Referring to Multiple Resources in the Session Initiation Protocol (SIP)
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Abstract

This document defines extensions to the SIP REFER method so that this method can be used to refer to multiple resources in a single
request. These extensions include the use of pointers to Uniform Resource Identifier (URI)-lists in the Refer-To header field and the "multiple-refer" SIP option-tag.

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1. Introduction

RFC 3261 (SIP) [RFC3261] is extended by RFC 3515 [RFC3515] with a REFER method that allows a user agent to request a second user agent to send a SIP request to a third party. Still, a number of applications need to request this second user agent to initiate transactions towards a set of destinations. In one example, the moderator of a conference may want the conference server to send BYE requests to a group of participants. In another example, the same moderator may want the conference server to INVITE a set of new participants.

We define an extension to the REFER method so that REFER requests can be used to refer other user agents (such as conference servers) to multiple destinations. In addition, this mechanism uses the suppression of the REFER method implicit subscription specified in RFC 4488 [RFC4488] to suppress REFER’s implicit subscription.

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 BCP 14, RFC 2119 [RFC2119] and indicate requirement levels for compliant implementations.

This document reuses the following terminology defined in RFC 3261 [RFC3261]:

- User Agent (UA)
- User Agent Client (UAC)
- User Agent Server (UAS)

This document defines the following new terms:

REFER-Issuer: a user agent issuing a REFER request.
REFER-Recipient: an entity receiving a REFER request and forwarding a SIP request to a number of REFER-Targets. The REFER-Recipient is typically a network entity, such as a URI-List server, that acts as a UAS for REFER requests and as a UAC for other SIP requests.
REFER-Target: a UA of the intended final recipient of a SIP request generated by the REFER-Recipient.
3. Overview of operation

This document describes an application of URI-List services
[I-D.ietf-sipping-uri-services] that allows a URI-List service to
receive a SIP REFER request containing a list of targets. The URI-
List service invokes the requested SIP method to each of the targets
contained in the list. This type of URI-List service is referred to
as a REFER-Recipient throughout this document.

This document defines an extension to the SIP REFER method specified
in RFC 3515 [RFC3515] that allows a SIP UAC to include a URI-list as
specified in the XML Format for Representing Resource Lists [RFC4826]
of REFER-Targets in a REFER request and send it to a REFER-Recipient.
The REFER-Recipient creates a new SIP request for each entry in the
URI-list and sends it to each REFER-Recipient.

The URI-list that contains the list of targets is used in conjunction
with the XML Format Extension for Representing Copy Control
Attributes in Resource Lists [I-D.ietf-sipping-capacity-attribute] to
allow the sender indicate the role (e.g., 'to', 'cc', or anonymous)
in which the REFER-Target is involved in the signalling.

We represent multiple targets of a REFER request using a URI-list as
specified in the XML Format for Representing Resource Lists
[RFC4826]. A REFER-Issuer that wants to refer a REFER-Recipient to a
set of destinations creates a SIP REFER request. The Refer-To header
contains a pointer to a URI-list, which is included in a body part,
and an option-tag in the Require header field: "multiple-refer".
This option-tag indicates the requirement to support the
functionality described in this specification.

When the REFER-Recipient receives such request it creates a new
request per REFER-Target and sends them, one to each REFER-Target.

This document does not provide any mechanism for REFER-Issuers to
find out about the results of a REFER request containing multiple
REFER-Targets. Furthermore, it does not provide support for the
implicit subscription mechanism that is part of the SIP REFER method.
The way REFER-Issuers are kept informed about the results of a REFER
is service specific. For example, a REFER-Issuer sending a REFER
request to invite a set of participants to a conference can discover
which participants were successfully brought into the conference by
subscribing to the conference state event package specified in RFC
4575 [RFC4575].
4. The multiple-refer SIP Option-Tag

We define a new SIP option-tag for the Require and Supported header fields: "multiple-refer".

A user agent including the "multiple-refer" option-tag in a Supported header field indicates compliance with this specification.

A user agent generating a REFER with a pointer to a URI-list in its Refer-To header field MUST include the "multiple-refer" option-tag in the Require header field of the REFER.

5. Suppressing REFER’s Implicit Subscription

REFER requests with a single REFER-Target establish implicitly a subscription to the refer event. The REFER-Issuer is informed about the result of the transaction towards the REFER-Target through this implicit subscription. As described in RFC 3515 [RFC3515], NOTIFY requests sent as a result of an implicit subscription created by a REFER request contain a body of type "message/sipfrag", RFC 3420 [RFC3420], that describes the status of the transaction initiated by the REFER-Recipient.

In the case of a REFER-Issuer that generates a REFER with multiple REFER-targets, the REFER-Issuer is typically already subscribed to other event package that can provide the information about the result of the transactions towards the REFER-Targets. For example, a moderator instructing a conference server to send a BYE request to a set of participants is usually subscribed to the conference state event package for the conference. Notifications to this event package will keep the moderator and the rest of the subscribers informed of the current list of conference participants.

Most of the applications using multiple REFER do not need its implicit subscription. Consequently, a SIP REFER-Issuer generating a REFER request with multiple REFER-Targets SHOULD include the "norefersub" option-tag in a Require header field and SHOULD include a Refer-Sub header field set to "false" to indicate that no notifications about the requests should be sent to the REFER-Issuer. The REFER-Recipient SHOULD honor the suggestion and also include a Refer-Sub header field set to "false" in the 200 (OK) response. The "norefersub" SIP option-tag and the Refer-Sub header field are specified in RFC 4488 [RFC4488].
RFC 4488 [RFC4488] indicates that a condition for the REFER-Issuer to include a Refer-Sub header is that the REFER-Issuer is sure that the REFER request will not fork.

At the time of writing, there is no extension that allows to report the status of several transactions over the implicit subscription associated with a REFER dialog. That is the motivation for this document to recommend the usage of the "norefersub" option-tag. If in the future such an extension is defined, REFER-Issuers using it could refrain from using the "norefersub" option-tag and use the new extension instead.

6. URI-List Format

As described in the Framework and Security Considerations for SIP URI-List Services [I-D.ietf-sipping-uri-services], specifications of individual URI-list services need to specify a default format for 'recipient-list' bodies used within the particular service.

The default format for 'recipient-list' bodies for REFER-Issuers and REFER-Recipients is the XML Formats for Representing Resource Lists [RFC4826] extended with the XML Format Extension for Representing Copy Control Attributes in Resource Lists [I-D.ietf-sipping-capacity-attribute]. REFER-Recipients handling 'recipient-list' bodies MUST support both of these formats. Both REFER-Issuers and REFER-Recipients MAY support other formats.

As described in the XML Format Extension for Representing Copy Control Attributes in Resource Lists [I-D.ietf-sipping-capacity-attribute], each URI can be tagged with a 'copyControl' attribute set to either "to", "cc", or "bcc", indicating the role in which the target will get the referred SIP request. However, depending on the target SIP method, a 'copyControl' attribute lacks sense. For example, while a 'copyControl' attribute can be applied to INVITE requests, it does not make sense with mid-dialog requests such as BYE requests.

In addition to the 'copyControl' attribute, URIs can be tagged with the 'anonymize' attribute, also specified in the XML Format Extension for Representing Copy Control Attributes in Resource Lists [I-D.ietf-sipping-capacity-attribute] to prevent that the REFER-Recipient discloses the target URI in a URI-list.

Additionally, the XML Format Extension for Representing Copy Control Attributes in Resource Lists [I-D.ietf-sipping-capacity-attribute] defines a 'recipient-list-history' body that contains the list of targets. The default format for 'recipient-list-history' bodies for
conference services is also the XML Formats for Representing Resource Lists [RFC4826] extended with the XML Format Extension for Representing Copy Control Attributes in Resource Lists [I-D.ietf-sipping-capacity attribute]. REFER-Recipients supporting this specification MUST support both of these formats; REFER-Targets MAY support these formats. Both REFER-Recipients and REFER-Targets MAY support other formats.

Nevertheless, the XML Format for Representing Resource Lists [RFC4826] document provides features, such as hierarchical lists and the ability to include entries by reference relative to the XCAP root URI, that are not needed by the multiple REFER service defined in this document.

Figure 1 shows an example of a flat list that follows the resource list document.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<resource-lists xmlns="urn:ietf:params:xml:ns:resource-lists"
        xmlns:cp="urn:ietf:params:xml:ns:copycontrol">
  <list>
    <entry uri="sip:bill@example.com" cp:copyControl="to" />
    <entry uri="sip:joe@example.org" cp:copyControl="cc" />
    <entry uri="sip:ted@example.net" cp:copyControl="bcc" />
  </list>
</resource-lists>
```

**Figure 1: URI List**

7. Behavior of SIP REFER-Issuers

As indicated in Section 4 and Section 5 a SIP REFER-Issuer that creates a REFER request with multiple REFER-Targets includes a "multiple-refer" and "norefersub" option-tags in the Require header field and, if appropriate, a Refer-Sub header field set to "false". The REFER-Issuer includes the set of REFER-Targets in a recipient-list body whose disposition type is 'recipient-list', as defined in the Framework and Security Considerations for SIP URI-List Services [I-D.ietf-sipping-uri-services]. The URI-list body is further described in Section 6.

The Refer-To header field of a REFER request with multiple REFER-Targets MUST contain a pointer (i.e., a Content-ID Uniform Resource Locator (URL) as per RFC 2392 [RFC2392]) that points to the body part that carries the URI-list. The REFER-Issuer SHOULD NOT include any particular URI more than once in the URI-list.
The XML Format for Representing Resource Lists [RFC4826] document provides features, such as hierarchical lists and the ability to include entries by reference relative to the XCAP root URI. However, these features are not needed by the multiple REFER service defined in this document. Therefore, when using the default resource list document, SIP REFER-Issuers generating REFER requests with multiple REFER-Targets SHOULD use flat lists (i.e., no hierarchical lists) and SHOULD NOT use <entry-ref> elements.

8. Behavior of REFER-Recipients

The REFER-Recipient follows the rules in Section 2.4.2 of RFC 3515 [RFC3515] to determine the status code of the response to the REFER.

The REFER-Recipient SHOULD not create an implicit subscription, and SHOULD add a Refer-Sub header field set to "false" in the 200 OK response.

The incoming REFER request typically contains a URI-list document or reference with the actual list of targets. If this URI-list includes resources tagged with the ‘copyControl’ attribute set to a value of "to" or "cc", and if appropriate for the service, e.g., if it is non-mid dialog request, the REFER-Recipient SHOULD include a URI-list in each of the outgoing requests. This list SHOULD be formatted according to the XML Format for Representing Resource Lists [RFC4826] and the XML Format Extension for Representing Copy Control Attributes in Resource Lists [I-D.ietf-sipping-capacity-attribute]. The REFER-Recipient MUST follow the procedures specified in XML Format for Representing Resource Lists [RFC4826] with respect handling of the ‘anonymize’, ‘count’ and ‘copyControl’ attributes.

Section 4 of the Framework and Security Considerations for SIP URI-List Services [I-D.ietf-sipping-uri-services] discusses cases when duplicated URIs are found in a URI-list. In order to avoid duplicated requests, REFER-Recipients MUST take those actions specified in Framework and Security Considerations for SIP URI-List Services [I-D.ietf-sipping-uri-services] into account to avoid sending duplicated request to the same target.

If the REFER-Recipient includes a URI-list in an outgoing request, it MUST include a Content-Disposition header field, specified in RFC 2183 [RFC2183], with the value set to ‘recipient-list-history’ and a ‘handling’ parameter, specified in RFC 3204 [RFC3204], set to "optional".

Since the multiple REFER service does not use hierarchical lists nor lists that include entries by reference to the XCAP root URI, a
REFER-Recipient receiving a URI-list with more information than what has been described in Section 6 MAY discard all the extra information.

The REFER-Recipient follows the rules in RFC 3515 [RFC3515] to generate the necessary requests towards the REFER-Targets, acting as if it had received a regular (no URI-list) REFER per each URI in the URI-list.

9. Example

Figure 2 shows an example flow where a REFER-Issuer sends a multiple-REFER request to the focus of a conference, which acts as the REFER-Recipient. The REFER-Recipient generates a BYE request per REFER-Target. Details for using REFER request to remove participants from a conference are specified in RFC 4579 [RFC4579].

```
+--------+         +---------+    +--------+  +--------+  +--------+
| REFER  |         |  REFER  |    | REFER  |  | REFER  |  | REFER  |
| issuer |         |recipient|    | target 1|  |target 2|  |target 3|
| Carol  |         | (focus) |    | Bill    |  | Joe   |  | Ted   |
+--------+         +---------+    +--------+  +--------+  +--------+

1. REFER
------------->
2. 202 Accepted
<-------------
3. BYE
------------>
4. BYE
----------------->
5. BYE
----------------->
6. 200 OK
<-------------
7. 200 OK
<-------------
8. 200 OK
```

Figure 2: Example flow of a REFER request containing multiple REFER-Targets

The REFER request (1) contains a Refer-To header field that includes a pointer to the message body, which carries a list with the URIs of
the REFER-Targets. In this example, the URI-list does not contain the copyControl attribute extension. The REFER’s Require header field carries the "multiple-refer" and "noreferrer" option-tags. The Request-URI is set to a Globally Routable User Agent URIs (GRUU) [I-D.ietf-sip-gruu] (as a guarantee that the REFER request will not fork). The Refer-Sub header field is set to "false" to request the suppression of the implicit subscription. Figure 3 shows an example of this REFER request. The resource list document contains the list of REFER-Target URIs along with the method of the SIP request that the REFER-Recipient generates.

REFER sip:conf-123@example.com;gruu;opaque=hha9s8d-999a  SIP/2.0
Via: SIP/2.0/TCP client.chicago.example.com
;branch=z9hG4bKhjhs8ass83
Max-Forwards: 70
To: "Conference 123" <sip:conf-123@example.com>
From: Carol <sip:carol@chicago.example.com>;tag=32331
Call-ID: d432fa84b4c76e66710
CSeq: 2 REFER
Contact: <sip:carol@client.chicago.example.com>
Refer-To: <cid:cn35t8jf02@example.com>
Refer-Sub: false
Require: multiple-refer, noreferrer
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, SUBSCRIBE, NOTIFY
Allow-Events: dialog
Accept: application/sdp, message/sipfrag
Content-Type: application/resource-lists+xml
Content-Disposition: recipient-list
Content-Length: 362
Content-ID: <cn35t8jf02@example.com>

<?xml version="1.0" encoding="UTF-8"?>
<resource-lists xmlns="urn:ietf:params:xml:ns:resource-lists"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <list>
    <entry uri="sip:bill@example.com?method=BYE" />
    <entry uri="sip:joe@example.org?method=BYE" />
    <entry uri="sip:ted@example.net?method=BYE" />
  </list>
</resource-lists>

Figure 3: REFER request with multiple REFER-Targets

Figure 4 shows an example of the BYE request (3) that the REFER-Recipient sends to the first REFER-Target.
10. Security Considerations

The Framework and Security Considerations for SIP URI-List Services [I-D.ietf-sipping-uri-services] document discusses issues related to SIP URI-list services. Given that a REFER-Recipient accepting REFER requests with multiple REFER-targets acts as a URI-list service, implementations of this type of server MUST follow the security-related rules in the Framework and Security Considerations for SIP URI-List Services [I-D.ietf-sipping-uri-services]. These rules include mandatory authentication and authorization of clients, and opt-in lists.

Additionally, REFER-Recipients SHOULD only accept REFER requests within the context of an application that the REFER-Recipient understands (e.g., a conferencing application). This implies that REFER-Recipients MUST NOT accept REFER requests for methods they do not understand. The idea behind these two rules is that REFER-Recipients are not used as dumb servers whose only function is to fan-out random messages they do not understand.

11. IANA Considerations

This document defines a new SIP option-tag: "multiple-refer". This option-tag should be registered in the SIP Parameters registry.

The following row shall be added to the "Option Tags" section of the SIP Parameter Registry:
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>multiple-refer</td>
<td>This option tag indicates support for REFER requests that contain a resource list document describing multiple REFER targets.</td>
<td>[RFCXXXX]</td>
</tr>
</tbody>
</table>

Table 1: Registration of the ‘multiple-refer’ Option-Tag in SIP

Note to the RFC Editor: Please replace [RFCXXXX] with the RFC number of this specification.

12. References

12.1. Normative References

- [RFC3420] Sparks, R., "Internet Media Type message/sipfrag", RFC 3420, November 2002.


12.2.  Informative References


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