Chapter 2: Network and Infrastructure Considerations

Overview

This chapter focuses on the infrastructure requirements and considerations for Cisco Unity deployment and operation. After Cisco Unity has been installed, the customer needs to ensure that the infrastructure is not changed in ways that will affect Cisco Unity performance and functionality. For example, congestion on the network can cause sporadically slow response times when Cisco Unity subscribers check voice messages over the phone, and an unreliable domain controller can prevent Cisco Unity from quickly authenticating administrators or subscribers.

Infrastructure Requirements

From the perspective of Cisco Unity, “infrastructure” refers to any server or gateway on which Cisco Unity depends. Cisco Unity is dependent on infrastructure and on network resources, so you must carefully attend to the infrastructure into which Cisco Unity is being installed as you are designing a system.

Physical Location of the Cisco Unity Server

The Cisco Unity server should be treated the same way the customer treats any other mission-critical server, as follows:

- Place the Cisco Unity server in a secure server room or computer room where rack storage space is available to support the server and related servers and hardware. For example, you may need rack storage space for an expansion chassis for voice cards, a secondary server for Cisco Unity failover, a Cisco Unity Bridge server, message store servers, a domain controller/global catalog (DC/GC) server, and so on.
- Ensure that the Cisco Unity server has the proper power source.
- Ensure that the Cisco Unity server has proper ventilation and air conditioning.

Cabling and Connectivity

Cisco Unity needs adequate network cabling to connect it to the network, for access to:

- Cisco CallManager.
- Cisco CallManager Express.
- SIP proxy server when Cisco Unity is integrated with an IP phone system.
- Circuit-switched phone system integrated via an Intel NetStructure PBX-IP Media Gateway (PIMG unit).

- Message store servers for all Unified Messaging configurations and for Voice Messaging configurations in which the message store is on a separate server.
- A secondary Cisco Unity server when Cisco Unity failover is configured.
- A Cisco Unity Bridge server when Cisco Unity is connected with an Avaya voice messaging system using Octelnet as the interoperability messaging protocol.
- Network backup servers and other network resources, as applicable.

When Cisco Unity is integrated with a circuit-switched phone system, other cabling is also required:

- Cabling between the phone system and voice cards in the Cisco Unity server.
- For serial integrations, a serial cable between the phone system and the Cisco Unity server.
- Other cabling when using integrations such as PBXLink for Nortel Meridians and Avaya G3.
- For integrations via a PIMG unit, cabling between the phone system and the PIMG unit, and between the PIMG unit and the LAN.
- If voice cards are installed in an expansion chassis, a cable between the Cisco Unity server and the expansion chassis.

Ensure that the cabling and the network switch are reliable and fully functional. Faulty cabling is often the reason for intermittent failures between Cisco Unity and the network or the phone system, and it is difficult to troubleshoot.

Availability of Network Resources

The following network resources must be available at all times and in close physical proximity to Cisco Unity (over a local area network, not a wide area network), or Cisco Unity functionality will be impaired:

- All name resolution hosts used by standard Windows 2000 networks, including DNS hosts and WINS, if a Windows NT network is present.
- Domain controllers that provide authentication for the Cisco Unity service accounts. Windows global catalog servers are also necessary if Cisco Unity services Exchange 2000.
- The message store servers and their corresponding directories. Each message store server on which Cisco Unity subscribers are homed must be accessible to Cisco Unity. The corresponding directory must also be available so that Cisco Unity can synchronize its local data with the directory.
- All gateways that provide Cisco Unity with access to required resources, such as name resolution hosts, domain controllers, message stores, and directories.

Name Resolution

Cisco Unity must be able to find the servers it interacts with by resolving the names of those servers to IP addresses, unless the Cisco Unity server is not connected with the network. For example, Cisco Unity can

send messages from outside callers to the message store server on which the mailbox of the recipient is homed only if Cisco Unity can find that message store server. Name resolution is also used when:

- A subscriber uses the Cisco Unity telephone user interface (TUI) to listen to messages or send messages to other subscribers. Name resolution is used by Cisco Unity whenever a process requires the Unity application to execute commands that leave the Cisco Unity server and access information across the network to the mailbox stores where subscriber mailboxes are located.
- Administrators access the Cisco Unity Administrator from other servers, which is primarily done when using the administrative web interfaces. Typically, if a server name is used instead of an IP address, the server name must be resolved to an IP address before access can occur over the network.
- Subscribers access the Cisco Unity Assistant or the Cisco Unity Inbox, which is primarily done when using the client web interfaces. Typically, if a server name is used instead of an IP address, the server name must be resolved to an IP address before access can occur over the network.

When deciding whether Cisco Unity should use DNS, WINS, or both, the customer should use the name resolution that is native to the directory and message store being accessed by Cisco Unity. Also consider the following best practices:

- If the Cisco Unity server is in a Windows 2000 domain, it must use Dynamic DNS (DDNS) or another version of DNS that supports dynamic updates. Simply creating a host file on the Cisco Unity server is not sufficient.

  Note: If a DNS host that fully supports Windows 2000 servers via dynamic server updates is used by a given organization, it is best to use the existing DNS host. Otherwise, a Windows 2000 DNS host must be made available to Cisco Unity and its supporting infrastructure to ensure the proper operation of all systems, including any domain controllers and message store servers that support Cisco Unity. The reason for providing dynamic server updates is to allow Windows 2000 servers to use the service locator records that are created as a part of the Windows domain structure in DNS. This structure must be present in DNS (for more information, refer to Microsoft documentation on using name resolution).

- Use the same name resolution used by the messaging clients. Usually, this is DNS, although DNS and WINS are sometimes used together. For example, when Outlook clients use DNS, Cisco Unity must also use DNS. Likewise, if Notes clients are using Notes Name Resolution, Cisco Unity must also use Notes Name Resolution, through the Notes client that is installed on the Cisco Unity server.
- When Cisco Unity is installed in a Windows 2000 domain, and when a company uses any version of DNS that does not fully support DDNS as described on the Microsoft website, a DDNS server must be installed to support Cisco Unity (see the note above regarding service locator records). When Cisco Unity is installed into a Windows 2000 domain, and when it services:
  - Domino Notes clients via DUC, DDNS is required on the Windows 2000 domain controller in the domain in which the Cisco Unity server belongs.
  - Exchange 2000 or Exchange 2003 mailboxes, a DDNS server must be present and accessible by Cisco Unity and the supporting Exchange 2000 or Exchange 2003 servers.

  - Exchange 5.5 mailboxes, a DDNS server must be present and accessible by Cisco Unity. Exchange 5.5 does not use DDNS, but DDNS is used for name resolution and for record locator information in the Windows 2000 domain.

- When Cisco Unity is installed in a Windows NT domain, servicing Exchange 5.5 mailboxes (this is the only circumstance in which a Cisco Unity server can be installed in a Windows NT domain), Cisco Unity does not require DDNS, but it does require WINS and possibly static DNS access.
- The Windows DNS service can only be installed on the Cisco Unity server in the following cases:
  - With Domino, the Cisco Unity server is configured as a Windows 2000 domain controller in order to service Domino Notes clients via DUC. This is a Cisco Unity requirement, not a DUC requirement. The Cisco Unity server supports its own dedicated domain for Domino. Cisco Unity supports Domino only in a Unified Messaging configuration, and not in a Voice Messaging configuration.
  - With Exchange 2000, Exchange 2003, or Exchange 5.5, the Cisco Unity server is configured as a Windows 2000 domain controller in a Voice Messaging only configuration, and all other servers in the domain are used only to support Cisco Unity (for example, a secondary server for Cisco Unity failover, message store servers, DC/GC server, and so on). In this configuration, the Cisco Unity server supports its own dedicated domain for Exchange 2000 or Exchange 2003 (in Cisco Unity 4.0(x) systems or systems upgraded from Cisco Unity 2.x or 3.x) and for Exchange 5.5 (systems upgraded from Cisco Unity 2.x or 3.x only).
  - When Cisco Unity is configured in a failover solution, in a Voice Messaging configuration, name resolution should not be located on the Cisco Unity servers, but on the Exchange mailstore server or dedicated DC/GC server.
- When the Cisco Unity server is a member server in a Windows 2000 domain, and it services Exchange 2000, Exchange 2003, or Exchange 5.5 in a Unified Messaging configuration, do not install the Windows DNS service on the Cisco Unity server.

Domain Controller Access and Availability

For all configurations and all message stores, Cisco Unity must have access to a Windows domain controller to authenticate service accounts. For Exchange 2000, Exchange 2003, and Exchange 5.5, Cisco Unity must also have access to a domain controller in order to authenticate subscribers. For Domino, subscribers can be authenticated for GUI-based access to Cisco Unity by using either Windows authentication or Domino authentication; Domino authentication does not require access to a Windows domain controller.

For Exchange 2000 and Exchange 2003, Cisco Unity must also have access to the same global catalog server(s) used by the Exchange 2000 and Exchange 2003 servers that Cisco Unity services.

Availability of Message Store Servers

When Cisco Unity is installed, the installer specifies one Domino or Exchange server that Cisco Unity connects with; this is known as the partner Domino server or the partner Exchange server. The partner server is the home of the Cisco Unity system mailbox (alias: Unity_<ServerName>. (The Unity system

mailbox is used for Exchange; Domino's setup is different. For more information about Domino, see Chapter 7, "Using Lotus Domino as the Directory and Message Store.") The Unity system mailbox is the mailbox that originates voice messages from outside callers. It is also the home for default mailboxes and distribution groups (Cisco Unity distribution lists) that are created during installation. If Cisco Unity subscribers are homed on servers other than the partner server, all voice messages from outside callers pass through the partner server on their way to the home servers for Cisco Unity subscribers.

When the partner server or a message store server on which Cisco Unity subscribers are homed is unavailable, Cisco Unity functionality is affected in the following ways:

- Messages from outside callers are stored on the Cisco Unity server in the Unity Message Repository (UMR), and can be retrieved during the outage. However, voice messages previously received by subscribers are not available until the home server is back online.
- When the home server of a calling subscriber is down, any messages from that subscriber are stored on the Cisco Unity server in the UMR, and can be retrieved by the recipient during the outage.
- When the home server of a message recipient is down, the home mailstore server of the calling subscriber holds the message until the home mailstore server of the recipient is available again. The recipient cannot retrieve this message.
- Message waiting indicators and message notification will not work.

When the partner server becomes available again, it may be necessary to restart Cisco Unity.

> Tip: Make sure that the importance of message store availability is clearly understood prior to installing one or more Cisco Unity servers, particularly those that service message stores on separate servers.

Message Store Performance and Capacity Planning

In addition to ensuring that every message store is available, you must ensure that the response time on each message store is fast—40 milliseconds or less. This is particularly important for Exchange. When subscribers play or record messages over the phone, Cisco Unity processes happen in real time. This can expose any delays in the message store that are not apparent when the subscriber uses Notes or Outlook to play and record messages from the desktop. If clients are already experiencing delays when accessing the message store server and retrieving messages, these delays must be resolved before Cisco Unity is installed.

For every subscriber homed on an Exchange message store server, Cisco Unity logs on to the subscriber mailbox, sends and receives messages on behalf of the subscriber, and queries the contents of the subscriber mailbox. The longer Cisco Unity takes to log on to a mailbox and retrieve messages, the longer it takes a subscriber to log on and hear messages by using the phone.

The message store server must meet IBM Lotus requirements for Domino, and Microsoft requirements for Exchange. These requirements include adhering to recommendations for: the maximum number of users per server, the proper amount of memory, the proper processors and processor speed, hard disks that can meet disk-access response times, and placement of data files and transaction log files.

Cisco Unity cannot support message store servers that have performance bottlenecks such as slow hard drives or insufficient memory. For example, if slow hard drives or the lack of a dedicated mirror for transaction logs cause delays in MAPI recording log transactions, MAPI access (which is used by Microsoft Outlook, Exchange, and Cisco Unity to access Exchange) will be temporarily suspended until the transaction buffers can be cleared to a certain level. This can substantially delay phone access to Cisco Unity.

Cisco Unity filters through messages in each subscriber mailbox to find new voice messages for which the message waiting indicator must be turned on. Filtering is much faster for small mailboxes than for large ones. Therefore we recommend that mailboxes not exceed 100 MB.

Directory Access and Availability

Directory access and availability are primarily issues in Unified Messaging configurations.

Cisco Unity stores a small amount of information in the directory, primarily subscriber information. This information also appears in a SQL Server/MSDE database on the Cisco Unity server. A Cisco Unity service keeps data in the directory synchronized with data in the SQL Server database. If there are multiple Cisco Unity servers, the SQL Server database on each Cisco Unity server also has a small amount of information about subscribers that are homed on other Cisco Unity servers.

Cisco Unity needs specific permissions to access the directory and write changes to it. Each Cisco Unity server must have at least the following access, or Cisco Unity will not work properly. Cisco Unity must be able to:

- Query the directory for changes to data that also appears in the SQL Server 2000/MSDE database. Cisco Unity must be able to find all of the subscribers in the directory, either by searching from the highest level in the directory hierarchy or by searching all of the domains where Cisco Unity subscribers are homed.
- Read and write to its own objects and to objects whose attributes are used by Cisco Unity.
- Read the objects used by other Cisco Unity servers so that it can store this information in its global tables.
- Write to specific attributes associated with each object serviced by Cisco Unity. It also must be able to read the rest of the attributes associated with each object serviced by Cisco Unity.
- Create, write to, and have full control over its own location documents or location objects in the directory. These location objects are specific to a given Cisco Unity server.

For more information on Cisco Unity and the Exchange 2000, Exchange 2003, and Exchange 5.5 directories, refer to the *White Paper: Cisco Unity Data and the Directory (All Versions with Microsoft Exchange)*, available at http://www.cisco.com/univercd/cc/td/doc/product/voice/c_unity/whitpapr/datadir.htm. Note that this document does not include information specific to Cisco Unity for Domino.

When running in a Unified Messaging configuration, Cisco Unity generally does not need a dedicated directory server. This means that a directory server must exist, but a directory server does not need to be set

up just to support Cisco Unity. The directory servers that are dedicated to the existing message store servers being serviced by Cisco Unity should be sufficient to support Cisco Unity.

When Cisco Unity is running in a Voice Messaging configuration, a directory server is typically dedicated to Cisco Unity, because the directory is a dedicated part of the messaging infrastructure.

Gateway Access

If a router separates Cisco Unity from the network resources on which it depends (for example, if there is a router between Cisco Unity and the Domino or Exchange servers), and if the router becomes unavailable, Cisco Unity will be affected. If the network infrastructure is configured with redundant paths, gateway access becomes less of an issue.

Keep in mind the expectation that Cisco Unity will be co-located with the messaging store servers it services. Separating Cisco Unity from the messaging stores creates too many points of failure, and creates an undesirable end-user experience due to delays in retrieving messages and mailbox information, and performing logins into end-user mailboxes.

In addition, if the router is slow or busy, and the network resources are on different segments, access to Cisco Unity over the phone will be affected.

Deployment Requirements

Deploying one or more Cisco Unity servers takes a significant amount of planning. Some deployments also require testing and acceptance, including:

- Migrating from an existing legacy voice messaging system by performing a flashcut from the existing system to Cisco Unity.
- Migrating from a legacy voice messaging system by setting up communication between the existing system and Cisco Unity, by using AMIS, the Cisco Unity Bridge (for Octel Analog Networking), or VPIM.
- Implementing a new Voice Messaging or Unified Messaging infrastructure to provide features and functionality the customer has never used, such as Cisco Unity failover.
- Supporting a migration from Exchange 5.5 to Exchange 2000 or Exchange 2003. For more information, see Chapter 6, “Migrating from Exchange 5.5 to Exchange 2000 for the Message Store.”

Each of these deployments requires its own set of planning criteria for the project to be successful. In addition, all of these deployments have a common set of criteria:

- When the customer is replacing another voice messaging system with Cisco Unity, consider the differences in how users interact with each system. For example, the options offered by the Cisco Unity standard conversation (the telephone user interface, or TUI), and the key presses used to accomplish tasks, may be different from what users are accustomed to using. As an alternative to the Cisco Unity standard conversation, some customers may want to activate Optional Conversation 1 (the ARIA-like conversation available in Cisco Unity) so that Cisco Unity subscribers hear message-

retrieval menus that more closely resemble the choices they are familiar with. However, other menus—those that outside callers and Cisco Unity subscribers use to send and manage messages, as well as the menus that subscribers use to change their Cisco Unity settings—are the same as those in the Cisco Unity standard conversation.

- Ensure that the customer understands Cisco Unity behaviors that are different from those of the voice messaging system it is replacing. For example, if the customer does not currently use an automated attendant feature and wants Cisco Unity to be configured the same way, this should be noted so that the installer configures Cisco Unity correctly. If it is necessary to change any Cisco Unity behavior, such as the opening greeting, or zeroing out to an operator option during a personal greeting, these changes should be made and tested prior to the day of the cutover.
- Plan a method for adding subscribers to Cisco Unity. Will they be imported from the message store (Domino or Exchange), imported from a text file (Exchange only), or entered by using the Cisco Unity Administrator (Exchange only)? If they will be imported from a text file or entered by using the Cisco Unity Administrator, where will the information come from? Creating subscribers requires planning and testing prior to the cutover.
- The larger the installation or number of servers, the greater the need to perform subscriber enrollment tasks prior to the day of the cutover. If too many subscribers try to enroll simultaneously, some subscribers (up to the number of voice ports available) will succeed in accessing the Cisco Unity server and enrolling, but the rest will get a busy signal.

  To prevent this negative user experience, smaller groups of subscribers should be told, perhaps a few days in advance, how to call the pilot number and enroll in Cisco Unity before the system goes live.
- If the customer has special audio-text applications set up in the existing voice messaging system, Cisco Unity equivalents should be planned and set up before cutover. Cisco Unity supports audio-text applications and provides tools for designing and configuring them.
- Cisco Unity does not support group mailboxes, but the same functionality can be made available by setting up a call handler whose greeting prompts the caller to “press 1 for Pat, press 2 for Chris,” and so on.
- The supporting infrastructure (for example, message store servers), whether dedicated to Cisco Unity or being used by Cisco Unity, must be evaluated for availability and responsiveness. This can be accomplished by helping a customer understand the dependencies Cisco Unity has on the infrastructure, and how Cisco Unity performance or functionality can be affected by loss of connectivity to any of the external dependencies. Any problem areas should be addressed prior to installation of Cisco Unity. Cisco Unity will expose any deficiencies on the network, due to the way it uses the resources available on the network.

When the Cisco Unity design is finalized and verified through lab qualification, Cisco Unity functionality should also be tested before cutover by running a simulated load test and by running application test plans.

Sizing and Scaling Cisco Unity Servers

When sizing a Cisco Unity server, follow the guidelines in the following sections.

For a list of servers that meet Cisco Unity specifications, refer to the *Cisco Unity Supported Platforms List*, available at http://cisco.com/en/US/products/sw/voicesw/ps2237/products_data_sheets_list.html.

Maximum Number of Users on Dedicated Domino or Exchange Servers

You should not allow the Domino or Exchange servers to service the maximum number of Domino or Exchange users that IBM Lotus or Microsoft allow. In addition, servers qualified by Cisco as Exchange message store servers for use with Cisco Unity have a maximum number of Exchange users, and the customer should not allow the number of users on these servers to reach the maximum.

You should also be careful not to exceed the disk capacity for the information store. For example, in order to enable recovery if the information store is corrupted, Microsoft recommends that the total size of an Exchange 2000 or Exchange 2003 information store never exceed 50 percent of the capacity of the drive on which the information store is installed. For more information, refer to the Microsoft website.

Storage Capacity for Voice Messages

For Cisco Unity systems configured for Voice Messaging, base the server requirements on the total number of voice storage minutes required for each subscriber. Typical hardware configurations accommodate a certain number of subscribers with 20 minutes or 30 minutes of messaging per subscriber.

For Cisco Unity systems configured for Unified Messaging, it is not possible to base server requirements on the total number of voice storage minutes required for each subscriber, because the message store also includes e-mail messages and possibly faxes. However, you can calculate the storage requirement for the desired number of voice storage minutes and add that to the current mailbox limits.

If the customer is replacing an existing voice messaging system with Cisco Unity, it may be possible to obtain information from the existing system on the average number of minutes of voice messages users currently have. You can then multiply the average number of minutes by the recording size per minute—according to the codec that Cisco Unity will use to record messages—to arrive at the average amount of disk space required for voice messages per user.

Start with a one-to-one correlation of legacy voice messaging system to Cisco Unity. If the legacy system handles a larger capacity than the largest Cisco Unity server, consider off-loading the legacy subscriber population onto more than one Cisco Unity server by extension number ranges or prefixes. Now, it isn't necessary to segment subscribers onto backend message stores by extension number ranges or prefixes but it may be easier to manage. Consider ways to organize subscribers on the backend message store in a voice messaging only configuration. Exchange 2000 and Exchange 2003 (Enterprise Editions) have the ability to support more than one mailstore per server. It may be useful to determine if multiple mailstores should be used on a single Exchange 2000 or Exchange 2003 server. However, remember if this is done, it requires more administrative overhead to manage Cisco Unity and the Exchange 2000 or Exchange 2003 backend for voice messaging.

If Cisco Unity is being installed in a Voice Messaging configuration with future plans to migrate to a Unified Messaging configuration, consider keeping the user density low on each Cisco Unity server to

facilitate a manageable migration process. It is easier to migration subscribers in smaller increments than it is to do the entire server at once, unless the server is sized to handle a smaller subscriber population.

Number of Voice Ports

To determine the number and configuration of voice ports required, you can start with the existing voice messaging system, if applicable. This may give you some idea how many ports are required for taking voice messages, for turning message waiting indicators on and off, and for message notification.

In a Unified Messaging configuration, Cisco Unity uses telephone record and playback (TRAP), to allow subscribers who use Notes or Outlook for voice messaging to play and record voice messages over the phone rather than by using speakers and a microphone. This feature is especially desirable when subscribers work in cubicles, where there is a lack of privacy. However, when a subscriber plays or records a message by using TRAP, a port on the Cisco Unity server is used. (No port is used when a subscriber uses speakers and a microphone to play and record messages.) If the customer wants subscribers to use TRAP, calculations for the total number of voice ports required will need to take this into account.

For Cisco Unity failover, the primary and secondary servers must have the same number of ports.

In some cases you might find that an existing voice messaging system has more than 72 ports, which is the current maximum number of voice ports on a Cisco Unity system. In this case, the customer can purchase additional Cisco Unity servers and connect them by using Cisco Unity Digital Networking.

Deployment Requirements for Placement of Servers

An important design issue is where to place a Cisco Unity server, both physically and logically. A Cisco Unity server must have acceptable access to its resources on the network, including all of the resources discussed in this chapter. Note the following best practices, particularly the first two bullets, as they are your primary design rules for deploying any Cisco Unity solution:

- If Cisco Unity is integrated with a circuit-switched phone system (except when integrated via a PIMG unit), ensure that the Cisco Unity server is within the maximum allowable cable length of the phone system. If Cisco Unity is integrated with Cisco CallManager or via a PIMG unit, the distance between the servers is less crucial.
- Install the Cisco Unity server as close as possible to the message store servers that will home Cisco Unity subscribers. The Cisco Unity server and the message store servers should be located in the same network segment, Windows 2000 site, and Windows 2000 or Windows NT domain as the message store servers, though this may not always be possible.
- For Cisco Unity for Exchange, the Cisco Unity server should also use the same DC/GC servers that the Exchange 2000 or Exchange 2003 servers are using. The more that Cisco Unity is separated from these resources, the longer it will take for authentication and for synchronizing changes between the Cisco Unity database and Active Directory. In addition, loss of access to a Windows 2000 Global Catalog server will render Cisco Unity inoperable.

- Ensure that Cisco Unity can resolve server names to IP addresses. If this is not possible on a given network segment, consider adding the necessary resource or moving the Cisco Unity server to a segment that provides easy access to these services.
- Because the Cisco Unity server provides mission-critical voice messaging for an entire enterprise, never place the Cisco Unity server outside of a firewall. Never allow Cisco Unity to be separated from its network dependency resources by a firewall.
- A single Cisco Unity server can service both local and remote subscribers, especially when Cisco Unity is integrated with Cisco CallManager, and when Cisco Unity is configured for Voice Messaging only. In a Voice Messaging only configuration, the message store server must be in the same location as the Cisco Unity server.

Acceptable Deployment Models

The key to a successful Cisco Unity deployment is to minimize the variables that can cause Cisco Unity to lose functionality or suffer in performance. Cisco Unity has dependencies on the messaging infrastructure it services and also on the call processing or IP telephony it is connected to and servicing. For this reason, any Cisco Unity design must use two sets of deployment models, one for messaging and one for call processing. (However, the dominant deployment model for any Cisco Unity design is the messaging deployment model.)

Messaging Deployment Models

The messaging deployment models represent the physical layout of a given messaging solution, and how its clients access messages. A messaging solution may have dependencies that reside on the network, such as name resolution, authentication providers, domain controllers, and directory services. To Cisco Unity, all of these dependencies are considered a part of the messaging infrastructure. In general, these messaging infrastructure components, which can change depending upon the messaging system that Cisco Unity is using, will typically be co-located. This usually implies a LAN or MAN but rarely a WAN. (Although WAN connectivity between a messaging server and an authentication provider such as a domain controller is technically possible, it is not practical, given that a loss of WAN connectivity or even bandwidth congestion will render the messaging server inoperable, or will cause its response to client requests to be unacceptably delayed).

Each messaging deployment model is based on the physical location of the messaging system that Cisco Unity is expected to service. It is also expected that the messaging infrastructure components will be located within the same physical network proximity as the messaging system they are servicing. Cisco Unity will use these messaging infrastructure components just as they are used by the messaging system and its clients. None of the messaging deployment models for Cisco Unity consider or support messaging systems where the messaging infrastructure components are remotely separated from the messaging system that Cisco Unity is expected to service. This is an important distinction between what is possible and what is practical as a sustainable solution. The primary reason for this rather strict adherence to pure messaging models (where all messaging infrastructure components are co-located within close physical proximity to the messaging system they service) is to improve the likelihood of acceptable response times between Cisco Unity and its subscribers.

There are three primary messaging deployment models for Cisco Unity: single site messaging, multi-site WAN with centralized messaging, and multi-site WAN with distributed messaging. In some cases, a large-scale deployment will contain more than one messaging deployment model.

Single Site Messaging

In a single site messaging deployment model, the messaging system and the messaging system infrastructure components are all located in the same site. This site can either be one physical location or several buildings in a campus interconnected via a high-speed campus network backbone. All clients of the messaging system are located at the single site. There may be WAN connectivity to remote sites, but the remote clients do not access the messaging systems over the WAN.

When deployed in a single site, Cisco Unity can be deployed in a Unified Messaging or a Voice Messaging configuration[1].

Multi-Site WAN with Centralized Messaging

In a centralized messaging deployment model, the messaging system and the messaging system infrastructure components are all located in a centralized location. This location can either be one physical location, which is typical, or part of a campus. Clients of the centralized messaging system will be both local and remote. The remote clients access the centralized messaging system over a WAN connection from their remote offices.

When deployed in a multi-site WAN with centralized messaging, Cisco Unity can be deployed in a Unified Messaging or a Voice Messaging configuration[2]. Cisco Unity can service both local and remote clients via the TUI. Local and remote clients should experience no difference in the TUI; however, the GUI experience will be different. The local clients can use VMO or the DUC client (depending upon whether Cisco Unity is implemented with Exchange or with Domino) and they can also use features such as TRAP and message streaming. Local clients can also use the Cisco Unity Inbox, accessed via the CPCA. Remote clients, however, will not be able to use TRAP and messaging streaming over the WAN. In fact, if they use a GUI client such as VMO or the DUC client, they should download messages before playback and also be configured not to use TRAP.

Multi-Site WAN with Distributed Messaging

In a distributed deployment model, the messaging systems and their messaging infrastructure components are co-located in a distributed fashion. There may be several locations, each with its own messaging system and messaging infrastructure components. All clients access their messages locally, because each is co-located with its messaging system. The messaging systems share a messaging backbone that spans to all locations. Thus, though the messaging systems are distributed, they still can deliver messages to a messaging backbone through a hub-and-spoke type of message routing infrastructure. The model can also be more elaborate, for example by including redundancy paths, and containing multiple hub-and-spoke configurations for message routing.

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1 All Cisco Unity Voice Messaging solutions use Microsoft Exchange 2000.

2 All Cisco Unity Voice Messaging solutions use Microsoft Exchange 2000.

When deployed in a multi-site WAN with distributed messaging, Cisco Unity can be deployed in a Unified Messaging or Voice Messaging configuration[3]. Cisco Unity will be co-located with the messaging systems it services. No messaging system should be separated from Cisco Unity via WAN connectivity. In a distributed messaging deployment model all subscribers are co-located with Cisco Unity just as they are co-located with their messaging system. This model is similar to many single-site messaging models, with a messaging backbone added to connect them.

Messaging Failover

There are two types of failover available with Cisco Unity. Both types require access to the same messaging systems and messaging infrastructure components. There is local failover, in which both the primary and secondary failover servers are co-located in the same physical site as the messaging system they service. There is also remote failover, where the primary and secondary failover servers are located in separate physical sites. In a remote failover configuration, the network connectivity should be no less than 100 Mbps between the sites, and the messaging systems and messaging infrastructure components must be accessible by both Cisco Unity servers. (Note that messaging infrastructure components include domain controllers and/or directory servers, global catalog servers, and name resolution hosts.) Regardless if your network connectivity bandwidth is at or greater than 100 Mbps, the response time between the Cisco Unity server and the Exchange servers it is connected to should be no more than a 40-millisecond round trip delay in order for Cisco Unity to service subscriber TUI requests normally.

Site Classification

To classify a site, determine the following:

- Where the e-mail clients are in relation to the messaging system they access.
- Where the messaging infrastructure components are located in relation to the messaging system they service. It is crucial that you verify that these messaging infrastructure components are in place to support Cisco Unity, just as they should be in place to support the messaging systems and clients to which they are connected.

When designing a Cisco Unity implementation, you must classify your sites before you can determine how Cisco Unity can best be deployed. When you know where your messaging systems are located, you should also be able to tell where Cisco Unity can be located, as it should be located in the same physical proximity to the messaging systems it will service.

IP Telephony Deployment Models

As mentioned at the beginning of this section, Cisco Unity requires both a messaging deployment model and a call processing deployment model for any Unity design.

Descriptions and use of IP Telephony deployment models can be found in the latest SRND for IP Telephony. However, Cisco Unity-specific dependencies for each combination can be found in this design guide.

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[3] All Cisco Unity Voice Messaging solutions use Microsoft Exchange 2000.

Deployment Model Combinations

Because Cisco Unity uses a messaging deployment model first, they are listed that way below. The design requirement therefore is to determine Unity's placement with the messaging deployment model prior to determining Unity's placement with the CallManager server or cluster it will connect to. For legacy PBX integrations, the cabling distance required between Cisco Unity and the legacy switch may dictate where Cisco Unity is located, but this is the only rule that may override the design requirement to place Unity as near as possible to the messaging system it will service. However, this does not mean that Cisco Unity should be deployed across a WAN from the messaging system. In fact, if this is the only option you have, then you do not have a deployable and sustainable solution for Cisco Unity.

Possible deployment model combinations include:

- Single Site Messaging and Single Site Call Processing
- Centralized Messaging and Centralized Call Processing
- Distributed Messaging and Centralized Call Processing
- Centralized Messaging and Distributed Call Processing
- Distributed Messaging and Distributed Call Processing

An acceptable failover deployment model combination is remote failover and Cisco CallManager clustering at the two Cisco Unity-specific failover locations only.

Network Traffic and Bandwidth Requirements

Cisco Unity depends on the infrastructure into which it is installed, so careful design consideration must be given to the amount of network traffic and the bandwidth available to Cisco Unity.

Cisco Unity depends on the timely responsiveness of the messaging systems it connects to. To prevent unwanted delays in recording and playing messages over the phone, always install Cisco Unity as close as possible to the messaging stores it services. The Cisco Unity server should always be in the same well-connected LAN, and in the same Domino domain or Windows 2000 domain.

Placement considerations include installing Cisco Unity into the same Windows 2000 site as the Exchange 2000 servers it services. Cisco Unity with Domino does not have this requirement. Also, Cisco Unity should be installed into the same VLAN as Exchange in order to avoid any unwanted delays with message waiting indicators. Cisco Unity for Domino does not have this requirement.

In addition, to prevent an unacceptable end user experience, adhere to the following requirements for connecting Cisco Unity to any messaging store it services (Microsoft Exchange or Lotus Domino, unless otherwise specified):

- A 100 Mbps or faster full-duplex network connection is required between the Cisco Unity server and the partner message store server.

- For Exchange 2000, Exchange 2003, or an Exchange mixed-mode environment, a 100 Mbps or faster full-duplex network connection is required between the Cisco Unity server and the DCs and GCs that service the message stores that home Cisco Unity subscribers.
- If Cisco Unity is integrated with Cisco CallManager, a 100 Mbps or faster full-duplex network connection is recommended between the Cisco Unity server and the Cisco CallManager server. However, when Cisco Unity is remotely connected with Cisco CallManager, it is acceptable to calculate the per-port bandwidth and necessary overhead. The aggregate total of bandwidth for all ports plus any necessary overhead should be the minimal bandwidth required.
- If the Cisco Unity server has two NICs, the NICs cannot be used for load balancing, either full or half duplex. If dual NICs are configured, we recommend that they be configured in adaptive fault tolerant (AFT) or network fault tolerant (NFT) mode. For additional information about dual NICs, refer to the "Customizing the Cisco Unity Platform" chapter in the *Cisco Unity Installation Guide*, available at http://www.cisco.com/en/US/products/sw/voicesw/ps2237/prod_installation_guides_list.html.
- For Exchange 2000, Exchange 2003, or an Exchange mixed-mode environment, the Cisco Unity server must not be separated by a firewall from the message store servers that home Cisco Unity subscribers, from the DCs and GCs that service those message store servers, or from other network resources necessary to operate normally.
- Cisco Unity cannot be connected to Exchange or Domino via a WAN connection.
- Cisco Unity failover servers may be on separate network segments or subnets. However, both servers must reside in the same Windows 2000 site, and both servers must directly connect to the DCs, GCs, message store servers, and other network resources necessary to operate normally. This is true even when using a remote failover deployment model.
- Subscribers who use IBM Lotus Domino Unified Communications Services (DUC) for Cisco Unity or ViewMail for Microsoft Outlook should not play or record messages over the phone if they must do so over a WAN connection (including streaming messages). This is important where Unity services remote clients in centralized messaging, centralized call processing deployment models.
- Use of the Cisco Unity Administrator and the Cisco Unity Assistant over a WAN should be kept to a minimum, especially if limited bandwidth is allocated for normal voice traffic. The Cisco Unity Inbox cannot effectively support message streaming over a WAN.
- Bandwidth requirements for connecting Cisco Unity with a SIP proxy server over a WAN have not been determined.

Connecting Cisco Unity with a Messaging System over a WAN

Cisco Unity cannot be connected over a WAN connection to a messaging system it supports, regardless of the bandwidth available. Cisco Unity must be installed with the messaging system and the messaging infrastructure components belonging to the messaging system. A WAN is a data communications network that serves users across a broad geographic area, often using transmission devices provided by common carriers, for example Frame Relay, SMDS, and MPLS. WAN speeds may vary, but are typically any speed lower than a 100Mbps Full Duplex Ethernet network.

A WAN is a computer and voice network bigger than a city or metropolitan area.

A WAN may be in place, and in fact most of the Cisco Unity deployment models have a WAN. However, Unity may or may not use the WAN connectivity to service subscribers, but it will not remotely connect to a mailstore in order to service subscribers.

Using Firewalls with Cisco Unity

Cisco Unity can coexist with firewalls. However, note the following:

- Cisco Unity should never be deployed outside of a firewall. Doing so can expose the Cisco Unity server to unwanted intrusion from the Internet, even if the server is hardened.
- Cisco Unity should never be separated by a firewall from the partner Domino or Exchange server or from any Domino or Exchange server that homes Cisco Unity subscribers.
- The best way to use the Cisco Unity Administrator, the Cisco Unity Assistant, or the Cisco Unity Inbox through a firewall is by using a virtual private network.

  Opening the firewall by filtering specific ports and protocols is a configuration challenge because the Cisco Unity Administrator, the Cisco Unity Assistant, and the Cisco Unity Inbox all use DCOM. Configuring DCOM to work through a firewall requires a significant amount of configuration (including opening several ports and port ranges) and testing. In addition, Network Address Translation (NAT) cannot be used because it is not supported by DCOM.

  Cisco Unity can be configured to use DCOM over HTTP, so HTTP can be opened up through the firewall directly into Cisco Unity. However, note that this configuration exposes Cisco Unity to potential threats that a web server might be exposed to from the Internet, including denial-of-service attacks, viruses, and hacking of sensitive information.

Processing Impact of Third-Party Applications Installed on the Cisco Unity Server

If third-party applications (for example, virus scanning software or backup software) are installed on the Cisco Unity server, we recommend that these applications not be started unless CPU usage remains below 70 percent while the system is under normal call traffic loads.

Access for Cisco TAC

The Cisco Technical Assistance Center (TAC) requires that Windows Terminal Services and at a minimum a modem are installed on the Cisco Unity server, thus giving support analysts access the server remotely, if necessary. The modem need not be connected to a phone line at all times; the customer can hook it up only when Cisco TAC requires access. The recommended method for remote TAC support is via a higher speed connection directly via the Internet. A VPN can be used to secure the remote access.

Audio Codecs

A codec is a coder/decoder algorithm or a compression/decompression algorithm. Codecs are used to encode/decode or compress/decompress various types of data that would otherwise use up large amounts of disk space, such as sound and video files. Cisco Unity uses audio codecs with streaming (live conversation) content and file-based (WAV file voice message) content.

The following audio codecs are supported for use with all versions of Cisco Unity:

- G.711 Mu-Law (the default codec)
- G.711 A-Law
- G.729a
- Intel Dialogic OKI ADPCM 8 kHz
- Intel Dialogic OKI ADPCM 6 kHz
- GSM 6.10

In addition, the G.726 codec is supported for use with a Cisco Unity version 4.0(1) or later system that is running Microsoft Exchange and using the Voice Profile for Internet Messaging (VPIM) networking option.

Codec Overview

Coding techniques are standardized by the International Telecommunications Union (ITU), headquartered in Geneva, Switzerland. The ITU is an international organization within which governments and the private sector coordinate global telecom networks and services. The two ITU G-series codecs that are fully supported by Cisco Unity—G.711 and G.729a—are among the most popular standards for Voice over IP (VoIP) applications.

G.711

The G.711 codec is the standard format for digital voice delivery in the public switched telephone network (PSTN) and through PBXs. It is widely used in the telecommunications field because it improves the signal-to-noise ratio without increasing the amount of data.

There are two subsets of the G.711 codec: Mu-Law and A-Law. Mu-Law is used in North American and Japanese phone networks, while A-Law is used in Europe and elsewhere around the world. (Sometimes these codecs are known as CCITT Mu- Law and CCITT A-Law. CCITT stands for the Comité Consultatif Internationale de Télégraphie et Téléphonie, the former French name of the ITU. The name lives on in some applications.)

Both Mu-Law and A-Law subsets use compressed speech carried in 8-bit samples. They use an 8-kHz sampling rate with 64 Kbps storage.

G.711 is supported by Cisco Systems, Intel Dialogic, and many other hardware manufacturers. It is also supported by Microsoft in all versions of its server and client operating systems.

To play messages recorded in G.711 format, Cisco Unity subscribers can use Cisco Unity ViewMail for Microsoft Outlook, IBM Lotus Domino Unified Communications Services (DUC) for Cisco Unity, Sound Recorder, or any other audio application that uses the Audio Compression Manager to decompress the audio signal.

G.711 MuLaw must be selected as the message recording and storage codec if you are using the Cisco Unity TTY language. Cisco Unity TTY is not compatible with G.729a or other message recording and storage codecs.

G.729a

The G.729 codec is a high-complexity algorithm, and G.729a (Annex A) is a medium-complexity variant of G.729. The undistorted, toll-quality speech ensured by this standard makes it a popular choice for applications such as teleconferencing, visual telephony, VoIP, cellular phones, and other wireless applications for which quality, delay, and bandwidth are important.

The advantage of G.729a is that it uses fewer digital signal processor (DSP) resources, making it easier to implement on lower- performance, less expensive DSP chips. G.729a uses an 8-kHz sampling rate with 8 Kbps storage.

G.729a is supported by Cisco Systems and many other hardware manufacturers. Note that G.729a is represented as G.729ar8 in some applications, including Cisco IOS gateways.

While some reports rate G.729a audio quality not as good as G.711, others rate it from very acceptable to astounding. One source said: “I recently experienced a LAN-based call using the G.729a codec and stood next to the person calling me. I could detect no perceptible delay between the direct path, his mouth to my ear, and the link across the network. If I had not known otherwise, I would have sworn it was a normal PSTN call. This codec is the future of Internet telephony.”

To play messages recorded in G.729a format, Cisco Unity subscribers must use either ViewMail for Microsoft Outlook or DUC for Cisco Unity, or download the G.729a codec to their desktops.

A second medium-complexity variant of G.729 exists and is known as G.729b (Annex B). G.729b does not interoperate with G.729a, and the G.729b codec is not supported for use with Cisco Unity.

ADPCM

The adaptive differential pulse code modulation (ADPCM) method of encoding sound data files takes up less storage space than the regular PCM format used by WAV, AIF, and CD audio. The algorithm encodes the difference between actual audio sample amplitude and predicted amplitude, and adapts resolution based on recent differential values.

Many versions of ADPCM exist. Cisco Unity supports two options for Intel Dialogic OKI ADPCM: an 8-kHz sampling rate with 32 Kbps storage, and a 6-kHz sampling rate with 24 Kbps storage.

OKI ADPCM is a hardware-based compression method that is used by Intel Dialogic analog voice cards. This method provides a data-compression alternative to G.711 for a traditional PBX integration. However, when used with an IP phone system integration, ADPCM compression and decompression happens at the CPU level, which can have a performance impact on a heavily loaded system.

OKI ADPCM is not compatible with Microsoft Windows ADPCM. To play recorded messages, Cisco Unity subscribers must use either ViewMail for Microsoft Outlook or DUC for Cisco Unity, or download the codec to their desktops.

To use the VPIM networking option when the OKI ADPCM codec is used for message recording and storage on Cisco Unity, the OKI ADPCM codec must be installed on the Exchange Voice Connector server.

G.726

The G.726 ADPCM voice codec, available from a variety of vendors, is used in many applications that require high-quality, robust speech reproduction, such as video conferencing systems, multimedia, flight recording, ISDN, and satellite communications.

In Cisco Unity version 4.0(1) and later with Microsoft Exchange, G.726 32 Kbps is used for outgoing VPIM messages from the Cisco Unity Exchange Voice Connector and is also supported for incoming VPIM messages.

G.726 is not recommended for system-wide voice message recording and storage on Cisco Unity. G.726 is also not supported as a region (line) format for a Cisco CallManager integration.

If VPIM messages are stored in G.726, all Cisco Unity servers and subscriber workstations must have the G.726 codec installed.

GSM 6.10

The Groupe Speciale Mobile (GSM), or Global System for Mobile Communications, set of standards is a cellular network architecture that originated in Europe and is used worldwide. It was developed for the European digital cellular phone network to make the most of tight bandwidth, by analyzing and deriving a mathematical formulation of small sections of speech using a model of the human vocal tract.

GSM 6.10 uses an 8-kHz sampling rate with 13 Kbps storage. It is optimized for speech reproduction, is used in many Internet phone applications, and is not dependent on the cellular network.

A Microsoft version of GSM 6.10, sometimes referred to as MSGSM, is shipped with Microsoft Windows. MSGSM is fully compatible with GSM 6.10.

GSM 6.10 is supported for message storage on Cisco Unity with all phone system integrations, and for storage of incoming VPIM messages. It is not supported with a Cisco CallManager integration as a region (line) format.

A Cisco Unity site might want to use GSM 6.10 to minimize the disk space used by voice messages and to ensure that messages are playable, even when a recipient does not have ViewMail for Microsoft Outlook or DUC for Cisco Unity.

GSM 6.10 is also supported for playback on a Pocket PC, and is a higher quality recording format than MP3.

Network, Software, and Hardware Considerations That Impact Codec Choice

In sites with only one Cisco Unity server installed, a single codec is chosen for recording and storage. In a networked environment, different Cisco Unity servers may be configured with different recording and storage codecs to meet the needs of their sites. We do, however, recommend minimizing the number of different codes in use on a Cisco Unity system (for message recording and storage, Cisco CallManager region, prompts, VPIM, etc.) in order to reduce the need for transcoding and, thus, minimize CPU performance impact and preserve audio quality.

Typical considerations when choosing an audio codec for Cisco Unity include the type of network and bandwidth available, disk storage space available for voice messages and greetings, and associated hardware and software support.

The default codec, G.711, is recommended for the following connections:

- Traffic between analog phones and IP phones normally on the same LAN.
- Traffic between an analog or digital trunk and an IP phone.
- Traffic between an analog phone, analog trunk, or digital trunk and a Cisco Unity integration with Cisco CallManager.

If calls go through a WAN link with limited bandwidth, a codec with voice compression/decompression may be desirable, such as G729a. G.729a is also recommended for traffic between analog phones and remote IP phones using VoIP over the WAN. The benefits of reduced file size for voice messages and greetings can be seen in the database and local e-mail folders, as well as in reduced network traffic associated with transferring voice messages to and from Cisco Unity subscriber workstations. To minimize the performance impact of transcoding when G.729a is used over WAN connections or remote IPT sites, use Cisco hardware resources for transcoding, such as transcoders and G.729a WAN partitions in Cisco CallManager servers, rather than having the Cisco Unity server do all of the transcoding. Other codecs can be used by Cisco Unity. For more information, refer to the *White Paper: Audio Codecs and Cisco Unity (All Versions)* available at http://www.cisco.com/univercd/cc/td/doc/product/voice/c_unity/whitpapr/codecs.htm.

When using ViewMail for Microsoft Outlook in a low-bandwidth deployment or with a slower modem, remote subscribers should download messages before playing them for best performance and quality. (For information on setting up ViewMail for Microsoft Outlook for low-bandwidth deployment, refer to the *Cisco Unity System Administration Guide*. The guide is available at http://www.cisco.com/en/US/products/sw/voicesw/ps2237/products_administration_guides_list.html.)

Bandwidth is also an issue when dial-up lines to the Internet are used for calls and voice-message retrieval. In the PSTN world, the audio on the local loop is digitized into a 64-Kbps digital data stream and presented to the phone company central office equipment, which then compresses the data for transport across the phone system backbone. Because G.711 requires a minimum bandwidth of 64 Kbps in each direction for full-quality voice, the codec does not make it practical to make calls or retrieve messages across a dial-up Internet connection of 56 Kbps.

When estimating network bandwidth savings among the different codecs, it is important to take into account that bandwidth savings are realized only on the actual voice frames. The compression method affects the ratio of IP packet overhead data to actual voice frames per packet, and packetizing overhead of IP headers can account for considerable bandwidth consumption. In one study, Tolly Research found that G.711-encoded traffic averaged about 110 Kbps. As the ITU defines G.711 as 64 Kbps, the remaining 46 Kbps is IP overhead. Compressed G.729a traffic, which can reduce voice-frame bandwidth consumption to as little as 8 Kbps, was also found to be bogged down by as much as 80 percent IP packet overhead.

For Cisco Unity sites using text to speech (TTS), any supported codec may be used to record messages. However, TTS output is currently available only in G.711 and G.729a audio formats.

Messages must be stored in either G.711 or G.729a when the Cisco Unity Bridge is installed.

Codec choice does not affect AMIS messages. (AMIS is the Audio Messaging Interchange Specification protocol, an analog mechanism for transferring voice messages between different voice messaging systems.)

GSM 6.10 is supported for playback on a Pocket PC, and is a higher quality recording format than MP3. G.711 and G.729a usually are not compatible with hand-held computers.

Table 1 shows a summary of decision factors to consider when choosing a codec for Cisco Unity.

Table 1. Network, Hardware, and Software Considerations for Supported Codecs

Audio Codec	Recommended Deployment Model	Client Workstation Operating System Native Support	ViewMail for Microsoft Outlook or DUC for Cisco Unity	Additional Supported Hardware and Software
G.711 Mu-Law and A-Law	• Single site messaging with single site call processing • Distributed messaging with distributed call processing	Windows	Not required	• Cisco CallManager • Cisco 7960 phones • Intel Dialogic voice cards • TTS output • Microsoft NetMeeting

Audio Codec	Recommended Deployment Model	Client Workstation Operating System Native Support	ViewMail for Microsoft Outlook or DUC for Cisco Unity	Additional Supported Hardware and Software
G.729a	• Centralized messaging with centralized call processing • Centralized messaging with distributed call processing • Distributed messaging with centralized call processing	Codec available from Cisco for Cisco Unity subscribers only	Required, if codec is not installed on workstation	• Cisco CallManager • Cisco 7960 phones • TTS output
OKI ADPCM 8 kHz	• Single site messaging with single site call processing • Distributed messaging with distributed call processing	Codec available from Cisco	Required, if codec is not installed on workstation	Intel Dialogic voice cards
OKI ADPCM 6 kHz	• Single site messaging with single site call processing • Distributed messaging with distributed call processing	Codec available from Cisco	Required, if codec is not installed on workstation	Intel Dialogic voice cards

Audio Codec	Recommended Deployment Model	Client Workstation Operating System Native Support	ViewMail for Microsoft Outlook or DUC for Cisco Unity	Additional Supported Hardware and Software
G.726 32 Kbps	• Centralized messaging with centralized call processing • Centralized messaging with distributed call processing • Distributed messaging with centralized call processing	Codec available from third-party vendors	Not required (codec must be installed on workstation)	Cisco Unity Exchange Voice Connector
GSM 6.10	• Single site messaging with single site call processing • Centralized messaging with centralized call processing • Centralized messaging with distributed call processing • Distributed messaging with centralized call processing	Windows	Not required	GSM wireless handsets

Table 2 shows a summary of codec considerations for Cisco Unity networking options.

Table 2. Networking Interoperability Comparison for Audio Codecs

Networking Option	Supported Codecs
AMIS	The AMIS protocol is not dependent on audio format. The Cisco Unity servers may use any of the supported codecs.
Cisco Unity Bridge	Octel Analog Networking is not dependent on audio format. The Cisco Unity servers must use either G.711 or G.729a in order to communicate with the Cisco Unity Bridge servers.
VPIM	VPIM supports the audio formats G.711, G.726, and GSM 6.10. The Cisco Unity servers may use any of the supported codecs.

Stored voice messages can consume considerable amounts of disk space. The amount of storage a WAV file uses depends on what kind of compression the codec uses, if any. The higher the compression, the smaller the file and the smaller the disk-space impact on the database and at the subscriber workstation. However, some sound-quality reduction and some CPU processing overhead may result when compressing messages during recording and decompressing at playback.

As illustrated in Table 3, voice messages recorded in G.711 Mu-Law and A-Law require the most disk space to store, while G.729a offers the smallest file size.

> **Note:** Audio quality ratings are subjective, and are provided here only for basic comparison between the different fully supported codecs.

Table 3. Voice Message File Sizes and Audio Quality Ratings

Audio Codec	Approximate File Size, 1-Minute Message	Quality Rating
G.711 Mu-Law and A-Law	480 KB	Excellent
G.726 32 Kbps	240 KB	Fine
OKI ADPCM 8 kHz	240 KB	Fine
OKI ADPCM 6 kHz	180 KB	Fine
GSM 6.10	98 KB	Good
G.729a	60 KB	Good

We recommend using G.711 whenever possible, because of its excellent quality for recording and playback. However, if bandwidth, disk space, Active Directory impact, or any other customer-site issue requires it, it is fine to use G.729a. G.729a is a voice-quality codec, and should be used when it is needed. Also consider the possibility that a large-scale or multiserver deployment may require the use of more than one codec.

For information on how codec choice affects Active Directory, refer to the *White Paper: Active Directory Capacity Planning (Cisco Unity Versions 4.0, 3.1, and 3.0(3) and Later with Microsoft Exchange)*, available at http://www.cisco.com/univercd/cc/td/doc/product/voice/c_unity/whitpapr/adsizing.htm.

Packetization

The Real-Time Transport Protocol (RTP) is used to send and receive audio packets over the IP network. Each discrete packet has a fixed-size header, but the packets themselves can vary in size, depending on the size of the audio stream to be transported (varies by codec) and the packetization setting. This variable size function helps utilize network bandwidth more efficiently—reducing the number of packets created per call sends fewer total bytes over the network.

Packetization is set in the CallManager Service Parameters, in the Preferred G711 Millisecond PacketSize and Preferred G729 Millisecond PacketSize parameters. When integrated with Cisco CallManager version 3.1 or later, and when using Cisco Unity-CM TSP version 7.0(3) and later, Cisco Unity supports any packet size up to 30ms for G.711 audio, and any packet size up to 60 ms for G.729a audio. The default setting is 20ms for both, and there can be latency issues with lower settings.

DSCP is a priority setting on each packet. DSCP helps intermediary routers manage network congestion and lets them know which packets to prioritize ahead of others. Following Cisco AVVID standards, the Cisco Unity-CM TSP marks the SCCP packets (call control) with a default DSCP value of 26 (the TOS octet is 0x68), and the RTP packets (audio traffic) with a default DSCP value of 46 (the TOS octet is 0xB8). Thus, the RTP audio packets can be assigned priority over other packets by using the router settings. Note that even though Cisco CallManager allows you set different DSCP values, when integrated with Cisco Unity, the DSCP values set by the Cisco Unity-CM TSP always take precedence.

With each new audio stream (once per call), Cisco CallManager tells Cisco Unity which packet size to use, and the Cisco Unity- CM TSP sets the DSCP priority for the stream. The entire stream (call) stays at the specified packet size and priority. For example, an audio stream could be broken up into packets of 30ms each. A 30ms G.729a audio stream would be 30 bytes plus the header per packet, and a 30ms G.711 stream would be 240 bytes plus the header per packet. For information on setting CallManager Service Parameters, refer to the Cisco CallManager documentation, available on Cisco.com.