Network Working Group
Request for Comments: 3515
Category: Standards Track

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April 2003

The Session Initiation Protocol (SIP) Refer Method

Status of this Memo

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Abstract

This document defines the REFER method. This Session Initiation Protocol (SIP) extension requests that the recipient REFER to a resource provided in the request. It provides a mechanism allowing the party sending the REFER to be notified of the outcome of the referenced request. This can be used to enable many applications, including call transfer.

In addition to the REFER method, this document defines the the refer event package and the Refer-To request header.

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1. Overview

This document defines the REFER method. This SIP [1] extension requests that the recipient REFER to a resource provided in the request.

This can be used to enable many applications, including Call Transfer. For instance, if Alice is in a call with Bob, and decides Bob needs to talk to Carol, Alice can instruct her SIP user agent (UA) to send a SIP 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. Bob's UA will then report whether it succeeded in reaching the contact to Alice's UA.

2. The REFER Method

REFER is a SIP method as defined by RFC 3261 [1]. The REFER method indicates that the recipient (identified by the Request-URI) should contact a third party using the contact information provided in the request.

Unless stated otherwise, the protocol for emitting and responding to a REFER request are identical to those for a BYE request in [1]. The behavior of SIP entities not implementing the REFER (or any other unknown) method is explicitly defined in [1].

A REFER request implicitly establishes a subscription to the refer event. Event subscriptions are defined in [2].

A REFER request MAY be placed outside the scope of a dialog created with an INVITE. REFER creates a dialog, and MAY be Record-Routed, hence MUST contain a single Contact header field value. REFERs occurring inside an existing dialog MUST follow the Route/Record-Route logic of that dialog.

2.1 The Refer-To Header Field

Refer-To is a request header field (request-header) as defined by [1]. It only appears in a REFER request. It provides a URL to reference.

```
Refer-To = ("Refer-To" / "r") HCOLON ( name-addr / addr-spec ) *
(SEMI generic-param)
```

The following should be interpreted as if it appeared in Table 3 of RFC 3261.

Header field	where	proxy	ACK	BYE	CAN	INV	OPT	REG
Refer-To	R		-	-	-	-	-	-

The Refer-To header field MAY be encrypted as part of end-to-end encryption.

The Contact header field is an important part of the Route/Record-Route mechanism and is not available to be used to indicate the target of the reference.

Examples

```
Refer-To: sip:alice@atlanta.example.com

Refer-To: <sip:bob@biloxi.example.net?Accept-Contact=sip:bobsdesk.
       biloxi.example.net&Call-ID%3D55432%40alicepc.atlanta.example.com>

Refer-To: <sip:dave@denver.example.org?Replaces=12345%40192.168.118.3%3B
          to-tag%3D12345%3Bfrom-tag%3D5FFE-3994>

Refer-To: <sip:carol@cleveland.example.org;method=SUBSCRIBE>

Refer-To: http://www.ietf.org
```

Long headers field values are line-wrapped here for clarity only.

2.2 Header Field Support for the REFER Method

This table adds a column to tables 2 and 3 in [1], describing header field presence in a REFER method. See [1] for a key for the symbols used. A row for the Refer-To request-header should be inferred, mandatory for REFER. Refer-To is not applicable for any other methods. The proxy column in [1] applies to the REFER method unmodified.

Header	Where	REFER
Accept	R	o
Accept	2xx	-
Accept	415	c
Accept-Encoding	R	o
Accept-Encoding	2xx	-
Accept-Encoding	415	c
Accept-Language	R	o
Accept-Language	2xx	-
Accept-Language	415	c
Alert-Info		-
Allow	Rr	o
Allow	405	m
Authentication-Info	2xx	o
Authorization	R	o
Call-ID	c	m
Call-Info		-
Contact	R	m
Contact	1xx	-
Contact	2xx	m
Contact	3-6xx	o
Content-Disposition		o
Content-Encoding		o

Content-Language		o
Content-Length		o
Content-Type		*
CSeq	c	m
Date		o
Error-Info	3-6xx	o
Expires	R	o
From	c	m
In-Reply-To		-
Max-Forwards	R	m
Min-Expires		-
MIME-Version		o
Organization		o
Priority	R	-
Proxy-Authenticate	401	o
Proxy-Authenticate	407	m
Proxy-Authorization	R	o
Proxy-Require	R	o
Record-Route	R	o
Record-Route	2xx,18x	o
Reply-To		-
Require		c
Retry-After	404,413,480,486	o
Retry-After	500,503	o
Retry-After	600,603	o
Route	R	c
Server	r	o
Subject	R	-
Supported	R,2xx	o
Timestamp		o
To	c(1)	m
Unsupported	420	o
User-Agent		o
Via	c(2)	m
Warning	r	o
WWW-Authenticate	401	m
WWW-Authenticate	407	o

Table 1: Header Field Support

2.3 Message Body Inclusion

A REFER method MAY contain a body. This specification assigns no meaning to such a body. A receiving agent may choose to process the body according to its Content-Type.

2.4 Behavior of SIP User Agents

2.4.1 Forming a REFER request

REFER is a SIP request and is constructed as defined in [1]. A REFER request MUST contain exactly one Refer-To header field value.

2.4.2 Processing a REFER request

A UA accepting a well-formed REFER request SHOULD request approval from the user to proceed (this request could be satisfied with an interactive query or through accessing configured policy). If approval is granted, the UA MUST contact the resource identified by the URI in the Refer-To header field value as discussed in Section 2.4.3.

If the approval sought above for a well-formed REFER request is immediately denied, the UA MAY decline the request.

An agent responding to a REFER method MUST return a 400 (Bad Request) if the request contained zero or more than one Refer-To header field values.

An agent (including proxies generating local responses) MAY return a 100 (Trying) or any appropriate 4xx-6xx class response as prescribed by [1].

Care should be taken when implementing the logic that determines whether or not to accept the REFER request. A UA not capable of accessing non-SIP URIs SHOULD NOT accept REFER requests to them.

If no final response has been generated according to the rules above, the UA MUST return a 202 Accepted response before the REFER transaction expires.

If a REFER request is accepted (that is, a 2xx class response is returned), the recipient MUST create a subscription and send notifications of the status of the refer as described in Section 2.4.4.

2.4.3 Accessing the Referred-to Resource

The resource identified by the Refer-To URI is contacted using the normal mechanisms for that URI type. For example, if the URI is a SIP URI indicating INVITE (using a method=INVITE URI parameter for example), the UA would issue a new INVITE using all of the normal rules for sending an INVITE defined in [1].

2.4.4 Using SIP Events to Report the Results of the Reference

The NOTIFY mechanism defined in [2] MUST be used to inform the agent sending the REFER of the status of the reference. The dialog identifiers (To, From, and Call-ID) of each NOTIFY must match those of the REFER as they would if the REFER had been a SUBSCRIBE request.

Each NOTIFY MUST contain an Event header field with a value of refer and possibly an id parameter (see Section 2.4.6).

Each NOTIFY MUST contain a body of type "message/sipfrag" [3].

The creation of a subscription as defined by [2] always results in an immediate NOTIFY. Analogous to the case for SUBSCRIBE described in that document, the agent that issued the REFER MUST be prepared to receive a NOTIFY before the REFER transaction completes.

The implicit subscription created by a REFER is the same as a subscription created with a SUBSCRIBE request. The agent issuing the REFER can terminate this subscription prematurely by unsubscribing using the mechanisms described in [2]. Terminating a subscription, either by explicitly unsubscribing or rejecting NOTIFY, is not an indication that the referenced request should be withdrawn or abandoned. In particular, an agent acting on a REFER request SHOULD NOT issue a CANCEL to any referenced SIP requests because the agent sending the REFER terminated its subscription to the refer event before the referenced request completes.

The agent issuing the REFER may extend its subscription using the subscription refresh mechanisms described in [2].

REFER is the only mechanism that can create a subscription to event refer. If a SUBSCRIBE request for event refer is received for a subscription that does not already exist, it MUST be rejected with a 403.

Notice that unlike SUBSCRIBE, the REFER transaction does not contain a duration for the subscription in either the request or the response. The lifetime of the state being subscribed to is determined by the progress of the referenced request. The duration of the subscription is chosen by the agent accepting the REFER and is communicated to the agent sending the REFER in the subscription's initial NOTIFY (using the Subscription-State expires header parameter). Note that agents accepting REFER and not wishing to hold subscription state can terminate the subscription with this initial NOTIFY.

2.4.5 The Body of the NOTIFY

Each NOTIFY MUST contain a body of type "message/sipfrag" [3]. The body of a NOTIFY MUST begin with a SIP Response Status-Line as defined in [1]. The response class in this status line indicates the status of the referred action. The body MAY contain other SIP header fields to provide information about the outcome of the referenced action. This body provides a complete statement of the status of the referred action. The refer event package does not support state deltas.

If a NOTIFY is generated when the subscription state is pending, its body should consist only of a status line containing a response code of 100.

A minimal, but complete, implementation can respond with a single NOTIFY containing either the body:

```
SIP/2.0 100 Trying
```

if the subscription is pending, the body:

```
SIP/2.0 200 OK
```

if the reference was successful, the body:

```
SIP/2.0 503 Service Unavailable
```

if the reference failed, or the body:

```
SIP/2.0 603 Declined
```

if the REFER request was accepted before approval to follow the reference could be obtained and that approval was subsequently denied (see Section 2.4.7).

An implementation MAY include more of a SIP message in that body to convey more information. Warning header field values received in responses to the referred action are good candidates. In fact, if the reference was to a SIP URI, the entire response to the referenced action could be returned (perhaps to assist with debugging). However, doing so could have grave security repercussions (see Section 5). Implementers must carefully consider what they choose to include.

Note that if the reference was to a non-SIP URI, status in any NOTIFYs to the referrer must still be in the form of SIP Response Status-Lines. The minimal implementation discussed above is

sufficient to provide a basic indication of success or failure. For example, if a client receives a REFER to a HTTP URL, and is successful in accessing the resource, its NOTIFY to the referrer can contain the message/sipfrag body of "SIP/2.0 200 OK". If the notifier wishes to return additional non-SIP protocol specific information about the status of the request, it may place it in the body of the sipfrag message.

2.4.6 Multiple REFER Requests in a Dialog

A REFER creates an implicit subscription sharing the dialog identifiers in the REFER request. If more than one REFER is issued in the same dialog (a second attempt at transferring a call for example), the dialog identifiers do not provide enough information to associate the resulting NOTIFYs with the proper REFER.

Thus, for the second and subsequent REFER requests a UA receives in a given dialog, it MUST include an id parameter[2] in the Event header field of each NOTIFY containing the sequence number (the number from the CSeq header field value) of the REFER this NOTIFY is associated with. This id parameter MAY be included in NOTIFYs to the first REFER a UA receives in a given dialog. A SUBSCRIBE sent to refresh or terminate this subscription MUST contain this id parameter.

2.4.7 Using the Subscription-State Header Field with Event Refer

Each NOTIFY must contain a Subscription-State header field as defined in [2]. The final NOTIFY sent in response to a REFER MUST indicate the subscription has been "terminated" with a reason of "noresource". (The resource being subscribed to is the state of the referenced request).

If a NOTIFY indicates a reason that indicates a re-subscribe is appropriate according to [2], the agent sending the REFER is NOT obligated to re-subscribe.

In the case where a REFER was accepted with a 202, but approval to follow the reference was subsequently denied, the reason and retry-after elements of the Subscription-State header field can be used to indicate if and when the REFER can be re-attempted (as described for SUBSCRIBE in [2]).

2.5 Behavior of SIP Registrars/Redirect Servers

A registrar that is unaware of the definition of the REFER method will return a 501 response as defined in [1]. A registrar aware of the definition of REFER SHOULD return a 405 response.

This specification places no requirements on redirect server behavior beyond those specified in [1]. Thus, it is possible for REFER requests to be redirected.

2.6 Behavior of SIP Proxies

SIP proxies do not require modification to support the REFER method. Specifically, as required by [1], a proxy should process a REFER request the same way it processes an OPTIONS request.

3. Package Details: Event refer

This document defines an event package as defined in [2].

3.1 Event Package Name

The name of this event package is "refer".

3.2 Event Package Parameters

This package uses the "id" parameter defined in [2]. Its use in package is described in Section 2.4.6.

3.3 SUBSCRIBE Bodies

SUBSCRIBE bodies have no special meaning for this event package.

3.4 Subscription Duration

The duration of an implicit subscription created by a REFER request is initially determined by the agent accepting the REFER and communicated to the subscribing agent in the Subscription-State header field's expire parameter in the first NOTIFY sent in the subscription. Reasonable choices for this initial duration depend on the type of request indicated in the Refer-To URI. The duration SHOULD be chosen to be longer than the time the referenced request will be given to complete. For example, if the Refer-To URI is a SIP INVITE URI, the subscription interval should be longer than the Expire value in the INVITE. Additional time MAY be included to account for time needed to authorize the subscription. The subscribing agent MAY extend the subscription by refreshing it, or terminate it by unsubscribing. As described in Section 2.4.7, the agent accepting the REFER will terminate the subscription when it reports the final result of the reference, indicating that termination in the Subscription-State header field.

3.5 NOTIFY Bodies

The bodies of NOTIFY requests for event refer are discussed in Section 2.4.5.

3.6 Notifier processing of SUBSCRIBE requests

Notifier processing of SUBSCRIBE requests is discussed in Section 2.4.4.

3.7 Notifier Generation of NOTIFY Requests

Notifier generation of NOTIFY requests is discussed in Section 2.4.4.

3.8 Subscriber Processing of NOTIFY Requests

Subscriber processing of NOTIFY requests is discussed in Section 2.4.4.

3.9 Handling of Forked Requests

A REFER sent within the scope of an existing dialog will not fork. A REFER sent outside the context of a dialog MAY fork, and if it is accepted by multiple agents, MAY create multiple subscriptions. These subscriptions are created and managed as per "Handling of Forked Requests" in [2] as if the REFER had been a SUBSCRIBE. The agent sending the REFER manages the state associated with each subscription separately. It does NOT merge the state from the separate subscriptions. The state is the status of the referenced request at each of the accepting agents.

3.10 Rate of Notifications

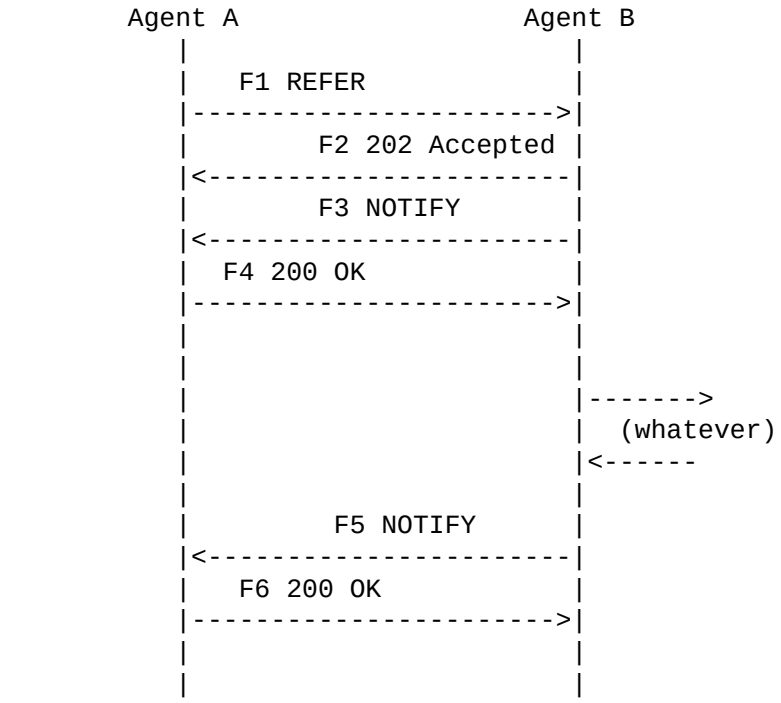
An event refer NOTIFY might be generated each time new knowledge of the status of a referenced requests becomes available. For instance, if the REFER was to a SIP INVITE, NOTIFYs might be generated with each provisional response and the final response to the INVITE. Alternatively, the subscription might only result in two NOTIFY requests, the immediate NOTIFY and the NOTIFY carrying the final result of the reference. NOTIFYs to event refer SHOULD NOT be sent more frequently than once per second.

3.11 State Agents

Separate state agents are not defined for event refer.

4. Examples

4.1 Prototypical REFER callflow



Here are examples of what the four messages between Agent A and Agent B might look like if the reference to (whatever) that Agent B makes is successful. The details of this flow indicate this particular REFER occurs outside a session (there is no To tag in the REFER request). If the REFER occurs inside a session, there would be a non-empty To tag in the request.

Message One (F1)

```
REFER sip:b@atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP agenta.atlanta.example.com;branch=z9hG4bK2293940223
To: <sip:b@atlanta.example.com>
From: <sip:a@atlanta.example.com>;tag=193402342
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 93809823 REFER
Max-Forwards: 70
Refer-To: (whatever URI)
Contact: sip:a@atlanta.example.com
Content-Length: 0
```

Message Two (F2)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP agenta.atlanta.example.com;branch=z9hG4bK2293940223
To: <sip:b@atlanta.example.com>;tag=4992881234
From: <sip:a@atlanta.example.com>;tag=193402342
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 93809823 REFER
Contact: sip:b@atlanta.example.com
Content-Length: 0
```

Message Three (F3)

```
NOTIFY sip:a@atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP agentb.atlanta.example.com;branch=z9hG4bK9922ef992-25
To: <sip:a@atlanta.example.com>;tag=193402342
From: <sip:b@atlanta.example.com>;tag=4992881234
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 1993402 NOTIFY
Max-Forwards: 70
Event: refer
Subscription-State: active;expires=(depends on Refer-To URI)
Contact: sip:b@atlanta.example.com
Content-Type: message/sipfrag;version=2.0
Content-Length: 20

SIP/2.0 100 Trying
```

Message Four (F4)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP agentb.atlanta.example.com;branch=z9hG4bK9922ef992-25
To: <sip:a@atlanta.example.com>;tag=193402342
From: <sip:b@atlanta.example.com>;tag=4992881234
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 1993402 NOTIFY
Contact: sip:a@atlanta.example.com
Content-Length: 0
```

Message Five (F5)

```
NOTIFY sip:a@atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP agentb.atlanta.example.com;branch=z9hG4bK9323394234
To: <sip:a@atlanta.example.com>;tag=193402342
From: <sip:b@atlanta.example.com>;tag=4992881234
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 1993403 NOTIFY
Max-Forwards: 70
```

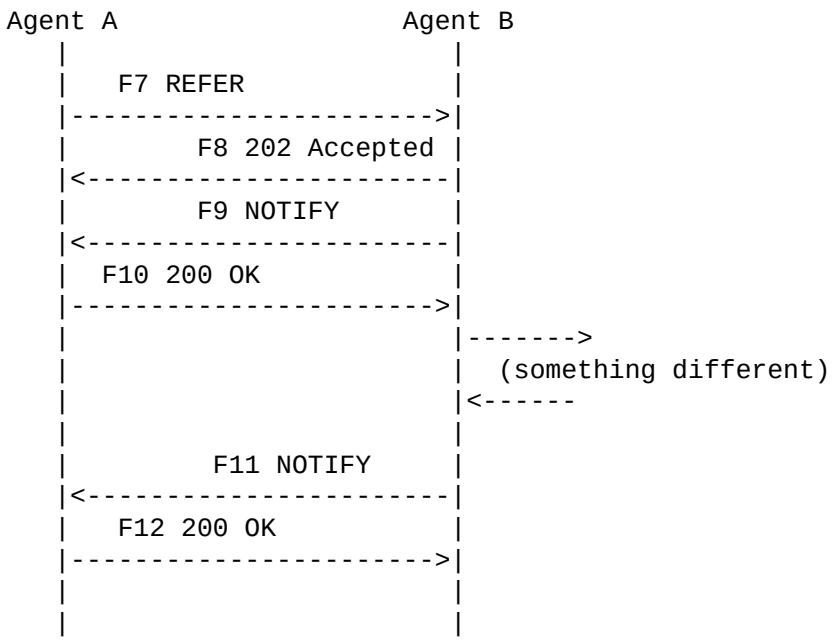
```
Event: refer
Subscription-State: terminated;reason=noresource
Contact: sip:b@atlanta.example.com
Content-Type: message/sipfrag;version=2.0
Content-Length: 16

SIP/2.0 200 OK
```

Message Six (F6)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP agentb.atlanta.example.com;branch=z9hG4bK9323394234
To: <sip:a@atlanta.example.com>;tag=193402342
From: <sip:b@atlanta.example.com>;tag=4992881234
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 1993403 NOTIFY
Contact: sip:a@atlanta.example.com
Content-Length: 0
```

4.2 Multiple REFERs in a dialog

Message One above brings an implicit subscription dialog into existence. Suppose Agent A issued a second REFER inside that dialog:



Message Seven (F7)

```
REFER sip:b@atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP agenta.atlanta.example.com;branch=z9hG4bK9390399231
To: <sip:b@atlanta.example.com>;tag=4992881234
From: <sip:a@atlanta.example.com>;tag=193402342
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 93809824 REFER
Max-Forwards: 70
Refer-To: (some different URI)
Contact: sip:a@atlanta.example.com
Content-Length: 0
```

Message Eight (F8)

```
SIP/2.0 202 Accepted
Via: SIP/2.0/UDP agenta.atlanta.example.com;branch=z9hG4bK9390399231
To: <sip:b@atlanta.example.com>;tag=4992881234
From: <sip:a@atlanta.example.com>;tag=193402342
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 93809824 REFER
Contact: sip:b@atlanta.example.com
Content-Length: 0
```

Message Nine (F9)

```
NOTIFY sip:a@atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP agentb.atlanta.example.com;branch=z9hG4bK9320394238995
To: <sip:a@atlanta.example.com>;tag=193402342
From: <sip:b@atlanta.example.com>;tag=4992881234
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 1993404 NOTIFY
Max-Forwards: 70
Event: refer;id=93809824
Subscription-State: active;expires=(depends on Refer-To URI)
Contact: sip:b@atlanta.example.com
Content-Type: message/sipfrag;version=2.0
Content-Length: 20

SIP/2.0 100 Trying
```

Message Ten (F10)

```
SIP/2.0 200 OK
Via: SIP/2.0/UDP agentb.atlanta.example.com;branch=z9hG4bK9320394238995
To: <sip:a@atlanta.example.com>;tag=193402342
From: <sip:b@atlanta.example.com>;tag=4992881234
Call-ID: 898234234@agenta.atlanta.example.com
```

```
CSeq: 1993404 NOTIFY
Contact: sip:a@atlanta.example.com
Content-Length: 0

Message Eleven (F11)

NOTIFY sip:a@atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP agentb.atlanta.example.com;branch=z9hG4bK2994a93eb-fe
To: <sip:a@atlanta.example.com>;tag=193402342
From: <sip:b@atlanta.example.com>;tag=4992881234
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 1993405 NOTIFY
Max-Forwards: 70
Event: refer;id=93809824
Subscription-State: terminated;reason=noresource
Contact: sip:b@atlanta.example.com
Content-Type: message/sipfrag;version=2.0
Content-Length: 16

SIP/2.0 200 OK

Message Twelve (F12)

SIP/2.0 200 OK
Via: SIP/2.0/UDP agentb.atlanta.example.com;branch=z9hG4bK2994a93eb-fe
To: <sip:a@atlanta.example.com>;tag=193402342
From: <sip:b@atlanta.example.com>;tag=4992881234
Call-ID: 898234234@agenta.atlanta.example.com
CSeq: 1993405 NOTIFY
Contact: sip:a@atlanta.example.com
Content-Length: 0
```

5. Security Considerations

The security considerations described in Section 26 of [1] apply to the REFER transaction. In particular, the implementation requirements and considerations in Section 26.3 address securing a generic SIP transaction. Special consideration is warranted for the authorization polices applied to REFER requests and for the use of message/sipfrag to convey the results of the referenced request.

5.1 Constructing a Refer-To URI

This mechanism relies on providing contact information for the referred-to resource to the party being referred. Care should be taken to provide a suitably restricted URI if the referred-to resource should be protected.

5.2 Authorization Considerations for REFER

As described in Section 2.4.2, an implementation can receive a REFER requests with a Refer-To URI containing an arbitrary scheme. For instance, a user could be referred to an online service such as a MUD using a telnet URI. Customer service could refer a customer to an order tracking web page using an HTTP URI. Section 2.4.2 allows a user agent to reject a REFER request when it can not process the referenced scheme. It also requires the user agent to obtain authorization from its user before attempting to use the URI. Generally, this could be achieved by prompting the user with the full URI and a question such as "Do you wish to access this resource (Y/N)". Of course, URIs can be arbitrarily long and are occasionally constructed with malicious intent, so care should be taken to avoid surprise even in the display of the URI itself (such as partial display or crashing). Further, care should be taken to expose as much information about the reference as possible to the user to mitigate the risk of being misled into a dangerous decision. For instance, the Refer-To header may contain a display name along with the URI. Nothing ensures that any property implied by that display name is shared by the URI. For instance, the display name may contain "secure" or "president" and when the URI indicates sip:agent59@telemarketing.example.com. Thus, prompting the user with the display name alone is insufficient.

In some cases, the user can provide authorization for some REFER requests ahead of time by providing policy to the user agent. This is appropriate, for instance, for call transfer as discussed in [4]. Here, a properly authenticated REFER request within an existing SIP dialog to a sip:, sips:, or tel: URI may be accepted through policy without interactively obtaining the user's authorization. Similarly, it may be appropriate to accept a properly authenticated REFER to an HTTP URI if the referror is on an explicit list of approved referrors. In the absence of such pre-provided authorization, the user must interactively provide authorization to reference the indicated resource.

To see the danger of a policy that blindly accepts and acts on an HTTP URI, for example, consider a web server configured to accept requests only from clients behind a small organization's firewall. As it sits in this soft-creamy-middle environment where the small organization trusts all its members and has little internal security, the web server is frequently behind on maintenance, leaving it vulnerable to attack through maliciously constructed URIs (resulting perhaps in running arbitrary code provided in the URI). If a SIP UA inside this firewall blindly accepted a reference to an arbitrary HTTP URI, an attacker outside the firewall could compromise the web server. On the other hand, if the UA's user has to take positive

action (such as responding to a prompt) before acting on this URI, the risk is reduced to the same level as the user clicking on the URI in a web-browser or email message.

The conclusion in the above paragraph generalizes to URIs with an arbitrary scheme. An agent that takes automated action to access a URI with a given scheme risks being used to indirectly attack another host that is vulnerable to some security flaw related to that scheme. This risk and the potential for harm to that other host is heightened when the host and agent reside behind a common policy-enforcement point such as a firewall. Furthermore, this agent increases its exposure to denial of service attacks through resource exhaustion, especially if each automated action involves opening a new connection.

User agents should take care when handing an arbitrary URI to a third-party service such as that provided by some modern operating systems, particularly if the user agent is not aware of the scheme and the possible ramifications using the protocols it indicates. The opportunity for violating the principal of least surprise is very high.

5.3 Considerations for the use of message/sipfrag

Using message/sipfrag bodies to return the progress and results of a REFER request is extremely powerful. Careless use of that capability can compromise confidentiality and privacy. Here are a couple of simple, somewhat contrived, examples to demonstrate the potential for harm.

5.3.1 Circumventing Privacy

Suppose Alice has a user agent that accepts REFER requests to SIP INVITE URIs, and NOTIFYs the referrer of the progress of the INVITE by copying each response to the INVITE into the body of a NOTIFY.

Suppose further that Carol has a reason to avoid Mallory and has configured her system at her proxy to only accept calls from a certain set of people she trusts (including Alice), so that Mallory doesn't learn when she's around, or what user agent she's actually using.

Mallory can send a REFER to Alice, with a Refer-To URI indicating Carol. If Alice can reach Carol, the 200 OK Carol sends gets returned to Mallory in a NOTIFY, letting him know not only that Carol is around, but also the IP address of the agent she's using.

5.3.2 Circumventing Confidentiality

Suppose Alice, with the same user agent as above, is working at a company that is working on the greatest SIP device ever invented - the SIP FOO. The company has been working for months building the device and the marketing materials, carefully keeping the idea, even the name of the idea secret (since a FOO is one of those things that anybody could do if they'd just had the idea first). FOO is up and running, and anyone at the company can use it, but it's not available outside the company firewall.

Mallory has heard rumor that Alice's company is onto something big, and has even managed to get his hands on a URI that he suspects might have something to do with it. He sends a REFER to ALICE with the mysterious URI and as Alice connects to the FOO, Mallory gets NOTIFYs with bodies containing

Server: FOO/v0.9.7

5.3.3 Limiting the Breach

For each of these cases, and in general, returning a carefully selected subset of the information available about the progress of the reference through the NOTIFYs mitigates risk. The minimal implementation described in Section 2.4.5 exposes the least information about what the agent operating on the REFER request has done, and is least likely to be a useful tool for malicious users.

5.3.4 Cut, Paste and Replay Considerations

The mechanism defined in this specification is not directly susceptible to abuse through copying the message/sipfrag bodies from NOTIFY requests and inserting them, in whole or in part, in future NOTIFY requests associated with the same or a different REFER. Under this specification the agent replying to the REFER request is in complete control of the content of the bodies of the NOTIFY it sends. There is no mechanism defined here requiring this agent to faithfully forward any information from the referenced party. Thus, saving a body for later replay gives the agent no more ability to affect the mechanism defined in this document at its peer than it has without that body. Similarly, capture of a message/sipfrag body by eavesdroppers will give them no more ability to affect this mechanism than they would have without it.

Future extensions may place additional constraints on the agent responding to REFER to allow using the message/sipfrag body part in a NOTIFY to make statements like "I contacted the party you referred me to, and here's cryptographic proof". These statements might be used

to affect the behavior of the receiving UA. This kind of extension will need to define additional mechanism to protect itself from copy based attacks.

6. Historic Material

This method was initially motivated by the call-transfer application. Starting as TRANSFER, and later generalizing to REFER, this method improved on the BYE/Also concept of the expired draft-ietf-sip-cc-01 by disassociating transfers from the processing of BYE. These changes facilitate recovery of failed transfers and clarify state management in the participating entities.

Early versions of this work required the agent responding to REFER to wait until the referred action completed before sending a final response to the REFER. That final response reflected the success or failure of the referred action. This was infeasible due to the transaction timeout rules defined for non-INVITE requests in [1]. A REFER must always receive an immediate (within the lifetime of a non-INVITE transaction) final response.

7. IANA Considerations

This document defines a new SIP method name (REFER), a new SIP header field name with a compact form (Refer-To and r respectively), and an event package (refer).

The following has been added to the method sub-registry under http://www.iana.org/assignments/sip-parameters.

REFER [RFC3515]

The following information also has been be added to the header sub-registry under http://www.iana.org/assignments/sip-parameters.

Header Name: Refer-To

Compact Form: r

Reference: RFC 3515

This specification registers an event package, based on the registration procedures defined in [2]. The following is the information required for such a registration:

Package Name: refer

Package or Package-Template: This is a package.

Published Specification: RFC 3515

Person to Contact: Robert Sparks, rsparks@dynamicsoft.com

8. Acknowledgments

This document is a collaborative product of the SIP working group.

9. References

9.1 Normative References

[1] Rosenberg, J., Schulzrinne, H., Camarillo, G., Johnston, A., Peterson, J., Sparks, R., Handley, M. and E. Schooler, "SIP: Session Initiation Protocol", RFC 3261, June 2002.

[2] Roach, A. B., "Session Initiation Protocol (SIP)-Specific Event Notification", RFC 3265, June 2002.

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

9.2 Informative References

[4] Sparks, R. and A. Johnston, "Session Initiation Protocol Call Control - Transfer", Work in Progress.

10. Intellectual Property Statement

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12. Full Copyright Statement

Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.