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SMTP and MIME Extensions for Content Conversion

Status of This Memo

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A message originator sometimes sends content in a form the recipient cannot process or would prefer not to process a form of lower quality than is preferred. Such content needs to be converted to an acceptable form, with the same information or constrained information (e.g., changing from color to black and white). In a store-and-forward environment, it may be convenient to have this conversion performed by an intermediary. This specification integrates two ESMTP extensions and three MIME content header fields, which defines a cooperative service that permits authorized, accountable content form conversion by intermediaries.

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1. Introduction

Internet specifications typically define common capabilities for a particular service that are supported by all participants. This permits the sending of basic data without knowing which additional capabilities individual recipients support. However, knowing those capabilities permits the sending of additional types of data and data of enhanced richness. Otherwise, a message originator will send content in a form the recipient cannot process or will send multiple forms of data. This specification extends the work of [CONMSG], which permits a recipient to solicit alternative content forms from the originator. The current specification enables MIME content conversion by intermediaries, on behalf of a message originator and a message recipient.

1.1. Background

MIME enables the distinguishing and labeling of different types of content [IMF, MEDTYP]. However, an email originator cannot know whether a recipient is able to support (interpret) a particular data type. To permit the basic use of MIME, a minimum set of data types is specified as its support base. How will an originator know whether a recipient can support any other data types?

A mechanism for describing MIME types is specified in [FEAT]. [CONMSG] specifies a mechanism that permits an originator to query a recipient about the types it supports using email messages for the control exchange. This permits a recipient to propagate information about its capabilities back to an originator. For the control exchange, using end-to-end email messages introduces considerable latency and some unreliability.

An alternative approach is for an originator to use the "best" form of data that it can, and to include the same types of permitted representation information used in [CONMSG]. Hopefully, the recipient, or an intermediary, can translate this into a form supported by a limited recipient. This specification defines such a mechanism. It defines a means of matching message content form to the capabilities of a recipient device or system, by using MIME content descriptors and the optional use of an SMTP-based negotiation mechanism [ESMTP1, ESMTP2].

1.2. Overview

An originator describes desirable content forms in MIME content descriptors. It may give "permission", to any intermediary or the recipient, to convert the content to one of those forms. Separately, an SMTP server may report the target's content capabilities back to the SMTP client. The client is then able to convert the message content into a form that is both supported by the target system and acceptable to the originator.

A conversion service needs to balance between directions provided by the originator, directions provided on behalf of the recipient, and capabilities of the intermediary that performs the conversions. This is complicated by the need to determine whether the directions are advisory or whether they are intended to be requirements. Conversions specified as advisory are performed if possible, but they do not alter message delivery. In contrast, conversion specifications that are treated as a requirement will prohibit delivery if the recipient will not be able to process the content.

These possibilities interact to form different processing scenarios, in the event that the intermediary cannot satisfy the desires of both the originator and the recipient:

Table 1: FAILURE HANDLING

\ RECEIVER / ORIGINATOR \	Advise	Require
Advise	Deliver original content	Deliver original content
Require	Return w/out delivery	Return w/out delivery

This table reflects a policy that determines failure handling solely based on the direction provided by the originator. Thus, information on behalf of the recipient is used to guide the details of conversion, but not delivery of the message.

This is intended to continue the existing email practice of delivering content that a recipient might not be able to process. Clearly, the above table could be modified to reflect a different policy. However, that would limit backward compatibility experienced by users.

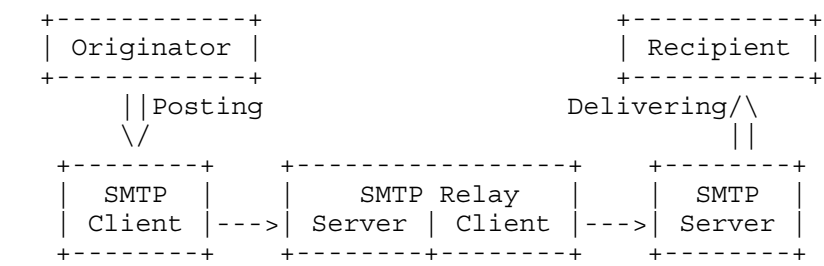
This specification provides mechanisms to support a controlled, transit-time mail content conversion service, through a series of mechanisms. These include:

* an optional ESMTP hop-by-hop service that uses the CONPERM SMTP service extensions, issued by the originator,

* an optional ESMTP hop-by-hop service that uses the CONNEG SMTP service extensions, issued on behalf of the recipient, and

* three MIME Content header fields (Content-Convert, Content-Previous and * Content-Features) that specify appropriate content header fields and record conversions that have been performed.

Figure 1: EXAMPLE RELAY ENVIRONMENT



1.3. Notational Conventions

In examples, "C:" and "S:" indicate lines sent by the client and server respectively.

The key words "MUST", "MUST NOT", "SHOULD", "SHOULD NOT" and "MAY" in this document are to be interpreted as defined in "Key words for use in RFCs to Indicate Requirement Levels" [KEYWORDS].

2. Applicability

This specification defines a cooperative mechanism that facilitates early transformation of content. The mechanism can be used to save bandwidth and to permit rendering on recipient devices that have limited capabilities. In the first case, the assumption is that conversion will produce smaller content. In the latter case, the assumption is that the recipient device can render content in a form derived from the original, but cannot render the original form.

The mechanism can impose significant resource requirements on intermediaries performing conversions. Further, the intermediary accepts responsibility for conversion prior to knowing whether it can perform the conversion. Also note that conversion is not possible for content that has been digitally signed or encrypted, unless the converting intermediary can decode and re-code the content.

3. Service Specification

This service integrates two ESMTP extensions and three MIME content header fields, in order to permit authorized, accountable content form conversion by intermediaries. Intermediaries are ESMTP hosts (clients and servers) along the transmission path between an originator and a recipient.

An originator specifies preferred content-types through the Content-Convert MIME content header field. The content header fields occur in each MIME body-part to which they apply. That is, each MIME body-part contains its own record of conversion guidance and history.

The originator's preferences are raised to the level of requirement through the ESMTP CONPERM service extension. The CONPERM mechanism is only needed when an originator requires that conversion limitations be enforced by the mail transfer service. If an acceptable content type cannot be delivered, then no delivery is to take place.

Target system capabilities are communicated in SMTP sessions through the ESMTP CONNEG service extension. This information is used to restrict the range of conversions that may be performed, but does not affect delivery.

When CONPERM is used, conversions are performed by the first ESMTP host that can obtain both the originator's permission and information about the capabilities supported by the recipient. If a relay or client is unable to transmit the message to a next-hop that supports CONPERM or to perform appropriate conversion, then it terminates message transmission and returns a [DSNSMTP, DSNFMT, SYSCOD] to the originator, with status code 5.6.3 (Conversion required but not supported).

When an SMTP relay or server performs content conversion, it records which specific conversions are made into Content-Previous and Content-Features MIME header fields associated with each converted MIME body-part.

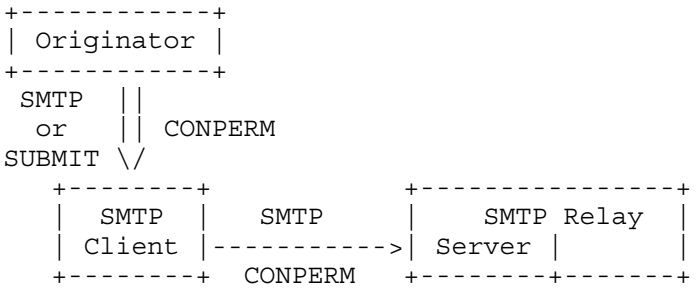
If a message is protected by strong content authentication or privacy techniques, then an intermediary that converts message content MUST ensure that the results of its processing are similarly protected. Otherwise it MUST NOT perform conversion.

Originator Action:

An originator specifies desired conversion results through the MIME Content-Convert header field. If the originator includes a Content-Convert header field, then it must also include a Content-Feature header field, to indicate the current form of the content. Intermediaries MAY interpret the presence of this header field as authorization to perform conversions. When Content-Convert header fields are the sole means for guiding conversions by intermediaries, then they serve only as advisories. Failure to satisfy the guidance of these header fields does not affect final delivery.

When posting a new message, the originator MAY specify transit-service enforcement of conversion limitations by using the ESMTP CONPERM service extension. In each of the MIME body-parts for which conversion is authorized, conversions MUST be limited to those specified in MIME Content-Convert header fields. If conversion is needed, but an authorized conversion cannot be performed, then the message will be returned to the originator. If CONPERM is not used, then failure to perform an authorized conversion will not affect normal delivery handling.

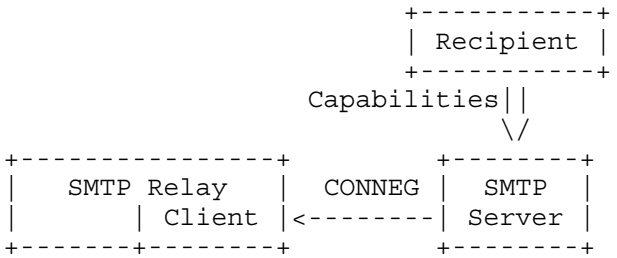
Figure 2: CONPERM USAGE



Recipient Action:

With the ESMTP mail transfer service, capabilities that can be supported on behalf of the recipient SHOULD be communicated to intermediaries by the ESMTP CONNEG service extension.

Figure 3: CONNEG USAGE



Intermediary Actions:

An intermediary MAY be given CONPERM direction when receiving a message, and MAY be given CONNEG guidance before sending the message. CONPERM and CONNEG operate on a per-message basis and are issued through the ESMTP MAIL-FROM request. CONNEG response

information is provided on a per-recipient basis, through the response to ESMTP RCPT-TO.

Conversion MUST be performed by the first CONPERM intermediary that obtains the CONNEG capability information. The MIME Content-Type MUST conform to the result of the converted content, as per [MEDTYP]. When an intermediary obtains different capability information for different recipients of the same message, it MAY either:

* Create a single, converted copy of the content that can be supported by all of the recipients, or

* Create multiple converted copies, matching the capabilities of subsets of the recipients. Each version is then sent separately to an appropriate subset of the recipients, using separate, standard SMTP sessions with separate, standard RFC2821.Rcpt-To lists of addresses.

A record of conversions is placed into MIME Content-Previous header fields. The current form of the content is described in MIME Content-Features header fields.

A special case of differential capabilities occurs when an intermediary receives capability information about some recipients, but no information about others. An example of this scenario can occur when sending a message to some recipients within one's own organization, along with recipients located elsewhere. The intermediary might have capability information about the local recipients, but will not have any for distant recipients. This is treated as a variation of the handling that is required for situations in which the permissible conversions are the null set -- that is, no valid conversions are possible for a recipient.

Rather than simply failing transmission to the recipients for which there is no capability information, the intermediary MAY choose to split the list of addressees into subsets of separate, standard RFC2821.Rcpt-To lists and separate, standard SMTP sessions, and then continue the transmission of the original content to those recipients via the **continued** use of the CONPERM mechanism. Hence, the handling for such recipients is performed as if no CONNEG transaction took place.

Once an intermediary has performed conversion, it MAY terminate use of CONPERM. However, some relay environments, such as those re-directing mail to a new target device, will benefit from further conversion. Intermediaries MAY continue to use

CONPERM or MAY re-initiate CONPERM use when they have knowledge of possible variations in a target device.

NOTE: A new, transformed version of content may have less information than the earlier version. Of course, a sequence of transformations may lose additional information at each step. Perhaps surprisingly, this can result in more loss than might be necessary. For example, transformation x could change content form A to content form B; then transformation y changes B to C. However, it is possible that transformation y might have accepted form A directly and produced form D, which has more of the original information than C.

NOTE: An originator MAY validate any conversions that are made by requesting a positive [DSNSMTP]. If the DSN request includes the "RET" parameter, the delivery agent SHOULD return an exact copy of the delivered (converted) message content. This will permit the originator to inspect the results of any conversion(s).

3.1. Sending Permission

A message originator that permits content conversion by intermediaries MAY use the CONPERM ESMTP service extension and Content-Convert MIME header fields to indicate what conversions are permitted by intermediaries. Other mechanisms, by which a message originator communicates this permission to the SMTP message transfer service, are outside the scope of this specification.

NOTE: This option requires that a server make an open-ended commitment to ensure that acceptable conversions are performed. In particular, it is possible that an intermediary will be required to perform conversion, but be unable to do so. The result will be that the intermediary will be required to perform conversion, but it will be performed in undelivered mail.

When an ESMTP client is authorized to participate in the CONPERM service, it MUST interact with the next SMTP hop server about:

* The server’s ability to enforce authorized conversions, through ESMTP CONPERM

* The capabilities supported for the target device or system, through ESMTP CONNEG

Successful use of CONPERM does not require that conversion take place along the message transfer path. Rather, it requires that conversion take place when a next-hop server reports capabilities that can be supported on behalf of the recipient (through CONNEG) and that those capabilities do not include support for the current representation of the content.

> NOTE: It is acceptable to have every SMTP server -- including the last-hop server -- support CONPERM, with none offering CONNEG. In this case, the message is delivered to the recipient in its original form. Any possible conversions to be performed are left to the recipient. Thus, the recipient is given the original form of the content, along with an explicit list of conversions deemed acceptable by the originator.

An SMTP server MAY offer ESMTP CONPERM, without being able to perform conversions, if it knows conversions can be performed along the remainder of the transfer path, or by the target device or system.

3.2. Returning Capabilities

A target recipient device or system arranges announcements of its content form capabilities to the SMTP service through a means outside the scope of this specification. Note that enabling a server to issue CONNEG information on behalf of the recipient may require a substantial mechanism between the recipient and server. When an ESMTP server knows a target's capabilities, it MAY offer the CONNEG ESMTP service extension.

> NOTE: One aspect of that mechanism, between the recipient and an ESMTP server offering the CONNEG ESMTP service extension could include offering capabilities beyond those directly supported by the recipient. In particular, the server -- or other intermediaries between the server and the recipient -- could support capabilities that they can convert to a recipient's capability. As long as the result is acceptable to the set specified in the relevant Content-Convert header fields of the message being converted, the details of these conversions are part of the recipient/server mechanism, and fall outside the scope of the current specification.

If a next-hop ESMTP server responds that it supports CONNEG when a message is being processed according to the CONPERM mechanism, then the SMTP client:

1) MUST request CONNEG information

2) MUST perform the requisite conversions, if possible, before sending the message to the next-hop SMTP server

3) MUST fail message processing, if any conversion for the message fails, and MUST return a failure DSN to the originator with status code 5.6.5 (Conversion failed).

When performing conversions, as specified in Content-Convert MIME header fields, the Client MUST:

1) Add a Content-Previous header field and a Content-Features header field to each MIME body-part that has been converted, removing any existing Content-Features header fields.

2) Either:

* Send a single copy to the next-hop SMTP server, using the best capabilities supported by all recipients along that path, or

* Separate the transfers into multiple, standard RFC2821.Rcpt-To and ESMTP sessions, in order to provide the best conversions possible for subsets of the recipients.

If the transfers are to be separated, then the current session MUST be terminated, and new sessions conducted for each subset.

The conversions to be performed are determined by the intersection of three lists:

* Conversions permitted by the originator

* Content capabilities of the target

* Conversions that can be performed by the SMTP client host

Failed Conversion

If the result of this intersection is the null set of representations, for an addressee, then delivery to that addressee MUST be handled as a conversion failure.

If handling is subject to the CONPERM mechanism and:

* the next-hop SMTP host does not indicate that it can represent the target's capabilities through CONNEG, but

* does respond that it can support CONPERM, then the client SMTP MUST send the existing content, if all other SMTP transmission requirements are satisfied.

If handling is not subject to the CONPERM mechanism, then conversion failures do not affect message delivery.

3.3. Next-Hop Non-Support of Service

If a Client is participating in the CONPERM mechanism, but the next-hop SMTP server does not support CONPERM or CONNEG, then the SMTP client

1) MUST terminate the session to the next-hop SMTP server, without sending the message

2) MUST return a DSN notification to the originator, with status code 5.6.3 (Conversion required but not supported). [DSNSMTP, DSNFMT, SYSCOD]

If a Client is participating in the CONPERM mechanism and the next-hop SMTP server supports CONNEG, but provides no capabilities for an individual RCPT-TO addressee, then the SMTP client's processing for that recipient MUST be either to:

1) Treat the addressee as a conversion failure, or

2) Separate the addressee from the address list that is processed according to CONNEG, and continue to process the addressee according to CONPERM.

4. Content Conversion Permission SMTP Extension

4.1. Content Conversion Permission Service Extension Definition

1) The name of the SMTP service extension is

   "Content-Conversion-Permission"

2) The EHLO keyword value associated with this extension is

   "CONPERM"

3) A parameter using the keyword "CONPERM" is added to the MAIL-FROM command.

4) The server responds with acceptance or rejection of support for CONPERM, for this message.

4.2. CONPERM Parameter to Mail-From

Parameter:

CONPERM

Arguments:

There are no arguments. Specification of permitted conversions is located in a Content-Convert header field for each MIME body-part in which conversion is permitted.

Client Action:

If the server issued a 250-CONPERM as part of its EHLO response for the current session, and the client is participating in the CONPERM service for this message -- such as by having received the message with a CONPERM requirement -- then the client MUST issue the CONPERM parameter in the MAIL-FROM. If the server does not issue 250-CONPERM, and the client is participating in the CONPERM service for this message, then the client MUST treat the transmission as permanently rejected.

Server Action:

If the client specifies CONPERM in the MAIL-FROM, but the server does not support the CONPERM parameter, the server MUST reject the MAIL-FROM command with a 504-CONPERM reply.

If the client issues the CONPERM parameter in the MAIL-FROM, then the server MUST conform to this specification. Either it MUST relay the message according to CONPERM, or it MUST convert the message according to CONNEG information.

4.3. Syntax

```
Content-Conversion-Permission =    "CONPERM"
```

5. Content Negotiation SMTP Extension

5.1. Content Negotiation Service Extension Definition

1) The name of the SMTP service extension is:

"Content-Negotiation"

2) The EHLO keyword value associated with this extension is:

"CONNEG"

3) A parameter, using the keyword "CONNEG", is added to the RCPT-TO command.

4) The server responds with a report indicating the content capabilities that can be received on behalf of the recipient device or system, associated with the target RCPT-TO address.

5.2. CONNEG Parameter to RCPT-TO

Parameter:

CONNEG

Arguments:

There are no arguments.

Client Action:

If a message is subject to CONPERM requirements and the server issues a 250-CONNEG, as part of its EHLO response for the current session, the client MUST issue the CONNEG parameter in the RCPT-TO request. If the message is not subject to CONPERM requirements, and the server issues a 250-CONNEG, the client MAY issue the CONNEG parameter with RCPT-TO.

If the client issues the CONNEG parameter with RCPT-TO, then it MUST honor the capabilities returned in the CONNEG RCPT-TO replies for that message. In addition, it MUST convert the message content, if the current form of the content is not included in the capabilities listed, on behalf of the recipient.

The conversions that are performed are determined by the intersection of the:

* Conversions permitted by the originator

* Content capabilities of the target

* Conversions that can be performed by the SMTP client host

If the result of this intersection is the null set of representations, then the Client processing depends upon whether the next-hop server has offered CONPERM, as well as CONNEG:

1) If the message will be subject to CONPERM at the next hop, the Client MAY transmit the original content to the next hop and continue CONPERM requirements.

2) Otherwise, the Client MUST treat the conversion as failed.

If the result of the intersection is not null, the client SHOULD convert the data to the "highest" level of capability of the server. Determination of the level that is highest is left to the discretion of the host performing the conversion.

Each converted MIME body-part MUST have a Content-Previous header field that indicates the previous body-part form and a Content-Features header field, indicating the new body-part form.

Server Action:

If the client specifies CONNEG in the RCPT-TO, but the server does not support the CONNEG parameter, the server MUST reject the RCPT-TO addressees with 504 replies.

If the server does support the CONNEG parameter, and it knows the capabilities of the target device or system, then it MUST provide that information through CONNEG. The server MAY provide a broader list than is supported by the recipient if the server can ensure that the form of content delivered can be processed by the recipient, while still satisfying the constraints of the author's Content-Convert specification(s).

The response to a CONNEG RCPT-TO request will be multi-line RCPT-TO replies. For successful (250) responses, at least the first line of the response must contain RCPT-TO information other than CONNEG. Additional response lines are for CONNEG. To avoid problems due to variations in line buffer sizes, the total parametric listing must be provided as a series of lines, each beginning with "250-CONNEG", except for the last line, which is "250 CONNEG".

The contents of the capability listing MUST conform to the specifications in [SYN] and cover the same range of specifications permitted in [CONMSG].

5.3. Syntax

```
Content-Negotiation =    "CONNEG"
Capability =             { <filter> specification,
                           as per [SYN] }
```

6. MIME Content-Features Header Field

The Content-Features header field describes the characteristics of the current version of the content for the MIME body-part in which the header field occurs. There is a separate Content-Features header field for each MIME body-part. The specification for this header field is contained in [FEAT].

7. MIME Content-Convert Header Field

Content-Convert is a header field that specifies preferred conversions for the associated content. It MAY be used without the other mechanisms defined in this document. If present, this header field MUST be carried unmodified and delivered to the recipient. In its absence, the content originator provides no guidance about content conversions, and intermediaries SHOULD NOT perform content conversion.

In the extended ABNF notation, the Content-Convert header field is defined as follows:

```
Convert =                "Content-convert" ":"
                         permitted

Permitted =              "ANY" / "NONE" / permitted-list

permitted-list =         { explicit list of permitted
                            final forms, using <filter>
                            syntax in [SYN] }
```

If the permitted conversions are specified as "ANY", then the intermediary may perform any conversions it deems appropriate.

If the permitted conversions are specified as "NONE", then the intermediary SHOULD NOT perform any conversions to this MIME body-part, even when the target device or system does not support the original form of the content.

If a Content-Convert header field is present, then a Content-Features header field MUST also be present to describe the current form of the Content.

8. MIME Content-Previous Header Field

When an intermediary has performed conversion of the associated content, the intermediary MUST record details of the previous representation, from which the conversion was performed. This information is placed in a Content-Previous header field that is part

of the MIME body-part with the converted content. There is a separate header field for each converted MIME body-part.

When an intermediary has performed conversion, the intermediary MUST record details of the result of the conversion by creating or revising the Content-Features header field for the converted MIME body-part.

In the extended [ABNF] notation, the Content-Previous header field is defined as follows:

```
previous =          "Content-Previous" [CFWS] ":"
                    [CFWS]
                    date by type

date =              "Date " [CFWS] date-time [CFWS] ";"
                    [CFWS]

by =                "By " [CFWS] domain [CFWS] ";"
                    [CFWS]

type =              { content characteristics, using
                      <filter> syntax in [SYN] }
```

The Date field specifies the date and time at which the indicated representation was converted into a newer representation.

The By field specifies the domain name of the intermediary that performed the conversion.

An intermediary MAY choose to derive the Content-Previous header field, for a body-part, from an already-existing Content-Features header field in that body-part, before that header field is replaced with the description of the current representation.

9. Examples

9.1. CONPERM Negotiation

```
S: 220 example.com IFAX
C: EHLO example.com
S: 250- example.com
S: 250-DSN
S: 250 CONPERM
C: MAIL FROM:May@some.example.com CONPERM
S: 250 <May@some.example.com> originator ok
C: RCPT TO:<June@some.example.com>
S: 250-<June@some.example.com> recipient ok
```

```
   C: DATA
   S: 354 okay, send data
   C: <<RFC 2822 message with MIME Content-Type:TIFF-FX
      Per:
      (  image-file-structure=TIFF-minimal
         dpi=400
         image-coding=JBIG
         size-x=2150/254
         paper-size=letter
      )
      with MIME body-parts including:
      Content-Convert:
         (&(image-file-structure=TIFF-minimal)
           (MRC-mode=0)
           (color=Binary)
           (|(&(dpi=204)
               (dpi-xyratio=[204/98,204/196]) )
             (&(dpi=200)
               (dpi-xyratio=[200/100,1]) )
             (&(dpi=400)
               (dpi-xyratio=1) ) )
           (|(image-coding=[MH,MR,MMR])
             (&(image-coding=JBIG)
               (image-coding-constraint=JBIG-T85)
               (JBIG-stripe-size=128) ) )
           (size-x<=2150/254)
           (paper-size=[letter,A4])
           (ua-media=stationery) )
      >>
   S: 250 message accepted
   C: QUIT
   S: 221 goodbye
```

9.2. Example CONNEG Negotiation

```
   S: 220 example.com IFAX
   C: EHLO example.com
   S: 250- example.com
   S: 250-DSN
   S: 250 CONNEG
   C: MAIL FROM:<May@some.example.com>
   S: 250 <May@some.example.com> originator ok
   C: RCPT TO:<June@ifax1.jp> CONNEG
   S: 250-<June@some.example.com> recipient ok
   S: 250-CONNEG (&(image-file-structure=TIFF-minimal)
   S: 250-CONNEG   (MRC-mode=0)
   S: 250-CONNEG   (color=Binary)
   S: 250-CONNEG   (|(&(dpi=204)
```

```
S: 250-CONNEG       (dpi-xyratio=[204/98,204/196]) )
S: 250-CONNEG     (&(dpi=200)
S: 250-CONNEG       (dpi-xyratio=[200/100,1]) ) )
S: 250-CONNEG   (image-coding=[MH,MR,MMR])
S: 250-CONNEG   (size-x<=2150/254)
S: 250-CONNEG   (paper-size=[letter,A4])
S: 250 CONNEG   (ua-media=stationery) )
C: DATA
S: 354 okay, send data
C: <<RFC 2822 message with MIME Content-Type:TIFF-FX
     Per:
     (  image-file-structure=TIFF-minimal
        dpi=400
        image-coding=JBIG
        size-x=2150/254
        paper-size=letter
      )
   >>
S: 250 message accepted
C: QUIT
S: 221 goodbye
```

9.3. Content-Previous

```
Content-Previous:
   Date  Tue, 1 Jul 2001 10:52:37 +0200;
   By    relay.example.com;
   (&(image-file-structure=TIFF-minimal)
     (MRC-mode=0)
     (color=Binary)
     (&(dpi=400)
       (dpi-xyratio=1) )
     (&(image-coding=JBIG)
       (image-coding-constraint=JBIG-T85)
       (JBIG-stripe-size=128) )
     (size-x=2150/254)
     (paper-size=A4)
     (ua-media=stationery) )
```

10. Security Considerations

This service calls for disclosure of capabilities, on behalf of recipients. Mechanisms for determining the requestor's and the respondent's authenticated identity are outside the scope of this specification. These mechanisms are intended to permit disclosure of information that is safe for public distribution; hence, there is no inherent need for security measures.