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Terminology and Goals for Internet Fax

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Abstract

This document defines a number of terms useful for the discussion of Internet Fax. In addition, it describes the goals of the Internet Fax working group and establishes a baseline of desired functionality against which protocols for Internet Fax can be judged. It encompasses the goals for all modes of facsimile delivery, including 'real-time', 'session', and 'store and forward'. Different levels of desirability are indicated throughout the document.

1. Introduction

Facsimile (Fax) has a long tradition as a telephony application for sending a document from one terminal device to another.

Many mechanisms for sending fax documents over the Internet have been demonstrated and deployed and are currently in use. The general application of using the Internet for facsimile is called "Internet Fax".

This document defines a number of terms useful for the discussion of Internet Fax. In addition, it describes the goals for Internet Fax and establishes a baseline of desired functionality against which protocols for Internet Fax can be judged. It encompasses the goals for all modes of facsimile delivery, including "real-time", "session", and "store and forward" (terms defined in [Section 2](#) of this document).

1.1 Terminology used within this document

Within this document, different levels of desirability for a protocol for Internet Fax are indicated by different priorities, indicated in {braces}:

- {1} there is general agreement that this is a critical characteristic of any definition of Internet Fax.
- {2} most believe that this is an important characteristic of Internet Fax.
- {3} there is general belief that this is a useful feature of Internet Fax, but that other factors might override;

a definition that does not provide this element is acceptable.

In addition, the following terms are used:

"service" An operational service offered by a service provider.
"application" A use of systems to perform a particular function.
"terminal" The endpoint of a communication application.
"goal" An objective of the standarization process.

2. Definitions and Operation Modes

This section defines some of the basic terms for Internet Fax.

2.1 User model of fax and basic operations

The phrase "traditional facsimile" or "G3Fax" is used to denote implementations of [T.30]. Facsimile (fax) is a telephony application for sending a document from one terminal device to another.

The telephone network is often referred to as the Public Switched Telephone Network (PSTN) or Global Switched Telephone Network (GSTN).

Communication over the telephone network is accomplished using modems. The transmission of data end-to-end is accompanied by negotiation (to ensure that the scanned data can be rendered at the recipient) and confirmation of delivery (to give the sender assurance that the final data has been received and processed.) Over time, facsimile has been extended to allow for PCs using fax modems to send and receive fax, to send data other than scanned facsimile images. In addition, there have been many extensions to the basic image model, to allow for additional compression methods and for representation of images with grey-scale and color. Other delivery extensions have included sub-addressing (additional signals after the call is established to facilitate automated routing of faxes to desktops or mailboxes), and enhanced features such as fax-back and polling.

Typically, the terminal device consists of a paper input device (scanner), a paper output device (printer), with (a limited amount of) processing power. Traditional facsimile has a simple user operational model; the user

- 1) inserts paper into a device
- 2) dials a number corresponding to the destination
- 3) presses the 'start' button on the device
- 4) the sending device connects to the receiving device using the telephone network
- 5) the sending device scans the paper and transmits the image of the paper
- 6) simultaneously, the remote device receives the transmission and prints the image on paper
- 7) upon completion of transmission and successful processing

by the recipient, the sending user is notified of success

Although not usually visible to the user, the operation (5) of transmission consists of

- 5a) negotiation: the capabilities of the recipient are obtained, and suitable mutually available parameters for the communication are selected
- 5b) scanning: creating digitized images of pages of a document
- 5c) compression: the image data is encoded using a data compression method
- 5d) transmission: the data is sent from one terminal to the other

In addition, the termination of operations (5d) and (6) may be characterized as consisting of:

- 6a) completed delivery: the message has completed transmission
- 6b) completed receipt: the message has been accepted by the recipient
- 6c) processing and disposition: the message has been processed

>From a protocol perspective, the information conveyed in the transmission consists of both "protocol" (control information, capabilities, identification) and also "document content".

The document content consists primarily of the "document image" plus additional metadata accompanying the image. The means by which an image of a document is encoded within the fax content is the "image data representation".

When the fax has been successfully transmitted, 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 sending user, although some error messages are visible, to allow a page to be retransmitted.

2.2 Definition of Internet Fax

The phrase "Internet Fax" is used to denote an application which supports an approximation to the user model of fax ([Section 2.1](#)), but where Internet protocols are used instead of the telephone network for (some portion of) the transmission. The exact modes and operations of traditional facsimile need not be duplicated exactly.

2.3 Internet Fax Roles

Internet Fax is a document transmission mechanism between various different devices and roles. Those devices and roles might come in a wide variety of configurations. To allow for a wide variety of configurations, it is useful to separate out the roles, as they may be made available separately or in combination. These roles are:

- * Network scanner

A device that can scan a paper document and transmit the scanned image via the Internet

* Network printer

A device that can accept an image transmission via the Internet and print the received document automatically

* Fax onramp gateway

A device that can accept a facsimile telephone call and automatically forward it via the Internet

* Fax offramp gateway

A device that can accept a transmission from the Internet and forward it to a traditional fax terminal

In addition, other traditional Internet applications might also participate in Internet Fax, including Internet mail users, Web browsers, Internet printing hosts.

2.4 Internet Fax Devices

The Internet Fax roles may be embedded in a variety of combinations and configurations within devices and larger applications. They may be combined with other elements, e.g., a traditional T.30 fax device. Many different configurations of applications and systems should {2} be able to participate in Internet Fax; the specification should not unnecessarily restrict the range of devices, applications and services that can participate.

A device that supports Internet Fax might support any combination of the roles defined in 2.3.

2.4.1 Gateway devices

A traditional fax terminal has a telephone line connection (GSTN) with a fax modem used to connect over the telephone network. To connect a fax terminal to the Internet requires a service which offers connections on one side to the GSTN using standard fax signals, and on the other side to the Internet. This role might be performed by a "relay" (e.g., transmitting T.30 signals over real-time controlled TCP connections) or a "gateway" (e.g., translating T.30 to TIFF/email).

With these applications, the role of Internet Fax is to transport the fax content across the Internet, e.g., with

```
[fax-term]-GSTNfax->[onramp]-Internet Fax->[recipient]
                [sender]-Internet Fax->[offramp]-GSTNFax->[fax-term]
```

An onramp and/or offramp application may be local to a single fax terminal. For example, the gateway application might exist within a small device which has a telephone interface on one side and a network connection on the other. To the fax machine, it looks like a telephone

connection, although it might shunt some or all connections to Internet Fax instead (Such devices are called "Bump-in-cord.")

An onramp or offramp application may be a local facility serving many fax terminals. For example, outgoing telephone fax calls through a company telephone PBX could be rerouted through a local onramp. An internet to telephone outbound connection could be part of a "LAN Fax" package.

Onramps and offramps may serve a wider area or broader collection of users, e.g., services run by service bureaus, offering subscription services; the telephone sender or the recipient might subscribe to the service.

The target of an offramp may be a "hunt group": a set of telephone numbers, each of which have a possibly different fax terminal attached.

2.4.2 New "Internet Fax" devices

Manufacturers may offer new devices which support any combination of the roles defined in section 2.3. In particular, a device resembling a traditional fax terminal, built out of similar components (scanner, processor, and printer), could offer a similar functionality to a traditional facsimile terminal, but be designed to connect to the Internet rather than, or in addition to, a telephone line connection.

Such devices might have a permanent Internet connection (through a LAN connection) or might have occasional connectivity through a (data) modem to an Internet Service Provider.

2.4.3 Internet hosts

Internet users using Internet hosts with standard application suites must {1} be able to exchange faxes with other participants in Internet Fax, with minimum required enhancements to their operating environment.

Interoperability with Internet mail users, either as Internet Fax senders or recipients, is highly desirable {2}.

Internet users might receive faxes over the Internet and display them on their screens, or have them automatically printed when received. Similarly, the Internet Fax messages originating from the user might be the output of a software application which would normally print, or specially constructed fax-sending software, or may be input directly from a scanner attached to the user's terminal.

The Internet Fax capability might be integrated into existing fax/network fax software or email software, e.g., by the addition of printer drivers that would render the document to the appropriate content-type and cause it to be delivered using an Internet Fax protocol.

In some cases, the user might have a multi-function peripheral which integrated a scanner and printer and which gave operability similar to that of the stand-alone fax terminal.

[2.4.4 Internet messaging](#)

In Internet mail, there are a number of components that operate in the infrastructure to perform additional functions beyond mail store-and-forward. Interoperability with these components is a consideration for the store and forward profile of Internet Fax. For example, mailing list software accepts mail to a single address and forwards it to a distribution list of many users. Mail archive software creates repositories of searchable messages. Mail firewalls operate at organizational boundaries and scan incoming messages for malicious or harmful mail attachments. Vacation programs send return messages to the senders of messages when the recipient is on vacation and not available to respond.

[2.4.5 Universal messaging](#)

Many software vendors are now promoting software packages that support "universal messaging": a combined communication package that combines electronic mail, voice mail, and fax.

[2.5 Operational Modes for Internet Fax](#)

Facsimile over the Internet can occur in several modes.

"Store and forward" Internet Fax entails a process of storing the entire document at a staging point, prior to transmitting it to the next staging point. Store and forward can be directly between sender and recipient or can have a series of intermediary staging points. The intermediate storage may involve an intermediate agent or sequence of agents in the communication.

"Session" Internet Fax is defined such that delivery notification is provided to the transmitting terminal prior to disconnection. Unlike "store and forward", there is an expectation that direct communication, negotiation, and retransmission can take place between the two endpoints.

"Real-time" Internet Fax allows for two [\[T.30\]](#) standard facsimile terminals to engage in a document transmission in a way that all of the essential elements of the [\[T.30\]](#) communication protocol are preserved and there is minimal elongation of the session as compared to Group 3 fax over the GSTN.

These modes are different in the end-user expectation of immediacy, reliability, and in the ease of total compatibility with legacy or traditional facsimile terminals; the modes may have different requirements on operational infrastructure connecting sender and

recipient.

3. Goals for Internet Fax

Facsimile over the Internet must define the mechanisms by which a document is transmitted from a sender to a recipient, and must {1} specify the following elements:

- Transmission protocol: what Internet protocol(s) and extensions are used? What options are available in that transmission?
- Data formats: what image data representation(s) are used, appropriate, required, within the transmission protocol? What other data representations are supported?
- Addressing: How are Internet Fax recipients identified? How may recipient identification be represented in user directories? How are traditional fax terminals addressed?
- Capabilities: The capabilities of the sender to generate different kinds of image data representations may be known to the recipient, and the capabilities, preferences, and characteristics of the recipient may be known to the sender. How are the capabilities, preferences, and characteristics of senders and recipients expressed, and communicated to each other?
- Security: Faxes may be authenticated as to their origin, or secured to protect the privacy of the message. How may the authenticity of a fax be determined by the recipient? How may the privacy of a message be guaranteed?

Specific goals for these elements are described in [section 5](#).

4. Operational Goals for Internet Fax

This section lists the necessary and desirable traits of an Internet Fax protocol.

[4.1](#) Functionality

Traditionally, images sent between fax machines are transmitted over the global switched telephone network. An Internet Fax protocol must {1} provide for a method to accomplish the most commonly used features of traditional fax using only Internet protocols. It is desirable {3} for Internet Fax to support all standard features and modes of standard facsimile.

[4.2](#) Interoperability

It is essential {1} that Internet Fax support interoperability between most of the devices and applications listed in [section 2](#), and desirable {3} to support all of them. To "support interoperability" means that a

compliant sender attempting to send to a compliant recipient will not fail because of incompatibility.

Overall interoperability requires {1} interoperability for all of the protocol elements: the image data representations must be understood, the transport protocol must function, it must be possible to address all manner of terminals, the security mechanism must not require manual operations in devices that are intended for unattended operation, and so forth.

Interoperability with Internet mail user agents is a requirement {1} only for the "store-and-forward" facsimile, although it would be useful {3} for "session" and "real-time" modes of delivery of Internet Fax.

The requirement for interoperability has strong implications for the protocol design. Interoperability must not {1} depend on having the same kind of networking equipment at each end.

As with most Internet application protocols, interoperability must {1} be independent of the nature of the networking link, whether a simple IP-based LAN, an internal private IP networks, or the public Internet. The standard for Internet Fax must {1} be "global": that is, a single specification which does not have or require special features of the transport mechanism for local operations.

If Internet Fax is to use the Internet mail transport mechanisms, it must {1} interoperate consistently with the current Internet mail environment, and, in particular, with the non-terminal devices listed in [section 2.4.4](#). If Internet Fax messages might arrive in user's mailboxes, it is required {1} that the protocol interoperate successfully with common user practices for mail messages: storing them in databases, retransmission, forwarding, creation of mail digests, replay of old messages at times long after the original receipt, and replying to messages using non-fax equipment.

It is desirable {3} that the Internet Fax standard support and facilitate universal messaging systems described in [section 2.4.5](#).

If Internet Fax requires additions to the operational environment (services, firewall support, gateways, quality of service, protocol extensions), then it is preferable {3} if those additions are useful for other applications than Fax. Features shared with other messaging applications (voice mail, short message service, paging, etc.) are desirable {3}, so as not to require different operational changes for other applications.

[4.3 Confirmation](#)

In almost all applications of traditional fax, it is considered very important that the user can get an assurance that the transmitted data

was received by a terminal at the address dialed by the user.

This goal translates to the Internet environment. The 'Internet Fax' application must {1} define the mechanisms by which a sender may request notification of the completion of transmission of the message, and receive a determinate response as to whether the message was delivered, not delivered, or that no confirmation of delivery is possible.

Originally, fax "confirmation" implied that the message was received and processed, e.g., delivered to the output paper tray of the recipient fax device. In reality, this implication was relying upon a signal produced by the receiving terminal that the incoming page had been inspected and was determined to be of reasonable (or unacceptable) quality, via an unspecified algorithm.

In later devices which support error correction mode, the ECM method (per [T.30]) enabled error checking via a specific algorithm, providing a more exact indication that the bits within the compressed image were not corrupted during transmission. With the addition of memory buffering, PC-based fax modems and the more common use of error correction mode, traditional fax confirmation still implies some assurance of processability; (e.g., a fax modem would not be able to receive an incoming fax if it required compression mechanisms that were not supported) without reporting on whether the image has been printed or viewed.

Consequently, the fax confirmation is not the same as a confirmation that the message was "read": that a human had confirmed that the message was received. It is desirable {3}, but not required, that Internet Fax support confirmation that a message has been read (above and beyond the confirmation that the message has been delivered).

4.4 Quick Delivery

In many cases, fax transmission is used for delivery of documents where there is a strong user requirement for timeliness, with some guarantees that if transmission begins at all, it will complete quickly. For example, it is a common practice to fax documents for discussion to other participants in a telephone conference call prior to the call.

Internet Fax should {2} allow the sender of a document to request immediate delivery, if such delivery is possible. In such cases, it should {2} be possible for the sender of a message to avoid sending the message at all, if quick delivery is not available for a particular recipient.

It is desirable {3} to have the protocol for requesting quick delivery be the same as, or similar to, the protocol for delayed delivery, so that two separate mechanisms are not required.

For real-time fax delivery, immediate delivery is the norm, since the protocol must guarantee that when the session connecting sender to recipient has terminated, the message has been delivered to the ultimate recipient.

4.5 Capabilities: reliable, upgrade possible

Traditionally, facsimile has guaranteed interworking between senders and recipients by having a strict method of negotiation of the capabilities between the two devices. The image representation of facsimile originally was a relatively low resolution, but has increasingly offered additional capabilities (higher resolution, color) as options.

The use of fax has grown in an evolving world (from 'Group 1' and 'Group 2', to 'Group 3' facsimile) because of two elements: (a) a useful baseline of capabilities that all terminals implemented, and (b) the use of capabilities exchange to go beyond that.

To accommodate current use as well as future growth, Internet Fax should {2} have a simple minimum set of required features that will guarantee interoperability, as well as a mechanism by which higher capability devices can be deployed into a network of lower capability devices while ensuring interoperability. If recipients with minimum capabilities were, for example, to merely drop non-minimum messages without warning, the result would be that no non-minimum message could be sent reliably. This situation can be avoided in a variety of ways, e.g., through communication of recipient capabilities or by sending multiple renditions.

The exchange of capabilities in Internet Fax should {2} be robust. To accomplish this, recipients should {2} be encouraged to provide capabilities, even while senders must {1} have a way to send messages to recipients whose capabilities are unknown.

Even minimum-capability recipients of messages should {2} be required to provide a capability indication in some reliable way. This might be accomplished by providing an entry in a directory service, by offering automatic or semi-automatic replies, or by sending some indication of in a reply to a message with multiple renditions, or as an addition to a negative acknowledgement requiring retransmission.

On the other hand, for reliability, senders cannot rely on capability information of recipients before transmission. That is, for reliability, senders should {2} have an operational mode which can function when capabilities are not present, even when recipients must always provide capabilities.

4.6 Simplicity

Internet Fax should not {2} require terminals to possess a large

amount of processing power, and a base level implementation must {1} interoperate, even if it does not offer complex processing.

Internet Fax should {2} allow interoperability with recipient devices which have limited buffering capabilities and cannot buffer an entire fax message prior to printing, or cannot buffer an entire set of fax pages before beginning transmission of scanned pages.

Different operational modes (real-time, session, store and forward) might use different protocols, in order to preserve the simplicity of each.

It is preferable {3} to make as few restrictions and additions to existing protocols as possible while satisfying the other requirements. It is important {2} that it be possible to use Internet Fax end-to-end in the current Internet environment without any changes to the existing infrastructure, although some features may require adoption of existing standards.

4.7 Security: Cause No Harm, Allow for privacy

The widespread introduction of Internet Fax must {1} not cause harm, either to its users or to others. For example, an automatic mechanism for returning notification of delivery or capabilities of fax recipients by email must {1} not expose the users or others to mail loops, bombs, or replicated delivery. Automatic capability exchange based on email might not be sufficiently robust and, without sufficient precautions, might expose users to denial of service attacks, or merely the bad effects of errors on the part of system administrators. Similar considerations apply in these areas to those that have been addressed by work on electronic mail receipt acknowledgements [[RFC 2298](#)].

Internet Fax should {2} not, by default, release information that the users consider private, e.g., as might be forthcoming in response to a broadcast requests for capabilities to a company's Internet fax devices. Public recipients of Internet Fax (e.g., public agencies which accept facsimile messages) should {2} not be required to broadcast messages with capability statements to all potential senders in order to receive facsimile messages appropriate for the capabilities of their device.

The possibility for "causing harm" might be created by a combination of facilities and other features which individually may be viewed as harmless. Thus, the overall operation of a network full of Internet Fax devices must {1} be considered.

Interoperation with ITU defined T.30 fax security methods, as well as standard Internet e-mail security methods is desirable {3}.

4.8 Reliability

The Internet Fax protocol should {2} operate reliably over a variety of configurations and situations.

In particular, operations which rely on time-delayed information might result in inconsistent information, and the protocol should be robust even in such situations.

For example, in a store-and-forward message environment, the capabilities and preferences of a fax recipient might be used by the sender to construct an appropriate message, e.g., sending a color fax to a color device but a black and white fax to a device that does not have color capability. However, the information about recipient capabilities must be accessible to the sender even when the recipient cannot be contacted directly. Thus, the sender must access recipient capabilities in some kind of storage mechanism, e.g., a directory. A directory of recipient capabilities is a kind of distributed database, and would be subject to all of the well-known failure modes of distributed databases. For example, update messages with capability descriptions might be delivered out of order, from old archives, might be lost, non-authenticated capability statements might be spoofed or widely distributed by malicious senders. The Internet Fax protocol should {2} be robust in these situations; messages should {2} not be lost or misprocessed even when the sender's knowledge of recipient capabilities are wrong, and robust mechanisms for delivery of recipient capabilities should {2} be used.

4.9 User Experience

The primary user experience with fax is:

- immediate delivery
- delivery confirmation
- ease of use

The primary user experience with email is:

- delayed delivery
- no delivery confirmation
- ability to reply to sender
- easy to send to multiple recipients

An Internet Fax standard should {2} attempt to reconcile the differences between the two environments.

4.10 Legal

An Internet Fax standard should {2} accomodate the legal requirements for facsimile, and attempt to support functionality similar to that legally required even for devices that do not operate over the public switched telephone network.

The United States Federal Communication Commission regulations

(applicable only within the USA) state:

"Identification Required on Fax Messages

The FCC's rules require that any message sent to a fax machine must clearly mark on the first page or on each page of the message:

- * the date and time the transmission is sent;
- * the identity of the sender; and
- * the telephone number of the sender or of the sending fax machine.

All fax machines manufactured on or after December 20, 1992 and all facsimile modem boards manufactured on or after December 13, 1995 must have the capability to clearly mark such identifying information on the first page or on each page of the transmission."

5. Functional Goals for Internet Fax

These goals for specific elements of Internet Fax follow from the operational goals described in [section 4](#).

5.1 Goals for image and other data representations

Interoperability with Internet Mail or other transmission mechanisms that cause data files to appear in Internet terminal environments requires {1} that Internet Fax use a format for images that is in wide use.

Interoperability with Internet Mail requires {2} that Internet Fax recipients handle those message types that are common in the email environment, including a minimum set of MIME mail formats.

Interoperability with traditional fax terminals requires {1} that the data format be capable of representing the commonly used compression mechanisms defined for traditional facsimile; support for all standard formats defined for traditional facsimile is highly desirable {2}. In addition, interoperability with 'private use' facsimile messages suggests {3} that the standard accommodate arbitrary bit sequences.

5.2 Goals for transmission

It is necessary {1} that Internet Fax to work in the context of the current Internet, Intranet, and the combination across firewalls.

A single protocol with various extensions is preferable {3} to multiple separate protocols, if there are devices that might require, at different times and for different recipients, different protocols.

5.3 Goals for addressing

Interoperability with the terminal types in [section 2](#) requires {1} the ability to address each of the kinds of recipient devices. The

address of a recipient must give sufficient information to allow the sender to initiate communication.

Interoperability with offramps to legacy fax terminals requires {1} that the message contain some way of addressing the final destination of facsimile messages, including telephone numbers, various ISDN addressing modes, and facsimile sub-addresses.

Interoperability with Internet Mail requires {1} that it be possible to address Internet Fax to any email address. Interworking with Internet mail also requires {1} that the addressing is in the email addressing headers, including mail transport envelope [[RFC1123](#)] and [RFC822](#) headers, as appropriate. The information must {1} appear nowhere else.

Sending devices might not have local storage for directories of addresses, and addresses might be cumbersome for users to type in. For these reasons, Internet Fax devices may require configuration to locate directories of recipients and their capabilities.

The source of a fax message must {1} be clearly identified. The address of the appropriate return message (whether via fax or via email) should {2} be clearly identified in a way that is visible to all manner of recipients. In the case of Internet Fax delivered by email, it should {2} be possible to use the normal 'reply' functions for email to return a message to the sender.

Traditionally, it is common for the first page of a fax message sent to a facsimile terminal to contain an (image) representation of the name, address, return number, etc. of the sender of the document. Some legal jurisdictions for facsimile require an identification of the sender on every page. The standard for Internet Fax should {2} cover the issues of sender and recipient identification in the cases where fax messages are re-routed, forwarded, sent through gateways.

[5.4 Goals for Security](#)

Users typically use GSTN-based fax for confidential document transmission, assuming a similar or higher level of confidentiality and protection from both deliberate and inadvertent eavesdropping as holds for telephone conversations; the higher level of confidentiality arising from the requirement for non-standard equipment to intercept and interpret an overheard fax transmission.

Similarly, in traditional fax there is an expectation (and, in some contexts, a legally recognized assurance) that the received fax is unaltered from the document originally transmitted.

It is important {2} that Internet Fax give users a level of assurance for privacy and integrity that is as good or better than that available for telephone-based fax. The Internet Fax standard should

{2} specify how secure messages can be sent, in an interoperable fashion. The Internet Fax protocol should {2} encourage the introduction of security features, e.g., by requiring that minimum capability devices still accept signed messages (even if ignoring the signature.)

In the case where the sender is responsible for payment for offramp services in a remote location, it is desirable {3} to provide for authentication and authorization of the sender, as well as enable billing related information from the offramp to be transferred securely.

5.5 Goals for capabilities exchange

Traditional fax supports a wide range of devices, including high resolution ("Superfine"); recent enhancements include methods for color and a variety of compression mechanisms. Fax messaging includes the capability for "non-standard frames", which allow vendors to introduce proprietary data formats. In addition, facsimile supports "binary file transfer": a method of sending arbitrary binary data in a fax message.

To support interoperability with these mechanisms, it should {2} be possible to express a wide variety of fax capabilities.

Capability support has three elements: expression of the capabilities of the sender (as far as a particular message is concerned), expressing the capabilities of a recipient (in advance of the transmission of the message), and then the protocol by which capabilities are exchanged.

The Internet Fax standard should {2} specify a uniform mechanism for capabilities expression. If capabilities are being sent at times other than the time of message transmission, then capabilities should {2} include sufficient information to allow it to be validated, authenticated, etc.

The Internet Fax standard may {3} include one or several methods for transmission, storage, or distribution of capabilities.

A request for capability information, if sent to a recipient at any time other than the immediate time of delivery of the message, should {2} clearly identify the sender, the recipient whose capabilities are being requested, and the time of the request. Some kind of signature would be useful, too.

A capability assertion (sent from recipient to sender) should {2} clearly identify the recipient and some indication of the date/time or range of validity of the information inside. To be secure, capability assertions should {2} be protected against interception and the substitution of valid data by invalid data.

6. Security Considerations

This document describes the goals for the Internet Fax protocol, including the security goals. An Internet Fax protocol must {1} address the security goals and provide adequate measures to provide users with expected security features.

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