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Message Body Handling in the Session Initiation Protocol (SIP)

Abstract

This document specifies how message bodies are handled in SIP. Additionally, this document specifies SIP user agent support for MIME (Multipurpose Internet Mail Extensions) in message bodies.

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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1. Introduction

Message body handling in SIP was originally specified in [RFC3261], which relied on earlier specifications (e.g., MIME) to describe some areas. This document contains background material on how bodies are handled in SIP and normative material on areas that had not been specified before or whose specifications needed to be completed. Sections containing background material are clearly identified as such by their titles. The material on the normative sections is based on experience gained since [RFC3261] was written. Implementers need to implement what is specified in [RFC3261] (and its references) in addition to what is specified in this document.

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 [RFC2119].

The following abbreviations are used in this document.

UA: User Agent

UAC: User Agent Client

UAS: User Agent Server

URL: Uniform Resource Locator

3. Message Body Encoding

This section deals with the encoding of message bodies in SIP.

3.1. Background on Message Body Encoding

SIP [RFC3261] messages consist of an initial line (request line in requests and status line in responses), a set of header fields, and an optional message body. The message body is described using header fields such as Content-Disposition, Content-Encoding, and Content-Type, which provide information on its contents. Figure 1 shows a SIP message that carries a body. Some of the header fields are not shown for simplicity:

```
INVITE sip:conf-fact@example.com SIP/2.0
Content-Type: application/sdp
Content-Length: 192

v=0
o=alice 2890844526 2890842807 IN IP4 atlanta.example.com
s=-
c=IN IP4 192.0.2.1
t=0 0
m=audio 20000 RTP/AVP 0
a=rtpmap:0 PCMU/8000
m=video 20002 RTP/AVP 31
a=rtpmap:31 H261/90000
```

Figure 1: SIP message carrying a body

The message body of a SIP message can be divided into various body parts. Multipart message bodies are encoded using the MIME (Multipurpose Internet Mail Extensions) [RFC2045] format. Body parts are also described using header fields such as Content-Disposition, Content-Encoding, and Content-Type, which provide information on the contents of a particular body part. Figure 2 shows a SIP message that carries two body parts. Some of the header fields are not shown for simplicity:

```
INVITE sip:conf-fact@example.com SIP/2.0
Content-Type: multipart/mixed;boundary="boundary1"
Content-Length: 619

--boundary1
Content-Type: application/sdp

v=0
o=alice 2890844526 2890842807 IN IP4 atlanta.example.com
s=-
c=IN IP4 192.0.2.1
t=0 0
m=audio 20000 RTP/AVP 0
a=rtpmap:0 PCMU/8000
m=video 20002 RTP/AVP 31
a=rtpmap:31 H261/90000

--boundary1
Content-Type: application/resource-lists+xml
Content-Disposition: recipient-list

<?xml version="1.0" encoding="UTF-8"?>
<resource-lists xmlns="urn:ietf:params:xml:ns:resource-lists">
  <list>
    <entry uri="sip:bill@example.com"/>
    <entry uri="sip:randy@example.net"/>
    <entry uri="sip:joe@example.org"/>
  </list>
</resource-lists>
--boundary1--
```

Figure 2: SIP message carrying a body

SIP uses S/MIME [RFC3851] to protect message bodies. As specified in [RFC3261], UASs that cannot decrypt a message body or a body part can use the 493 (Undecipherable) response to report the error.

3.2. UA Behavior to Encode Binary Message Bodies

SIP messages can carry binary message bodies such as legacy signalling objects [RFC3204]. SIP proxy servers are 8-bit safe. That is, they are able to handle binary bodies. Therefore, there is no need to use encodings such as base64 to transport binary bodies in SIP messages. Consequently, UAs SHOULD use the binary transfer encoding [RFC4289] for all payloads in SIP, including binary payloads. The only case where a UA MAY use a different encoding is when transferring application data between applications that only handle a different encoding (e.g., base64).

4. 'multipart' Message Bodies

This section deals with 'multipart' message bodies and their handling.

4.1. Background on 'multipart' Message Bodies

[RFC3261] did not mandate support for 'multipart' message bodies in MIME format [RFC2046]. However, since [RFC3261] was written, many SIP extensions rely on them.

The use of 'multipart/mixed' MIME bodies is a useful tool to build SIP extensions. An example of such an extension could be the inclusion of location information in an INVITE request. Such an INVITE request would use the 'multipart/mixed' MIME type [RFC2046] to carry two body parts: a session description and a location object. An example of an existing extension that uses 'multipart/mixed' to send a session description and a legacy-signalling object is defined in [RFC3204].

Another MIME type that is useful to build SIP extensions is 'multipart/alternative' [RFC2046]. Each body part within a 'multipart/alternative' carries an alternative version of the same information.

The transition from SDP to new session description protocols could be implemented using 'multipart/alternative' bodies. SIP messages (e.g., INVITE requests) could carry a 'multipart/alternative' body with two body parts: a session description written in SDP and a session description written in a newer session description format. Legacy recipient UAs would use the session description written in SDP. New recipient UAs would use the one written in the newer format.

Nested MIME bodies are yet another useful tool to build and combine SIP extensions. Using the extensions in the previous examples, a UA that supported a new session description format and that needed to include a location object in an INVITE request would include a 'multipart/mixed' body with two body parts: a location object and a 'multipart/alternative'. The 'multipart/alternative' body part would, in turn, have two body parts: a session description written in SDP and a session description written in the newer session description format.

4.2. Mandatory Support for 'multipart' Message Bodies

For all MIME-based extensions to work, the recipient needs to be able to decode the multipart bodies. Therefore, SIP UAs MUST support parsing 'multipart' MIME bodies, including nested body parts. Additionally, UAs MUST support the 'multipart/mixed' and 'multipart/alternative' MIME types. Support for other MIME types such as 'multipart/related' is OPTIONAL.

Note that, by default, unknown 'multipart' subtypes are treated as 'multipart/mixed'. Also note that SIP extensions can also include 'multipart' MIME bodies in responses. That is why both UACs and UASs need to support 'multipart' bodies.

Legacy SIP UAs without support for 'multipart' bodies generate a 415 (Unsupported Media Type) response when they receive a 'multipart' body in a request. A UAC sending a 'multipart' body can receive such an error response when communicating with a legacy SIP UA that predates this specification.

It has been observed in the field that a number of legacy SIP UAs without support for 'multipart' bodies simply ignored those bodies when they were received. These UAs did not return any error response. Unsurprisingly, SIP UAs not being able to report this type of error have caused serious interoperability problems in the past.

4.3. UA Behavior to Generate 'multipart' Message Bodies

UAs SHOULD avoid unnecessarily nesting body parts because doing so would, unnecessarily, make processing the body more laborious for the receiver. However, [RFC2046] states that a 'multipart' media type with a single body part is useful in some circumstances (e.g., for sending non-text media types). In any case, UAs SHOULD NOT nest one 'multipart/mixed' within another unless there is a need to reference the nested one (i.e., using the Content ID of the nested body part). Additionally, UAs SHOULD NOT nest one 'multipart/alternative' within another.

Note that UAs receiving unnecessarily nested body parts treat them as if they were not nested.

5. 'multipart/mixed' Message Bodies

This section does not specify any additional behavior regarding how to generate and process 'multipart/mixed' bodies. This section is simply included for completeness.

6. 'multipart/alternative' Message Bodies

This section deals with 'multipart/alternative' message bodies and their handling.

6.1. Background on 'multipart/alternative' Message Bodies

Each body part within a 'multipart/alternative' carries an alternative version of the same information. The body parts are ordered so that the last one is the richest representation of the information. The recipient of a 'multipart/alternative' body chooses the last body part it understands.

Note that within a body part encoded in a given format (i.e., of a given content type), there can be optional elements that can provide richer information to the recipient in case the recipient supports them. For example, in SDP (Session Description Protocol) [RFC4566], those optional elements are encoded in 'a' lines. These types of optional elements are internal to a body part and are not visible at the MIME level. That is, a body part is understood if the recipient understands its content type, regardless of whether or not the body part's optional elements are understood.

Note as well that each part of a 'multipart/alternative' body represents the same data, but the mapping between any two parts is not necessarily without information loss. For example, information can be lost when translating 'text/html' to 'text/plain'. [RFC2046] recommends that each part should have a different Content-ID value in the case where the information content of the two parts is not identical.

6.2. UA Behavior to Generate 'multipart/alternative' Message Bodies

Section 8.2 mandates all the top-level body parts within a 'multipart/alternative' to have the same disposition type.

The 'session' and 'early-session' [RFC3959] disposition types require that all the body parts of a 'multipart/alternative' body have different content types. Consequently, for the 'session' and 'early-session' disposition types, UAs MUST NOT place more than one body part with a given content type in a 'multipart/alternative' body. That is, for 'session' and 'early-session', no body part within a 'multipart/alternative' can have the same content type as another body part within the same 'multipart/alternative'.

6.3. UA Behavior to Process 'multipart/alternative' Message Bodies

This section does not specify any additional behavior regarding how to process 'multipart/alternative' bodies. This section is simply included for completeness.

7. 'multipart/related' Message Bodies

This section deals with 'multipart/related' message bodies and their handling.

7.1. Background on 'multipart/related' Message Bodies

Compound objects in MIME are represented using the 'multipart/related' content type [RFC2387]. The body parts within a particular 'multipart/related' body are all part of a compound object and are processed as such. The body part within a 'multipart/related' body that needs to be processed first is referred to as the 'root' body part. The root body part of a 'multipart/related' body is identified by the 'start' parameter, which is a Content-Type header field parameter and contains a Content-ID URL pointing to the root body part. If the start parameter is not present, the root body part is, by default, the first body part of the 'multipart/related'. An example of a compound object is a web page that contains images. The html body part would be the root. The remaining body parts would contain the images. An example of a SIP extension using 'multipart/related' is specified in [RFC4662].

7.2. UA Behavior to Generate 'multipart/related' Message Bodies

This section does not specify any additional behavior regarding how to generate 'multipart/related' bodies. This section is simply included for completeness.

7.3. UA Behavior to Process 'multipart/related' Message Bodies

Per [RFC2387], a UA processing a 'multipart/related' body processes the body as a compound object ignoring the disposition types of the body parts within it. Ignoring the disposition types of the individual body parts makes sense in the context in which 'multipart/related' was originally specified. For instance, in the example of the web page, the implicit disposition type for the images would be 'inline', since the images are displayed as indicated by the root html file. However, in SIP, the disposition types of the individual body parts within a 'multipart/related' play an important role and, thus, need to be considered by the UA processing the 'multipart/related'. Different SIP extensions that use the same disposition type for the 'multipart/related' body can be distinguished by the

disposition types of the individual body parts within the 'multipart/related'. Consequently, SIP UAs processing a 'multipart/related' body with a given disposition type MUST process the disposition types of the body parts within it according to the SIP extension making use the disposition type of the 'multipart/related'.

Note that UAs that do not understand 'multipart/related' will treat 'multipart/related' bodies as 'multipart/mixed' bodies. These UAs will not be able to process a given body as a compound object. Instead, they will process the body parts according to their disposition type as if each body part was independent from each other.

8. Disposition Types

This section deals with disposition types in message bodies.

8.1. Background on Content and Disposition Types in SIP

The Content-Disposition header field, defined in [RFC2183] and extended by [RFC3261], describes how to handle a SIP message's body or an individual body part. Examples of disposition types used in SIP in the Content-Disposition header field are 'session' and 'render'.

[RFC3204] and [RFC3459] define the 'handling' parameter for the Content-Disposition header field. This parameter describes how a UAS reacts if it receives a message body whose content type or disposition type it does not understand. If the parameter has the value 'optional', the UAS ignores the message body; if the parameter has the value 'required', the UAS returns a 415 (Unsupported Media Type) response. The default value for the 'handling' parameter is 'required'. The following is an example of a Content-Disposition header field:

```
Content-Disposition: signal; handling=optional
```

[RFC3204] identifies two situations where a UAS (User Agent Server) needs to reject a request with a body part whose handling is required:

1. if it has an unknown content type.
2. if it has an unknown disposition type.

If the UAS did not understand the content type of the body part, the UAS can add an Accept header field to its 415 (Unsupported Media Type) response listing the content types that the UAS does

understand. Nevertheless, there is no mechanism for a UAS that does not understand the disposition type of a body part to inform the UAC about which disposition type was not understood or about the disposition types that are understood by the UAS.

The reason for not having such a mechanism is that disposition types are typically supported within a context. Outside that context, a UA need not support the disposition type. For example, a UA can support the 'session' disposition type for body parts in INVITE and UPDATE requests and their responses. However, the same UA would not support the 'session' disposition type in MESSAGE requests.

In another example, a UA can support the 'render' disposition type for 'text/plain' and 'text/html' body parts in MESSAGE requests. Additionally, the UA can support the 'session' disposition type for 'application/sdp' body parts in INVITE and UPDATE requests and their responses. However, the UA might not support the 'render' disposition type for 'application/sdp' body parts in MESSAGE requests, even if, in different contexts, the UA supported all of the following: the 'render' disposition type, the 'application/sdp' content type, and the MESSAGE method.

A given context is generally (but not necessarily) defined by a method, a disposition type, and a content type. Support for a specific context is usually defined within an extension. For example, the extension for instant messaging in SIP [RFC3428] mandates support for the MESSAGE method, the 'render' disposition type, and the 'text/plain' content type.

Note that, effectively, content types are also supported within a context. Therefore, the use of the Accept header field in a 415 (Unsupported Media Type) response is not enough to describe in which contexts a particular content type is supported.

Therefore, support for a particular disposition type within a given context is typically signalled by the use of a particular method or an option-tag in a Supported or a Require header field. When support for a particular disposition type within a context is mandated, support for a default content type is also mandated (e.g., a UA that supports the 'session' disposition type in an INVITE request needs to support the 'application/sdp' content type).

8.2. UA Behavior to Set the 'handling' Parameter

As stated earlier, the 'handling' Content-Disposition parameter can take two values: 'required' or 'optional'. While it is typically easy for a UA to decide which type of handling an individual body part requires, setting the 'handling' parameter of 'multipart' bodies requires extra considerations.

If the handling of a 'multipart/mixed' body as a whole is required for processing its enclosing body part or message, the UA MUST set the 'handling' parameter of the 'multipart/mixed' body to 'required'. Otherwise, the UA MUST set it to 'optional'. The 'handling' parameters of the top-level body parts within the 'multipart/mixed' body are set independently from the 'handling' parameter of the 'multipart/mixed' body. If the handling of a particular top-level body part is required, the UA MUST set the 'handling' parameter of that body part 'required'. Otherwise, the UA MUST set it to 'optional'.

Per the previous rules, a 'multipart/mixed' body whose handling is optional can contain body parts whose handling is required. In such case, the receiver is required to process the body parts whose handling is required if and only if the receiver decides to process the optional 'multipart/mixed' body.

Also per the previous rules, a 'multipart/mixed' body whose handling is required can contain only body parts whose handling is optional. In such case, the receiver is required to process the body as a whole but, when processing it, the receiver may decide (based on its local policy) not to process any of the body parts.

The 'handling' parameter is a Content-Disposition parameter. Therefore, in order to set this parameter, it is necessary to provide the 'multipart/mixed' body with a disposition type. Per [RFC3261], the default disposition type for 'application/sdp' is 'session' and for other bodies is 'render'. UAs SHOULD assign 'multipart/mixed' bodies a disposition type of 'render'.

Note that the fact that 'multipart/mixed' bodies have a default disposition type of 'render' does not imply that they will be rendered to the user. The way the body parts within the 'multipart/mixed' are handled depends on the disposition types of the individual body parts. The actual disposition type of the whole 'multipart/mixed' is irrelevant. The 'render' disposition type has been chosen for 'multipart/mixed' bodies simply because 'render' is the default disposition type in SIP.

If the handling of a 'multipart/alternative' body as a whole is required for processing its enclosing body part or message, the UA MUST set the 'handling' parameter of the 'multipart/alternative' body to 'required'. Otherwise, the UA MUST set it to 'optional'. The UA SHOULD also set the 'handling' parameter of all the top-level body part within the 'multipart/alternative' to 'optional'.

The receiver will process the body parts based on the handling parameter of the 'multipart/alternative' body. The receiver will ignore the handling parameters of the body parts. That is why setting them to 'optional' is at the "SHOULD" level and not at the "MUST" level -- their value is irrelevant.

The UA MUST use the same disposition type for the 'multipart/alternative' body and all its top-level body parts.

If the handling of a 'multipart/related' body as a whole is required for processing its enclosing body part or message, the UA MUST set the 'handling' parameter of the 'multipart/related' body to 'required'. Otherwise, the UA MUST set it to 'optional'. The 'handling' parameters of the top-level body parts within the 'multipart/related' body are set independently from the 'handling' parameter of the 'multipart/related' body. If the handling of a particular top-level body part is required, the UA MUST set the 'handling' parameter of that body part to 'required'. Otherwise, the UA MUST set it to 'optional'. If at least one top-level body part within a 'multipart/related' body has a 'handling' parameter of 'required', the UA SHOULD set the 'handling' parameter of the root body part to 'required'.

8.3. UA Behavior to Process 'multipart/alternative'

The receiver of a 'multipart/alternative' body MUST process the body based on its handling parameter. The receiver SHOULD ignore the handling parameters of the body parts within the 'multipart/alternative'.

8.4. UAS Behavior to Report Unsupported Message Bodies

If a UAS cannot process a request because, in the given context, the UAS does not support the content type or the disposition type of a body part whose handling is required, the UAS SHOULD return a 415 (Unsupported Media Type) response even if the UAS supported the content type, the disposition type, or both in a different context.

Consequently, it is possible to receive a 415 (Unsupported Media Type) response with an Accept header field containing all the content types used in the request.

If a UAS receives a request with a body part whose disposition type is not compatible with the way the body part is supposed to be handled according to other parts of the SIP message (e.g., a Refer-To header field with a Content-ID URL pointing to a body part whose disposition type is 'session'), the UAS SHOULD return a 415 (Unsupported Media Type) response.

9. Message Body Processing

This section deals with the processing of message bodies and how that processing is influenced by the presence of references to them.

9.1. Background on References to Message Body Parts

Content-ID URLs allow creating references to body parts. A given Content-ID URL [RFC2392], which can appear in a header field or within a body part (e.g., in an SDP attribute), points to a particular body part. The way to handle that body part is defined by the field the Content-ID URL appears. For example, the extension to refer to multiple resources in SIP [RFC5368] places a Content-ID URL in a Refer-To header field. Such a Content-ID URL points to a body part that carries a URI list. In another example, the extension for file transfer in SDP [RFC5547] places a Content-ID URL in a 'file-icon' SDP attribute. This Content-ID URL points to a body part that carries a (typically small) picture.

9.2. UA Behavior to Generate References to Message Bodies

UAs MUST only include forward references in the SIP messages they generate. That is, an element in a SIP message can reference a body part only if the body part appears after the element. Consequently, a given body part can only be referenced by another body part that appears before it or by a header field. Having only forward references allows recipients to process body parts as they parse them. They do not need to parse the remainder of the message in order to process a body part.

It was considered to only allow (forward) references among body parts that belonged to the same 'multipart/related' [RFC2387] wrapper. However, it was finally decided that this extra constraint was not necessary.

9.3. UA Behavior to Process Message Bodies

In order to process a message body or a body part, a UA needs to know whether a SIP header field or another body part contains a reference to the message body or body part (e.g., a Content-ID URL pointing to it). If the body part is not referenced in any way (e.g., there are

no header fields or other body parts with a Content-ID URL pointing to it), the UA processes the body part as indicated by its disposition type and the context in which the body part was received.

If the SIP message contains a reference to the body part, the UA processes the body part according to the reference. If the SIP message contains more than one reference to the body part (e.g., two header fields contain Content-ID URLs pointing to the body part), the UA processes the body part as many times as references are.

Note that, following the rules in [RFC3204], if a UA does not understand a body part whose handling is optional, the UA ignores it. Also note that the content indirection mechanism in SIP [RFC4483] allows UAs to point to external bodies. Therefore, a UA receiving a SIP message that uses content indirection could need to fetch a body part (e.g., using HTTP [RFC2616]) in order to process it.

9.4. The 'by-reference' Disposition Type

Per the rules in Section 9.3, if a SIP message contains a reference to a body part, the UA processes the body part according to the reference. Since the reference provides the context in which the body part needs to be processed, the disposition type of the body part is irrelevant. However, a UA that missed a reference to a body part (e.g., because the reference was in a header field the UA did not support) would attempt to process the body part according to its disposition type alone. To keep this from happening, we define a new disposition type for the Content-Disposition header field: by-reference.

A body part whose disposition type is 'by-reference' needs to be handled according to a reference to the body part that is located in the same SIP message as the body part (given that SIP only allows forward references, the reference will appear in the same SIP message before the body part). A recipient of a body part whose disposition type is 'by-reference' that cannot find any reference to the body part (e.g., the reference was in a header field the recipient does not support and, thus, did not process) MUST NOT process the body part. Consequently, if the handling of the body part was required, the UA needs to report an error.

Note that extensions that predate this specification use references to body parts whose disposition type is not 'by-reference'. Those extensions use option-tags to make sure the recipient understands the whole extension and, thus, cannot miss the reference and attempt to process the body part according to its disposition type alone.

10. Guidelines to Authors of SIP Extensions

These guidelines are intended for authors of SIP extensions that involve, in some way, message bodies or body parts. These guidelines discuss aspects that authors of such extensions need to consider when designing them.

This specification mandates support for 'multipart/mixed' and 'multipart/alternative'. At present, there are no SIP extensions that use different 'multipart' subtypes such as parallel [RFC2046] or digest [RFC2046]. If such extensions were to be defined in the future, their authors would need to make sure (e.g., by using an option-tag or by other means) that entities receiving those 'multipart' subtypes were able to process them. As stated earlier, UAs treat unknown 'multipart' subtypes as 'multipart/mixed'.

Authors of SIP extensions making use of 'multipart/related' bodies have to explicitly address the handling of the disposition types of the body parts within the 'multipart/related' body. Authors wishing to make use of 'multipart/related' bodies should keep in mind that UAs that do not understand 'multipart/related' will treat it as 'multipart/mixed'. If such treatment by a recipient is not acceptable for a particular extension, the authors of such extension would need to make sure (e.g., by using an option-tag or by other means) that entities receiving the 'multipart/related' body were able to correctly process them.

As stated earlier, SIP extensions can also include 'multipart' MIME bodies in responses. Hence, a response can be extremely complex and the UAC receiving the response might not be able to process it correctly. Because UACs receiving a response cannot report errors to the UAS that generated the response (i.e., error responses can only be generated for requests), authors of SIP extensions need to make sure that requests clearly indicate (e.g., by using an option-tag or by other means) the capabilities of the UAC so that UASs can decide what to include in their responses.

11. Security Considerations

This document specifies how SIP entities handle message bodies. [RFC3261] discusses what type of information is encoded in SIP message bodies and how SIP entities can protect that information. In addition to the hop-by-hop security SIP can provide, SIP can also secure information in an end-to-end fashion. SIP message bodies can be end-to-end encrypted and integrity protected using S/MIME [RFC3851], as described in [RFC3261].

12. IANA Considerations

This document contains two actions that have been completed by IANA.

12.1. Registration of the 'by-reference' Disposition Type

This document defines a new Content-Disposition header field disposition type (by-reference) Section 9.4. This value has been registered in the IANA registry for Mail Content Disposition Values with the following description:

by-reference	The body needs to be handled according to a reference to the body that is located in the same SIP message as the body.
--------------	--

12.2. Update of the 'handling' Parameter Registration

References to this specification, to [RFC3204], and to [RFC3459] have been added to the entry for the Content-Disposition 'handling' parameter in the Header Field Parameters and Parameter Values registry. The following is the resulting entry.

Header Field	Parameter Name	Predefined Values	Reference
-----	-----	-----	-----
Content-Disposition	handling	Yes	[RFC3204] [RFC3261] [RFC3459] [RFC5621]

13. Acknowledgements

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