Key Considerations in Choosing a Zero Client Environment for View Virtual Desktops in VMware Horizon
Table of Contents

Introduction ................................................................. 3
Zero Clients Explained .................................................. 4
PCoIP: The Leading Choice for a Virtual Desktop Infrastructure ............... 5
High-Quality End-User Experience ..................................... 6
  Media Rendering ......................................................... 6
  Encoding Algorithms .................................................. 6
  Image Compression ..................................................... 6
Security and Compliance ................................................ 7
Cost of Operation .......................................................... 8
Rapid Deployment .......................................................... 8
Wide Range of Applicability ............................................. 9
  Education ................................................................. 9
  Healthcare .............................................................. 9
  Government .............................................................. 9
Zero Clients are a Complementary Solution ................................ 10
  Real-Time Audio-Video ................................................. 10
  Multimedia Redirection ................................................ 10
  Unified Communications Integration with Avaya, Cisco, Microsoft, and Mitel 10
Conclusion ................................................................. 11
Additional Resources ..................................................... 11
Authors and Contributors ............................................... 12
Introduction

In the age of the virtual cubicle, enterprises must find ways to adapt to the needs of end users. End users must be able to access information from a variety of devices and locations. Enterprises need a high-quality, secure, low-cost, low-maintenance solution to manage information and workspaces for end users. Converting to a virtual desktop environment can address these needs, and increase productivity for nearly any organization.

A key factor in this decision is choosing the appropriate hardware client for the virtual desktop. Organizations transitioning to a virtual desktop environment have a variety of hardware options available on the market. These options range from larger thick clients, to lower-maintenance thin clients, to small zero clients. These can be no more than an LCD display with minimal hardware and physical space requirements. Many organizations prefer to use the smallest, easiest to manage, most cost-effective device at the endpoint, a zero client.

The key points for considering zero clients are:

• High-quality end-user experience
• Security and compliance
• Low cost of operation
• Rapid deployment
• Use cases for end users

When choosing a virtualization solution, organizations are faced with a number of concerns. Will the end users be satisfied with their experience in the virtual environment? Will sensitive information be secure? Is the solution cost effective? How much maintenance is required? Several solutions on the market promise the best bandwidth or highest fidelity, but at what cost? Can end users leverage the tools they need to stay connected and be productive?

This paper addresses these concerns, and looks at some key considerations in determining if a zero client environment is right for your organization. The specific example used here for the virtual desktop infrastructure is VMware® Horizon™ with View™, with the PCoIP protocol. In this context, zero clients are discussed as the preferred client to meet many needs.
Zero Clients Explained

Before a decision can be made as to whether zero clients are appropriate for any given organization, it is helpful to have some understanding of the technology. The technology behind zero client devices is aligned with the architecture of virtual desktop infrastructure (VDI), where infrastructure management and data are centralized in the data center.

When implementing a virtual desktop environment, each user must have a device, or client, in order to display the desktop, which is stored in the data center. Zero clients are one type of client. They come in different form factors and contain no local storage, no operating system, no CPU, and no moving parts. Instead, zero clients contain a chip that performs the decoding of PCoIP at the hardware level, designed specifically for rendering pixels onto the user’s display. Each user has a zero client, a display monitor, and human interface devices (HID) such as a keyboard and a mouse. Due to the absence of moving parts or other components, zero clients use just a fraction of the energy consumed by traditional PCs. Zero clients are the easiest to configure, manage, and deploy. Zero clients are available in a variety of formats, such as desktop devices, integrated monitors, and laptops. Figure 1 shows how a typical zero client might appear.

Zero clients can be contrasted with thin clients and thick clients. Thin clients are similar to zero clients, but they contain a local operating system, CPU, flash memory, and local storage. Thick clients are essentially traditional PCs or laptops, with a software client installed specifically for displaying the virtual desktop. Although thin and thick clients allow for a wider range of features and can enable more use cases, they are also the more costly option, require the most maintenance, and are the highest energy consumers.

Teradici, a PCoIP solutions vendor, partners with nearly 30 manufacturers that build the hardware for zero clients. The Teradici ecosystem includes such companies as Dell, HP, LG, Samsung, and many others. The manufacturers embed the PCoIP protocol into software clients for use with thin or thick clients, or into hardware within zero clients and thin clients.
PCoIP: The Leading Choice for a Virtual Desktop Infrastructure

The PCoIP technology developed by Teradici is the innovative remote-display protocol used in VMware Horizon with View virtual desktops. The PCoIP protocol is available in software format, such as in VMware Horizon Clients, and hardware-based clients, such as PCoIP zero clients. In PCoIP zero clients, Teradici embeds the PCoIP protocol in a silicon-based chipset, the Teradici processor, designed for hardware-level decode of the PCoIP protocol. This protocol is made up of a set of coded algorithms. These algorithms employ multiple intelligent codecs to encode and compress data into pixels. With this host-rendered protocol, no data is transmitted over the network, only pixels.

Another feature of PCoIP technology is that it is a UDP-based protocol rather than TCP-based. User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) are the two forms of Internet Protocol (IP) transmission, the means in which messages are transmitted from one IP address to another. TCP is a connection-oriented protocol, meaning that one IP address establishes a connection to another and maintains that connection for the duration of the transfer. Transmissions are sent bidirectionally, from one IP address to another; in the event that packets are lost, they are retransmitted to ensure delivery. This method places a higher load on the client machine. UDP is a connectionless protocol and is lightweight. Packets of data can be sent without a connection to the receiving IP address, and UDP is therefore simpler and more efficient. This protocol is ideal for streaming audio and video, delivering a responsive, low-latency user experience over any network.
High-Quality End-User Experience

An important consideration in selecting a virtual desktop infrastructure is the experience of the end user. VDI end users seek a seamless experience, one in which there is no delay in data retrieval or image rendering. Users are also concerned with the quality of the media rendered, which could be text, images, audio, or other streaming media.

Media Rendering

Within a virtual desktop environment, there are two types of media rendering available: host rendering and client rendering. Each method enables end users to have a good experience in most virtual environments. The key difference is which one can provide the best end-user experience for variable network conditions. This difference determines which approach is more suitable for your environment.

When using host rendering, the first step in the process is to encode or compress the information to be transmitted. With zero clients, this step takes place in the data center, where compute-intensive resources are readily available. The advantage of host rendering in this case is that the data is highly compressed before it is sent to the endpoint, or client.

Encoding Algorithms

PCoIP employs a variety of encoding algorithms, or codecs, for the multiple types of information to be displayed. Different imaging algorithms are applied, depending on the type of information being encoded. For example, the algorithm used for text is different from the algorithm used for streaming video, photos, graphics, or icons. Each data format is unique, and has specific characteristics that determine how the image is perceived by the end user. The use of multiple codecs within the PCoIP protocol allows each type of content to be handled in the most appropriate and efficient way, thereby optimizing use of available network bandwidth.

The PCoIP processor in zero client devices takes the information sent down from the server and translates it into pixels to be displayed on the monitor. Zero clients transmit information from devices such as a keyboard and a mouse up to the server over a separate prioritized channel to further improve response time for end-user interactions.

Image Compression

Image compression can take two forms: lossless data compression or lossy data compression. With lossless compression, the program recreates the original file for the end user. Lossy codecs eliminate information that the program considers to be unnecessary. This results in the compression program’s reinterpretation of the original file, rendering an image of lesser quality. Lossy compression is used when a file does not need to be recreated exactly like the original file. Lossless compression is better in situations where the user wants or needs the original file or media to be recreated exactly. PCoIP zero clients are able to build to lossless, if you need a pixel-perfect image displayed at the endpoint.

Other image-rendering technologies can build only lossy images that do not contain all the information from the original file. This is because sending the entirety of the data to the endpoint is bandwidth- and performance-prohibitive. With these other technologies, image quality must be diminished so that optimal bandwidth and performance can be maintained. With PCoIP zero clients, users do not have to sacrifice image quality for high performance and low network bandwidth usage. IT administrators can choose their level of compression, lossy or lossless, based on their network constraints and the needs of end users.
Security and Compliance

Security remains the top concern for many organizations when deploying a server-hosted virtual desktop environment. The heightened need for security has been demonstrated numerous times with the theft of laptops and USB devices containing customer account information or other sensitive data. The risk of confidential information getting into the wrong hands has never been higher.

A related concern is corporate compliance. Government regulations such as the Sarbanes-Oxley Act, Gramm-Leach-Bliley Act, and Health Insurance Portability and Accountability Act (HIPAA) have mandated that organizations follow specific measures and auditing practices in protecting customer, patient, and employee information. Corporate compliance guidelines are good business and decrease enterprise liability.

How do zero clients help with these concerns? Zero clients provide maximum security and centralized control in a server-hosted virtual desktop environment. Absolutely no data is stored on the endpoint. With PCoIP zero clients, only the display of graphical information is transmitted to the end user, and it is encrypted before it is sent. Sensitive corporate data remains protected in the data center. Figure 2 shows how encrypted PCoIP pixels are sent over the network connection.

![Figure 2: Pixels Sent over Network Connection to PCoIP Zero Client](image)

Zero clients provide an ultra-secure environment with host-rendering. All data remains locked down in the data center, centrally protected and managed. All media is host-rendered and encoded in the data center, then delivered to these stateless, decode-only devices. PCoIP zero clients have no operating system, hard drive, or local memory. This eliminates the risk of data theft through USB devices, or damage to data from viruses or malware, as well as data loss from hardware failure. Table 1 shows the security features and benefits of a zero client.

<table>
<thead>
<tr>
<th>SECURITY FEATURE</th>
<th>SECURITY BENEFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>No operating system</td>
<td>No viruses or spyware, no patches, no maintenance</td>
</tr>
<tr>
<td>No persistent user data</td>
<td>No local storage to lock down</td>
</tr>
<tr>
<td>No application data sent over network</td>
<td>Only fully AES-encrypted pixels are sent over the network</td>
</tr>
<tr>
<td>SIPR hardware token support</td>
<td>Supports secure SIPR authentication mandated by DoD</td>
</tr>
<tr>
<td>Ability to disable USB device access</td>
<td>Full control over USB devices</td>
</tr>
<tr>
<td>802.1X network authentication</td>
<td>Allows network devices to be authenticated before use</td>
</tr>
<tr>
<td>Fiber support (100BASE-FX)</td>
<td>Fiber option to further secure endpoints on network</td>
</tr>
</tbody>
</table>
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### Security Features and Benefits

<table>
<thead>
<tr>
<th>SECURITY FEATURE</th>
<th>SECURITY BENEFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPv6 Ready</td>
<td>Ready for government mandates for IPv6 deployments</td>
</tr>
<tr>
<td>Support for CAC/PIV smart cards</td>
<td>Supports a variety of CAC/PIV smart cards required by federal, state, and local government agencies</td>
</tr>
</tbody>
</table>

Table 1: Zero Client Security Features and Benefits

One use case for secure zero clients is the VMware Horizon View Federal Secure Desktop. This security solution was designed with the compliance needs of federal agencies in mind. Federal IT organizations are moving toward virtual computing in order to lower their carbon footprint, improve employee work and life balance, and allow for constant availability of e-government infrastructure. The challenge is in keeping sensitive data secure. To meet this challenge, VMware established the Federal Secure Desktop Validated Design Guide. Within the particular architecture of the federal validated design, zero clients play a key role.

### Cost of Operation

In addition to high-quality image rendering and secure data, implementing View with zero clients allows enterprises to lower their total cost of ownership (TCO). The lack of moving parts within zero clients ensures that the devices last longer and are more reliable than traditional desktop computers. These small, stateless devices require minimal maintenance, take up far less space than legacy desktop computer towers, cost less than PCs or laptops, and consume only a fraction of the energy required to operate a PC.

Traditional desktop PCs require a significant amount of maintenance. Hardware breaks down and must be replaced. Applications require updating. Maintaining PCs can place an undue burden on IT administrators. If a user has a problem, maintenance must be done on location, at the user’s workplace. In an environment that relies on full laptop and desktop support, organizations can spend $2,000 or more per year on maintaining each device.

The inefficiencies and escalating costs of managing PCs at the endpoint are well documented. The Gartner Report *Total Cost of Ownership Comparison of PCs With Hosted Virtual Desktops, 2011 Update* itemizes these costs and compares them to a server-hosted virtual desktop environment. Zero clients, which require no maintenance, free IT workers for other necessary tasks. Most CIOs agree that zero management at the client is the most efficient, easiest, lowest-cost implementation for virtualizing desktops.

Maintenance is just one concern for IT administrators. Other concerns are energy consumption and the workspace footprint. Traditional PCs consume a great deal of electricity, up to 250 watts of power each hour. Desktops also take up a large portion of the user’s physical workspace, minimizing the available work area. In comparison, zero clients consume a minimal amount of electricity, about 6 to 14 watts of power per hour. This is comparable to the power expended by a small bulb on a string of lights. Also, the small size of the machine frees up physical workspace for end users.

### Rapid Deployment

Another advantage of zero clients is rapid deployment. Zero clients are essentially plug-and-play devices. Out of the box, they require only minutes to set up and seconds to boot. Several zero client models receive power via Ethernet, eliminating the need for a power cord. After a display and human interface devices such as a keyboard and mouse are connected, the zero client workstation is ready to be utilized.
Wide Range of Applicability

PCoIP zero clients are deployed in a wide range of circumstances. From schools to healthcare facilities to government organizations, zero clients are providing desktop virtualization solutions for a variety of enterprise needs.

Education

The Ministry of Education in Malaysia deployed 25,000 View virtual desktop seats and Teradici PCoIP zero client devices to bring digital learning to K-12 students at 1,250 rural and inland schools across Malaysia. This private cloud deployment gives students access to high-quality computing and educational resources, in some cases for the very first time, as part of a national effort led by the Malaysian Ministry of Education to modernize education and bridge the digital divide.

To demonstrate the viability of a large-scale VDI solution and the resilience of low-power, high-performance PCoIP zero client desktops, the Ministry of Education initiated a pilot program at 120 elementary schools in the state of Sabah. This is an area of the country where electricity is provided by solar panels and diesel generators, and Internet is delivered by a VSAT satellite link of up to 2Mbps. Today, teachers and administrators at all 1,250 schools have access to desktops, applications, and data using a virtual desktop infrastructure. With minimal onsite IT setup or modification to the classroom environment, high-performance computing and educational resources are delivered to students and teachers across devices—even in rural and inland areas with extremely poor access to connectivity and electricity. Educational resources are now shared among these schools, and IT administrators have been empowered to manage, secure, and broker services to students and staff in accordance with Ministry policies.

The Thomas Jefferson School of Law (TJSL) in San Diego, California, converted to VDI with PCoIP zero clients in 2011. The facility took the opportunity to update its technology when moving to a new building. TJSL wanted to provide a technologically advanced learning environment for students, while also improving the institution’s environmental impact. The school deployed 200 Samsung PCoIP zero clients, eliminated 200 desktop PCs, and reduced the amount of servers from 35 to 7.

Healthcare

Zero clients perform well in the healthcare industry by providing mobility to healthcare providers. North Kansas City Hospital in Kansas City, Missouri, found the increased mobility ideal for its facility. This nationally recognized acute-care facility needed a solution that granted healthcare workers quick access to patient information. Before zero client deployment, nurses would have to return to a specific PC in order to access patient information. With the implementation of VMware Horizon with View and zero clients, doctors and nurses can easily sign in and out of virtual desktops at any location within the facility. Patient information is quickly accessed at the display endpoints using badge readers. This reduces idle time, and increases caregiver efficiency and productivity.

In Wilmington, North Carolina, Lower Cape Fear Hospice & LifeCareCenter chose to virtualize its workplace. The in-patient care facility was faced with ongoing maintenance costs for its legacy PC setup. Rather than continue to struggle with the cost of updating and repairing their old machines, the hospice center replaced them with zero clients displaying View virtual desktops. On-site endpoint maintenance visits decreased from once a week to once a month. Electricity costs for the center decreased by 20 percent. The rapid deployment of the zero client machines resulted in a labor cost savings of $150 or more per system for setup of the new endpoints.

Government

The VMware Federal Secure Validated Design Guide provides a model of zero client deployment for governmental agencies. A real-world example of zero clients employed by government is found in Hamilton County, Indiana. The local government of Hamilton County wanted to virtualize its desktops for 1,000 employees and a 20-person IT support team. Their legacy PC setup strained to operate the latest software application updates. The solution to this problem was to virtualize over 400 desktops by implementing Horizon with View, and a mix of zero clients and thin clients. The improved efficiency of this setup allowed county workers to provide more services to citizens while reducing operating costs for the county.
Zero Clients are a Complementary Solution

View can be configured for any endpoint, from zero clients to thin clients to traditional desktops. There might be some circumstances in which a zero client-only environment is not ideal. For example, in an environment where real-time audio-video or multimedia redirection capabilities are crucial, a thin client or software client could provide these features. In addition, zero clients do not fit the needs of BYOD (Bring Your Own Device) implementations. Thin clients and software clients with View make BYOD possible with VDI.

IT administrators can select the ideal endpoint devices for their particular installation requirements, based on each device’s specific capabilities, benefits, and advantages. While thin clients or full View software clients offer flexibility, zero clients offer strong security, consistent performance, and ease of management. This section addresses some features that might be better suited for a thin client or software client environment.

Real-Time Audio-Video

Zero clients are capable of supporting real-time audio devices like headsets and microphones with applications running inside View desktops. However, the ability to utilize webcams and rich video applications such as Skype, Google Talk, and WebEx from within virtual desktops requires Real-Time Audio-Video (RTAV) support, which is available on View software clients, on Windows, Linux, and Mac OS. For more information on RTAV in View, see Real-Time Audio-Video (RTAV) for Horizon View, Part 3.

Multimedia Redirection

Multimedia redirection (MMR) provides a better user experience for video viewing, particularly for users on a WAN, and reduces network bandwidth consumption. MMR redirects the media stream in its native bit rate to the client endpoint for media processing and rendering. This local multimedia decoding requires the View software client and at least the View 5.3 Feature Pack 1. If this feature is important for your organization, see VMware Horizon with View Feature Pack Installation and Administration.

Unified Communications Integration with Avaya, Cisco, Microsoft, and Mitel

Organizations that require enterprise-grade unified communications (UC) support for virtual desktops can acquire it with View on Windows-embedded thin clients. VMware has collaborated with vendors such as Avaya, Cisco, Microsoft, and Mitel to deliver this capability with full support for VoIP and video chat. Partner-provided plug-ins for View software clients offload the data center server by performing all media processing of audio and video on the client endpoint. For more information on unified communications in View, see the Business Process Desktop.

For organizations that are considering zero clients as endpoints, a UC solution is available that extends voice, instant messaging, presence, and address integration capabilities. The VoIP UC solution on Tera2 PCoIP zero clients works with the CounterPath Bria Virtualized Edition Softphone. Bria is a standards-based softphone that interoperates across a broad range of SIP-compliant network equipment providers including Alcatel-Lucent, Avaya, Broadsoft, Cisco, Metaswitch Networks, and Mitel. Voice traffic is routed from the zero client directly to the endpoint, avoiding the “hair-pinning” effect of routing VoIP media traffic through the data center. By offloading the media handling from the data center servers and pushing this function to the endpoints, the virtualized servers can scale to hundreds or thousands of users to facilitate communications.
Conclusion

The decision to virtualize the workplace is not always a simple one. It represents a departure from the PC-centric mindset that has been prevalent in business for the past 30 years, and a move toward a more user-centric model. Many different variables must be considered. When customers choose a client, they must consider the use cases their employees have not only today, but also a few years in the future.

The solution and examples presented illustrate that choosing a zero client environment will reap many benefits. Zero clients require very little ongoing maintenance, and provide the highest security. A zero client environment delivers a desktop virtualization solution that has excellent host-rendering capabilities, and provides a consistent user experience across the broadest set of network conditions. It is the combination of zero client features—no maintenance, security, rapid deployment, and low TCO—that distinguishes zero clients as important players in VDI.

PCoIP zero clients provide a highly secure, powerful, low-maintenance, high-quality end-user experience for a wide variety of VDI needs. With the Teradici PCoIP technology, the power of data center resources is harnessed for fast, efficient transfer of information. Data is centrally managed and protected within the data center. Sensitive information is protected from data loss resulting from theft, viruses, or hardware failure. PCoIP zero clients render pixels only at the endpoint display. The security and efficiency of zero clients makes them an ideal choice for enterprise VDI solutions.

Additional Resources

Case Study: Government of Hamilton County, Indiana
Case Study: Lower Cape Fear Hospice & LifeCareCenter
Case Study: North Kansas City Hospital
Case Study: Thomas Jefferson School of Law
Closing the Digital Divide in Education with VMware Horizon View and Teradici PCoIP Zero Clients
Desktop Virtualization with VMware View 5 Compared to Citrix XenDesktop 5.5
Gartner Report Total Cost of Ownership Comparison of PCs with Hosted Virtual Desktops, 2011 Update
Government on the Go: Zero-Client Solutions Get Agencies Up to Speed with Secure, Anywhere Access
VMware Federal Secure Desktop and BYOD: Straight Talk About Security
VMware Federal Secure Desktop Validated Design Guide
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