

U.S. Army Thin Client/Client Computing



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Section 1: Executive Summary

1.1. Project Overview

This white paper document is intended to provide a strong survey of current design considerations for U.S. Army and other U.S. Government customers considering a transition from traditional desktop computing to virtual desktop computing including thin client technologies. In addition, this white paper makes specific sample recommendations for Government clients with fewer than 500 seats as well as those with greater than 500 seats up to 1000.

Connection's approach is always to customize virtual desktop solutions based on each client's specific needs to produce the infrastructure most suited to those needs. Thus, the intent of this document is to serve as a general example of each environment that will hopefully prove to be foundational to specific client requests.

Section 2 reviews the methodology that Connection employs to design and deliver a successful virtual desktop solution.

Section 3 details the key design concepts of a virtual desktop solution and surveys the design considerations for choosing appropriate thin clients. It also provides operational details for the recommended desktop virtualization platform, VMware Horizon 7, and explains many of the key virtualization concepts integral to Horizon 7.

Section 4 defines the recommended sample solution for clients with fewer than 500 seats.

Section 5 defines the recommended sample solution for clients with greater than 500 seats.

Section 6 documents the acceptance criteria and virtual desktop profile choices associated with the recommended sample solutions.

1.2. Project Goals

The goals of this project are to educate the reader on the many design choices and concepts associated with virtualized desktop environments, including thin client technologies; to explain the process and methodology for moving to a virtualized desktop environment; and to illustrate typical virtualized desktop environments by way of examples.

1.3. Solution Summary

Under 500 seats:

The 500 seats or fewer solution consists of the following major components:

- (3) HP DL360 Gen10 Management Servers
- (6) HP DL360 Gen10 VMware Horizon Servers
- (500) HP t620 Flexible Series Thin Clients
- VMware Horizon 7 Enterprise

Over 500 seats:

The 500 seats or greater solution consists of the following major components:

- (6) HP DL360 Gen10 Management Servers
- (20) HP DL360 Gen10 VMware Horizon Servers
- (1000) HP t620 Plus Flexible Series Thin Clients
- VMware Horizon 7 Enterprise

Both solutions are largely built on the same server building block: HP DL 360 Gen10 servers for both management servers and VMware Horizon servers. The over 500 seat configuration incorporates VMware AlwaysOn architecture which sets up two parallel highly-available instances that can each service end users. End user/thin clients may connect to either infrastructure at any particular time. From the user's point of view, the experience with either infrastructure is completely transparent.

As a result, the management and VMware Horizon server counts are larger than in the under 500 seat scenario not just because the seat count is higher but also because of the need to build out parallel infrastructures.

The other difference between the two scenarios is that the under 500 seat configuration is comprised of HP t620 thin clients while the over 500 seat configuration employs HP t620 Plus thin clients. The primary difference between thin client models is that the Plus thin clients can support Quad Graphics.

Section 2: Virtual Desktop Design Methodology

When Connection began actively working on Virtual Desktop Infrastructure (VDI) initiatives with our customers, it became clear that VDI could be designed and implemented in any number of ways, and that some of those ways led to successful adoption and others did not. We combined our experience with manufacturer best practices to develop the following VDI methodology. We based our methodology on the industry best-practice ADIM (Assess, Design, Implement, and Manage) model used prevalently throughout our services organization.

Each phase of the ADIM model leads logically into the next, and adherence to the model results in well-managed, efficient, and productive IT solutions.

Our Service teams also focus on delivering best-practice results and identifying emerging solution offerings. This allows our customers to consistently benefit as new technologies mature into mainstream adoption.



Assessment

The key to knowing where you are going is first knowing where you are. In the Assessment phase, we will assess the physical infrastructure to collect metric data on how the current environment is performing. This lets us understand your starting point. Next, we work with you to understand where you want to go. These requirements become the Critical Success Criteria that we use to design a successful proof of concept (POC). With those requirements defined, we can then track towards measurable outcomes at the end of the POC. This helps you understand whether all the functionality you require will be available in a Virtual Desktop Infrastructure and whether it makes sense to continue your VDI journey.

Design

Once you have defined your current state and planned your future state, it's time to develop a well-formed design to accomplish that transition. We'll take the data gathered in the assessment and POC and use it to scope a pilot environment. We'll virtualize a test group of users and measure their experience in the pilot VDI environment. This will essentially confirm the requirements needed for your production environment and further validate how this technology will function in your unique environment.

Implementation

In the Implementation phase, we will build out your production environment, customize additional product functionality, and roll out the environment to user groups. This is also where you will develop strategies on how to manage the environment moving forward with regards to backup, persona management, application management, client management, anti-virus, and graphic acceleration. Regular use of monitoring tools will greatly affect your success since you will be able to identify performance issues as you grow and remediate.

Maintain

Maintaining involves more than just moves, adds, and changes. In this phase, you need to acquire and maintain training, implement advanced functionality, and update the software as new minor and major releases occur. Regularly performed health checks are a key ingredient to ensure that your environment is configured consistently to best practices as you grow and expand it. You will also be actively engaged in managing the backup strategy developed during the implementation phase.

Section 3: Design Concepts

3.1. Thin Clients

3.1.1. Thin Client Definition

A thin client is a lightweight stateless computer with no hard drives or fans. It is purposely built to display a remote desktop session running on a remote server. All data processing which typically takes place locally on a desktop PC, including applications, memory, storage, etc., are located safely back in the data center. If a thin client is damaged or stolen, no data is at risk.

3.1.2. Thin Client Advantages and Disadvantages

Advantages of Thin Clients

- Centralized management
- Enhanced security
- Cost savings over a desktop
- Power savings over a desktop
- Enhanced reliability, no moving parts

Disadvantages of Thin Clients

- Needs to connect to a remote server to access data
- Requires management
- No local storage for most thin clients

3.1.3. Types of Thin Clients

Types of Clients

- Windows Embedded
- Linux-based
- Flexible Thin Clients
- Zero Clients

3.1.4. Choosing the Right Thin Client for your Needs

3.1.4.1. Important Considerations and Options

Below is a guide to help design the ideal thin client model for your environment. Knowing exactly what you require will help you avoid purchasing a thin client that is not suited for its intended job.

- RAM to run programs
- Flash storage to hold OS and data
- Networking (Ethernet/Wi-Fi)
- Number of displays required
- Expandability (the ability to add additional display adapters, network cards, etc.)
- OS Type (Windows, Linux, Zero)
- Manageability
- Security (CAC)
- Flexibility
- VDI Brokers supported

3.1.4.2. Major Manufacturers

- Dell Wyse
- HP
- Samsung

3.1.4.3. Form Factors

- Desktop (requires connection a monitor)
- All in One (one piece includes thin client and monitor)

3.1.5. Thin Client Types

3.1.5.1. Microsoft Windows Embedded

Windows Embedded thin clients run a light version of Windows and are considered the fattest of the thin clients because of the size of the embedded Windows operating system.

Use Case: Windows embedded thin clients are a good choice when the most user flexibility is desired. Windows embedded thin clients have the ability to log into multiple remote sessions such as VMware Horizon, Citrix, or RDSH (Terminal Server). They can also run Windows applications and Web-based applications from the thin client itself.

Pros

- Most flexible of the thin clients
- Can run certain Windows applications and multiple broker clients simultaneously
- Browser support allows access to the internet and web-based applications
- Wireless enabled
- Manageability through vendor tools

Cons

- Large software footprint
- May need occasional patching and updating
- Not as secure as zero clients
- More expensive than a zero client
- Software based PCoIP

3.1.5.2. Linux Thin Clients

Linux thin clients are based on a hardened modified Linux kernel which is smaller in size and presents a smaller attack surface compared to Windows embedded OS.

Use Case: Use this operating system when a more secure user environment is required. It can run multiple connection brokers and Web-based applications as well.

Pros

- Smaller software footprint than Windows embedded thin clients
- Can run multiple broker clients simultaneously
- A built-in browser allows access to Internet and Web-based applications on the thin client
- More secure than Windows embedded thin clients and with a smaller attack profile
- Wireless enabled
- Manageability through vendor tools

Cons

- Not as flexible as Windows embedded thin client
- Usually contains a proprietary Linux kernel, making modifications difficult
- Still requires updating and still has an attack profile
- Software based PCoIP
- Device drivers not as available

3.1.5.3. Flexible Thin Clients

Flexible thin clients are the chameleons of the thin client landscape as they can change their identity and job role simply by changing their software. A flexible thin client can be a Windows embedded, Linux, or even software based zero client. The advantage to flexible thin clients is that they can adapt and change as your environment and your needs evolve. There is no need to purchase new hardware.

Use case: As implied, they are flexible and easily adapt to new requirements. Flexible thin clients are a good choice if you want to have different brokers and requirements for different sets of users but yet still maintain a single hardware platform.

Pros

- Flexible configuration (Windows, Linux, Smart Zero)
- Wireless enabled (excludes zero clients)
- Not dedicated to a single configuration
- Manageability through vendor tools
- Can change settings/profile to enhance performance based on transport protocol

Cons

- PCoIP is software-based rather than hardware
- Not a secure hardware-based zero client

3.1.5.4. Zero Clients

Zero clients have the smallest operating system of all the thin clients.

Use Case: Zero clients are purpose driven and only work with a specific type of connection broker. They are very easy to replace and upgrade as there is no user data held on the client.

Pros

- Software is ROM-based and not easily compromised
- Require minimal or no configuration
- Do not require software patching and updating like Windows thin clients
- Hardware based PCoIP
- Smallest physical footprint

Cons

- Single broker—you must purchase the correct model for your environment
- Zero clients cannot be repurposed for different VDI brokers
- No hardware expandability
- Not wireless enabled
- Limited manageability through vendor tools (usually limited to just firmware and configuration)

3.1.6. Thin Client Management

3.1.6.1. Major Vendors

Major Vendors

- HP Device Manager
- Dell Wyse Device Manager
- Teradici console

Each manufacturer has a management platform for their thin clients. As most features are hardware or agent based they cannot manage another vendor's thin clients. The Teradici Console can manage all hardware-based Teradici PCoIP chipset clients regardless of the vendor.

3.1.6.2. Typical Management Functions

Typical management functions include (but vary depending on the thin client OS):

- Asset and inventory management
- Thin client settings and connection cloning
- Software updates
- Patch and client updates
- Remote control
- Remote power management
- Inventory, firmware updating, and configuration changes

3.2. VMware Horizon 7

VMware Horizon 7 is an application and desktop delivery solution that provides end users with access to all of their virtual desktops, applications, and online services through a single digital workspace.

3.2.1. VMware Horizon 7 Benefits and Features

- When you manage enterprise desktops with Horizon 7, the benefits include increased reliability, security, hardware independence, and convenience.
- Desktops and applications can be centralized by integrating with VMware vSphere® and virtualizing server, storage, and networking resources. Placing desktop operating systems and applications on a server in the data center provides the following advantages:
 - Access to data can easily be restricted. Sensitive data can be prevented from being copied onto a remote employee's home computer.
 - Integration with Workspace means that end users have on-demand access to remote desktops through the same Web-based application catalog they use to access SaaS, Web, and Windows applications. Inside a remote desktop, users can also use Workspace Catalog to access applications
 - Remote desktops and applications that are hosted in a data center experience little or no downtime.
 - Virtual machines can reside on high-availability clusters of VMware servers.
- Provisioning desktops and applications for end users is a quick process. It does not require installation of applications one by one on each end user's physical PC. End users connect to a remote application or a remote desktop complete with applications. End users can access their same remote desktop or application from various devices at various locations.
- Using VMware vSphere to host virtual desktops and RDS host servers provides the following benefits:
 - Administration tasks and management chores are reduced. Administrators can patch and upgrade applications and operating systems without touching a user's physical PC.
 - Integration with Workspace means that IT managers can use the Web-based Workspace administration interface to monitor user and group entitlements to remote desktops.

- Features included in Horizon support usability, security, centralized control, and scalability.
- The following features provide a familiar experience for the end user:
 - Use multiple monitors. With PCoIP and Extreme Blast multiple-monitor support, you can adjust the display resolution and rotation separately for each monitor.
 - Access USB devices and other peripherals that are connected to the local device that displays your virtual desktop.
 - You can specify which types of USB devices end users are allowed to connect to. For composite devices that contain multiple types of devices, such as a video input device and a storage device, you can split the device so that one device (for example, the video input device) is allowed, but the other device (for example, the storage device) is not.
- Horizon offers the following security features, among others:
 - Use of two-factor authentication, such as RSA SecurID or RADIUS (Remote Authentication Dial-In User Service), or smart cards to log in
 - Use of pre-created Active Directory accounts when provisioning remote desktops and applications in environments that have read-only access policies for Active Directory
 - Use of SSL tunneling to ensure that all connections are completely encrypted
 - Use of VMware High Availability to ensure automatic failover
- Scalability features depend on the VMware virtualization platform to manage both desktops and servers:
 - Use Horizon Composer to quickly create desktop images that share virtual disks with a master image. Using linked clones in this way conserves disk space and simplifies the management of patches and updates to the operating system.
- The following features provide centralized administration and management:
 - Use Microsoft Active Directory to manage access to remote desktops and applications and to manage policies
 - Use the Web-based administrative console to manage remote desktops and applications from any location
 - Use App Volumes to inject the right app stack for each user group or use case
 - Use User Environment Manager to handle profile management, used to replace Microsoft Group Policy (GPO) management or to help enhance Microsoft GPO management
 - Use Administrator to distribute and manage applications packaged with VMware ThinApp for Create conflict free applications and allow legacy applications to run on newer operating systems

- Integrate with WorkspaceONE so that end users can access remote desktops through the Workspace user portal on the Web, as well as use the Workspace user portal on the Web from inside a remote desktop

3.2.2. VMware Horizon Connection Server

This software service acts as a broker for client connections. Horizon Connection Server authenticates users through Windows Active Directory and directs the request to the appropriate virtual machine, physical PC, or Microsoft RDS host.

- Horizon Connection Server provides the following management capabilities:
 - Authenticating users
 - Entitling users to specific desktops and pools
 - Assigning applications packaged with VMware ThinApp to specific desktops and pools
 - Managing remote desktop and application sessions
 - Establishing secure connections between users and remote desktops and applications
 - Enabling single sign-on
 - Setting and applying policies
- Inside the corporate firewall, you install and configure a group of two or more Horizon Connection Server instances. Their configuration data is stored in an embedded LDAP directory and is replicated among members of the group.
- Outside the corporate firewall, in the DMZ, you can install and configure Horizon Connection Server as a security server. Security servers in the DMZ communicate with Horizon Connection Servers inside the corporate firewall. Security servers ensure that the only remote desktop and application traffic that can enter the corporate data center is traffic on behalf of a strongly authenticated user. Users can access only the resources that they are authorized to access.
- Security servers offer a subset of functionality and are not required to be in an Active Directory domain. You install Horizon Connection Server in a Windows Server 2008, Windows Server 2012, or Windows Server 2012 R2 server, preferably on a VMware virtual machine.

3.2.3. VMware Horizon Client

- The client software for accessing remote desktops and applications can run on a tablet, a phone, a Windows, Linux, or Mac PC or laptop, a thin client, and more.
- Features differ according to which Horizon Client you use. This guide focuses on Horizon Client for Windows. The following types of clients are not described in detail in this guide:
 - Details about Horizon Client for tablets, Linux clients, and Mac clients. For more information, see the Horizon Client documentation at https://www.vmware.com/support/viewclients/doc/viewclients_pubs.html

3.2.4. VMware Horizon Administrator

This Web-based application allows administrators to configure Horizon Connection Server, deploy and manage remote desktops and applications, control user authentication, and troubleshoot end-user issues.

When you install a Horizon Connection Server instance, the Horizon Administrator application is also installed. This application allows administrators to manage Horizon Connection Server instances from anywhere without having to install an application on their local computer.

3.2.5. VMware vCenter Server

This service acts as a central administrator for VMware ESXi servers that are connected on a network. vCenter server provides the central point for configuring, provisioning, and managing virtual machines in the data center.

- In addition to using these virtual machines as sources for virtual machine desktop pools, you can use virtual machines to host the server components of VMware Horizon, including Horizon Connection Server instances, Active Directory servers, Microsoft RDS hosts, and vCenter Server instances.
- You can install Horizon Composer on the same server as vCenter Server or on a different server. vCenter Server then manages the assignment of the virtual machines to physical servers and storage and manages the assignment of CPU and memory resources to virtual machines.
- You can install vCenter server either as a VMware virtual appliance or install vCenter Server in a Windows Server 2008 R2 server, a Windows Server 2012 R2 server, or a Windows Server 2016 server, preferably on a VMware virtual machine.

3.2.6. VMware App Volumes

VMware App Volumes is a real-time application management tool for delivering and maintaining applications in virtual desktop environments. App Volumes makes it possible to provision and upgrade applications through virtual disks, without having to package, modify or stream the applications. Optimized to run within VMware vSphere, App Volumes applications can target specific users, groups, or devices. Once IT installs an application, an administrator can deliver or upgrade its workload in seconds. IT controls the entire application lifecycle, from installing to updating to replacing the application. From the end user's perspective, the application performs just like one that is natively installed.

- App Volumes applications are stored on read-only virtual disks, with a writeable volume available to each user so that any customized settings and data persist upon virtual desktop logon and logoff. IT admins can set up the disks on any supported vSphere data store, such as VMware Virtual SAN, allowing IT to implement the most appropriate storage for their organization, rather than having to stream the applications across the network
- App Volumes is a good way to deliver applications from a non-persistent state while still persisting user data
- App Volumes then uses virtual machine disks to deliver applications to VMware Horizon virtual desktops, without needing to modify the desktops or the applications. That helps reduce storage requirements, lowering the overall cost of managing virtual desktops. App Volumes provides users with persistent applications on top of non-persistent virtual desktop pools, delivering the applications from one virtual disk to multiple desktops. Administrators can deliver and upgrade the applications in real time and make them immediately available to users, while they're already logged in or at boot up.

3.2.6.1. VMware App Volumes Components

- There are several components that go into an App Volumes installation. App Volumes, vSphere and Horizon work together to deliver the applications to virtual desktops (Figure 1)

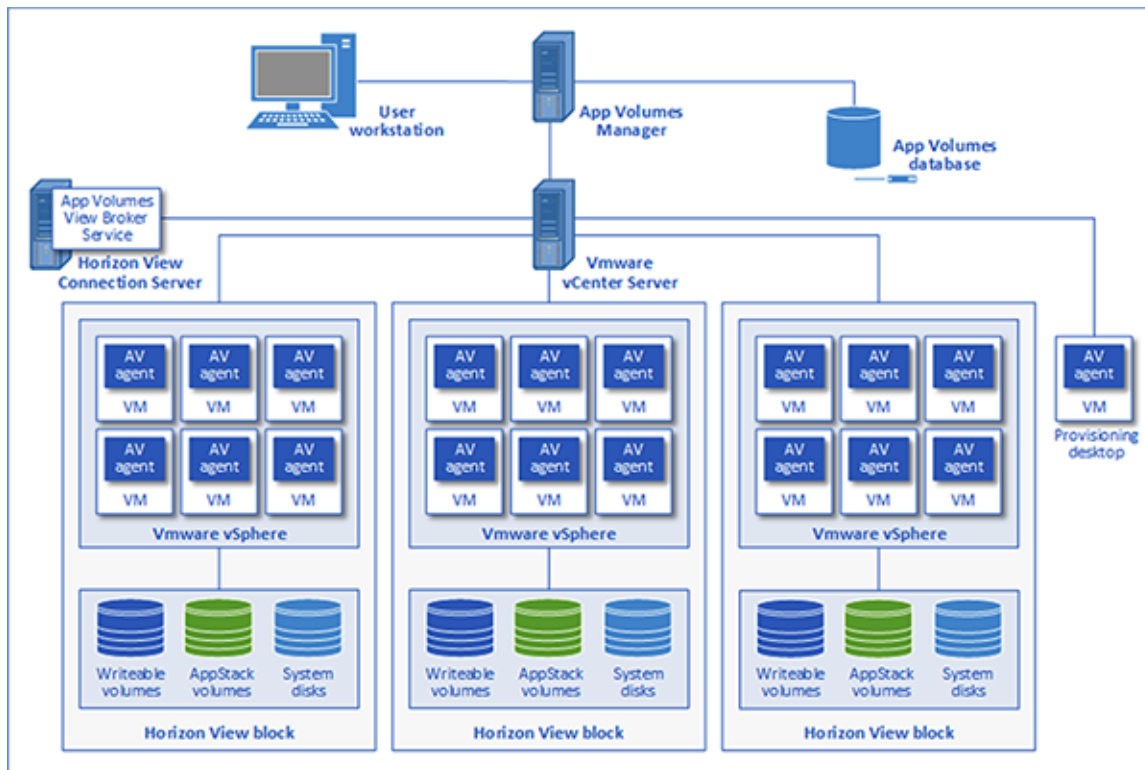


Figure 1. How App Volumes fits into VMware VDI

- The App Volumes Manager server provides a Web-based interface for administering and configuring App Volumes, as well as assigning the read-only virtual disks—called AppStack volumes—and the writeable virtual disks—writeable volumes. App Volumes Manager also serves as a broker for the App Volumes agent that runs within each virtual machine (VM).
- App Volumes uses a SQL Server database to store configuration information for the AppStack and writeable volumes, as well as information about users, physical and virtual machines, data transactions and application access rules.
- Another important player in the App Volumes ecosystem is vCenter Server. In addition to managing the vSphere infrastructure, vCenter Server provides App Volumes with operational connectivity to VM, storage, and vSphere host resources as well as makes application inventory information available. App

Volumes facilitates faster user logins by running the App Volumes Horizon Broker Service on the Horizon Connection Server.

- Finally, App Volumes requires that IT installs its agent on each vSphere VM. The agent runs as a service, handling application calls and file system redirects to the AppStack and writeable volumes. The agent must also run on the target virtual desktop.

3.2.6.2. How VMware AppStack and Writeable Volumes Work

At the heart of the App Volumes operation are the AppStack volumes, read-only disks containing one or more Windows applications. Each AppStack volume can support multiple systems or users. Administrators can assign volumes to Active Directory user accounts, groups, or organizational units, as well as to computer accounts.

- There is a default 20GB template for AppStack volumes, but administrators can also create customized templates. A customized template can target a specific application deployment scenario and be smaller than 20GB, allowing it to deploy faster than the default one.
- If there is a dependency between applications, they should run on the same AppStack volume. Also, if an application such as anti-virus or security software needs to run when users are logged out, it should not run on an AppStack volume, but instead be installed on the base image.
- Unlike the AppStack volumes, the writeable volumes provide a way to persist user data. Each one is specific to a user and is used to store customized data such as local profile information, application settings, or user-installed applications. IT can only associate a writeable volume with one user at a time, making it possible for the volume to move with the user from one VM to the next. The volume deploys when the user authenticates their login on the virtual desktop
- App Volumes is a good way to deliver applications from a non-persistent state while still persisting user data. According to VMware, App Volumes will also support non-VMware virtual desktop environments, such as Citrix XenDesktop and Microsoft Remote Desktop Session Host. IT shops will have to determine whether the benefits of using App Volumes are enough to offset the licensing fees or whether they even need to introduce this type of application layering.

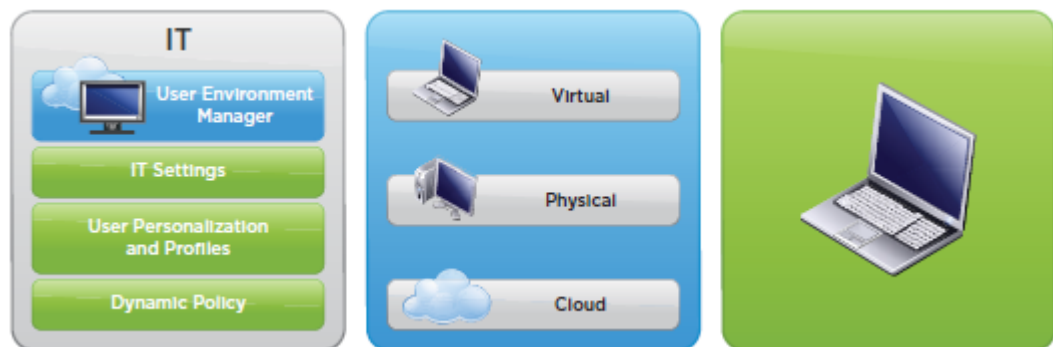
3.2.6.3. Other App Volume Features

- **AppToggle** – A new patent pending capability that enables per user entitlement and installation of applications within a single AppStack for maximum flexibility. This helps IT reduce the number of AppStacks that need to be managed, lowers storage capacity and management costs even further, improves performance, and allows applications to share or have different dependencies in a single AppStack. The AppToggle architectural approach of only installing entitled applications also offers greater security as opposed to simply hiding installed applications, which can easily be exploited.
- **AppCapture with AppIsolation** – A new capability that easily captures and updates applications to simplify application packaging, delivery and isolation with a command line interface that enables IT to distribute AppStack creation to different teams and merge AppStacks for simplified delivery and management. With support for AppIsolation, AppCapture also integrates with VMware ThinApp to enable IT to deliver native applications and VMware ThinApp applications in one consistent format through AppStacks.
- **AppScaling with Multizones** – Allows integrated application availability across datacenters so customers no longer need additional software to replicate AppStacks across sites. IT admins can add multiple file shares to host AppStacks and pair them to VMware vCenter™ instances. An import service will then scan the file shares and populate the AppStacks into the data stores of the vCenter instances. This removes the requirement of having a shared data store between vCenter instances to replicate AppStacks.
- **Integrated Application, User Management and Monitoring Architecture** – A new modern architecture for the VMware App Volumes manager component offers the industry's only solution that combines application and user environment management with monitoring. With an architecture streamlined for faster provisioning and context-aware user policy, this offers a flexible and reliable application and lifecycle management solution for the digital workspace.
- **Unified Administration Console** – A single pane of glass across application management, user environment management and monitoring. This next-generation admin view recognizes patterns to create simple, yet powerful workflows for application delivery, user environment management (beta for this release), and desktop and published application environment monitoring. This removes the complexity of managing multiple consoles but still enables customers to use legacy consoles if desired. Out of the box functionality also enables IT admins to address end-user needs quickly and efficiently.

3.2.7. User Environment Manager

User Environment Manager simplifies end-user profile management with a single, scalable solution that leverages existing infrastructure.

- Centralized and simplified user environment management
- Simple profile and policy management makes adoption, management, and day-to-day operations easy, while enabling compliance
- Easy-to-apply policy follows users across devices and locations and helps accelerate management, migrations and onboarding, including configuration settings for applications, shortcuts, mappings, and group policy settings
- Integration with Horizon Cloud Manager eases deployment and reduces management complexity
- Enterprise-grade user management with low up-front investment
- Scale out services with a single solution that supports virtual, physical, and cloud-hosted environments
- Drive down user management costs and leverage existing infrastructure
- Respond to changing business dynamics with the ability to quickly add and remove profile and personalization services
- Personalized end-user experience: User Environment Manager (UEM) gives end users a consistent and personalized experience across devices and locations
- Maintain personalized settings across multiple devices, even non-persistent VDI sessions
- Experience auto-mapping printers and networks as you roam between locations
- Enjoy speedy logon times and faster time-to-application, with minimal downtime



3.2.8. Workspace ONE Suite

Introduction

The digital workspace is the defining model for end-user computing in the mobile cloud era. Business is changing. Ownership models, mobile work styles, cloud computing, and expectations of ever greater consumer style of computing within the enterprise have disrupted the traditional model for end-user computing. As users increasingly leverage a portfolio of heterogeneous devices and applications through wireless networks and unpredictable security environments, today's mobile-cloud era is rapidly rendering the previously dominant client-server model obsolete. This technical and cultural evolution creates unique challenges for IT, while simultaneously generating new opportunities for businesses and their users.

Features:

- Unified Management for All Endpoints
- Mobile Device and App Management
- Intelligent Insight and Automation
- Device-Aware Access Management
- Content-based Actions and Notifications
- Comprehensive and Predictive Security

Leverages the following technologies:

- Workspace ONE Suite
 - Identity Manager
 - AirWatch
 - Workspace ONE

Identity Manager

VMware Identity Manager™ services provide the identity-related components, including authentication for users who single sign-on to their resources for the VMware Workspace ONE platform. You create a set of policies that relate to networking and authentication to control access to these resources. VMware Identity Manager comes as a cloud product, or as an on-premises installation.

AirWatch

VMware AirWatch provides Enterprise Mobility Management that allows you to manage and configure devices across multiple platforms. Manage the device from initial on-boarding, configure apps and settings, apply security policies, and remotely troubleshoot issues. Protect your corporate applications and data on any network with a comprehensive security model. AirWatch provides a layered security approach that encompasses the user, endpoint, app, data, and network. Support use cases across your organization, including corporate-owned, BYO, and line of business such as kiosks or shared devices.

Workspace ONE UEM

VMware Workspace™ ONE™ is a secure enterprise platform that delivers and manages applications on iOS, Android, and Windows 10 devices. Identity, application, and enterprise mobility management are integrated into the Workspace ONE platform.

3.2.9. Transport Protocol

Customers can choose between three transport protocols based on their use cases and client device choices. The transport protocols are:

- Remote Desktop Protocol (RDP)
- PCoIP
- Blast Extreme

3.2.9.1. Remote Desktop Protocol (RDP)

Remote Desktop Protocol is the same multichannel protocol many people already use to access their work computer from their home computer. Microsoft Remote Desktop Connection (RDC) uses RDP to transmit data.

Microsoft RDP is a supported display protocol for remote desktops that use virtual machines, physical machines, or shared session desktops on an RDS host. (Only the PCoIP display protocol is supported for remote applications.) Microsoft RDP provides the following features:

- With RDP 7, you can use multiple monitors in span mode; RDP 7 has true multiple monitor support, for up to 16 monitors
- You can copy and paste text and system objects such as folders and files between the local system and the Horizon desktop
- RDP supports 32-bit color
- RDP Supports 128-bit encryption
- You can use this protocol for making secure, encrypted connections to a Security Server in the corporate DMZ

3.2.9.2. PCoIP

PCoIP is a high-performance remote display protocol provided by VMware.

This protocol is available for Horizon desktops that are sourced from virtual machines, Teradici clients, and physical machines that have Teradici-enabled host cards.

PCoIP can compensate for an increase in latency or a reduction in bandwidth, to ensure that end users can remain productive regardless of network conditions. PCoIP is optimized for delivery of images, audio, and video content for a wide range of users on the LAN or across the WAN.

PCoIP provides the following features:

- You can use 3D applications such as Windows Aero themes or Google Earth, with screen resolution up to 1920 x 1200. With this no hardware accelerated graphics feature, you can run DirectX 9 and OpenGL 2.1 applications without a physical graphics processing unit (GPU).
- You can use up to 4 monitors and adjust the resolution for each monitor separately, up to 2560 x 1600 resolution per display. When 3D feature is enabled, up to 2 monitors are supported with a resolution of up to 1920x1200.
- You can copy and paste text and images between the local system and the desktop, up to 1MB. Supported file formats include text, images, and RTF (Rich Text Format). You cannot copy and paste system objects such as folders and files between systems.
- PCoIP supports 32-bit color.
- PCoIP supports Advanced Encryption Standard (AES) 128-bit encryption, which is turned on by default.
- Client hardware must support the following requirements:
 - x86-based processor with SSE2 extensions, with a 800MHz or higher processor speed
 - ARM processor with NEON (preferred) or WMMX2 extensions, with a 1GHz or higher processor speed

3.2.9.3. VMware Blast Extreme

Adding to PCoIP, VMware now offers customers additional choice and flexibility with brand new Blast Extreme display technology, purpose built and optimized for the mobile cloud.

Built on industry-standard H.264 protocol, Blast Extreme supports the broadest range of client devices, billions of client devices are already H.264 capable.

Blast Extreme offers a lot of inherent advantages in addition to client device support. These include:

- Significantly less network bandwidth consumed
- The ability to leverage both TCP or UDP network transport
- Agility in adapting to challenging, lossy network conditions
- Lower CPU consumption for longer battery life on mobile devices
- Additionally, when combined with GPU-based hardware acceleration in the host, such as NVIDIA GRID, VMware has a complete solution that dramatically improves graphics performance end to end for the most visually intensive applications, in any use case

3.2.10. VMware vRealize Operations for Horizon 7

VMware vRealize® Operations for Horizon® provides end-to-end visibility into the health, performance, and efficiency of VMware virtual desktop and application environments from the data center and the network, all the way through to devices. It enables desktop administrators to proactively optimize end-user experience, avert incidents, and eliminate bottlenecks.

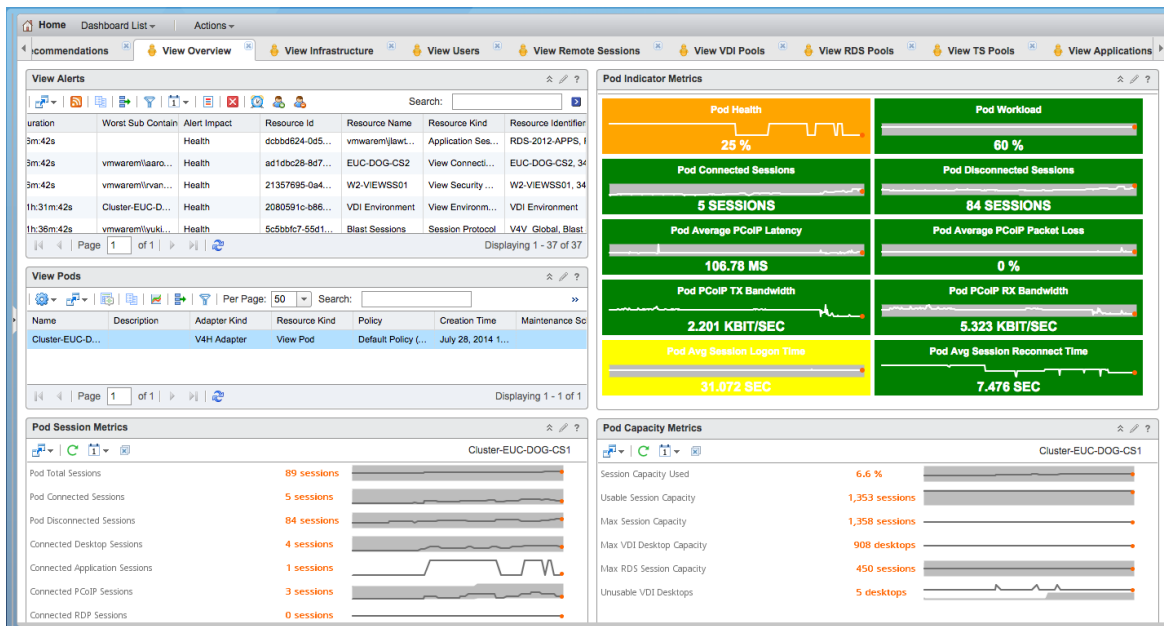
Designed for VMware Horizon and XenDesktop environments, vRealize Operations for Horizon reduces costs and expedites Time to Resolution (TTR) with in-depth monitoring.

3.2.10.1. Key Benefits

- Comprehensive visibility into the performance and health of Horizon and deployments on VMware vSphere® expedites troubleshooting and improves user experience to enhance workplace productivity
- Intelligent automation of root-cause analysis and auto-correlation of monitoring data across the entire stack reduces troubleshooting times and improves team productivity by up to 50 percent
- Self-learning analytics that notify desktop administrators of impending issues before they impact end users enable proactive management and process improvements
- Out-of-the box reporting templates and remediation recommendations help ensure compliance and enhance SLAs

3.2.10.2. Key Troubleshooting Benefits

- Troubleshooting desktop issues has never been easier with intuitive dashboards and heat map that use patented advanced analytics and root cause analysis to identify the problem before the users are impacted
- vRealize for Horizon provides key troubleshooting data for these metrics and more:
 - PCoIP statistics
 - Network latency
 - CPU usage
 - Memory usage
 - Storage latency
 - Under or oversized VMs
 - vSphere infrastructure health
 - User Sessions
 - Licensing reports
- See figure below for an example of the comprehensive dashboard into the VDI environment



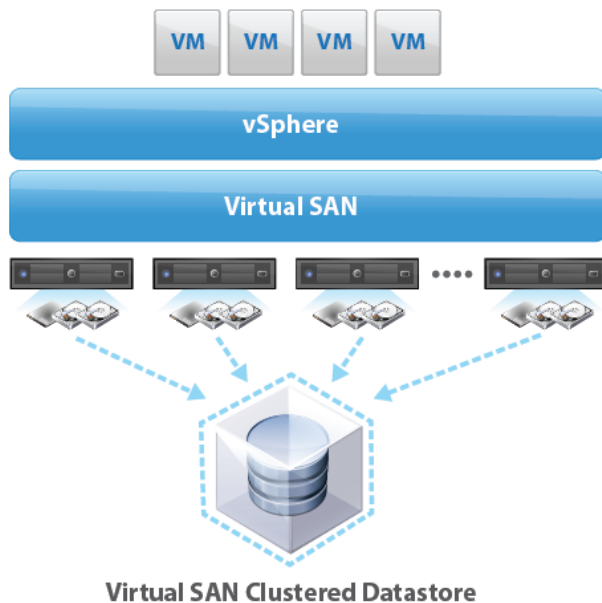
3.2.11. VMware Virtual SAN

Virtual SAN is a hypervisor-converged, software-defined storage platform that is fully integrated with vSphere. Virtual SAN aggregates locally attached disks of hosts that are members of a vSphere cluster to create a distributed shared storage solution. Because Virtual SAN sits directly in the I/O data path, it can deliver the highest levels of performance, scalability, and resilience without taxing the CPU with additional overhead. Virtual SAN enables the rapid provisioning of storage within VMware vCenter™ during virtual machine creation and deployment operations.

Virtual SAN uses a hybrid disk architecture that leverages flash-based devices for performance and magnetic disks for capacity and persistent data storage. Its distributed datastore is an object-store file system that leverages the vSphere Storage Policy-Based Management feature to deliver centrally managed, application-centric storage services and capabilities.

Administrators can specify storage attributes, such as capacity, performance, and availability, as a policy on a per virtual machine basis. The policies dynamically self-tune and load-balance the system so that each virtual machine has the right level of resources.

Virtual SAN architecture



3.3. HP Device Manager

HP Device Manager is enterprise-class thin client management software that allows customers to view their thin client assets remotely and manipulate those thin clients to meet the required business need.

From one interface, HP Device Manager enables management of thin clients for the following:

- Configuration
- Automatic device discovery
- Device grouping for easy recognition
- Security certificate assignments
- FTP loading of images

Asset tracking and inventory management

HP Device Manager generates detailed reports to track health and performance of hardware and software assets:

- Multiple formats: CSV, Excel, PDF, RTF, HTML
- Auto registration of devices and gateways via DHCP or DNS
- Device import via CSV file

Thin client settings and connection cloning

- Backup and restore utility
- Connection management
- System settings
- Task data
- Device data

Imaging and client updates tools

- OS imaging
- Operating system upgrades
- Image cloning
- File-based imaging for WES

Remote control

HP Device Manager provides users with cost-effective, one-to-one IT support without physically having to visit endpoint devices for the following: Citrix, RDP, TeamTalk, VDM Web.

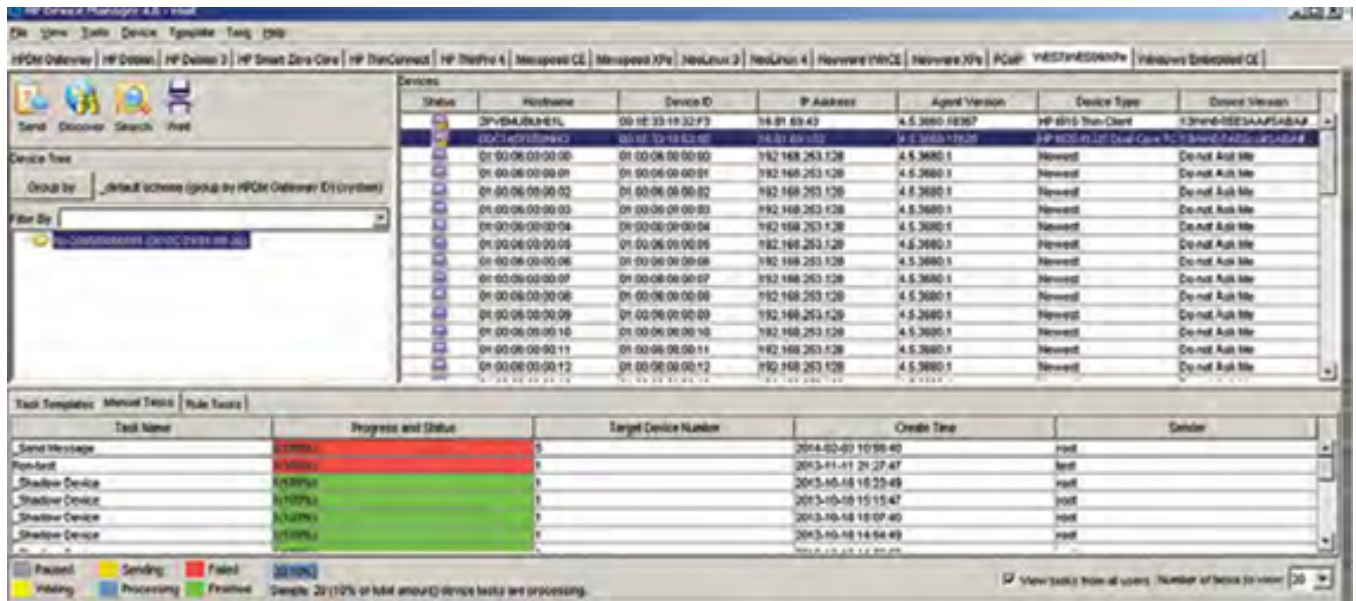
Remote power management

Quickly restart, shut down, or Wake-on-LAN (WoL) thin clients.

Help desk and troubleshooting

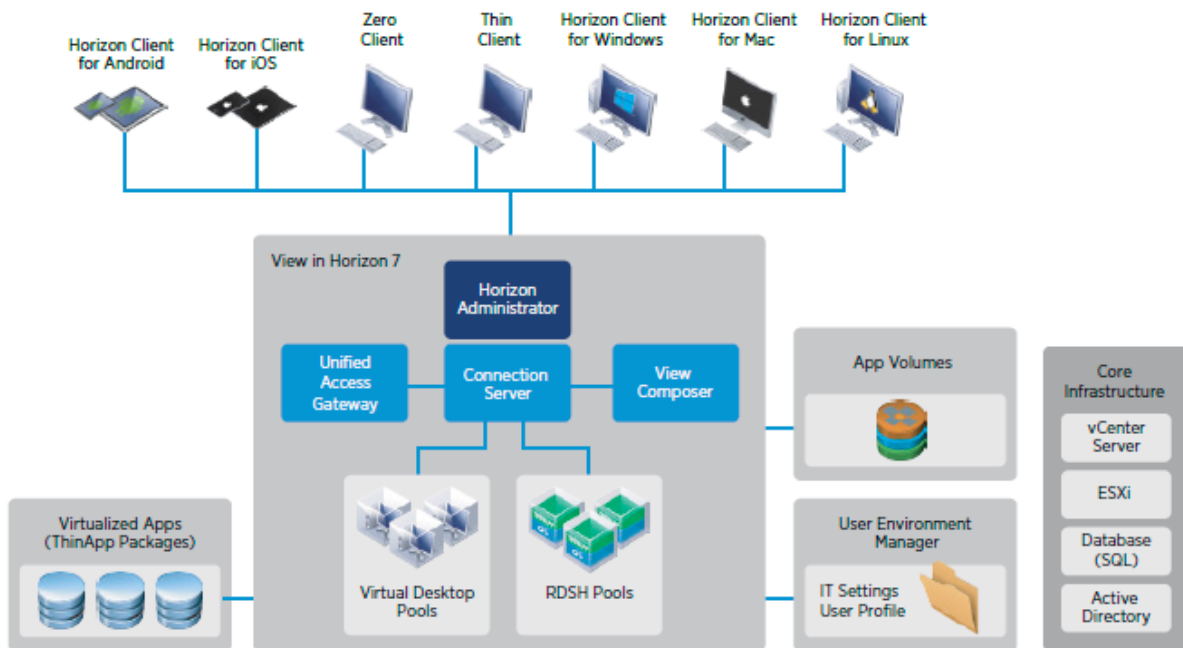
- Shadowing (OS dependent)
- PING
- Trace-Route
- Online/Offline status

See figure below for an example of the HP Device Manager management interface.



3.3.1. VMware Horizon Topology

Overall view of VMware Horizon Environment



Section 4: Thin Client Solution for 500 Seats and Below

4.1. Solution Design Recommendation

Connection's solution design for 500 seats and below consists of these major components:

- (3) HP DL360 Gen10 Management Servers
- (6) HP DL360 Gen10 VMware Horizon Servers
- (500) HP t620 Flexible Series Thin Clients
- VMware Horizon 7 Enterprise

The following assumptions were used in defining this design:

Hardware Assumptions

- Management server cluster
 - External access is required
 - 100% concurrent access is required
- VMware Horizon server/desktop cluster
 - Virtual Desktop profile
 - Windows 7
 - 2 vCPU
 - One 40GB hard drive
 - 2.5GB of RAM
 - Department applications
 - Microsoft Office, Internet access
 - Local printing
 - Smart Card authentication
 - Assumptions for Cluster
 - 90% memory utilization
 - 90% CPU utilization
 - 120 users per host (5 users per core)
 - Assumptions for Virtual SAN
 - 1 host failure for fault tolerance
 - RAID 1
 - 60% read
 - 25 IOPS per VM
- Thin client hardware
 - Flexible Thin Clients – HP t620
 - Monitors (as needed, dual video display support standard; HP t620 plus can, with appropriate video card, support quad video displays)

Software Assumptions

- VMware Horizon Enterprise (Licensed per named user)

4.2. Bill of Materials (500 Seats and Below)

Note: This is a representative bill of materials (BOM). Only major components are listed; items such as switches, cables, monitors, etc. are not included.

QTY	Description
	HORIZON HOST CONFIGURATION
6	HPE ProLiant DL360 Gen10 5118 2.3GHz 12C 105W 2P 32G-2R P408i-a 8SFF 2x800W Perf Server
132	HPE 16GB (1x16GB) Single Rank x4 DDR4-2666 CAS-19-19-19 Registered Smart Memory Kit
12	HPE 400GB SAS 12G Mixed Use SFF (2.5in) SC 3yr Wty Digitally Signed Firmware SSD
24	HPE 1.2TB SAS 12G Enterprise 10K SFF (2.5in) SC 3yr Wty Digitally Signed Firmware HDD
6	HPE Ethernet 1Gb 4-port 366T Adapter
6	HPE iLO Advanced Electronic License with 1yr Support on iLO Licensed Features
6	HPE OneView w/o iLO including 3yr 24x7 Support Flexible Quantity E-LTU
6	HPE 3 Year Foundation Care Call-To-Repair DL360 Gen10 Service
	MANAGEMENT CLUSTER
3	HPE ProLiant DL360 Gen10 5118 2.3GHz 12C 105W 2P 32G-2R P408i-a 8SFF 2x800W Perf Server
18	HPE 16GB (1x16GB) Single Rank x4 DDR4-2666 CAS-19-19-19 Registered Smart Memory Kit
3	HPE 400GB SAS 12G Mixed Use SFF (2.5in) SC 3yr Wty Digitally Signed Firmware SSD
12	HPE 1.2TB SAS 12G Enterprise 10K SFF (2.5in) SC 3yr Wty Digitally Signed Firmware HDD
3	HPE Ethernet 1Gb 4-port 366T Adapter
3	HPE iLO Advanced Electronic License with 1yr Support on iLO Licensed Features
3	HPE OneView w/o iLO including 3yr 24x7 Support Flexible Quantity E-LTU
3	HPE 3 Year Foundation Care Call-To-Repair DL360 Gen10 Service
	HORIZON SOFTWARE and SUPPORT
5	Horizon Enterprise software pricing (100 seats per)
5	Horizon 3 year support (100 seats per)
	THIN CLIENT HARDWARE
500	HP t620 ThinPro AMD Fusion Quad Core 8GF/4GB

4.3. Major Component Details

Management Server Hardware Requirements	
Server Information	Description
HP DL360 Gen10 Server	Quantity: 3 HP DL360 Gen10 servers using Virtual SAN
Recommended Sizing	Three servers for redundancy/failover. These servers will house the following: VMware vCenter, Horizon Composer server, Connection servers, Security servers/Access Points, SQL Server database, AppVolumes servers, profile data, UEM, vRealize Operations for Horizon and HP Device Manager server.

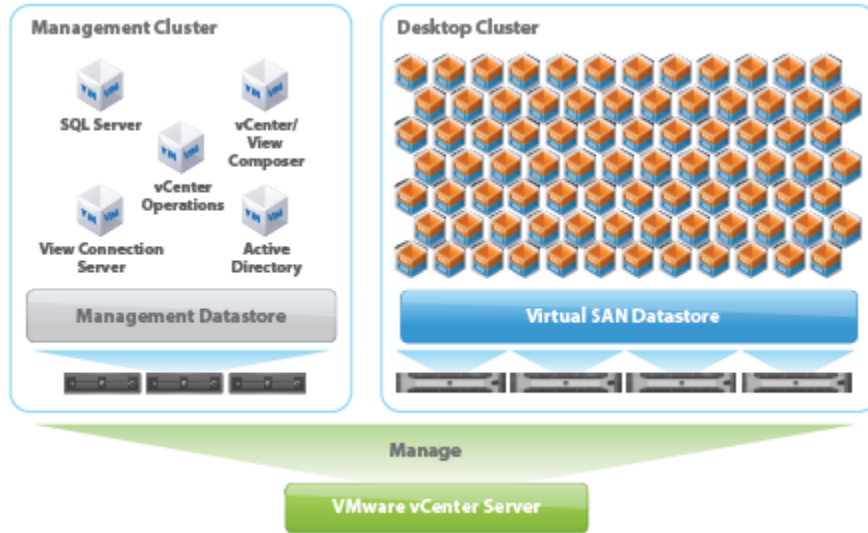
VMware Horizon Server/Desktop Hardware Requirements	
Server Information	Description
HP DL360 Gen10 Server	Quantity 6 DL360 Gen10 rackmount servers, dual 5118 2.3Ghz processors, 12 core, 384GB of RAM, single 400GB SSD drive, four 1TB SAS, 2 x 10GbE Ethernet connections and 4 x 1GB Ethernet connections
Recommended Sizing	One server for approximately 120 users, includes failover/load balancing servers to support the 500 users. 5+1 for redundancy
Assumption	Customer has open 10GbE ports on existing switches within the environment.

Thin Client Hardware Requirements	
Thin Client Information	Description
HP t620 ThinPro AMD Fusion Quad Core 8GF/4GB	Operating System: HP ThinPro 32, 4 GB 1600 MHz DDR3L SDRAM, 8 GB MLC M.2 SSD, Integrated AMD Radeon HD 8330E. Supports Citrix ICA, Citrix HDX, Microsoft RDP, Microsoft RemoteFX (RFX), VMware Horizon View through RDP and PCoIP; (2) USB 3.0 and (6) USB 2.0 ports
Smart Card Reader (CAC)	Gemalto USB-SW Smart Card Reader
Recommended Sizing	One per user

Software Requirements	
Software	Description
VMware Horizon 7 Enterprise	Horizon 7 provides a streamlined approach to delivering, protecting and managing virtual desktops (VDI) and apps while containing costs and ensuring that end users can work anytime, anywhere, across any device.
VMware Horizon 7 Enterprise License	Sold per concurrent user or named user

4.4. Proposed Solution Architecture

4.4.1. Management and Desktop Clusters (POD)



The Management Cluster (left) would, for the 500 seat and below configuration, be comprised of three HP DL360 Gen10 servers. The VMware Horizon servers (lower right) would be comprised of six HP DL360 Gen10 servers. The thin client pool (upper right) would be comprised of up to 500 HP t620 Flexible Thin Clients.

4.5. Description of Costs and Project Timeline

The costs to implement the suggested 500 seat and below configuration would consist of the following:

1. Proof of Concept services
2. Desktop Assessment
3. Hardware, Software, and Support costs for the solution
4. Implementation Services
 - a. Hardware Installation
 - b. VMware vCenter Installation
 - c. VMware Horizon 7 Installation
 - d. Documentation and Knowledge Transfer

500 Seats and Below

Description	Duration
Proof of Concept Services	Variable, 4–8 weeks on average
Desktop Assessment	40 days
Hardware, Software and Support for Final Solution	Product Lead Time
Implementation Services for Final Solution: <ul style="list-style-type: none"> • Hardware Installation • VMware vCenter Installation • VMware Horizon 7 Installation • Documentation and Knowledge Transfer 	Variable, 2 weeks on-site 1-week documentation and project close-out

Section 5: Thin Client Solution for up to 1000 Seats

5.1. Solution Design Recommendation

Connection's solution design for up to 1000 seats consists of these major components (there is a doubling of server requirements to support VMware's AlwaysOn functionality (see Section 5.4) in this scenario as well as an increase in the number of Horizon servers to support the higher seat count):

- (6) HP DL360 Gen10 Management Servers
- (20) HP DL360 Gen10 VMware Horizon Servers
- (1000) HP t620 Plus Flexible Series Thin Clients
- VMware Horizon 7 Enterprise

The following assumptions were used in defining this design:

Hardware Assumptions

- Management server cluster
 - External access is required
 - 100% concurrent access is required
- VMware Horizon server/desktop cluster
 - Virtual Desktop profile
 - Windows 7
 - 2 vCPU
 - One 40GB hard drive
 - 2.5 GB of RAM
 - Department applications
 - Microsoft Office, Internet access
 - Local printing
 - Smart Card authentication
 - Assumptions for Cluster
 - 90% memory utilization
 - 90% CPU utilization
 - 120 users per host (5 users per core)

- Assumptions for Virtual SAN
 - 1 host failure for fault tolerance
 - RAID 1
 - 60% read
 - 25 IOPS per VM
- Thin client hardware
 - Flexible Thin Clients – HP t620
 - Monitors (as needed, dual video display support standard; HP t620 plus can, with appropriate video card, support quad video displays)

Software Assumptions

- VMware Horizon Enterprise (Licensed per named user)

5.2. Bill of Materials (up to 1000 Seats)

Note: This is a representative bill of materials (BOM). Only major components are listed; items such as switches, cables, monitors, etc. are not included.

QTY	Description
	HORIZON HOST CONFIGURATION – SITE 1
10	HPE ProLiant DL360 Gen10 5118 2.3GHz 12C 105W 2P 32G-2R P408i-a 8SFF 2x800W Perf Server
220	HPE 16GB (1x16GB) Single Rank x4 DDR4-2666 CAS-19-19-19 Registered Smart Memory Kit
20	HPE 400GB SAS 12G Mixed Use SFF (2.5in) SC 3yr Wty Digitally Signed Firmware SSD
40	HPE 1.2TB SAS 12G Enterprise 10K SFF (2.5in) SC 3yr Wty Digitally Signed Firmware HDD
10	HPE Ethernet 1Gb 4-port 366T Adapter
10	HPE iLO Advanced Electronic License with 1yr Support on iLO Licensed Features
10	HPE OneView w/o iLO including 3yr 24x7 Support Flexible Quantity E-LTU
10	HPE 3 Year Foundation Care Call-To-Repair DL360 Gen10 Service
	MANAGEMENT CLUSTER – SITE 1
3	HPE ProLiant DL360 Gen10 5118 2.3GHz 12C 105W 2P 32G-2R P408i-a 8SFF 2x800W Perf Server
6	HPE 16GB (1x16GB) Single Rank x4 DDR4-2666 CAS-19-19-19 Registered Smart Memory Kit
12	HPE 400GB SAS 12G Mixed Use SFF (2.5in) SC 3yr Wty Digitally Signed Firmware SSD
3	HPE 1.2TB SAS 12G Enterprise 10K SFF (2.5in) SC 3yr Wty Digitally Signed Firmware HDD
3	HPE Ethernet 1Gb 4-port 366T Adapter
3	HPE iLO Advanced Electronic License with 1yr Support on iLO Licensed Features
3	HPE OneView w/o iLO including 3yr 24x7 Support Flex Qty E LTU
3	HPE 3 Year Foundation Care Call-To-Repair DL360 Gen10 Service
	HORIZON HOST CONFIGURATION – SITE 2
10	HPE ProLiant DL360 Gen10 5118 2.3GHz 12C 105W 2P 32G-2R P408i-a 8SFF 2x800W Perf Server
220	HPE 16GB (1x16GB) Single Rank x4 DDR4-2666 CAS-19-19-19 Registered Smart Memory Kit
20	HPE 400GB SAS 12G Mixed Use SFF (2.5in) SC 3yr Wty Digitally Signed Firmware SSD
40	HPE 1.2TB SAS 12G Enterprise 10K SFF (2.5in) SC 3yr Wty Digitally Signed Firmware HDD
10	HPE Ethernet 1Gb 4-port 366T Adapter
10	HPE iLO Advanced Electronic License with 1yr Support on iLO Licensed Features
10	HPE OneView w/o iLO including 3yr 24x7 Support Flexible Quantity E-LTU
10	HPE 3 Year Foundation Care Call-To-Repair DL360 Gen10 Service
	MANAGEMENT CLUSTER – SITE 2
3	HPE ProLiant DL360 Gen10 5118 2.3GHz 12C 105W 2P 32G-2R P408i-a 8SFF 2x800W Perf Server
6	HPE 16GB (1x16GB) Single Rank x4 DDR4-2666 CAS-19-19-19 Registered Smart Memory Kit
12	HPE 400GB SAS 12G Mixed Use SFF (2.5in) SC 3yr Wty Digitally Signed Firmware SSD
3	HPE 1.2TB SAS 12G Enterprise 10K SFF (2.5in) SC 3yr Wty Digitally Signed Firmware HDD
3	HPE Ethernet 1Gb 4-port 366T Adapter
3	HPE iLO Advanced Electronic License with 1yr Support on iLO Licensed Features
3	HPE OneView w/o iLO including 3yr 24x7 Support Flex Qty E LTU
3	HPE 3 Year Foundation Care Call-To-Repair DL360 Gen10 Service
	HORIZON SOFTWARE and SUPPORT
10	Horizon Enterprise software pricing (100 seats per)
10	Horizon 3 year support (100 seats per)
	THIN CLIENT HARDWARE
1000	HP t620 PLUS ThinPro AMD Fusion Quad Core 8GF/4GB Quad Video

5.3. Major Component Details

Management Server Hardware Requirements	
Server Information	Description
HP DL360 Gen10 Server	Quantity: 6 (AlwaysOn) (3 per site) HP DL360 Gen10 servers using Virtual SAN
Recommended Sizing	Three servers for redundancy/failover. These servers will house the following: VMware vCenter, Horizon Composer server, Connection servers, Security servers/Access Points, SQL Server database, AppVolumes servers, profile data, UEM, vRealize Operations for Horizon and HP Device Manager

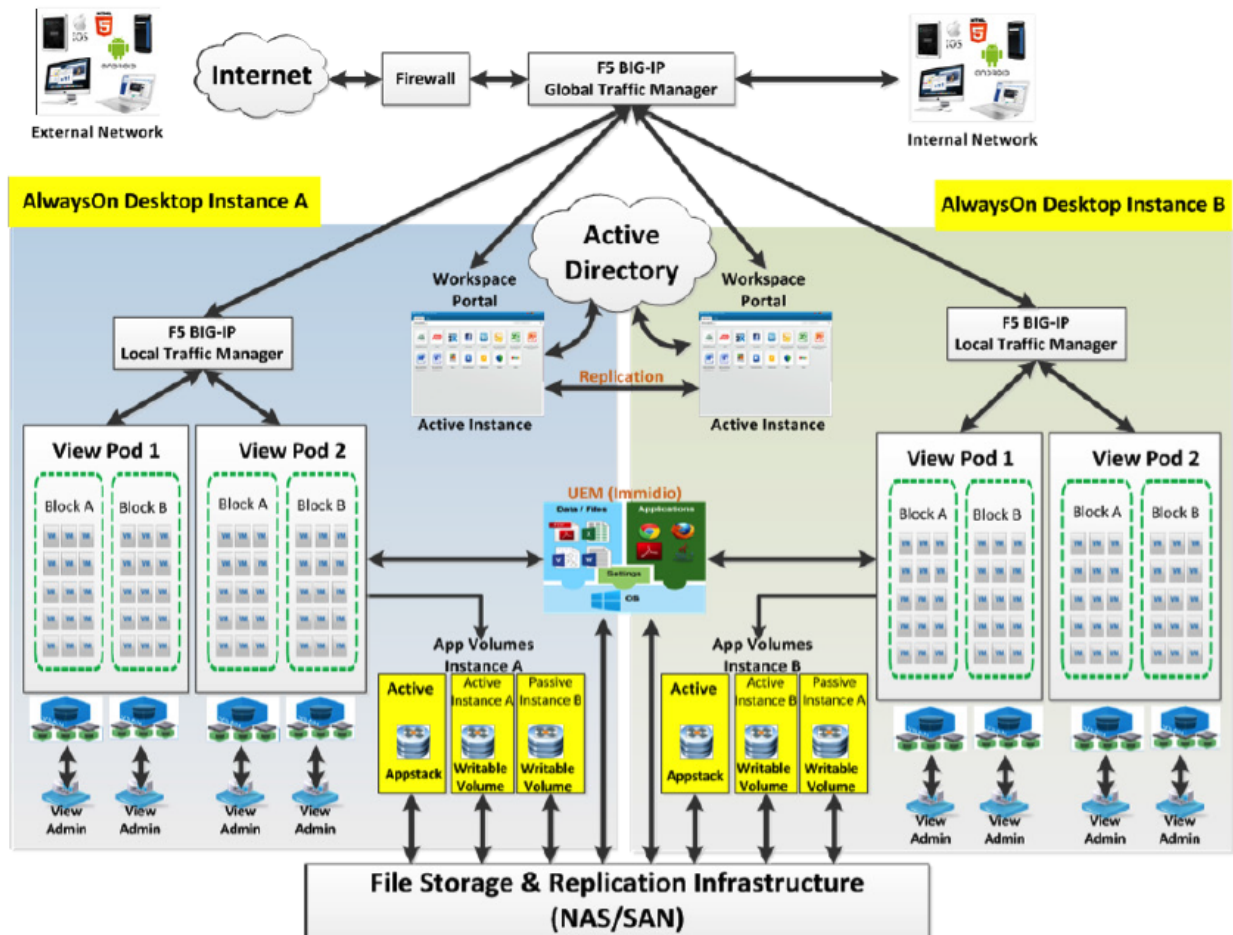
VMware Horizon Server/Desktop Hardware Requirements for 1000 Users	
Server Information	Description
HP DL360 Gen10 Server	Quantity 20 (AlwaysOn) (10 per site) DL360 Gen10 rackmount servers, dual 5118 2.3Ghz processors, 12 core, 384GB of RAM, single 400GB SSD drive, four 1TB SAS, 2 x 10GbE Ethernet connections and 4 x 1GB Ethernet connections
Recommended Sizing	One server for approximately 120 users, includes failover/load balancing servers to support the 1000 users. 9+1 for redundancy

Thin Client Hardware Requirements	
Thin Client Information	Description
HP t620 PLUS ThinPro AMD Fusion Quad Core 8GF/4GB Quad Video	Operating System: HP ThinPro 32, 4 GB 1600 MHz DDR3L SDRAM, 8 GB MLC M.2 SSD, Integrated AMD Radeon HD 8400E. Supports Citrix ICA, Citrix HDX, Microsoft RDP, Microsoft RemoteFX (RFX), VMware Horizon through RDP and PCoIP; (2) USB 3.0 and (6) USB 2.0 ports
Smart Card Reader (CAC)	Gemalto USB-SW Smart Card Reader
Recommended Sizing	One per user

Software Requirements	
Software	Description
VMware Horizon 7 Enterprise	Horizon 7 provides a streamlined approach to delivering, protecting and managing virtual desktops (VDI) and apps while containing costs and ensuring that end users can work anytime, anywhere, across any device.
VMware Horizon 7 Enterprise License	Sold per concurrent user or named user

5.4. Proposed Solution Architecture – AlwaysOn

5.4.1. AlwaysOn Architecture



The diagram above shows the proposed architecture for the initial 1000 desktops. This environment is a pod design that will support up to 2,000 desktops / RDSH sessions. This design is easily scalable by replication. In addition, Horizon 7 supports global pools and namespaces within the cloud pod architecture which would allow scalability of up to 20,000 desktops within a single namespace. These desktop pools and pods can also be separated via WAN to provide disaster recovery or high availability.

5.4.2. Virtual Desktop

The proposed design leverages the Horizon 7 VDI solution to provide floating pools of either linked clone or instant clone desktops. These desktops can be accessed internally or externally via F5 load balanced pairs of connection servers and security servers.

The security servers (Unified Access Gateway) sit in the DMZ and provide a secure tunnel to the user's VDI or RDSH sessions. This design dedicates a pair of F5 load balanced connection servers for internal use and a pair for external use. Tags can be used to easily specify desktop pools which can only be accessed internal or pools that can only be accessed external to the network.

There is a Virtual Center with the composer service on it installed in the Horizon Management cluster to create and manage the linked clone desktops. By leveraging App Volumes, a generic gold image can be used and groups of applications can be attached dynamically as locally installed applications to the Virtual Desktops based on AD entitlements. App Volumes also allow the installation of user installed applications (if supported) which persist across floating desktop sessions.

VMware User Environment Manager (UEM) will be used to manage Windows settings, Application settings and the user environment (mapped drives, printers, etc.). These settings will persist dynamically between physical systems, virtual desktops, and RDSH sessions. When paired with App Volumes, the user will have a floating desktop which looks and feels to them exactly like a persistent desktop. Operationally, these floating desktops can easily be patched and the applications designated to them can be modified and updated in real time with App Volumes.

These desktops can be brokered from a native VMware Horizon client leveraging the highly optimized PCoIP protocol or via the HTML5 protocol which can be accessed from any HTML5 browser with no plugins required. The native client is available for iOS and Android, as well as Windows, Mac, and Linux. The mobile clients are optimized for mobile devices with the Unity Touch feature set. The workspace portal can also launch virtual desktop sessions via SSO. Horizon can publish desktops with Windows client or Server OS (both native and desktop compatibility mode) as well as Linux.

5.4.3. RDSH Published Applications

Applications can easily be published with Horizon 7. The technology leverages the Windows server RDSH capability and is supported on Windows 2008 R2 as well as Windows 2012 Server. Servers are grouped into farms. Each farm of servers should have the same application set installed. Horizon will load balance sessions across the servers in the farm. Applications can be delivered via the native client or via HTML5 (6.1.2) to any device. Application management in each RDSH farm is simplified by the use of VMware App Volumes which can attach the appropriate applications to each server in the farm in real-time. There is only one instance of the application to manage and update and consistency can be maintained easily.

VMware UEM will be used to manage user settings for the applications which are published. For instance, if a user has particular settings for Microsoft Excel on their physical or virtual desktop, those settings will follow them dynamically to their RDSH published version of Excel on any device. RDSH application publishing is managed from the same administrative console as virtual desktops and it shares the same underlying infrastructure of connection servers for internal access and security servers for external access. RDSH published applications can also be brokered via SSO from the VMware Workspace Portal.

5.5. Description of Costs and Project Timeline

The costs to implement the suggested up to a 1000 seats configuration would consist of the following:

1. Proof of Concept services
2. Desktop Assessment
3. Hardware, Software and Support costs for the solution
4. Implementation Services
 - a. Hardware Installation
 - b. VMware vCenter Installation
 - c. VMware Horizon 7 Installation
 - d. Documentation and Knowledge Transfer

Up to 1000 seats

Description	Duration
Proof of Concept Services	Variable, 4–8 weeks on average
Desktop Assessment	60 days
Hardware, Software, and Support for Final Solution	Product Lead Time
Implementation Services for Final Solution: <ul style="list-style-type: none"> • Hardware Installation • VM vCenter Installation • VMware Horizon 7 Installation • Documentation and Knowledge Transfer 	5 weeks on-site 2 weeks pre-planning, desktop optimization, documentation and project close-out

Section 6: Attachments and References

6.1. Acceptance Criteria/Virtual Desktop Profile

Connection uses the following table to help implement a Proof of Concept (POC) within a customer's environment. The questions help us facilitate a successful POC. For each of the scenarios used within this whitepaper this Acceptance Criteria questionnaire was used to help determine hardware required for the virtual desktop scenarios. The end result for the data we used gave us the following profile for the virtual desktop:

- 2 vCPU
- 2.5GB of RAM
- 40GB hard drive
 - o May need a second drive to store user installed applications
- Microsoft Office applications
- Department applications
- Smart Card authentication
- Local printing
- Profiles stored in the data center

VDI Functionality Critical Success Factors

Criteria	Comments	Description
Desktop Requirements	40GB internal Drive. 2GB of RAM, Microsoft applications such as Outlook, Excel, Word, and Internet access	Please describe your current desktop.
What USB devices need to be tested?	Printer	List different USB devices that need for the desktops, i.e. USB microphones, scanners, flash storage
Printers	yes	End users should be able to print to their local or network-attached printers from within their virtual desktop. Print to a local USB or network-attached printer.
Multi-monitor capabilities	Yes	Do end users need multiple monitors?
Profile Management	Yes	Ability to store profile and user data outside of the system image
Desktop Antivirus	No	Offloaded antivirus versus traditional agent
Graphics	None	What graphic intensive apps are they running? Do end users have dedicated graphic cards in their desktops?

Criteria	Comments	Description
Remote Users	Yes, we have some users that are allowed access from home.	Do you have users at remote locations?
Applications	<p>MS office applications, a few departmental applications</p> <p>Users are not allowed to install applications.</p> <p>Some users can install their own applications.</p>	<p>What are the applications that are needed for the desktops?</p> <p>Are there any user-installed applications that need to be addressed?</p> <p>Can users install their own applications?</p>
Multi-factor Authentication	Yes, CAC	Do you use multi-factor authentication in your environment, such as smart cards?
Voice	No	Are you using VOIP? Do any soft clients need to be tested?

Document Control

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2.0	3/28/16	Second Draft	Kathy Orben-Hall
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