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A Mechanism for Content Indirection in Session Initiation Protocol (SIP) Messages

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Abstract

This document defines an extension to the URL MIME External-Body Access-Type to satisfy the content indirection requirements for the Session Initiation Protocol (SIP). These extensions are aimed at allowing any MIME part in a SIP message to be referred to indirectly via a URI.

Table of Contents

1. Introduction

The purpose of the Session Initiation Protocol [9] (SIP) is to create, modify, or terminate sessions with one or more participants. SIP messages, like HTTP, are syntactically composed of a start line, one or more headers, and an optional body. Unlike HTTP, SIP is not designed as a general-purpose data transport protocol.

There are numerous reasons why it might be desirable to specify the content of the SIP message body indirectly. For bandwidth-limited applications such as cellular wireless, indirection provides a means to annotate the (indirect) content with meta-data, which may be used by the recipient to determine whether or not to retrieve the content over a resource-limited link.

It is also possible that the content size to be transferred might overwhelm intermediate signaling proxies, thereby unnecessarily increasing network latency. For time-sensitive SIP applications, this may be unacceptable. Indirect content can remedy this by moving the transfer of this content out of the SIP signaling network and into a potentially separate data transfer channel.

There may also be scenarios where the session-related data (body) that needs to be conveyed does not directly reside on the endpoint or User Agent. In such scenarios, it is desirable to have a mechanism whereby the SIP message can contain an indirect reference to the desired content. The receiving party would then use this indirect reference to retrieve the content via a non-SIP transfer channel such as HTTP, FTP, or LDAP.

The purpose of content indirection is purely to provide an alternative transport mechanism for SIP MIME body parts. With the exception of the transport mechanism, indirect body parts are

equivalent to, and should have the same treatment as, in-line body parts.

Previous attempts at solving the content indirection problem made use of the text/uri-list [6] MIME type. While attractive for its simplicity (a list of URIs delimited by end-of-line markers), it failed to satisfy a number of the requirements for a more general-purpose content indirection mechanism in SIP. Most notably lacking is the ability to specify various attributes on a per-URI basis. These attributes might include version information, the MIME type of the referenced content, etc.

RFC 2017 defines a strong candidate for a replacement for the text/uri-list MIME type. RFC 2017 [1] defines an extension to the message/external-body MIME type originally defined in RFC2046 [3]. The extension that RFC 2017 makes allows a generic URI to specify the location of the content rather than protocol-specific parameters for FTP, etc., as originally defined in RFC2046. Although it provides most of the functionality needed for a SIP content indirection mechanism, RFC 2017 by itself is not a complete solution. This document specifies the usage of RFC 2017 necessary to fulfill the requirements outlined for content indirection.

The requirements can be classified as applying either to the URI, which indirectly references the desired content, or to the content itself. Where possible, existing MIME parameters and entity headers are used to satisfy those requirements. MIME (Content-Type) parameters are the preferred manner of describing the URI, while entity headers are the preferred manner of describing the (indirect) content. See RFC 2045 [2] for a description of most of these entity headers and MIME parameters.

2. Terminology

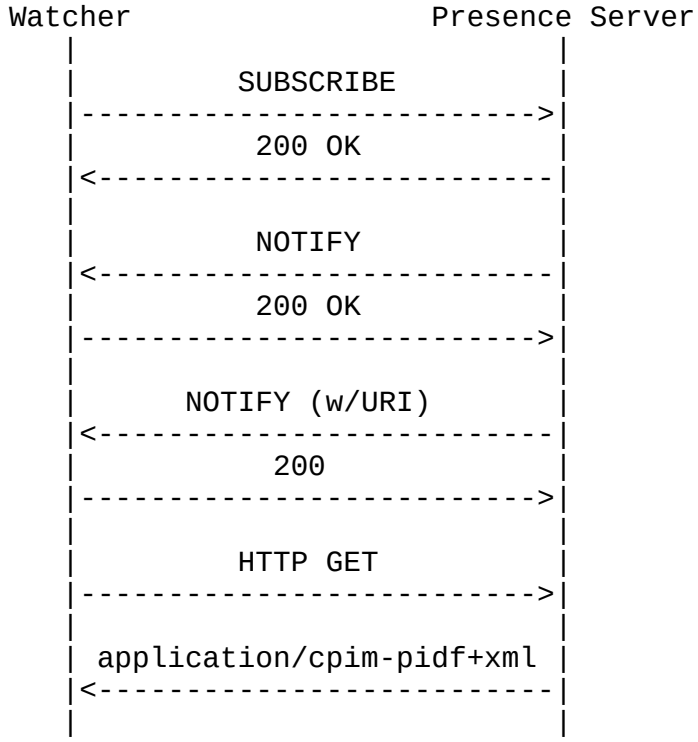
RFC 2119 [5] defines the keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL".

3. Use Case Examples

There are several examples of using the content indirection mechanism. These are examples only and are not intended to limit the scope or applicability of the mechanism.

3.1. Presence Notification

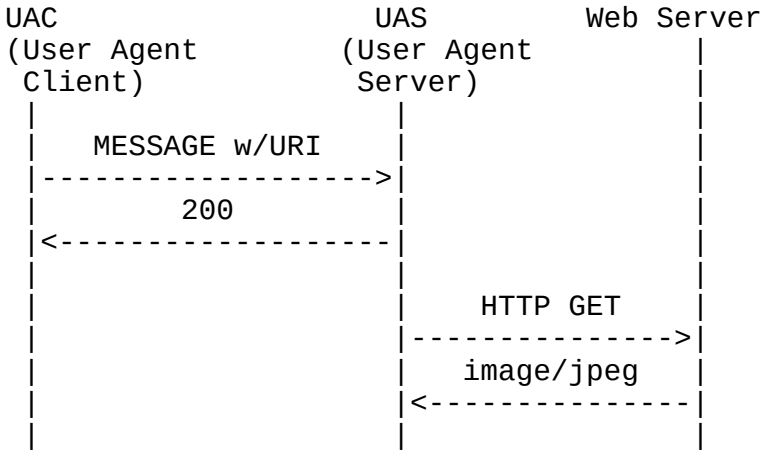
The information carried in a presence document could exceed the recommended size for a SIP (NOTIFY) request, particularly if the document carries aggregated information from multiple endpoints. In such a situation, it would be desirable to send the NOTIFY request with an indirect pointer to the presence document, which could then be retrieved by, for example, HTTP.



In this example, the presence server returns an HTTP URI pointing to a presence document on the presence server, which the watcher can then fetch by using an HTTP GET.

3.2. Document Sharing

During an instant messaging conversation, a useful service is document sharing, wherein one party sends an IM (MESSAGE request) with an indirect pointer to a document that is meant to be rendered by the remote party. Carrying such a document directly in the MESSAGE request is not an appropriate use of the signaling channel. Furthermore, the document to be shared may reside on a completely independent server from that of the originating party.



In this example, a user UAC wishes to exchange a JPEG image that she has stored on her web server with user UAS with whom she has an IM conversation. She intends to render the JPEG inline in the IM conversation. The recipient of the MESSAGE request launches an HTTP GET request to the web server to retrieve the JPEG image.

4. Requirements

- It MUST be possible to specify the location of content via a URI. Such URIs MUST conform with RFC2396 [7].

- It MUST be possible to specify the length of the indirect content.

- It MUST be possible to specify the type of the indirect content.

- It MUST be possible to specify the disposition of each URI independently.

- It MUST be possible to label each URI to identify if and when the content referred to by that URI has changed. Applications of this mechanism may send the same URI more than once. The intention of this requirement is to allow the receiving party to determine whether the content referenced by the URI has changed, without having to retrieve that content. Examples of ways the URI could be labeled include a sequence number, timestamp, and version number. When used with HTTP, the entity-tag (ETAG) mechanism, as defined in RFC2068 [4], may be appropriate. Note that we are labeling not the URI itself but the content to which the URI refers, and that the label is therefore effectively "metadata" of the content itself.

- It MUST be possible to specify the time span for which a given URI is valid. This may or may not be the same as the lifetime for the content itself.

- It MUST be possible for the UAC and the UAS to indicate support of this content indirection mechanism. A fallback mechanism SHOULD be specified in the event that one of the parties is unable to support content indirection.

- It MUST be possible for the UAC and UAS to negotiate the type of the indirect content when using the content indirection mechanism.

- It MUST be possible for the UAC and UAS to negotiate support for any URI scheme to be used in the content indirection mechanism. This is in addition to the ability to negotiate the content type.

- It SHOULD be possible to ensure the integrity and confidentiality of the URI when it is received by the remote party.

- It MUST be possible to process the content indirection without human intervention.

- It MUST allow for indirect transference of content in any SIP message that would otherwise carry that content as a body.

5. Application of RFC 2017 to the Content Indirection Problem

The following text describes the application of RFC 2017 to the requirements for content indirection.

5.1. Specifying Support for Content Indirection

A UAC/UAS indicates support for content indirection by including the message/external-body MIME type in the Accept header. The UAC/UAS MAY supply additional values in the Accept header to indicate the content types that it is willing to accept, either directly or through content indirection. User-Agents supporting content indirection MUST support content indirection of the application/sdp MIME type.

For example:

```
Accept: message/external-body, image/*, application/sdp
```

5.2. Mandatory support for HTTP URI

Applications that use this content indirection mechanism MUST support the HTTP URI scheme. Additional URI schemes MAY be used, but a UAC/UAS MUST support receiving a HTTP URI for indirect content if it advertises support for content indirection.

The UAS MAY advertise alternate access schemes in the schemes parameter of the Contact header in the UAS response to the UAC's session establishment request (e.g., INVITE, SUBSCRIBE), as described in RFC 3840 [11].

5.3. Rejecting Content Indirection

If a UAS receives a SIP request that contains a content indirection payload and the UAS cannot or does not wish to support such a content type, it MUST reject the request with a 415 Unsupported Media Type response as defined in section 21.4.13 of SIP [9]. In particular, the UAC should note the absence of the message/external-body MIME type in the Accept header of this response to indicate that the UAS does not support content indirection, or the absence of the particular MIME type of the requested comment to indicate that the UAS does not support the particular media type.

5.4. Specifying the Location of the Content via a URI

The URI for the indirect content is specified in a "URI" parameter of the message/external-body MIME type. An access-type parameter indicates that the external content is referenced by a URI. HTTP URI specifications MUST conform to RFC 2396 [7].

For example:

```
Content-Type: message/external-body; access-type="URL";
    URL="http://www.example.com/the-indirect-content"
```

5.5. Marking Indirect Content Optional

Some content is not critical to the context of the communication if there is a fetch or conversion failure. The content indirection mechanism uses the Critical-Content mechanism described in RFC 3459 [10]. In particular, if the UAS is unable to fetch or render an optional body part, then the server MUST NOT return an error to the UAC.

5.6. Specifying Versioning Information for the URI

In order to determine whether the content indirectly referenced by the URI has changed, a Content-ID entity header is used. The syntax of this header is defined in RFC 2045 [2]. Changes in the underlying content referred to by a URI MUST result in a change in the Content-ID associated with that URI. Multiple SIP messages carrying URIs that refer to the same content SHOULD reuse the same Content-ID, to allow the receiver to cache this content and to avoid unnecessary retrievals. The Content-ID is intended to be globally unique and SHOULD be temporally unique across SIP dialogs.

For example:

```
Content-ID: <4232423424@www.example.com>
```

5.7. Specifying the URI Lifetime

The URI supplied by the Content-Type header is not required to be accessible or valid for an indefinite period of time. Rather, the supplier of the URI MUST specify the time period for which this URI is valid and accessible. This is done through an "EXPIRATION" parameter of the Content-Type. The format of this expiration parameter is an RFC 1123 [12] date-time value. This is further restricted in this application to use only GMT time, consistent with the Date: header in SIP. This is a mandatory parameter. Note that the date-time value can range from minutes to days or even years.

For example:

```
Content-Type: message/external-body;
              expiration="Mon, 24 June 2002 09:00:00 GMT"
```

5.8. Specifying the type of the Indirect Content

To support existing SIP mechanisms for the negotiation of content types, a Content-Type entity header SHOULD be present in the entity (payload) itself. If the protocol (scheme) of the URI supports its own content negotiation mechanisms (e.g., HTTP), this header may be omitted. The sender MUST, however, be prepared for the receiving party to reject content indirection if the receiver is unable to negotiate an appropriate MIME type by using the underlying protocol for the URI scheme.

For example:

```
Content-Type: message/external-body; access-type="URL";
    expiration="Mon, 24 June 2002 09:00:00 GMT";
    URL="http://www.example.com/the-indirect-content"
<CRLF>
Content-Type: application/sdp
Content-Disposition: session
<CRLF>
```

5.9. Specifying the Size of the Indirect Content

When known in advance, the size of the indirect content in bytes SHOULD be supplied via a size parameter on the Content-Type header. This is an extension of RFC 2017 but is in line with other access types defined for the message/external-body MIME type in RFC 2046. The content size is useful for the receiving party to make a determination about whether to retrieve the content. As with directly supplied content, a UAS may return a 513 error response in the event that the content size is too large. Size is an optional parameter.

For example:

```
Content-Type: message/external-body; access-type="URL";
    expiration="Mon, 24 June 2002 09:00:00 GMT";
    URL="http://www.example.com/the-indirect-content";
    size=4123
```

5.10. Specifying the Purpose of the Indirect Content

A Content-Disposition entity header MUST be present for all indirect content.

For example:

```
Content-Type: message/external-body; access-type="URL";
    expiration="Mon, 24 June 2002 09:00:00 GMT";
    URL="http://www.example.com/the-indirect-content"
<CRLF>
Content-Type: image/jpeg
Content-Disposition: render
```

5.11. Specifying Multiple URIs for Content Indirection

If there is a need to send multiple URIs for content indirection, an appropriate multipart MIME type [3] should be used. Each URI MUST be contained in a single entity. Indirect content may be mixed with directly-supplied content. This is particularly useful with the multipart/alternative MIME type.

NOTE: This specification does not change the meanings of the various multipart flavors, particularly multipart/related, as described in RFC 2387 [13].

For example:

```
MIME-Version: 1.0
Content-Type: multipart/mixed; boundary=boundary42

--boundary42
Content-Type: text/plain; charset=us-ascii

The company announcement for June, 2002 follows:
--boundary42
Content-Type: message/external-body;
     access-type="URL";
     expiration="Mon, 24 June 2002 09:00:00 GMT";
     URL="http://www.example.com/announcements/07242002";
     size=4123

Content-Type: text/html
Content-Disposition: render

--boundary42--
```

5.12. Specifying a Hash Value for the Indirect Content

If the sender knows the specific content being referenced by the indirection, and if the sender wishes the recipient to be able to validate that this content has not been altered from that intended by the sender, the sender includes a SHA-1 [8] hash of the content. If it is included, the hash is encoded by extending the MIME syntax [3] to include a "hash" parameter for the content type "message/external-body", whose value is a hexadecimal encoding of the hash.

For example:

```
Content-Type: message/external-body;
    access-type="URL";
    expiration="Mon, 24 June 2002 09:00:00 GMT";
    URL="http://www.example.com/the-indirect-content.au";
    size=52723;
    hash=10AB568E91245681AC1B
<CRLF>
Content-Disposition: render
```

5.13. Supplying Additional Comments about the Indirect Content

One MAY use the Content-Description entity header to provide optional, freeform text to comment on the indirect content. This text MAY be displayed to the end user but MUST NOT used by other elements to determine the disposition of the body.

For example:

```
Content-Type: message/external-body;
    access-type="URL";
    expiration="Mon, 24 June 2002 09:00:00 GMT";
    URL="http://www.example.com/the-indirect-content";
    size=52723
<CRLF>
Content-Description: Multicast gaming session
Content-Disposition: render
```

5.14. Relationship to Call-Info, Error-Info, and Alert-Info Headers

SIP [9] defines three headers that supply additional information with regard to a session, a particular error response, or alerting. All three of these headers allow the UAC or UAS to indicate additional information through a URI. They may be considered a form of content indirection. The content indirection mechanism defined in this document is not intended as a replacement for these headers. Rather, the headers defined in SIP MUST be used in preference to this mechanism, where applicable, because of the well-defined semantics of those headers.

6. Examples

6.1. Single Content Indirection

```
INVITE sip:boromir@example.com SIP/2.0
From: <sip:gandalf@example.net>;tag=347242
To: <sip:boromir@example.com>
Call-ID: 3573853342923422@example.net
CSeq: 2131 INVITE
Accept: message/external-body application/sdp
Content-Type: message/external-body;
     ACCESS-TYPE=URL;
     URL="http://www.example.net/party/06/2002/announcement";
     EXPIRATION="Sat, 20 Jun 2002 12:00:00 GMT";
     size=231
Content-Length: 105

Content-Type: application/sdp
Content-Disposition: session
Content-ID: <4e5562cd1214427d@example.net>
```

6.2. Multipart MIME with Content Indirection

```
MESSAGE sip:boromir@example.com SIP/2.0
From: <sip:gandalf@example.net>;tag=34589882
To: <sip:boromir@example.com>
Call-ID: 9242892442211117@example.net
CSeq: 388 MESSAGE
Accept: message/external-body, text/html, text/plain,
        image/*, text/x-emoticon
MIME-Version: 1.0
Content-Type: multipart/mixed; boundary=zz993453

--zz993453
Content-Type: message/external-body;
     access-type="URL";
     expiration="Mon, 24 June 2002 09:00:00 GMT";
     URL="http://www.example.net/company_picnic/image1.png";
     size=234422

Content-Type: image/png
Content-ID: <9535035333@example.net>
Content-Disposition: render
Content-Description: Kevin getting dunked in the wading pool

--zz993453
```

```
Content-Type: message/external-body;
     access-type="URL";
     expiration="Mon, 24 June 2002 09:00:00 GMT";
     URL="http://www.example.net/company_picnic/image2.png";
     size=233811

Content-Type: image/png
Content-ID: <1134299224244@example.net>
Content-Disposition: render
Content-Description: Peter on his tricycle

--zz993453--
```

7. Security Considerations

Any content indirection mechanism introduces additional security concerns. By its nature, content indirection requires an extra processing step and information transfer. There are a number of potential abuses of a content indirection mechanism:

- Content indirection allows the initiator to choose an alternative protocol with weaker security or known vulnerabilities for the content transfer (for example, asking the recipient to issue an HTTP request that results in a Basic authentication challenge).

- Content indirection allows the initiator to ask the recipient to consume additional resources in the information transfer and content processing, potentially creating an avenue for denial-of-service attacks (for example, an active FTP URL consuming 2 connections for every indirect content message).

- Content indirection could be used as a form of port-scanning attack where the indirect content URL is actually a bogus URL pointing to an internal resource of the recipient. The response to the content indirection request could reveal information about open (and vulnerable) ports on these internal resources.

- A content indirection URL can disclose sensitive information about the initiator such as an internal user name (as part of an HTTP URL) or possibly geolocation information.

Fortunately, all of these potential threats can be mitigated through careful screening of both the indirect content URIs that are received and those that are sent. Integrity and confidentiality protection of the indirect content URI can prevent additional attacks as well.

For confidentiality, integrity, and authentication, this content indirection mechanism relies on the security mechanisms outlined in

RFC 3261. In particular, the usage of S/MIME as defined in section 23 of RFC 3261 provides the necessary mechanism to ensure integrity, protection, and confidentiality of the indirect content URI and associated parameters.

Securing the transfer of the indirect content is the responsibility of the underlying protocol used for this transfer. If HTTP is used, applications implementing this content indirection method SHOULD support the HTTPS URI scheme for secure transfer of content and MUST support the upgrading of connections to TLS, by using starttls. Note that a failure to complete HTTPS or starttls (for example, due to certificate or encryption mismatch) after having accepted the indirect content in the SIP request is not the same as rejecting the SIP request, and it may require additional user-user communication for correction.

Note that this document does not advocate the use of transitive trust. That is, just because the UAS receives a URI from a UAC that the UAS trusts, the UAS SHOULD NOT implicitly trust the object referred to by the URI without establishing its own trust relationship with the URI provider.

Access control to the content referenced by the URI is not defined by this specification. Access control mechanisms may be defined by the protocol for the scheme of the indirect content URI.

If the UAC knows the content in advance, the UAC SHOULD include a hash parameter in the content indirection. The hash parameter is a hexadecimal-encoded SHA-1 [8] hash of the indirect content. If a hash value is included, the recipient MUST check the indirect content against that hash and indicate any mismatch to the user.

In addition, if the hash parameter is included and the target URI involves setting up a security context using certificates, the UAS MUST ignore the results of the certificate validation procedure, and instead verify that the hash of the (canonicalized) content received matches the hash presented in the content-indirection hash parameter.

If the hash parameter is NOT included, the sender SHOULD use only schemes that offer message integrity (such as https:). When the hash parameter is not included and security using certificates is used, the UAS MUST verify any server certificates, by using the UAS's list of trusted top-level certificate authorities.

If hashing of indirect content is not used, the content returned to the recipient by exercise of the indirection might have been altered from that intended by the sender.

8. Contributions

Sean Olson, seanol@microsoft.com, provided the vast majority of the content of this document, including editorship through the first IESG review. Dean Willis touched it next.

Eric Burger edited the document and addressed IESG comments, including the access protocol negotiation mechanism.

9. Acknowledgements

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