



Fax Services

Version History

Version Number	Date	Notes
1	08/20/2001	This document was created.

This document describes in detail how Cisco implements T.37 store-and-forward fax, and presents configuration guidelines and examples for both on-ramp and off-ramp fax gateways. It also describes how Cisco implements T.38 real-time fax and fax rollover, or *never-busy* fax, and presents configuration guidelines for those applications.

Fax Services contains the following sections:

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Fax Services Overview

Fax services enable store-and-forward fax gateways to take calls from Group 3 (G3) fax machines, convert the calls into e-mail messages, and then transport them over the Internet as e-mail attachments. At the terminating end of the call, another store-and-forward fax gateway receives the e-mail message, converts it back into a fax message, and delivers it to a G3 fax machine. The receiving store-and-forward fax gateway can also deliver received faxes as e-mail attachments, and can send standard e-mail messages that will be delivered as a fax to a standard G3 fax machine.

The International Telecommunication Union Telecommunication Standardization Sector (ITU-T) developed the T.30 recommendation (for PSTN fax) and adopted the Simple Mail Transfer Protocol (SMTP) for fax called Multipurpose Internet Mail Extensions (MIME) as part of the T.37 recommendation for store-and-forward fax on the Internet.

Fax services also includes support for ITU-T recommendation T.38 for G3 fax relay over IP networks, and real-time fax with spoofing. Using this standard, real-time fax gateways can deliver faxes to remote fax machines while the sending fax machines are still processing fax pages. With fax relay, the gateway receives an analog fax signal and demodulates it into its digital form using a fax modem. The digital,

demodulated fax is then packetized and sent over the IP network. At the receiving end, the fax gateway remodulates the digital fax packets into T.30 analog fax signals to be sent to the destination fax machine through a gateway modem.

Traditional Fax over Circuit-Switched Networks

Fax has a long tradition as a telephony application for sending documents between terminal devices. The phrase *traditional facsimile* or G3 fax is commonly used to denote implementations of ITU-T recommendations T.30 and T.4. The T.30 protocol describes the formatting of nonpage data, such as messages that are used for capabilities negotiation. The T.4 protocol describes the formatting of page data.

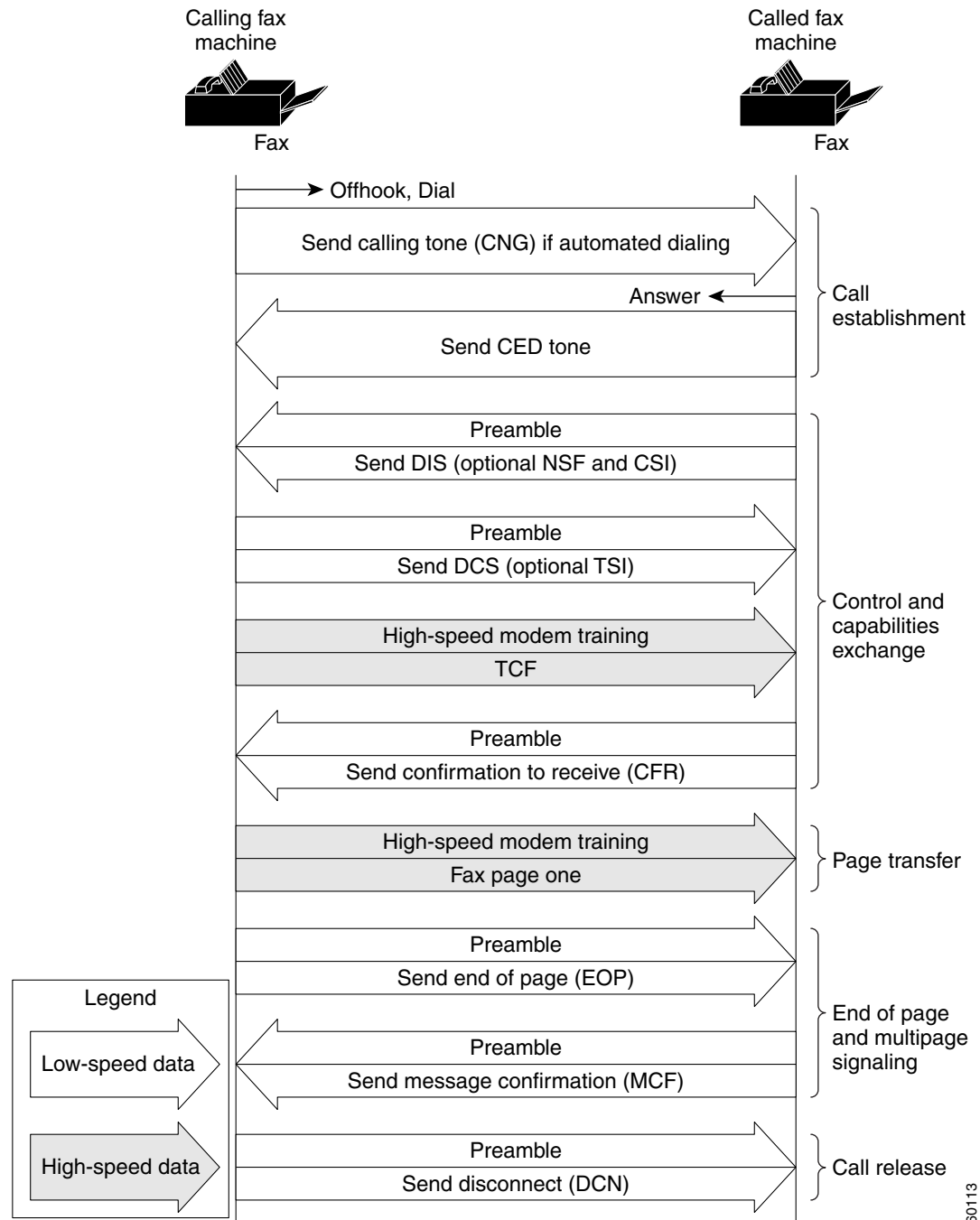
The transmission of fax data end to end is accompanied by two actions:

- Negotiation—to ensure that the scanned data can be rendered at the recipient
- Confirmation of delivery—to give the sender assurance that the final data has been received and processed

All fax machines use the V.21 protocol (300 baud) for the negotiation stage (LS fax) of fax transmission. The page transfer stage (HS) is negotiated at higher speeds (V.17, V.27, and so on).

Figure 1 illustrates a typical fax call flow.

Figure 1 PSTN Fax Call Flow



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The information conveyed in the transmission consists of both *protocol* and *document content*. Protocol comprises identification, control information, and capabilities. Document content consists primarily of the *document image* plus metadata accompanying the image. The *image data representation* is the means by which an image of a document is encoded within the fax content.

When the fax has been successfully sent, the sender receives a *confirmation*: an indication that the fax content was delivered. This confirmation is an internal signal and is not normally visible to the sender. Some error messages are visible, however, to allow a page to be re-sent.

The traditional fax is sent over the Public Switched Telephone Network (PSTN) using a point-to-point switched circuit for each call. At startup, the T.30 engines synchronize, negotiate connection and transmission parameters, send page data, signal success or failure, and then disconnect.

Reducing Fax Costs

The cost of using the PSTN for traditional fax transmissions can be very expensive, especially if the fax communication is international. Heavily used corporate fax machines can generate thousands of dollars of calling charges per month. When these long distance calls are instead sent over the Internet, the savings can be dramatic. Standards are currently being defined for two types of Internet (IP packet-based) fax: store-and-forward fax and real-time fax.

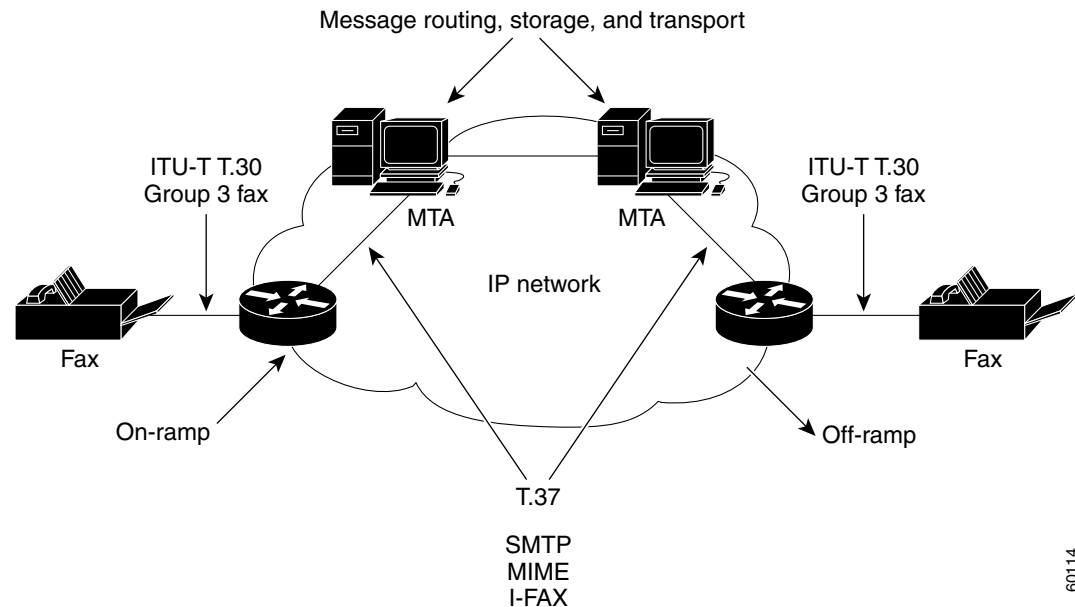
Store-and-Forward Fax and the T.37 Standard

Store-and-forward fax gateways can take calls from G3 fax machines, convert them into e-mail messages, and send them over the Internet. Another store-and-forward fax gateway at the terminating end of the call receives the e-mail message, converts it back into a fax message, and delivers it to a G3 fax machine.

Store-and-forward fax is generally sent as an e-mail attachment. An extension to SMTP called MIME is available for this fax service from the Internet Engineering Task Force (IETF). These standards are covered by RFC 2301 through 2306. Fax images are attached to e-mail headers and are encoded in Tag Image File Format (TIFF). TIFF-F describes the data format for compressed fax images.

The ITU-T developed the T.30 protocol and other fax standards, and has adopted the SMTP MIME protocol for fax as part of a new ITU-T standard called T.37. This standard defines store-and-forward fax by e-mail and has approved *simple mode* (RFC 2305). Extended, or *full mode*, is still under study. Simple mode restricts TIFF-F encoding to the *s-profile* (the minimal black-and-white subset of TIFF for facsimile), limiting fax transmission to only the most popular fax machine formats. These formats use Modified Huffman (MH) image compression with standard or fine resolution. In T.37 terminology, fax gateways can send faxes to a conventional PSTN-connected fax machine or to another fax gateway over an IP network. The originating (sending) gateway is referred to as an *on-ramp gateway*; the terminating (receiving) gateway is an *off-ramp gateway*.

Cisco fax gateways support ITU-T standard T.37 as independent on-ramp gateways, independent off-ramp gateways, or on-ramp and off-ramp combinations. Because the mail server first stores the fax message (page by page) and then forwards it, the confirmation that the sender receives is delayed. Although the lack of an immediate confirmation message is a disadvantage, store-and-forward fax has several advantages, including delivery at off-peak hours, sophisticated retry-on-busy algorithms, and the ability to broadcast a single fax to multiple receiving fax machines. Figure 2 illustrates the store-and-forward fax service model.

Figure 2 Store-and-Forward Fax Service Model

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Real-Time Fax and the T.38 Standard

Real-time fax gateways can deliver a fax to a remote fax machine while the sending fax machine is still processing fax pages. Delivery confirmation is the processing of the last page without an error message. In the real-time fax model, delivery confirmation is immediate.

The T.38 standard defines the IP network protocol used by Internet-aware T.38 fax devices and T.38 IP fax gateways. T.38 fax gateways provide the following functions:

- Demodulate incoming T.30 fax signals at the sending gateway
- Translate T.30 fax signals into T.38 Internet Fax Protocol (IFP) packets
- Exchange IFP packets between the sending and receiving T.38 gateways
- Translate T.38 IFP packets back into T.30 signals at the receiving gateway

You can deploy the ITU-T T.38 recommendation using two implementations:

- Fax relay
- Real-time fax with spoofing

These implementations differ in their ability to deal with IP network delay.

Fax Relay

With fax relay, the gateway receives an analog fax signal and demodulates it into its digital form using a fax modem. The digital, demodulated fax is then packetized and sent over the IP network. At the receiving end, the fax gateway remodulates the digital fax packets into T.30 analog fax signals to be sent to the destination fax machine through a gateway modem. There is no requirement that the gateway provide T.30 signals of its own, just fax modems and the T.38 IP data protocol.

Network delay becomes a factor when real-time fax is deployed. In controlled private data networks and networks that have been tuned for VoIP traffic, delay has been reduced to less than 500 milliseconds (ms) end to end and fax relay can be used effectively. If delays become too long, such as gateways employed over the Internet, where delay is not under direct administrator control, real-time fax with spoofing can be used.

Real-Time Fax with Spoofing

Spoofing techniques are used to extend the delay tolerance of fax machines. These techniques add to the T.30 protocol used by fax machines to communicate, keeping them on line beyond their normal T.30 timeout intervals. Extra line padding techniques, T.30 protocol spoofing, and sending redundant data are used to provide image packet jitter tolerance. Spoofing and jitter compensation allow the fax machines to tolerate network delay without losing communication. These mechanisms are sufficient for faxing over the Internet.

The T.38 standard defines different protocols, depending on the real-time fax transport mechanism used.

UDP/IP Transport

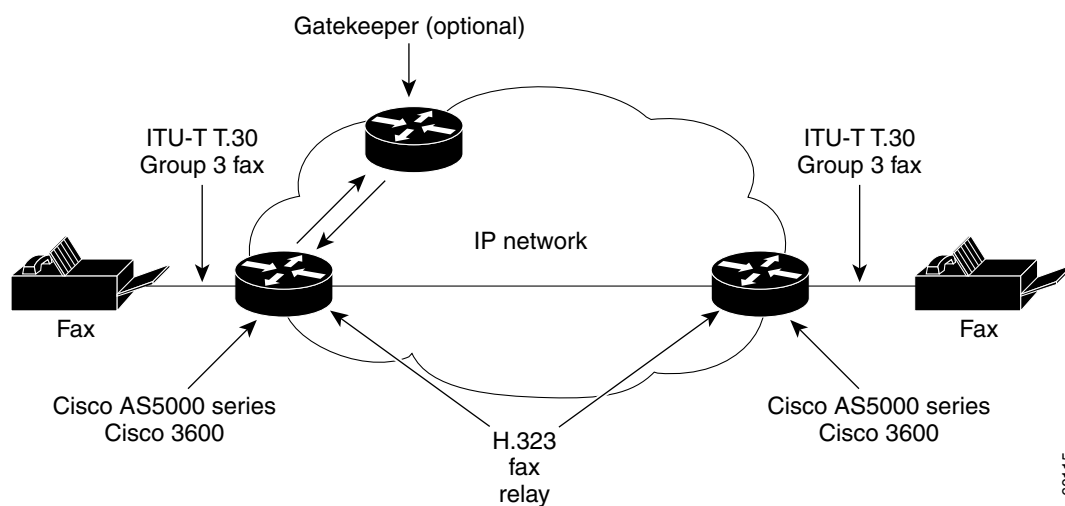
User Datagram Protocol (UDP) is a fast but unreliable transport protocol. The speed of UDP allows it to be employed for real-time fax without the need for spoofing. In addition, the T.38 protocol provides two methods to improve the reliability of the UDP transport mechanism. One method uses redundancy of the image data; the other uses a simple forward error correction (FEC) scheme.

TCP/IP Transport

Although TCP adds reliability through the use of error-checking mechanisms at each router it transits, it also adds delay. T.38 specifies a simple protocol for transport by TCP that includes no error checking.

The T.38 real-time fax-over-IP service model is illustrated in Figure 3.

Figure 3 Real-Time Fax Service Model



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The Cisco AS5300 access server and Cisco 3600 router families of voice gateways support both ITU-T recommendations: T.37 for store-and-forward fax, and T.38 for real-time fax as of Cisco IOS Release 12.1(3)XI. The Cisco MC3810 multiservice concentrator and Cisco 2600 router families support ITU-T recommendation T.38 as of Cisco IOS Release 12.1(3)T. The Cisco AS5300 also requires the recommended VCWare Version 7.16. The proper VCWare is bundled within Cisco IOS software for the Cisco 3600 series. Real-time fax works like a voice over IP (VoIP) call and requires no extra configuration. Store-and-forward fax configuration and testing are the focus of this document.

This document also explains the *never-busy* fax solution. This solution uses a Toolkit Command Language (TCL) Interactive Voice Response (IVR) script to *roll over* a T.38 fax that receives a busy signal into a T.37 fax. This feature is documented in a later section of this document.

Cisco T.37 Store-and-Forward Fax

Store-and-forward fax enables Cisco AS5300 voice gateways to send and receive faxes across packet-based networks without the timeout restrictions imposed by real-time fax transport methods. Store-and-forward fax is an implementation of the RFC 2305 and RFC 2532 proposed standards from the IETF. RFC 2305 proposes a standard aligned with the T.37 recommendation from the ITU-T. With this feature, your access server becomes a multiservice platform, providing both data and fax communication. Store-and-forward fax enables you to perform the following tasks:

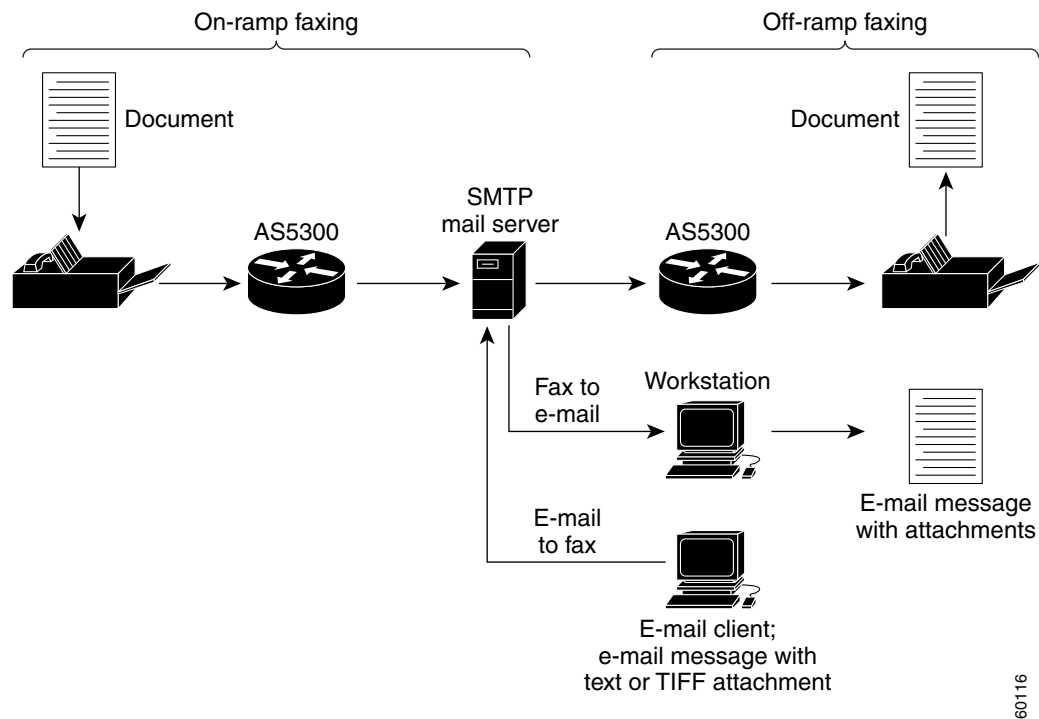
- Send and receive faxes to and from Group 3 fax devices
- Receive faxes that will be delivered as e-mail attachments
- Create and send a standard e-mail message that will be delivered as a fax to a standard Group 3 fax device

Store-and-forward fax functionality is facilitated through SMTP. Additional functionality described in RFC 2532, *Extended Facsimile Using Internet Mail*, confirms delivery using existing SMTP mechanisms. Examples of such mechanisms are delivery status notifications (DSNs) in RFC 1891 and message disposition notifications (MDNs) in RFC 2298.

When store-and-forward fax is configured, the on-ramp gateway receives faxes from traditional PSTN-based Group 3 fax devices and converts them into TIFF file attachments. It then creates a standard MIME e-mail message and attaches the TIFF files to it. The on-ramp gateway then forwards this fax mail to the messaging infrastructure of a designated SMTP server, where the fax-mail message is stored. The messaging infrastructure performs message routing, message storage, and transport, and can be either custom store-and-forward SMTP software or a standard Internet mail transport agent (MTA) such as UNIX sendmail or Netscape MailServer.

After the fax mail is stored on the SMTP server, it can be delivered in two ways: as an e-mail message with attachment, or as a fax to a standard PSTN-based Group 3 fax device. In the latter case, the SMTP server mail delivery infrastructure delivers the fax mail to the Cisco off-ramp gateway. The off-ramp gateway router converts the attached TIFF file back into standard fax format and sends the information to a standard PSTN-based Group 3 fax device. The off-ramp gateway is also responsible for generating DSNs and MDNs, as appropriate. This simple topology is illustrated in Figure 4.

Figure 4 Topology of Store-and-Forward Fax Functionality



Store-and-forward fax is used in conjunction with the VoIP software feature for Cisco voice gateways. The supporting digital signal processor (DSP) technology can be either c542 or c549. To understand the voice feature card (VFC) and VoIP technology and architecture, search for these topics on the Cisco website, www.cisco.com. To learn about VCWare and DSP technology in particular, refer to the following link:

http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/5300/hw_inst/mod_inst/53mvopv2.htm

Compatibility issues are addressed at the following link:

http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/5300/iosrn/vcwrn/vcwrmtx.htm

Handling of Enclosures

Store-and-forward fax can process e-mail with the following MIME media content types:

- Text/plain
- Text/enriched
- Image/TIFF (Group 3 Profile S [RFC 2301 Section 3] ImageWidth=1728)

The Cisco implementation uses an enriched *Profile S* media content type that allows modified read (MR) and modified modified read (MMR) image encoding. The important property of the TIFF images supported by Cisco gateways is that the TIFF image file descriptor (IFD) header precedes the actual TIFF data. This header location allows TIFF-to-fax conversion in streaming mode without storage of the TIFF image on the gateway. (Note that Cisco store-and-forward gateways support only the specific TIFF format described previously.)

Store-and-forward fax supports the following MIME content-transfer encodings:

- Seven-bit
- Eight-bit
- Base 64
- Quotable printable

These content transfer encodings can be wrapped in any multipart content type. Nesting of multipart (multipart-in-multipart) is not supported.

When a Cisco off-ramp gateway receives a message with the content type of multipart/alternative, it processes the first part of the multipart/alternative message and records a count of what was and was not successfully sent to the PSTN-based Group 3 fax device. The off-ramp gateway then discards the other parts of the message. For example, if a multipart/alternative message has two parts, a text/plain part and a text/HTML part (and the text/plain part is first), the off-ramp gateway sends only the first part (the text/plain part) to the PSTN-based Group 3 fax device.

**Note**

An e-mail client can determine the content type described. In the Eudora e-mail client, for example, content type is configurable in the **Tools > Options > Styled Text** section. If you choose the option **Send both plain and styled**, then that is the same as enabling multipart/alternative, and the behavior described in the preceding paragraph will be observed. Choosing **Send styled text only** enables multipart/* . If you want to send both text and TIFF attachments to an off-ramp fax gateway, you must choose **Send styled text only** in the Eudora client. Other e-mail clients have similar configuration options.

**Note**

The TIFF file format must conform to RFC 2301, *File Format for Internet Fax*. The Cisco off-ramp gateway does not support UUencoded files, JPEG, JBIG, Word, PDF, or multiraster content.

**Caution**

The Cisco off-ramp gateway recognizes only the listed file attachment types for store-and-forward fax activities. If the Cisco gateway receives a file format different from one of the defined acceptable formats, it discards the data.

T.37 Fax Connection Protocol

All fax machines use the 300-baud V.21 protocol for the negotiation stage (LS) of fax transmission. The page transfer stage (HS) is negotiated at higher speeds.

Image Encoding and Image Resolution

Depending on your specific needs, you might want to increase or decrease the resolution of the received fax image. As a default, image resolution in store-and-forward fax is set to *passthrough*, which means that the image is forwarded exactly as it is received. If you want to specify a different resolution for the fax TIFF image, whether greater or lesser, use the **image resolution** dial-peer configuration command as an attribute of the on-ramp Multimedia Mail over IP (MMoIP) dial peer.

Depending on the capacity of the fax machines in your network, you might want to use a different image encoding (compression) scheme for the fax TIFF image that store-and-forward fax creates. As a default, image encoding in store-and-forward fax is set to passthrough, which means that the image is forwarded exactly as it is received. If you want to specify a specific encoding (compression) scheme for the fax TIFF image, use the **image encoding** dial-peer configuration command as an attribute of the on-ramp MMoIP dial peer.

**Note**

The **image encoding** configuration command is an on-ramp-only command. Even though the command-line interface (CLI) will allow configuration of passthrough mode on the off-ramp dial peers, it is unacceptable to do so. Configuring encoding and resolution values on off-ramp dial peers can cause problems and should be avoided.

Quality of Service and Cisco T.37 Fax

Quality of service (QoS) is an important issue in voice packet networks and is discussed in detail elsewhere in this document. The following QoS mechanisms are employed in Cisco gateway-based T.37 fax to improve fax quality:

- Received fax data is checked for quality when it is totally decoded and reencoded in TIFF format.
- The Cisco IOS code has values for the allowed number of bad lines versus good lines in a page.
- Bad lines are recovered by replicating good lines.
- T.37 has some level of protocol deviation correction.
- Normal training and retraining occur in the initial message exchange.
- There is middle fax retraining, but no retransmissions.

Benefits of Cisco T.37 Store-and-Forward Fax

Cost Savings

The worldwide IP fax service market is projected to reach about \$2 billion by 2002. Analysts estimate that corporate customers can reduce their annual fax bills by 30 to 50 percent by using converged IP voice, data, and fax networks.

In addition, corporate users can continue to use their existing applications. For example, you can use existing e-mail programs such as Eudora, Netscape, or Outlook to send a fax by inserting a fax number in the To: field (for example, fax=+5551212@off-ramp.cisco.com) and then clicking the Send button. You can also send and receive both fax and e-mail messages from your private e-mail inboxes, and you can use existing standalone fax machines with no user retraining.

Universal Inbox for Fax and E-Mail

The Cisco AS5300 allows configuration of direct-inward-dial (DID) numbers to deliver faxes to a specific electronic mailbox. This feature greatly simplifies receiving faxes while traveling. Receiving e-mail on the road is commonplace, whereas receiving faxes on the road can be problematic. That problem is solved with store-and-forward fax mail.

E-Mail Can Be Sent as a Fax Transmission

The Cisco AS5300 can receive an e-mail message with both TIFF image files and text files attached, and then send that message to a PSTN-based Group 3 fax device. This feature allows you to easily combine e-mail and fax recipients from your existing user agent (Eudora, Netscape, Outlook) and send faxes to multiple recipients by using group e-mail aliases.

Toll Bypass

In an enterprise environment in which offices in different cities are connected by a WAN, you can bypass toll charges by sending faxes over the WAN to the same city as the PSTN-based Group 3 fax recipient and use the off-ramp gateway to deliver the faxes in that city. Because the fax message is stored on the mail server until SMTP forwards messages to the recipient, you can configure SMTP to forward fax e-mail attachments to the Cisco off-ramp gateway during off-peak hours (for example, during evenings and weekends), thereby reducing peak-time bandwidth demands. As another example, some estimates show that as much as 60 percent of all long distance traffic to Japan is faxes. Routing this fax traffic over e-mail data links represents a considerable savings potential.

Broadcast to Multiple Recipients

Because store-and-forward fax uses e-mail messages as the transporting vehicle for the fax, you can send e-mail fax attachments to multiple recipients by addressing the fax mail to an e-mail list alias. The e-mail server will generate multiple e-mails, one for each recipient on the list, and forward them to the off-ramp gateway for faxing.

Restrictions for Cisco T.37 Store-and-Forward Fax

Store-and-forward fax on-ramp faxing has been designed to work by using either the DID feature or a redialer. A redialer is an interface hardware device that interconnects between a fax device and the PSTN. If you choose to not enable DID, you must configure and enable a redialer on the originating fax machine for store-and-forward fax to be operational. And, you must add a TCL IVR script on the incoming dial peer that informs the processing engine to look for the second dialed number.

A third alternative is available that requires user training. This method entails setting up a two-stage dial scenario in which the caller first dials the access number of the on-ramp gateway, waits for a secondary dial tone, and then dials the actual destination fax machine number.

When implementing authentication, authorization, and accounting (AAA) for T.37 fax, you might need to use the H.323 *aaa method list* to perform authentication for both on-ramp and off-ramp faxes. The *aaa method list* is configured in the **aaa new-model** command component as shown in the following example. (The method list is the boldface item in the configuration lines.)

```
gateway1 (config)# aaa new-model
gateway1 (config)# aaa authentication login fax group radius
gateway1 (config)# aaa authentication login h323 group radius
```

You can include the fax method list in your configuration, but if you want authentication to succeed, you must configure the H.323 method list.

Accounting, also, is configured under the **aaa new-model** command component. For example:

```
gateway1 (config)# aaa accounting connection fax stop-only group radius
```

This configuration item is successful with the fax method list. Unfortunately, some TCL IVR scripts available on the Cisco website do not have the configuration line that supports accounting. When accounting is enabled using one of the faulty scripts, the debug output message received is:

```
moip_aaa_offramp: NULL acct list
```

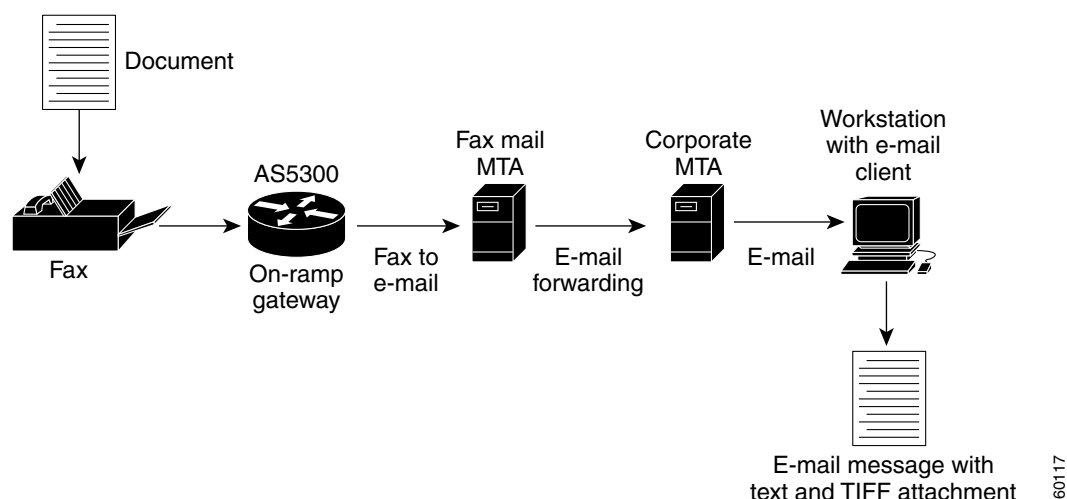
This message is an indication that accounting is not enabled in the TCL IVR script. The solution is to obtain a script in which accounting is enabled. The Cisco Technical Assistance Center (TAC) should be able to provide links to the proper scripts.

Configuration Guidelines for On-Ramp Store-and-Forward Fax

On-ramp store-and-forward fax functionality includes accepting a fax from a PSTN-based Group 3 fax machine, converting the fax to a TIFF file attachment, and then delivering that fax mail to an MTA. In this scenario, the fax mail will be delivered to the recipient e-mail account with the fax portion of the message contained in a TIFF attachment. If the fax portion is more than one page, the recipient is required to use a graphics program that can create a multipage TIFF file.

The on-ramp gateway can also be configured to forward the fax mail to an off-ramp gateway. For now, we will concentrate on the delivery to an MTA and subsequently to a recipient e-mail inbox. Figure 5 shows a model of an on-ramp gateway.

Figure 5 On-Ramp Fax Service Model



On-ramp gateway configuration is described in the following sections:

- Configuring On-Ramp Dial Peers
- Configuring On-Ramp TCL IVR and Call Application Parameters
- Configuring On-Ramp Fax Receive and MTA Send Parameters
- Configuring Other On-Ramp Variables

Configuring On-Ramp Dial Peers

Cisco fax-over IP technology uses the concept of dial peers to identify the properties of a call. Dial peers describe the entities to or from which a call is established. All voice technologies use dial peers to define the characteristics associated with a *call leg*. A call leg is a discrete segment of a call connection that lies between two points in the connection. An end-to-end call comprises four call legs, two from the perspective of the source route, and two from the perspective of the destination route.

You use dial peers to apply specific attributes (such a fax rate) to call legs and to identify call origin and destination. A dial peer can be incoming (answer) or outgoing (originate), and either from or to the PSTN (telephony) or from or to the IP network (VoIP). A call entering or leaving a voice gateway is identified with a dial peer configured in the gateway. This dial peer contains information about the call, including encoding technique, call properties, and how the call should be handled.

POTS Dial Peers

Plain old telephone service (POTS) dial peers can be thought of as the answering or destination number of the gateway. If a call is coming from the telephony side, the POTS dial peer is an answer telephony dial peer. If the POTS dial peer is sending a call to the PSTN, then it is an originate telephony dial peer. The line coming into the fax gateway is assigned one or more numbers by the service provider. These are the dialed numbers that the fax gateway answers. If the gateway dial-in port answers only one dialed number, then it can have only one POTS dial peer of significance. If the gateway is configured with more than one access number, these numbers can be differentiated by the configuration parameters in the POTS dial peers.

MMoIP Dial Peers

MMoIP dial peers can be thought of as a mapping between a dialed number and a data network location. In the case of on-ramp fax mail, that data network location is an e-mail address. VoIP dial peers are equivalent to MMoIP dial peers. They both serve the same function for different call types. MMoIP dial peers are used for T.37 fax; VoIP dial peers are used for voice and T.38 fax.

On-Ramp Dial Peer Call Routing

When the fax on-ramp gateway receives a call, it decides how to route the call based on the configuration of the gateway. The call-processing engine determines the call type according to the dialed number identification service (DNIS) that was received in the call setup messages. The DNIS is also referred to as the called party number.

After receiving the DNIS, the gateway examines its POTS dial peers and searches for a match between the DNIS (called number) and the incoming called number in a POTS dial peer. For example, consider a DNIS of 9991144 and the following POTS dial peer:

```
dial-peer voice 999 pots
  application on-ramp
  incoming called-number 99911..
  direct-inward-dial
```

The DNIS is matched as the called number in this POTS dial peer because the trailing digits are wildcards (the “.” represents one and only one legal digit). Because of the wildcards, all the numbers from 9991100 through 9991199 are matches. Finding a match, the on-ramp gateway next sees that the application named *on-ramp* and *direct-inward-dial* are configured on this dial peer.

The **application on-ramp** command tells the processing engine to look for a tool command language (TCL) interactive voice response (IVR) call application script reference in the call application parameters (to be discussed shortly). The **direct-inward-dial** command tells the gateway to look for an outbound MMoIP dial peer that matches the dialed number 9991144. In the following configuration

example, the gateway finds mmoip dial-peer 990. The **destination-pattern** command in the MMoIP dial peer matches the dialed number.

```
dial-peer voice 990 mmoip
  application fax_on_vfc_onramp_app out-bound
  destination-pattern 9991144
  information-type fax
  session target mailto:owner@domain.cisco.com
  dsn success
```

Assuming that there is an exact match, the on-ramp gateway now knows what to do with the call to 9991144: run the C-based application called fax_on_vfc_onramp_app with the argument out-bound. This application is compiled into Cisco IOS software for the purpose of setting up the fax call after all the authentication and other activities are successfully completed. If these activities do not successfully complete, the call is handed to the application with the failure flag set and the call is torn down.

After the preliminary steps are successfully completed, the application sets up the call with the destination specified in the **session target** command. In this example, it sends an e-mail with the fax content as a TIFF attachment to owner@domain.cisco.com. The session target is hard coded to represent a static address assignment; the hard-coded SMTP address requires an exact match to the dialed number in the dial peer.

Dynamic matching can be achieved with the following session target statement:

```
session target mailto:$d$@domain.cisco.com
```

This target statement could be matched to a range of dialed numbers. The \$d\$ substitution inserts the string fax=<dialed number> into the mailto: statement. After substitution, the session target (IP destination) becomes fax=<dialed number>@domain.cisco.com. An alias must be configured in the MTA that will accept fax=<dialed number>@domain.cisco.com and translate that address to a viable target e-mail address, which might be another off-ramp fax gateway or a normal user mailbox. The MTA alias procedure is covered in the section on mailers, but be aware that many MTAs are on the market, and most of them are configured differently.

Dedicating a mailer to your fax-mail function is an excellent idea. If you dedicate a mailer, you are better positioned to experiment with the properties of your mailer without risking the company e-mail system. Be sure to obtain permission from the postmaster if the e-mail system is the company live e-mail system.

Figure 5 shows how you can deploy a specialized fax-mail MTA to receive fax mail from the on-ramp gateway. This setup allows for configuring aliases and other fax-specific variables on the fax-mail MTA that might conflict with the settings on the corporate mailer. The fax-mail MTA thus can be devoted to fax mail and can simply forward the fax mail-turned-e-mail to the corporate MTA for delivery to the recipient in the regular way.

DID Versus Redialers

When on-ramp functionality is implemented, a telephone number translation is required at the on-ramp gateway so that the sender of the fax needs to dial only one telephone number. The sender dials the telephone number of the destination fax machine, but the fax gateway on-ramp access number is the number actually reached. The on-ramp gateway maps the number dialed by the sender to the desired destination. This mapping is accomplished by use of the **direct-inward-dial** command in the POTS dial peer.

An alternative to DID in the on-ramp configuration is to use a redialer, or prompt the sender for the destination number after the access number has been dialed. A redialer is a device that is situated between the fax machine and the POTS RJ-11 connector. It is programmed to capture the digits of the destination number that the sender dials in to the fax machine. It then dials the access number of the fax on-ramp gateway (this number is programmed into the redialer) and sends the captured digits to the fax

on-ramp gateway when the fax on-ramp gateway requests them. The on-ramp gateway then matches the captured digits to an MMoIP dial peer and performs steps exactly as described previously for the DID method. Many redialers are available; exploring their use and functionality is not covered in this document.

If neither the redialer access method nor DID is configured, then the default access method is to prompt the sender. This access method can also be configured explicitly in the call application options. When prompt user is the access method, after the access gateway is dialed, the on-ramp TCL IVR script plays the prompt, "Please enter the phone number you wish to reach." The sender then dials the destination fax number and sends the fax.

Configuring On-Ramp TCL IVR and Call Application Parameters

When voice feature cards (VFCs) are used, Cisco store-and-forward fax uses TCL IVR scripts for call control. T.37 store-and-forward fax on VFCs requires TCL IVR Version 2.0 and Cisco voice extensions that are available in Cisco IOS Release 12.1(3)XI or a later release.

TCL IVR scripts are loaded dynamically by the voice-fax gateway either at the time they are configured or upon reboot. Configuring a call application script requires a tag and a URL for the script and is accomplished in the following way:

```
mmoip-b(config)# call application voice on-ramp tftp://topeka/sffax_onramp9.2.0.0.tcl
Loading sffax_onramp9.2.0.0.tcl from 172.19.49.14 (via FastEthernet0): !!!
[OK - 11013/21504 bytes]
Read script succeeded. size=11013, url=tftp://sffax_onramp9.2.0.0.tcl
```

The tag in the preceding configuration line is *on-ramp* and is the name that will be referred to by the dial peer to have that script activated. The URL is the machine topeka, the base directory is /tftpboot (understood by the TFTP server), and the actual filename is sffax_onramp9.2.0.0.tcl. The command is entered in global configuration mode. As soon as the command is entered, the gateway attempts to access the TFTP server and download the particular TCL IVR file named in the configuration line.

After the script is successfully loaded, you can enter other parameters to control the behavior of the script. Basic on-ramp faxing requires two other call application parameters: one to tell the script which language to use, the other to tell the gateway where to find the audio files that are required for the prompts, even if the prompts will not be used. The required command lines are as follows:

```
call application voice on-ramp language 1 en
call application voice on-ramp set-location en 0 tftp://topeka/prompts/en/
```

In the first line, English is chosen as the language. Languages are referred to with their International Organization for Standardization (ISO) two-character code. The second line gives the path for the gateway to find the audio file prompts to use. It is important to remember to enter the final slash (/) at the end of the path to the audio prompts. The TCL IVR script prepends the path to the prompt name, and if the slash is not at the end of the path, the language code will be concatenated onto the audio file name and the script will not be able to load the file. The result will be silence and a failed call.

You can download TCL IVR scripts and associated audio file prompts from Cisco.com at:

<http://www.cisco.com/cgi-bin/tablebuild.pl/tclware>



Note

It is very important when entering a TCL IVR filename into the Cisco CLI that you spell it exactly as it appears on Cisco.com. You can display a list of possible TCL IVR filenames by entering the **show call application voice summary** command, but some of the filenames might not display in their entirety due to limitations of the CLI parser.

To display the TCL IVR script in its entirety, enter the **show call application voice** command with the *on-ramp* argument. (Note that the on-ramp argument is the tag name that we have assigned to the filename `sffax_onramp9.2.0.0.tcl`.) At the beginning of the output is an explanation of the call flow decisions made by the script.

Configuring On-Ramp Fax Receive and MTA Send Parameters

Fax receive, MTA send, and MMoIP AAA parameters are configured using a series of global configuration commands. The AAA parameters are considered in a separate section. Table 1 lists the necessary and optional on-ramp parameters.

Table 1 *On-Ramp Fax and MTA Parameters*

Global Command	Description
fax receive called-subscriber <i>\$d\$</i>	Substitutes the string <code>fax=<diald fax number></code> for <i>\$d\$</i> in the session target parameter in the MMoIP dial peer. The session target can also be hard coded, as in the preceding MMoIP dial peer, in which case this variable will not be used.
fax interface-type <i>vfc</i>	Tells the gateway that fax calls are processed in DSPs rather than modems.
mta send server <i>server@domain.com</i>	Specifies the destination mail server. It can be an IP address or a fully qualified domain name.
mta send subject <i>fax subject line</i>	The variable configured here will be listed in the subject line of the e-mail message that is generated.
mta send postmaster <i>name@mailserver.domain.com</i>	Defines the address of a person to whom undeliverable mail is sent.
mta send mail-from username <i>username</i> mta send mail-from hostname <i>mailserver.domain.com</i>	Together these two commands comprise the From header of the fax-mail message; for example, <code>username@mailserv.domain.com</code> .
mta send return-receipt-to hostname <i>mail.domain.com</i> mta send return-receipt-to username <i>username</i>	These two commands configure the e-mail address of the person to whom MDNs are sent; for example, <code>postmaster@mailserv.domain.com</code>

Fax and MTA Variables

The fax and MTA variables configured in the gateway control the behavior of the faxes and fax mail leaving the gateway. A minimal configuration for on-ramp faxing requires the following fax and MTA variables:

1. `fax receive called-subscriber d`
2. `fax interface-type vfc`
3. `mta send server 172.16.167.33`
4. `mta send server fresno.cisco.com`
5. `mta send subject VoIP TME Faxmail`
6. `mta send postmaster mailman@172.19.49.30`

7. mta send mail-from hostname fresno.cisco.com
8. mta send mail-from username \$\$
9. mta send return-receipt-to hostname cisco.com
10. mta send return-receipt-to username joeuser

Line 1 substitutes the DNIS for \$d\$, which is used in the MMoIP dial peer as the username part of the session target.

Line 2 is necessary to define the interface type being used for fax. Although VFCs are used exclusively in the latest Cisco IOS software, the first implementation of T.37 fax in Cisco gateways used modems.

Lines 3 and 4 configure the MTAs to which the fax mail is sent from the on-ramp gateway. Use the **mta send server** command to provide a backup destination server in case the first configured mail server is unavailable. (This command is not intended to be used for load distribution.)

You can configure up to ten different destination mail servers using the **mta send server** command. If you configure more than one destination mail server, the Cisco gateway attempts to contact the first mail server configured. If the first mail server is unavailable, the gateway contacts the next configured destination mail server, and so on.

Line 5 configures the message that is inserted into the subject line of the fax mail sent.

Line 6 configures the e-mail address of the postmaster to whom the DSN messages are sent.

Lines 7 and 8 configure the ID of the fax mail sender. The \$\$ substitution for the username inserts the automatic number identification (ANI) of the caller. Do not confuse the ANI with the phone number configured in the fax machine. The number configured in the fax machine by the person that maintains the fax machine does not always coincide with the ANI. In our case, the following appears in the From: line of a received fax mail in a Eudora 4.3.2 e-mail client:

```
From: "4089191827" FAX=408@fresno.Cisco.com
```

The number in quotes is the number configured in the fax machine itself, while the 408 in FAX=408@... represents the ANI that is delivered from the Cisco Centrex system. Thus, the \$\$ variable referenced in Line 8 is the ANI from the PSTN. It is the number in quotes that appears in the subject line of a Eudora e-mail client, not the PSTN ANI. When you actually open the fax mail, you can see both numbers, as shown in the preceding paragraph.

Lines 9 and 10 configure the recipient of return receipts if message disposition notification (MDN) is configured in the MMoIP dial peer. It takes the form of username@hostname.

Configuring Other On-Ramp Variables

The variables that do not fit into any of the preceding categories are discussed in this section.

If you are resolving machine names with DNS, you will need to enter the following commands on the gateway:

```
ip domain-lookup          (this command is ON by default)
ip domain-name domain.com (domain name is the domain name of your network)
ip name-server 10.10.10.10 (the IP address of your DNS server)
```

These commands attach the gateway to a domain and point it to a DNS server. Six different DNS servers can be configured; the gateway tries each of them in turn.

To perform accurate accounting, make sure that both the gateways and the RADIUS server agree on the time of day. The typical way to ensure agreement among IP-based devices is through the use of Network Time Protocol (NTP). In the following example, the first command sets the gateway in a particular time zone with a certain offset in hours from Greenwich Mean Time (GMT). The default is to use GMT (also referred to as Coordinated Universal Time, or UTC).

```
clock timezone PST -8          (Pacific Standard Time, minus 8 hours from GMT)
```

If you do not enter a time zone, the gateway assumes that it is GMT. The next command tells the gateway where to go to get the correct time:

```
ntp server 172.19.49.11
```

A list of freely accessible NTP servers in every time zone can be found on the Internet. Use your browser search engine or try the list at:

<http://www.eecis.udel.edu/~mills/ntp/clock2.htm>

On-Ramp Store-and-Forward Fax Configuration Example

If we start with a configuration that has IP connectivity and then configure all the items in the preceding sections, the gateway configuration should resemble the following annotated example:

```
mmoip-b# write terminal
Building configuration...
Current configuration:
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service internal
service udp-small-servers
service tcp-small-servers
!
hostname mmoip-b
!
enable secret 5 $1$CF2w$GbYL.9.Y5ccJKSdEBh13f0
!
resource-pool disable
!
clock timezone PST -8
ip subnet-zero
ip host topeka 172.19.49.14          This maps topeka to its IP address.
ip domain-name cisco.com
ip name-server 172.18.10.70
ip name-server 171.18.10.140
!
isdn switch-type primary-5ess
isdn voice-call-failure 0
call application voice on-ramp tftp://topeka/ifax/sffax_onramp9.2.0.0.tcl
call application voice on-ramp language 1 en
call application voice on-ramp set-location en 0 tftp://topeka/prompts/en/
!
fax receive called-subscriber $d$
fax interface-type vfc
mta send server fresno.cisco.com
mta send server 172.29.187.33
mta send subject VoIP TME Faxmail
mta send origin-prefix "Cisco Powered Fax Mail"
mta send postmaster mailman@172.19.149.30
```

```

mta send mail-from hostname voip-tme.cisco.com
mta send mail-from username $$
mta send return-receipt-to hostname cisco.com
mta send return-receipt-to username joeuser
!
controller T1 0                                Only one controller port is active on this router.
  framing esf
  clock source line primary
  linecode b8zs
  pri-group timeslots 1-24
!
controller T1 1
  clock source line secondary 1
!

controller T1 2
  clock source line secondary 2
!
controller T1 3
  clock source line secondary 3
!
!interface Ethernet0                            Any interface in "shutdown" mode is not in service,
  no ip address                                  nor is it needed for this operation.
  shutdown
!
interface Serial0
  no ip address
  no ip mroute-cache
  shutdown
  no fair-queue
  clockrate 2015232
!
interface Serial1
  no ip address
  shutdown
  no fair-queue
  clockrate 2015232
!
interface Serial2
  no ip address
  shutdown
  no fair-queue
  clockrate 2015232
!
interface Serial3
  no ip address
  shutdown
  no fair-queue
  clockrate 2015232
!
interface Serial0:23                            This interface relates to the signaling channel
  description 3590576 and 3611460-1479          of Port 0; these are the numbers serviced.
  no ip address
  ip mroute-cache
  isdn switch-type primary-5ess
  isdn incoming-voice modem                    This provides voice bearer capability.
  isdn disconnect-cause 1
!
interface FastEthernet0
  ip address 172.19.49.20 255.255.255.128
  duplex auto
  speed auto
!
ip classless

```

```

ip route 0.0.0.0 0.0.0.0 172.19.49.1
no ip http server
!
!
!
voice-port 0:D
!
dial-peer voice 1 pots
  application on-ramp
  incoming called-number 361....
  direct-inward-dial
!

port 0:D
!
dial-peer voice 60 mmoip
  application fax_on_vfc_onramp_app out-bound
  destination-pattern 3611460
  information-type fax
  session target mailto:owner@cisco.com
  mdn
  dsn success

dial-peer voice 73 mmoip
  application fax_on_vfc_onramp_app out
  destination-pattern 3611473
  information-type fax
  session target mailto:$d$fresno.cisco.com
  mdn
  dsn success
!
!
line con 0
  exec-timeout 0 0
  transport input none
line aux 0
line vty 0 4
  no login
!
ntp clock-period 17180024
ntp server 172.19.49.11
end

```

This POTS port answers incoming calls that begin with 361 and have seven digits. It runs the application "on-ramp" referred to earlier. DID directs it to look for an MMoIP dial peer with that destination pattern.

This MMoIP dial peer will be found if the dialed number is 3611460. It will run the application fax_on_vfc_onramp and will direct the fax mail to owner@cisco.com. The target can be any valid e-mail address; the postmaster will be informed of successful message delivery.

This dial peer answers to 3611473 and is the same as dial peer 60 except that it directs the fax mail to FAX=3611473@fresno.cisco.com. There is an MTA at this address that has an alias configured to translate FAX=3611473 into a valid username and send the fax mail on.

Verifying On-Ramp Fax Operation

With the preceding configuration, on-ramp faxing should now be in service. To ensure that the TCL IVR script is working properly, enter the following debug commands:

```

mmoip-b# debug voip ivr
mmoip-b# show debug
ivr:
  ivr errors debugging is on
  ivr state transitions debugging is on
  ivr settlement activities debugging is on
  ivr script debugging is on
  ivr script debugging is on
  ivr app library debugging is on
  ivr tcl commands debugging is on
  ivr digit collect debugging is on
  ivr call setup debugging is on

```

To examine the different call states of a successful on-ramp call, enter the following debug command:

```
mmoip-b# debug foip on-ramp
FOIP On ramp faxmail debugging is on
```

If there is a problem with the configuration or with the on-ramp fax operation, the debug output will indicate where the problem is occurring. The actual debug output is too lengthy to include in this document. For more information about solving problems with on-ramp fax operations, go to http://www.cisco.com/cpropart/salestools/cc/so/cuso/sp/faxov_in.htm.

As an example of a fax mail application, the PRI line that is terminated in a Cisco Technical Marketing Group on-ramp gateway has 21 numbers mapped to it. (The service provider that manages the phone lines provides this functionality.). Each person in the group has an MMoIP dial peer that corresponds to an individual phone number. The POTS dial peer with that same number maps its DID to the corresponding MMoIP dial peer. That MMoIP dial peer is mapped to the e-mail address of the person having that phone number. Now every person with their own fax-mail number can receive faxes through e-mail wherever they might be. Receiving e-mail on the road is commonplace; receiving a fax on the road is problematic at best. That problem is solved with store-and-forward fax mail.

Fine-Tuning the Fax Mail Transport Agent

The configurations in this document use two different MTAs. For both on-ramp and off-ramp functionality, both MTAs are used. The on-ramp gateway receives the fax mail, converts the pages to a TIFF file, and sends the message to its primary MTA, which is a Netscape Messaging Server V3.6. The Netscape MTA finds an alias for fax=number and sends the mail to the recipient that was configured in its alias file. This second mailer is the Cisco corporate mailer, which is a Solaris UNIX machine running sendmail.



Caution

Extreme caution should be used when dealing with the corporate mail system. E-mail systems are maximized for delivering e-mail, and the demands and behavior of fax mail might cause problems if configured improperly.

The off-ramp gateway accepts an e-mail and changes any TIFF or text attachments into T.4 fax format. The gateway then attempts to deliver the T.4 fax format to a PSTN-based Group 3 fax device. The chance of creating problems is more severe with the off-ramp gateway than with the on-ramp gateway.

Many MTAs are on the market that will work without modification with both the on-ramp and off-ramp features of store-and-forward fax. We recommend that you dedicate a mail server to fax mail and avoid the conflicting configuration requirements of traditional e-mail and fax-mail servers. Optimize each mail server for its individual functions—for example, fax messages should usually retry transmissions every 5 minutes versus normal e-mail, which retries every 30 minutes; fax messages should give up after 3 to 4 hours versus normal e-mail, which tries for 4 to 5 days.

To avoid any complications arising from the difference between the SMTP e-mail and fax delivery requirements, modify the following parameters:

- Delivery to one recipient
- Message priority
- Connection cache size
- Minimum queue age

**Note**

In some countries it is illegal to try to send a fax more than three times in a row if the transmission fails.

**Note**

It is extremely important to modify SMTP delivery requirement parameters. Failure to do so can result in a monopoly of network bandwidth and off-ramp fax resources.

**Note**

Sendmail is a freeware mailer included with many UNIX implementations; it is also available from sendmail.org and from sendmail.com. It is not the only MTA available; there are many others, including qmail, Netscape Messaging Server, Post.Office, Microsoft Exchange, PMDF, and vmailer.

Configuring the SMTP Server to Support Store-and-Forward Fax

If you choose to configure your SMTP server, edit the SMTP server alias file to include an alias for fax transmissions. For example, suppose you create the following alias: fax=5551212:user@hostname.com.

In this example, if a fax is sent to the telephone number 5551212, the on-ramp gateway will automatically forward it to the mailbox for user@hostname.com. If you create aliases to forward faxes to particular e-mail addresses, you need to configure the on-ramp MMoIP dial peer **session target** dial peer voice configuration command as follows:

```
router(config-dial-peer)# session target mailto:$d$@hostname.com
```

The \$d\$ keyword specifies that the destination fax machine telephone number is inserted into the Envelope to: field of the fax mail that is sent to the SMTP server.

The Cisco AS5300 off-ramp gateway accepts only one e-mail recipient per SMTP transaction for the following reasons:

- The SMTP server in the Cisco AS5300 off-ramp gateway does not queue messages in its memory because of their size and the lack of nonvolatile storage in the Cisco AS5300.
- SMTP does not provide a mechanism to allow the receiving MTA to indicate the success or failure of each recipient. Instead, the receiving MTA must indicate the success or failure of the entire transaction.

The Cisco AS5300 prevents multiple recipients in one SMTP transaction by responding to the second and subsequent recipient (RCPT) commands with a 450 reply code. Because of the typical mailer configuration, there will be a cumulative 30-minute delay for each recipient (immediate delivery for the first recipient, 30-minute delay for the second recipient, 60-minute delay for the third recipient, and so on).

Forcing All Mail Through One Mailer

To simplify system administration, it is often desirable to have all mail to the Cisco AS5300 go through one mailer. One way to arrange for the use of one mailer is to set up a DNS mail exchange (MX) record for the Cisco AS5300 pointing to the one mailer, and set up that mailer to omit MX record processing when delivering mail to the Cisco AS5300.

For example, the following two records would be added to the DNS:

```
sj-offramp in mx 10 sj-mailer
sj-offramp in a 1.2.3.4
```

To help prevent unauthorized use of the fax off-ramp gateway, and to force all mail to go through sj-mailer, we recommend that you configure the Cisco AS5300 with Access Control Lists (ACLs) to block incoming connections to its mail port (TCP Port 25) from any other IP address. For more information about ACLs, refer to the *Cisco IOS Security Configuration Guide* and the “Security Considerations” section of this document.

Tuning the Sending Mailer for a Single Recipient

The sending mailer can be tuned to work faster with store-and-forward fax off-ramp gateways and to reduce delays caused by attempting to send to multiple recipients. You can achieve this functionality by configuring the mailer to send to each recipient serially, but without delay between each transmission. Configuring the mailer to send messages in parallel would require sending each message back through the mailer again (perhaps on a different port) and running multiple client processes on the system. Such configuration changes are beyond the scope of this document.



Caution

Modifying the sending mailer configuration can break all e-mail into and out of the fax gateway for your entire enterprise. Perform sendmail configuration modifications only after you have notified the postmaster at your site.

Configuration Guidelines for Off-Ramp Store-and-Forward Fax

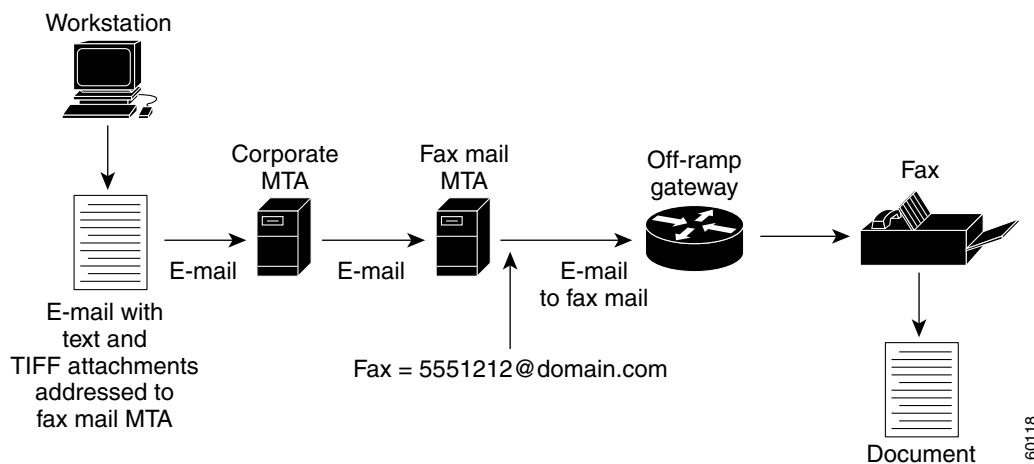
Off-ramp faxing requires the off-ramp gateway to communicate with a PSTN-based Group 3 fax device using standard fax protocols. The off-ramp gateway can send a message containing a TIFF image, a text message, or a message containing both.

The off-ramp gateway performs the following functions:

- It converts a TIFF file or text file to a standard fax format and sends it to a PSTN-based Group 3 fax device. Store-and-forward fax does not alter the TIFF or text file from its original format when converting it into the standard fax format. The off-ramp gateway uses the dial peers to dial the correct telephone number for the PSTN-based Group 3 fax device.
- It delivers an e-mail message as a standard fax transmission, which is received and processed by a Group 3 fax device. The source of this transmission is an e-mail message. The Cisco off-ramp gateway generates information to be appended to the top of each text-to-fax page and creates a fax cover sheet. The off-ramp gateway uses the receiving MTA, dial peers, and commands specific to formatting the appended information and generating a fax cover sheet to deliver e-mail messages as fax transmissions.

Configuration guidelines for the off-ramp gateway are described in the following sections. Off-ramp configuration consists of the same four tasks as on-ramp configuration. Figure 6 shows a suggested off-ramp gateway model. Call flow is similar and is handled by the same service modules.

Figure 6 Off-Ramp Fax Service Model



Note

Note: Two MTAs are in use, allowing specialized fax-specific delivery variables in the fax-mail gateway. The corporate MTA is present so that users will not need to reconfigure their personal e-mail clients to point to the fax-mail server. The fax mail is sent as a regular e-mail with text or TIFF attachments with an address similar to the following:
 fax=5551212@faxmailmta.domain.com.

Off-ramp gateway configuration consists of the following tasks:

- Configuring Off-Ramp Dial Peers
- Configuring Off-Ramp TCL IVR and Call Application Parameters
- Configuring Off-Ramp Fax Send and MTA Receive Parameters
- Configuring Other Off-Ramp Variables

Configuring Off-Ramp Dial Peers

Off-ramp faxing is the second half of the store-and-forward fax topology illustrated in Figure 4. With off-ramp faxing, the package delivered to the voice fax gateway is an SMTP message. The content of the message is encoded by the gateway into a TIFF attachment file and the message headers are transferred to a cover page for the fax.

Because an off-ramp fax is delivered to a terminating gateway, it is delivered using IP, and the dial peer that it finds in the gateway is an MMoIP dial peer. This MMoIP dial peer runs the off-ramp fax TCL IVR script, which hands the call to a matching POTS dial peer. The POTS dial peer sets up a call to a fax machine on the telephony side of the gateway, remodulates the IP packets into a G3 fax, and delivers the fax to a G3 fax machine.

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Following is an example of a pair of dial peers configured for off-ramp faxing:

```
dial-peer voice 100 mmoip
  application off
  incoming called-number 8.....
  information-type fax
!
dial-peer voice 101 pots
  destination-pattern 8.....
  port 0:D
  prefix 8
```

The DNIS of the destination fax machine is a seven-digit number beginning with 8. This number is received by MMoIP dial peer 100 in the off-ramp fax gateway. SMTP directs the call to the IP address of the gateway, while the number configured in the username portion of the SMTP message (fax=8531827@) links the message to a particular dial peer in the gateway.

This dial peer is configured with the TCL IVR application named off. After the off-ramp parameters are collected, the script hands off the call to POTS dial peer 101 for delivery to the destination fax machine.

POTS Dial Peers

To configure the POTS dial peers on the off-ramp gateway, enter the various phone numbers for the fax machines that will be receiving fax mail. An example follows:

```
dial-peer voice 1 pots
  destination-pattern .....
  port 0:D
```

The preceding dial peer will initiate a connection to any fax machine within the present area code because the seven dots represent wildcards. This dial peer requires seven digits because there are seven dots. If you wish to enable some long distance fax machines, configure the POTS dial peers as follows:

```
dial-peer voice 1 pots
  destination-pattern 1408.....
  port 0:D
  prefix 1408
```

The preceding dial peer will match an incoming number of 1408 plus seven more digits represented by the seven dots. Because POTS dial peers strip all numbers that are not wildcards, the dial peer will strip the 1408. The **prefix** command will prepend the 1408 back onto the dial peer, thus allowing any fax machine number in the 408 area code to be reachable. You can enable or restrict dial peers for any or all area codes in this manner.

MMOIP Dial Peers

The primary function of the MMoIP dial peer is to run the TCL IVR application for the off-ramp fax. The incoming IP call setup matches the *incoming called-number* configured in the MMoIP dial peer to the actual DNIS of the call being established. If that dial peer is configured with an application, then that application is launched.

Configuring Off-Ramp TCL IVR and Call Application Parameters

The TCL IVR script for an off-ramp gateway is very similar to the on-ramp script previously discussed in this document. The primary function of the off-ramp script is to gather authentication, accounting, and calling parameters and, if configured to do so, communicate these parameters to a RADIUS server.

After the parameter-gathering is completed, the call is handed off to the internal off-ramp application with the related call-control information. You can display the TCL IVR script name and a short description by entering the **show call application voice summary** command in privileged EXEC mode.

For a complete discussion of TCL IVR script loading, configuring, and call flow control, see “Configuring On-Ramp TCL IVR and Call Application Parameters” earlier in this document.

Configuring Off-Ramp Fax Send and MTA Receive Parameters

With on-ramp faxing, the fax and MTA parameters are *fax receive* and *MTA send*; for off-ramp faxing, the parameters are *fax send* and *MTA receive*. Table 2 and Table 3 list the necessary and optional off-ramp parameters.

Table 2 Off-Ramp MTA Receive Parameters



Global Command	Description
<code>mta receive aliases <i>string</i></code>	<p>Defines a host name to be used as an alias for the off-ramp gateway. You can define up to ten different aliases.</p> <p> Note The SMTP server of the off-ramp device will accept incoming mail only if the destination host name of the incoming mail matches one of the aliases as configured by the mta receive aliases command.</p> <p> Note This command does not automatically include reception for a domain IP address—it must be explicitly added. If you add an IP address, you must enclose the address in brackets as follows: [xxx.xxx.xxx.xxx].</p> <p>Note that RFC1123 requires that mail servers accept mail for all their IP interfaces; however, in practice, this is usually not a requirement in most mail environments.</p>

Table 2 Off-Ramp MTA Receive Parameters (continued)


Global Command	Description
mta receive generate-mdn	(Optional) Configures the off-ramp gateway to generate an MDN message when requested to do so. Some sites may want to enable or disable this feature, depending on corporate policy or the types of mail user agents in use.
mta receive maximum-recipients <i>number</i>	Defines the number of simultaneous SMTP recipients handled by this device. This is intended to limit the number of resources (modems) allocated for fax transmissions.  Note Only one recipient will be accepted per SMTP transaction, and it is not controllable by this setting.

Table 3 Off-Ramp Fax Send Parameters

Global Command	Description
fax send transmitting-subscriber { <i>\$\$</i> <i>string</i> }	Defines the number that appears in the LCD display of the receiving fax device. This parameter defines the transmitting subscriber identifier (TSI).
fax send left-header { <i>\$a</i> <i>\$d</i> <i>\$p</i> <i>\$s</i> <i>\$t</i> <i>string</i> }	Specifies the header information to be displayed in the left header position. The wildcards used in this command insert the following information: <ul style="list-style-type: none"> • <i>\$a</i>—Date • <i>\$d</i>—Destination address • <i>\$p</i>—Page count • <i>\$s</i>—Sender address • <i>\$t</i>—Transmission time The variables can be preceded by words; for example, Page: <i>\$p</i> . Use the string variable in this command to insert a personalized text string.
fax send center-header { <i>\$a</i> <i>\$d</i> <i>\$p</i> <i>\$s</i> <i>\$t</i> <i>string</i> }	Specifies the header information to be displayed in the center header position. The wildcards used in this command insert the same information as in the fax send left-header command.
fax send right-header { <i>\$a</i> <i>\$d</i> <i>\$p</i> <i>\$s</i> <i>\$t</i> <i>string</i> }	Specifies the header information to be displayed in the right header position. The wildcards used in this command insert the same information as in the fax send left-header command.

Table 3 Off-Ramp Fax Send Parameters (continued)

Global Command	Description
fax send coveragepage enable	Enables the off-ramp gateway to send a cover sheet with faxes that originate from e-mail messages.
fax send coveragepage show-detail	(Optional) Prints all the e-mail header information as part of the fax cover sheet text.
fax send coveragepage comment <i>string</i>	(Optional) Adds personalized text in the title field of the fax cover sheet.

Configuring Other Off-Ramp Variables

For off-ramp faxing, only one additional variable does not fit into the MTA receive and Fax send categories:

```
fax interface-type vfc
```

This global command tells Cisco IOS software to use the voice feature card DSPs for fax processing instead of modems.

Off-Ramp Store-and-Forward Fax Configuration Example

After the preceding commands have been entered, the off-ramp gateway configuration should look similar to the following (IP routing commands and command lines not associated with store-and-forward fax have been removed to save space):

```
mmoip-b# write terminal
!
hostname mmoip-b
!
call rsvp-sync
call application voice off tftp://beagle/sffax_offramp5.2.0.0.tcl
clock timezone PST -8
!
isdn switch-type primary-5ess
isdn voice-call-failure 0
!
!
fax send left-header $$
fax send center-header $t$
fax send right-header Page: $p$
fax send coveragepage enable
fax send coveragepage email-controllable
fax send coveragepage comment VoIP TME Generated Fax
fax interface-type vfc
mta receive aliases mmoip-b.cisco.com
mta receive aliases cisco.com
mta receive aliases [xx.xxx.xxx.xxx]
mta receive maximum-recipients 255
mta receive generate-mdn
!
!
controller T1 0
 framing esf
 clock source line primary
 linecode b8zs
```

```
    pri-group timeslots 1-24
    !
    controller T1 1
        clock source line secondary 1
    !
    controller T1 2
        clock source line secondary 2
    !
    controller T1 3
        clock source line secondary 3
    !
    interface Serial0:23
    no ip address
    ip mroute-cache
    isdn switch-type primary-5ess
    isdn incoming-voice modem
    isdn disconnect-cause 1
    !
    interface FastEthernet0
    ip address 172.19.49.20 255.255.255.128
    duplex auto
    speed auto
    !
    ip classless
    ip route 0.0.0.0 0.0.0.0 172.19.49.1
    !
    voice-port 0:D
    !
    dial-peer voice 100 mmoip
        application off
        incoming called-number 8.....
        information-type fax
    !
    dial-peer voice 101 pots
        destination-pattern 8.....
        port 0:D
        prefix 8
    !
    dial-peer voice 1000 pots
        destination-pattern 1831.....
        port 0:D
        prefix 1831
    !
    dial-peer voice 1001 mmoip
        application off
        incoming called-number 1831.....
        information-type fax
    !
    ntp clock-period 17179630
    ntp server xx.xx.xxx.xxx
```

Complete On-Ramp/Off-Ramp Gateway Configuration Example

Following is an example of a Cisco gateway configured for both on-ramp and off-ramp store-and-forward fax (IP routing commands and command lines not associated with store-and-forward fax have been removed to save space):

```

mmoip-b# write terminal
!
hostname mmoip-b
!
enable secret 5 $1$CF2w$GbYL.9.Y5ccJKSdEBh13f0
!
username ted password 7 151A1E0A02
!
resource-pool disable
!
clock timezone PST -8
!
isdn switch-type primary-5ess
isdn voice-call-failure 0
call application voice roll tftp://beagle/fax_rollover_on_busy.tcl
call application voice off tftp://beagle/t37_offramp.0.0.6.tcl
call application voice off accounting enable
call application voice off accounting-list fax
call application voice off language 1 en
call application voice off set-location en 0 tftp://beagle/prompts/en/
!
call application voice onramp tftp://beagle/t37_onramp13.tcl
call application voice onramp password 1234
call application voice onramp authen-method dnis
call application voice onramp authen-list fax
call application voice onramp authentication enable
call application voice onramp accounting enable
call application voice onramp accounting-list fax
call application voice onramp language 1 en
call application voice onramp set-location en 0 tftp://topeka/prompts/en/
voice hunt user-busy
!
voice service voip
!
fax receive called-subscriber $d$
fax send max-speed 9600
fax send left-header $$
fax send center-header $t$
fax send right-header Page: $p$
fax send coverpage enable
fax send coverpage email-controllable
fax send coverpage comment VoIP TME Generated Fax
fax interface-type vfc
mta send server fresno.cisco.com
mta send server 171.44.45.7
mta send subject VoIP TME Faxmail
mta send origin-prefix "Cisco Powered Fax Mail"
mta send postmaster mailman@xxx.xxx.xxx.xxx
mta send mail-from hostname voip-tme.cisco.com
mta send mail-from username $$
mta send return-receipt-to hostname cisco.com
mta send return-receipt-to username joeuser
mta receive aliases mmoip-b.cisco.com
mta receive aliases cisco.com
mta receive aliases [xxx.xxx.xxx.xxx]
mta receive aliases [xxx.xxx.xxx.xxx]
mta receive maximum-recipients 255

```

```
mta receive generate-mdn
!
controller T1 0
  framing esf
  clock source line primary
  linecode b8zs
  pri-group timeslots 1-24
!
controller T1 1
  clock source line secondary 1
!
controller T1 2
  clock source line secondary 2
!
controller T1 3
  clock source line secondary 3
!
gw-accounting h323
gw-accounting h323 vsa
gw-accounting voip
!
interface Serial0:23
  no ip address
  ip mroute-cache
  isdn switch-type primary-5ess
  isdn incoming-voice modem
  isdn disconnect-cause 1
!
interface FastEthernet0
  ip address xxx.xxx.xxx.xxx 255.255.255.128
  duplex auto
  speed auto
!
voice-port 0:D
!
dial-peer voice 1 pots
  application sandf
  incoming called-number xxx....
  direct-inward-dial
!
dial-peer voice 2 pots
  application sandf
  incoming called-number xxx....
  direct-inward-dial
!
dial-peer voice 3 pots
  application sandf
  incoming called-number xxxx.....
  direct-inward-dial
!
dial-peer voice 68 mmoip
  application fax_on_vfc_onramp_app out-bound
  destination-pattern xxxxxxxx
  information-type fax
  session target mailto:user1@cisco.com
  mdn
  dsn delayed
  dsn success
  dsn failure
!
dial-peer voice 69 mmoip
  application fax_on_vfc_onramp_app out-bound
  destination-pattern xxxxxxxx
  information-type fax
```

```
session target mailto:user2@cisco.com
mdn
dsn delayed
dsn success
dsn failure
!
dial-peer voice 1477 pots
application roll
incoming called-number xxxxxxxx
direct-inward-dial
!
dial-peer voice 77 voip
preference 1
application roll
destination-pattern xxxxxxxx
session target ipv4:xxx.xx.xxx.xx
fax rate 14400
!
dial-peer voice 771 mmoip
preference 2
application fax_on_vfc_onramp_app out-bound
destination-pattern xxxxxxxx
information-type fax
session target mailto:user3@cisco.com
!
dial-peer voice 79 mmoip
application fax_on_vfc_onramp_app out-bound
destination-pattern xxxxxxxx
information-type fax
session target mailto:jamesbond@fresno.cisco.com
mdn
dsn success
!
dial-peer voice 853 mmoip
application off
incoming called-number 8.....
information-type fax
!
dial-peer voice 1853 pots
destination-pattern 8.....
port 0:D
prefix 8
!
dial-peer voice 831 mmoip
application off
incoming called-number 1831.....
information-type fax
!
dial-peer voice 1831 pots
destination-pattern 1831.....
port 0:D
prefix 1831
!
line con 0
exec-timeout 0 0
transport input none
line aux 0
line vty 0 4
!
ntp clock-period 17179630
ntp server xxx.xx.xx.xxx
end
```


Sending an Off-Ramp Fax

A debug function is built into Cisco IOS software so that you can determine whether off-ramp faxing is working. The application sends an off-ramp fax from the off-ramp gateway to the number that is entered on the command line. Following is an example:

```
mmoip-b# debug mmoip send fax 8531827
mmoip_send_test_fax: phone num=8531827
Test succeed!
```

The test command sends a one-page fax with the following short message to the number specified: “This is a test fax sent by Cisco Powered Libretto Faxmail.” If the test fax does not succeed, use the **debug foip offramp** command to try to determine the cause of the problem.

We mentioned earlier that an off-ramp fax can be sent by using an e-mail client such as Netscape or Eudora. Because the off-ramp gateway contains a compliant SMTP engine, off-ramp faxes can also be sent by a direct Telnet connection to the SMTP port (Port 25) of the off-ramp gateway. This method is employed by many bulk fax service providers.

A typical off-ramp fax session using Telnet has the following steps:

1. Telnet to Port 25 of the off-ramp gateway.
2. Signal the connection.
3. Send the sender address.
4. Send the recipient address.
5. Enable Xacct (optional).
6. Send cover-page data and attachments (optional).
7. Send test data.
8. Disconnect.

From a machine enabled with a Telnet client, start a Telnet session to Port 25 of the off-ramp gateway. Commands entered at the Telnet client are in boldface; responses from the off-ramp gateway are in regular type.

```
orange% telnet 172.19.49.20 25
Trying 172.19.49.20...
Connected to 172.19.49.20.
Escape character is '^]'.
220 mmoip-b.cisco.com Cisco NetWorks ESMTP server

ehlo world
250-mmoip-b.cisco.com, hello world [172.19.49.14] (really )
250-ENHANCEDSTATUSCODES
250-8BITMIME
250-PIPELINING
250-HELP
250-DSN
250 XACCOUNTING

mail from:sender@cisco.com
250 2.5.0 Sender <sender@cisco.com> ok

rcpt to:fax=8531827@mmoip-b.cisco.com
250 2.1.5 Recipient <fax=8531827@mmoip-b.cisco.com> ok, maps to '8531827' (cp=yes)

data
354 Enter mail, end with a single "."
subject: Store and Forward fax mail
```

```

date: Dec 12, 2000
(empty line sent here)
Now is the time for all good men to come to the aid of their party.
.
250 2.5.0 Message delivered to remote fax machine

```

The fax process begins when you enter the **data** command, but text data is not received until you enter a blank line. The data entered before the blank line is extra cover-page material, such as the date and subject of the fax mail. This is also where you add attachments. After entering cover-page data and attachments, you must enter a blank line.

After entering the blank line, you can enter fax-page text data. Different third-party applications have different ways of generating text and attaching TIFF files. You can create a UNIX script, for example, that will automatically generate an off-ramp fax with an attachment through a Telnet connection.

After all the text and attachments have been entered, signal the end of the transmission by entering a period (.) on a line by itself. If the fax transmission is successful, the remote fax machine will send a successful transfer message to the off-ramp gateway, and the last line in the preceding example will be displayed on your Telnet client.

Cisco T.38 Real-Time Fax and Never-Busy Fax Service

The configuration of T.38 real-time fax on Cisco voice gateways is similar to the configuration of VoIP calls. Telephony dial peers are POTS dial peers; network dial peers are VoIP dial peers. In the following T.38 dial peer configuration example, dial peers 1 and 2 are on the originating gateway; dial peer 3 is on the terminating gateway:

```

dial-peer 1 pots
incoming called-number 555....
direct-inward-dial
dial-peer voice 2 voip
destination-pattern 5551212
session target ipv4:172.19.26.49

```

```

dial-peer voice 3 pots
destination-pattern.
port 0:D

```

This configuration assumes that the fax machine is plugged directly into the gateway or that a redialer is being used. See the section “Configuration Guidelines for On-Ramp Store-and-Forward Fax” for more details. This section examines the *never-busy* functionality of T.38 fax.

In the scenario previously described, if the far-end fax machine is busy or unreachable, the near-end fax machine tries to redial for a configurable number of times and then quits without success if the far-end gateway is down. With the addition of some dial peers and call application parameters, a T.38 fax can be configured to roll over to a T.37 fax session when the far end is busy or unreachable.

Add the TCL IVR rollover application to the on-ramp gateway. See the section “Configuring On-Ramp TCL IVR and Call Application Parameters” for details on TCL IVR scripts. The script in the 2.0 TCL IVR bundle is named `fax_rollover_on_busy.2.0.0.tcl`, and is added to the originating gateway with the following command:

```

mnoip-b(config)# $call application voice roll tftp://topeka/ifax/fax_rollover_on_busy.tcl
Loading ifax/fax_rollover_on_busy.tcl from 172.19.49.14 (via FastEthernet0): !
[OK - 4803/9216 bytes]
Read script succeeded. size=4803,
url=tftp://topeka/ifax/fax_rollover_on_busy.tcl

```

Notice that the rollover application is given the name `roll` in the preceding **call application voice** command. After installing the script in the originating gateway, add the application to the POTS dial peer that will answer T.38 calls and run the rollover application:

```
dial-peer voice 1 pots
  application roll
  incoming called-number 325...
  direct-inward-dial
```

The POTS dial peer will answer all calls to seven-digit numbers starting with 325. The rollover application will be launched, and because DID is configured, the POTS dial peer will pass the call to a VoIP dial peer that matches the DNIS. The TCL IVR application has a procedure for setting up the call, waiting for success, and, upon receiving a busy or gateway-down message, setting up the same call again with new destination parameters. When the call is returned to the originating gateway, the gateway searches for a new VoIP dial peer with the same destination number, and a preference equal to or greater than the first dial peer that it found. If it finds one, it sets up the call again. The configuration for the VoIP dial peers follows—the first being the T.38 dial peer and the second being the T.37 dial peer:

```
dial-peer voice 78 voip
  preference 1
  destination-pattern 3251478
  session target ipv4:172.19.49.12
  fax rate 14400
  fax protocol t38 ls-redundancy 0 hs-redundancy 0
  !
dial-peer voice 781 mmoip
  preference 2
  application fax_on_vfc_onramp_app out-bound
  destination-pattern 3251478
  information-type fax
  session target mailto:$d$@cisco.com
```

Because the dial peers are configured with the same destination pattern and different preferences, the gateway will try the destination with the lowest preference number (meaning the highest preference) first, and then, if required, try the next preferential choice, and so on. If several dial peers are configured with the same preference, then the gateway will choose the first one present in the configuration.

If a T.38 call is initiated to the number 3251478, the first choice will be to send the fax according to the details in dial peer 78. If the destination number is busy or the gateway at 172.19.49.12 is down, the call will be retried with the details contained in dial peer 781, namely a T.37 fax to `d@cisco.com`. This model results in the fax being delivered—regardless of the fact that the far-end fax machine is busy.

**Note**

If the destination fax machine is an extension on a PBX, this feature might not function correctly. Typically, the PBX answers the call request and then makes the connection to the end device. The proper behavior of the PBX would be to connect to the far end before sending back a connection signal to the near end. If, for various configuration reasons, the PBX sends a connect acknowledgment to the near-end fax machine before actually connecting to the far-end fax machine, the rollover function will never take place, even if the far end is busy. Because the originating fax machine receives a connect acknowledgment followed by a setup failure, it tries to redial the same number again. The originating fax machine will retry for the configured number of times, and then ultimately fail.

Assuming no PBX, or a properly configured PBX, the preceding scenario will provide a *never-busy* model for faxing.

Security Considerations

Security for connections is supported in Cisco gateways through the use of the AAA protocol. Security on the off-ramp gateway can be further enhanced by using Cisco IOS access lists.

AAA On-Ramp Authentication

AAA is used on the on-ramp gateway to perform authentication and accounting. Authentication is employed to restrict access, and is performed in conjunction with a RADIUS or TACACS+ server. Access can be restricted through authentication of one of the following attributes:

- Gateway ID
- DNIS
- ANI
- Redialer ID
- Redialer DNIS
- Prompt the user

To choose an authentication method, use the **call application voice authen-method** command in global configuration mode. To authenticate an on-ramp fax using one of the preceding methods, there must be an authentication server configured with the chosen authentication parameters.

AAA authentication for on-ramp gateways uses the fax method list. This method list authenticates the incoming call according to the authen-method configured in the call application parameters. All AAA configuration begins with the **aaa new-model** command. The AAA and call application command lines for authentication are as follows:

```
aaa new-model
aaa authentication login fax group radius local
aaa authorization exec fax group radius
```

The RADIUS protocol does authentication (who) and authorization (what) together. Without the **aaa authorization** command, authentication will fail. After entering the **aaa** commands, you may enter the **radius-server** commands. Trying to enter **radius-server** commands before enabling AAA with the **aaa new-model** command will result in the Unrecognized command error message.

The following RADIUS commands are required for authentication:

```
radius-server host ip-address auth-port 1645 acct-port 1646
radius-server key test
```

The auth-port 1645 and acct-port 1646 values shown in the preceding **radius-server host** command are the default port assignments from the fax gateway. Other ports may be configured if the RADIUS server in the network requires it. If no port assignments are specified, the default ports will be assigned automatically.

The **radius-server key** command denotes the password that is exchanged with the RADIUS server through the use of the Challenge Handshake Authentication Protocol (CHAP).

Other RADIUS commands may be entered at this point, but they are not necessary to successful authentication. Other RADIUS commands control the behavior of the RADIUS client in the gateway by controlling parameters such as timeout, retry count, and retry interval. Consult the Cisco security documentation for a complete list.

In addition to enabling authentication and specifying the authentication method and the authentication list, you must configure **call application voice** commands for the authentication portion of AAA. The TCL IVR script also requires at least one language selection, and its corresponding URL must point to the location of the audio files. Following is an example showing the commands you must use:

```
call application voice onramp authentication enable
call application voice onramp authen-list fax
call application voice onramp authen-method dnis
call application voice onramp password foip
call application voice onramp language 1 en
call application voice onramp set location en 0 tftp://topeka/prompts/en/
```

The variables configured are retrieved by the TCL IVR on-ramp application. To observe the actions of the TCL IVR script, use the **debug voip ivr** command.

Problems with authentication can occur in many different forms. For example, you might need to use the h323 method list instead of the fax method list for authentication to work properly. This *h323* method list is configured with the following command:

```
aaa authentication login h323 group radius
```

Other problems with on-ramp authentication can be uncovered with the following debug commands:

```
debug mmoip aaa
debug aaa authentication
debug aaa authorization
```

In summary, on-ramp authentication is accomplished by creating a username and password in the RADIUS server that conforms to the method chosen for authentication. This method does not make sense for off-ramp faxing because the connection is coming from an MTA rather than from dual-tone multifrequency (DTMF) or redialer information from the PSTN side.

AAA Off-Ramp Authentication

Off-ramp authentication is the process of allowing or denying other MTAs to connect to the gateway MTA. This authentication can be easily accomplished with ACLs. An ACL is configured on the off-ramp gateway that allows only specified MTAs—identified by their IP addresses—to connect to the gateway and deliver an SMTP message to be sent out as a T.37 fax.

Following is a simple ACL configuration. For more detailed information about ACLs, refer to the *Cisco IOS Security Configuration Guide*.

Configure the list and specify the allowed hosts:

```
access-list 1 permit ip-address 0.0.0.0
```

There is an implicit *deny all* at the end of every access list. The result of the preceding list would be to allow only one host to connect to the gateway. The following command would permit any host in the range of 172.19.49.1 to 172.19.49.126:

```
access-list 2 permit 172.19.49.0 0.0.0.127
```

To activate an access list, you must apply it to an interface:

```
gateway (config)# interface FastEthernet 0
gateway (config-if)# ip access-group 1 in
```

You can apply the access list to incoming or outgoing connections. The connection from the MTA is incoming, and therefore is applied with the **in** keyword.

**Note**

Activating AAA in gateways outlined in this chapter and conforming to T.37 fax on VFCs is a different model from previous configurations of T.37 on Cisco gateways. AAA is now under the control of the TCL IVR scripts. Commands such as the following are no longer used or recognized by the T.37 gateway:

```
mmoip aaa receive-id primary
mmoip aaa global-password
mmoip aaa send-accounting enable
```

**Note**

Be aware that when you configure access lists, you can inadvertently restrict all connectivity to your gateway, or break connectivity that you want to keep. Advanced access lists can be very specific to accomplish the level of security that you seek.

Billing and Accounting

Fax over IP (I-fax) accounting records can be obtained through the use of RADIUS, TACACS+, SNMP, and SMTP. The supported SNMP Management Information Bases (MIBs) involved in store-and-forward fax are as follows:

- MMoIP DIAL-CONTROL-MIB
- MODEM-MANAGEMENT-MIB
- CISCO-ANALOG-VOICE-IF-MIB
- CISCO-VOICE-DIAL-CONTROL-MIB
- CISCO-VOICE-IF-MIB

This section covers RADIUS and SMTP accounting. SNMP accounting is not covered. Implementation of TACACS+ is similar to RADIUS and is also not covered.

RADIUS Accounting and Billing

RADIUS records sent to the RADIUS server include both standard RADIUS attributes and Cisco vendor-specific attributes (VSAs). The RADIUS server must be able to understand VSAs as described in RFC 2138 (Attribute 26). For a description of standard RADIUS attributes, refer to the following documents:

- RFC 2865, *Remote Authentication Dial In User Service (RADIUS)*
- RFC 2866, *RADIUS Accounting*
- *Configuration Guide for AAA Billing Features in Cisco Voice-Enabled Routers and Access Servers* at: http://www.cisco.com/warp/public/cc/so/cuso/sp/sms/acct/caaaf_cg.htm
- *RADIUS Vendor-Specific Attributes Voice Implementation Guide* at: http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/vapp_dev/vsaig3.htm

VSA call detail record (CDR) variables used in store-and-forward fax billing and accounting are listed in Table 4.

Table 4 Cisco VSAs

VSA Attribute Number	VSA Name	Description
VSA 3	cisco_fax_account_id_origin	Indicates the account ID origin as defined by the system administrator for the mmoip aaa receive-id or mmoip aaa send-id command.
VSA 4	cisco_fax_msg_id	Indicates a unique fax message identification number assigned by store-and-forward fax.
VSA 5	cisco_fax_pages	Indicates the number of pages sent or received during this fax session; this page count includes cover pages.
VSA 6	cisco_fax_cover_page	Boolean variable (true or false) describing whether or not the fax includes a cover page (off-ramp gateway specific).
VSA 7	cisco_fax_modem_time	Delivers two values in seconds; the first describes the modem transmission time, the second describes the total fax session time.
VSA 8	cisco_fax_connect_speed	Modem transmission speed in bits per second (bps); possible values are 1200, 4800, 9600, and 14400.
VSA 9	cisco_fax_recipient_count	Indicates the number of recipients for this fax transmission; until e-mail servers support session mode, the number should be 1.
VSA10	cisco_fax_process_about_flag	Indicates whether the fax session was aborted or successful; true means that the session was aborted; false means that the session was successful.
VSA 11	cisco_fax_dsn_address	Indicates the address to which DSNs will be sent.
VSA 12	cisco_fax_dsn_flag	Indicates whether DSN has been enabled; true indicates that DSN was enabled; false means that DSN was not enabled.
VSA 13	cisco_fax_mdn_address	Indicates the address to which MDNs will be sent.
VSA 14	cisco_fax_mdn_flag	Indicates whether message delivery notification (MDN) has been enabled; true indicates that MDN was enabled; false means that MDN was not enabled.

Table 4 Cisco VSAs (continued)

VSA Attribute Number	VSA Name	Description
VSA 15	cisco_fax_auth_status	Indicates whether authentication for this fax session was successful; possible values for this field are success, failed, bypassed, or unknown.
VSA 16	cisco_email_server_address	Indicates the IP address of the e-mail server handling the on-ramp fax-mail message.
VSA 17	cisco_email_server_ack_flag	Indicates that the on-ramp gateway has received a positive acknowledgment from the e-mail server accepting the fax-mail message.
VSA 18	cisco_gateway_id	Indicates the name of the gateway that processed the fax session; the name appears in the following format: hostname.domain-name.
VSA 19	cisco_call_type	Describes the type of fax activity: fax receive or fax send.
VSA 20	cisco_port_used	Indicates the slot and port number of the Cisco AS5300 used to either send or receive this fax mail.
VSA 21	cisco_abort_cause	If the fax session aborts, indicates the system component that signaled the abort. Examples of system components that could trigger an abort are FAP (fax application process), TIFF (the TIFF reader or the TIFF writer), fax-mail client, fax-mail server, Extended Simple Mail Transfer Protocol (ESMTP) client, or ESMTP server.

Mmoip Accounting

Store-and-forward fax was designed to use the fax accounting method list. This method list adds the capability to receive accounting records through the mmoip-aaa facility. These CDRs can be displayed in the off-ramp or on-ramp gateway through the use of the **debug mmoip aaa** command. Following is a configuration extract from the off-ramp gateway and an accounting session from an off-ramp fax, with this debug command turned on:

```

aaa new-model
aaa authentication login default local
aaa authentication login fax group radius
aaa authentication login h323 group radius
aaa authorization exec fax group radius
aaa accounting connection fax stop-only group radius
enable secret 5 $1$4L6w$W0SoUHw2YgkK4IPJ7VtHc1
fl-----configuration items deleted -----+
call application voice off tftp://topeka/ifax/t37_offramp6.2.0.0.tcl
call application voice off accounting enable
call application voice off accounting-list fax
call application voice off authentication enable
call application voice off password foip
call application voice off authen-list fax
call application voice off authen-method gateway
call application voice off language 1 en
call application voice off set-location en 0 tftp://topeka/prompts/en/

1w0d: %ISDN-6-DISCONNECT: Interface Serial0:22 disconnected from 8531827 , call lasted
    121 seconds
1w0d: mmoip_aaa_offramp: Called-Station-Id = fax=8531827@[172.19.49.20]
1w0d: mmoip_aaa_offramp: authenID = kansas.cisco.com
1w0d: mmoip_aaa_offramp: fax_account_id_origin = GATEWAY_ID
1w0d: mmoip_aaa_offramp: fax_msg_id =
1w0d: mmoip_aaa_offramp: fax_pages = 5
1w0d: mmoip_aaa_offramp: fax_modem_time = 121/123
1w0d: mmoip_aaa_offramp: fax_connect_speed = 9600
1w0d: mmoip_aaa_offramp: fax_auth_status = USER AUTHENTICATED
1w0d: mmoip_aaa_offramp: email_server_ack_flag = TRUE
1w0d: mmoip_aaa_offramp: gateway_id = kansas.cisco.com
1w0d: mmoip_aaa_offramp: call_type = Fax Send
1w0d: mmoip_aaa_offramp: port_used = 0:D (60)
1w0d: mmoip_aaa_offramp: abort_cause = 10
1w0d: mmoip_aaa_offramp: Called-Station-Id = fax=8531827@[172.19.49.20]
1w0d: mmoip_aaa_offramp: authenID = kansas.cisco.com
1w0d: mmoip_aaa_offramp: fax_account_id_origin = GATEWAY_ID
1w0d: mmoip_aaa_offramp: fax_msg_id =
1w0d: mmoip_aaa_offramp: fax_connect_speed = 9600
1w0d: mmoip_aaa_offramp: fax_auth_status = USER AUTHENTICATED
1w0d: mmoip_aaa_offramp: email_server_ack_flag = TRUE
1w0d: mmoip_aaa_offramp: gateway_id = kansas.cisco.com
1w0d: mmoip_aaa_offramp: call_type = Fax Send
1w0d: mmoip_aaa_offramp: abort_cause = 10

```

The debug call details come only at the call termination because *stop-only* accounting is enabled. They cover some of the same variables as the radius debugs but are more fax-centric. The variable `fax_modem_time` records the time spent sending fax information and the total time of the connection. In this example, the connection was up for 123 seconds and fax page information was sent for 121 seconds.


```

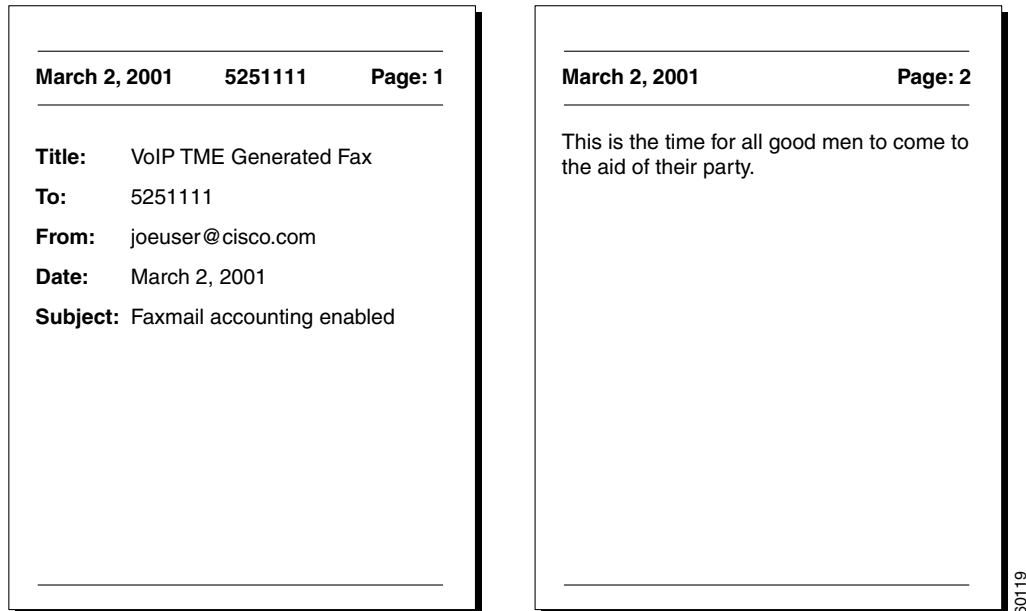
250-2.5.0 Message delivered to remote fax machine
250-2.5.0 fax_modem_time = 51/60      (These numbers are actual fax transmission
                                       time/total connection time.)

250-2.5.0 fax_pages = 2
250-2.5.0 gateway_id = belmont.cisco.com
250-2.5.0 fax_connect_speed = 14400bps
250-2.5.0 transmit_bytes = 22585
250-2.5.0 port_used = slot:1 port:5
250-2.5.0 call_type = Fax Send
250-2.5.0 abort_cause = 0
250-2.5.0 T30_error_code = 0
250-2.5.0 ISDN_disconnect_code = 16
250 2.5.0 CSID =5251111
quit
221 2.3.0 Goodbye from fresno.cisco.com; closing connection
Connection closed by foreign host.
fresno.cisco.com%

```

Figure 7 depicts the fax that was received from the preceding transmission.

Figure 7 **Received Fax**



Note that all the accounting fields are preceded by a number string. In the preceding example, the string is 250-2.5.0.

The SMTP server replies to the terminating period (.) following standard SMTP rules, which require that each line of the reply string start with a three-digit number, and that continuation lines have a hyphen (-) in the fourth position. Because the Cisco AS5300 SMTP server also implements enhanced SMTP error codes (RFC 2034), each line will also contain a one- to three-digit number, a period, a one- to three-digit number, a period, a one- to three-digit number, and a space. The following accounting information described is sent after the SMTP response code and the SMTP enhanced error code. Accounting information is always sent one per line.

Some typical responses sent by the SMTP server application after the terminating period (.) are shown in the following paragraph. Note that 250 represents success, 450 is a transient error (meaning that the e-mail client should or will retry); 554 means a permanent error.

```
250-2.5.0 Message delivered to remote fax machine
450 4.3.2 Could not reserve a modem
450-4.4.2 A fax protocol delivery error occurred.
554-5.1.1 Destination is not a receive FAX
```

Following are definitions of the accounting fields:

- `fax_modem_time`—Indicates the amount of time in seconds the modem sent fax data (x) and the amount of time in seconds of the total fax session (y), including both fax mail and PSTN time, in the form x/y. In the previous example, 51/60 means that the transfer time took 51 seconds and the total fax session took 60 seconds.
- `fax_pages`—Number of pages, including cover.
- `gateway_id`—hostname.domain, name of the gateway.
- `fax_connect_speed`—Connection speed in bps.
- `transmit_bytes`—Amount of data sent, in bytes.
- `port_used`—slot refers to carrier card shelf; port refers to modem on the card.
- `call_type`—Can be fax send or fax receive. For off-ramp gateway, it is always fax send.
- `abort_cause`—Defines the internal gateway component that signaled an abort condition, if any.
- `CSID`—Called subscriber ID (the number or ID of the called fax machine)

The following are valid abort codes:

```
0 NO_ABORT
1 FAP_ABORT, (Fax application process)
2 ESMTP_ABORT
3 TIF_ABORT
4 T2F_ABORT, (Text to Fax process)
5 AUTHENTICATION_ABORT
```

The following are valid T30 error codes:

```
/* Call Placement */
0 NORMAL_CONNECTION
1 RING_DETECT_NOCONNECT
2 USER_ABORT
3 NO_LOOP_CURRENT

/* Start proprietary codes */
4 AT_TIMEOUT
5 AT_ERROR
6 AT_NO_DIALTONE
7 AT_BUSY
8 AT_NO_CARRIER
/* End proprietary codes */

/* Transmit Phase A & Miscellaneous Errors */
10 PHASE_A_ERROR
11 NO_ANSWER_T30_TIMEOUT

/* Transmit Phase B Hangup Codes */
20 TRANSMIT_PHASE_B_ERROR
21 REMOTE_CANNOT_RECEIVE_SEND
22 COMREC_ERR_TRANSMIT_PHASE_B
23 COMREC_INVALID_COMMAND
24 RSPEC_ERROR_B
```

```

25 DCS_NO_RESPONSE
26 DIS_DTC_RECEIVED_3_TIMES
27 FTT_2400
28 RSPREC_INVALID_RESPONSE_B

/* Transmit Phase C Hangup Codes */
40 TRANSMIT_PHASE_C_ERROR
43 DTE_DCE_UNDERFLOW

/* Transmit Phase D Hangup Codes */
50 TRANSMIT_PHASE_D_ERROR
51 RSPREC_ERROR_D
52 NO_RESPONSE_MPS
53 INVALID_RESPONSE_MPS
54 NO_RESPONSE_EOP
55 INVALID_RESPONSE_EOP
56 NO_RESPONSE_EOM
57 INVALID_RESPONSE_EOM
58 UNABLE_CONTINUE

/* Receive Phase B Hangup Codes */
70 RECEIVE_PHASE_B_ERROR
71 RXSPREC_ERROR
72 COMREC_ERROR_RXB
73 T30_T2_TIMEOUT_PAGE
74 T30_T1_TIMEOUT_EOM

/* Receive Phase C Hangup Codes */
90 RECEIVE_PHASE_C_ERROR
91 MISSING_EOL
92 UNUSED_CODE
93 DCE_TO_DTE_OVERFLOW

/* Receive Phase D Hangup Codes */
100 RECEIVE_PHASE_D_ERROR
101 RSPREC_INVALID_RESPONSE_RECEIVED_D
102 COMREC_INVALID_RESPONSE_RECEIVED_D
103 UNABLE_TO_CONTINUE_AFTER_PIN_PIP

```

Following are the valid ISDN_disconnect_code values:

```

CC_CAUSE_UNINITIALIZED           = 0, /* un-initialized (0) */
CC_CAUSE_UANUM                   = 1, /* unassigned num */
CC_CAUSE_NO_ROUTE_TO_TRANSIT_NETWORK = 2,
CC_CAUSE_NO_ROUTE                 = 3, /* no rt to dest */
CC_CAUSE_SEND_INFO_TONE           = 4,
CC_CAUSE_MISDIALLED_TRUNK_PREFIX  = 5,
CC_CAUSE_CHANNEL_UNACCEPTABLE     = 6,
CC_CAUSE_CALL_AWARDED             = 7,
CC_CAUSE_PREEMPTION               = 8,
CC_CAUSE_PREEMPTION_RESERVED      = 9,
CC_CAUSE_NORM                     = 16,
CC_CAUSE_BUS                      = 17, /* user busy */
CC_CAUSE_NORS                     = 18, /* no user response*/
CC_CAUSE_NOAN                     = 19, /* no user answer. */
CC_CAUSE_SUBSCRIBER_ABSENT        = 20,
CC_CAUSE_REJECT                   = 21, /* call rejected. */
CC_CAUSE_NUMBER_CHANGED           = 22,
CC_CAUSE_NON_SELECTED_USER_CLEARING = 26,
CC_CAUSE_DESTINATION_OUT_OF_ORDER = 27,
CC_CAUSE_INVALID_NUMBER           = 28,
CC_CAUSE_FACILITY_REJECTED        = 29,
CC_CAUSE_RESPONSE_TO_STATUS_ENQUIRY = 30,
CC_CAUSE_UNSP                     = 31, /* unspecified. */

```

```

CC_CAUSE_NO_CIRCUIT = 34, /* no circuit. */
CC_CAUSE_REQUESTED_VPCI_VCI_NOT_AVAILABLE = 35
CC_CAUSE_VPCI_VCI_ASSIGNMENT_FAILURE = 36,
CC_CAUSE_CELL_RATE_NOT_AVAILABLE = 37,
CC_CAUSE_NETWORK_OUT_OF_ORDER = 38,
CC_CAUSE_PERM_FRAME_MODE_OUT_OF_SERVICE = 39,
CC_CAUSE_PERM_FRAME_MODE_OPERATIONAL = 40,
CC_CAUSE_TEMPORARY_FAILURE = 41,
CC_CAUSE_SWITCH_CONGESTION = 42,
CC_CAUSE_ACCESS_INFO_DISCARDED = 43,
CC_CAUSE_NO_REQ_CIRCUIT = 44,
CC_CAUSE_NO_VPCI_VCI_AVAILABLE = 45,
CC_CAUSE_PRECEDENCE_CALL_BLOCKED = 46,
CC_CAUSE_NO_RESOURCE = 47, /* no resource. */
CC_CAUSE_QOS_UNAVAILABLE = 49,
CC_CAUSE_FACILITY_NOT_SUBSCRIBED = 50,
CC_CAUSE_CUG_OUTGOING_CALLS_BARRED = 53,
CC_CAUSE_CUG_INCOMING_CALLS_BARRED = 55,
CC_CAUSE_BEARER_CAPABILITY_NOT_AUTHORIZED = 57,
CC_CAUSE_BEARER_CAPABILITY_NOT_AVAILABLE = 58,
CC_CAUSE_INCONSISTENCY_IN_INFO_AND_CLASS = 62,
CC_CAUSE_NOSV = 63,
/* service or option * not available, * unspecified. */
CC_CAUSE_BEARER_CAPABILITY_NOT_IMPLEMENTED = 65,
CC_CAUSE_CHAN_TYPE_NOT_IMPLEMENTED = 66,
CC_CAUSE_FACILITY_NOT_IMPLEMENTED = 69,
CC_CAUSE_RESTRICTED_DIGITAL_INFO_BC_ONLY = 70,
CC_CAUSE_SERVICE_NOT_IMPLEMENTED = 79,
CC_CAUSE_INVALID_CALL_REF_VALUE = 81,
CC_CAUSE_CHANNEL_DOES_NOT_EXIST = 82,
CC_CAUSE_CALL_EXISTS_CALL_ID_IN_USE = 83,
CC_CAUSE_CALL_ID_IN_USE = 84,
CC_CAUSE_NO_CALL_SUSPENDED = 85,
CC_CAUSE_CALL_CLEARED = 86,
CC_CAUSE_USER_NOT_IN_CUG = 87,
CC_CAUSE_INCOMPATIBLE_DESTINATION = 88,
CC_CAUSE_NON_EXISTENT_CUG = 90,
CC_CAUSE_INVALID_TRANSIT_NETWORK = 91,
CC_CAUSE_AAL_PARMS_NOT_SUPPORTED = 93,
CC_CAUSE_INVALID_MESSAGE = 95,
CC_CAUSE_MANDATORY_IE_MISSING = 96,
CC_CAUSE_MESSAGE_TYPE_NOT_IMPLEMENTED = 97,
CC_CAUSE_MESSAGE_TYPE_NOT_COMPATIBLE = 98,
CC_CAUSE_IE_NOT_IMPLEMENTED = 99,
CC_CAUSE_INVALID_IE_CONTENTS = 100,
CC_CAUSE_MESSAGE_IN_INCOMP_CALL_STATE = 101,
CC_CAUSE_RECOVERY_ON_TIMER_EXPIRY = 102,
CC_CAUSE_NON_IMPLEMENTED_PARAM_PASSED_ON = 103,
CC_CAUSE_UNRECOGNIZED_PARAM_MSG_DISCARDED = 110,
CC_CAUSE_PROTOCOL_ERROR = 111,
CC_CAUSE_INTERWORKING = 127,
CC_CAUSE_NEXT_NODE_UNREACHABLE = 128,
CC_CAUSE_DTL_TRANSIT_NOT_MY_NODE_ID = 160,

```

Using SMTP accounting, vendors implementing proprietary intelligent fax applications can collect accounting and CDR information on fax transmissions without the deployment of a RADIUS server.

Related Documents

- ITU-T T.4, *Standardization of Group 3 facsimile terminals for document transmission*
- ITU-T T.30, *Procedures for document facsimile transmission in the general switched telephone network*
- ITU-T T.37, *Procedures for the transfer of facsimile data via store-and-forward on the internet*
- ITU-T T.38, *Procedures for real-time Group 3 facsimile communication over IP networks*
- RFC 1891, *SMTP Service Extension for Delivery Status Notifications*
- RFC 2298, *An Extensible Message Format for Message Disposition Notifications*
- RFC 2301, *File Format for Internet Fax*
- RFC 2302, *Tag Image File Format (TIFF) – image/tiff MIME Sub-type Registration*
- RFC 2303, *Minimal PSTN address format in Internet Mail*
- RFC 2304, *Minimal FAX address format in Internet Mail*
- RFC 2305, *A Simple Mode of Facsimile Using Internet Mail*
- RFC 2306, *Tag Image File Format (TIFF) – F Profile for Facsimile*
- RFC 2821, *Simple Mail Transfer Protocol*
- RFC 2532, *Extended Facsimile Using Internet Mail*
- RFC 2865, *Remote Authentication Dial In User Service (RADIUS)*
- RFC 2866, *RADIUS Accounting*
- *Configuration Guide for AAA Billing Features in Cisco Voice-Enabled Routers and Access Servers*
http://www.cisco.com/warp/public/cc/so/cuso/sp/sms/acct/caaaf_cg.htm
- *RADIUS Vendor-Specific Attributes Voice Implementation Guide*
http://www.cisco.com/univercd/cc/td/doc/product/access/acs_serv/vapp_dev/vsaig3.htm
- *Cisco IOS Security Configuration Guide, Release 12.2*
http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fsecur_c/

