports three remote access protocols:

1. Standard Microsoft RDP/RemoteFX, extended with features such as Universal Printing and Ericom True Seamless – seamless windows for both VDI and Session Hosts
2. Blaze accelerated RDP, which provides up to x10 times improvements in performance, especially over WAN and congested LAN
3. Ericom AccessNow for browser-based, clientless remote access using HTML5

Clients are available for mobile devices (AccessToGo), Windows, Mac, Linux, thin clients, and any modern browser on any platform.

#### LICENSING

PowerTerm WebConnect editions relevant for this smackdown are: RemoteView (for mixed environments of RDS and VDI) and DeskView (VDI only). Each edition includes the WebConnect connection broker as well as the following additional Ericom components: Ericom Blaze (RDP acceleration and compression), Ericom AccessNow (HTML5 RDP solution), Ericom AccessToGo (native RDP client for iOS, Android and Chrome) and Ericom Secure Gateway (SSL).

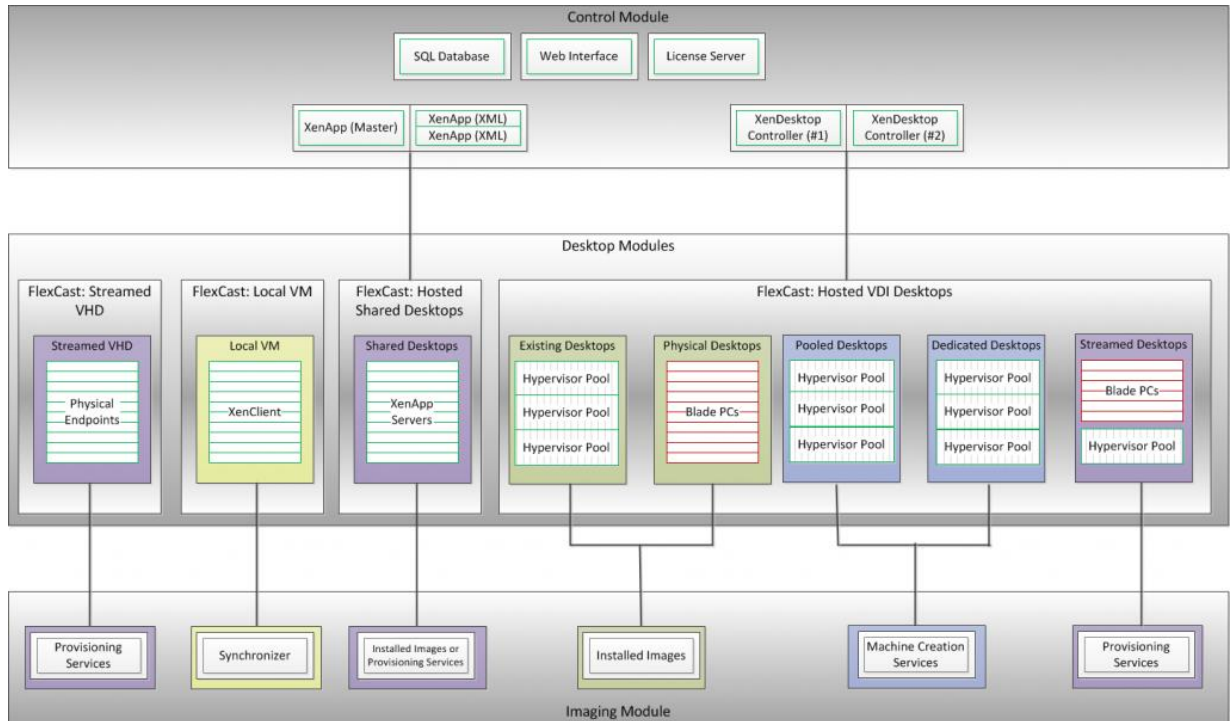
Both RemoteView and DeskView are available as concurrent user and seat licenses. Ericom offers subscription licensing options for service providers, and special pricing for education, government and charity/non-profit customers.

## 5.3 CITRIX XENDESKTOP

### INTRODUCTION

Citrix has a long history in Server Based Computing with its XenApp product (formally known as MetaFrame/Presentation Server). To expand the market, Citrix focused on using a broad set of virtualization technologies to create XenDesktop, an end-to-end solution for providing virtual

desktops and apps for a broad set of use cases. XenDesktop includes the ability to host personal, pooled, and dedicated virtual machines (traditionally known as VDI,) but also enables cost-effective and scalable hosted-shared environments with powerful personalization tools, locally executed desktops with XenClient (a Type-1 hypervisor) and streamed VHD (real-time streamed OS at boot). Finally XenDesktop also enables GPU enabled PC blades and GPU assisted Hypervisors for providing rich, pixel-perfect 3D professional graphics support. All these different options are all part of the Flexcast Management Architecture.



**Figure 5, Citrix Flexcast Management Architecture**

However, not every user needs a full virtual desktop. Increasingly, the demands for extending Windows apps to tablet and smartphone form factors or the need to provision virtual apps on-demand to BYO laptops have increased the need for an integrated application virtualization and delivery infrastructure. XenDesktop includes these capabilities to support enterprise workers who may roam between device types and networks but need a consistent work environment that is easy to use, centrally managed and secure.

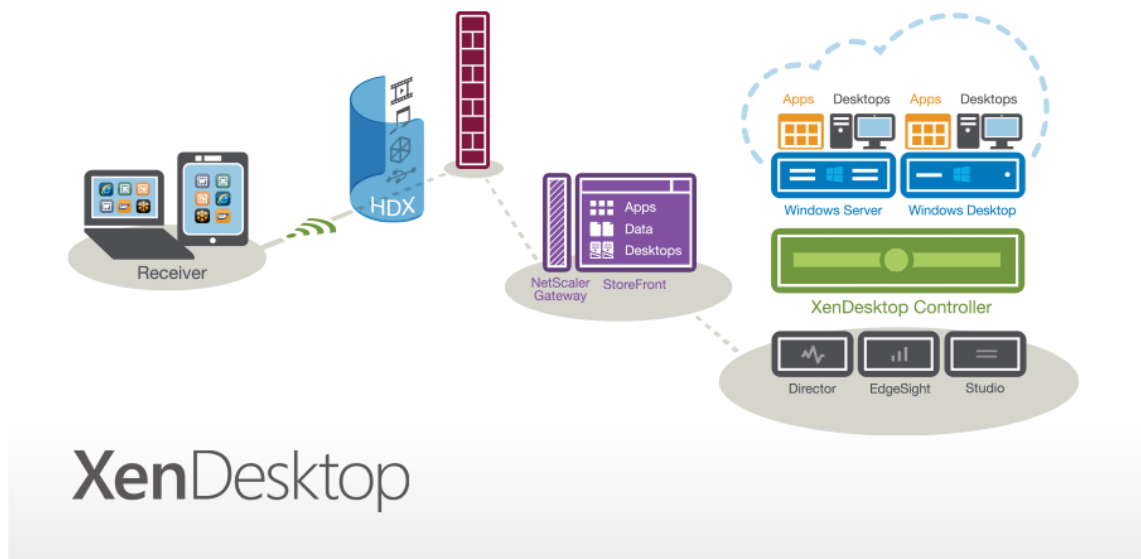
**ARCHITECTURE**

The architecture of XenDesktop, today, consists of multiple components. This makes the initial setup of XenDesktop more complex than some other solutions, but is designed for flexibility and scale. The tasks of the connection broker or the "Delivery Controller" are:

- Authenticates users
- Manages assembling the user’s desktop environment
- Brokers connections between the user and his virtual desktop

Other components of the XenDesktop infrastructure are: Virtual Infrastructure (XenServer, Microsoft Hyper-V or VMware vSphere), Licensing server, database, Provisioning server, Storefront, Director and NetScaler Gateway for secure remote access. Introduced in XenDesktop 7 is a single architecture to host virtual machines, remote pc and hosted shared desktops. XenApp is deprecated, but the functionality of hosting shared desktops through a Remote Desktop Services based Windows Server OS is built into XenDesktop. The XenDesktop

infrastructure is hereby capable to include access to remote or streamed applications on a Windows Server OS.



**Figure 6, XenDesktop architecture**

A XenDesktop agent is required in the guest VM or Blade PC. The agent enables direct connections between the endpoint and the user’s virtual desktop. On the endpoint the Citrix Receiver or Receiver for HTML5 can be used to provide simple access from any device, anywhere, to virtual desktops and applications. The Citrix Receiver provides the most comprehensive experience, while the Receiver for HTML5 has less endpoint requirements.

The protocol used for XenDesktop (and XenApp) is the ICA protocol and has some special features. The ICA protocol performs better on limited bandwidth and higher latency than the RDP/RemoteFX protocol.

Citrix HDX Technologies were introduced in XenDesktop 3. HDX consists of several elements that should improve the user experience, such as VoIP and webcam support, 3D support, enhanced audio and optimization for use over WAN.

**LICENSING**

XenDesktop is available in four editions:

- VDI
- App
- Enterprise
- Platinum

Each license type includes, next to the XenDesktop Controller (the broker) the right to use certain components and features of Citrix XenDesktop: VDI desktops, Hosted Shared Desktops, XenServer, Provisioning Server, NetScaler Gateway, EdgeSight, etc. VDI edition is the most basic version with a partial but still strong feature set for pure VDI deployments. Platinum is the most advanced edition and delivers the complete feature set. An overview of the 4 different editions and their features can be found [here](#).

*"Citrix changes from a Windows application virtualizer to an all application mobilizer"*

## 5.4 CITRIX VDI-IN-A-BOX (KAVIZA)

### INTRODUCTION

Many customers have been priced out of traditional VDI solutions because of the complexity and the high upfront cost of deploying these solutions. Citrix addresses this market with VDI-in-a-Box, an easy, affordable all-in-one virtual appliance that enables Windows administrators to deliver centrally-managed virtual desktops with built-in high-availability to any user, anytime, on any device – for less than the cost of new PCs. VDI-in-a-Box eliminates complexity by bundling all the VDI functions including load balancing, connection brokering, dynamic desktop provisioning, and high-availability into a single turnkey virtual appliance. VDI-in-a-Box eliminates over 60% of traditional VDI infrastructure - including management servers and shared storage (SANs) – by creating a grid of off-the-shelf industry standard servers with direct-attached storage. The VDI-in-a-Box grid scales on-demand and additional servers can be added as desktop needs grow.

Customers can buy VDI-in-a-Box virtual desktops with build-in HDX for \$160 per concurrent user without needing any XenDesktop or XenApp licenses. VDI-in-a-Box supports the latest versions of Citrix XenServer, Microsoft Hyper-V and VMware vSphere.

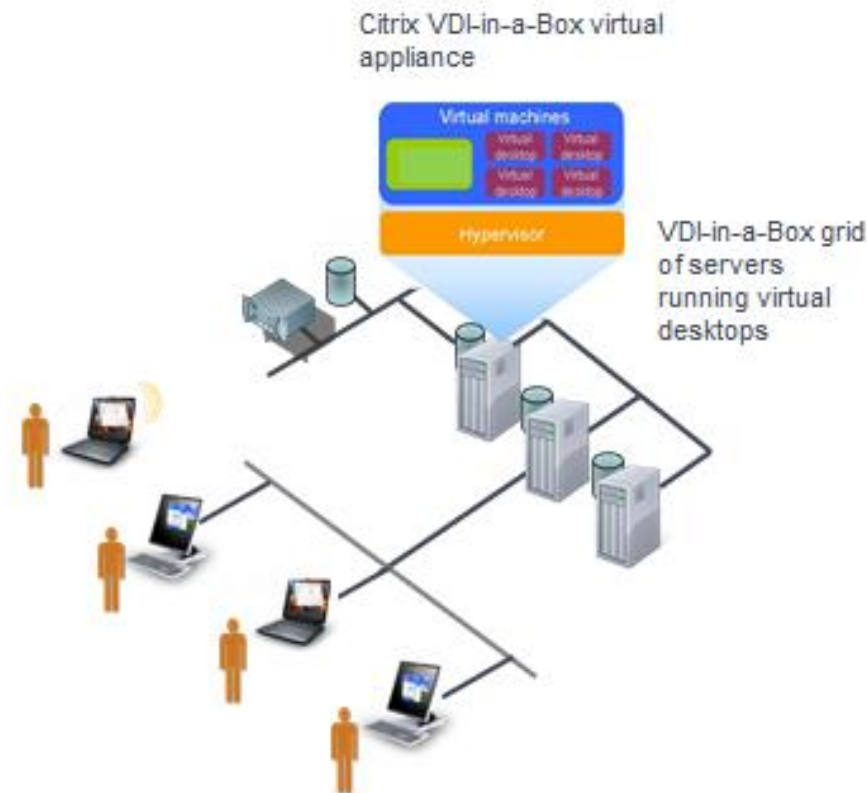


Figure 7, VIAB architecture

### ARCHITECTURE

As shown above, VDI-in-a-Box uses a distributed grid architecture that consists of one or more servers each running a hypervisor and the VDI-in-a-Box vdiManager virtual appliance.

Each vdiManager can be set up to run as a single physical server or it can be a part of a cohesive fabric of physical servers referred to as a VDI-in-a-Box grid. Each vdiManager in a grid

performs the following functions:

- Creates virtual desktops from a template, a template consists of:
  1. An image that includes a desktop operating system (such as Windows 7/8 or Windows XP), a set of applications, and the VDI-in-a-Box Desktop Agent, which communicates with the vdiManager about user connections and desktop health. Multiple templates can use the same image.
  2. Policies that specify characteristics such as how many desktops to create, how much RAM to allocate to them, whether local USB peripherals can be accessed by the virtual desktop, and the desktop refresh policy.
- Balances the load across the grid. vdiManagers create desktops across servers running vdiManager based on how many desktops are currently running on each server and the availability of computing resources (memory and cores) on each server. When a user logs on, vdiManager provisions a desktop from a lightly loaded server.
- Provides high availability. vdiManager instances on physical servers communicate with each other to share key operational and configuration information. For instance, VDI-in-a-Box templates and images are stored on multiple servers so they are not lost if a physical server fails. When a physical server fails, the remaining servers in the grid have the needed information to create extra desktops to replace those on the failed server. When the failed server is repaired and rejoins the grid, the key operational and configuration information is sent to it and it then resumes desktop provisioning.
- Brokers connections so that a user can log on to any server in the grid.
- Provides a web-based interface, the VDI-in-a-Box console, used to configure and manage servers running vdiManager, desktops, templates, images, users, and the grid, all at the grid level. In the VDI-in-a-Box console, the grid appears as one logical server running vdiManager. It is also possible to view the status and activity of each server individually when required. When you update vdiManager on one server, vdiManager distributes the changes to all servers in the grid.

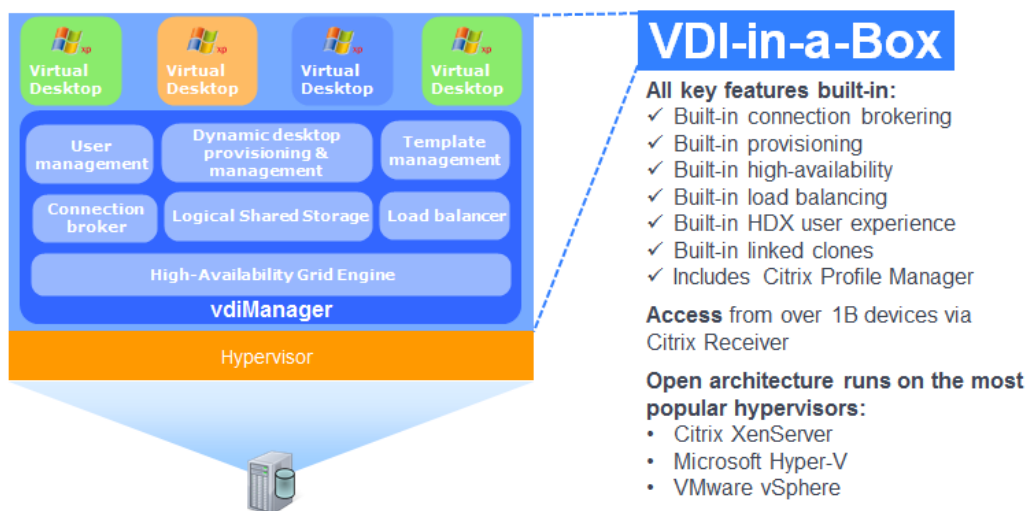


Figure 8, VIAB overview

### LICENSING

All VDI-in-a-Box licenses are Concurrent User (CCU) licensing based on concurrent user device connections to VDI-in-a-Box. A license is only considered in use when a user's device has



established an active connection to a virtual desktop. This allows multiple users or multiple devices to share licenses.

Two license options:

1. **Perpetual** – The customer pays once for the license and they may use it on a perpetual basis.
2. **Annual** – THESE LICENSES ARE VALID FOR 12 MONTHS, AFTER WHICH POINT THE LICENSE WILL EXPIRE.

## 5.5 DELL vWORKSPACE

### INTRODUCTION

Dell (formerly Quest) vWorkspace is the result of an acquisition in 2007 by Quest of a company called Provision Networks. Founded in 2004, Provision Networks aimed to reduce the adoption barriers of virtual desktop deployment and application delivery, through cutting-edge technologies that address the end-to-end requirements of global deployments. Quest vWorkspace delivers virtual applications and desktops from multiple hypervisors, Remote Desktop Services and blade PCs through a single user access point and management center.

A key component of the vWorkspace offering is Quest EOP (Experience Optimized Protocol), a set of technologies that embrace and extend the Microsoft RDP/RemoteFX protocol to provide a near local user experience over both LAN and WAN.

### ARCHITECTURE

The connection broker is called the vWorkspace Connection Broker. Other components are a vWorkspace configuration database, vWorkspace web interface and vWorkspace SSL gateway server. The protocol that is used to connect to the desktop is the regular RDP/RemoteFX protocol. For a user experience over WAN, EOP (Experience Optimized Protocol) can be used with RemoteFX and RDP.

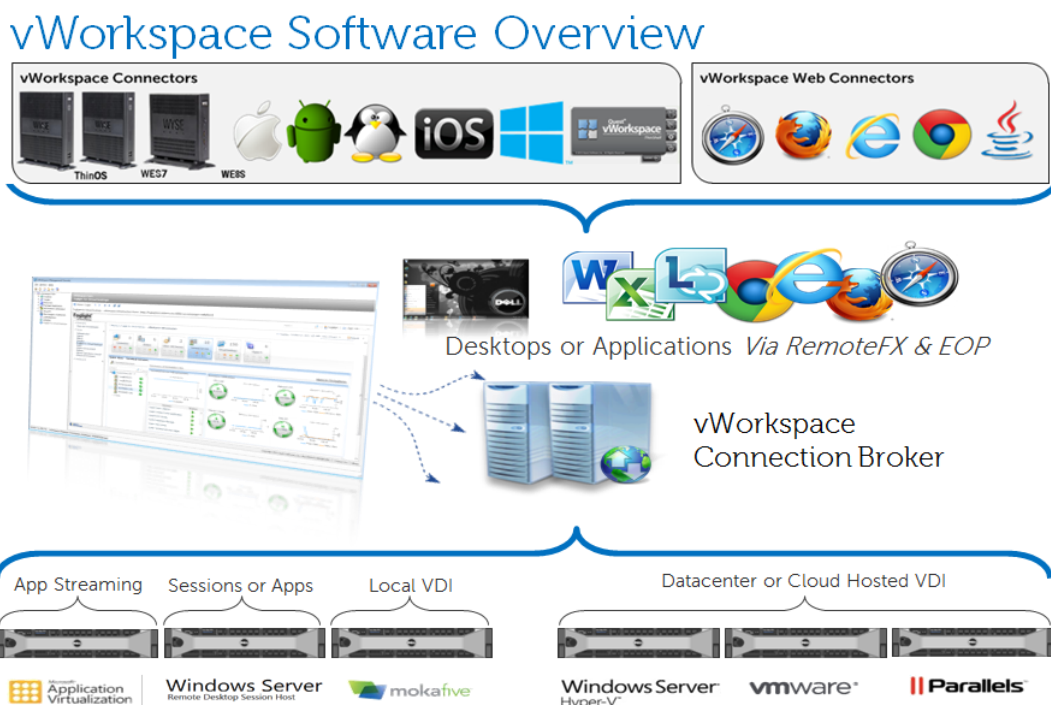


Figure 9, Quest/Dell vWorkspace solutions overview

**LICENSING**

Dell vWorkspace is available in 3 types of license: Premier (RDS and VDI, including Dell Foglight-based monitoring), Enterprise (RDS and VDI) and Desktop Edition (VDI only). Both are available as concurrent and device based licenses. Licensing and pricing options are also available for education and Service Providers.

**5.6 DESKSTONE**

*Note from the author: Desktone is an interesting solution in the Desktop as a Service (DaaS – SaaS) marketplace. While Desktone isn't a Virtual Desktop Infrastructure software solution as such, we believe it is wise to add Desktone to this whitepaper and inform you about the functionality. VMware acquired Desktone October 15<sup>th</sup> 2013*

**INTRODUCTION**

Founded in 2007 out of a project to build a scalable VDI solution for Merrill Lynch, Desktone recognized a void in the desktop virtualization solutions market in that available platforms were not developed for or capable of delivering a cloud-hosted Desktop service. In 2008, Desktone launched a virtual desktop platform designed for service providers to offer virtual desktops as a service (DaaS). Desktone pioneered the concept of cloud-hosted Desktops as a Service. DaaS provides IT departments with all of the benefits of VDI without the upfront costs and management complexity of desktop virtualization and transforms desktops from a CAPEX to OPEX item. In 2009, IBM and many other service providers partnered with Desktone to leverage the virtual desktop platform to offer DaaS offerings. Today, Desktone has more than 20 global service provider partners and continues to be the only multi-tenanted desktop virtualization platform in the marketplace.

**FUNCTIONALITY**

The Desktone platform offers a very simple platform for service providers to offer DaaS. Requiring nothing more than a simple web form for a new tenant and a series of events is triggered: a VLAN is created for the tenant, the appropriate connection broker and desktop management appliances are provisioned onto that VLAN, and a storage mount point and compute is assigned based on the needed quota of desktops.

The Desktone platform also offers a web based interface for the end user customer to customize or upload their desktop templates, provision out pools of persistent or non-persistent desktops and then assign these to their user base. As these tenants are most often joined to the enterprise network with a site-to-site VPN or MPLS connection, they are automatically provisioned into the enterprise OUs and all of the existing policies and management tools apply to these cloud hosted desktops.

The simplicity, ease of use and elimination of operational complexity are all drivers for the platform. The only challenge is that end user customers the low end of the market sometimes expect to also receive Help Desk and IT support for their desktops at the basic price point. This is addressed by Managed Service Providers, who will not only offer the DaaS offering, but also all surrounding desktop services.

**ARCHITECTURE**

The Desktone DaaS platform is agnostic to hardware technologies. It currently supports NFS storage, virtualized compute running on the vSphere, KVM or XenServer hypervisor and VRF capable networking. The three primary software modules (Resource Manager, Desktop Manager and Access Manager) are bundled into hardened Linux based virtual appliances. A deployment begins with a single Resource Manager being deployed on the Service Provider



VLAN. It is also dual homed on a non-routable VLAN (link local) known as the Service Grid backbone. The Resource Manager is responsible for the actual hardware stack and capacity management. A web interface allows the Service Provider to register a new tenant. The only required information points are a customer chosen subnet range and the quota of desktops allocated to the customer. The Resource Manager will add a new VLAN and provision the management appliances onto this network.

The Access Manager is a patented and highly scalable connection broker that brokers the connection to the desktops, while the Desktop Manager is responsible for provisioning new desktops and maintaining session state information. These management appliances are also dual homed on the Service Grid backbone, preventing any chance of address collision and access from the tenant environment to the SP environment. Finally, the Resource Manager will provision a storage mount point for each tenant and assign compute based on the desktop type – dedicated for Windows client desktops (VDA requirement) and shared for others.

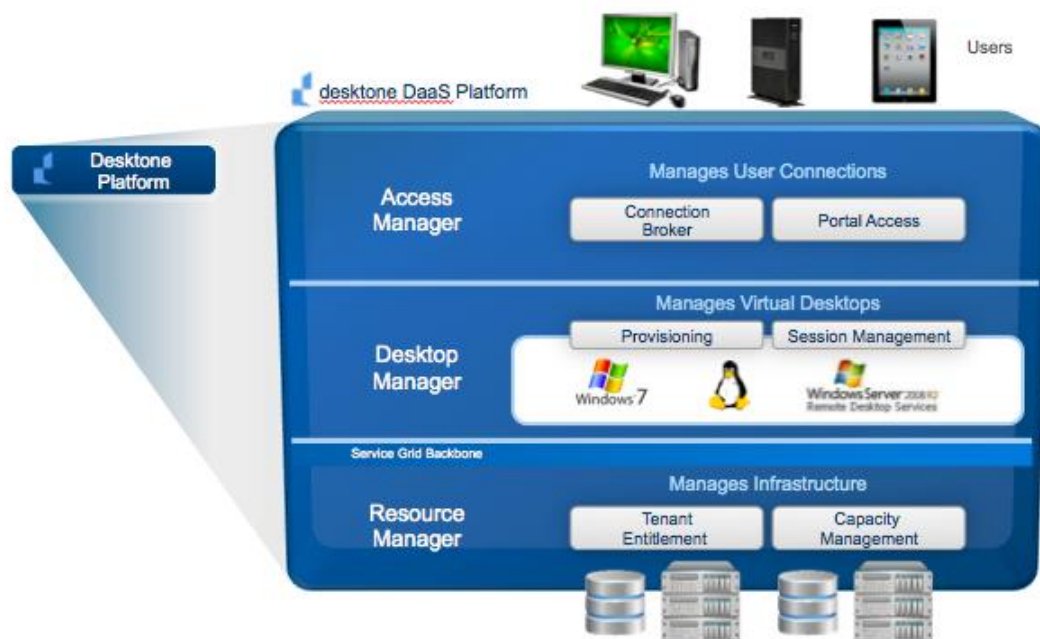


Figure 10, Deskstone DaaS platform

**WHAT MAKES DESKTONE UNIQUE**

Deskstone is unique because it was built from the ground up specifically to deliver DaaS. There are many DaaS specific features but unlike other desktop virtualization products Deskstone’s platform has true multi-tenancy, which is a pre-requisite for delivering a cloud offering.

The Deskstone platform is designed to be highly scalable. The management appliances are deployed in a peer-to-peer or fabric based method, with information stores being replicated between the nodes. This prevents any single point of failure and allows a customer to be deployed to a virtually unlimited number of desktops.

The multi-tenant platform is designed to be secure. There is resource separation at the compute level (as required), desktop storage level, network level and metadata management level. There is also inherent separation between the service provider and the tenant. Unless the client provides credentials in the client Directory Services, the service provider is unable to access either the client Enterprise Center where desktops are provisioned and assigned, or the Desktop Portal and desktops.

The Deskstone platform is also designed to be cost effective. By supporting multiple hypervisors such as KVM, XenServer and vSphere, as well as NFS storage, the service provider can choose the most effective supporting hardware and platform. Deskstone does provide a recommended blueprint based on our experience and testing of numerous types of platforms. It is also important to note that the Deskstone software platform is built on an open source stack and does not require any third party OS or database licensing such as Windows Server or SQL. The multi-tenancy also drastically reduces management costs by providing a single management layer across many customers or 'tenants'.

The platform supports the widest variety of desktop virtualization technologies for DaaS including: Dedicated server-hosted virtual desktops (VDI), Dedicated Windows Server desktops, and Remote Desktop Services (RDS) desktops. This enables service providers to provide best fit desktops under one multitenant platform.

"We are the only one that support multiple forests per customer and segregate customers completely, while keeping a common infrastructure for all the desktops".

#### **LICENSING**

Service Provider Licensing – monthly royalty model. Service providers pay a monthly price per desktop they deliver to the end user. The price point per desktop scales based on the number of desktops they are delivering. The service provider adds in their hardware, operating costs and margin to develop a monthly price point. The price can start as low as \$20 per desktop/per month. All service providers price slightly different depending on the cloud efficiencies they can receive and the value added services they add to the desktop.

*Note from the author: VMware's public DaaS offering is based on Deskstone.*

## **5.7 LISTEQ BOXEDVDI**

*Note from the author: Listeq BoxedVDI is a small vendor with a different approach to Server Hosted VDI focused on SME customers. We believe it is wise to add the solution to this whitepaper and inform you about the functionality because it's great to see newer solutions in this space.*

#### **INTRODUCTION**

LISTEQ provides BoXedVDI, which is a "plug & play" alternative to the traditional VDI solutions. Traditional VDI solutions are very complex, as they are primarily focused on the server side and therefore only feasible for the high-end enterprise market. BoXedVDI is an easy to deploy and manage end-to-end VDI solution that is fully hypervisor, hardware and OS agnostic. An additionally available HTML5 Client makes it possible to use BoXedVDI anywhere from any device.

BoXedVDI can be bought for € 125,- per seat and doesn't require any additional hypervisor licensing.

#### **ARCHITECTURE**

BoXedVDI's architecture comprises of server(s) running a hypervisor and the BoXedVDI Virtual Machines.

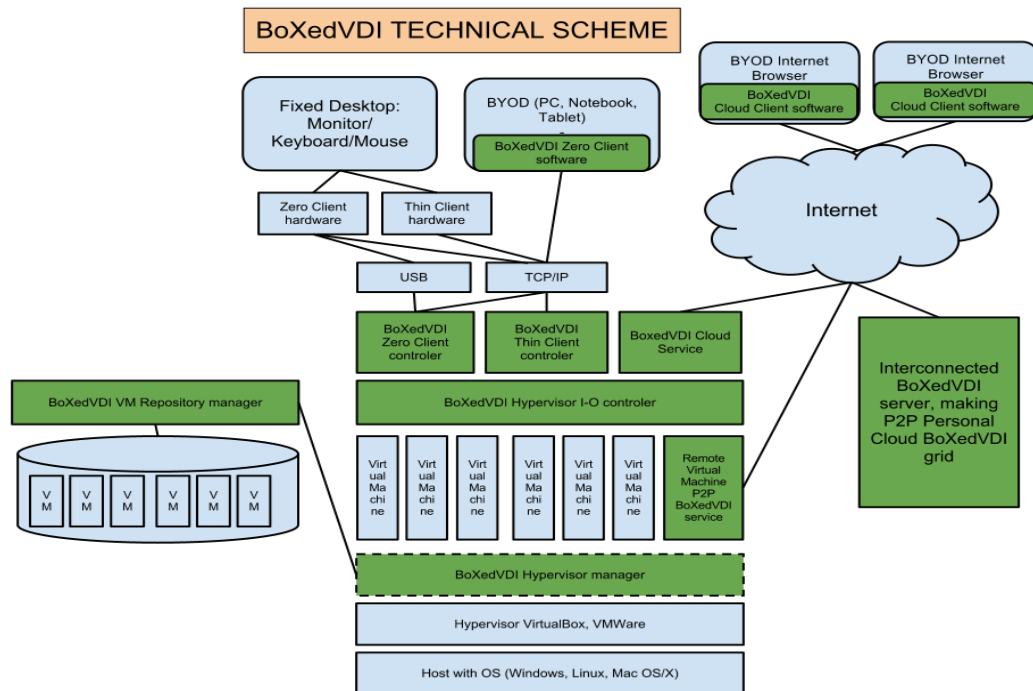


Figure 11, BoXedVDI architecture

- Besides support for all types of thin/thick clients, BoXedVDI also provides direct access to the native protocol of graphics over USB chipsets (like DisplayLink), through which low-cost ultimate Zero clients can be used.
- BoXed VDI uses Oracle Virtualbox as its native hypervisor. Other hypervisors are supported through their own specific I/O layers.
- BoXedVDI runs on top of the native I/O layer of the hypervisor (not using any client agents or VM RDP stack). Therefore BoXedVDI can support any OS running within the hypervisor. Running VM's based on ChromeOS, DOS, Mac-OSX and even Android X86 are possible,
- BoXedVDI has the option to use the RDP stack of the VM, making it also possible to provision Terminal Server based VDI configurations. BoXedVDI has an integrated RDP client connector to communicate with the RDP Server stack.
- BoXedVDI has a very advanced interconnectivity protocol making a grid of BoXedVDI servers completely transparent for management and users.
- BoXedVDI has a special hosted internet service ([www.BoXedVDI.net](http://www.BoXedVDI.net)) which makes it very easy to share Private Cloud VM's in the Public Cloud. The setup of this service and communication with privately hosted BoXedVDI is completely firewall transparent.
- BoXedVDI has a complete integrated HTML5/Websocket client-server engine. Making native HTML5 communication with BoXedVDI core possible. No additional gateways are needed to set up a BYOD infrastructure based on HTML5.
- BoXedVDI has 3 different ways to provision VM's to a specific user or physical client machine.
  - Dedicated assignment of VM.
  - Assignment of VM from a pool of VM's.
  - Assignment based on a PXE boot of VM from a assigned fixed VM appliance.
- BoXedVDI uses native storage support of different hypervisors. Storage support within Oracle Virtualbox makes native use of iSCSI and ZFS possible, which provides the option to use low-cost SAN and NAS solutions.

## LICENSING

Licensing of BoXedVDI is based on the number of seats. Licensing can be on a perpetual basis or through a monthly subscription.

## 5.8 NICE DCV

### INTRODUCTION

NICE is a software and consulting Services Company that is dedicated to improving ease of use and productivity, and achieving major hardware cost savings for companies running high performance technical applications. NICE developed the world's first HPC web portal, EnginFrame, some 15 years ago and this is widely used by engineers, geologists and others to ease the process of submitting HPC computations. EnginFrame is application aware, has a rich set of data management features and provides feedback to the user while the job is running. More recently, NICE acquired DCV from IBM, after many years of development, and has since further developed this software to the point where it has a broader set of capabilities than any other software of its kind. NICE Desktop Cloud Visualisation (DCV) enables remote visualisation, and workstation virtualisation for a mix of Windows and Linux HPC applications, all sharing graphics cards (GPUs).

### SOLUTION

Providing both high-performance computing (HPC) and visualization tools is becoming more difficult than ever. The rising cost of workstation management, larger file sizes, more remote workers, and the resulting need for collaboration are requiring IT professionals to reexamine how they deliver services.

NICE EnginFrame, NICE's HPC portal offering, is an advanced portal that provides access to grid-enabled infrastructures, HPC clusters, data, licenses, and interactive applications. It can be accessed by any authorized user with a standard web browser. EnginFrame handles computational-intensive and sometimes parallel job submission, control, and monitoring. EnginFrame is based on standard protocols that facilitate the deployment of engineer-friendly portals to create, discover, and explore more efficiently. It provides for encrypted access and file transfers, protecting intellectual property and infrastructures.

EnginFrame provides HPC capabilities for large calculations, while Desktop Cloud Visualization provides the 3D modeling tools needed for complex, detailed models. Used together, they meet the computing needs for technical end users while delivering services in an intuitive, user-friendly interface.

### ARCHITECTURE

The NICE DCV Technical Cloud software consists of three main components

**Self-service portal:** The self-service portal enables engineers and scientists to access the applications and data in a web browser-based setting. It also provides security, monitoring, and management to ensure that users cannot leak company data and that IT managers can track usage. Engineers and scientists access applications and data directly from their web browsers, with no need for a separate software installation on their local client.

**Resource control and abstraction layer:** The resource control and abstraction layer lies underneath the portal, not visible to end users. It handles job scheduling, remote visualization, resource provisioning, interactive workloads, and distributed data management without detracting from the user experience. This layer translates the user request from the browser and facilitates the delivery of resources needed to complete the visualization or HPC tasks. This

layer has a scalable architecture to work on a single cluster or server, as well as a multi-site WAN implementation.

Computational and storage resources: The technical cloud's horsepower includes the company's existing or newly provisioned industry-standard resources, such as servers, HPC schedulers, memory, graphical processing units (GPUs), and visualization servers, as well as the required storage to host application binaries, models and intermediate results. These are all accessed through the web-based portal via the resource control and abstraction layer and are provisioned according to the end user's needs by the middle layer.

Technical cloud software is built on common technology standards. The software adapts to network infrastructures so that an enterprise can create its own secure engineering cloud without major network upgrades. The software also secures data, removing the need to transfer it and stage it on the workstation, since both technical applications and data stay in the cloud. These solutions feature the best characteristics of cloud computing—simple, self-service, dynamic, and scalable, while still being powerful enough to provide 3D visualization as well as HPC capabilities to end users, regardless of their location.

The technical cloud software solution can be specialized and optimized in two primary ways:

- HPC portal
- Remote 3D "Virtual Workstations". >> the focus of this whitepaper is VDI

#### **REMOTE 3D "VIRTUAL WORKSTATIONS"**

This model is ideal for 3D visualization and connecting remote users to OpenGL applications that run in a data center. Users access full desktops - like in common VDI (Virtual Desktop Infrastructure) – or individual applications and data through a web browser, but the 3D performance is much better than a traditional VDI. The "Virtual Workstation" model of technical cloud software primarily provides visualization capabilities. It includes visualization servers equipped with one or more GPUs that may or may not be shared among users. These GPUs provide OpenGL acceleration required by technical applications that can be installed and run in the cloud without modifications. The end user works from a thin client, such as a laptop equipped with a web browser, that is only used to show pixels and requires no data or application logic locally. Therefore, even tablets can therefore be used to work or collaborate. Data and applications are kept in the data center, but remote desktop access allows engineers and scientists to use them and be productive from remote locations. Technical cloud software can be designed and installed by in-house IT staff; however, technical cloud consulting firms can provide support throughout the implementation processes. Thus managers and architects can focus on delivering the required HPC and visualization capabilities while minimizing disruption to business operations.

## **5.9 MICROSOFT RDVH - VIRTUAL DESKTOP INFRASTRUCTURE**

### **INTRODUCTION**

With the technology originally called Terminal Services, a user is connected with a session on a Windows Server which allows for providing a full desktop session or individual programs (called RemoteApp) on the user's client device. With the launch of Windows Server 2008 R2 in October 2009, the name "Terminal Services" was replaced by "Remote Desktop Services Session Host" (RDSH).

Windows Server 2008 R2 also introduced a new role, namely "Remote Desktop Virtualization Host". By adding this role to Microsoft's hardware virtualization platform, called Hyper-V, Remote Desktop Services Virtualization Host now also allows for providing users with a dedicated virtual desktop running a Windows Client operating system.

With SP1 for Windows Server 2008 R2, Microsoft added RemoteFX to Remote Desktop Services. The RemoteFX technology allows for a better user experience when using Remote Desktop Services. RemoteFX allows USB redirection, high-definition video and using 3D applications over Microsoft's Remote Desktop Protocol. RemoteFX works for virtual desktops as well as session based desktops.

With the Windows Server 2012 release Microsoft redesigned the complete Remote Desktop Services stack to improve the ease of deployment and management. RemoteFX features are also improved and broadened to support a new generation of Windows (8) devices. RemoteFX is optimized for WAN deployments and touch-based devices. Microsoft also delivers a builtin profile management solution for virtual desktops and session based desktops.

*Note from the author: As Microsoft only provided a Remote Desktop Connection software client for the Microsoft Windows operating system we decided to add a small comparison matrix as an appendix. In October 2013 Microsoft announced the release of a RDP application for iOS, Android and OS X, these applications are based on acquired assets from the iTap products of HWL Software. Please read "RemoteFX/RDP 3<sup>rd</sup> party clients" for a comparison of available RDP software clients for MAC OSX and mobile OSes such as Apple IOS and Android.*

## **ARCHITECTURE**

Microsoft utilizes its own Remote Desktop Protocol (RDP) with RemoteFX (RFX) enhancements to provide the remote desktop or remote application to the user. For the best experience and functionality a client device should run Windows 7 SP1 or Windows 8 with RDP8.

The Microsoft Virtual Desktop Infrastructure consists of the following Windows Server 2012 roles:

- *Remote Desktop Gateway (RDG)*  
This is an optional role to provide secure access to the Microsoft Virtual Desktop Infrastructure from internet-based clients.
- *Remote Desktop Web Access (RDWA)*  
This role provides access to the desktops and/or remote applications available for a specific user. After the user browses to the Web Access URL and authenticates, Web Access provides a webpage displaying the shortcuts to the resources available to this user. If the client device is running Windows 7/8 and is on the corporate LAN the shortcuts can be also integrated in the user's Start Menu.
- *Remote Desktop Connection Broker (RDCB)*  
The Connection Broker tells Web Access which resources are available to the user. The RDCB role is the broker which connects the client to the correct resource selected by the user in Web Access. The Connection Broker also contains the Remote Desktop Management Service. The Remote Desktop Management Service maintains a database with the static configuration of the deployed RDG, RDWA, RDCB, RDSH and RDVH roles, and dynamic session information of the managed RDSH and RDVH servers.
- *Remote Desktop Session Host (RDSH)*  
Formerly known as a Terminal Server, RDSH provides server hosted desktops or remote applications to the client. The RDSH role is not required for a Windows Server 2012 virtual desktop infrastructure, but could be added to provide a hybrid solution.



- Remote Desktop Virtualization Host(RDVH)*  
 A Virtualization Host is a Microsoft Hyper-V host with the Virtualization Host agent service installed. RDVH provides virtual desktops or remote applications to the client. The Virtualization Host agent service manages the starting of the virtual machines or remote applications (in a virtual machine) when a user wants to connect.

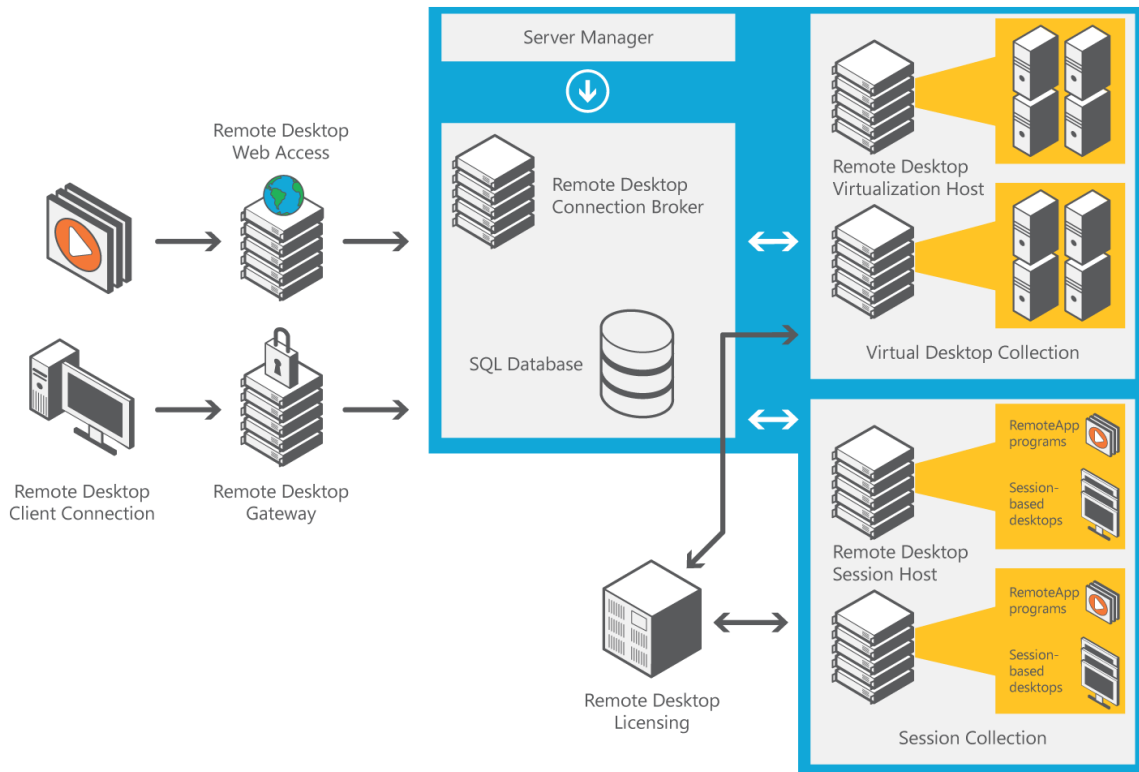


Figure 12, Microsoft VDI architecture

## 5.10 ORACLE VIRTUAL DESKTOP INFRASTRUCTURE

*NOTE FROM THE AUTHOR: ORACLE DISCONTINUED NEW DEVELOPMENTS OF ORACLE VDI AND SUN RAY SOFTWARE AND HARDWARE.*

### INTRODUCTION

Oracle (previously SUN) offers a VDI solution that is made up of four main components: **virtualization platform, session management (VDI Core), desktop access clients and storage.** The central component is the Oracle VDI core (broker). This component is responsible for session management. IT architects can mix and match the different components to fit the needs of the customer. For example, when a customer wants to use Or Ray thin clients but not the Sun VDI core as a broker, the customer can use VMware View as a broker with the Sun Ray software to use the Appliance Link Protocol (ALP), which is used by Sun Ray ultra-thin clients.

### ARCHITECTURE

The architecture of Oracle VDI is described below.

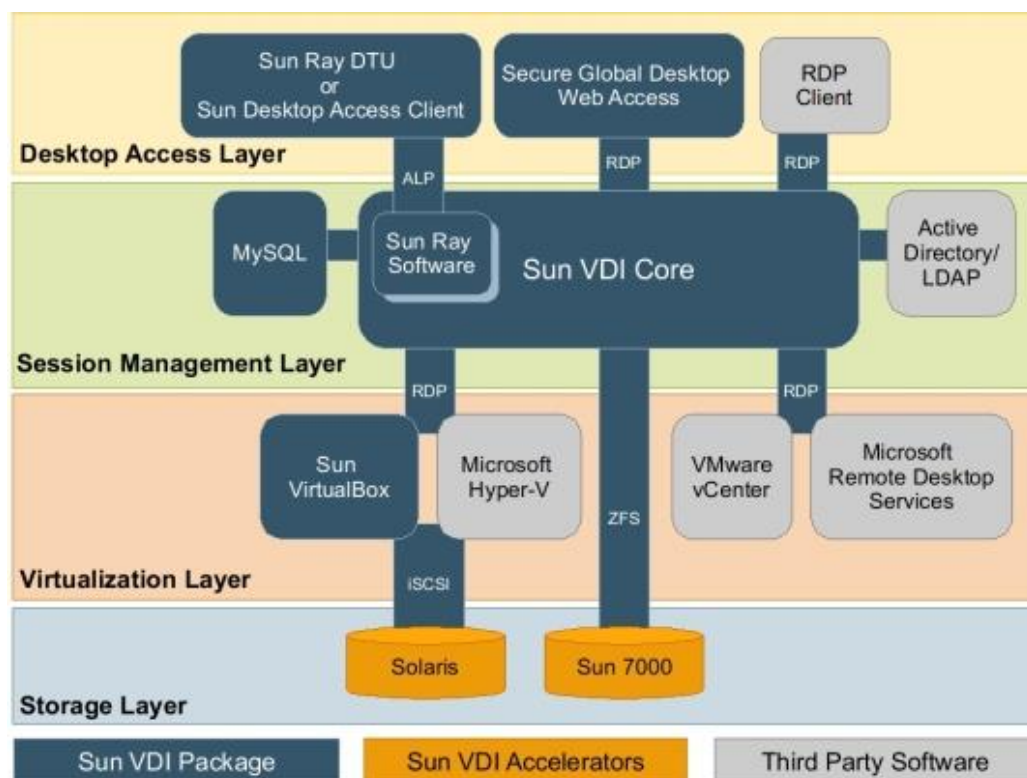


Figure 13, Oracle VDI stack

The basis for a VDI architecture is the virtualization platform. In addition to create and store virtual machines, the virtualization platform offers the core functionality needed for virtual desktop management such as starting, stopping, and snapshotting virtual machines. Sun VDI 3.1 supports the Oracle VirtualBox, VMware vCenter, Microsoft Hyper-V, and Microsoft Remote Desktop Services virtualization platforms.

### SESSION MANAGEMENT

The central component of the Sun VDI is the Sun VDI Core. The VDI Core provides all the functionality needed to build and manage large-scale virtual machine deployments. In addition



to its management capabilities, the VDI Core is also responsible for the brokering of virtual desktops on behalf of desktop access clients.

### **DESKTOP ACCESS**

Three distinct mechanisms are supported for access to virtual desktops.

Sun Ray DTU or Sun Desktop Access Client - Users can access their virtual desktops through a Sun Ray Desktop Unit (DTU) or through Sun Desktop Access Client software by authenticating themselves with a user name and password, or a token card can be inserted in a Sun Ray DTU instead of providing a user name. Successful authentication initiates a custom Sun Ray Software Kiosk Session. The custom Kiosk Session uses the Sun VDI Core to request access to a virtual desktop on behalf of the user. Once a virtual desktop has been assigned to the user, a Remote Desktop Protocol (RDP) connection to the desktop is established for the session using the Sun Ray Windows Connector.

Secure Web Access with SGD - In this case, the browser is used to initiate a Sun Secure Global Desktop Software (SGD) session. SGD, in turn, uses the VDI Core's RDP redirection capability to establish a connection to an assigned virtual desktop.

RDP Client Access - (RDP redirection must be supported on the client side to use this mechanism). As with the previous case, the VDI Core's redirection capability is used to establish a connection to an assigned virtual desktop.

Note from the author: Oracle's VDI technology developments have halted (July 2013)

## **5.11 RED HAT ENTERPRISE VIRTUALIZATION FOR DESKTOPS**

### **INTRODUCTION**

Red Hat, the world's leading provider of open source solutions and an S&P 500 company, is headquartered in Raleigh, NC with over 65 offices spanning the globe. CIOs ranked Red Hat as one of the top vendors delivering value in Enterprise Software for six consecutive years in the CIO Insight Magazine Vendor Value survey. Red Hat provides high-quality, affordable technology with its operating system platform, Red Hat Enterprise Linux, together with virtualization, applications, management and Services Oriented Architecture (SOA) solutions, including Red Hat Enterprise Virtualization and JBoss Enterprise Middleware.

Red Hat Enterprise Virtualization (or RHEV) is an enterprise grade open source server and desktop virtualization platform. RHEV leverages the power of KVM (the Kernel based Virtual Machine) and various other open source components to deliver a scalable, high performance solution. The Red Hat solution stands out on providing a full-blown platform for Windows as well as Linux guest systems. In 2008, when RedHat acquired Qumranet, Red Hat obtained the SPICE display protocol and added it into this solution in 2010. With this protocol Red Hat has a mature display protocol that competes with the latest RDP and ICA protocol versions. SPICE for example supports bi-directional audio and video, full USB support and offloading of multimedia processing, raising the vm-host density.

Other key features of the RHEV for Desktops solution are:

- Search-based management
- Desktop pooling
- Linked images
- Rapid Provisioning
- Multi-monitor support
- High Resolution (Full HD- 1920x1080)

Worth mentioning is that because of the Qumranet acquisition the solution is more Microsoft-centered than one might expect from a Red Hat solution. Also the licensing structure is completely different from what most of us are used to. Also see the "licensing" paragraph down below for more details.

**ARCHITECTURE**

The Red Hat solution consists of the following core components:

- Red Hat Enterprise Virtualization Hypervisor
- Red Hat Enterprise Virtualization Manager
- Red Hat Enterprise Virtualization Connection Broker (integrated)
- SPICE remote display protocol

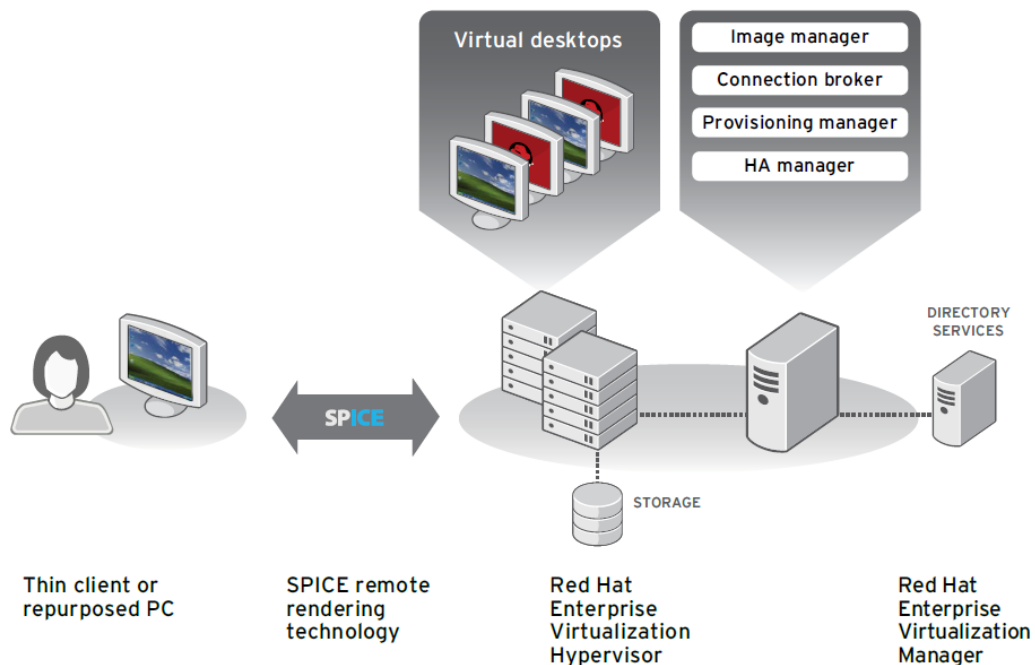


Figure 14, RedHat RHEV architectural overview

**LICENSING**

Red Hat Enterprise Virtualization uses a pricing model which is different than the models used by VMware for vSphere 4 and Microsoft for Hyper-V. It is important to understand these differences to accurately compare costs across platforms.

In a typical virtualization environment, you may have the following elements: hypervisor, management server, management agent, and guest operating system. For each element, you may also need to think about an upfront license fee and a subscription fee for maintenance and support.

All Red Hat products are offered under a subscription model. There are no upfront license costs, but an annual subscription based on the level of support you need. Red Hat Enterprise Virtualization for Servers subscription pricing is based on number of managed sockets: each managed socket on a virtualization host requires 1 subscription of Red Hat Enterprise Virtualization for Servers. Each virtualization host that is fully licensed for Red Hat Enterprise Virtualization for Servers is entitled to run the included Red Hat Enterprise Virtualization Hypervisor, a bare-metal hypervisor based on the full Red Hat Linux Kernel. There is no separate management agent in Red Hat Enterprise Virtualization.

## 5.12 VIRTUAL BRIDGES, VERDE

Founded in 2006, Virtual Bridges is based in Texas, USA. In 2009 Virtual Bridges launched VERDE, an end-to-end desktop management solution that combines online and offline VDI and remote branch solutions. VERDE = Virtual Enterprise Remote Desktop Environment and is an end-to-end virtual desktop infrastructure and management solution that combines VDI, offline VDI and VDI remote branch solutions to remove the management burden, complexity and cost traditionally associated with desktop virtualization solutions.

VERDE offers unified management and reporting through a single console and is adaptable for today's dynamic environment. Ideal for companies of all sizes, VERDE can scale up to ten thousand clustered servers or scale down to a single-server configuration.

The VERDE suite includes: *VERDE Core*, *VERDE Console*, *VERDE VDI*, *VERDE LEAF*, *VERDE Cloud Branch*;

VERDE Core includes:

- Servers and Clusters
- Gold Master Images
- AD/Directory Services
- Shared Storage

VERDE VDI includes

- Desktops hosted and managed in datacenter
- Clients: PCs, Mac, Thin Clients & PDAs, Windows and Linux
- VERDE Display protocol, RDP, NX, SPICE

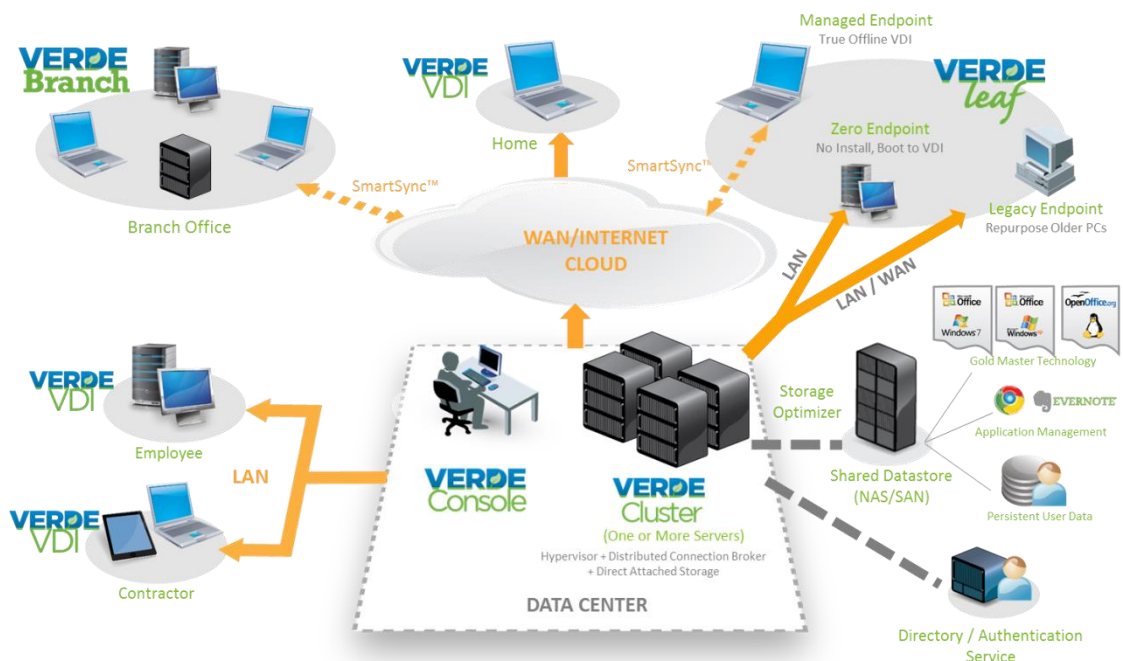


Figure 15, VERDE overview

VERDE Console is a web-based monitoring console which offers real-time visibility to all virtual desktop sessions running on VERDE cluster servers. Administrators have the flexibility to view

virtual desktop sessions grouped by user or server or based on type of Golden Image. In addition, the console provides real-time server utilization metrics

VERDE LEAF (Live Environment Access Format) provides both connected (access to remote virtual desktop sessions) and disconnected (virtual desktop session is locally cached and executed on the client machine) access. LEAF is a self-contained local desktop virtualization platform that is fully secure, so there's no need to worry about external endpoint security solutions. LEAF comes in three flavors:

- LEAF Managed Endpoint: Run a centrally managed image on a Type 1 client-side hypervisor, including bi-directional user data synchronization.
- LEAF Legacy Endpoint: Virtual Bridges' "thin client" OS to run online VDI sessions on a small-footprint OS, suitable for installation on legacy devices such as older PC inventory.
- LEAF Zero Endpoint: Run online VDI sessions as a "zero-client" booted over the network on legacy devices such as PC inventory.

VERDE Cloud Branch eliminates WAN latency to deliver a native-PC experience even over choppy and unreliable networks. VERDE Cloud Branch reduces network bandwidth in many scenarios while providing business continuity even if the network is down. The Cloud Branch server connects directly to the VERDE Cluster and Gold Master Image repository, providing a consistent, high-quality experience.

## **5.13 VMWARE VIEW**

VMware was founded in 1998 and in the early years focused on providing a platform to run Windows- and Linux-based machines virtually. In 1999 this resulted in VMware Workstation. After the launch of ESX in 2001, VMware made a name in server virtualization and quickly became the market leader in this segment.

In early 2008 VMware entered the VDI market with the launch of VMware VDM 2.0. VMware VDM gave users a centrally hosted desktop. The name of VDM evolved into a new product suite: VMware View.

In 2009 VMware partnered with Teradici for their display protocol specifically developed for server hosted (virtual) desktops and BladePCs, PC-over-IP. This partnership allowed VMware to make a change to the remote display capacity that resulted in a major enhancement to the user experience. PC-over-IP technology is delivered in both hardware and software implementations. VMware View 4.x and above are based on the software version. PC-over-IP resolved the challenges of provisioning, managing, and securing enterprise desktops.

In 2010 VMware introduced View with Local Mode for offline desktop support. Local Mode allows end users to:

- Check out a desktop from the datacenter to run on the client device regardless of network connectivity. Enjoy a full fidelity desktop experience with 3D DirectX9c support, Aero glass effects on Win7, support for devices like web cams and VoIP.
- Immediately get access to a replica desktop if the client device (e.g., laptop) fails or is lost.
- Get a real choice of client devices.

### **ARCHITECTURE**

VMware View's architecture is shown below. Apart from the VMware Virtual infrastructure, you only need the View Connection Server to be up and running. To use the linked-clones

technology, the VMware View Composer is installed on the VMware vCenter server. With this feature it is possible to use one (snapshot of a) golden image to deploy virtual desktop VMs and save disk space because the VMs use the same golden image and an additional Delta file of changes. The protocols used with VMware View 4.x and above are RDP and PCoIP.

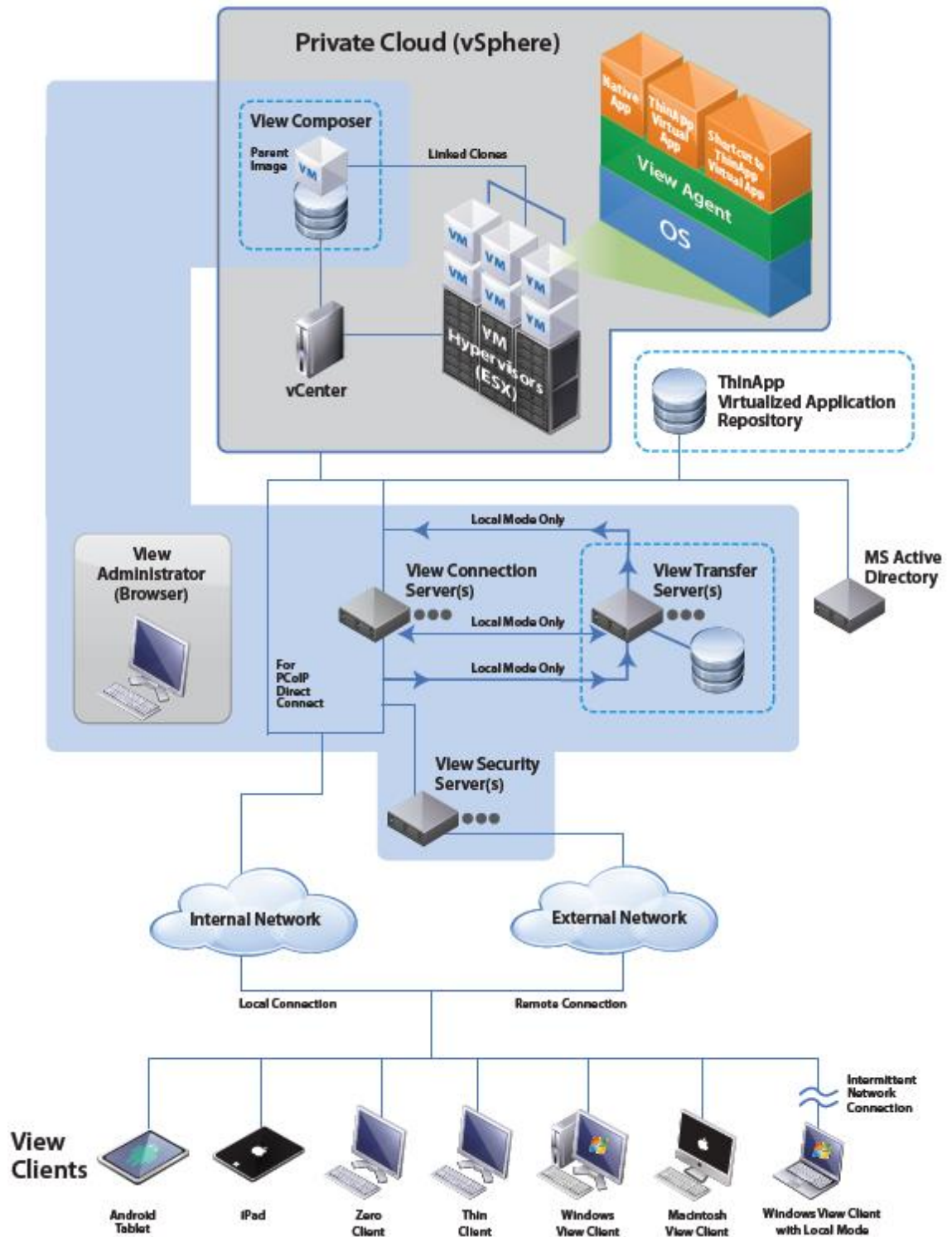


Figure 16, VMware VDI solution

**LICENSING**

Horizon View includes Persona Management (User Profile Management), View Composer (linked clones, single disk-image provisioning), View Client with Local Mode, VMware vShield Endpoint (antivirus component) and VMware ThinApp (Application Virtualization). There are two packages available to Horizon View: Bundle and Add-on. Horizon View Bundle includes all components needed for the virtual desktop infrastructure: vSphere Desktop, vCenter Server Standard Desktop, View Manager 5 and related edition components. Horizon View Add-On only includes desktop components and customers must already have vSphere in their environment or purchase vSphere Desktop separately.

Horizon View is also available as part of the Horizon Suite, which includes Horizon Workspace and Horizon Mirage.

**5.14 VMWARE MIRAGE**

*Note from the author: VMware acquired Wanova in May 2012. Though Mirage is not a server hosted VDI solution, today it offers the manageability benefits of VDI while providing local execution on the endpoints (Mirage does not require a hypervisor on clients or servers).*

**Introduction**

With VMware Mirage, IT can centrally manage physical desktops, laptops, and virtual machines remotely while their end users continue to leverage all of the local power of those devices. Mirage will centralize virtual copies to the data center of every endpoint that the Mirage client (no hypervisors) is installed on. Mirage will keep that device synchronized with the data center but the end user can use that endpoint online or offline any time, any place. When IT has all of these endpoints centralized, they can perform remote disaster recovery, hardware refreshes, Windows7 migrations, and single image management. And in addition to that, Mirage was designed to excel over the WAN by leveraging deduplication both in storage and during network transfers. Mirage offers the benefits of centralization and VDI manageability coupled with the power of lo-cal execution and persistent end-user personalization.

**Architecture**

To centralize an endpoint with the Mirage server, simply install the 2 Megabyte Mirage client (no hyper-visors required). Once installed, the Mirage software works at the Windows service level, meaning your end-users endpoint is still just a fully functional Windows end-point. When installed, Mirage will centralize a complete virtual copy of that end-point to the data center which includes everything: the Operating System, installed-applications, the user files, and user profile. The entire end-point will be continuously synchronized with the data center when the endpoint is online, but the end user can use their endpoint online or offline at any time. Mirage will synch all the changes when the user is connected again. The entity that Mirage keeps in the data center for each endpoint is referred to as a CVD which stands for "Centralized Virtual Desktop". In addition to that, Mirage's optimized deduplication keeps storage and network requirements low.



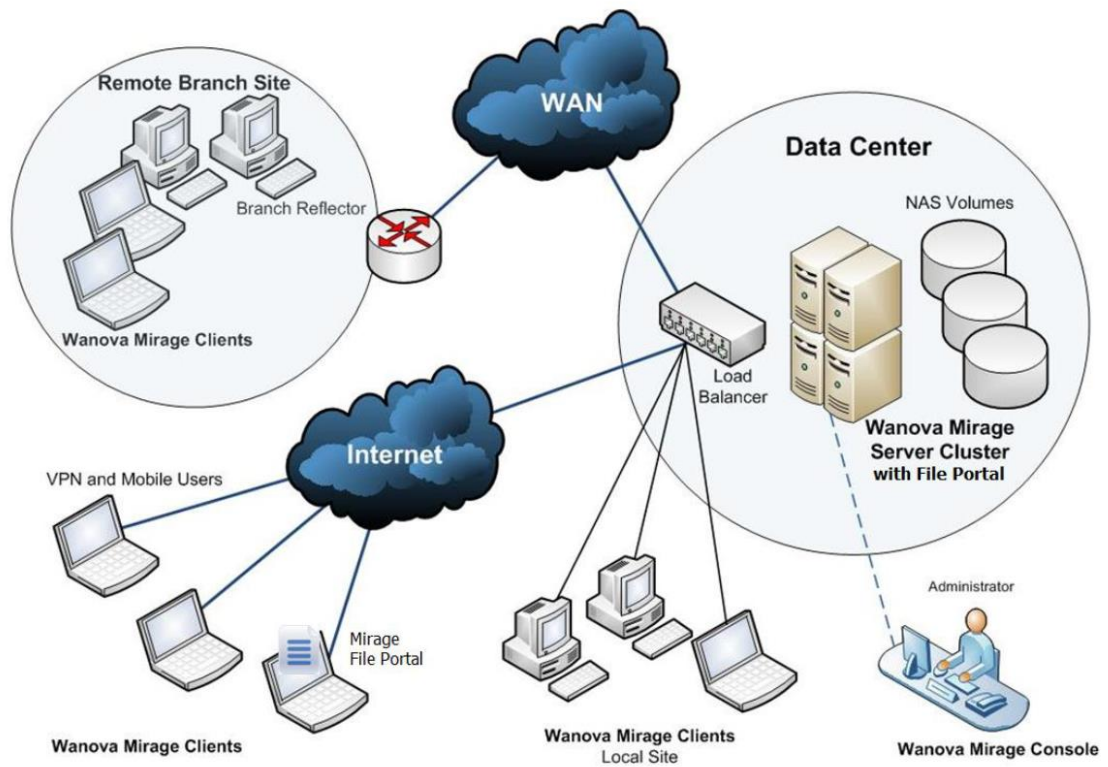
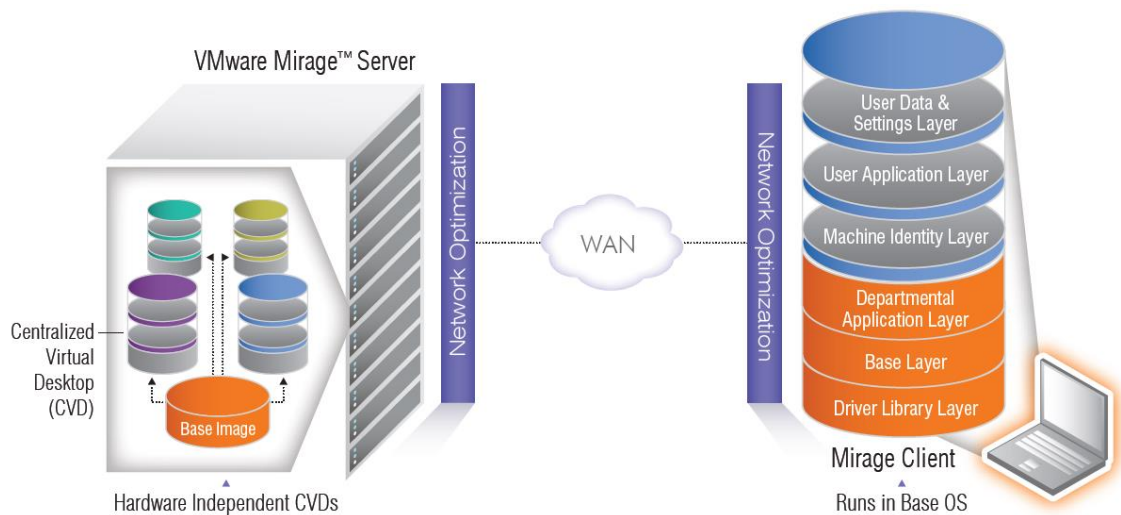


Figure 17, VMware Mirage architecture

When the Mirage client is installed on an endpoint, Mirage breaks that endpoint into six logical layers. Mirage does not manipulate the endpoint, but instead uses these logical layers to perform more granular operations on that endpoint. The six logical layers are as follows:

1. User Data & Settings
2. User-installed applications
3. Machine Identity Layer
4. Department Applications
5. Operating System & Core System Applications
6. Driver Library

The bottom 3 (orange) layers are generic layers, managed centrally and pushed to the user endpoints via IT. The top 3 (blue) layers are user-centric and will not be over-written by the layers delivered by IT. All six layers are continuously synchronized with the data center.



**Figure 18, VMware Mirage networking**

**Benefits**

- Centralized control of a full desktop instance in a distributed infrastructure.
- Full support for offline use while retaining user data and customizations.
- Single image management: Update a single Base Layer in the data center, and automatically synchronize the full image with all associated endpoints when they connect to the network.
- Enforce the Base Layer for remote-break-fix operations and/or corporate compliance without overwriting user-installed applications, data or preferences.
- Quickly restore a user’s complete desktop image, including user –installed applications, user data, and user profile, to a Replacement device of any make or model.
- Leverage Mirage re-imaging and fast snapshot restore to resolve desktop issues while preserving user customizations and data.
- Enable end users to restore previous versions of files and deleted files with self-service file-level restore.
- CVD archiving to preserve data, snapshots, and operational history for long-term retention.
- Obtain Mirage reports of storage utilization and application inventory.
- Perform comparative analysis with Base Layer download projections.
- Migrate existing Windows XP endpoints to Windows 7/8 while preserving user profile and data. Migration is optimized to operate over WAN without infrastructure requirements on the client side.

**Functionality**

- True single image management for physical and virtual desktops. Create a single image for all your virtual and physical endpoints and leverage the Driver Library feature to manage drivers as needed for those endpoints. This results in a hardware-agnostic single-image management solution.
- Profile Management. Mirage stores the User Data and Settings in a specific layer that can be migrated anywhere. Using this technology Mirage delivers a simple profile management solution.
- Applications are divided in three categories:
  - Core applications (everybody; like Office, Acrobat reader etc.)



- Departmental applications (departments/groups; like Drawing and Financial apps)
- User installed applications (defined and installed by the user)
- Central off-premise desktop/laptop management.  
The VMware Mirage clients can connect and synchronize no matter where they are, as long as they are connected to the internet. And synchronizing means that user-layers are synchronized back to the datacenter, but also that changes to the base image or centrally managed apps are synchronized to the client.
- Offline Desktop support. Mirage is a solution that can be executed locally as well, no network connection is required. As soon as the desktop can connect to the Management Environment, the data is synchronized.
- Off premise Backup/replication. Because there always is a centralized copy of the entire image (intelligently de-duped), there is a full backup of the user workspace. This relieves you from using expensive cloud-based backup services.
- OS Migration support. Because the OS is just one of the layers, migrating to a new OS is just a matter of applying a new Base Layer to an endpoint (or collection of endpoints).
- Hardware migration support. Quickly migrate users from old hardware to new hardware without affecting or losing their user layers.
- Snapshot based restore. Anytime an end user device breaks, IT can quickly and easily send a previous working snapshot to that endpoint (without over-writing or losing user-data) Remote File Access via any web browser using the File Portal feature

## 5.15 UNIDESK

*Note from the author: Unidesk is an increasingly popular desktop provisioning, application delivery, and management platform in the Server Hosted Desktop (VDI) space. Unidesk's layering technology is often used in place of VMware Linked Clones, View Composer, View Persona, and VMware ThinApp by VMware View customers and in place of Citrix Provisioning Server, Citrix Machine Creation Services, Citrix XenApp, Microsoft App-V, Citrix Personal vDisk, and Citrix Profile Management by Citrix XenDesktop customers.*

### INTRODUCTION

Unidesk is a provisioning and application delivery solution for virtual desktops hosted on VMware vSphere. Customers use the Unidesk layering platform in combination with VMware View, Citrix XenDesktop, and other brokers when:

- They have a large number of applications that cannot be easily virtualized;
- They want to keep the number of gold images to 1 to simplify Windows OS patching and updates;
- They have users who require persistent desktops to keep user-installed applications and other customizations;

They want to reduce the amount of storage needed for VDI up to 85%.

### BENEFITS

#### Cost Savings

- Reduce storage requirements: Unidesk shares single layers of the OS and applications across many virtual desktops and thin provisions user space to reduce SAN and NAS capacity requirements up to 85% for both persistent and non-persistent desktops.
- Reduce OpEx: Customers report that with Unidesk, they can layer almost any application in less than 30 minutes, compared to the days it may require to virtualize the same applications. Also, most Unidesk customers have only 1 gold image for all desktops, compared to the 1 gold image for every 50-100 desktops required by non-Unidesk VDI implementations. The savings in Windows patching and application delivery time alone enables Unidesk to pay for itself in less than 6 months.
- Reduce desktop support costs. Unidesk enables Level 1 service desk personnel to repair damaged virtual desktops simply by rolling the desktop's User layer back to a previous snapshot. Bad registry keys and DLLs, malware, viruses, and other problems can be fixed with a simple reboot, without having to reimage the desktop or lose all user customizations.

#### IT Benefits

- Minimize complexity. Unidesk's interface, "layer cake" approach to creating desktops and full feature set means fewer point tools to learn.
- Simplify application packaging and delivery. Traditional application virtualization requires time and business knowledge to deal with the compatibility issues caused by process isolation, and there are many applications that cannot be virtualized. Unidesk can package any application in a fraction of the time. Just install the app the way you would on a physical PC, and it can be immediately assigned to any number of desktops.

- Reduce patching time and costs. With only 1 gold image layer as the basis for all desktops, Unidesk can deliver a virtually unlimited number of Windows hot fixes and updates to all desktops in 1 day, without the patch failure rates typical of agent-based PC management approaches.

### **End User Benefits**

- Full, rich desktop. Unidesk provides a consistently personal desktop experience that ensures virtual desktop acceptance and enhances job satisfaction by making sure user data, profile settings, and user-installed applications survive logouts, reboots, patches, and upgrades.
- Quickly receive new applications, updates, and patches from IT. Unidesk accelerates delivery of new revenue-generating applications and patches needed for security and compliance without time-consuming install procedures, scripting, or risk of patch failure.
- Repair "broken" desktops instantly. End users don't have to deal with lengthy desktop downtime, or worry that personal settings and data will survive an attempted repair. Unidesk can roll back user-installed applications or surgically repair specific applications, leaving all user data intact.

### **FUNCTIONALITY**

#### **Simpler, More Powerful Application Delivery**

Unidesk can package and deliver applications in a fraction of the time required to virtualize the same applications. Unidesk can also deliver antivirus, printer/scanner drivers, Office plug-ins, and the many other applications that traditional application virtualization cannot. With Unidesk layers, IT administrators can package or patch apps once, then assign them to any or all desktops. If a mistake is made, they can simply roll the layer back to a previous version to undo the problem.

#### **Single Image OS Management**

With all applications layered separately, all desktops can be created from a single, pristine Microsoft Windows gold OS layer. Administrators can patch the gold once, and all desktops get updated. End users won't lose user customizations like they will with cloning solutions. Also, the patch failures common with agent-based PC configuration tools are no longer an issue because of how Unidesk composites the new OS layer into every desktop using file system and Registry virtualization.

#### **100% Persistent Personalization**

Profile management only captures user customizations that can be stored in a profile. Unidesk's storage-efficient persistent desktops capture everything - including profile settings, data, and user-installed applications - and eliminate the need for profile management in most cases.

#### **85% Less Storage**

By sharing the same OS and application layers across many desktops and thin provisioning user layers, Unidesk cuts the VDI storage footprint up to 85% for both persistent and non-persistent desktops.

#### **Broker Integration**

Unidesk brokering connectors for VMware View and Citrix XenDesktop enable Unidesk desktops to be provisioned directly into View and XenDesktop pools and catalogs.

### Web-Based Management Interface

Unidesk's elegant management interface makes it easy for administrators to provision, update, manage, and report on their entire VDI estate. The web-based management console enables administrators to dynamically assemble desktops from a pick list of independently packaged and versioned Microsoft Windows OS and application layers.



Figure 19, Unidesk web-based management

### ARCHITECTURE

Unidesk is implemented as a system of "scale-out" virtual appliances that run on existing VMware infrastructure.

The Unidesk Management Appliance hosts the Web-based management application that is used by administrators to provision, patch, assign and report on virtual desktops. Only one Management Appliance is typically needed for a VDI environment. The Management Appliance also manages Unidesk policy and configuration, including information about Unidesk layers, desktops and users. The Management Appliance can be deployed on any host in the virtual infrastructure as long as it can communicate over TCP/IP with Unidesk CachePoint appliances and VMware vCenter Server.

The first Unidesk CachePoint appliance deployed takes on the special role of Master CachePoint, storing all Operating System (OS) and Application layers. In production VDI environments, a dedicated Master CachePoint appliance should be deployed on a

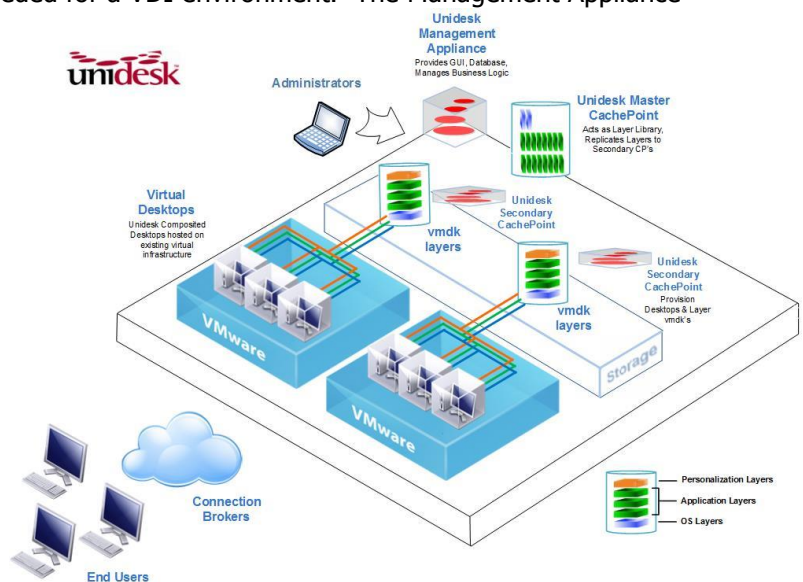


Figure 20, Unidesk architecture

separate host server to maximize virtual desktop performance. The Master CachePoint automatically replicates OS and Application layers to other secondary CachePoints, where the layers are cached as VMDKs. Layers are replicated only if they are needed by at least one of the desktops associated with a CachePoint.

Each secondary CachePoint caches the OS, Application and Personalization layers for the desktops it hosts. The desktops are created with a small boot image in a VMDK file. At boot, this disk supplies enough of the desktop operating system to load any drivers or early start services required prior to the Unidesk filesystem drivers loading. Once the Unidesk drivers are loaded, the desktop establishes connectivity to the correct OS, Application and Personalization layers, stored as VMDKs in a directory structure under the CachePoint. All desktops assigned to a CachePoint share the same OS and Application layers for dramatic storage savings. The Personalization layer for each desktop is then combined on top of the IT-controlled OS and App layers. The virtual infrastructure and connection broker see Unidesk desktops as standard virtual machines.

#### **LICENSING**

Unidesk is based on a perpetual licensing model, with annual Complete Care service (support and maintenance) mandatory for all purchases. The licensing unit is a Managed Desktop, defined as the number of virtual desktops created, updated, and managed by Unidesk. This may include persistent desktops (assigned to specific users, retain state, and used only by those users), non-persistent (don't retain state, shared by many users e.g. labs), and non-concurrent (may or may not retain state, shared by multiple users, but not at same time, e.g. shift workers). Customers may purchase 3 years of Complete Care Service upfront in return for a discounted price. Unidesk also plans to add term/subscription licensing options for service providers and site/enterprise licensing options for large opportunities.

## 6. VDI FEATURES COMPARISON

### 6.1 INTRODUCTION

It's important to understand that comparing features is the last step in the decision tree. Vision, Strategy and Technology are the former steps. Each VDI solution has its own functionality and feature-set. This chapter describes the features in a very detailed way.

### 6.2 PRODUCT VERSION

This detailed feature compare matrix is developed with the following products and versions:

Product	Version	Release date
Citrix XenDesktop	7.1	October 2013
Citrix VDI-in-a-Box	5.3	June 2013
Microsoft VDI/RDS	Server2012R2 (RFX) Windows 8.1	October 2013
Dell vWorkspace	8.0	April 2013
VMware View	5.3	October 2013

Table 3, Product versions

*Note: Although most of the solutions have sub-versions, we used the highest level version where appropriate. The features focus is with VDI in mind.*

### 6.3 SCOPE

The scope of the feature compare matrix is to have **focus on the desktop virtualization solution**. Integration with Microsoft SCCM or other Client Management Solutions or integration with workspace aggregators such as VMware Horizon which will add valuable functionality to the solution in general is out the scope of this whitepaper. It's out of scope for this whitepaper to explain the 'It depends' remarks'.

### 6.4 FEATURE COMPARE MATRIX

	VDI solutions and features
Goal:	Detailed description of features
Requirements:	Hands-on-experience, vendor involvement
Result:	Whitepaper
Method of Execution:	Hands-on experience, read articles, communicate with vendors and discuss with colleagues

**Used legend:**

✓=Applicable; ✗=Not applicable; --Not needed; ~=It depends; #= Under investigation

A green ✓ or red ✗ has nothing to do with advantage or disadvantage of a solution. It just presents the availability of the functionality.

**RDP** =Only supported with RDP; **RFX** =Only supported with RemoteFX (**Citrix XenDesktop** and **VDI-in-a-Box** default remote display protocol is **HDX/ICA**)

- **Microsoft** VDI/RDVH default Remote Display protocol is **RDP 8/RemoteFX**
- **Quest vWorkspace** default Remote Display protocol RDP with **EOP**
- **VMware View** default Remote Display protocol is **PCoverIP**; Legacy is RDP

## 6.5 COMPARE MATRIX, FEATURES

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
<b>User Experience</b>						
Connect Client Drives at logon	✓	✓	✓	✓	RDP	
Connect Client Printers at logon	✓	✓	✓	✓	✓	
Connect Client COM ports at logon	✓	✓	✓	✓	✓	
Microphone support	✓	✓	✓	✓	✓	
Speaker support	✓	✓	✓	✓	✓	
Bi-directional audio LAN (11kbps each way)	✓	✓	✓	✓	✓	
Bi-directional audio WAN; (11kbps each way) latency reduction	✓	✓	X	✓	X	
Bi-directional audio WAN; (11kbps each way) bandwidth compression	✓	✓	X	✓	X	
USB device support; USB hub – Full USB	✓	✓	✓	✓	✓	
USB device support; USB 2.0 isochronous	✓	✓	✓	✓	✓	
USB Camera (Mass Storage Device)	✓	✓	✓	✓	✓	
USB device access restrictions 'granular' (type/serial)	✓	✓	X	✓	✓	
Clipboard; text	✓	✓	✓	✓	✓	
Twain (scanner) device support	✓	✓	✓	✓	✓	
Client-to-server Folder redirection	✓	✓	X	✓	RDP	
Client time zone redirection	✓	✓	X	✓	✓	
Regional settings redirection	✓	✓	X	X	✓	
Webcam support (LAN)	✓	✓	✓	✓	✓	
Webcam support (WAN); bandwidth compression	✓	✓	X	✓	✓	
Webcam support (WAN); latency reduction	✓	✓	X	✓	✓	
Audio codec - System sounds (22Kbps)	✓	✓	✓	✓	✓	
Audio codec - Optimized for Speech (34kbps)	✓	✓	✓	✓	✓	



Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Audio codec - HQ audio (192Kbps)	✓	✓	✓	✓	✓	
Adobe Flash support; server-side rendered	✓	✓	✓	✓	✓	
Adobe Flash support; client-side rendering	✓	✓	✗	✓	--	
Adobe Flash v11 support; client-side rendering	✓	✓	✗	✓	--	
Adobe Flash support; client-side failover to server-side when network latency exceeds threshold	✓	✓	✗	✓	--	
Server-side content/Adobe flash fetching	✓	✓	✓	✓	✓	
Client-side content/Adobe flash fetching	✓	✓	✗	✓	--	
Windows media; client-side content fetching	✓	✓	✗	✗	✗	
Microsoft Silverlight; server-side rendered	✓	✓	✓	✓	✓	
Microsoft Silverlight; client-side rendering	✗	✗	✗	✗	--	
Multimedia (A/V) redirection; server-side rendering	✓	✓	✓	✓	✓	
Multimedia (A/V) redirection; client-side rendering	✓	✓	✓	✓	~	MMR for Windows 7 H.264 only
Progressive Display (2D/3D) – Perceptually lossless	✓	✓	✓	✓	✓	
Default frame limit	✓	✓	✓	✓	✓	
Internet Explorer Redirection (Server -> Client)	✗	✗	✗	✓	✗	
Local application file-type extensions; open local file-types and use centralized apps	✓	✗	✓	✓	✗	
Automatically adjust image quality based on avail. network bandwidth	✓	✓	✓	✓	✓	
Network latency masking / reduction	✓	✓	✓	✓	✓	
Connect network printers with vendor vDesktop policies	✓	✓	~	✓	✓	
Clear Type fonts support	✓	✓	✓	✓	✓	
Windows 7 Aero redirection to Windows endpoint	✓	✓	✗	✗	--	Looks negative like this, in fact is a major plus for VMware. No client dependency
Windows 7 Aero support on Windows endpoint	✓	✓	✓	✓	✓	
Windows 7 Aero support on non-Windows endpoint	✓	✓	✗	✗	✓	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Windows 8 Desktop Window Manager redirection to Windows endpoint	✓	✓	✓	✗	✗	
Windows 8 Desktop Window Manager redirection to non-Windows endpoint	✗	✗	✗	✗	✗	
Native Windows 8 touch support from VDI vendor	✗	✗	✓	✗	✗	
Touch optimization from VDI vendor for OSs which are not designed for touch gestures	✓	✓	✗	✗	✓	
3D OpenGL support, software assist GPU; inside VM	✗	✗	✗	✗	✓	ESX v5 only
3D OpenGL support, hardware assist GPU	✓	✗	✗	✗	✓	
3D DirectX support <v9.1, software assist GPU; inside VM	✗	✗	✗	✗	✓	ESX v5 only
3D DirectX support >v10, software assist GPU; inside VM	✗	✗	✗	✗	✗	
3D DirectX support >v11, software assist GPU; inside VM	✗	✗	✓	✗	✗	
3D DirectX support ;<9.1, hardware assist GPU	✓	✗	✓	RFX	✓	
3D DirectX support >10, hardware assist GPU	✓	✗	✓	RFX	✓	
3D DirectX support >v11, hardware assist GPU	✓	✗	✓	✗	✓	
Compression of Remote Desktop protocol by GPU	✓	✗	✓	RFX	✗	✓ HDX3Dpro (extreme compression)
Multi monitor support while using GPU compression	✓	--	✓	RFX	--	
GPU PassThrough from Hypervisor to vDesktop; 1:1	✓	✗	✗	✗	✓	
GPU Virtualization, share GPU with multiple vDesktops	✓	✗	✓	RFX	✓	
16-bit color support	✓	✓	✓	✓	✓	
24-bit color support	✓	✓	✓	✓	✓	
32-bit color support	✓	✓	✓	✓	✓	
Multi-monitor support – Span/extend	✓	✓	✓	✓	✓	
Multi-monitor support – Clone	✓	✓	✓	✓	✓	
Multi-monitor support – Pivot	✓	✓	✗	✓	✓	
Multi-monitor support ≤2	✓	✓	✓	✓	✓	
Multi-monitor support ≤4	✓	✓	✓	✓	✓	
Multi-monitor support >4	✓	✓	✓	✓	RDP	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Full-HD support (1920x1200) per monitor	✓	✓	✓	✓	✓	
Maximum resolution ≤ 4096 x 2048	✓	✓	✓	✓	RDP	
2560*1600	✓	✓	✓	✓	✓	
1920*1200	✓	✓	✓	✓	✓	
1680*1050	✓	✓	✓	✓	✓	
<1400*900	✓	✓	✓	✓	✓	
Language bar docking	✓	✓	✓	✓	✓	
Auto-resize user desktop	✓	✓	✓	✓	✓	
Dynamically adjust client printer configuration	✓	✓	X	✓	✓	
Dynamically adjust network printer configuration	✓	✓	X	✓	✓	
Dynamically adjusts client monitor configuration	✓	✓	X	✓	✓	
Printing bandwidth optimization; image compression	✓	✓	X	✓	✓	
Printing bandwidth optimization; image compression and redundant image removal	✓	✓	X	✓	~	ThinPrint
Printing speed optimization; page per page level streaming	X	X	X	✓	X	
Printing bandwidth control; limit maximum site to site printing bandwidth	✓	✓	X	✓	X	
Session reconnection from new and current clients	✓	✓	✓	✓	✓	
Unified Communications (OCS/Lync) <u>VDI vendor support</u> and best practices A/V in LAN scenarios. (Audio via USB phone pairing)	✓	✓	X	✓	✓	MS support policy is key ( <a href="#">limited support!</a> )
Unified Communications (OCS/Lync) <u>VDI vendor support</u> and best practices A/V in WAN scenario's; (Audio via USB phone pairing)	✓	✓	X	✓	✓	MS support policy is key ( <a href="#">limited support!</a> )
Unified Communications (OCS/Lync 2013) <u>Microsoft support</u> of Lync VDI plugin over RDP; solution over Dynamic Virtual Channels	✓	✓	✓	✓	✓	
Unified Communications (OCS/Lync 2013) <u>VDI vendor support</u> and implementation of Dynamic Virtual Channel APIs in vendor client software and backend infrastructure for support over vendor default Remote Display protocol	✓	✓	✓	X	✓	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Unified Communication A/V rendered (peer-2-peer communication) on end-point OCS/Lync	✓	✓	✗	✗	✓	
Unified Communication A/V rendered (peer-2-peer communication) on end-point UC Avaya	✓	✓	✗	✗	✓	
Unified Communication A/V rendered (peer-2-peer communication) on end-point UC Cisco	✓	✓	✗	✗	✓	
Unified Communication A/V rendered (peer-2-peer communication) on end-point UC Mitel	✗	✗	✗	✗	✓	
Unified Communication A/V rendered (peer-2-peer communication) on end-point Skype	✗	✗	✗	✗	✗	
Unified Communication A/V; API can be leveraged by partners to support advanced call routing functionality	✓	✗	~	~	✓	~ Lync API
Conferencing applications; optimized real time A/V redirection (instead USB redirection) on Windows endpoint	✓	✓	✗	✗	✓	
Conferencing applications; optimized real time A/V redirection (instead USB redirection) on non-Windows endpoint	✓	✓	✗	✗	✓	
Toolbar; connect/disconnect client devices	✓	✓	✓	✓	✓	
Toolbar; determine client-side file access	✓	✓	✗	✗	✗	
Session pre-launch; Fast session connect and reconnect	✗	✗	✗	✗	✗	
User Installed Applications integrated in vDesktop	✓	✓	✗	✗	✗	
Optimized for bandwidth restricted environments (<256 Kbps) and - high latency connections (>150 ms)	✓	✓	✓	✓	✓	
Single Sign-on from Windows endpoint to vDesktop	✓	✓	✓	✓	✓	
Desktop lockdown, alternate shell to provide simplified access to the desktop	✓	✓	✗	✓	✗	
Redirect Ctrl+Alt+Del to the remote desktop	✓	✓	✗	✗	✗	
Seamless application publishing to endpoint	✓	✗	✓	✓	✗	
Reverse seamless, Windows- and Web application publishing	✓	✗	✗	✗	✗	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Welcome screen, customizable	✓	✓	✗	✗	✓	
Remote Display Protocol Experience <u>monitor</u> (troubleshooting)	✓	✓	✓	✓	✓	
Remote Display Protocol performance <u>metrics</u> (troubleshooting)	✓	✗	✓	✗	✓	
Remote Display Protocol <u>Signal Applet</u> (Experience index for End-user)	✓	✗	✓	✗	✗	
On-demand web installer for Windows endpoint client software	✓	✓	✓	✓	✓	
On-demand web installer for Mac OSX endpoint client software	✓	✓	✗	✗	✓	
Connection resiliency, Session Reliability	✓	✓	✓	✓	✓	
Connect directly to the vDesktop from any endpoint using vendor's Remote Display Protocol without using a connection broker	✓	✗	✓	✓	✓	
<b>Supported Remote Display Protocols</b>						
Microsoft RDP 6.1	✓	✓	✓	✓	✓	
Microsoft RDP 7.0	✓	✓	✓	✓	✓	
Microsoft RDP 7.1 (RemoteFX)	✓	✓	✓	✓	✓	
Microsoft RDP 8.0	✓	✓	✓	✓	✓	
Microsoft RDP 8.1	✓	✗	✓	✓	✓	
Citrix ICA/HDX	✓	✓	✗	✗	✗	
VMware / Teradici PCoIP	✗	✗	✗	✗	✓	
HP RGS	✗	✗	✗	✓	✗	
VNC	✗	✗	✗	✗	✗	
SUN ALP	✗	✗	✗	✗	✓	
RAdmin	✗	✗	✗	✗	✗	
NX	✗	✗	✗	✗	✗	
Quest EOP	✗	✗	✗	✓	✗	
xRDP	✗	✗	✗	✓	✗	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
SPICE	X	X	X	X	X	
<b>Management</b>						
User Profile Management in vDesktop	✓	✓	✓	✓	✓	
User Profile Management in FAT Client scenario	X	X	X	~	✓	~ focus in hosted desktops
One time migration Windows XP to Windows 7/8 profile management	✓	✓	X	X	✓	
Bandwidth/resource management: printing	✓	✓	X	✓	✓	
Bandwidth/resource management: client drives	✓	✓	X	✓	~	
Bandwidth/resource management: USB	✓	✓	X	✓	X	
Bandwidth/resource management: Audio	✓	✓	X	✓	✓	
Bandwidth/resource management: Video	✓	✓	X	✓	✓	
Bandwidth/resource management: Adobe Flash	X	X	X	✓	✓	
Universal print driver; <u>client</u> connected printers	✓	✓	✓	✓	✓	
Universal print driver; server side / <u>network</u> printers	✓	X	X	✓	X	
Universal printer driver: EMF support	✓	✓	✓	✓	✓	
Universal print server; one universal print driver on vDesktop	✓	✓	X	✓	X	
Manage client drive redirection	✓	✓	✓	✓	✓	
Manage client USB redirection	✓	✓	X	✓	✓	
Remote session control; session shadowing	~	~	✓	✓	~	~ Windows Remote Assistant
Bandwidth Protocol Management	✓	✓	X	X	✓	Limit bandwidth per session/ channel
Adobe Flash Quality; configure through policy	✓	X	X	X	✓	
Support low bandwidth/high latency WAN connections	✓	✓	~	✓	✓	WAN = 50kbps/150ms
Supports WAN acceleration TCP based devices	✓	✓	✓	✓	✓	
Supports WAN acceleration UDP based devices	✓	✓	✓	✓	✓	
Support Multistream UPD/TCP	✓	✓	X	X	✓	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Desktop pools support for Multi VLAN or network labels	✓	✓	✓	✓	✓	
Additional instrumentation (end-to-end monitoring) for vDesktop included in a VDI software bundle	✓	✗	✗	✗	✓	
Additional instrumentation (VDI Infrastructure Monitoring and Diagnose) for vDesktop included in a VDI software bundle	✓	✗	✗	✓	✓	
Additional instrumentation (Infrastructure and E2E Monitoring, Diagnose) for vDesktop part of the vendor software portfolio	✓	✓	✗	✓	✓	
PowerShell SDK	✓	✗	✓	✓	✓	
Scripting (none PowerShell) support and command-line interface	✓	✗	✓	✓	✓	
Microsoft Group Policy-based management for agent/client settings	✓	✓	✓	✓	✓	
Desktop agent auto deployment from management console	✗	✓	~	✗	✗	
Desktop agent auto upgrade from management console	✗	✓	✗	✗	✗	
Historical (CCU, performance metrics, events, counters) data is available via GUI	~	✗	✗	✗	✗	
RDSH / TS provisioning support from main management console	✗	✗	✗	✓	✗	
Built-in DHCP scope depletion protection	✗	✗	✗	✓	✗	
<b>Security and Networking</b>						
Integrates (SSO) with Citrix Access Gateway	✓	✓	✗	✗	✗	
Integrates (SSO) with Citrix Access Gateway enterprise	✓	✓	✗	✗	✗	
Integrates (SSO) with Cisco ASA	✓	✗	✗	✓	✗	
Integrates (SSO) with Juniper SSL-VPN	✓	✗	✗	✓	✓	
Integrates (SSO) with Microsoft IAG/UAG	✓	✗	✓	✓	✗	
Integrates (SSO) with F5 FirePass	✗	✗	✗	✓	✗	
Integrates with Microsoft caradigm expreSSO solution	✗	✗	✗	✓	✓	
Integrates with Microsoft Remote Desktop Gateway	✗	✓	✓	✓	✗	



Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Two-factor authentication - RSA Secure ID	✓	✗	✓	✓	✓	
Two-factor authentication - SMS passcode support	✓	✗	✓	✗	✓	
Two-factor authentication - Full Radius / IAS support	✓	✗	✓	✓	~	~ Currently support for RADIUS challenges is limited to prompting for text input
Tunneling Display Protocol (SSL/NoTCP-443) through Security Server	--	--	--	--	✓	
Tunneling Display Protocol (SSL/TCP-443) through Security Server	✓	✓	✓	✓	RDP	
Client device location awareness	✓	✓	✗	✓	✓	
Smartcard pass-through support	✓	✓	✗	✓	✓	
Smartcard logon support for Windows endpoints	✓	✓	✓	✓	✓	
Smartcard logon support for Linux endpoints	✓	✓	✓	✓	~	VMware ThinClient Linux Partners
Local credentials pass-through	✓	✓	✓	✓	✓	
Remoting Protocol network traffic shaping	✓	✓	✓	✓	✓	
Remoting Protocol network QoS	✓	✓	✓	✓	✓	
Dynamic prioritization of Remote Display Protocol traffic by (3 <sup>rd</sup> party) WAN accelerators	✓	✓	✓	✓	✓	<a href="http://t.co/KmmIPEuudp">http://t.co/KmmIPEuudp</a>
Client traffic is secured	✓	✓	✓	✓	✓	
Management traffic is secured	✓	✓	✓	✓	✓	
Auditing and security logging of admin actions	✗	✓	✗	✓	✓	
Security Hardening Guidelines	✓	✓	✗	✗	✓	
2048-Bit SSL Certificate Support (WebAccess/SecureGateway)	✓	✓	✓	✓	✓	
Reuse pre-configured Active Directory computer accounts	✓	✓	✓	✓	✓	
<b>VDI Desktop Assignment</b>						
Integrated with AD	✓	✓	✓	✓	✓	
Multi-AD support	✓	✓	✓	✓	✓	
Multi-AD support; same forest and 2-way trust	✓	✗	✓	✓	✓	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Based on AD group	✓	✓	✓	✓	✓	
Based on AD user	✓	✓	✓	✓	✓	
Based on AD OU	✓	✓	✗	✓	✗	
Based on Device Name	✓	✗	✗	✓	≈	≈ kiosk mode
Based on Device Address	✓	✓	✗	✓	≈	≈ kiosk mode
Restrict access based on time/location/device	✓	✓	✗	✓	✓	
Restrict functionality based on time/location/device	✓	✗	✗	✓	✗	
OpenLDAP support	✗	✗	✗	✗	✗	
Novell eDirectory official support	✗	✗	✗	✗	✗	(Novell not included in QA)
Novell Domain Services for Windows official support	✗	✗	✗	✗	✗	(Novell not included in QA)
<b>Desktop Provisioning</b>						
Offline vDesktops, type #1 'bare metal' included in license	✓	✗	✗	✗	✗	Offline support as core offering in VDI
Offline vDesktops, type #2 'client-hosted' included in license	✗	✗	✗	✗	✓	
Offline vDesktops; integrated in VDI management solution	✗	✗	✗	✗	✓	Assigned (stateful) desktops only
Imaging delivery to vDesktop through LAN (OS streaming)	✓	✗	✗	✗	✗	
Imaging delivery to vDesktop through WAN (OS streaming)	✗	✗	✗	✗	✗	
Imaging delivery to vDesktop through SAN	✓	✗	✓	✓	✓	
Imaging delivery to vDesktop through local storage	✓	✓	✓	✓	✓	
Provisioning Services using local storage 'Quick Deploy'	✓	✓	✓	✓	✓	
Disposable disks; standard images in Pooled Desktops	✓	✓	✓	✓	✓	
Disposable disk drive letter customizable	✗	✗	✗	✗	✓	
Stateful; assigned/private images	✓	✗	✓	✓	✓	
Integrates with Microsoft Hyper-V differencing disks	✓	✓	✓	✓	✗	
Stateless; pooled/standard images	✓	✓	✓	✓	✓	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Stateless; pooled/standard images centrally managed – version control	✓	✗	~	✓	✓	
Stateless; pooled/standard images centrally managed – replication	✗	✓	✗	✓	✓	
vDisk write cache can be stored on CIFS share	✓	✗	✗	✗	✗	
vDisk write cache can be stored in memory	✓	✗	✗	✗	✗	
Differencing disks across different storage types, storage tiering	✓	✓	✗	✓	✓	
Automatic creation of desktops	✓	✓	✓	✓	✓	
Manual creation of desktops	✓	✓	✓	✓	✓	
Instantaneous provisioning; no requirement to wait for VM template replication to complete	✗	✗	✗	✓	✗	
Automatic replication of VM template to configured storage location(s)	✓	✓	✓	✓	✓	
Provision desktops across hypervisor multiple resource pools	✓	-	✗	✓	✓	
Provision Desktops across multiple data stores with local datastore	✓	✓	✓	✓	✓	
Single disk image build-in	✓	✓	✓	✓	✓	
Single disk image 3 <sup>rd</sup> party	✓	✓	✗	✓	✓	
Physical desktops / Blade PCs	✓	✗	✗	✓	✓	
IOPS savings (Read and Write) without any additional software component required	✗	✗	✗	✓	✗	Hyper-V only
IOPS savings (Read and Write) without any additional software component required, Hypervisor independent.	✗	✗	✗	✗	✗	
vDesktop is <u>provisioned</u> to the hypervisor with the best performance without need of advanced Virtual Infrastructure MgMt. solutions such as SCVMM, vCenter, XenCenter	✗	✗	✓	✓	✗	
User with vDesktop at connect time is <u>load balanced</u> to the hypervisor with the best performance without usage of advanced Virtual Infrastructure MgMt. solutions such as SCVMM, vCenter, XenCenter	✗	✗	✗	✓	✗	
Hypervisor block based Read Cache in RAM; integrated in VDI vendor solution	✗	✗	✓	✓	✓	
Hypervisor block based Read Cache on local storage; integrated in VDI vendor solution	✓	✗	✗	✗	✗	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Offload specific storage operations, storage integration (e.g. VAAI/ODF)	X	X	✓	✓	✓	
<b>Guest (VM) Operating System support</b>						
Microsoft Windows Server 2012 R2 (Server OS as VDI ≠RDSH)	X	X	X	X	X	
Microsoft Windows Server 2012 (Server OS as VDI ≠RDSH)	X	X	X	X	X	
Microsoft Windows 2008 R2 (Server OS as VDI ≠RDSH)	✓	X	X	X	✓	
Microsoft Windows 8.1 32-bit	✓	X	✓	✓	✓	
Microsoft Windows 8.1 64-bit	✓	X	✓	✓	✓	
Microsoft Windows 8.0 32-bit	✓	✓	✓	✓	✓	
Microsoft Windows 8.0 64-bit	✓	✓	✓	✓	✓	
Microsoft Windows 7 32-bit	✓	✓	X	✓	✓	
Microsoft Windows 7 64-bit	✓	✓	X	✓	✓	
Microsoft Windows 7 SP1	✓	✓	✓	✓	✓	
Microsoft Windows Vista 32-bit	✓	X	X	✓	✓	
Microsoft Windows Vista 64-bit	✓	X	X	✓	X	
Microsoft Windows XP Professional 32-bit	✓	✓	X	✓	✓	
MS Windows 95 / 98	X	X	X	X	X	
MAC OS X	X	X	X	X	X	
Linux CentOS 6.0	X	X	X	✓	X	
Red Hat Enterprise Linux 6	X	X	X	✓	X	
<b>Client (endpoint) Operating System support</b>						
Microsoft Windows 8 32-bit	✓	✓	✓	✓	✓	
Microsoft Windows 8 64-bit	✓	✓	✓	✓	✓	
Microsoft Windows 8 - RT	✓	✓	✓	X	RDP	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Microsoft Windows 7 Professional	✓	✓	✓	✓	✓	
Microsoft Windows Vista Professional	✓	✓	~	✓	✓	~ RDC v8 not avail.
Microsoft Windows XP Professional	✓	✓	~	✓	✓	~ RDC v8 not avail.
Microsoft Windows 2000 Professional	✗	✗	✗	✗	✗	
Microsoft Windows Server 2003R2	✓	✓	~	✓	✗	~ RDC v8 not avail.
Microsoft Windows Server 2008	✓	✓	~	✓	✗	~ RDC v8 not avail.
Microsoft Windows Server 2008 R2	✓	✓	✓	✓	✗	
Microsoft Windows Server 2012	✓	✓	✓	✗	✗	
Microsoft Windows Server 2012R2	✓	✓	✓	✗	✗	
Windows 9x	✗	✗	~	✗	✗	~ RDC v8 not avail.
Windows XPe	✓	✓	~	✓	✓	~ RDC v8 not avail.
Windows CE	✓	✓	~	✓	✓	~ RDC v8 not avail.
Windows Embedded Standard 7	✓	✓	✓	✓	✓	
MAC OS X	✓	✓	✓	✓	✓	3rd party client; Wyse Pocket Cloud / iTap
Any OS running Java*	✓	✓	✗	✓	✗	*) limited functionality
Unix flavors	✓	✓	✗	✗	✗	
Linux flavors	✓	✓	✗	✓	~	~ RDC v7 not avail. ~ No universal client, only vendor-based
Linux - Ubuntu	✓	✓	✗	✓	✓	
IBM OS/2	✗	✗	✗	✗	✗	
EPOC / Symbian	✓	✓	✗	✗	✗	
Dell Wyse Thin OS (WTOS)	✓	✓	✓	✓	RDP	
Dell Wyse Xenith zero client	✓	✓	✗	✗	✗	
Dell Wyse P25 zero client	✗	✗	✗	✗	✓	
Apple iPhone/iPod IOS v6.x	✓	✓	✓	✓	✓	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Apple iPad IOS v6.x	✓	✓	✓	✓	✓	
Apple iPhone/iPod IOS v7.x	✓	✓	✓	✓	✓	
Apple iPad IOS v7.x	✓	✓	✓	✓	✓	
Google Android	✓	✓	✓	✓	✓	
RIM BlackBerry	✓	✓	✗	✗	✗	
Windows Phone 7	✗	✗	✗	✗	✗	
Windows Phone 8	✓	✓	✗	✗	✗	
HTML5 browser support, available through VDI software vendor	✓	✓	✗	✗	✓	
HTML5 browser support, available through 3 <sup>rd</sup> party vendor	✓	✗	✓	✓	RDP	
<b>Internet Browser support for web based access to vDesktop</b>						
Internet Explorer 6.x	✓	✗	✓	✓	✗	
Internet Explorer 7.x	✓	✓	✓	✓	✗	
Internet Explorer 8.x	✓	✓	✓	✓	✗	
Internet Explorer 9.x	✓	✓	✓	✓	✓	
Internet Explorer 10.x	✓	✓	✓	✓	✓	
Internet Explorer 11.x	✓	✓	✓	✓	✓	
Mozilla FireFox 2.x	✓	✗	✓	✓	✗	
Mozilla FireFox 3.x	✓	✓	✓	✓	✗	
Mozilla FireFox 16.x	✓	✓	✓	✓	✓	
Opera v9	✓	✗	✓	✓	✗	
Safari v4	✓	✗	✓	✓	✗	
Safari v5	✓	✓	✓	✓	✓	
Google Chrome	✓	✓	✓	✓	✓	
Java client	✓	✓	✗	✓	✗	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
<b>Supported Protocols for all VDI infrastructure related components</b>						
TCP/IP v4	✓	✓	✓	✓	✓	
TCP/IP v6	✓	✗	✓	✗	✗	
<b>Virtual Infrastructure (Hypervisor) support</b>						
Citrix XenServer 5.x	✓	✗	✗	✗	✗	
Citrix XenServer 5.6 SP2	✓	✓	✗	✗	✗	
Citrix XenServer 6.0	✓	✓	✗	✗	✗	
Citrix XenServer 6.1	✓	✓	✗	✗	✗	
Citrix XenServer 6.2	✓	✓	✗	✗	✗	
VMware VI 3.5	✗	✗	✗	✓	✗	
VMware vSphere 4.0/4.1	✓	✓	✗	✓	✓	
VMware vSphere 5.0	✓	✓	✗	✓	✓	
VMware vSphere 5.1	✓	✓	✗	✓	✓	
VMware vSphere 5.5	✓	✓	✗	✗	✓	
Microsoft Hyper-V Windows Server 2008	✓	✓	✗	✓	✗	
Microsoft Hyper-V Windows Server 2008 R2 SP1	✓	✓	✗	✓	✗	
Microsoft Hyper-V Windows Server 2012	✓	✓	✓	✓	✗	
Microsoft Hyper-V Windows Server 2012 R2	✓	✗	✓	✗	✗	
Oracle Virtual Iron	✗	✗	✗	✗	✗	
Parallels Virtuozzo 5.6	✗	✗	✗	✓	✗	
Oracle VM	✗	✗	✗	✗	✗	
VMware View Composer is limited to <amount>of hosts on VMFS	--	--	--	--	<b>32</b>	32/Max vSphere Cluster Size with vSphere 5.1 and View 5.3



Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
VMware View Composer is limited to <amount> of hosts on NFS	--	--	--	--	32	
<b>Virtual Infrastructure Integrated (snapshot, create, delete ) Management</b>						
Citrix XenCenter	✓	✓	✗	✗	✗	
Microsoft SCVMM 2008R2	✓	~	✗	✓	✗	
Microsoft SCVMM 2012 SP1	✓	✗	✓	✓	✗	
VMware Virtual Center	✓	✓	✗	✓	✓	
Virtual Iron	✗	✗	✗	✗	✗	
Parallels Virtuozzo 5.6	✗	✗	✗	✓	✗	
Oracle VM	✗	✗	✗	✗	✗	
<b>Service / Connection Broker</b>						
Includes / build-in Load balancing	✗	✓	✗	✓	✗	
Includes / build-in High Availability	✓	✓	✓	✓	✓	
Centralized management console	✓	✓	✓	✓	✓	
Web-based management interface, daily admin tasks	✓	✓	✗	✗	✓	
Microsoft Management Console (MMC) based Interface	✓	✗	✓	✓	✗	
Delegation of control	✓	✓	✗	✓	✓	
Delegation of control, granular delegated administration roles	✓	✗	✗	✓	✓	
Console supports multiple concurrent administrators	✓	✓	✓	✓	✓	
Manage VDI Infrastructure and Hypervisor from single console	✗	✗	✗	✓	✓	
Connect to VM Console from Broker Management Console	✗	✗	✗	✓	✗	
Single management console supports 5K vDesktops – VDI	✓	✓	✗	✓	✓	
VM pool management	✓	✓	✓	✓	✓	
VM power management	✓	✗	✓	✓	✓	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Virtual machine power policy	✓	✗	✓	✓	✓	Power Policy when VM's are not in use
User session management	✓	✓	✗	✓	✓	
User session disconnect policy; Do nothing/logoff/shutdown	✓	✓	✗	✓	✓	
Allow users to reset their desktop	✓	✓	✗	✗	✓	
Multiple active sessions per user	✓	✓	~	✓	✓	
Connection (one) broker <u>supports</u> 1.000 concurrent connections	✓	✓	✓	✓	✓	
Connection (one) broker <u>supports</u> 2.000 concurrent connections	✓	✓	✓	✓	✓	
Connection (one) broker <u>supports</u> 5.000 concurrent connections	✓	✗	✗	✓	✗	
Connection (one) broker <u>supports</u> 10.000 concurrent connections	✓	✗	✗	✗	✗	
Connection (one) broker <u>supports</u> 20.000 concurrent connections	✓	✗	✗	✗	✗	
Total <u>supported</u> vDesktops per 'farm/pod' ≤ 10.000 CCU	✓	✓	✓	✓	✓	
Total <u>supported</u> vDesktops per 'farm/pod' 10.000 - 25.000 CCU	✓	✗	✗	✓	✗	
Total <u>supported</u> vDesktops per 'farm/pod' ≥ 25.000 CCU	✓	✗	✗	✓	✗	
Provides a Web-based connection interface	✓	✓	✓	✓	✓	
Provides a Windows based connection interface	✓	✓	✓	✓	✓	
Provides an Apple Mac OS X supported connection interface	✓	✓	✗	✓	✓	
Single interface for accessing VDI, RDS/TS	✓	✗	✓	✓	✓	
Single interface for accessing VDI, RDS/TS and PC	✓	✗	✗	✓	✓	
Web interface is customizable through GUI	✓	✗	✗	✓	✗	
Terminal Server 2003 integration with VDI, a single end-user interface for accessing VDI and RDS	✓	✗	✗	✓	✓	
Remote Desktop Services Host 2008 (R2) integration with VDI; a single end-user interface for accessing VDI and RDS	✓	✗	✓	✓	✓	
Remote Desktop Services Host 2012 integration with VDI; a single end-user interface for accessing VDI and RDS	✓	✗	✓	✓	✗	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
RDSH/XenApp license part of the VDI solution	✓	✗	~	✓	~	
Integration with 3 <sup>rd</sup> party systems management solutions	✓	~	✓	✗	✓	
Integration with 3 <sup>rd</sup> party client management solutions	✓	✓	✗	✗	✗	
Includes client endpoint search capabilities	~	✗	✗	✓	✗	
Support for (wildcard) searching across management console	✗	✗	✗	✓	✗	
Scales performance horizontally via complementary application delivery platform. Application delivery platform; Include Application Streaming/Virtualization, RDSH, OS Streaming to physical PC.	✓	✗	~	✓	~	
Daily Admin Management Console is customizable; change/add/move columns, change view layout	✓	✗	✓	✓	✓	
FIPS 140-2 compliance	✓	✗	✓	✓	✓	
<b>Connection Broker / Service OS support</b>						
Microsoft Windows Server 2000	✗	✗	✗	✗	✗	
Microsoft Windows Server 2003 R2	✗	✗	✗	✗	✓	
Microsoft Windows Server 2003 R2-64-bit	✗	✗	✗	✗	✗	
Microsoft Windows Server 2008	✓	✗	✗	✗	✗	
Microsoft Windows Server 2008 64-bit	✓	✗	✗	✗	✗	
Microsoft Windows Server 2008 R2 64-bit	✓	✗	✗	✓	✓	
Microsoft Windows Server 2012	✓	✗	✓	✓	✗	
Microsoft Windows Server 2012R2	✓	✗	✓	✓	✗	
Virtual (Linux) appliance	✗	✓	✗	✗	✗	
<b>Datastore / database OS support</b>						
Microsoft SQL Server 2005 Express Edition	✗	--	✗	✓	✓	

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
Microsoft SQL Server 2008/SP1 Express Edition	✓	--	✗	✓	✓	
Microsoft SQL Server 2008R2 Express Edition	✓	--	✓	✓	✓	
Microsoft SQL Server 2005	✗	--	✗	✓	✓	
Microsoft SQL Server 2008R2	✓	--	✓	✓	✓	
Microsoft SQL Server 2008/SP2	✓	--	✗	✓	✓	
Microsoft SQL Server 2012	✓	--	✓	✓	✗	
Microsoft Access	✗	--	✗	✗	✗	
Oracle Enterprise 10.2	✗	--	✗	✗	✓	
<b>Support and Community</b>						
Certification program for 3rd-party VDI software vendors	✓	✗	✓	✗	✓	
Certification program for thin-client vendors; "Ready"	✓	✓	✓	✓	✓	
Public and active community forum	✓	✓	✓	✓	✓	
Official training classes available	✓	✓	✓	✓	✓	
Official certification program, VUE or Prometric	✓	✗	✓	✗	✓	
VDI technology stack is proven, the solution is being used for 1+ year in enterprise production environments. 10K+ endpoint, various deployment scenarios	✓	✗	✗	✓	✓	
10+ of public available enterprise (10K CCU) references in EU using VDI technology stack	✓	✗	✗	✗	✓	We didn't receive a list with public references from vendors.
10+ of public available enterprise (10K CCU) references in US using VDI technology stack	✓	✗	✗	✗	✓	We didn't receive a list with public references from vendors.
Vendor created reference design for enterprise architecture, public available	✓	✗	✗	✓	✓	
SMB Reference Architecture , public available	✓	✓	✓	✓	✓	
<b>Licenses</b>						

Category	Citrix XenDesktop	Citrix VDI-in-a-Box	Microsoft VDI	Dell vWorkspace	VMware View	Remarks
No external license service required	✗	✓	✗	✓	✓	
First year support and maintenance included in license	✓	✗	✓	✓	✓	
Software Maintenance is mandatory for 1 <sup>st</sup> year	--	✓	--	--	--	
24 x 7 support included in license	✗	✗	✗	✓	✗	✓ 1st year included
Concurrent user/desktop licenses	✓	✓	✗	✓	✓	
Per device licenses	✓	✓	✓	✓	✗	
Per named user licenses	✓	✗	~	✓	~	~ VMware -> Local VDI = CCU
Grace period	✓	✓	✓	✗	--	
Free for personal usage (FFPU)	✓	✗	✗	✗	✗	✓10 usr Express Edition
<b>Various</b>						
VDI Workload assessment software included in license	✓	✗	✗	✓	✗	
Virtual desktop template optimization documentation provided by VDI vendor	✓	✓	✓	✓	✓	
Virtual desktop template optimization utility / script provided by VDI vendor	✓	✗	✗	✓	✓	



## 7. REMOTEFX/RDP SOFTWARE CLIENTS

Until October 2013 Microsoft didn't provide clients for other operating systems than Microsoft Windows to connect and work with the Remote Desktop Protocol / RemoteFX. The Remote Desktop Protocol (RDP) is used to connect to the Microsoft VDI/RDS solutions based on Windows Server 2012 (R2), Windows 8.x, Windows Server 2008 R2 and Windows 7. Before Microsoft released RDP applications for iOS, Android and OS X organizations had to rely on third party clients for MAC OSX and these mobile OSes to facilitate access on devices based on these OSes. This possibly meant organizations had to account for extra costs as most third party applications don't come for free.

With this information in mind we decided to create a 'mini smackdown' containing basic information on the available RDP clients for MAC OSX and mobile OSes. The comparison consists of available products with their capabilities and global pricing information. Some vendors provide multiple versions of their product with different capabilities, the compare is always based on the most capable version.

*Note from the author: As we want to evaluate the movement initiated by Microsoft we will continue this chapter. However, it's not about third party clients, but RDP software clients for MAC OSX and mobile OSes in general. In the comparison the iTap mobile RDP is renamed to Microsoft RDP and pricing information is updated.*

Naturally there are more vendors offering products to provide access based on the RDP protocol, this is however a list of easy to find and capable clients. Besides connecting through the RDP protocol there are also vendors that provide maybe even more enhanced and accelerated solutions. These however do not utilize the native RDP protocol and often require extra components. As such, these products are out of scope of this comparison as well.

While making this comparison it was sometimes difficult to find specific details from the vendors. Information on the website and available in the Apple App Store and Google Playstore stores isn't always as detailed as we would have liked. Information on supported access methods and supported RDP protocol versions lacks detail in most cases. This made it challenging and sometimes impossible to fill in the compare matrix. We decided that for this comparison we would not use the # 'Under investigation' checkmark. Information on features that could not explicitly be found, is considered as X 'Not applicable'.

As previously stated, we try to provide accurate, clear, complete and usable information. And we also appreciate your feedback! If you have any comments, corrections or suggestions for improvements we want to hear from you! Please send an e-mail to Ruben Spruijt ([rsp@pqr.nl](mailto:rsp@pqr.nl)) Include the product name, version number and the title of the document in your message.

### 7.1 VENDORS AND THEIR SOLUTIONS

#### 7.1.1 Introduction

To get an overview of some vendors of Remote Desktop Protocol clients for MAC OSX and mobile OSes, a number of products are explained in this chapter (sorted alphabetically by vendor). The goal of this chapter is to enable a better understanding of the options in this space from a vendor perspective.

#### 7.1.2 2X Client RDP

2X Software is a global leader in virtual desktop and application delivery, remote access and corporate mobility. Thousands of enterprises worldwide trust in the reliability and scalability of 2X products. Cloud computing is shifting from a competitive advantage to an operational necessity. 2X offers a range of solutions to make the leap to cloud computing simple and affordable.



Stay connected to your home or office Windows PC with the free 2X Client. 2X Client allows you to simply connect, via RDP to your remote Windows desktop & applications at work or home. 2x offers the following features:

- Connect to Remote Desktops
- Run Published Applications
- Native RDP Connections
- Device Redirection
- Supports All Major VDIs

### **7.1.3 Ericom AccessToGo**

Ericom Software is a leading global provider of Access, Virtualization and RDP Acceleration solutions. Since 1993, Ericom enables organizations across all industries to provide secure, centrally managed access to applications, desktops and data running on Microsoft RDS / Terminal Services, VDI, Cloud platforms, and other systems, from a broad range of end user computers and mobile devices.

AccessToGo is the fastest mobile RDP client on the market, enabling quick, easy and secure mobile RDP access to your office or home PC and Windows apps from smartphones and tablets. Enjoy highly accurate screen control, intuitive up-down scrolling and the only mobile RDP client that supports both touchpad and floating pointers. AccessToGo remote desktop RDP client also offers a unique function bar for tablets that displays popular keys (Esc, Tab, Ctrl, Alt, and Windows) and other productivity functions.

### **7.1.4 Microsoft RDP (based on acquired assets from the iTap apps)**

Microsoft offers remote desktop clients for various platforms. Manage your Windows desktop or specific application from your mobile device. The Microsoft RDP apps give you complete control over and fast access to your Windows PC from anywhere.

Microsoft RDP apps support the RD Gateway. It is fast, secure and optimized for business and home use. Compared to other iPhone clients the Microsoft RDP app can be more than twice as fast as the next best competitor.

- Secure – the Microsoft RDP app is the only RDP client available supporting FIPS 140-2 compliant encryption, NLA and TS Gateway.
- Fast - Utilizing the RDP protocol, the Microsoft RDP app gives you complete control and fast access from anywhere. With advanced compression and caching technologies, the Microsoft RDP app allows you to use your Windows desktop conveniently, even when forced to use slower EDGE or GPRS connections.
- Usable – the Microsoft RDP app puts you in full control over your desktop. Whether you need to scroll, drag and drop, or just right-click, you can perform all your tasks without having extra buttons or bars cluttering up your screen.  
The built in keyboard features all the keys and modifiers found on a traditional PC keyboard. Additionally it has full support for international languages, including eastern Asian input methods.

### **7.1.5 Wyse PocketCloud Remote Desktop Pro**

Dell acquired Wyse in May 2012. Dell Wyse is the global leader in Cloud Client Computing. The Dell Wyse portfolio includes industry-leading thin, zero and cloud PC client solutions with advanced management, desktop virtualization and cloud software supporting desktops, laptops and next generation mobile devices.

PocketCloud is a secure and fast way to remotely connect to your Mac or Windows desktop with your mobile device, no matter where you are. Access your files, pictures, and applications like Outlook, Word, Photoshop, games or any other program. Simple to install with powerful features, enterprise security and RDP/VNC compatibility, PocketCloud is a great choice for remote desktop access.

So leave your laptop behind and don't be concerned with copying files you need from your desktop. Access them all with PocketCloud—make an important presentation, grab a forgotten report, help a friend with a computer problem, or edit and email a spreadsheet while traveling as lightly as possible.

### **7.1.6 Nulana Remotix RDP**

Nulana LTD is a privately held software company founded in 2007. Since then we've focused on creating great apps for Mac OS X, iOS and Android platforms.

We are a small team of creative thinkers, highly experienced in software craftsmanship design. We create our own software and offer our clients software-design services. We develop cross-platform software from simple standalone applications to complex server/client solutions.

Remotix RDP makes your PC one touch away with all your files, applications, photos, music and games. It's a fast, secure and feature-packed Remote Desktop Protocol client. Remotix RDP offers the following features:

- Fast and Comfortable Remote Management
- Complete sound support
- External keyboard support
- iCloud
- Automatic Discovery of PCs running Windows
- Security

### **7.1.7 Remote RDP Enterprise**

Remote Spark is a Canadian startup company in Calgary, Alberta. We are dedicated to providing best remote access software. With our comprehensive products, you can access Windows, Linux, Mac OS from anywhere, any operating system (including Chrome OS, iOS, Android, BlackBerry Tablet OS, webOS etc.), any devices.

Remote RDP/VNC is our native RDP/VNC clients which supports both RDP and RFB(VNC) protocols. It is the only RDP client which supports FULL PC keyboard and mouse.

### **7.1.8 Thinstuff RDC**

Thinstuff s.r.o. is a young company specialized in software development and research in the Server Based Computing (SBC) and Desktop Virtualisation (VDI) market.

Our mission is to offer revolutionary software solutions and extend access to any SBC or VDI backend by Citrix like features and beyond such as TSX Multimedia (Multimedia acceleration), TSX USB (USB redirection), TSX Gateway (RDP over https), TSX Remote Programs (Seamless access to remote applications), TSX Web Access (Web portal for remote application access), etc.

Thinstuff Remote Desktop Connection (RDC) is a fast and secure application to access your desktop from anywhere.

You can simply use your mobile device to start all your applications like Word, Outlook, Adobe Photoshop, games or any other installed application.

The simple installation, intuitive usage, session bookmarks, customizable resolutions and the powerful features bring remote desktop access to a higher level and makes Thinstuff Remote Desktop your perfect choice.

### **7.1.9 VMLite Remote Client**

VMLite is a Silicon Valley company dedicated in providing unique virtual machine technologies and products. Our mission is to provide end users with an unbreakable, recoverable and parallel computing environment.

VMLite Remote Client allows you to quickly and securely view and control any of your PCs from your mobile device using Microsoft RDP or the VNC protocol.

It provides the most advanced features equivalent to Windows 7 RDP client, such as remote

sound, remote audio recording, file sharing, multimedia redirection, RemoteFX, etc. It performs very well even with slow network connection. For example, you can comfortably listen to remote music on your home PC while on road using 3G network, or you can use a Windows application to record your voice.

## 7.2 PRODUCT VERSION

This RDP software clients feature compare matrix is developed with the following products and versions:

Product	Version	Release date
2X Client RDP	Varies with platform	19-04-2013
Ericom AccessToGo	Varies with platform	05-06-2013
Microsoft RDP	Varies with platform	10-2013
PocketCloud RD Pro	Varies with platform	08-08-2013
Remotix RDP	Varies with platform	27-04-2013
Remote RDP Enterprise	Varies with platform	24-04-2013
Thinstuff RDC	Varies with platform	07-05-2013
VMLite Remote Client	Varies with platform	03-05-2012

### 7.3 3<sup>RD</sup> PARTY SOFTWARE RDP CLIENT MATRIX, FEATURES

Category	2X Client RDP	Ericom AccessToGo	Microsoft RDP	PocketCloud RD Pro	Remotix RDP	Remote RDP Enterprise	Thinstuff RDC	VMLite Remote Client	Remarks
<b>Supported mobile OS versions</b>									
Apple iOS 5.x	✓	✓	✓	✓	✓	✗	✓	✓	
Apple iOS 6.x	✓	✓	✓	✓	✓	✗	✓	✓	
Apple MAC OSX	✓	✗	✓	✗	✓	✗	~	✗	~ Coming soon
Android 2.x	~	✓	✓	✓	✓	✓	✓	✗	~ Varies with device
Android 3.x	~	✓	✓	✓	✓	✓	✓	✗	~ Varies with device
Android 4.x	~	✓	✓	✓	✓	✓	✓	✗	~ Varies with device
Blackberry	✓	✓	✗	✗	✗	✓	✗	✗	
Windows RT	✗	✗	✗	✗	✗	✗	✗	✗	
<b>User Experience</b>									
Remote Desktop	✓	✓	✓	✓	✓	✓	✓	✓	
RemoteApp	✓	✓	✓	✓	✗	✓	✗	✗	
Published application feeds (RDWeb feed)	✗	✗	✓	✗	✗	✗	✗	✗	
Sound support	✓	✓	✓	✓	✓	✓	✗	✓	
Clipboard support	✓	✓	✓	✓	✓	✓	✗	✓	
Customizable resolution	✗	✗	✗	✗	✓	✓	✓	✗	
Drive redirections	✓	✗	✗	✗	✓	✓	✗	✓	
Create session bookmarks	✓	✓	✓	✓	✓	✓	✓	✓	
Automatically synchronize bookmarks between devices (free hosted service)	✗	✗	✗	✗	✓	✗	✗	✗	

Category	2X Client RDP	Ericom AccessToGo	Microsoft RDP	PocketCloud RD Pro	Remotix RDP	Remote RDP Enterprise	Thinstuff RDC	VMLite Remote Client	Remarks
<b>Supported connections</b>									
Network Level Authentication	X	X	✓	✓	✓	✓	✓	X	
RDP 7.0	✓	✓	✓	✓	✓	✓	✓	✓	
RemoteFX / RDP 7.1	X	X	✓	X	X	✓	✓	✓	
RemoteFX / RDP 8.0	X	X	✓	X	X	X	X	X	
RemoteFX / RDP 8.1	X	X	X	X	X	X	X	X	
RD Gateway	X	X	✓	✓	X	✓	X	X	
RD Gateway – Windows Server 2008 R2	X	X	✓	✓	X	✓	X	X	
RD Gateway – Windows Server 2012	X	X	✓	✓	X	✓	X	X	
RD Web Access	X	X	✓	X	X	✓	X	X	
Open and sparse .RDP files	X	X	✓	✓	X	X	X	X	
<b>Supported guests</b>									
Windows 7	✓	✓	✓	✓	✓	✓	✓	✓	
Windows 8	✓	✓	✓	✓	✓	✓	✓	✓	
RD Session Host – Windows Server 2008 R2	✓	✓	✓	✓	✓	✓	X	✓	
RD Session Host – Windows Server 2012	✓	✓	✓	✓	✓	✓	X	✓	
<b>Pricing</b>									
Price per device for Apple iPad (iOS) in US dollars (\$)	free	free	free	19,92	14,99	--	free	14,99	
Price per device for Apple iPhone (iOS) in US dollars (\$)	free	free	free	19,92	14,99	--	free	14,99	
Price per device for Apple MAC (OSX) in US dollars (\$)	free	--	free	--	39,99	--	--	--	

Category	2X Client RDP	Ericom AccessToGo	Microsoft RDP	PocketCloud RD Pro	Remotix RDP	Remote RDP Enterprise	Thinstuff RDC	VMLite Remote Client	Remarks
Price per device for Android in US dollars (\$)	free	free	free	15,32	14,99	18,76	free	--	
Price per device for Blackberry in US dollars (\$)	free	--	--	--	--	--	--	--	

## 8. CONCLUSION

Which Virtual Desktop Infrastructure (VDI) solution is THE best?

It's impossible to give an accurate answer to the question without a better understanding of the requirements..

In essence it depends on various areas as mentioned in paragraph 4.5, 'VDI Strategy'.

It's important to have a **Vision** and **Strategy** around Application and Desktop Delivery.

Designing, building, managing and maintaining the Optimized Desktop infrastructure using the right **Technologies**, corresponding vendors and products is an important step.

Success = Vision x Execution x Adoption.

"This whitepaper is a useful resource in this journey!"

Keep in mind: "*Desktop virtualization is a solution, providing access to applications and data across devices is the goal*".



## 9. APPENDIX A: A-TEAM (PQR) MEMBERS

**Rob Beekmans:** Rob (1969) started in the IT field managing a Novell environment but worked in many different areas since then. Mainly his focus has been on SBC environments starting with Citrix Winframe 1.7 in the '80s'. So with over 15 years of experience he has seen IT grow to a mature and cloud business as it is now. Rob is a Sr. Consultant for PQR with his primary focus on application and desktop delivery and User Environment Management. Rob is a Citrix Certified Enterprise Engineer (CCEE) and a RES Workspace manager Certified Professional (RPFPCP). Rob can be reached at [rbe@pqr.nl](mailto:rbe@pqr.nl) or [twitter](#).

**Matthijs Haverink:** Matthijs (1980) started his career as a system engineer and meanwhile has over 10 years of experience in the business of IT from support engineering to team management to design and implementation of complex ICT infrastructures. His focus now, as a technical Consultant at PQR, is on Application and Desktop Delivery including hardware virtualization, software virtualization and User Environment Management. Matthijs advises, designs, implements and migrates advanced ICT-infrastructures. Matthijs has achieved certifications as a Microsoft Certified Systems Engineer (MCSE +E), VMware Certified Professional (VCP) and Citrix Certified Administrator on Citrix Solutions like Provisioning Server, XenServer, XenDesktop and so on. You can reach Matthijs at [mha@pqr.nl](mailto:mha@pqr.nl) or [twitter](#)

**Sven Huisman:** Sven (1977) studied Information Management in Utrecht. He started his career as a system engineer and meanwhile he has over 10 years of experience in the IT business. He is one of PQR's technical Consultants, focusing on Application and Desktop Delivery, hardware and software virtualization. Sven advises, designs, implements and migrates advanced ICT-infrastructures. Having achieved the highest certifications of its most important partners, Sven is a Citrix Certified Enterprise Administrator (CCEA), a Microsoft Certified Systems Engineer (MCSE) and a VMware Certified Professional (VCP). Sven is awarded as VMware vExpert from 2009 to 2013. You can reach Sven at [shu@pqr.nl](mailto:shu@pqr.nl) or [twitter](#)

**Jits Langedijk:** Jits (1979) started his career in IT as a service engineer and meanwhile he has over 10 years of experience in the IT business. As a technical consultant at PQR his primary focus is Application and Desktop Delivery, hardware and software virtualization. Jits advises, designs, implements and migrates advanced ICT-infrastructures. Having achieved the highest certifications of its most important partners, Jits is a Citrix Certified Enterprise Administrator (CCEE), a Microsoft Certified IT Professional Enterprise Administrator (MCITP:EA) and a VMware Certified Professional (VCP). You can reach Jits at [jla@pqr.nl](mailto:jla@pqr.nl)

**Peter Sterk:** Peter Sterk is a solution architect at PQR. In this position he supports customers with any technical challenge they may encounter, following PQR's credo 'Simplicity in ICT'. Although he is primarily focused on Enterprise Mobility and Application and Desktop Delivery, Peter is also able to overlook and advise on other components in IT infrastructures. Peter is active in communicating the vision of PQR on subjects like Application and Desktop Delivery and Enterprise Mobility on various events. You can reach Peter at [pst@pqr.nl](mailto:pst@pqr.nl) or [twitter](#).

**Erik van Veenendaal:** Erik (1982) is a technical consultant at PQR. Erik started his IT career as a system engineer, and meanwhile has over 10 years of experience in complex ICT infrastructures. His focus is Application and Desktop Delivery solutions including User Environment Management. Erik is analytical and has a broad knowledge he can utilize within advises, designs, implementations and migrations of advanced ICT-infrastructures. Erik has reached certification levels like a Citrix Certified Integration Architect (CCIA), Microsoft Certified Solutions Associate (MCSA): Windows Server 2012, RES Workspace manager Certified Professional (RPFPCP). You reach Erik at [eve@pqr.nl](mailto:eve@pqr.nl) or [twitter](#).

**Jan-Paul Plaisier:** Jan-Paul (1986) is a technical consultant at PQR. In 2006 Jan-Paul started his IT-career as a system engineer. Last year he focused on Application and Desktop Delivery solutions including User Environment Management. Jan-Paul advises, designs, implements and troubleshoots ICT-infrastructures. Jan-Paul has achieved certifications as Microsoft Certified Solutions Expert (MCSE) Server Infrastructure, MCSE Desktop Infrastructure, Citrix Certified Enterprise Engineer (CCEE), RES Workspace Manager 2012 Certified Professional (RWMCP 2012) and VMware Certified Professional 5 (VCP5). You can reach Jan-Paul at [jpa@pqr.nl](mailto:jpa@pqr.nl) or [twitter](#).

## 10. APPENDIX B: CHANGE LOG

### Date February 2011; Document version 1.2

- Updated 2.1 'About PQR'
- Updated 2.2 'Team Members'
- Updated chapter 3; (vendor names/solutions)
- Updated chapter 4; (vendor names/solutions)
- Updated chapter 4.4 'Strategy'; Adding various themes
- Updated 5.4 Microsoft VDI
- Added chapter 5.6 - Virtual Bridges Verde
- Updated chapter 5.10 - Roadmap
- Updated chapter 6.1
- New features added
  - Client endpoint OS support (RIM, Android, WP7, HTML5)
  - Internet Explorer Browser support
  - Progressive Display (2D/3D) – Perceptually lossless Virtual Infrastructure (Hypervisor) support; XenServer 5.6 FP1
  - Printing image compression and redundant image removal
  - SDK and PowerShell cmdlets to Management
  - Multimonitor support using GPU compression
  - Seamless application publishing
  - Reverse seamless application publishing
  - Welcome screen, customizable
  - Provisioning Services using local storage 'Quick Deploy'
  - vDesktop Agent High Availability
  - Adobe Flash support; client-side failover to server-side when network latency exceeds threshold
  - FIPS 140-2 compliance
  - 24 x 7 support included in license
  - Microsoft Group Policy-based management
  - On-demand web installer for Windows endpoint client software
  - On-demand web installer for Mac OSX endpoint client software
  - Support offline vDesktops, type #1 'bare-metal'
  - Support offline vDesktops, type #2 'client-hosted'
  - USB device access restrictions 'granular' (type/serial)
  - RemoteFX support changed (also other vendors)
  - Disposable disks
  - Stateless; pooled/standard images centrally managed
  - Windows 7 SP1 Guest (VM) Operating System support
  - GPU Virtualization, share GPU with multiple vDesktops
  - Security Hardening Guidelines
  - Enterprise Reference Architecture, public available
  - Remote Display Protocol support for Guest – xRDP (linux)
  - Integrates with Microsoft Hyper-V differencing disks
  - Internet Explorer Redirection (Server -> Client)
  - 2048-Bit SSL Certificate Support (WebAccess/SecureGateway)
  - Integrates with Microsoft Sentinel SSO solution
  - Guest (VM) Operating System support; Linux CentOS

- VDI Assessment software included in license
- Total supported vDesktops per 'farm/pod' ≤ 5.000 CCU
- Total supported vDesktops per 'farm/pod' 10.000 – 25.000 CCU
- Total supported vDesktops per 'farm' ≥ 25.000 CCU
- Server instance support 10.000 concurrent connections
- Server instance support 20.000 concurrent connections
- Changed Dynamic prioritization of remote Protocol traffic by (3<sup>rd</sup> party) WAN accelerators
- Integrates (SSO) with F5 FirePass
- Changed features in Citrix XenDesktop5
  - Changed Webcam support (LAN)
  - Changed Webcam support (WAN); bandwidth compression and latency reduction
  - Removed Access, Oracle, SQL 2005 support
  - Changed GPU Compression comments
  - Changed Aero, 3D OpenGL and 3D DirectX support
  - Changed Connection Broker / Service OS support
  - Changed Datastore/database OS support
  - Changed Management, Remote session control; session shadowing
  - Changed Connection Broker / Service, Web-based management interface
  - Changed 'No single point of failure by design without additions'
  - Changed: Single management console supports 5K vDesktops
- Updated Features VMware View 4.5/4.6
  - Changed RBAC and Delegated Administration
  - Integrated application virtualization management
  - Improved scalability to 10,000 desktops per management domain
  - Improved reporting and auditing features
  - Localization of the View clients and documentation in French, German, Japanese, and Simplified Chinese languages
  - Changed Official Certification program, VUE or Prometric Changed Network latency masking / reduction
  - Changed USB device support; USB hub – Full USB
  - Changed USB device support; USB 2.0 isochronous
  - Changed USB Camera (Mass Storage Device)
  - Changed No single point of failure by design without additions
  - Added Windows 7 and Windows 7 x64 Guest support
  - Added Windows 7 Client (endpoint) Operating System support
  - Added Per named user licenses (local VDI mode, concurrent user)
  - Support offline vDesktops; integrated in VDI management solution
  - Removed Microsoft Windows Vista 64-bit guest OS support
  - Changed Integration with Systems management solutions (SCOM)
  - Changed Datastore / database OS support, Oracle for event logging
  - Change Adobe Flash support; client-side rendering; Wyse TCX doesn't support client side rendering.
  - Changed Internet Browser support for web based access to vDesktop
  - Changed Virtual Infrastructure (Hypervisor) support, VI 3.5
  - Changed Remote Desktop Services Host 2008/2008R2 integration
  - Changed Connection Broker / Service OS support
  - Changed Single management console supports 5K vDesktops

- Quest vWorkspace v7.2
  - Changed Datastore / database OS support, Oracle
  - Changed: Webcam support (WAN); latency reduction and bandwidth compression and latency reduction
  - changed: Universal print driver; server side / network printers
  - Changed: Auditing and security logging of admin actions
  - Changed: Guest (VM) Operating System support/ Linux
  - Changed: Apple iPad support
  - Changed: Single management console supports 5K vDesktops
  - Printing bandwidth optimization; image compression
  - Added 3D OpenGL support; RFX only
  - Added 3D DirectX support; RFX only
  - Added GPU Virtualization, share GPU with multiple vDesktops; RFX only
  - Added Microsoft Windows 7 SP1; Guest (VM) Operating System support (30days after release feb 2011)
  - Changed: Certification program for thin-client vendors; "Ready"
  - Changed: Single management console supports 5K vDesktops
  - Changed Printing bandwidth optimization; image compression and redundant image removal
  - Changed Printing bandwidth optimization; image compression
- Microsoft VDI/RemoteFX
  - Changed USB device support; USB hub – Full USB; RFX only
  - Changed USB device support; USB 2.0 isochronous; RFX only
  - Changed USB Camera (Mass Storage Device); RFX only
  - Changed Twain (scanner) device support; RFX only
  - Changed Webcam support (LAN); RFX only
  - Changed Aero support (Win7); RFX only
  - Changed 3D OpenGL support; RFX only
  - Changed 3D DirectX support; RFX only
  - Added GPU Virtualization, share GPU with multiple vDesktops; RFX only
  - Changed Multi-monitor support ≤4; RFX only
  - Changed Maximum resolution ≤ 4096 x 2048; RDP Only
  - Changed 2560\*1600; RDP only
  - Changed Microsoft RDP 7.1
  - Added Microsoft Windows 7 SP1; Guest (VM) Operating System support (30days after release feb 2011)

**Date February 2011; Document version 1.21**

- Removed some typographical errors
- Updated chapter 2.1 'About PQR'
- Updated VMware View vendors information chapter 5.6
- New features added:
  - Novell Domain Services for Windows support
- Citrix XenDesktop
  - Changed 2048-Bit SSL Certificate Support (WebAccess/SecureGateway)
  - Changed VDI Desktop Assignment Based on AD OU
  - Changed Concurrent user/desktop licenses
- Microsoft RemoteFX
  - Changed: User experience with 3D OpenGL support (RFX)
- Quest vWorkspace

- Changed: User experience with 3D OpenGL support (RFX)
- Changed: Web interface is customizable through GUI
- VMware View 4.5/4.6
  - Changed Service / Connection Broker; Integrated Load balancing
  - Changed On-demand web installer for Windows endpoint client software
  - Changed On-demand web installer for Mac OSX endpoint client software
  - Changed Smartcard pass-through support
  - Changed VDI Desktop Assignment Based on Device Name and Based on Device Address
  - Changed Datastore / database OS support Oracle Enterprise 10.2
  - Changed Total supported vDesktops per 'farm'  $\geq 25.000$  CCU

**Date April 2011; Document version 1.22**

- Updated chapter 3.7;
- Changed Novell DsFW official support statement
- VMware View 4.5/4.6
  - Changed IPv6 support
  - Changed Novell DsFW official support statement
  - Changed Tunneling (SSL) through Security Server

**Date August 2011; Document version 1.23**

- Updated 3.10; added VMware as RDS supplier
- Updated 3.13; added VMware View on multiple solution areas
- Updated 4.3.1; added VMware View as SHSRD supplier
- Updated 4.3.4; added VMware as SHPRPD supplier
- Updated 5; added RHEV for Desktops as supplier
- Updated 6.1; XenDesktop version to SP1
- Updated 6.2 matrix – description/notes only:
  - Integrated load balancing – at broker level
- Updated 6.2 matrix with VMware View 4.6 features
  - Aero & 3D features: Teradici/VMware functionality ~
  - Multi-monitor support pivoting: (PCoIP support)
  - Multi-monitor support >4
  - Optimized for bandwidth restricted...
  - Bandwidth/resource mgmt. Flash
  - Manage Client USB redirection
  - Bandwidth Protocol Management
  - Auditing and security logging of admin actions
  - Restrict access based on time/location/device
  - Microsoft Windows 7 SP1 support
  - Linux Flavors
  - Apple iPad IO v4.x support
  - Delegation of control
  - Delegation of control, granular delegated administration console
  - Grace period (licenses)
- Citrix (XenDesktop 5 SP1) updates
  - Citrix XenServer 5.6 SP2 support
  - Centralized Management console
  - Delegation of control, granular delegated administration console

**Date February 2012; Document version 1.3**

- Updated Chapter 1, Introduction
- Added Chapter 1.4, suggestions and Improvements
- Updated Chapter 2.1, About PQR
- Updated Chapter 2.2, A-Team members
- Updated Chapter 3.1, Strategy
- Updated Chapter 3.2, The Essence of Application and Desktop Delivery
- Updated Chapter 3.3, Overview of Application and Desktop Delivery Solutions
- Updated Chapter 3.4, Vendor matrix
- Added Chapter 4.2, user Centric Computing
- Updated Chapter 4.4, Overview of Desktop Virtualization Solutions
- Updated Chapter 4.4.4, Server-Hosted VDI with GPU Acceleration
- Updated Chapter 4.5, VDI Strategy
- Updated Chapter 5.2, Citrix XenDesktop Architecture picture
- Updated Chapter 5.3, VDI in a Box (Kaviza)
- Added Chapter 5.4, Desktone
- Updated Chapter 5.6, Quest vWorkspace
- Updated Chapter 5.8, Virtual Bridges, Verde
- Updated Chapter 5.9, VMware View
- Added Chapter 5.10, Unidesk
- Removed Chapter 5.11, Roadmap
- Updated Chapter 6.1, Introduction
- Updated Chapter 6.2, Product Version
- Added Chapter 6.3, Roadmap and Future additions
- Added Chapter 6.4, Feature Compare Matrix
- Added Chapter 6.5, Citrix "VDI in a Box" added to the matrix
- New Features in Chapter 6.5
  - User Experience, Aero redirection to Windows endpoint
  - User Experience, Aero support on Windows endpoint
  - User Experience, Aero support on non-Windows endpoint
  - User Experience, Remote Display Protocol Experience Monitor (troubleshooting)
  - User Experience, Remote Display Protocol Signal Applet (Experience index for End-user)
  - Management, Historical (performance metrics, events, counters) data is available
  - Stateless; pooled/standard images centrally managed – replication
  - Stateless; pooled/standard images centrally managed – version control
  - Guest (VM) Operating System support, Microsoft Windows 8 32-bit
  - Guest (VM) Operating System support, Microsoft Windows 8 64-bit
  - Client (endpoint) Operating System support, Microsoft Windows 8 32-bit
  - Client (endpoint) Operating System support, Microsoft Windows 8 64-bit
  - Virtual Infrastructure (Hypervisor) support, VMware vSphere 5.0
  - Virtual Infrastructure Integrated Management, SCVMM 2012
  - Support and Community, SMB Reference Architecture , public available
  - Various, VDI Workload Assessment software included in license
  - Various, virtual desktop template optimization utility
  - Various, virtual desktop template optimization documentation
  - Client (endpoint) Operating System support, Linux – Ubuntu
  - User Experience, GPU PassThrough through Hypervisor



- User Experience, Adobe Flash 11 client-side rendering support
  - Service / Connection Broker, Integrated High Availability
  - Licenses, Software Maintenance is mandatory for 1st year
  - Client (endpoint) Operating System support, HTML5 browser support, available through 3rd party vendor
  - Client (endpoint) Operating System support, HTML5 browser support, available through VDI software vendor
  - Desktop Provisioning, IOPS savings (Read and Write) without any additional software component required
  - Desktop Provisioning, IOPS savings (Read and Write) without any additional software component required, Hypervisor independent.
  - Management, Additional instrumentation (end-to-end monitoring) for vDesktop included in a VDI software bundle
  - Management, Additional instrumentation (VDI Infrastructure Monitoring and Diagnose) for vDesktop included in a VDI software bundle.
  - Management, Additional instrumentation (Infrastructure and E2E Monitoring, Diagnose) for vDesktop part of the vendor software portfolio
  - Management, RDSH / TS provisioning support from main management console
  - Management, Built-in DHCP scope depletion protection
  - User Experience, Bi-directional audio WAN; (11kbps each way) bandwidth compression
  - User Experience, Webcam support (WAN); latency reduction
  - User Experience, Default Frame rate limit
  - Unified Communication A/V; API can be leveraged by partners to support advanced call routing functionality
  - Management, Support Multistream UDP/TCP
  - Security and Networking, Tunneling Display Protocol (SSL/TCP-443) through Security Server
  - Security and Networking, Tunneling Display Protocol (SS/NoTCP-443) through Security Server
  - Desktop Provisioning, differencing disks across different storage types, storage tiering
  - Service / Connection Broker, Manage VDI Infrastructure and Hypervisor from single console
  - Desktop Provisioning, vDesktop is provisioned to the hypervisor with the best performance without need of advanced Virtual Infrastructure MgMt. solutions such as SCVMM, vCenter, XenCenter
  - Desktop Provisioning, User with vDesktop at connect time is load balanced to the hypervisor with the best performance without usage of advanced Virtual Infrastructure MgMt. solutions such as SCVMM, vCenter, XenCenter
- **Changed Features in Chapter 6.5, Citrix XenDesktop**
    - User Installed Applications integrated in vDesktop (RingCube TechPreview)
    - Supported Remote Display Protocols, Microsoft RDP 7.1 (RemoteFX)
    - Management, Bandwidth/resource management: Video
    - Management, Adobe Flash Quality; configure through policy
    - Desktop Provisioning, Support offline vDesktops, type #1 'bare metal'
    - Guest (VM) Operating System support, Windows 7 SP1
    - Internet Browser support for web based access to vDesktop, IE 9.x



- Service / Connection Broker, Centralized management console
  - Service / Connection Broker, Web-based management interface
  - Service / Connection Broker, Delegation of control, granular delegated administration roles
  - Service / Connection Broker, Customizable Management Console ; change/add/move columns
  - Service / Connection Broker, Web-based management interface, daily admin tasks
  - User Experience, Multimonitor support using GPU compression
  - VDI Desktop Assignment, Based on Device Address
  - VDI Desktop Assignment, Based on Device Name
- **Changed Features in Chapter 6.5, Microsoft VDI**
    - User Experience, Compression of Remote Desktop protocol by GPU
    - User Experience, Multi monitor support while using GPU compression
- **Changed Features in Chapter 6.5, VMware View**
    - User Experience, USB device access restrictions 'granular' (type/serial)
    - User Experience, Clipboard re-direction; files-folders
    - User Experience, Client time zone redirection
    - User Experience, Adobe Flash support; server-side rendered
    - User Experience, Microsoft Silverlight; server-side rendered
    - User Experience, Multi-monitor support - Pivoting
    - User Experience, Optimized for bandwidth restricted environments (<256 Kbps) and - high latency connections (>150 ms)
    - Supported Remote Display Protocols, Microsoft RDP 7.0
    - Supported Remote Display Protocols, HP RGS
    - Management, User Profile Management
    - Management, Bandwidth/resource management: client drives
    - Management, Auditing and security logging of admin actions
    - VDI Desktop Assignment, Restrict access based on time/location/device
    - Guest (VM) Operating System support, Windows 7 SP1
    - Client (endpoint) Operating System support, MAC OS X
    - Client (endpoint) Operating System support, Linux flavors
    - Client (endpoint) Operating System support, Apple iPad IOS v4.x
    - Client (endpoint) Operating System support, Google Android
    - Virtual Infrastructure (Hypervisor) support, VMware VI 3.5
    - Service / Connection Broker, Delegation of control
    - Service / Connection Broker, Delegation of control, granular delegated administration roles
    - Service / Connection Broker, RDSH 2008 integration
    - Service / Connection Broker, Remote Desktop Services Host 2008 R2 integration with VDI
    - Licenses, Grace period
    - Licenses, First year support and maintenance included in license
    - Virtual Infrastructure (Hypervisor) support, Integration with server virtualization storage-provisioning features
    - Management, Bandwidth/resource management: Video
    - Management, Bandwidth/resource management: Audio

- User Experience, Printing bandwidth optimization; image compression and redundant image removal
- User Experience, 3D OpenGL support, software assist GPU; inside VM
- User Experience, 3D DirectX support <v9.1, software assist GPU; inside VM
- User Experience, Connect network printers with vDesktop policies
- User Experience, VoIP; Bi-directional audio LAN (11kbps each way)
- Service / Connection Broker, Provides an Apple Mac OS X supported connection interface (View)
- User Experience, Dynamically adjust client printer configuration
- User Experience, Dynamically adjust network printer configuration
- User Experience, Welcome screen, customizable
- Management, Support low bandwidth/high latency WAN connections
- Management, Scripting (none PowerShell) support and command-line interface
- Security and Networking, Remoting Protocol network QoS
- Client (endpoint) Operating System support, Linux – Ubuntu
- User Experience, Automatically adjust image quality based on avail. network bandwidth
- **Changed Features in Chapter 6.5, Quest vWorkspace**
  - User Experience, Remote Display Protocol performance metrics (troubleshooting)
  - Management, Bandwidth/resource management: client drives
  - Management, Microsoft Group Policy-based management for agent/client settings
  - Desktop Provisioning, Provisioning Services using local storage 'Quick Deploy'
  - Desktop Provisioning, Disposable disks; standard images in Pooled Desktops
  - Desktop Provisioning, Stateless; pooled/standard images centrally managed – version control
  - Desktop Provisioning, Stateless; pooled/standard images centrally managed – replication
  - Client (endpoint) Operating System support, Google Android
  - Service / Connection Broker, Connection broker supports 5.000 concurrent connections
  - User Experience, Unified Communications (OCS/Lync) VDI vendor support and best practices A/V in LAN scenario's
  - User Experience, Unified Communications (OCS/Lync) VDI vendor support and best practices A/V in WAN scenario's; latency reduction and bandwidth compression
  - Manage VDI Infrastructure and Hypervisor from single console
  - Compression of Remote Desktop protocol by GPU

**Date July 2012; Document version 1.4**

- Overall – spell checking and updates to URLs
- Updated chapter 4.5 – VDI Strategy
- New Features in Chapter 6.5
  - Virtual Infrastructure Integrated (snapshot, create, delete ) Management, Microsoft SCVMM 2012
  - Guest (VM) Operating System support, Microsoft Windows 2008 R2
  - Desktop Provisioning, Offload specific storage operations, storage integration (e.g. VAAI)
  - Desktop Provisioning, Content Based Read Cache
  - Desktop Provisioning, Disposable disk drive letter customizable
  - Desktop Provisioning, Imaging delivery to vDesktop through local storage
  - Desktop Provisioning, Imaging delivery to vDesktop through WAN (OS streaming)
  - Security and Networking, Reuse pre-configured Active Directory computer accounts
  - Management, Supports WAN acceleration UDP based devices
  - Management, One time migration Windows XP to Windows 7/8 profile management
  - Management; User Profile Management in FAT client desktop
  - Supported Remote Display Protocols, SPICE
  - Guest (VM) Operating System support, Microsoft Windows Server 2012
  - Client (endpoint) Operating System support, Microsoft Windows Server 2012
  - Connection Broker / Service OS support, Microsoft Windows Server 2012
  - Local application file-type extensions, open local file-types and use centralized apps
- Changed Features in Chapter 6.5, Citrix XenDesktop 5.6 FP1
  - User Experience, User Installed Applications integrated in vDesktop
  - Virtual Infrastructure Integrated (snapshot, create, delete ) Management, Microsoft SCVMM 2012
  - User Experience; Unified Communication A/V rendered (peer-2-peer communication) on end-point OCS/Lync
  - Management; Universal print driver; server side / network printers
- Changed Features in Chapter 6.5, **Quest vWorkspace 7.6**
  - New features added in chapter 6.5
  - Management, Bandwidth/resource management, Adobe Flash
- Changed Features in Chapter 6.5, **VMware View 5.1**
  - Management, User Profile Management in Rich client desktop
  - Management, One time migration Windows XP to Windows 7 profile management
  - Security and Networking, Two-factor authentication - RSA Secure ID
  - Security and Networking, Two-factor authentication - SMS passcode support
  - Security and Networking, Two-factor authentication - Radius/ IAS
  - Security and Networking, Reuse pre-configured Active Directory computer accounts

- Security and Networking , VMware changed Security and Networking; Integrates with Microsoft Sentinel SSO solution
- Virtual Infrastructure (Hypervisor) Support, VMware View Composer is limited to <amount> of hosts on NFS
- User Experience; Remote Display Protocol Experience monitor (troubleshooting)
- User Experience; User Installed Applications integrated in vDesktop

### **Date March 2013; Document version 2.0**

- Overall: updated text, spell checking and updates to URLs
- Updated chapter 2
- Updated chapter 3
- Updated chapter 4.5, VDI Strategy
- Added chapter 4.6, From niche to getting mature
- Added chapter [4.7](#), Microsoft Licensing
- Added chapter 4.8, HTML5
- Added chapter 4.9, Workspace aggregation
- Updated chapter 5.2, Dell vWorkspace
- Added chapter 5.6, ListeQ BoxedVDI
- Updated chapter 5.7, Microsoft RDVH - Virtual Desktop Infrastructure
- Added chapter 5.11, VMware Mirage
- Updated chapter 6.2, Product Version
- Updated chapter 6.4, Compare matrix, legend
- Overall – Microsoft RDP/RemoteFX
- New Features in Chapter 6.5
  - User Experience, 3D DirectX support >v11, software assist GPU; inside VM
  - User Experience, 3D DirectX support >v11, hardware assist GPU
  - User Experience, Unified Communications (OCS/Lync 2013) Microsoft VDI plugin support; solution over Dynamic Virtual Channels (Audio via USB phone pairing)
  - User Experience, Desktop lockdown, alternate shell to provide simplified access to the desktop
  - Supported Remote Display Protocols, Microsoft RDP 8.0
  - Security and Networking, Integrates with Microsoft Remote Desktop Gateway
  - Desktop Provisioning, Hypervisor block based Read Cache in RAM; integrated in VDI vendor solution
  - Desktop Provisioning, Hypervisor block based Read Cache on local storage; integrated in VDI vendor solution
  - Client (endpoint) Operating System support, Dell Wyse R10L
  - Internet Browser support for web based access to vDesktop, Internet Explorer 10.x
  - Internet Browser support for web based access to vDesktop, Mozilla FireFox 18.x
  - Virtual Infrastructure (Hypervisor) support, Citrix XenServer 6.0
  - Virtual Infrastructure (Hypervisor) support, Citrix XenServer 6.1
  - Virtual Infrastructure (Hypervisor) support, VMware vSphere 5.1

- Virtual Infrastructure (Hypervisor) support, Microsoft Hyper-V Windows Server 2012
- Service / Connection Broker, Remote Desktop Services Host 2012 integration with VDI; a single end-user interface for accessing VDI and RDS
- Management, support WAN acceleration UDP based devices
- Management, support desktop pools for multi-VLAN or network labels
- **Changed Features in Chapter 6.5, Citrix XenDesktop 5.6 FP1**
  - User Experience, Local application file-type extensions; open local file-types and use centralized apps
  - User Experience, Unified Communication A/V rendered (peer-2-peer communication) on end-point UC Avaya
  - User Experience, Unified Communication A/V rendered (peer-2-peer communication) on end-point UC Cisco
  - Management, One time migration Windows XP to Windows 7/8 profile management
  - Security and Networking, Reuse pre-configured Active Directory computer accounts
  - Desktop Provisioning, Offline vDesktops; integrated in VDI management solution
  - Desktop Provisioning, Disposable disks; standard images in Pooled Desktops
  - Desktop Provisioning, Integrates with Microsoft Hyper-V differencing disks
  - Client (endpoint) Operating System support, HTML5 browser support, available through VDI software vendor
  - Client (endpoint) Operating System support, HTML5 browser support, available through 3<sup>rd</sup> party vendor
  - Virtual Infrastructure (Hypervisor) support, VMware VI 3.5
- **Changed Features in Chapter 6.5, Citrix VDI-in-a-Box 5.2**
  - User Experience, Local application file-type extensions; open local file-types and use centralized apps
  - User Experience, Internet Explorer Redirection (Server -> Client)
  - User Experience, Unified Communication A/V rendered (peer-2-peer communication) on end-point UC Avaya
  - User Experience, Unified Communication A/V rendered (peer-2-peer communication) on end-point UC Cisco
  - User Experience, User Installed Applications integrated in vDesktop
  - User Experience, Desktop lockdown, alternate shell to provide simplified access to the desktop
  - Management, One time migration Windows XP to Windows 7/8 profile management
  - Management, Remote session control; session shadowing
  - Security and Networking, Management traffic is secured
  - Desktop Provisioning, Provision Desktops across multiple data stores
  - Desktop Provisioning, Differencing disks across different storage types, storage tiering
  - Desktop Provisioning, Stateless; pooled/standard images centrally managed – version control
  - Client (endpoint) Operating System support, Dell Wyse R10L

- Service / connection broker, Connection (one) broker supports 2.000 concurrent connections
- **Changed Features in Chapter 6.5, Microsoft VDI**
  - User Experience, Bi-directional audio LAN (11kbps each way)
  - User Experience, Default frame limit
  - User Experience, Automatically adjust image quality based on avail. network bandwidth
  - User Experience, Network latency masking / reduction
  - User Experience, 3D DirectX support ;<9.1, hardware assist GPU
  - User Experience, 3D DirectX support >9.1, hardware assist GPU
  - User Experience, Local application file-type extensions; open local file-types and use centralized apps
  - User Experience, Multi-monitor support >4
  - User Experience, Optimized for bandwidth restricted environments (<256 Kbps) and - high latency connections (>150 ms)
  - User Experience, Single Sign-on from Windows endpoint to vDesktop
  - User Experience, Seamless application publishing to endpoint
  - User Experience, Remote Display Protocol Experience monitor (troubleshooting)
  - User Experience, Remote Display Protocol Signal Applet (Experience index for End-user)
  - User Experience, Connection resiliency, Session Reliability
  - Management, User Profile Management in vDesktop
  - Management, Universal print driver; client connected printers
  - Security and Networking, Two-factor authentication - SMS passcode support
  - Security and Networking, Reuse pre-configured Active Directory computer accounts
  - VDI Desktop Assignment, Multi-AD support
  - Desktop Provisioning, Provisioning Services using local storage 'Quick Deploy'
  - Desktop Provisioning, Disposable disks; standard images in Pooled Desktops
  - Desktop Provisioning, Integrates with Microsoft Hyper-V differencing disks
  - Desktop Provisioning, Automatic creation of desktops
  - Desktop Provisioning, Provision Desktops across multiple data stores
  - Desktop Provisioning, Stateless; pooled/standard images centrally managed – version control
  - Desktop Provisioning, vDesktop is provisioned to the hypervisor with the best performance without need of advanced Virtual Infrastructure Mgmt. solutions such as SCVMM, vCenter, XenCenter
  - Desktop Provisioning, Single disk image build-in
  - Desktop Provisioning, Hypervisor block based Read Cache in RAM; integrated in VDI vendor solution
  - Desktop Provisioning, Offload specific storage operations, storage integration (e.g. VAAI)
  - Guest (VM) Operating System support, Microsoft Windows 8 32-bit
  - Guest (VM) Operating System support, Microsoft Windows 8 64-bit
  - Guest (VM) Operating System support, Microsoft Windows 7 32-bit

- Guest (VM) Operating System support, Microsoft Windows 7 64-bit
- Guest (VM) Operating System support, Microsoft Windows Vista 32-bit
- Guest (VM) Operating System support, Microsoft Windows Vista 64-bit
- Guest (VM) Operating System support, Microsoft Windows XP Professional 32-bit
- Guest (VM) Operating System support, Microsoft Windows Server 2012
- Client (endpoint) Operating System support, Microsoft Windows 8 32-bit
- Client (endpoint) Operating System support, Microsoft Windows 8 64-bit
- Client (endpoint) Operating System support, Microsoft Windows 8 – RT
- Client (endpoint) Operating System support, Microsoft Windows Vista Professional
- Client (endpoint) Operating System support, Microsoft Windows XP Professional
- Client (endpoint) Operating System support, Microsoft Windows Server 2003R2
- Client (endpoint) Operating System support, Microsoft Windows Server 2008
- Client (endpoint) Operating System support, Microsoft Windows Server 2012
- Client (endpoint) Operating System support, Windows 9x
- Client (endpoint) Operating System support, Windows XPe
- Client (endpoint) Operating System support, Windows CE
- Client (endpoint) Operating System support, MAC OS X
- Client (endpoint) Operating System support, Dell Wyse Thin OS (WTOS)
- Client (endpoint) Operating System support, Dell Wyse R10L
- Client (endpoint) Operating System support, HTML5 browser support, available through 3rd party vendor
- Internet Browser support for web based access to vDesktop, Internet Explorer 10.x
- Internet Browser support for web based access to vDesktop, Mozilla FireFox 2.x
- Internet Browser support for web based access to vDesktop, Mozilla FireFox 3.x
- Internet Browser support for web based access to vDesktop, Opera v9
- Internet Browser support for web based access to vDesktop, Safari v4
- Internet Browser support for web based access to vDesktop, Safari v5
- Internet Browser support for web based access to vDesktop, Google Chrome
- Virtual Infrastructure (Hypervisor) support, Microsoft SCVMM 2008R2
- Virtual Infrastructure Integrated (snapshot, create, delete ) Management, Microsoft SCVMM 2012
- Service / Connection Broker, Terminal Server 2003 integration with VDI, a single end-user interface for accessing VDI and RDS
- Service / Connection Broker, RDSH/XenApp license part of the VDI solution
- Service / Connection Broker, Includes / build-in High Availability
- Service / Connection Broker, Daily Admin Management Console is customizable; change/add/move columns, change view layout
- Service / Connection Broker, VM power management
- Service / Connection Broker, Virtual machine power policy



- Connection Broker / Service OS support, Microsoft Windows Server 2008 R2 64-bit
- Connection Broker / Service OS support, Microsoft Windows Server 2012
- Datastore / database OS support, Microsoft SQL Server 2005 Express Edition
- Datastore / database OS support, Microsoft SQL Server 2008/SP1 Express Edition
- Datastore / database OS support, Microsoft SQL Server 2005
- Datastore / database OS support, Microsoft SQL Server 2008/SP2
- Datastore / database OS support, Microsoft SQL Server 2012
- Support and Community, No external license service required
- Support and Community, Certification program for thin-client vendors; "Ready"
- Support and Community, SMB Reference Architecture , public available
- Licenses, Per named user licenses
- **Changed Features in Chapter 6.5, VMware View 5.1**
  - User Experience, Windows 8 hardware acceleration (3D effects) support on Windows endpoint
  - User Experience, Windows 8 hardware acceleration (3D effects) support on non-Windows endpoint
  - User Experience, Touch optimization from VDI vendor for OSs which are not designed for touch gestures
  - User Experience, 3D DirectX support ; <9.1, hardware assist GPU
  - User Experience, GPU Virtualization, share GPU with multiple vDesktops
  - User Experience, Unified Communications (OCS/Lync) VDI vendor support and best practices A/V in LAN scenario's. (Audio via USB phone pairing)
  - User Experience, Unified Communications (OCS/Lync) VDI vendor support and best practices A/V in WAN scenario's; (Audio via USB phone pairing) latency reduction and bandwidth compression
  - Unified Communications (OCS/Lync) VDI Vendor support and best practices in LAN Scenario
  - User Experience, Unified Communication A/V rendered (peer-2-peer communication) on end-point OCS/Lync
  - Client (endpoint) Operating System support, Microsoft Windows 8 32-bit
  - Client (endpoint) Operating System support, Microsoft Windows 8 64-bit
  - Client (endpoint) Operating System support, Apple iPhone/iPod IOS v6.x
  - Client (endpoint) Operating System support, HTML5 browser support, available through VDI software vendor
  - Guest (VM) Operating System support, Microsoft Windows 8 32-bit
  - Guest (VM) Operating System support, Microsoft Windows 8 64-bit
  - Internet Browser support for web based access to vDesktop, Internet Explorer 9.x
  - Internet Browser support for web based access to vDesktop, Internet Explorer 10.x
  - Internet Browser support for web based access to vDesktop, Mozilla FireFox 16.x
  - Internet Browser support for web based access to vDesktop, Safari v5
  - Internet Browser support for web based access to vDesktop, Google Chrome



- Security and Networking, Remoting Protocol network traffic shaping
- Desktop Provisioning, Imaging delivery to vDesktop through LAN (OS streaming)
- Desktop Provisioning, Imaging delivery to vDesktop through WAN (OS streaming)
- Virtual Infrastructure (Hypervisor) support, VMware View Composer is limited to <amount>of hosts on VMFS
- Changed Features in Chapter 6.5, **Quest vWorkspace 7.6**
  - User Experience, Default frame limit
  - User Experience, Connection resiliency, Session Reliability
  - Management, One time migration Windows XP to Windows 7/8 profile management
  - Client (endpoint) Operating System support, Dell Wyse R10L
  - Virtual Infrastructure (Hypervisor) support, VMware vSphere 5.0

### **Date May 2013; Document version 2.1**

- Updated chapter [3.4](#), Vendor matrix, who delivers what
- Updated chapter [4.7](#), Microsoft Licensing for VDI solutions
- Added chapter [5.7](#), Ericom PowerTerm WebConnect
- Updated chapter [5.8](#), Microsoft RDVH – Virtual Desktop Infrastructure
- Updated chapter [6.2](#), Product Version
- Updated chapter [6.4](#), Compare matrix, legend
- New Features in Chapter 6.5
  - User Experience, Printing speed optimization; page per page level streaming
  - User Experience, Printing bandwidth control; limit maximum site to site printing bandwidth
  - User Experience, Redirect Ctrl+Alt+Del to the remote desktop
  - Desktop Provisioning, Instantaneous provisioning; no requirement to wait for VM template replication to complete
  - Desktop Provisioning, Automatic replication of VM template to configured storage location(s)
  - Guest (VM) Operating System support, Red Hat Enterprise Linux 6
  - Service / Connection Broker, Connect to VM Console from Broker Management Console
- Changed Features in Chapter 6.5, **Microsoft VDI**
  - User Experience, 3D DirectX support ;<9.1, hardware assist GPU
  - User Experience, 3D DirectX support >10, hardware assist GPU
  - Service / Connection Broker, Single management console supports 5K vDesktops -- VDI
- Changed Features in Chapter 6.5, **VMware View 5.2**
  - User Experience, Dynamically adjusts client monitor configuration
  - Client (endpoint) Operating System support, Microsoft Windows 8 - RT
- Changed Features in Chapter 6.5, **Quest vWorkspace 8.0**
  - User Experience, Adobe Flash support; client-side failover to server-side when network latency exceeds threshold
  - User Experience, Client-side content/Adobe flash fetching

- User Experience, Local application file-type extensions; open local file-types and use centralized apps
- User Experience, Automatically adjust image quality based on avail. network bandwidth
- User Experience, Windows 8 hardware acceleration (3D effects) support on Windows endpoint
- User Experience, Desktop lockdown, alternate shell to provide simplified access to the desktop
- User Experience, Remote Display Protocol Experience monitor (troubleshooting)
- Supported Remote Display Protocols, Microsoft RDP 8.0
- Management, Bandwidth/resource management: Adobe Flash
- VDI Desktop Assignment, Multi-AD support
- Desktop Provisioning, Hypervisor block based Read Cache in RAM; integrated in VDI vendor solution
- Desktop Provisioning, Offload specific storage operations, storage integration (e.g. VAAI/ODF)
- Guest (VM) Operating System support, Linux CentOS 6.0
- Guest (VM) Operating System support, Microsoft Windows Server 2012
- Client (endpoint) Operating System support, Dell Wyse P250 zero client
- Virtual Infrastructure (Hypervisor) support, VMware vSphere 5.0
- Virtual Infrastructure (Hypervisor) support, VMware vSphere 5.1
- Virtual Infrastructure (Hypervisor) support, Microsoft Hyper-V Windows Server 2012
- Virtual Infrastructure Integrated (snapshot, create, delete ) Management, Microsoft SCVMM 2012 SP1
- Service / Connection Broker, Includes / build-in Load balancing
- Service / Connection Broker, Remote Desktop Services Host 2012 integration with VDI; a single end-user interface for accessing VDI and RDS
- Connection Broker / Service OS support, Microsoft Windows Server 2003 R2
- Connection Broker / Service OS support, Microsoft Windows Server 2003 R2-64-bit
- Connection Broker / Service OS support, Microsoft Windows Server 2008
- Connection Broker / Service OS support, Microsoft Windows Server 2008 64-bit
- Connection Broker / Service OS support, Microsoft Windows Server 2012
- Added chapter 7: RDP/RFX 3<sup>rd</sup> party clients

### **Date September 2013; Document version 2.2**

- Overall: updated figure numbering
- Updated chapter [3.1](#), Strategy
- Added chapter [3.10](#), Application layering
- Updated chapter [3.12](#), Server-Hosted Desktop Infrastructure
- Updated chapter [3.18](#), Vendor matrix, who delivers what
- Updated chapter [4.4.2](#), Non-persistent, persistent and layered virtual desktops
- Updated chapter [5.2](#), Citrix XenDesktop
- Updated chapter [5.4](#), Dell vWorkspace

- Updated chapter [5.11](#), VMware View
- Updated chapter [5.13](#), Unidesk
- Updated chapter [6.2](#), Product version
- New Features in Chapter 6.5
  - User Experience, Windows media; client-side content fetching
  - User Experience, Windows 8 Desktop Window Manager redirection support to Windows endpoint
  - User Experience, Windows 8 Desktop Window Manager redirection support to non-Windows endpoint
  - User Experience, Conferencing applications; optimized real time A/V redirection (instead USB redirection) on Windows endpoint
  - User Experience, Conferencing applications; optimized real time A/V redirection (instead USB redirection) on non-Windows endpoint
  - Management, Universal print server; one universal print driver on vDesktop
  - Client (endpoint) Operating System support, Windows Phone 8
  - Virtual Infrastructure (Hypervisor) support, Citrix XenServer 6.2
- Changed Features in Chapter 6.5, Citrix XenDesktop
  - User Experience, Windows 7 Aero support on non-Windows endpoint
  - User Experience, GPU PassThrough from Hypervisor to vDesktop; 1:1
  - User Experience, GPU Virtualization, share GPU with multiple vDesktops
  - User Experience, Unified Communications (OCS/Lync 2013) Microsoft support of Lync VDI plugin over RDP; solution over Dynamic Virtual Channels
  - User Experience, Unified Communications (OCS/Lync 2013) VDI vendor support and implementation of Dynamic Virtual Channel APIs in vendor client software and backend infrastructure for support over vendor default Remote Display protocol
  - User Experience, Reverse seamless, Windows- and Web application publishing
  - Guest (VM) Operating System support, Microsoft Windows 8 32-bit
  - Guest (VM) Operating System support, Microsoft Windows 8 64-bit
  - Guest (VM) Operating System support, Microsoft Windows 2012
  - Client (endpoint) Operating System support, Microsoft Windows 8 32-bit
  - Client (endpoint) Operating System support, Microsoft Windows 8 64-bit
  - Client (endpoint) Operating System support, Microsoft Windows 8 - RT
  - Client (endpoint) Operating System support, Microsoft Windows Server 2012
  - Supported Protocols for all VDI infrastructure related components, TCP/IP v6
  - Virtual Infrastructure (Hypervisor) support, VMware vSphere 5.1
  - Virtual Infrastructure (Hypervisor) support, Microsoft Hyper-V Windows Server 2012
  - Virtual Infrastructure Integrated (snapshot, create, delete ) Management, Microsoft SCVMM 2012 SP1
  - Service / Connection Broker, Delegation of control, granular delegated administration roles
  - Service / Connection Broker, Remote Desktop Services Host 2012 integration with VDI; a single end-user interface for accessing VDI and RDS
  - Connection Broker / Service OS support, Microsoft Windows Server 2012

- Datastore / database OS support, Microsoft SQL Server 2012
- Changed Features in Chapter 6.5, Citrix VDI-in-a-Box
  - User Experience, Adobe Flash v11 support; client-side rendering
  - User Experience, Windows 7 Aero support on non-Windows endpoint
  - User Experience, Unified Communications (OCS/Lync 2013) Microsoft support of Lync VDI plugin over RDP; solution over Dynamic Virtual Channels
  - User Experience, Unified Communications (OCS/Lync 2013) VDI vendor support and implementation of Dynamic Virtual Channel APIs in vendor client software and backend infrastructure for support over vendor default Remote Display protocol
  - Guest (VM) Operating System support, Microsoft Windows 2012
  - Client (endpoint) Operating System support, Microsoft Windows 8 32-bit
  - Client (endpoint) Operating System support, Microsoft Windows 8 64-bit
  - Client (endpoint) Operating System support, Microsoft Windows 8 - RT
  - Client (endpoint) Operating System support, Microsoft Windows Server 2012
- Changed Features in Chapter 6.5, Microsoft VDI
  - User Experience, Unified Communications (OCS/Lync 2013) Microsoft support of Lync VDI plugin over RDP; solution over Dynamic Virtual Channels
  - User Experience, Unified Communications (OCS/Lync 2013) VDI vendor support and implementation of Dynamic Virtual Channel APIs in vendor client software and backend infrastructure for support over vendor default Remote Display protocol
- Changed Features in Chapter 6.5, Dell vWorkspace
  - User Experience, Unified Communications (OCS/Lync 2013) Microsoft support of Lync VDI plugin over RDP; solution over Dynamic Virtual Channels
  - Client (endpoint) Operating System support, Microsoft Windows 8 32-bit
  - Client (endpoint) Operating System support, Microsoft Windows 8 64-bit
  - Support and Community, Vendor created reference design for enterprise architecture, public available
  - Support and Community, SMB Reference Architecture , public available
- Changed Features in Chapter 6.5, VMware View
  - User Experience, Webcam support (LAN)
  - User Experience, Webcam support (WAN); bandwidth compression
  - User Experience, Webcam support (WAN); latency reduction
  - User Experience, Unified Communications (OCS/Lync 2013) Microsoft support of Lync VDI plugin over RDP; solution over Dynamic Virtual Channels
  - User Experience, Unified Communications (OCS/Lync 2013) VDI vendor support and implementation of Dynamic Virtual Channel APIs in vendor client software and backend infrastructure for support over vendor default Remote Display protocol
- Updated chapter [7.2](#), Product Version
- Changed Features in Chapter 7.3, 2X Client RDP
  - User Experience, RemoteApp
  - User Experience, Clipboard support

- Changed Features in Chapter 7.3, iTap mobile RDP
  - Pricing
- Changed Features in Chapter 7.3, PocketCloud RD Pro
  - User Experience, Sound support
  - User Experience, Clipboard support
  - Supported connections, Network Level Authentication
  - Pricing
- Changed Features in Chapter 7.3, Remotix RDP
  - Pricing
- Changed Features in Chapter 7.3, VMLite Remote Client
  - Pricing

### **Date October 2013; Document version 2.3**

- Feature updated XenDesktop 7.1
- Added chapter 5.x, NICE DCV
- Updated chapter 5.x, Microsoft RDVH – Virtual Desktop Infrastructure
- Updated chapter 6.2, changed product versions
- New Features in Chapter 6.5
  - Supported Remote Display Protocols, Microsoft RDP 8.1
  - Security and Networking, Reuse pre-configured Active Directory computer accounts
  - Desktop Provisioning, Imaging delivery to vDesktop through local storage
  - Guest (VM) Operating System support, Microsoft Windows Server 2012 R2 (Server OS as VDI ≠RDSH)
  - Guest (VM) Operating System support, Microsoft Windows 8.1 32-bit
  - Guest (VM) Operating System support, Microsoft Windows 8.1 64-bit
  - Client (endpoint) Operating System support, Microsoft Windows Server 2012R2
  - Client (endpoint) Operating System support, Apple iPhone/iPod IOS v7.x
  - Client (endpoint) Operating System support, Apple iPad IOS v7.x
  - Internet Browser support for web based access to vDesktop, Internet Explorer 11.x
  - Virtual Infrastructure (Hypervisor) support, VMware vSphere 5.5
  - Virtual Infrastructure (Hypervisor) support, Microsoft Hyper-V Windows Server 2012 R2
  - Virtual Infrastructure Integrated (snapshot, create, delete ) Management, Includes / build-in Load balancing
  - Virtual Infrastructure Integrated (snapshot, create, delete ) Management, Includes / build-in High Availability
  - Connection Broker / Service OS support, Microsoft Windows Server 2012R2
- Changed Features in Chapter 6.5, Citrix XenDesktop
  - Supported Remote Display Protocols, Microsoft RDP 8.0
  - Supported Remote Display Protocols, Microsoft RDP 8.1
  - User Experience, 3D OpenGL support, hardware assist GPU
  - User Experience, 3D DirectX support ;<9.1, hardware assist GPU
  - User Experience, 3D DirectX support >10, hardware assist GPU
  - User Experience, 3D DirectX support >v11, hardware assist GPU
  - User Experience, Unified Communication A/V; API can be leveraged by partners to support advanced call routing functionality
  - Supported Remote Display Protocols, Microsoft RDP 8.0
  - Guest (VM) Operating System support, Microsoft Windows Server 2012 (Server OS as VDI ≠RDSH)

- Guest (VM) Operating System support, Microsoft Windows 2008 R2 (Server OS as VDI ≠RDSH)
- Service / Connection Broker, Integration with 3rd party client management solutions
- Support and Community, 10+ of public available enterprise (10K CCU) references in EU using VDI technology stack
- Support and Community, 10+ of public available enterprise (10K CCU) references in US using VDI technology stack
- Changed Features in Chapter 6.5, Citrix VDI-in-a-Box
  - Supported Remote Display Protocols, Microsoft RDP 7.1 (RemoteFX)
  - Supported Remote Display Protocols, Microsoft RDP 8.0
  - User Experience, Unified Communication A/V; API can be leveraged by partners to support advanced call routing functionality
  - Supported Remote Display Protocols, Microsoft RDP 7.1 (RemoteFX)
  - Supported Remote Display Protocols, Microsoft RDP 8.0
  - Guest (VM) Operating System support, Microsoft Windows Server 2012 (Server OS as VDI ≠RDSH)
- Changed Features in Chapter 6.5, Microsoft VDI
  - Management, Remote session control; session shadowing
  - User Experience, Unified Communication A/V; API can be leveraged by partners to support advanced call routing functionality
  - Remote session control; session shadowing
  - Management, Desktop pools support for Multi VLAN or network labels
  - Security and Networking, Integrates (SSO) with Citrix Access Gateway enterprise
  - Desktop Provisioning, Offline vDesktops; integrated in VDI management solution
  - Guest (VM) Operating System support, Microsoft Windows Server 2012 R2 (Server OS as VDI ≠RDSH)
  - Guest (VM) Operating System support, Microsoft Windows Server 2012 (Server OS as VDI ≠RDSH)
- Changed Features in Chapter 6.5, VMware View
  - User Experience, Windows media; client-side content fetching
  - User Experience, Multimedia (A/V) redirection; client-side rendering
  - User Experience, 3D OpenGL support, hardware assist GPU
  - User Experience, 3D DirectX support >10, hardware assist GPU
  - User Experience, 3D DirectX support >v11, hardware assist GPU
  - User Experience, GPU PassThrough from Hypervisor to vDesktop; 1:1
  - User Experience, Conferencing applications; optimized real time A/V redirection (instead USB redirection) on non-Windows endpoint
  - User Experience, User Installed Applications integrated in vDesktop
  - Supported Remote Display Protocols, Microsoft RDP 8.0
  - Management, Supports WAN acceleration TCP based devices
  - Management, Additional instrumentation (end-to-end monitoring) for vDesktop included in a VDI software bundle
  - Management, Additional instrumentation (VDI Infrastructure Monitoring and Diagnose) for vDesktop included in a VDI software bundle
  - Security and Networking, xIntegrates (SSO) with F5 FirePass
  - Security and Networking, Dynamic prioritization of Remote Display Protocol traffic by (3<sup>rd</sup> party) WAN accelerators
  - Guest (VM) Operating System support, Microsoft Windows 2008 R2 (Server OS as VDI ≠RDSH)
  - Service / Connection Broker, Daily Admin Management Console is customizable; change/add/move columns, change view layout
  - Support and Community, 10+ of public available enterprise (10K CCU) references in EU using VDI technology stack

- Support and Community, 10+ of public available enterprise (10K CCU) references in US using VDI technology stack
- Changed Features in Chapter 6.5, Dell vWorkspace
  - User Experience, Unified Communication A/V; API can be leveraged by partners to support advanced call routing functionality
  - Management, User Profile Management in FAT Client scenario
  - Management, Desktop pools support for Multi VLAN or network labels
  - Guest (VM) Operating System support, Microsoft Windows Server 2012 (Server OS as VDI ≠RDSH)
- Updated chapter 7, RemoteFX/RDP Software clients
- Changed Features in Chapter 7.3, Microsoft RDP
  - Supported connections, RemoteFX / RDP 8.0
  - Supported connections, RD Gateway
  - Pricing, Price per device for Apple iPad (iOS) in US dollars (\$)
  - Pricing, Price per device for Apple iPhone (iOS) in US dollars (\$)
  - Pricing, Price per device for Apple MAC (OSX) in US dollars (\$)
  - Pricing, Price per device for Android in US dollars (\$)
- Updated Chapter 9, A-team (PQR) Members
  - Added a new member





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