White Paper: Cisco Unity Data Architecture and How Cisco Unity Works

Published April 12, 2002

Overview

Cisco Unity interacts with several other applications, including Microsoft SQL Server 2000 or Microsoft Data Engine (MSDE), Microsoft Exchange 2000 or Microsoft Exchange 5.5, and Active Directory (if messages are stored in Exchange 2000). This white paper explains where Cisco Unity stores data and then explains what happens behind the scenes when you perform basic operations, including leaving a voice message, listening to a voice message, and changing subscriber information.

Where Cisco Unity Stores Data

Cisco Unity stores data in a variety of locations, as described in the following topics:

Voice Messages Are Stored in Exchange 2000 or Exchange 5.5

Cisco Unity can store voice messages in the Exchange 2000 message store, the Exchange 5.5 message store, or both. For some Cisco Unity configurations, Exchange is installed on the Cisco Unity server, and all Cisco Unity subscribers have their Exchange mailboxes on the Cisco Unity server. (A Cisco Unity subscriber is someone who has an Exchange mailbox and whose Active Directory or Exchange 5.5 account includes Cisco Unity-specific information.)

For other Cisco Unity configurations, Exchange is installed on one or more other servers instead of or in addition to being installed on the Cisco Unity server. For these configurations, some or all subscribers may have their Exchange mailboxes on other Exchange servers.

Cisco Unity can service subscribers on multiple Exchange servers. You specify one Exchange server through which Cisco Unity communicates with the other Exchange servers. In this case, Cisco Unity can communicate with Exchange installed on the Cisco Unity server or with Exchange installed on a separate server.

Cisco Unity can also service subscribers on both active/active and active/passive clusters. For active/passive clustering, Cisco Unity can service subscribers only on two-node clusters. Do not install Cisco Unity on a server in an Exchange cluster.

Cisco Unity does not support Exchange 5.5 clustering.

All Subscriber Information Is Stored in a SQL Server 2000 Database

Cisco Unity 3.x stores all information about Cisco Unity subscribers, as well as selected Cisco Unity configuration data, in a SQL Server 2000 or Microsoft Data Engine (MSDE) database on the Cisco Unity server. (The number of voice ports on the Cisco Unity server and, therefore, the number of subscribers the server can support, determines whether data is stored in SQL Server 2000 or in MSDE, which is a data engine that is fully compatible with SQL Server 2000.)

When two or more Cisco Unity servers are added to the same Active Directory forest or Exchange 5.5 directory, the SQL Server 2000 database on each Cisco Unity server also includes a small amount of information about all of the subscribers on the other Cisco Unity servers. (For Exchange 5.5, the SQL Server 2000 database on each Cisco Unity server may include subscribers for every Cisco Unity server in the Exchange organization or only for the servers in the current Exchange site. This scope is specified on each Cisco Unity server.)

By storing all subscriber data in a SQL Server 2000 database, Cisco Unity provides the following benefits:

- **Performance:** Because the SQL Server 2000 database is on the Cisco Unity server itself and because the data is heavily indexed, accessing data—including looking up subscriber extensions—is fast. There is no limit to the maximum number of Cisco Unity subscribers in a Global Address List (GAL).

- **Reliability:** Because subscriber data is stored on the Cisco Unity server, Cisco Unity can answer calls, let outside callers look up subscriber extensions, and take messages when the Exchange network is down. (While the Exchange network is unavailable, the messages are stored on the Cisco Unity server, and subscribers have access to those messages.)

- **Scalability:** SQL Server 2000 was designed to support the largest enterprise data processing systems, so there is more than enough room for storing the Cisco Unity data. Although MSDE has storage limitations that SQL Server does not, it is also more than adequate for the Cisco Unity configurations for which it is sold.

- **Network impact:** Only a small subset of subscriber information needs to be stored in the directory, and that information does not change frequently. Therefore, directory replication caused by changes to Cisco Unity data is minimal after subscriber accounts have been created.

Some Subscriber Information Also Appears in Active Directory or in the Exchange 5.5 Directory

A small amount of data that appears in the SQL Server 2000 database also appears in Active Directory or in the Exchange 5.5 directory. This information, mostly subscriber data (including the recorded voice name), is replicated in the directory for the following reasons:

- To enable Cisco Unity servers to communicate with one another
- To enable communication between Cisco Unity and other voice messaging systems

Cisco Unity uses a directory monitor to keep the data synchronized. For more information, see the "Data That Appears in Both the SQL Server 2000 Database and in the Directory Is Automatically Synchronized" section on page 6.

If you are using Exchange 2000, you need to extend the Active Directory schema with a few Cisco Unity-specific attributes. If you are using Exchange 5.5, Cisco Unity uses several Exchange 5.5 custom attributes. For more information about these attributes, refer to *White Paper: Cisco Unity Data and the Directory,* available on Cisco.com at http://www.cisco.com/univercd/cc/td/doc/product/voice/c_unity/whitpapr/datadir.htm.

Enabling Cisco Unity Servers To Communicate with One Another

When two or more Cisco Unity servers are added to the same Active Directory forest or Exchange 5.5 directory, each Cisco Unity server serves a distinct group of subscribers. (By default, the directory monitor searches the Exchange 5.5 directory at the site level. This scope can be expanded to the organization.) Allowing the servers to communicate with one another provides several benefits, including being able to administer subscriber accounts on all Cisco Unity servers from a single location, and giving callers the ability to leave messages for any subscriber, regardless of which Cisco Unity server the subscriber is associated with. To make this possible, two types of Cisco Unity data are stored in the directory:

- **A primary location object for each Cisco Unity server:** This unique identifier contains the addressing information that Cisco Unity needs to route messages to other Cisco Unity servers. The directory contains one primary location object for each Cisco Unity server in the forest (Active Directory) or in the Exchange site (Exchange 5.5).

- **Selected subscriber data:** The stored properties include the Cisco Unity server that the subscriber is associated with, the subscriber extension, and a recording of the subscriber name.

Because this information is stored in the directory, the information replicates to all domain controllers in the forest (if you are using Exchange 2000) or all Exchange 5.5 servers in the site (or organization, if appropriate), thus ensuring appropriate access to information.

For detailed information on adding two or more Cisco Unity servers to the same forest or Exchange 5.5 organization, refer to the *Networking in Cisco Unity* guide, which is available on Cisco.com at http://www.cisco.com/univercd/cc/td/doc/product/voice/c_unity/index.htm.

Enabling Communication Between Cisco Unity and Other Voice Messaging Systems

Cisco Unity supports the Audio Messaging Interchange Specification (AMIS) protocol, which provides an analog mechanism for transferring voice messages between different voice messaging systems. To send and receive voice messages via AMIS, you create a delivery location object for each remote voice messaging system. As with the primary location objects, which allow one Cisco Unity server to send messages to subscribers associated with another Cisco Unity server, delivery location objects contain the information necessary for Cisco Unity subscribers to exchange voice messages with people who are using another voice messaging system.

Beginning with version 3.1(3), Cisco Unity will also be able to communicate with Octel servers by using the Cisco Unity Bridge, which acts as a networking gateway between Cisco Unity servers and Octel servers. The Cisco Unity Bridge communicates with Octel servers by using the OctelNet analog protocol; it communicates with Cisco Unity servers by using the Digital Networking protocol, which is based on the Voice Profile for Internet Mail (VPIM) protocol, with proprietary extensions.

Because the servers use different protocols, Cisco Unity Bridge uses the concept of a node to translate messages as appropriate for each server. For the Octel node, Cisco Unity Bridge maintains a table that contains the Octel server name, unique serial number, and phone number. For the Unity node, it maintains another table that contains the Cisco Unity server name, assigned serial number, and domain name. By using these two tables, the Cisco Unity Bridge server can, for example, receive a message from an Octel node, look up the routing information from the Unity node table, reformat the information for the destination Unity node, and then send the message to the Unity node.

For detailed information on how Cisco Unity works with other voice messaging systems by using AMIS and/or the Cisco Unity Bridge, refer to the *Networking in Cisco Unity* guide, which is available on Cisco.com at http://www.cisco.com/univercd/cc/td/doc/product/voice/c_unity/index.htm. (Note that information about the Cisco Unity Bridge appears in the *Networking in Cisco Unity* guide beginning with the 3.1(3) version.)

Data That Appears in Both the SQL Server 2000 Database and in the Directory Is Automatically Synchronized

Some Cisco Unity information is stored in both the SQL Server 2000 database and in the directory. In addition, the data can be changed from within Cisco Unity (for example, you can change subscriber information by using the Cisco Unity Administrator), and from outside Cisco Unity (for example, you can change subscriber information by using Active Directory Users and Computers). Because this information can be stored and changed in two different locations, it must be regularly synchronized. Cisco Unity includes a directory monitor that keeps the directory synchronized with the SQL Server 2000 database. (There are separate directory monitors for Active Directory and for Exchange 5.5.) Every few minutes, the directory monitor checks for new, changed, and deleted objects, and replicates the information.

When two or more Cisco Unity servers are added to the same Active Directory forest, a global catalog monitor keeps the SQL Server 2000 database synchronized with the global catalog. This is how each Cisco Unity server gathers information on subscribers who are associated with other Cisco Unity servers.

Because the amount of data stored in the directory is so small, the impact of replication between the SQL Server 2000 database and the directory is minimal (except when you first create Cisco Unity subscribers by importing them in bulk from Exchange or from a text file).

Messages from Outside Callers Are Temporarily Stored on the Cisco Unity Server

All messages from outside callers are temporarily stored on the Cisco Unity server before they are forwarded to Exchange for storage in the subscriber mailbox. This allows Cisco Unity to continue functioning when the network connection is down between the Cisco Unity server and the Exchange servers, or when one or more Exchange servers are down.

While Exchange or the network is off line, Cisco Unity can still answer calls, allow outside callers to look up subscriber extensions, and record voice messages. During this time, subscribers who check their voice messages hear the Unity Messaging Repository conversation, which explains that their Exchange server is not available, but lets them access voice messages left since it went down. When the Exchange server or network is back on line, the voice messages stored in the messaging repository are routed to the subscriber mailboxes. (In some cases when a network connection or an Exchange server is down, subscriber-to-subscriber messages are also treated as outside caller messages and stored on the Cisco Unity server until they can be delivered to the appropriate mailbox.)

For more information, see the "An Outside Caller Leaves a Message" section on page 8 and the "A Subscriber Leaves a Message Over the Phone" section on page 9.

Some Subscriber Information and Configuration Settings Are Stored on the Cisco Unity Server

Selected recordings and configuration settings are stored in files on the Cisco Unity server, including subscriber greetings ("Hi, this is Pat and I am out of the office today..."), recorded voice names, and some phone system integration settings.

Some Configuration Settings Are Stored in the Registry

Selected server-specific configuration settings are stored in the Windows registry, including some phone system integration and logging settings.

How Cisco Unity Performs Basic Operations

See the following topics for an explanation of what happens when:

For a discussion of ViewMail for Microsoft Outlook, see:

For a discussion of the Cisco Unity Visual Messaging Interface, see:

An Outside Caller Leaves a Message

When an outside caller (also known as an unidentified caller) leaves a message, the following occurs:

1. A caller dials the subscriber extension. If the subscriber phone is busy or the subscriber does not answer, the phone system routes the call and information about the call, including the subscriber extension, to Cisco Unity.

2. Cisco Unity answers the call, looks up the subscriber extension in the Microsoft SQL Server 2000 database, retrieves and plays the subscriber greeting, and lets the caller leave a message.

   The subscriber greeting is stored in a file on the Cisco Unity server rather than in Active Directory or the Exchange 5.5 directory.

3. When the caller ends the call, the message is temporarily saved on the hard disk on the Cisco Unity server.

4. Cisco Unity gives the message to Exchange, which routes the message to the subscriber home server (if not the Cisco Unity server) and stores it in the subscriber mailbox. The message is identified as coming from the Unity Messaging System mailbox, which is homed on the Exchange server that Cisco Unity gives the message to.

    If the connection to the subscriber home Exchange server is down, Exchange queues up the message and attempts delivery at a specified interval (by default, every 10 minutes for 24 hours). If after 24 hours the message is still undeliverable, it is delivered to the Unaddressed Messages public distribution list, which is a distribution list automatically created by Cisco Unity.

    If the entire network is down or if the Exchange server that Cisco Unity communicates with is down, Cisco Unity retains the message on the Cisco Unity server until the network or Exchange is available again.

    If a subscriber mailbox is full, message delivery fails, and the message is forwarded to the Unaddressed Messages distribution list.

    Note that as long as Cisco Unity is running, it continues to answer calls, play greetings, and record messages.

5. Cisco Unity monitors every subscriber inbox individually, and promptly informs the subscriber that a message has arrived, regardless of the source of the call. (Some voice messaging systems activate message waiting indicators only when a message is left the phone.) Cisco Unity notifies the subscriber in one or more of the following ways:

    –   If the subscriber has a phone connected to the phone system and has no other new voice messages, Cisco Unity activates the subscriber message waiting indicator.

    –   If Cisco Unity is installed as a unified messaging system, the message appears in the subscriber e-mail inbox.

    –   Depending on how the subscriber configures personal options in ActiveAssistant, Cisco Unity can also call one or more phones or pagers, or send an e-mail to a text pager, to notify the subscriber that a new voice message has arrived.

A Subscriber Leaves a Message Over the Phone

Cisco Unity works much the same way when a subscriber leaves a message as it does when an outside caller leaves a message. The conversation that Cisco Unity plays for a subscriber is a bit different because a subscriber has options that an outside caller does not (for example, a subscriber has options for changing personal settings). In addition, the message is identified as coming from the calling subscriber instead of coming from the Unity Messaging System mailbox.

The main difference in what happens to subscriber messages—as opposed to messages left by outside callers—is when the network or one or more Exchange servers are down. In this circumstance:

- If the recipient's home Exchange server or the network connection to that server is down, the caller's home Exchange server holds the message until it can be delivered. (Voice messages between subscribers originate on the caller's home server.)

- If the caller's home Exchange server or the network connection to that server is down, and the caller calls the recipient's extension and is forwarded to Cisco Unity, the caller can leave a message. However, note that the message is identified as an outside-caller message from the Unity Messaging System mailbox.

- If the caller's home Exchange server or the network connection to that server is down and the caller calls Cisco Unity and tries to sign in as a subscriber, the sign-in attempt fails.

- If there are multiple Exchange servers on which Cisco Unity subscribers have their mailboxes, Cisco Unity sends messages through one of those Exchange servers. If that server or the network connection to that server is down, all subscriber-to-subscriber messages are treated as messages from outside callers and are stored on the Cisco Unity server until the Exchange server comes back up.

A Subscriber Listens to Messages Over the Phone

When a subscriber listens to messages over the phone, the following occurs:

1. The subscriber calls Cisco Unity and logs in by entering his or her extension and password.

If the phone system supports identified subscriber messaging (ISM), and if the subscriber is calling Cisco Unity from his or her office phone, entering the extension is not necessary.

2. Cisco Unity checks the SQL database to verify that the subscriber entered the correct password for the extension.

3. Cisco Unity logs into the Exchange mailbox of the subscriber by using MAPI.

   If the home Exchange server of the subscriber, the Exchange server that Cisco Unity communicates with, or the network connection to those servers is down, the Cisco Unity prompts explain that the mailbox is unavailable and then ask if the subscriber would like to listen to messages from outside callers. (These messages are available because they are stored on the Cisco Unity server, not on the home Exchange server of the subscriber.)

4. The subscriber follows the Cisco Unity prompts to listen to a message.

5. The message is streamed from the Exchange home server through the Cisco Unity server (if they are different servers) and through the phone system to the subscriber phone.

Note When a subscriber listens to messages over the phone, either by calling Cisco Unity directly or by using ViewMail, a port on the Cisco Unity server is used to play the messages. When a subscriber listens to messages by using ViewMail and speakers, no ports are used, which decreases the load on the Cisco Unity server and leaves ports open for other functions.

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6. The subscriber follows the Cisco Unity prompts to save or delete the message, or to listen to it again.

A Subscriber Does Not Have ViewMail or Is Using Another E-mail Application

If Cisco Unity is configured as unified messaging (and therefore voice messages are sent to subscriber e-mail inboxes), but you are using Microsoft Outlook without also using ViewMail for Outlook (or if you are using another e-mail application), voice messages appear in subscriber inboxes as e-mail messages

with WAV file attachments. In order for the subscriber to listen to messages, each subscriber computer must have a codec installed that corresponds to the format in which Cisco Unity is recording messages. By default, Cisco Unity records messages in G.711 format, which is natively supported by Windows. The recording format can be changed if necessary.

For more information about codecs, refer to *White Paper: Audio Codecs and Cisco Unity*, which is available on Cisco.com at http://www.cisco.com/univercd/cc/td/doc/product/voice/c_unity/whitpapr/codecs.htm.

You Add a Subscriber or Change Subscriber Information

When you change Cisco Unity subscriber data by using the Cisco Unity Administrator:

1. You log on to the Cisco Unity Administrator by using a Cisco Unity subscriber account that has the necessary class of service permissions.

2. You add subscribers by doing one of the following:

   – You enter information on the Subscriber pages in the Cisco Unity Administrator. The Active Directory or Exchange 5.5 account is created by the Cisco Unity service account, which owns selected Cisco Unity services.

   – You import accounts from Active Directory or from the Exchange 5.5 directory.

   – You import accounts from a text file.

3. Cisco Unity stores the information in its SQL Server 2000 database.

4. The Cisco Unity directory monitor synchronizes the information in the SQL Server 2000 database with information in Active Directory or in the Exchange 5.5 directory.

When you change Cisco Unity data by using another application (for example, you change subscriber data by using Active Directory Users and Computers), the Cisco Unity directory monitor automatically detects the change and replicates it to the SQL Server 2000 database.

How ViewMail for Microsoft Outlook Works

If ViewMail for Microsoft Outlook is installed on client computers, Outlook displays voice messages in a custom ViewMail form. This form is the standard Outlook e-mail form with the inclusion of a VCR-like control for recording and playing messages. If ViewMail is not installed, the voice message appears as an attachment to a regular e-mail.

You can record and send voice messages by using the phone or a computer microphone, and you can play voice messages by using the phone or computer speakers. Recording or playing messages by using the phone requires a voice port on the Cisco Unity server, while using a microphone or speakers does not.

Recording and Sending Voice Messages by Using the Phone

If ViewMail is configured to record messages by using the phone, the following occurs when a subscriber records and sends a message:

1. The subscriber clicks **New Voice Message** on the Outlook Actions menu or clicks the **New Voice Message** icon in the Outlook toolbar.

2. Outlook displays the ViewMail form.

3. The subscriber clicks the **Record** icon in the ViewMail form.

4. ViewMail asks Cisco Unity to create a file on the Cisco Unity server hard disk where a new voice message is stored until it is sent.

5. Cisco Unity creates the file and tells ViewMail that the file is available.

6. ViewMail asks Cisco Unity to place a call to the subscriber extension.

7. Cisco Unity calls the extension.

8. The subscriber answers the phone and records the message. While the subscriber is recording the message, ViewMail streams the message to the file on the Cisco Unity server hard disk.

9. When the subscriber hangs up, ViewMail tells Cisco Unity that recording is finished.

10. The subscriber clicks **Send**.

11. Cisco Unity sends the file to Exchange along with a request to create a new voice message with the file as an attachment.

12. Exchange creates the voice message and sends it.

Recording and Sending Voice Messages by Using a Microphone

If ViewMail is configured to record messages by using a microphone, the following occurs when a subscriber records and sends a message:

1. The subscriber clicks **New Voice Message** on the Outlook Actions menu or clicks the **New Voice Message** icon in the Outlook toolbar.

2. Outlook displays the ViewMail form.

3. The subscriber clicks the **Record** icon in the ViewMail form.

4. ViewMail asks Outlook to create a WAV file attachment.

5. While the subscriber records the message, ViewMail streams the message to the Outlook WAV file.

6. The subscriber clicks **Send**.

7. Outlook sends the message, with the WAV file attachment, to Exchange.

Listening to Voice Messages by Using the Phone

If ViewMail is configured to play messages through the phone, the following occurs when a subscriber plays a message:

1. The subscriber opens the message in Outlook, and clicks the **Play** icon.

2. ViewMail asks Exchange for the WAV attachment, and Exchange sends the attachment back.

3. ViewMail asks Cisco Unity to place a call to the subscriber extension.

4. Cisco Unity calls the extension.

5. The subscriber answers the phone.

6. ViewMail asks Cisco Unity to play the message.

7. Cisco Unity plays the message over the phone.

Listening to Voice Messages by Using Speakers

If ViewMail is configured to play messages through the speakers, the following occurs when a subscriber plays a message:

1. The subscriber opens a voice message in the Outlook inbox.

2. ViewMail streams the message from the home Exchange server. Streaming occurs on demand, regardless of network traffic.

Streaming can be disabled, so the message begins to play only after it has been completely downloaded to the subscriber computer.

3. ViewMail begins to play the message through the speakers on the subscriber computer.

How the Cisco Unity Visual Messaging Interface Works

The Cisco Unity Visual Messaging Interface (VMI) is a web page that lets users play and record voice messages. Subscribers are alerted to check for messages by the standard message waiting indicator, for example, a light on the phone. In addition, when Cisco Unity VMI message notification is set up, subscribers can receive an e-mail notification whenever a new voice message arrives. The e-mail includes a link to the URL for the Cisco Unity VMI Inbox. Cisco Unity VMI notification requires an SMTP gateway.

Cisco Unity VMI is a system key-controlled feature, and it can be accessed only if it is purchased. A subscriber with the proper class of service rights can access Cisco Unity VMI at the following URL: http://<server name>/web/vmi.

Recording and Sending Voice Messages by Using the Phone

If Cisco Unity VMI is configured to record messages by using the phone, the following occurs when a subscriber records and sends a message:

1. The subscriber clicks **Compose Voice Message** in Cisco Unity VMI.

2. Cisco Unity VMI asks Cisco Unity to create a file on the Cisco Unity server hard disk where a new voice message is stored until it is sent.

3. Cisco Unity creates the file and tells Cisco Unity VMI that the file is available.

4. Cisco Unity VMI asks Cisco Unity to place a call to the subscriber extension.

5. Cisco Unity calls the extension.

6. The subscriber answers the phone and records the message. While the subscriber is recording the message, the message is being sent to the file on the Cisco Unity server hard disk.

7. When the subscriber hangs up, Cisco Unity VMI tells Cisco Unity that recording is finished.

8. Cisco Unity sends the file to Exchange along with a request to create a new voice message with the file as an attachment.

9. Exchange creates the voice message and sends it.

Recording and Sending Voice Messages by Using a Microphone

If Cisco Unity VMI is configured to record messages by using a microphone, the following occurs when a subscriber records and sends a message:

1. The subscriber clicks **Compose Voice Message** in Cisco Unity VMI.

2. Cisco Unity VMI asks Cisco Unity to create a file on the Cisco Unity server hard disk where a new voice message is stored until it is sent.

3. Cisco Unity creates the file and tells Cisco Unity VMI that the file is available.

4. While the subscriber records the message, the message is being sent to the file on the Cisco Unity server hard disk.

5. When the subscriber clicks **Send**, Cisco Unity VMI tells Cisco Unity that recording is finished.

6. Cisco Unity sends the file to Exchange along with a request to create a new voice message with the file as an attachment.

7. Exchange creates the voice message and sends it.

Listening to Voice Messages by Using the Phone

If Cisco Unity VMI is configured to play messages through the phone, the following occurs when a subscriber plays a message:

1. The subscriber clicks a message in Cisco Unity VMI.

2. Cisco Unity VMI asks Cisco Unity to get the message from Exchange.

3. Cisco Unity gets the message from Exchange, and tells Cisco Unity VMI that the message has arrived.

4. Cisco Unity VMI asks Cisco Unity to place a call to the subscriber extension.

5. Cisco Unity calls the extension.

6. The subscriber answers the phone.

7. Cisco Unity plays the message over the phone.

Listening to Voice Messages by Using Speakers

If Cisco Unity VMI is configured to play messages through the speakers, the following occurs when a subscriber plays a message:

1. The subscriber clicks a message in Cisco Unity VMI.

2. Cisco Unity VMI asks Cisco Unity to get the message from Exchange.

3. Cisco Unity gets the message from Exchange.

4. Cisco Unity streams the message back to Cisco Unity VMI. Streaming occurs on demand, regardless of network traffic.

5. Cisco Unity VMI begins to play the message through the speakers as soon as a few seconds of the message are buffered in memory on the subscriber computer.