PathNavigator™ Deployment Guide

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POLYCOM®

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Introduction

The purpose of this guide is to describe the PathNavigator™ deployment architectures. PathNavigator is a Call Processing Server (CPS) for multimedia communications, primarily video communications. A CPS is a routing engine and management sub-system. PathNavigator is used to manage the call sessions between terminals, multipoint control units (MCU), and Gateways (GW); using both the H.323 and H.320 ITU communication protocols. PathNavigator is also used for generic tasks typically associated with H.323 Gatekeepers, such as name resolution, provisioning, and bandwidth policy management. Additionally, PathNavigator contains tools to aid in the accelerated deployment of video terminals, throughout your network.

PathNavigator is licensed based on the number of call sessions and registrants being managed. There are three different license configurations (see Table 1).

The number of registrants is the maximum number of terminals that a PathNavigator can have registered to it at one time. The number of call sessions represents the maximum number of calls that can be managed at one time. A call is the connection of two endpoints for the purpose of communication; endpoints can be terminals, MCU ports, or GW ports. As an example, a multipoint call to three other sites from ViewStation MP will use three sessions to connect those four endpoints.

The 100 and 500 pack licenses are additive; they can be added to current installations to permit growth inside the enterprise up to a maximum of 3000 registrants.

Table 1. PathNavigator Configuration/License Options

PathNavigator License Pack	Maximum Number of Registrants	Maximum Number of Call Sessions	List Price
25	25	12	$4,999
100	100	30	$9,999
500	500	150	$24,999
3000	3000	600	$49,999

Best Practices

Before we begin our discussion of CPS architectures, let us first review the basic minimum requirements of IP multimedia communications.

Polycom recommends the following as best practices when deploying Polycom IP voice and video applications.

1. When considering the deployment of video conferencing applications, understand that latency, jitter, and packet loss are obstacles to high quality audio and video.
   a. Latency should be less than 150 ms in one direction or 300 ms end to end.
   b. Jitter should be held to less than 50 ms.
   c. There should be no more than 1% packet loss.

2. Be sure to meet the minimum server hardware requirements of all software-based products.

3. Building an end-to-end H.323 video network requires an infrastructure based on layer 2 and layer 3 switches and routers.

4. When considering the deployment of multimedia communication applications, ensure that switches and routers can handle more than one class of service, i.e., has more than one queue and is enabled to process applications with different requirements relating to latency, jitter, and loss characteristics.

5. Polycom systems can set the precedence bit for use in Quality of Service (QoS) enable networks. Precedence bit five is the default (critical).

   a. Caution: All IP routing protocols use IP Precedence bit 6 by default. IP Precedence 7 also is reserved for network traffic control. IP Precedence bits 6 and 7 are not recommended for user traffic.

   b. Note: Because diffserv code point (DSCP) field definitions were not clearly defined until recently, the diffserv architecture was initially supported using the 3-bit IP Precedence field. Cisco IOS is fully aligned with the diffserv architecture and provides all network edge and core QoS functions based on the 3-bit IP Precedence field.

Always consider the total amount of bandwidth associated with video sessions prior to deployment. Once this figure is known, a network administrator has a better ability to architect a solution appropriate to the usage level required. The formula is: Video bandwidth + Audio bandwidth * 20% {for IP protocol overhead}. See Table 2.

Table 2. Actual Bandwidth Consumption

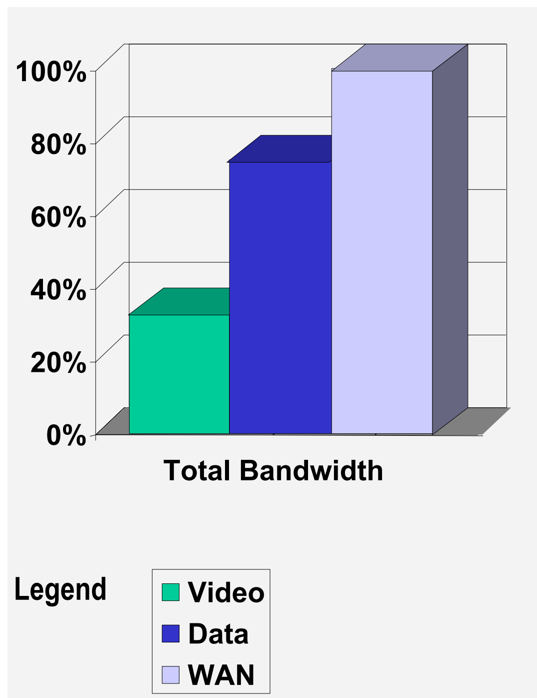
IP Dialing Speed	Actual Network Bandwidth Required
128 Kbps	153 Kbps
384 Kbps	460 Kbps
512 Kbps	614 Kbps
768 Kbps	921 Kbps
1.5 Mbps	1.8 Mbps

7. It is recommended that all H.323 video endpoints, CPSs, GWs, and MCUs be connected to a dedicated 10/100 switched-Ethernet port.
   - Older Polycom ViewStations and the RADVision MCUs and GWs both support 10 Mbps half duplex only.

There are known issues with some older Cisco Catalyst 10/100 switches and video endpoints negotiating half/ full duplex. If the negotiation fails, the endpoint will still function, but the system will experience video freezing every three to five seconds.

8. Use the following guidelines for WAN link capacity planning.
   a. Never use more than 75% of WAN bandwidth for applications traffic.
   b. Leave 25% for routing, keep-alives, email, and HTTP.
   c. Video applications should consume no more than 33% of total WAN bandwidth.

Figure 1. Network Bandwidth Allocation



Deployment Architectures

The deployment architectures of CPSs like PathNavigator can be categorized into four basic categories:

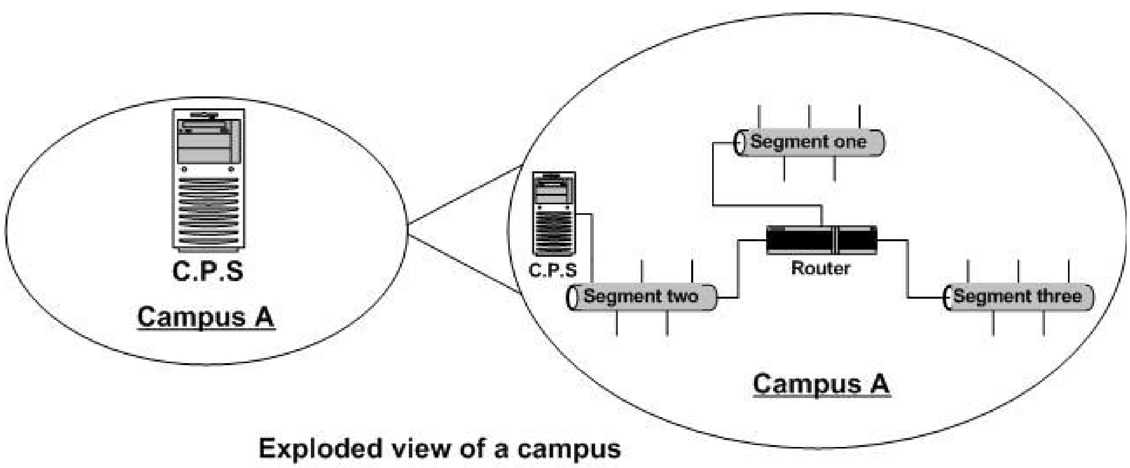
1. Single CPS with a single campus.
2. Single CPS with multiple campuses.
3. Multiple CPS with multiple campuses.
4. Multiple CPS with multiple campuses and a directory CPS.

Single CPS with a Single Campus (SCSC)

The single CPS with a single campus architecture is the simplest architecture to understand. See Figure 2. Notice that the CPS can service multiple IP segments (subnets) within a single campus. H.323 gatekeeper design refers to single CPS with a single campus architecture as a single zone architecture. Following is a list of situations when to deploy this architecture.

- Any pilot IP video communication deployments.
- All point-to-point and multipoint calls are within this one campus.
- The majority of the off-campus calls are routed via an H.320 GW.
- Very few or no calls will traverse (pass through) the IP WAN.

Figure 2. Single CPS with a Single Campus

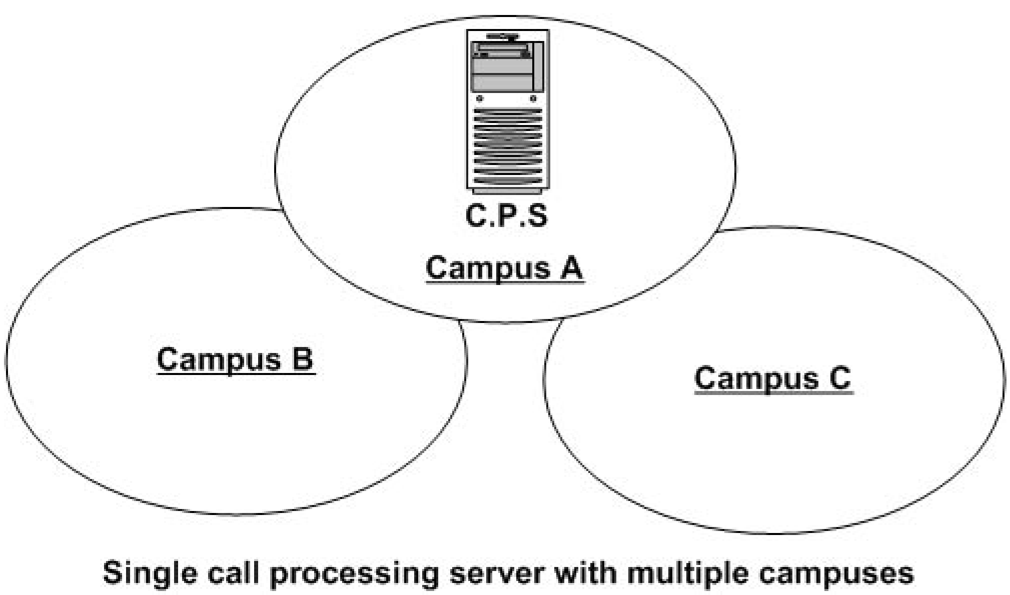


Single CPS with Multiple Campuses (SCMC)

The single CPS with multiple campuses architecture is shown in Figure 3. This architecture is a cost effective way to deploy a large number of call sessions with only one CPS. The H.323 standard would consider this a single zone architecture. This architecture is recommended when:

- A small number of terminals are deployed at each campus.
- The majority of off-campus calls are done via an H.320 GW and do not use IP WAN bandwidth.
- MCU resources are centralized on the campus with the CPS.
- GWs may be distributed onto campuses without a local CPS.
- The number of terminals deployed per campus is less than 25% of the maximum number of call sessions supported by the CPS.
- Least cost routing is a requirement between campuses (PathNavigator version 1.0 restriction).

Figure 3. Single CPS with Multiple Campuses

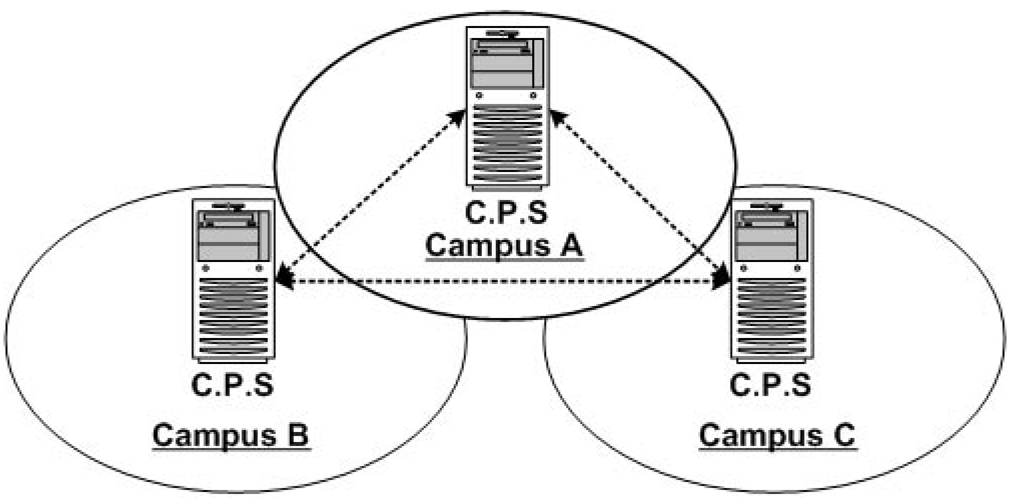


Multiple CPS with Multiple Campuses (MCMC)

The multiple CPS with multiple campuses architecture is designed to deploy a larger number of call sessions than the single campus with only one CPS or single CPS with multiple campuses architectures. See Figure 4. The number of hops between terminals and their CPS directly affects call connect time. As the number of call sessions increase, it becomes more important to have a local CPS. This ensures faster call connect times and better quality of call control service to users. The H.323 standard would consider this a multiple zone architecture. Each call processing server registers with the other call processing servers forming a "meshed" call processing environment. This architecture is recommended for the following situations:

- A large number of terminals will be deployed at each campus (> 50% of CPS call session capacity).
- Terminals are deployed on sub-campuses and are deriving service from a local campus CPS.
- The majority of off-campus calls are done via the IP WAN.
- MCUs are or will be deployed at each campus.
- GWs are or will be deployed at each campus.
- The number of terminals deployed per campus is near to 50% of the maximum number of call sessions supported by the CPS.
- The WAN is not capable of supporting 50% of the smallest deployed CPS's call session capacity.

Figure 4. Multiple Call Processing Servers with Multiple Campuses

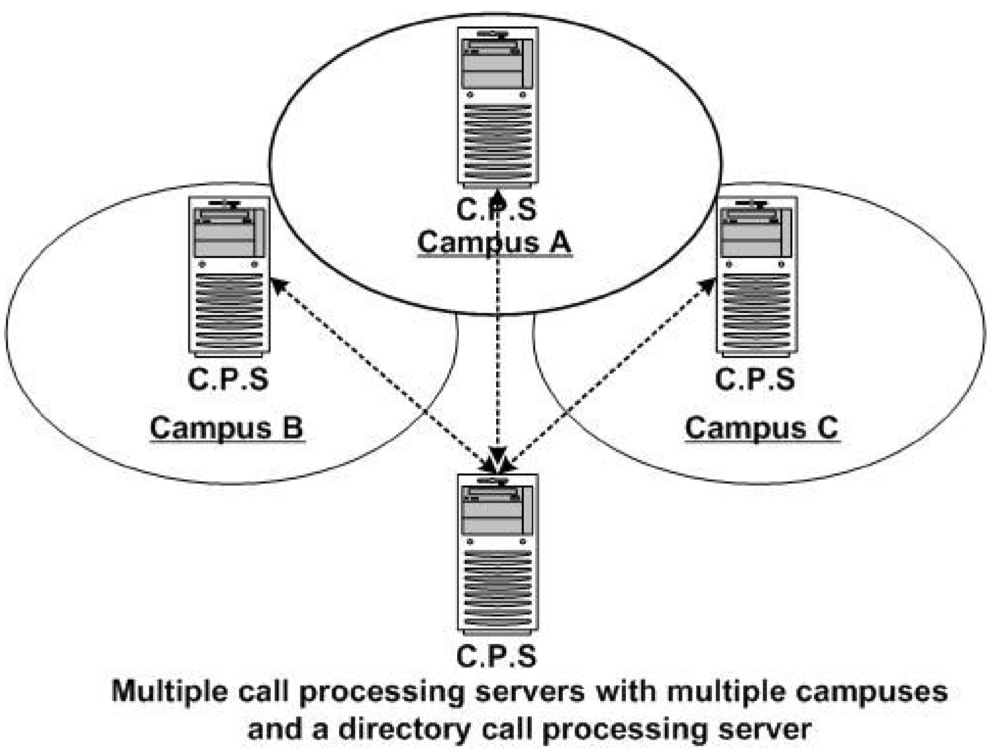


Multiple call processing servers with multiple campuses

Multiple CPS with Multiple Campuses and a Directory CPS (MCMCD)

The multiple CPS with multiple campuses and a directory CPS architecture is designed to deploy the greatest number of call sessions. See Figure 5. The number of hops between terminals and their CPS directly affects call connect time. As the number of call sessions increase, it becomes more important to have a local CPS. This ensures faster call connect times and better quality of call control service to users. The multiple CPS with multiple campuses and a directory-CPS architecture provides the fastest call connect time for large scale deployments. Fast call connect time is critical when multiple simultaneous point–to-point, point -to-mltipoint, and GW calls are planned. This ensures better quality of call control service to users. H.323 gatekeeper design refers to this as multiple zone architecture or directory gatekeeper design. Each CPS registers with the directory CPS, forming a "star" call processing environment. All terminals register with their local CPS. All CPSs register with the directory CPS. However terminals and infrastructure do not register with the directory CPS, this reduces the overall processing costs associated with multiple lookups during the process of call routing; leaving the individual CPS to process only the call requests that are their direct responsibility. This

Figure 5. Multiple CPS, Multiple Campuses, and Directory CPS



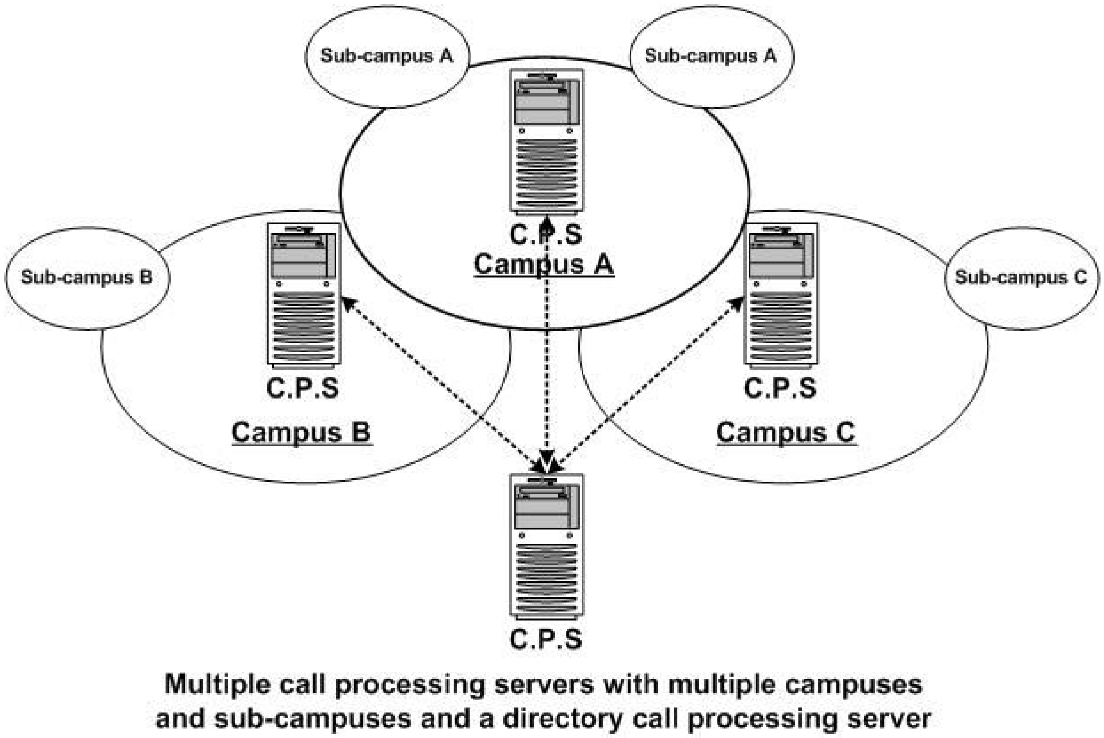
architecture is recommended for the following situations:

- A large number of terminals will be deployed at each campus (> 75% of CPS call session capacity).
- The majority of off-campus calls are done via the IP WAN.
- MCUs are or will be deployed at each campus.
- GWs are or will be deployed at each campus.
- The WAN is capable of supporting 50% of the smallest deployed CPS's call session capacity.
- There are more than 10 campuses.
- A complete deployment plan is to eventually scale to add many more campuses, and potential CPSs beyond the initial installation.

Sub-campuses

Sub-campuses must be considered when deploying a CPS. Figure 6 shows how to account for smaller local sub-campuses. Sub-campuses are defined as smaller branch locations geographically close to a campus. These branch offices are generally connected to the main campus via a slow WAN link (< 1.5 Mbps). Each sub-campus is considered part of the total number of terminals supported by a local CPS. If the total number of sub-campus terminals approaches 25% of the campus' CPS call session capacity, it must then be considered its own campus. The growth of smaller branch offices affects the entire CPS architecture.

Figure 6. Sub-Campuses



Architectures Summary

When selecting a CPS architecture it is critically important to understand all of the variables relating to a deployment. The issues of initial configuration size versus the ultimate deployment scale must be clearly forecasted. Understanding the deployment scale will save the costs associated with changing an architecture after the initial installation is completed. The downtime and rework associated with improper forecasting can be costly in reference to downtime of users and the additional work load required of your IT staff. Look at least one year out before deciding on a final architecture. The call session count and number of sessions that will traverse WAN links is also critical in order to arrive at the correct CPS architecture for each potential deployment. Use this guide as a tool in your deployment process. The most successful deployments will always require a clear understanding of an application's use and volume prior to proceeding to the actual work of deployment. In other words, doing the up front work correctly and thoroughly first, saves time and money as the deployment begins to scale.

Appendix A: A Deployment Case Study

Introduction

In the following scenario, the network designer needs to recommend the proper number and size of CPS(s) for a specific deployment. This case study is also a good opportunity to explore the Polycom Accelerated Communications (architecture, as it relates to a typical deployment. Deploying multimedia communication applications spans many Polycom products. Multimedia communication deployments typically have the following desired outcomes; it must satisfy users requirement, be cost effective, and be easy to deploy and manage with limited IT resources. Additionally, application deployments must leverage the investments already made in newer IP network infrastructure. The architecture consists of all of the management and network infrastructure components required to provide the easiest to use and richest user experience in the industry. The architecture is key to reducing the overall costs and complexity of deploying multimedia communication application. The promise of deploying a network capable of supporting multiple applications over a single protocol (IP) can easily be delivered by the combination and your layer 2 and 3 routed and switched IP network.

Company XYZ is in the process of designing a Polycom solution for their multimedia communication needs.

The following is an excerpt from the specification contained in the request for proposal (RFP) that lead to Polycom's selection.

Background

Company XYZ has just completed a renovation of their data network. They have installed layer 2 and 3 IP switches and routers throughout their network. Their renovation project took into account the requirements of real time application like voice and video communications. Therefore, latency, jitter, and packet loss will be well within acceptable levels. WAN connections have enough capacity to handle the number of calls required. Company XYZ would like to deploy video communications over their IP network. They also need to be able to support ISDN-based calls between every IP node and their outside ISDN-based partners. Company XYZ started a pilot last year to investigate IP videoconferencing. They deployed a RADVision/Cisco single PRI GW at each location with its on-board gatekeeper. Since Company XYZ is planning to scale to multiple PRIs at each campus and requires an integrated communications solution, they will phase these GWs out as the MGC-50s come on-line. Additionally, the MGC-50's ability to support multiple formats of continuous presence in mixed multipoint calls as well as speed matching from H.323 to H.320 is a prime motivation for this phase out.

Company XYZ's Perspective

Company XYZ requires the maximum in call performance, speed and call reliability. Company XYZ has allotted a budget to meet this objective. Several entities within company XYZ plan to leverage this investment including the travel department, training, and management for internal ongoing project management and employee meetings. Therefore a more rapid return on investment (ROI) is planned. This also provided for a larger total budget to get the project funded and started. Company XYZ is planning on implementing the entire project from start to finish in less than one year.

Specification

The vendor and proposed equipment selected for this project must meet and include the following requirements:

- Possess the financial stability to stay solvent for the duration of the deployment's ROI three-year cycle.
- Manufactures 80% of the technology required to meet the specification.
- Solution must be scalable.
- Centralized web-based management system.
- Centralized directory services (LDAP compliant).
- Call Detail Records for cost accounting.
- Process both IP and ISDN calls.
- Detect rogue deployments of H.323 terminals.
- Provide multipoint and GW solutions for both IP and ISDN.
- Provide speed matching and audio & video protocol transcoding.
- Provide multiple continuous presence formats for both IP and ISDN connection.
- Provide redundant call paths; should IP WAN links fail. Note: (this is supported between PathNavigator and the MGC for all terminals associated with a direct inward dial (DID) phone number).
- Web-based scheduling and conference control solution.
- Leverage existing investment in IP infrastructure.
- The solution must provide assurance of investment protection from changing communication and network transport technologies, e.g., Protocol and Transport independence.

What did they select?

Company XYZ has decided to deploy the following Polycom products:

- ViewStation FX - group video communication appliances.
- ViewStation 512 MP - group video communication appliances.
- ViaVideo - desktop video communication appliances.
- Global Management System - Video network management system and directory services.
- PathNavigator - Video network call processing server.
- Polycom MGC-50 - combination MCU and GW system.

Company XYZ plans to eventually deploy 500 video systems. This will be a mix of both group and desktop systems. The selected dial speed will be 384 Kbps over WAN links. No restriction on call bandwidth will be made inter-campus.

Since Company XYZ requires centralized management and directory services, as well as the ability to provide proactive monitoring of video sessions and terminals on the network, they will deploy the Polycom Global Management System. The Global Management System provisioning services will be used for deployment. Provisioning is the ability to set default configuration profiles for all terminals so deployment is as simple as setting up the unit and then downloading a preconfigured profile.

The Polycom PathNavigator product will be used to provide call processing services. PathNavigator automatically assigns the required configuration information to terminals for accessing call processing services. Services such as direct inward dialing (DID) can be automatically assigned from a pool of public E.164 numbers (subscribed from your carrier for GWs services). DID when used in conjunction with the MGC and PathNavigator products, affords every IP device an actual ISDN phone number for conferencing outside of the network with ISDN-based partners. PathNavigator will be deployed in an appropriate architecture and capacity to accommodate for both today's requirements as well as the planned future growth.

The MGC-50 systems for campuses two and three are equipped with NET-4 PRI cards (4 PRI ports), to accommodate for future session growth. Campus one has purchased a NET-8 PRI card (8 PRI ports) for their MGC. Company XYZ will only use enough PRI resources today to get them started. More PRI network can be added as the project scales. Should the IP WAN fail, calls will be automatically routed over the publicly switched telephone network via the PRI attached to the MGC-50s.

Technical Details
Number of campuses: 3
Numbers of terminals total: 100 today, upwards of 500 planned
For a better understanding of company XYZ's network topology see figure 6.

Campus One

	Today	Planned
Number of terminals	50	300
Number of calls allowed over WAN	6 @ 384 Kbps	18 @ 384 Kbps
Total video Bandwidth over the WAN	2.765 Mbps	8.294 Kbps
Total non video Bandwidth available	apx. 3.520 Mbps	apx. 10.5 Mbps
Size of WAN	apx. 9 Mbps	apx. 25.1 Mbps
Number of MCUs	1	1
Number of GWs	1	1
Number of GW sessions at 384 Kbps	7 @ 384 Kbps	28 @ 384 Kbps
ISDN PRI Bandwidth for the MGC-50	2 PRI (3 Mbps)	8 PRI (12 Mbps)

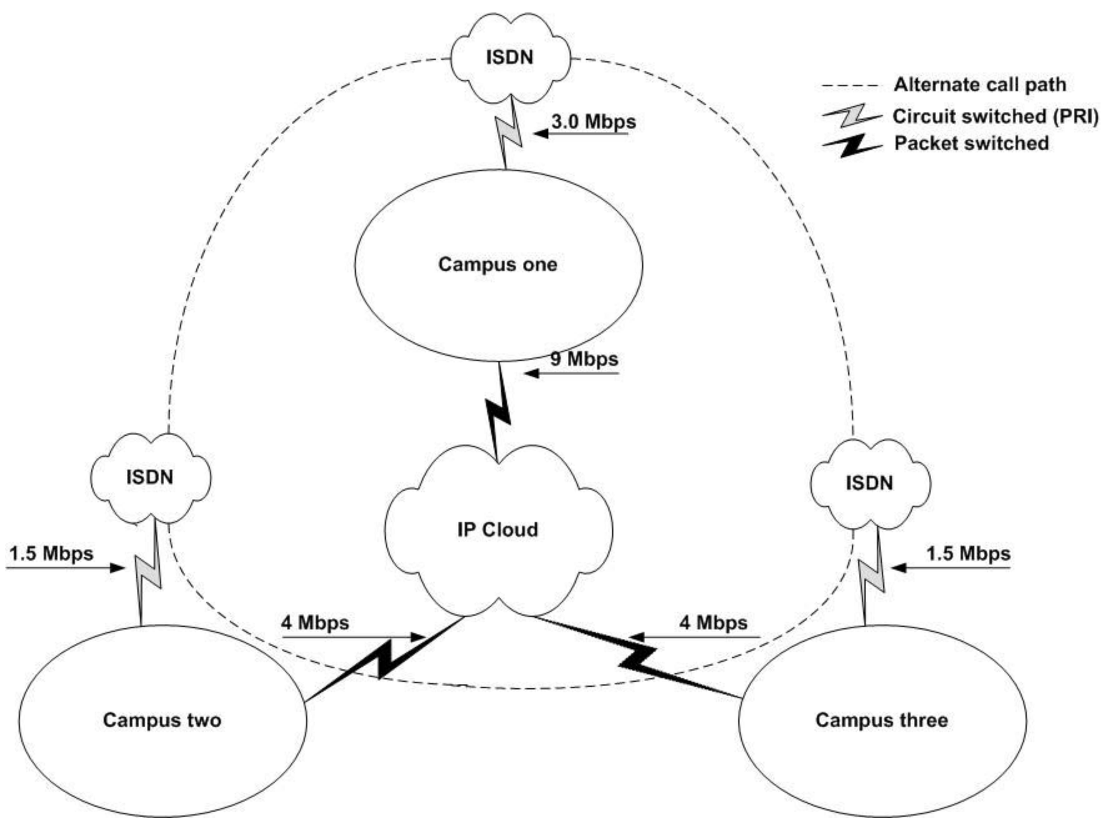
Campus Two

	Today	Planned
Number of terminals	25	100
Number of calls allowed over WAN	3 @ 384 Kbps	12 @ 384 Kbps
Total video Bandwidth over the WAN	1.382 Mbps	5.5 Mbps
Total non video Bandwidth available	apx. 1.795 Mbps	apx. 7 Mbps
Size of WAN	apx. 4 Mbps	apx. 17 Mbps
Number of MCUs	1	1
Number of GWs	1	1
Number of GW sessions at 384 Kbps	3 @ 384Kbps	14 @ 384 Kbps
ISDN PRI Bandwidth for the MGC-50	1 PRI (1.5Mbps)	4 PRI (6 Mbps)

Campus Three

	Today	Planned
Number of terminals	25	100
Number of calls allowed over WAN	3 @ 384Kbps	12 @ 384 Kbps
Total video Bandwidth over the WAN	1.382 Mbps	5.5 Mbps
Total non video Bandwidth available	apx. 1.795 Mbps	apx. 7 Mbps
Size of WAN	apx. 4 Mbps	apx. 17 Mbps
Number of MCUs	1	1
Number of GWs	1	1
Number of GW sessions at 384 Kbps	3 @ 384 Kbps	14 @ 384 Kbps
ISDN PRI Bandwidth for the MGC-50	1 PRI (1.5 Mbps)	4 PRI (6 Mbps)

Figure 6. Company XYZ's Network Topology



Selecting a PathNavigator Architecture

As stated previously in the introduction, "The architecture chosen should be based on a number of variables like, number of communication sessions, numbers of campuses, and size of WAN links between terminals and the PathNavigator". Cost also plays into the decision making process. The definition of the different architectures also gives some guidelines as to the speed of call processing; whether or not the infrastructure is present locally, and the ratio of actual planned call session count in relation to the PathNavigator listed session capacity. There are usually two architectures that will meet deployment requirements. The issues that tips the scale toward one architecture over another usually relates to cost, rate of growth, and the rating of how critical a service multimedia communication is to the individual company. The higher the level of performance and reliability usually equals the greater cost of deployment.

Process of Elimination

Based on the following conditions both the single CPS with a single campus and single CPS with multiple campuses architectures can be eliminated as possible CPS architectures.

- The majority of off campus calls are done via the IP WAN.
- MCU's are or will be deployed at each campus.
- GWs are or will be deployed at each campus.
- The number of terminals planned for deployment per campus is near to 50% of the maximum number of call sessions supported by the CPS.

Recommendation

Both the multiple CPS with multiple campuses and multiple CPS with multiple campuses and a directory CPS architectures are possible solutions for this deployment. Since Company XYZ believes there will be a maximum of 11 simultaneous calls over the IP WAN to start, and 31 simultaneous calls over the next year; a directory gatekeeper does not appear to be viable. This really becomes an issue of whether or not the addition of a directory CPS will alleviate any call set up delays. For this deployment a multiple CPS with multiple campuses architecture is recommended. The capacity of intra-campus WAN IP calls in this scenario will not scale enough to warrant a directory CPS. If the intra-campus call session count begins to approach 50% of any of the deployed CPS, then a directory CPS should be recommended. For example, if the plan for intra-campus call sessions was to scale to over 75 calls, a directory CPS could add significant benefit to call setup times. The capacity the WAN can support is also an important indicator of the need for a directory CPS. For instance, if the total number of intra-campus calls approaches 50% of any one CPS; recommend a directory CPS. This is because within the multiple CPS with multiple campuses architecture, any time a call is initiated from one campus to another, neighboring CPS could potentially be requested to process the call. This could put undue load on the local CPS as it is already working to process local request. Therefore, if your enterprise has a very large WAN and anticipate large intra-campus call volume for point-to-point, multipoint calls, a multiple CPS with multiple campuses and a directory CPS (MCMC) architecture should be recommended.

Phased Deployments

Since Company XYZ is planning on implementing the entire project from start to finish in under one year, there is no real benefit derived from starting with smaller capacity PathNavigator configurations to save up front costs. This can actually be more costly in the long run, e.g., three PathNavigator 150-registration packs, as shown below, actually cost more than one PathNavigator 600-registration pack.

The process of increasing from one license pack size to the next is quite a simple process. Therefore, if cost was not a concern, and the project was to be phased in over time, Company XYZ could phase in license packs as the deployment grew. Below is a view of a phased approach.

Phased Approach

	Phase One PathNavigator Configurations	Phase Two PathNavigator Configurations	Phase Three PathNavigator Configurations	List Price
Campus One	100-pack	100-pack	100-pack	$29,997.00
Campus Two	100-pack			$9,999.00
Campus Three	100-pack			$9,999.00
			Total	**$49,995.00**

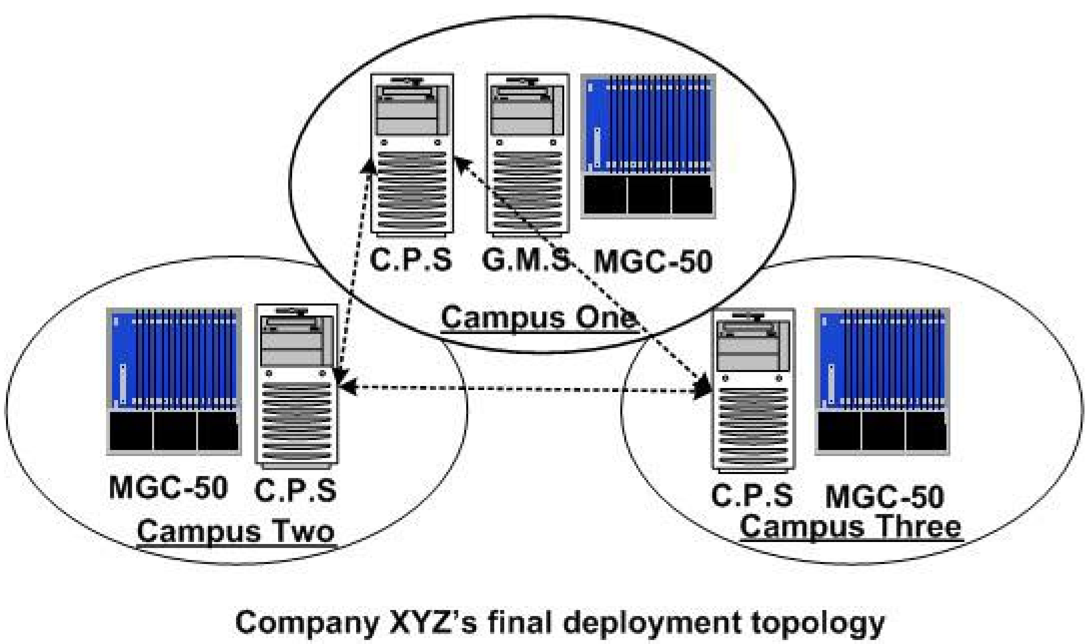
Non-Phased Approach

	Phase One			List price
Campus One	600-pack			$24,999.00
Campus Two	150-pack			$9,999.00
Campus Three	150-pack			$9,999.00
			Total	**$44,997.00**

Company XYZ's Actual Deployment Plan

Since Company XYZ's main IT group is located at Campus One, they have elected to centralize the management of videoconferencing services there. The Global Management System will be installed at Campus One, see Figure 7. It should be noted that each campus will have access to these services directly via Global Management System's web interface. GW support within the MGC-50 also includes the added features of hot swappable GW modules and speed/protocol transcoding capabilities. Each campus will deploy a PathNavigator, with the other campuses programmed in as neighbors. This will provide a meshed or multiple CPS with multiple campuses Architecture. This will also remove the requirement of users having to use complex dialing prefixes to get GW services. Additionally, user will now be able to initiate Conference on Demand calls using the exclusive Polycom OneDial ™ technology, which enables automatic launching of a multipoint call.

Figure 7. Deployment Topology



Terminology

Term	Definition
Rogue H.323 terminal detection	The ability of a gatekeeper to automatically detect an unauthorized user from gaining access to network resources.
Prefix-less dialing	Most H.323 gatekeepers require a dialing prefix to be manually inserted by a user into the dialed string of characters to properly route H.323 calls.
MCM	Cisco's Multimedia Conferencing Manager is a combination H.323 Gatekeeper, Firewall and QoS proxy.
Gatekeeper zone	A zone is a logical grouping of H.323 infrastructure components managed by a single gatekeeper. Zones are not dependent on physical network topology or IP subnets. Zones may span one or more network segments or IP subnets, and are simply a logical grouping of devices registered to a single gatekeeper. A CPS can also manage network zones, but does not require them to enable least-cost routing or any other advanced CPS feature. A single CPS can manage multiple LANs and WANs which would require separate gatekeepers in the past.

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