



PHILIPS

IntelliSite

Pathology Solution

Whitepaper Pathology Remote Viewing IT requirements

Hardware and software prerequisites for optimal connectivity and usage of Philips IntelliSite Pathology Solution

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1 Management summary

By digitizing images that pathologists normally view through a microscope, Philips aims to offer integrated solutions that help to enhance the operational efficiency and productivity of pathology departments.

The Philips IntelliSite Pathology Solution platform, which is an automated digital slide creation, management, viewing and analysis system is designed to meet the needs of high volume labs and expand to create virtual networks across multiple labs. Distributing scans instead of samples can simplify the pooling of knowledge of highly specialized pathologists in different locations. It can also remove logistics and difficulties related to inter-lab distribution and retrieval of specimens. However, to make the most of these benefits and offer an opportunity to improve user experience and workflow, the network must be optimized for this application. This has consequences for the hospital IT infrastructure and client side infrastructure. The adaptations, if any are required, are relatively minor and will have no far-reaching consequences for network infrastructure. Data safety is also guaranteed at all times.

This whitepaper, provides a description of the solution workflow, hardware and software components and the most common requirements and guidelines, across different topologies, with regard to:

- Network and device specifications
- Providing sufficient network capacity at the central hosting location, VPN gateway and client site

- Configuring HTTPS as a business critical application to connect to the IMS application server
- Configuring the VPN client to allow IMS client / server communication
- Elements that affect performance: from firewalls to virus scanners and cabling
- Secure Internet DNS implementation to prevent DNS time-outs
- An overview and explanation of the factors affecting network performance
- Philips Digital Pathology Solutions will assist customers during the project assessment and implementation to help meet the network requirements for deployment and Intended Use.

Potential benefits obtained by digitizing slides

- Case distribution and workload balancing
- Turn-around time
- Reduced courier costs
- Research, education and collaboration
- Access to digitally stored archives
- Image analyse tools available

Source: The U.S. Anatomic Pathology Market 2011

2 Introduction

The Philips IntelliSite Pathology Solution is an automated, integrated digital slide creation, management, viewing and analysis system. It enables digitization of pathology specimens and secure digital distribution of high-quality scans across multiple sites. In this way, utilizing the knowledge and resources of highly specialized pathologists with specific areas of expertise, becomes easier. This approach also removes logistics and difficulties related to inter-lab distribution and retrieval of specimens. Full integration with patient information and administrative systems makes the process even more efficient.



Specimens are scanned in batches using the Philips Ultra Fast Scanner (UFS). The resulting images can be viewed and evaluated / read on a screen, with bespoke IMS software. Scans are assigned to appropriate pathologists, with specific areas of expertise. Each file is tagged with all the relevant patient data and linked to relevant additional information and notes. The pathologist is assigned a caseload by the case administrator. He/she logs on to the Philips Image Management System (IMS) website and sees his/her case list with images, which he/she can analyze, along with related patient data and notes from the pathologist who sent the scan.

The aim is that with digital pathology throughput times, and the time during which need to be wait for a result may become significantly shorter. Around the world, medical institutions are looking for ways of improving quality whilst cutting cost. The Philips IntelliSite Pathology Solution is developed to provide support in doing so. However, this solution implies specific requirements for the communications network and

infrastructure. If these are not met, the system performance quality, ease of workflow and speed can vary. Errors can be the result of physical problems or data having to travel long distances across the network, but may also, for example, be the result of firewall and system configuration settings or issues with the provider.

For an optimal user experience and full functionality the network must be optimized for this application, and firewalls configured accordingly, freeing up https ports. There should be adequate network capacity and sufficient redundancy, based on usage patterns, and a maximum number of possible (simultaneous) users. In this document we have listed a number of practical requirements, based on practical usage, which will result in safe, rapid, error-free and user friendly operation. A dedicated model and specifications describe how to achieve optimum performance when using the system on a hospital campus, over a high-speed network. Adhering to these models avoid latency, loss of connections and system errors.

Why this document?

This document has been created to support network related discussions between labs, hospital departments and IT professionals. It should be noted that this document focuses on internal and external (internet-facilitated) collaboration usage with multiple user locations. We can discern two client/usage types. Broadly speaking, one has a strong internal focus, and is more research-oriented. The solution can be used over the internal LAN networks which this group typically uses. Setting this up is fairly straightforward. A 1 Gb/s connected server and 100Mb/s client connection will work perfectly.

The other user type relies on licensing and external partners in SOHO-type settings. Regional panels consisting of multiple pathologists, for example, who peer review each other's work. For this group, we have developed the DMZ system, which is accessible through the internet. Remote users are a different story. When you have a wide dispersion of pathologists across the hospital site, or when they are working from home or

remote locations, the network topology changes. Often, home office connections run through a consumer-grade network. In short: a poor quality network means delays. Bandwidth is usually between 20-100 Mb/s, which is also dependent on the number of simultaneous users. When working from home, latency can be caused by oversubscription. Furthermore, these networks are generally not symmetrical, and upload speeds are significantly lower than downloads. This means that the network at the hospital end must be of the highest quality and carefully configured for this application.

Hospital IT policies understandably emphasize patient data security and prefer to keep their networks as 'closed' as possible'. Philips can provide assessments, depending on how extensive the network is, to find the optimal balance between maintaining security and guaranteeing a positive user experience

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A closer look at the Image Management System

How does it work?

The solution is a platform based on the Philips Ultra Fast Scanner (UFS) - and the Philips Image Management System (IMS). The UFS is responsible for the acquisition of image data and the IMS for storage, retrieval, archiving and management of the Whole Slide Images (WSI). It also links slides to the corresponding cases, patient data and notes. The IMS deploys the IMS web-based client - the application for users to interact with the IMS application server. This client allows viewing, including functions such as panning and zooming, sharing taking measurements, creating annotations and bookmarking of the presentation states of the WSI. The Philips IMS Viewer guides the user through the steps of the workflow using task-oriented pages.

The IMS web client uses HTTPS* to connect to the IMS application server. This guarantees confidentiality and integrity of the transmitted information that meet privacy laws and regulations requirements. Performance of the Philips IMS web client plays a very important role in the entire user experience. Below, we will describe the characteristics of the Philips IMS web client, allowing customers to take the network requirements into account when implementing the Philips Digital Pathology Solution.

IMS application characteristics

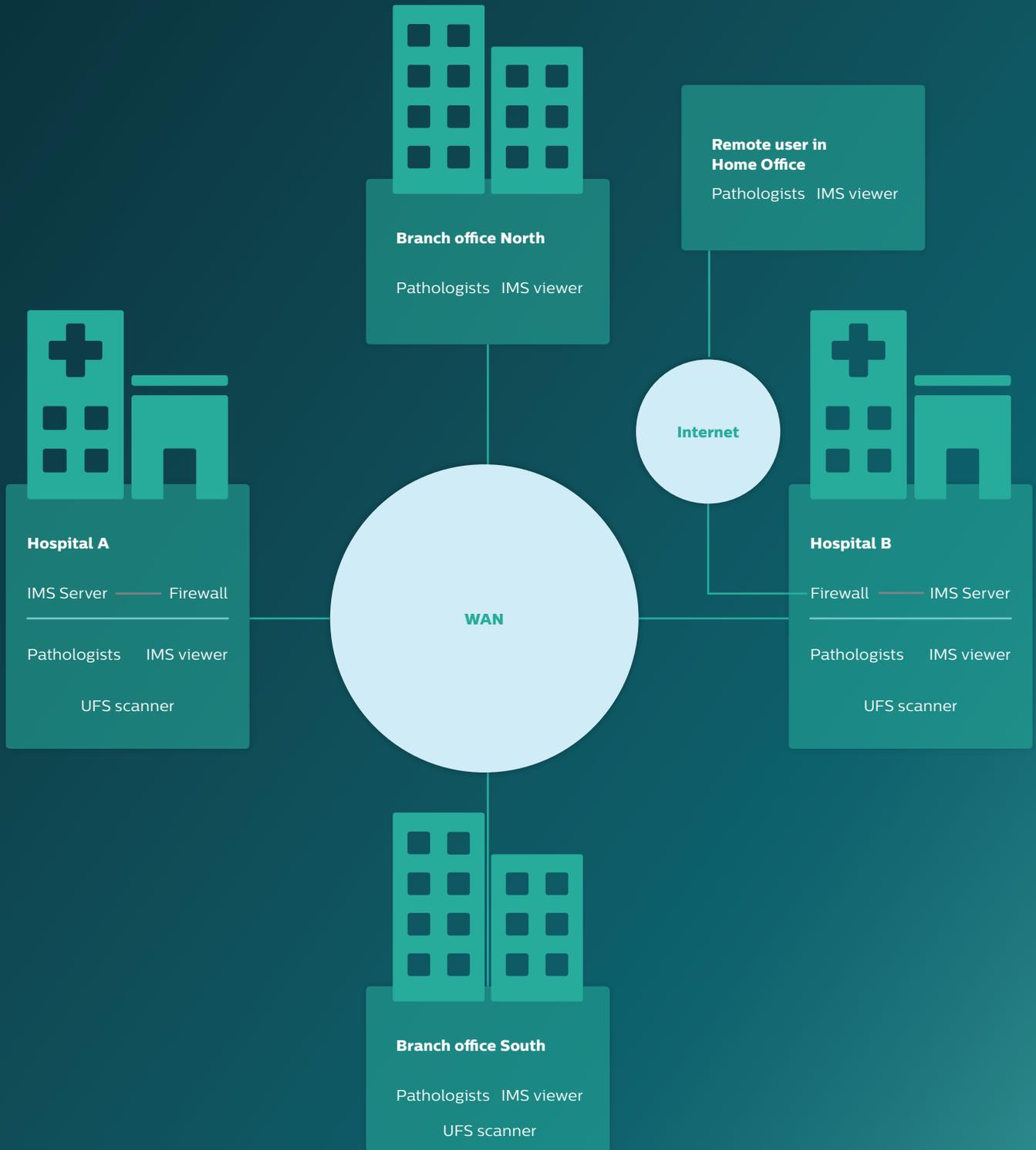
A pathologist who has been assigned a case through integration with the Laboratory Information System, (LIS) can view the entire slide image, which presents tissue as scanned by the Philips Ultra Fast Scanner (UFS). Bandwidth, latency and 'backup logs' are vital to maintaining the high image quality which is required for diagnostics. Every time the pathologist zooms or pans, the workstation screen needs to be refreshed and the demanding application settings required to do this can affect system performance and network requirements.

As a workaround for this on slower systems or during peak data traffic times, users are offered a choice of two compression settings: 'Compression level 1' - which has higher network requirements - and 'Compressed', with lower network

requirements. These settings can be configured by the application user, or determined at server level. When a user is viewing in the 'degraded' performance mode, this is clearly indicated on the screen. This is especially important as tissue scan viewing must be carried out in line with a number of legal and compliance requirements.

Updating the monitor requires data to be sent from the IMS server to the IMS web client. In a typical scenario, the pathologist will start to view the image at 10x magnification and will increase to 20x or 40x for regions of interest. This panning and zooming will require ongoing image updates on the monitor of the pathologist workstation, requiring uninterrupted data to flow from the IMS server to the IMS client. For a smooth viewing experience when viewing in highest quality the network requirement is 40 Mb/s. For Compressed viewing quality, this is 10 Mb/s. When a pathologist is not viewing slides, for example whilst writing notes, data flow between server and client is minimal. For each implementation of the Philips Digital Pathology Solution, the effective network capacity and quality requirements are determined by the workflow, the number of pathologists and the number of slides.

* Secure HTTP, the standard protocol for secure access to web applications



Capacity issues, latency and packet loss may all have an impact on the performance of the IMS web client. Also, the network topology and quality play a major part in determining the IMS viewing performance level. What steps does an IT department need to take to ensure that the network configuration provides an optimal deployment and performance for the Philips IMS application? We will discuss these items below. (For an explanation and definition of these elements, please turn to the chapter 'Network performance explained' at the back of this document.)

IMS deployments

The Philips Image Management System (IMS) can be deployed in a single site or across multiple sites within the same network, allowing access from all locations. Users can connect to the IMS application through a LAN, WAN, Internet VPN or direct Internet connection. Deployments on Internet are optional.

Multisite deployment: working with the Philips IMS application using a WAN and Internet topology

Before using the solution, it is important to check whether all the software elements are available/compatible with your system, and whether the latest updates and patches have been installed. The IMS application server software runs on Windows Server platform and the Microsoft Internet Information Server (IIS) is used to host web-based application services. For secure transmission Philips use the HTTPS protocol which includes TLS encryption via a X.509 server certificate. The web client is downloaded and installed automatically during the first logon. The web client is using Microsoft Silverlight technology which is available as an add-on for all major web browsers. Web browser communication and web security settings also affect the IMS web application.

A closer look at usage across topologies

LAN

In a LAN topology all users have a high speed wired connection of 100 Mb/s or 1 Gb/s. A wired network provides the best quality; a wireless network is an extension of the LAN. The wireless part of the network is shared by multiple users, which means wireless network capacity will typically be between 10 and 50 Mb/s, depending on the number of users. Latency and packet loss will be higher than over a LAN. For a good performance the IT department needs to ensure the network speed per client system meets the minimum requirements for your Intended Use / image viewing quality. A 1 Gb/s connection is advised.

WAN

When multiple sites are interconnected the topology is referred to as a Wide Area Network (WAN). Pathologists located at the remote

branch offices are using the Philips IMS located in the datacenter at the main location. A WAN connection is provided by a single provider and typically has a capacity between 2 and 50 Mb/s for small to medium sites and between 50 and 200 Mb/s for the main location where the servers are located. Latency for continental connections can be between 20 and 60 ms or up to 250 ms for intercontinental connections. See below for an overview of the Philips IMS in a WAN topology.

WAN connection between IMS client and server

This figure shows that there is greater distance between client and server and more active network components are involved. This will affect capacity, latency and packet loss values.

Internet

When using the solution across the Internet, latency, packet loss and the number of 'hops' between networks can be substantially higher than in a WAN topology. Multiple telecom operators and network exchanges may be required to create the interconnected network and end-to-end capacity or Quality of Service cannot be guaranteed. Each interconnection between operators may lead to network congestion and introduce higher latency and packet loss. Https can be placed in a higher cue position, ensuring the data has greater priority. Companies which already use a number of web-based applications will probably already have this configured on the client side.

Internet connection between IMS client and server.

Home Office and VPN over Internet

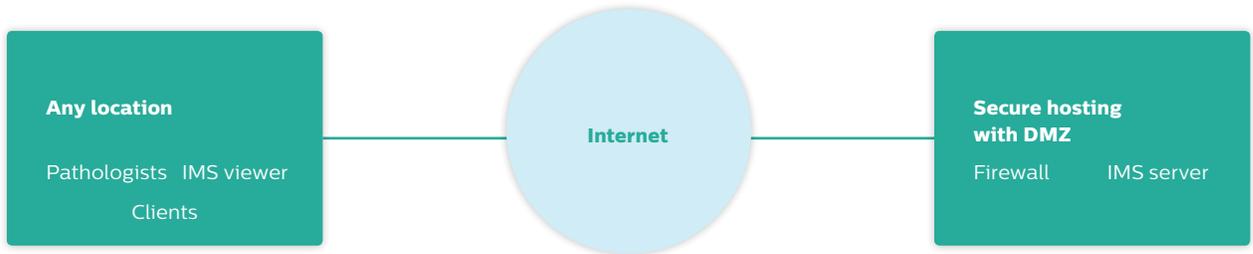
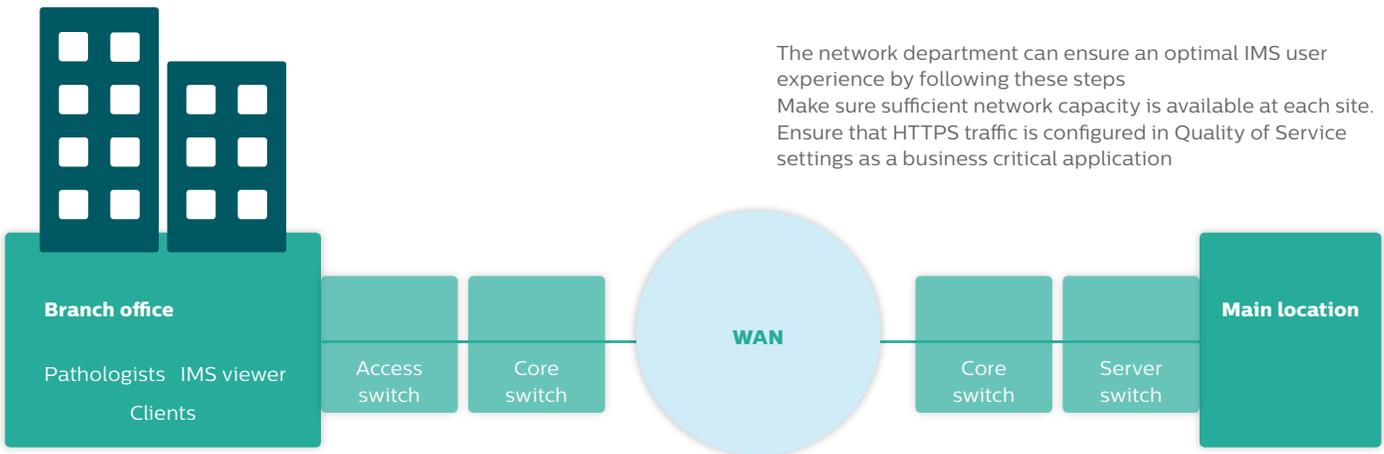
Working from home introduces a number of components that may influence the IMS user experience. The connection at home is provided by an Internet Service Provider (ISP) and will most likely be a consumer-grade connection with a pre-specified upstream/downstream capacity (e.g. up 4 Mb/s / down 50 Mb/s). Its inherent

oversubscription means that the physical network capacity provided by the ISP will be shared by many customers, which can reduce the available bandwidth and introduce packet loss and higher latency. In addition, ISPs interconnect their networks with a fixed capacity, and that can also cause network congestion.

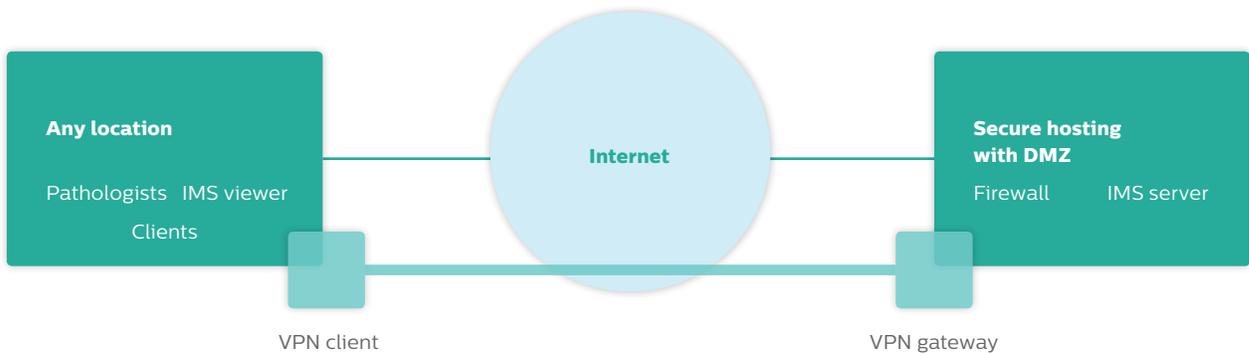
For secure remote access to applications hosted in the hospital network, a Virtual Private Network (VPN) connection is used. A VPN connection is created between the client workstation and a VPN gateway located in the hospital network. A VPN gateway is typically located in the Demilitarized Zone (DMZ) which protects the hospital network and applications from Internet threats. A VPN connection adds security by authenticating the remote user and by encrypting the network connection. This added security will cause additional latencies or impact available capacity.

Internet connection with secure VPN between IMS client and server. The user is authenticated on the workstation, and uses a VPN client to obtain a 'secure tunnel' over the Internet to the VPN gateway.

The network department can ensure an optimal IMS user experience by following these steps
 Make sure sufficient network capacity is available at each site.
 Ensure that HTTPS traffic is configured in Quality of Service settings as a business critical application



The network department can ensure an optimal IMS user experience by following these steps, as an extension to the previously mentioned steps for Internet hosting
 Make sure sufficient capacity is available on the VPN gateway (network capacity, CPU and number of connections)
 Ensure that the VPN client is configured to allow IMS client / server communication



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Summary of network requirements

For a good Philips IMS Application user experience, requirements given in table 1 should be met:

Description	Requirement
Network speed on IMS server	1 or 10 Gb/s
Network capacity per client	
• High Quality viewing quality	40 Mb/s, average data flow from server to client
• Compressed viewing quality	10 Mb/s, average data flow from server to client
Latency	As low as possible, advised between 1 and 60 ms
Number of network hops	As low as possible, advised maximum is 12 hops

Network capacity

For clarification, we will calculate the network capacity requirements for four typical usage scenarios:

Cases	Network Capacity Requirement
Case 1	
High Quality viewing setting	Branch office incoming: $40 \text{ Mb/s} \times 10 \times 0.2 = 80 \text{ Mb/s}$
10 pathologists in one branch office	Main site outgoing: 80 Mb/s
Concurrent usage is 20%	
Case 2	
High Quality viewing setting	Branch office incoming: $40 \text{ Mb/s} \times 5 \times 0.3 = 67 \text{ Mb/s}$
5 pathologists in each branch office	Main site outgoing: 100 Mb/s
4 branch offices	
Concurrent usage is 30%	
Case 3	
Compressed viewing setting	Home office incoming: 10 Mb/s
10 pathologists working from home	Central Internet connection outgoing:
Concurrent usage is 20%	• $10 \text{ Mb/s} \times 10 \times 0.2 = 20 \text{ Mb/s}$
Case 4	
Compressed viewing setting	Home office incoming: 10 Mb/s
40 pathologists working from home	Central Internet connection outgoing:
Concurrent usage is 40%	• $10 \text{ Mb/s} \times 40 \times 0.4 = 100 \text{ Mb/s}$

5 Addendum

Network performance explained

Network capacity is expressed in Megabits per second (Mb/s) or Gigabit per second (Gb/s). Typical network speeds for a Local Area Network (LAN) are 10/100 Mb/s or 1/10 Gb/s. In a Wide Area Network (WAN) speeds can range from 2 to 200 Mb/s. Internet connection speeds can be anything between 10 and 100 Mb/s for domestic locations or between 10 Mb/s and 1 Gb/s for business locations.

Latency is the delay in milliseconds (ms) between client and server. This delay is the result of three key factors. It takes time for a signal to travel the distance between client and server. Over a fibre network, signals travel at the speed of light. Therefore: the greater the distance between two points the longer it takes for signals to travel from origin to destination.

The second cause of latency is network components. These components can be network interfaces, switches or routers that route IP packets from one network to another. Each network 'hop' might require a few milliseconds of processing. This adds delay to the network connection. The third element is security measures such as firewalls and encryption. It takes time to verify and secure each connection.

Packet loss can be caused by any component in the end-to-end network infrastructure. Packet loss occurs whenever data sent across a network is dropped, for example because a buffer on a network port is full or a faulty cable has been used.

Like to know more?

Would you like to know more about the integrated pathology solution, or discover how this solution might benefit your organization? Feel free to get in touch.

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