PCoIP Display Protocol: Information and Scenario-Based Network Sizing Guide

INFORMATION GUIDE

vmware® PCoIP™

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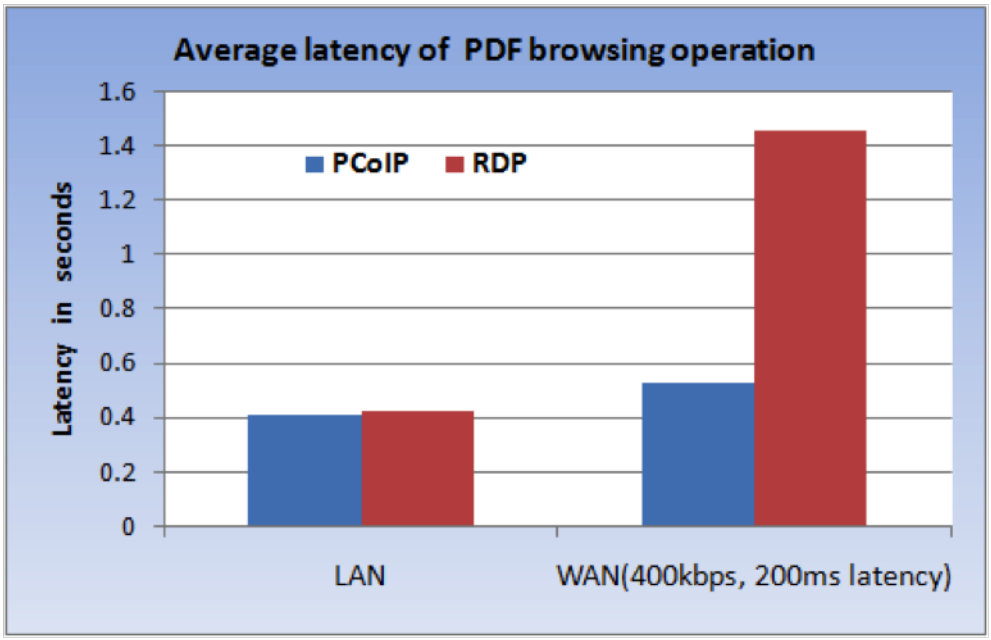
Desktop Virtualization and the Display Protocol

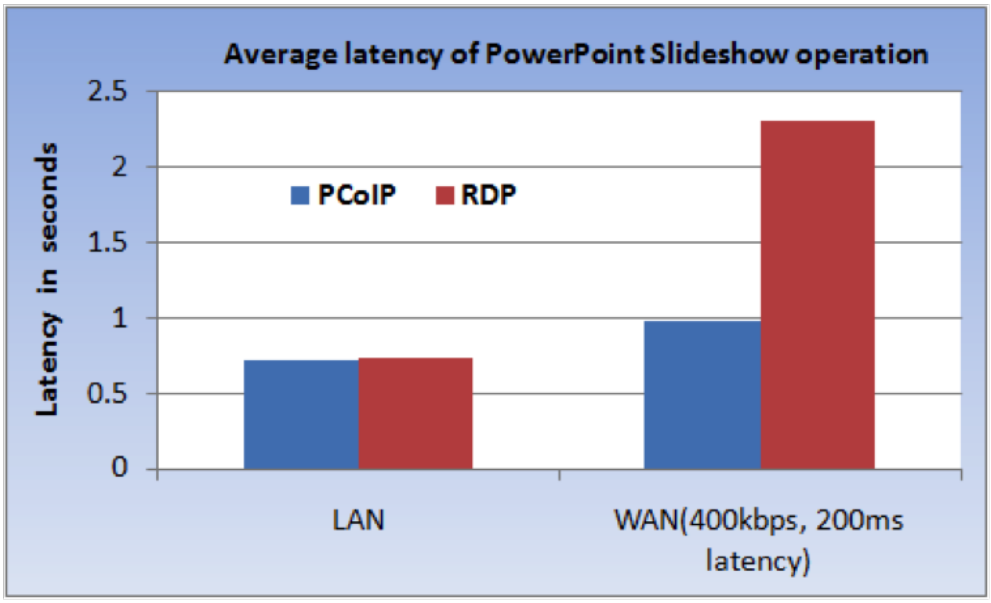
Desktop virtualization aims to reduce the total cost of ownership (TCO) for desktop management, while providing an equivalent or better end-user experience to what is available with a physical PC. The VMware® View™ approach to desktop virtualization includes management of virtual machines both in = the datacenter as well as on local devices through the client virtualization platform.

For desktops hosted in the datacenter, the screen, keyboard, and mouse must be 'displayed' to a remote endpoint. The display protocol performs this function and is one of the primary factors defining the quality of the end-user experience when users perform functions such as moving application windows, scrolling through documents and accessing rich media content. IT organizations have historically faced challenges when using traditional display protocols to try to deliver a full fidelity experience to end-users, therefore reducing the reach and limiting the possible use cases for desktop virtualization. The introduction of VMware View with PCoIP delivers a rich user experience over any IP network—thus addressing more use cases and accelerating the adoption of desktop virtualization solutions.

PCoIP: A Purpose Built Protocol

VMware View with the PCoIP protocol was designed to deliver an uncompromised desktop experience to a broad set of users with a single protocol over the LAN and WAN. To meet this objective, the protocol approaches the task of delivering the virtual desktop differently than other display protocols. The vision from the beginning was to deliver a rich desktop experience, made up of content such as application windows, web pages, graphics, text, streaming video, and audio. To deliver on this vision, PCoIP was architected to recognize different types of content and then use different compression algorithms based on the content type. Recognizing that the desktop is a composite of different content types resulted in a display protocol ideally suited to deliver on the promise of a rich user experience. PCoIP delivers a much-improved experience to end-users accessing virtual desktops across the WAN when compared to legacy display protocols such as RDP. The graphs below compare PCoIP to RDP and show a more than 50 percent reduction in display latency for the common operations of manipulating presentations and scrolling through lengthy PDF documents.





PCoIP: What is Unique?

The software version of the PCoIP protocol with VMware View provides end-users with a dramatic improvement in user experience across a wide variety of tasks and end point locations. The all-software implementation of the PCoIP display protocol is the result of a co-development effort between VMware and Teradici, the primary inventors. VMware View with PCoIP is unique in that it is the only virtual desktop solution with both software, and proven hardware solutions that serve some of the most demanding customer environments. VMware View customers can take advantage of the PCoIP protocol to deliver virtual desktops across the LAN and WAN, for usage scenarios that span from task-based users to designers with demanding 3D requirements. VMware View with PCoIP provides IT organizations with a single point of management and a flexible deployment model to deliver the best user experience and an increased return on investment.

Host-Rendered Pixel Encoding

With PCoIP, all pixels are rendered in the host and encoded in the datacenter. This is a powerful design, because encoded pixels can then simply be broadcast to either the "zero clients" or to the VMware View software client loaded on a PC.

"Host rendering" has several distinct advantages:

- Independence from network latency and bandwidth
- No application dependencies — future applications just work since client-side rendering (which requires specific CODECs) is not needed
- Application performance is not impacted

PCoIP advantages over "client rendered" protocols (HDX/RDP):

- Similar or superior experience over any network
- Always builds to lossless quality
- No application dependencies
- WAN optimizations built into the protocol
- Simple, stateless, secure zero management clients

The Right Algorithms: "Specific Algorithms for Specific Images"

PCoIP is unique because it can apply the right imaging CODECs to the pixels that are intended for a specific graphic image. These graphic images can be an icon on the desktop, text, graphical images, photos, or video. This "intelligent" capability is important because it means that images can be encoded individually, instead of as part of an entire screen image. The benefit is that pixel encoding is optimized for each image type, resulting in superior image quality for the available bandwidth when compared with protocols with only a single imaging CODEC. See Figure 1.

For users, it means the following:

- Every application, whether it uses text, computer graphics, or natural images, will be delivered to the screen with optimal clarity.
- Images always build to "lossless" state, once they stop changing.

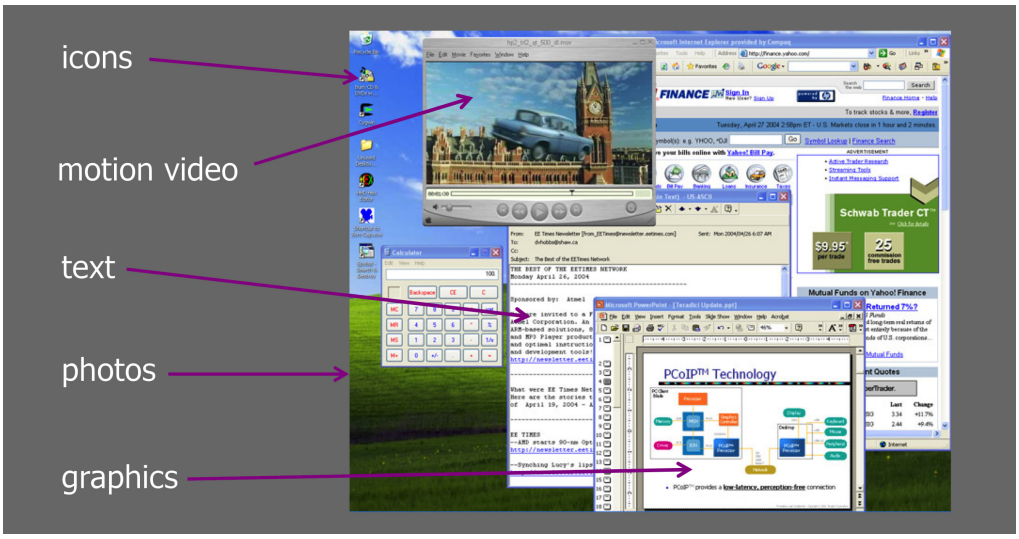


Figure 1. The Right Algorithm for Specific Image Types

Best Experience on the LAN or WAN: "Progressive Build, Dynamic Adaption"

PCoIP uses an encoding approach called "progressive build". Progressive build works to provide the best overall user experience even under constrained network conditions. Progressive build will provide a highly compressed initial image (a "lossy" image) that is then progressively built to a full "lossless" state. A lossless state means that the image appears with the full fidelity intended. On the LAN, text is always displayed using a lossless compression, but if available bandwidth per session drops below 1Mbs, the initial text image will be lossy, followed by a rapid build to lossless. This allows the desktop to remain responsive and display the best possible image during varying network conditions, providing the best possible experience for users. With PCoIP, this functionality is turned "on" by default — the protocol is efficient enough to always offer this important capability. While other protocols, such as HDX (used with XenDesktop) claim to offer a progressive build, it is turned "off" by default because the implementation is not efficient.

Key Attributes of Progressive Build:

- Dynamic image quality adjustment
- Automatically reduces image quality on congested networks
- Responsiveness maintained by reducing screen update latency
- Resumes maximum image quality when no longer congested
- Experience is similar or superior for same network constraints

PCoIP and the Network

PCoIP "dynamically adapts" to varying latency and bandwidth conditions. This means that PCoIP intentionally takes as much bandwidth as is available at a given moment, but as soon as network conditions change (based on factors such as users logging on, logging off, types of applications accessed, and so on), PCoIP will adjust to the amount of bandwidth available, utilize specific algorithms, and still provide the optimal user experience. This dynamic nature means that overall the system is more efficient. With PCoIP, as soon as the user interacts with the display environment, PCoIP knows and directs resources to the application window where the user is working. If the user moves to another window, PCoIP stops rendering the initial window and immediately resources the area of the screen that the user is interacting with.

TCP is used for session establishment and control while UDP can be leveraged for optimal performance of media and streaming content. The PCoIP protocol can tolerate high latency and low bandwidth and still deliver a responsive desktop experience. The adaptive network management functions within the protocol address of quality of service controls and configuration. The display stream is encrypted with 128bit AES and when used in its hardware implementation, can use AES or Salsa20.

The PCoIP protocol has many WAN optimization techniques built into the base protocol. WAN optimization is very valuable for speeding up applications such as Exchange and TCP-based protocols like ICA and RDP. These protocols have a lot of "handshaking" between the client and the server, which can really slow things down when the latency of the "handshakes" gets to be large, as they often do on a WAN. WAN accelerators help this problem by "spoofing" replies to the handshakes so that the latency of the network is hidden from the protocol. Because the PCoIP protocol is UDP-based, this form of WAN acceleration is unnecessary. WAN accelerators also compress the network traffic between the client and the server. This compression must be lossless compression, so is typically limited to 2:1 compression ratios. Even at 2:1 compression, this allows the data to be delivered in half the time over a constrained WAN so it is still valuable. However, the PCoIP protocol is able to use lossy compression on images and audio when the network is constrained. Lossy compression can exceed 100:1 compression ratios, providing significantly more acceleration of WAN traffic than 2:1 compression can.

So on the LAN, the strategy is to present "lossless" images, and adjust to network conditions ("good citizen" on the network).

On the WAN, the strategy is to render to lossless, bring just enough quickly, decouple text from images and bring the text as soon as possible to provide a compelling user experience. Users can work from home or remote offices. It now becomes much easier to establish a business continuity plan. It becomes much easier to meet security and compliance requirements since the data and applications never leave your data center.

The PCoIP End-User Experience

The PCoIP protocol allows IT organizations to present a rich desktop experience to the end-user, which makes use of multiple monitors, audio, video, and local peripherals. The following features characterize this experience:

- True Multi-Monitor support — up to 1920 x 1200 resolution, clear-type fonts, and 32bit color per monitor for up to 4 monitors.
- Auto Display scaling, dynamic resizing, and support of monitor pivoting to accommodate users who continue their session between machines with different monitor set-ups.
- Multimedia redirection for content in WMV, WMA, AC3, MP3, MPG-1, MPG-2, and MPG-4-part2.
- USB support for Human Interface Devices (HID), Mass Storage Devices, printers, scanners, and isochronous devices.
- Support for host-based rendering of Flash with administrative controls for quality and bandwidth consumption.
- Bi-directional audio of recording quality for dictation or transcription needs.

Flexible Deployment with Both Software and Hardware Options

With VMware View and PCoIP, customers can choose the client deployment option that best suits their users. For example, 3D designers have demanding requirements for a productive desktop environment, while the task user (based on applications, number of displays, and so on) is less demanding.

For the power user, customers can choose a hardware enabled PCoIP desktop device to connect to a blade workstation. For the task worker, the software based PCoIP client (loaded on a desktop or laptop), or the Teradici hardware enabled client (a "zero client") can connect to a virtual desktop. VMware View provides customers the capability to pair the demands of users with a range of software or hardware options on both the client and server. See Figure 2 for deployment options.

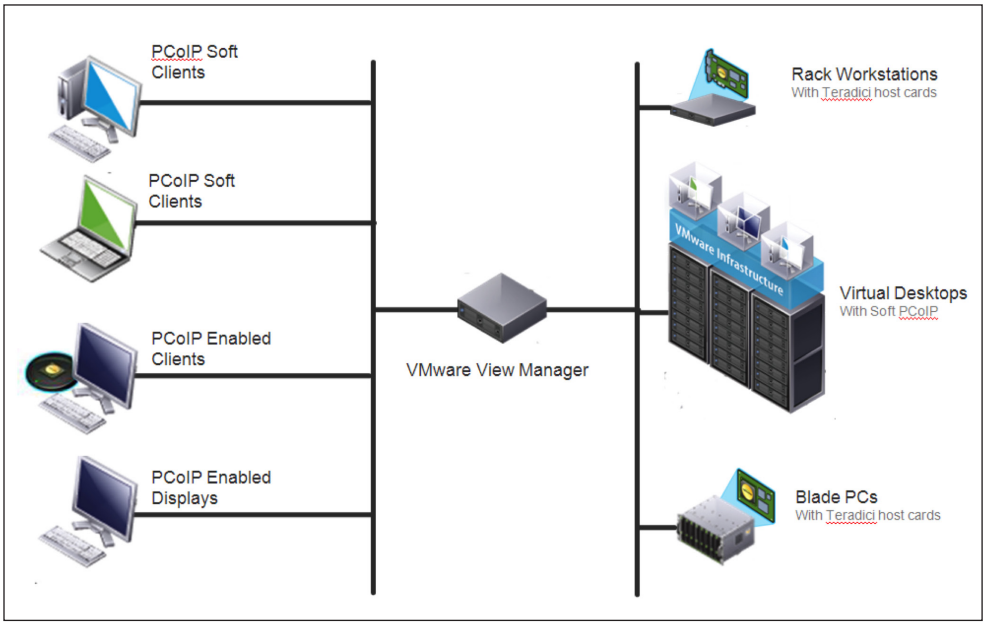


Figure 2. Flexible Deployment with PCoIP

Figure 3 illustrates a potential healthcare deployment in which the same "zero client" device in a hospital room can be used by anyone in the hospital, from an administrator to a radiologist, with the VMware View manager brokering the connection between the "zero client" and the appropriate workstation or virtual desktop in the datacenter.

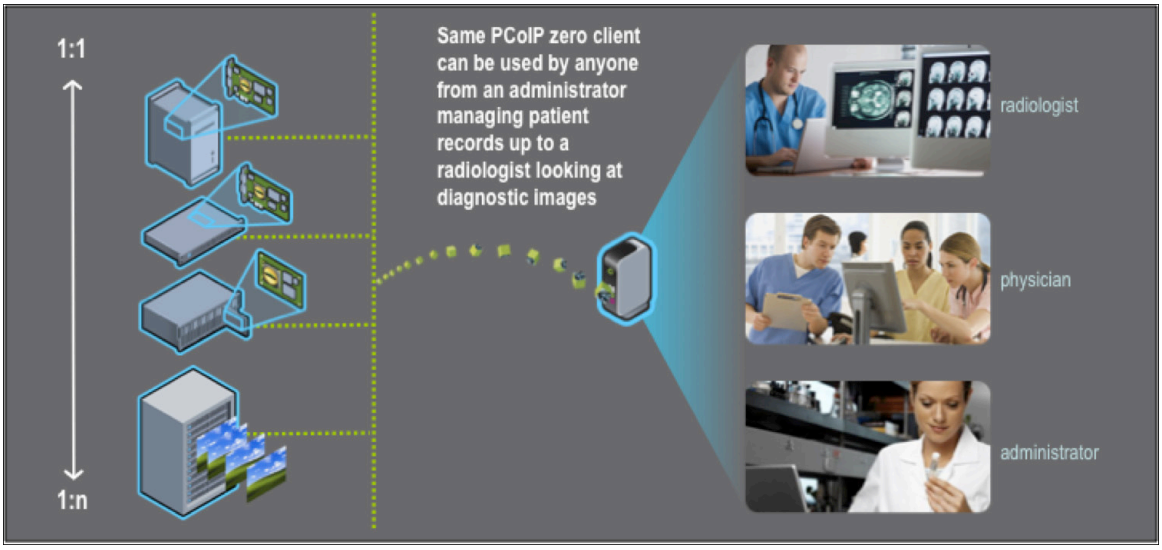


Figure 3. Example of a Healthcare Deployment using VMware View Manager

PCoIP and Endpoints: The Importance of the "Zero Client"

VMware View will support both software enabled (the VMware View client) devices (PCs, laptops, netbooks, thin clients), and Teradici hardware based endpoints. The Teradici hardware based end-points are known as "zero clients" – called such because they have no Windows or Linux operating system (OS) resident. Zero clients have several significant advantages:

- No OS patches needed
- No anti-virus, anti-spyware required
- No local device drivers
- Long life cycle
- Reduced number of devices on the desktop (in the case of the flat panel zero client)

These benefits are important because they lead to simpler deployments and lower cost of ownership.

Zero clients come in two basic designs: integrated into a flat panel display, and a version that looks like a thin client and drives external monitors.

See a dynamic updated list of the supported HCL for VMware View at:

http://www.vmware.com/resources/compatibility/search.php

See a list of OEMs with PCoIP enabled devices at:

http://www.teradici.com/pcoip/pcoip-products/oem-solutions.php

Scenario Based Network Sizing Guidance

This section provides some typical scenarios to explain bandwidth characteristics of PCoIP. These should be considered "guidance only", as every customer scenario requires analysis of the many variables that impact network sizing. It is also important to note that these scenarios map to active concurrent users as opposed to the total number of users. The reason for this is that an idle desktop connection uses a negligible amount of bandwidth when not being utilized.

Scenario 1: "Work from Home"
Assumptions: One user with dedicated Cable or DSL connection with 4-8Mb download and less than 300ms latency

- Two monitors 1920x1080
- Typical Microsoft Office applications
- Light usage of Flash embedded web browsing
- Periodic usage of multimedia
- Light printing needs with locally connected USB printer

Guidance:

Dedicated WAN connections even with moderate latency will provide excellent performance for a single user. There is a strong case for Work from Home and Telecommunicating use cases with VMware View desktops.

Scenario 2: "Road Warrior"
Assumptions: One user with dedicated 3G connection with 3-500Kb download and less than 300ms latency

- Single monitor
- Typical Microsoft Office applications
- Light usage of Flash embedded web browsing
- Light printing needs with locally connected USB printer

Guidance:

A WAN 3G connection provides adequate bandwidth and tolerable latency to deliver an acceptable user experience that maps to the 'mobility' use case. End-users should be trained to use local applications to access multimedia content.

Scenario 3: "ROBO with T1"
Assumptions: T1 connection with 1.54Mb download and less than 300ms latency

- Single monitor, 1920x1080 resolution
- Typical Microsoft Office applications
- Light usage of Flash embedded web browsing
- No multimedia
- Network-based printing

Guidance:

VMware View desktops accessed over a shared branch or remote office WAN can perform poorly without network management that limits multimedia and peripheral use, and that manages print traffic. It is important to either provide adequate bandwidth or restrict the types of content accessed via the desktop. It is also important to optimize the desktop image per recommendations given in the "XP Deployment Guide". Given the assumptions above, a T1 will provide acceptable performance for 3-5 concurrent users.

Scenario 4: "Branch with Site-to-Site VPN"
Assumptions: 20Mb dedicated site-to-site VPN with less than 200ms latency, MPLS

- Two monitors, 1920x1080
- Typical Microsoft Office applications
- Light multimedia usage of Flash content
- Light printing needs with locally connected USB printer

Guidance:

Most branch offices with a substantial dedicated network link make use of site-to-site VPNs. As PCoIP is a UDP-based display protocol, performance will be most consistent when the VPN link is also UDP-based. In terms of guidance for numbers of active users, a good rule of thumb is three users per 1Mb. This allows for variance in the display activity between multiple users and provides a range of bandwidth most likely to provide acceptable performance for users.

Scenario 5: "Enterprise LAN"
Assumptions: Full LAN with 100Mb or 1Gb switched network

- Two monitors 1920x1080
- Heavy use of Microsoft Office applications
- Heavy use of Flash embedded web browsing
- Frequent use of multimedia with limited use of full screen mode
- Frequent use of USB based peripherals
- Network based printing

Guidance:

Customers with a PC replacement objective can utilize LAN based deployments of VMware View desktops that offer full functionality and multimedia experience. It is important to point out the significance of governing multimedia usage, as this function will predictably consume 1Mb of bandwidth per active user. The number of active users and the amount of multimedia are the two primary factors that will affect performance on a given LAN segment. The capacity of a LAN based environment will be determined by the core switching and routing infrastructure.

About The Author

Aaron Black is a Senior Technical Marketing Manager at VMware. In this role, his primary focus is to develop technical content to aid in evaluation and implementation of VMware desktop and application virtualization technology. Aaron's background includes roles as a systems engineer and solutions consultant in the Technical Services organization. His previous positions include systems engineer with Citrix Systems, leading a technical corporate IT team at Sprint, and solutions design for customers of Choice Solutions, a platinum reseller of VMware products.

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