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

Status of This Memo

Abstract

This document defines extensions to the SIP REFER method so that it 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.

Table of Contents

1. Introduction

RFC 3261 (SIP) [RFC3261] is extended by RFC 3515 [RFC3515] with a REFER method that allows a user agent (UA) to request a second UA to send a SIP request to a third party. For example, if Alice is in a call with Bob, and decides Bob needs to talk to Carol, Alice can instruct her SIP UA to send a REFER request to Bob's UA providing Carol's SIP Contact information. Assuming Bob has given it permission, Bob's UA will attempt to call Carol using that contact. That is, it will send an INVITE request to that contact.

A number of applications need to request this second UA 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].

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 [RFC5363] 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 RFC 4826 [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 RFC 5364 [RFC5364] 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 RFC 4826 [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 a 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 packages 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 the multiple REFER technology described in this memo 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 RFC 5363 [RFC5363], 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 RFC 4826 [RFC4826] extended with RFC 5364 [RFC5364]. 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 RFC 5364 [RFC5364], 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 RFC 5364 [RFC5364]) to prevent that the REFER-Recipient discloses the target URI in a URI list.

Additionally, RFC 5364 [RFC5364] 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 RFC 4826 [RFC4826] extended with RFC 5364 [RFC5364]. 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, RFC 4826 [RFC4826] provides features, such as hierarchical lists and the ability to include entries by reference relative to the XML Configuration Access Protocol (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 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 Sections 4 and 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 RFC 5363 [RFC5363]. 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.

RFC 4826 [RFC4826] 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 the request is appropriate for the service, e.g., it is not received mid-dialog, the REFER-Recipient SHOULD include a URI list in each of the outgoing requests. This list SHOULD be formatted according to RFC 4826 [RFC4826] and RFC 5364 [RFC5364]. The REFER-Recipient MUST follow the procedures specified in RFC 4826 [RFC4826] with respect to handling of the 'anonymize', 'count', and 'copyControl' attributes.

Section 4 of RFC 5363 [RFC5363] 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 RFC 5363 [RFC5363] into account to avoid sending a 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].

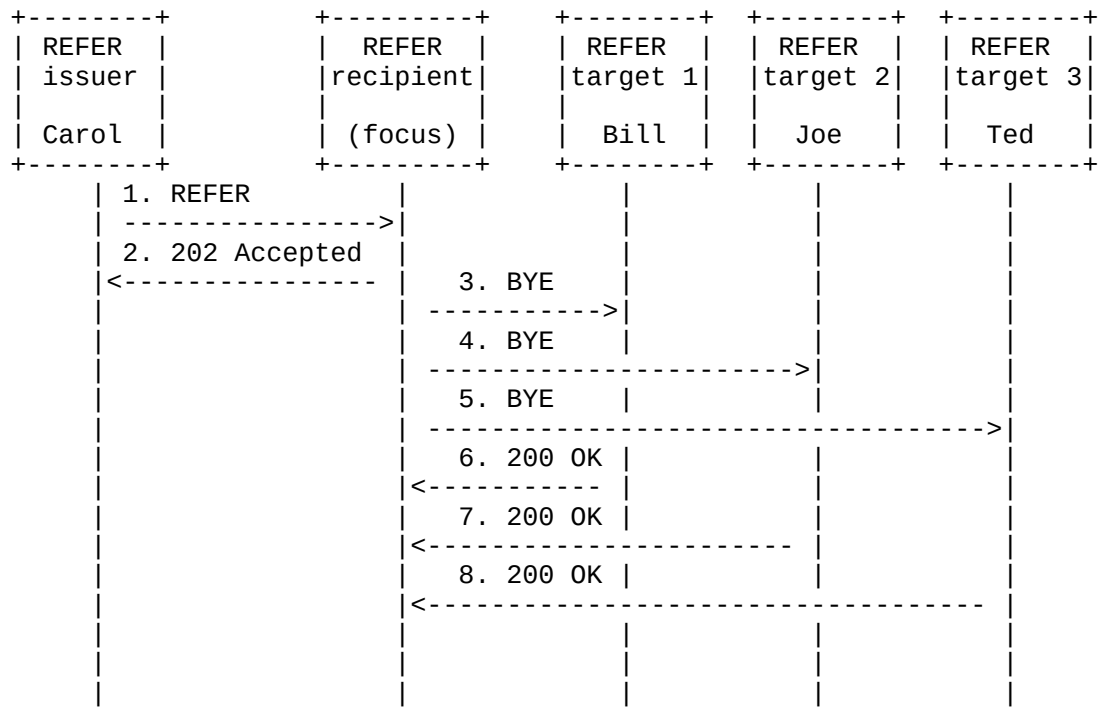

Figure 2: Example flow of a REFER request containing multiple REFER-Targets

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 "norefersub" option-tags. The Request-URI is set to a Globally Routable User Agent URI (GRUU) [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, norefersub
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.

```
BYE sip:bill@example.com SIP/2.0
Via: SIP/2.0/TCP conference.example.com
        ;branch=z9hG4bKhjhs8assmm
Max-Forwards: 70
From: "Conference 123" <sip:conf-123@example.com>;tag=88734
To: <sip:bill@example.com>;tag=29872
Call-ID: d432fa84b4c34098s812
CSeq: 34 BYE
Content-Length: 0
```

Figure 4: BYE request

10. Security Considerations

RFC 5363 [RFC5363] 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 RFC 5363 [RFC5363]. These rules include opt-in lists and mandatory authentication and authorization of clients.

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 has been registered in the SIP Parameters registry.

The following row has been added to the "Option Tags" section of the SIP Parameter Registry:

Name	Description	Reference
multiple-refer	This option tag indicates support for REFER requests that contain a resource list document describing multiple REFER targets.	[RFC5368]

Table 1: Registration of the ’multiple-refer’ option-tag in SIP

12. References

12.1. Normative References

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[RFC3204] Zimmerer, E., Peterson, J., Vemuri, A., Ong, L., Audet, F., Watson, M., and M. Zonoun, "MIME media types for ISUP and QSIG Objects", RFC 3204, December 2001.

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[RFC4488] Levin, O., "Suppression of Session Initiation Protocol (SIP) REFER Method Implicit Subscription", RFC 4488, May 2006.

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[RFC5364] Garcia-Martin, M. and G. Camarillo, "Extensible Markup Language (XML) Format Extension for Representing Copy Control Attributes in Resource Lists", RFC 5364, October 2008.

12.2. Informative References

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