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Post-Delivery Message Downgrading for Internationalized Email Messages

Abstract

The Email Address Internationalization (SMTPUTF8) extension to SMTP allows Unicode characters encoded in UTF-8 and outside the ASCII repertoire in mail header fields. Upgraded POP and IMAP servers support internationalized messages. If a POP or IMAP client does not support Email Address Internationalization, a POP or IMAP server cannot deliver internationalized messages to the client and cannot remove the message. To avoid that situation, this document describes a mechanism for converting internationalized messages into the traditional message format. As part of the conversion process, message elements that require internationalized treatment are recoded or removed, and receivers are able to recognize that they received messages containing such elements, even if they cannot process the internationalized elements.

Status of This Memo

This is an Internet Standards Track document.

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1. Introduction

1.1. Problem Statement

Traditional (legacy) mail systems, which are defined by the Internet Message Format [RFC5322] and other specifications, allow only ASCII characters in mail header field values. The SMTPUTF8 extension [RFC6530] [RFC6531] [RFC6532] allows Unicode characters encoded in UTF-8 [RFC3629] in these mail header fields. "Raw non-ASCII strings" refers to strings of those characters in which at least one of them is not part of the ASCII repertoire.

If a header field contains non-ASCII strings, a POP or IMAP server cannot deliver internationalized messages to legacy clients that do not send UTF8 commands or have UTF8 capability. Also, because they have no obvious or standardized way to explain what is going on to clients, a POP or IMAP server cannot even safely discard the message.

1.2. Possible Solutions

There are four plausible approaches to the problem. The preferred approach depends on the particular circumstances and relationship among the delivery SMTP server, the mail store, the POP or IMAP server, and the users and their Mail User Agent (MUA) clients. The four approaches are as follows:

1. If the delivery Mail Transport Agent (MTA) has sufficient knowledge about the POP or IMAP server and the clients being used, the message may be rejected as undeliverable.
2. A new, surrogate, message may be created by downgrading the original one in the POP or IMAP server in a way that preserves maximum information at the expense of some complexity and that does not create security or operational problems in the mail system. These surrogate messages are referred to as "downgraded" in this specification and as "surrogate messages" elsewhere.
3. Some intermediate downgrading may be applied that balances additional information loss against lower complexity and greater ease of implementation.
4. The POP or IMAP server may fabricate a message that is intended to notify the client that an internationalized message is waiting but cannot be delivered until an upgraded client is available.

1.3. Approach Taken in This Specification

This specification describes the second of these options. It is worth noting that, at least in the general case, none of these options preserves sufficient information to guarantee that it is possible to reply to an incoming message without loss of information, so the choice may be considered one of the available "least bad" options. While this document specifies a well-designed mechanism, it is only an interim solution while clients are being upgraded [RFC6855] [RFC6856].

This message downgrading mechanism converts mail header fields to an all-ASCII representation. The POP or IMAP server can use the downgrading mechanism and then deliver the internationalized message in a traditional form, which allows receivers to know whether a message is internationalized or unknown or broken.

The Internationalized Mail Header specification [RFC6532] allows UTF-8 characters (see Section 2) to be used in mail header fields and MIME header fields. The Internationalized Mail Transport specification [RFC6531] allows UTF-8 characters to be used in some trace header fields. The message downgrading mechanism specified here describes the method by which internationalized messages [RFC6530] [RFC6532] are converted to traditional email messages [RFC5322].

This document provides a precise definition of the minimum-information-loss message downgrading process.

Downgrading consists of the following two parts:

- o Email header field downgrading
- o MIME header field downgrading

Email header field downgrading is described in Section 3. It generates ASCII-only header fields.

Header fields starting with Downgraded- are introduced in Section 3.1.10. They preserve the information that appeared in the original header fields.

The definition of MIME header fields in internationalized messages is described in RFC 6532. A delivery status notification may contain non-ASCII addresses. MIME header field downgrading is described in Section 4.1. Delivery status notification downgrading is described in Section 4.2. It generates ASCII-only MIME header fields.

Displaying downgraded messages that originally contained internationalized header fields is out of scope of this document. A POP or IMAP client that does not support UTF8 extensions as defined for POP3 "UTF8 command" and IMAP "ENABLE UTF8=ACCEPT command" does not recognize the internationalized message format [RFC6532].

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

Many of the specialized terms used in this specification are defined in other documents. They include "Overview and Framework for Internationalized Email" [RFC6530], the Internet Message Format specification [RFC5322], and some of the basic MIME documents [RFC2045] [RFC2183]. This specification makes extensive use of the MIME Message Header Extensions [RFC2047] and extended MIME parameter encodings [RFC2231]. For convenience, both are described as "encoded-words" or "encoded-word encoding". All of the encoded-words generated according to this specification use UTF-8 as their charset.

The terms "U-label", "A-label", and "IDNA" are used as defined in the IDNA Definitions document [RFC5890]. The terms "ASCII address", "non-ASCII address", "SMTPUTF8", "message", and "internationalized message" are used as defined RFC 6530. The term "non-ASCII string" is used with the definition provided in the Internationalized Email Headers document [RFC6532]. The term "UTF-8 character" is used informally in this document to denote a Unicode character, encoded in UTF-8, outside the ASCII repertoire. Such characters are more formally described using the ABNF element <UTF8-non-ascii>, defined in RFC 6532.

This document refers to the Augmented Backus-Naur Form (ABNF) [RFC5234] elements that appear in RFC 5322 and RFC 2045. RFC 5322 describes the ABNF elements <CFWS>, <comment>, <display-name>, <group>, <id-left>, <id-right>, <mailbox>, <quoted-string>, <unstructured>, and <word>. RFC 2045 describes the ABNF element <value>. Section 3.3 of the Internationalized Mail Transport specification [RFC6531] and Section 3.2 of the Internationalized Email Headers document [RFC6532] updated <domain> to allow non-ASCII characters.

Some additional terms are defined locally in-line below.

3. Email Message Header Field Downgrading

This section defines the method for converting each header field that may contain non-ASCII strings into ASCII. Section 3.1 describes the methods for rewriting each ABNF element. Section 3.2 describes the methods for rewriting each header field.

3.1. Downgrading Method for Each ABNF Element

Header field downgrading is defined below for each ABNF element. Conversion of the header field terminates when no characters other than those in the ASCII repertoire remain in the header field.

3.1.1. Unstructured Downgrading

If the header field has an <unstructured> field that contains non-ASCII strings, apply encoded-word encoding.

3.1.2. Word Downgrading

If the header field has any <word> fields that contain non-ASCII strings, apply encoded-word encoding.

3.1.3. Comment Downgrading

If the header field has any <comment> fields that contain non-ASCII strings, apply encoded-word encoding.

3.1.4. MIME-Value Downgrading

If the header field has any <value> elements [RFC2045] that contain non-ASCII strings, remove any <CFWS> that appear outside DQUOTE [RFC5234] that appear in those elements, then encode the <value> elements as extended MIME parameter encodings [RFC2231] and leave the language information empty.

3.1.5. Display-Name Downgrading

If the header field has any <address> (<mailbox> or <group>) elements, and they have <display-name> elements that contain non-ASCII strings, encode the <display-name> elements as encoded-words. Display-Name downgrading uses the same algorithm as Word downgrading.

3.1.6. Domain Downgrading

If the header field has any <domain> elements that contain U-labels, rewrite the non-ASCII domain name into an ASCII domain name using A-labels [RFC5891].

3.1.7. Group Downgrading

<group> is defined in Section 3.4 of the Internet Message Format specification [RFC5322]. The <group> element may contain <mailbox> elements that contain non-ASCII addresses.

If a <group> element contains <mailbox> elements and one of those <mailbox> elements contains a non-ASCII <local-part>, rewrite the <group> element as

```
display-name " " ENCODED_WORD " ;"
```

where the <ENCODED_WORD> is the original <group-list> encoded as encoded-words.

Otherwise, the <group> element contains an ASCII-only <local-part>. If the <group> element contains non-ASCII <mailbox> elements, they contain non-ASCII domain names. Rewrite the non-ASCII domain names into ASCII domain names using A-labels [RFC5891]. Generated <mailbox> elements contain ASCII addresses only.

3.1.8. Mailbox Downgrading

If the <local-part> of the <mailbox> element contains no characters other than those in the ASCII repertoire, the <domain> element may contain non-ASCII characters. Rewrite the non-ASCII domain names into ASCII domain names using A-labels [RFC5891].

Otherwise, the <local-part> may contain non-ASCII characters. The <local-part> that contains characters outside the ASCII repertoire has no equivalent format for ASCII addresses. The <addr-spec> element that contains non-ASCII strings may appear in two forms as:

```
"<" addr-spec ">"
```

or

```
addr-spec
```

Rewrite both as:

```
ENCODED-WORD " ;"
```


where the <ENCODED-WORD> is the original <addr-spec> encoded as encoded-words.

3.1.9. Type-Addr Downgrading

If the header field contains <utf-8-type-addr> and the <utf-8-type-addr> contains raw non-ASCII strings (<UTF8-non-ascii>), it is in utf-8-address form [RFC6533]. Convert it to utf-8-addr-xtext form [RFC6533]. Comment downgrading is also performed in this case. If the address type is unrecognized and the header field contains non-ASCII strings, then fall back to using Encapsulation on the entire header field as specified in Section 3.1.10.

3.1.10. Encapsulation: A Last Resort

As a last resort, when header fields cannot be converted as discussed in the previous subsection, the fields are deleted and replaced by specialized new header fields. Those fields are defined to preserve, in encoded form, as much information as possible from the header field values of the incoming message. This mechanism is known as Encapsulation downgrading in this specification because it preserves the original information in a different form. The syntax of these new header fields is:

fields =/ downgraded

```
downgraded = "Downgraded-Message-Id:"      unstructured CRLF /
             "Downgraded-Resent-Message-Id:" unstructured CRLF /
             "Downgraded-In-Reply-To:"      unstructured CRLF /
             "Downgraded-References:"      unstructured CRLF /
             "Downgraded-Original-Recipient:" unstructured CRLF /
             "Downgraded-Final-Recipient:"  unstructured CRLF
```

Applying this procedure to the "Received:" header field is prohibited. Encapsulation downgrading is allowed for "Message-ID:", "In-Reply-To:", "References:", "Original-Recipient:", and "Final-Recipient:" header fields.

To preserve a header field in a Downgraded- header field:

1. Generate a new header field.

- * The field name is a concatenation of Downgraded- and the original field name.
- * The initial new field value is the original header field value.

2. Treat the initial new header field value as if it were unstructured, and then apply the encoded-word encoding as necessary so that the resulting new header field value is completely in ASCII.
3. Remove the original header field.

3.2. Downgrading Method for Each Header Field

The Mail and MIME Header Fields document [RFC4021] establishes a registry of header fields. This section describes the downgrading method for each header field listed in that registry as of the date of publication of this specification.

If the entire mail header field contains no characters other than those in the ASCII repertoire, email header field downgrading is not required. Each header field's downgrading method is described below.

3.2.1. Address Header Fields That Contain <address> Elements

From:
Sender:
To:
Cc:
Bcc:
Reply-To:
Resent-From:
Resent-Sender:
Resent-To:
Resent-Cc:
Resent-Bcc:
Resent-Reply-To:
Return-Path:
Disposition-Notification-To:

If the header field contains non-ASCII characters, first perform Comment downgrading and Display-Name downgrading as described in the corresponding subsections of Section 3.1. If the header field still contains non-ASCII characters, complete the following two steps:

1. If the header field contains <group> elements that contain non-ASCII addresses, perform Group downgrading on those elements.
2. If the header field contains <mailbox> elements that contain non-ASCII addresses, perform Mailbox downgrading on those elements.

This procedure may generate empty <group> elements in the "From:" and "Sender:" header fields. The Group Syntax document [RFC6854] updates the Internet Message Format specification [RFC5322] to allow (empty) <group> elements in the "From:" and "Sender:" header fields.

3.2.2. Non-ASCII Strings in <comment> Elements

Date:
Resent-Date:
MIME-Version:
Content-ID:
Content-Transfer-Encoding:
Content-Language:
Accept-Language:
Auto-Submitted:

Except in comments, these header fields do not contain characters other than those in the ASCII repertoire. If the header field contains UTF-8 characters in comments, perform Comment downgrading.

3.2.3. Message-ID Header Fields

Message-ID:
Resent-Message-ID:
In-Reply-To:
References:

If there are non-ASCII strings in <id-left> or <id-right> elements, perform Encapsulation. Otherwise, the header field contains UTF-8 characters in comments and Comment downgrading should be performed.

3.2.4. Received Header Field

Received:

If <domain> elements or <mailbox> elements contain U-labels, perform Domain downgrading as specified in Section 3.1.6. Comments may contain non-ASCII strings; if so, perform Comment downgrading.

After the Domain downgrading and the Comment downgrading, if the "FOR" clause contains a non-ASCII <local-part>, remove the FOR clause. If the "ID" clause contains a non-ASCII value, remove the ID clause.

3.2.5. MIME Content Header Fields

Content-Type:
Content-Disposition:

If there are non-ASCII strings in <value> or <CFWS> elements, perform MIME-Value and Comment downgrading.

3.2.6. Non-ASCII Characters in <unstructured> Elements

Subject:
Comments:
Content-Description:

If non-ASCII strings are present in <unstructured> elements, perform Unstructured downgrading.

3.2.7. Non-ASCII Characters in <phrase> Elements

Keywords:

If non-ASCII strings are present in <phrase> elements, perform Word downgrading.

3.2.8. Other Header Fields

Other header fields that are not covered in this document (such as implementation-specific or user-defined fields) might also contain non-ASCII strings. Any header field that does not have a conversion method defined above will be in this category and treated as follows.

If there are non-ASCII strings present in the header fields, perform Unstructured downgrading.

If the software understands the header field's structure and a downgrading algorithm other than Unstructured is applicable, that software SHOULD use that algorithm; Unstructured downgrading is used when there is no other option.

Mailing list header fields (those that start in "List-") are part of this category.

4. MIME Body Parts and Delivery Status Notifications

Both the MIME body part header fields [RFC2045] [RFC6532] and the contents of a delivery status notification [RFC6533] may contain non-ASCII characters.

4.1. MIME Body Part Header Field Downgrading

RFC 6532 specifies an extension that permits MIME header fields, including body part header fields, to contain non-ASCII strings. This section defines the conversion method to ASCII-only header fields for each MIME header field that contains non-ASCII strings. Parse the message body's MIME structure at all levels and check each MIME header field to see whether it contains non-ASCII strings. If the header field contains non-ASCII strings in the header field value, the header field is a target of the MIME body part header field's downgrading. The downgrading methods used for the MIME body part header fields Content-ID, Content-Type, Content-Disposition, and Content-Description are the same as those used for the header fields of the same name described in Section 3.2

4.2. Delivery Status Notification Downgrading

If the message contains a delivery status notification (see Section 6 of the SMTP DSN Extension [RFC3461]), perform the following tests and conversions.

If there are "Original-Recipient:" and "Final-Recipient:" header fields, and the header fields contain non-ASCII strings, perform Type-Addr downgrading.

5. Security Considerations

The purpose of post-delivery message downgrading is to allow POP and IMAP servers to deliver internationalized messages to traditional POP and IMAP clients and to permit the clients to display those messages. Users that receive such messages can know that they were internationalized. It does not permit receivers to read the messages in their original form and, in general, will not permit generating replies, at least without significant user intervention.

After downgrading as specified in this document, the header fields of a message will contain ASCII characters only, some of them in encoded-word form. Nothing in this document or other SMTPUTF8 specifications [RFC6530] [RFC6531] alters the basic properties of MIME that allow characters outside the ASCII repertoire in encodings as specified for them. Thus, this document inherits the security considerations associated with MIME-encoded header fields as specified in RFC 2047 [RFC2047] and with UTF-8 itself as specified in RFC 3629 [RFC3629].

Rewriting header fields increases the opportunities for undetected spoofing by malicious senders. However, the rewritten header field values are preserved in equivalent MIME form or in newly defined

header fields for which traditional MUAs have no special processing procedures.

The techniques described here may invalidate methods that depend on digital signatures over any part of the message, which includes the top-level header fields and body part header fields. Depending on the specific message being downgraded, at least the following techniques are likely to break: DomainKeys Identified Mail (DKIM) and possibly S/MIME and Pretty Good Privacy (PGP). The downgrade mechanism SHOULD NOT remove signatures even if the signatures will fail validation after downgrading. As much of the information as possible from the original message SHOULD be preserved. In addition, MUAs may be able to use the presence of an Authentication-Results header field [RFC5451] to assess whether the digital signatures were valid before the header fields were downgraded.

While information in any email header field should usually be treated with some suspicion, current email systems commonly employ various mechanisms and protocols to make the information more trustworthy. Information in the new Downgraded-* header fields is not inspected by traditional MUAs and may be even less trustworthy than the traditional header fields. Note that the Downgraded-* header fields could have been inserted with malicious intent (and with content unrelated to the traditional header fields); however, traditional MUAs do not evaluate Downgraded-* header fields.

See the Security Considerations sections in the Group Syntax document [RFC6854] and the Internationalized Email Framework [RFC6530] for more discussion.

6. Implementation Note: Encoded-Word Encoding

While the specification of encoded-words includes specific rules for dealing with whitespace in adjacent encoded words [RFC2047], there are a number of deployed implementations that fail to implement the algorithm correctly. As a result, whitespace behavior is somewhat unpredictable, in practice, when multiple encoded words are used.

While RFC 5322 states that implementations SHOULD limit lines to 78 characters or less, implementations MAY choose to allow overly long encoded words to work around faulty implementations of encoded-words. Implementations that choose to do so SHOULD have an optional mechanism to limit line length to 78 characters.

7. IANA Considerations

The experimental specification from which this document was partially derived [RFC5504] specifies that no new header fields beginning with Downgraded- are to be registered. That restriction is now lifted, and this document makes a new set of registrations, replacing the experimental fields with standard ones.

7.1. Obsolescence of Existing Downgraded-* Header Fields

The Downgraded-* header fields that were registered as experimental fields in RFC 5504 are no longer in use. IANA has changed the status from "experimental" to "obsoleted" for every name in the "Permanent Message Header Field Names" registry that began with Downgraded-.

7.2. Registration of New Downgraded-* Header Fields

The following header fields have been registered in the "Permanent Message Header Field Names" registry, in accordance with the procedures set out in the Header Field Registration document [RFC3864].

Header field name: Downgraded-Message-Id
Applicable protocol: mail
Status: standard
Author/change controller: IETF
Specification document(s): This document (Section 3.1.10)

Header field name: Downgraded-In-Reply-To
Applicable protocol: mail
Status: standard
Author/change controller: IETF
Specification document(s): This document (Section 3.1.10)

Header field name: Downgraded-References
Applicable protocol: mail
Status: standard
Author/change controller: IETF
Specification document(s): This document (Section 3.1.10)

Header field name: Downgraded-Original-Recipient
Applicable protocol: mail
Status: standard
Author/change controller: IETF
Specification document(s): This document (Section 3.1.10)

Header field name: Downgraded-Final-Recipient
Applicable protocol: mail
Status: standard
Author/change controller: IETF
Specification document(s): This document (Section 3.1.10)

8. Acknowledgements

This document draws heavily from the experimental in-transit message downgrading procedure described RFC 5504. The contributions of the coauthor of that earlier document, Y. Yoneya, are gratefully acknowledged. Significant comments and suggestions were received from John Klensin, Barry Leiba, Randall Gellens, Pete Resnick, Martin J. Durst, and other WG participants.

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Appendix A. Downgrading Example

This appendix shows a message downgrading example. Consider a received mail message where:

- o The sender address is a non-ASCII address, "NON-ASCII-LOCAL@example.com". Its display-name is "DISPLAY-LOCAL".
- o The "To:" header field contains two non-ASCII addresses, "NON-ASCII-REMOTE1@example.net" and "NON-ASCII-REMOTE2@example.com". Their display-names are "DISPLAY-REMOTE1" and "DISPLAY-REMOTE2".
- o The "Cc:" header field contains a non-ASCII address, "NON-ASCII-REMOTE3@example.org". Its display-name is "DISPLAY-REMOTE3".
- o Four display-names contain non-ASCII characters.
- o The "Subject:" header field is "NON-ASCII-SUBJECT", which contains non-ASCII strings.
- o The "Message-Id:" header field contains "NON-ASCII-MESSAGE_ID", which contains non-ASCII strings.
- o There is an unknown header field "X-Unknown-Header:", which contains non-ASCII strings.

```
Return-Path: <NON-ASCII-LOCAL@example.com>
Received: from ... by ... for <NON-ASCII-REMOTE1@example.net>
Received: from ... by ... for <NON-ASCII-REMOTE1@example.net>
From: DISPLAY-LOCAL <NON-ASCII-LOCAL@example.com>
To: DISPLAY-REMOTE1 <NON-ASCII-REMOTE1@example.net>,
    DISPLAY-REMOTE2 <NON-ASCII-REMOTE2@example.com>
Cc: DISPLAY-REMOTE3 <NON-ASCII-REMOTE3@example.org>
Subject: NON-ASCII-SUBJECT
Date: Mon, 30 Jul 2012 01:23:45 -0000
Message-Id: NON-ASCII-MESSAGE_ID
Mime-Version: 1.0
Content-Type: text/plain; charset="UTF-8"
Content-Transfer-Encoding: 8bit
X-Unknown-Header: NON-ASCII-CHARACTERS
```

MAIL_BODY

Figure 1: Received Message in a Maildrop

The downgraded message is shown in Figure 2. "Return-Path:", "From:", "To:", and "Cc:" header fields are rewritten. "Subject:" and "X-Unknown-Header:" header fields are encoded as encoded-words. The "Message-Id:" header field is encapsulated as a "Downgraded-Message-Id:" header field.

```
Return-Path: =?UTF-8?Q?NON-ASCII-LOCAL@example.com?= :;
Received: from ... by ...
Received: from ... by ...
From: =?UTF-8?Q?DISPLAY-LOCAL?=
      =?UTF-8?Q?NON-ASCII-LOCAL@example.com?= :;
To: =?UTF-8?Q?DISPLAY-REMOTE1?=
    =?UTF-8?Q?NON-ASCII-REMOTE1@example.net?= :;,
    =?UTF-8?Q?DISPLAY-REMOTE2?=
    =?UTF-8?Q?NON-ASCII-REMOTE2@example.com?= :;,
Cc: =?UTF-8?Q?DISPLAY-REMOTE3?=
    =?UTF-8?Q?NON-ASCII-REMOTE3@example.org?= :;
Subject: =?UTF-8?Q?NON-ASCII-SUBJECT?=
Date: Mon, 30 Jul 2012 01:23:45 -0000
Downgraded-Message-Id: =?UTF-8?Q?MESSAGE_ID?=
Mime-Version: 1.0
Content-Type: text/plain; charset="UTF-8"
Content-Transfer-Encoding: 8bit
X-Unknown-Header: =?UTF-8?Q?NON-ASCII-CHARACTERS?=

MAIL_BODY
```

Figure 2: Downgraded Message

Author's Address

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