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Session Initiation Protocol Call Control - Transfer
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Abstract

This document describes providing Call Transfer capabilities in the Session Initiation Protocol (SIP). This work is part of the SIP Multiparty Call Control Framework.

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1. Overview

This document describes providing Call Transfer capabilities and requirements in SIP [1]. This work is part of the Multiparty Call Control Framework [6].

The mechanisms discussed here are most closely related to traditional basic and consultation hold transfers. This document does not discuss transfer scenarios involving ad-hoc conferences (where all parties involved are briefly in a conference until this transferor drops out).

This document details the use of REFER method [2] and Replaces [3] header field to achieve call transfer.

A user agent that fully supports the transfer mechanisms described in this document MUST support REFER[2] and Replaces[3] in addition to [RFC 3261](#) [1].

2. Actors and Roles

There are three actors in a given transfer event, each playing one of the following roles:

- Transferee - the party being transferred to the Transfer Target.
- Transferor - the party initiating the transfer
- Transfer Target - the new party being introduced into a call with the Transferee.

The following roles are used to describe transfer requirements and scenarios:

- Originator - wishes to place a call to the Recipient. This actor is the source of the first INVITE in a session, to either a Facilitator or a Screener.
- Facilitator - receives a call or out-of-band request from the Originator, establishes a call to the Recipient through the Screener, and connects the Originator to the Recipient.
- Screener - receives a call ultimately intended for the Recipient and transfers the calling party to the Recipient if appropriate.

Recipient - the party the Originator is ultimately connected to.

3. Requirements

1. Any party in a SIP session MUST be able to transfer any other party in that session at any point in that session.
2. The Transferor and the Transferee MUST NOT be removed from a session as part of a transfer transaction.

At first glance, requirement 2 may seem to indicate that the user experience in a transfer must be significantly different from what a current PBX or Centrex user expects. As the call-flows in this document show, this is not the case. A client MAY preserve the current experience. In fact, without this requirement, some forms of the current experience (ringback on transfer failure for instance) will be lost.

3. The Transferor MUST know whether or not the transfer was successful (this is significantly different from the requirements of the earlier BYE-Also approach to transfer).
4. The Transferee MUST be able to replace an existing dialog with a new dialog.
5. The Transferor and Transferee SHOULD indicate their support for the primitives required to achieve transfer.

4. Using REFER to achieve Call Transfer

A REFER [2] can be issued by the Transferor to cause the Transferee to issue an INVITE to the Transfer-Target. Note that a successful REFER transaction does not terminate the session between the Transferor and the Transferee. If those parties wish to terminate their session, they must do so with a subsequent BYE request. The media negotiated between the transferee and the transfer target is not affected by the media that had been negotiated between the transferor and the transferee. In particular, the INVITE issued by the Transferee will have the same SDP body it would have if he Transferee had initiated that INVITE on its own. Further, the disposition of the media streams between the Transferor and the Transferee is not altered by the REFER method. Agents may alter a session's media through additional signaling. For example, they may make use of the SIP hold re-INVITE [1] or the conferencing extensions provided by this framework.

5. Basic Transfer

Basic Transfer consists of the Transferor providing the Transfer Target's contact to the Transferee. The Transferee attempts to establish a session using that contact and reports the results of that attempt to the Transferor. The signaling relationship between the Transferor and Transferee is not terminated, so the call is recoverable if the Transfer Target cannot be reached. Note that the Transfer Target's contact information has been exposed to the Transferee. The provided contact can be used to make new calls in the future.

The participants in a basic transfer should indicate support for the REFER and NOTIFY methods in Allow header fields in INVITE, 200 OK to INVITE, and OPTIONS.

The diagrams below show indicate the first line of each message. The first column of the figure shows the Call-ID used in that particular message. In these diagrams, media is managed through re-INVITE holds, but other mechanisms (mixing multiple media streams at the UA or using the conferencing extensions for example) are valid. Selected message details are shown labeled as message F1, F2, etc.

Each of the flows below shows the dialog between the Transferor and the Transferee remaining connected (on hold) during the REFER process. While this provides the greatest flexibility for recovery from failure, it is not necessary. If the Transferor's agent does not wish to participate in the remainder of the REFER process and has no intention of assisting with recovery from transfer failure, it could emit a BYE to the Transferee as soon as the REFER transaction completes. This flow is sometimes known as "unattended transfer".

5.1 Successful Transfer

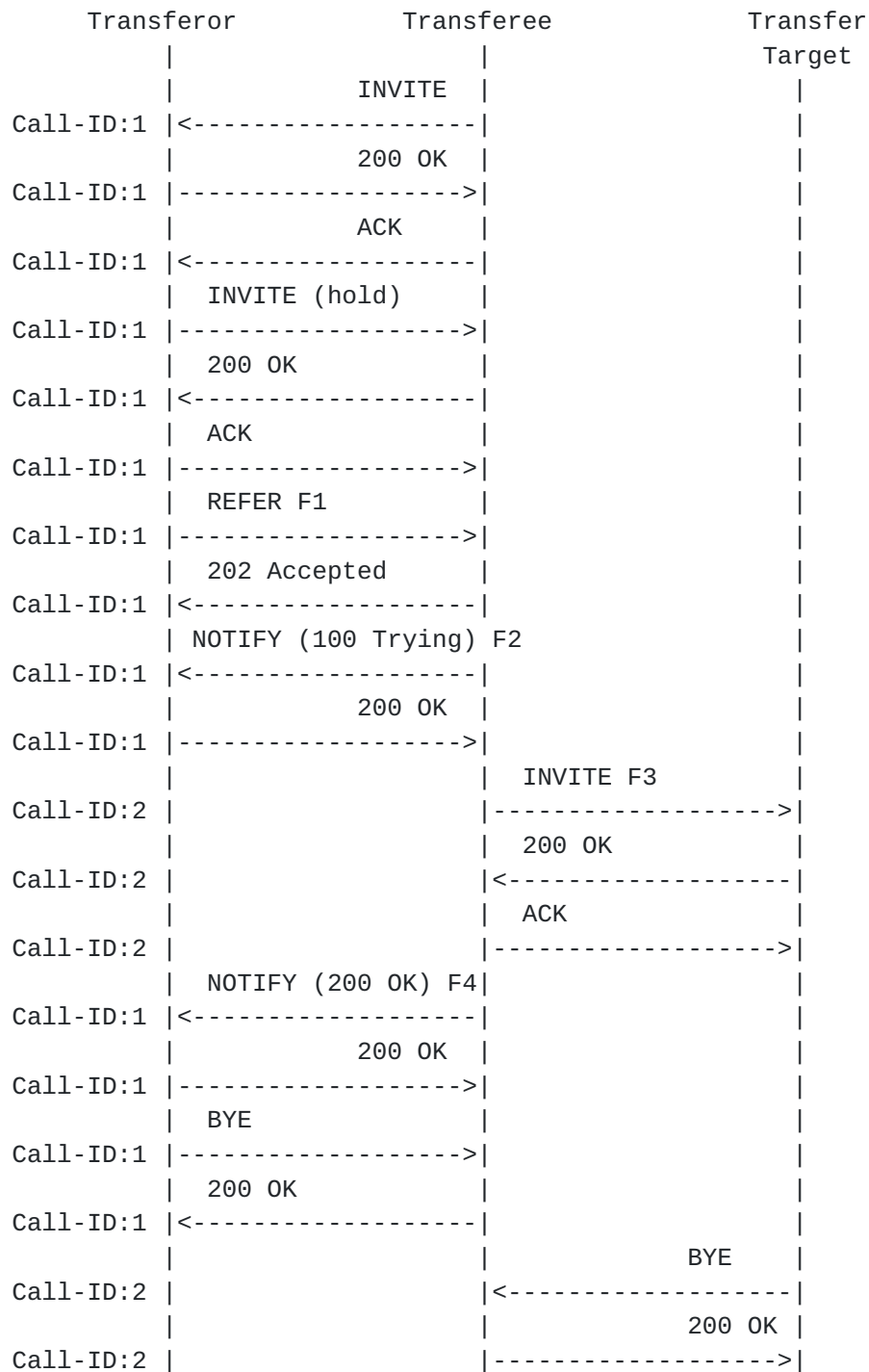


Figure 1. Basic Transfer Call Flow.

F1 REFER Transferor -> Transferee

REFER sip:transferee@192.0.2.4 SIP/2.0
Via: SIP/2.0/UDP pc33.atlanta.example.com;branch=z9hG4bKna9
Max-Forwards: 70
To: <sip:transferee@biloxi.example.com>;tag=a6c85cf
From: <sip:transferor@atlanta.example.com>;tag=1928301774
Call-ID: a84b4c76e66710
CSeq: 314159 REFER
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Refer-To: <sip:transfertarget@chicago.example.com>
Contact: <sip:transferor@pc33.atlanta.example.com>
Content-Length: 0

F2 NOTIFY Transferee -> Transferor

NOTIFY sip:transferor@pc33.atlanta.com SIP/2.0
Via: SIP/2.0/UDP 192.0.2.4;branch=z9hG4bKnas432
Max-Forwards: 70
To: <sip:transferor@atlanta.example.com>;tag=1928301774
From: <sip:transferee@biloxi.example.com>;tag=a6c85cf
Call-ID: a84b4c76e66710
CSeq: 73 NOTIFY
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Event: refer
Subscription-State: active;expires=60
Content-Type: message/sipfrag
Content-Length: ...

SIP/2.0 100 Trying

F3 INVITE Transferee -> Transfer Target

INVITE sip:transfertarget@chicago.example.com SIP/2.0
Via: SIP/2.0/UDP 192.0.2.4;branch=z9hG4bKnas41234
Max-Forwards: 70
To: <sip:transfertarget@chicago.example.com>
From: <sip:transferee@biloxi.example.com>;tag=j3kso3iqhq
Call-ID: 90422f3sd23m4g56832034
CSeq: 521 REFER
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Contact: <sip:transferee@192.0.2.4>
Content-Type: application/sdp
Content-Length: ...

F4 NOTIFY Transferee -> Transferor

NOTIFY sip:transferor@pc33.atlanta.com SIP/2.0
Via: SIP/2.0/UDP 192.0.2.4;branch=z9hG4bKnas432
Max-Forwards: 70
To: <sip:transferor@atlanta.example.com>;tag=1928301774
From: <sip:transferee@biloxi.example.com>;tag=a6c85cf
Call-ID: a84b4c76e66710
CSeq: 74 NOTIFY
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Event: refer
Subscription-State: terminated;reason=noresource
Content-Type: message/sipfrag
Content-Length: ...

SIP/2.0 200 OK

5.2 Failed Transfer

This section shows examples of failed transfer attempts. After the transfer failure occurs, the Transferor takes the Transferee off hold and resumes the session.

5.2.1 Target Busy

Transferor	Transferee	Transfer Target
	INVITE	
Call-ID:1	<-----	
	200 OK	
Call-ID:1	----->	
	ACK	
Call-ID:1	<-----	
	INVITE (hold)	
Call-ID:1	----->	
	200 OK	
Call-ID:1	<-----	
	ACK	
Call-ID:1	----->	
	REFER	
Call-ID:1	----->	
	202 Accepted	
Call-ID:1	<-----	
	NOTIFY (100 Trying)	
Call-ID:1	<-----	
	200 OK	
Call-ID:1	----->	
	INVITE	
Call-ID:2	----->	
	486 Busy Here	
Call-ID:2	<-----	
	ACK	
Call-ID:2	----->	
	NOTIFY (503 Service Unavailable) or NOTIFY (486 Busy Here)	
Call-ID:1	<-----	
	200 OK	
Call-ID:1	----->	
	INVITE (unhold)	
Call-ID:1	----->	
	200 OK	
Call-ID:1	<-----	
	ACK	


```

Call-ID:1 |----->|
          | BYE      |
Call-ID:1 |----->|
          | 200 OK   |
Call-ID:1 |<-----|

```

Figure 2. Failed Transfer - Target Busy

5.2.2 Transfer Target does not answer

Transferor	Transferee	Transfer Target
	INVITE	
Call-ID:1	<-----	
	200 OK	
Call-ID:1	----->	
	ACK	
Call-ID:1	<-----	
	INVITE (hold)	
Call-ID:1	----->	
	200 OK	
Call-ID:1	<-----	
	ACK	
Call-ID:1	----->	
	REFER	
Call-ID:1	----->	
	202 Accepted	
Call-ID:1	<-----	
	NOTIFY (100 Trying)	
Call-ID:1	<-----	
	200 OK	
Call-ID:1	----->	
	INVITE	
Call-ID:2	----->	
	180 Ringing	
Call-ID:2	<-----	
	(Transferee gets tired of waiting)	
	CANCEL	
Call-ID:2	----->	
	200 OK (CANCEL)	
Call-ID:2	<-----	
	487 Request Cancelled (INVITE)	
Call-ID:2	<-----	
	ACK	
Call-ID:2	----->	
	NOTIFY (487 Request Cancelled)	
Call-ID:1	<-----	

		200 OK		
Call-ID:1		----->		
		INVITE (unhold)		
Call-ID:1		----->		
		200 OK		
Call-ID:1		<-----		
		ACK		
Call-ID:1		----->		
		BYE		
Call-ID:1		----->		
		200 OK		
Call-ID:1		<-----		

Figure 3. Failed Transfer - Target Does Not Answer.

6. Transfer with Consultation Hold

Transfer with Consultation Hold involves a session between the transferor and the transfer target before the transfer actually takes place. This is implemented with SIP Hold and Transfer as described above.

6.1 Exposing transfer target

The transferor places the transferee on hold, establishes a call with the transfer target to alert them to the impending transfer, terminates the connection with the transfer target, then proceeds with transfer as above. This variation can be used to provide an experience similar to that expected by current PBX and Centrex users.

To (hopefully) improve clarity, non-REFER transactions have been collapsed into one indicator with the arrow showing the direction of the request.

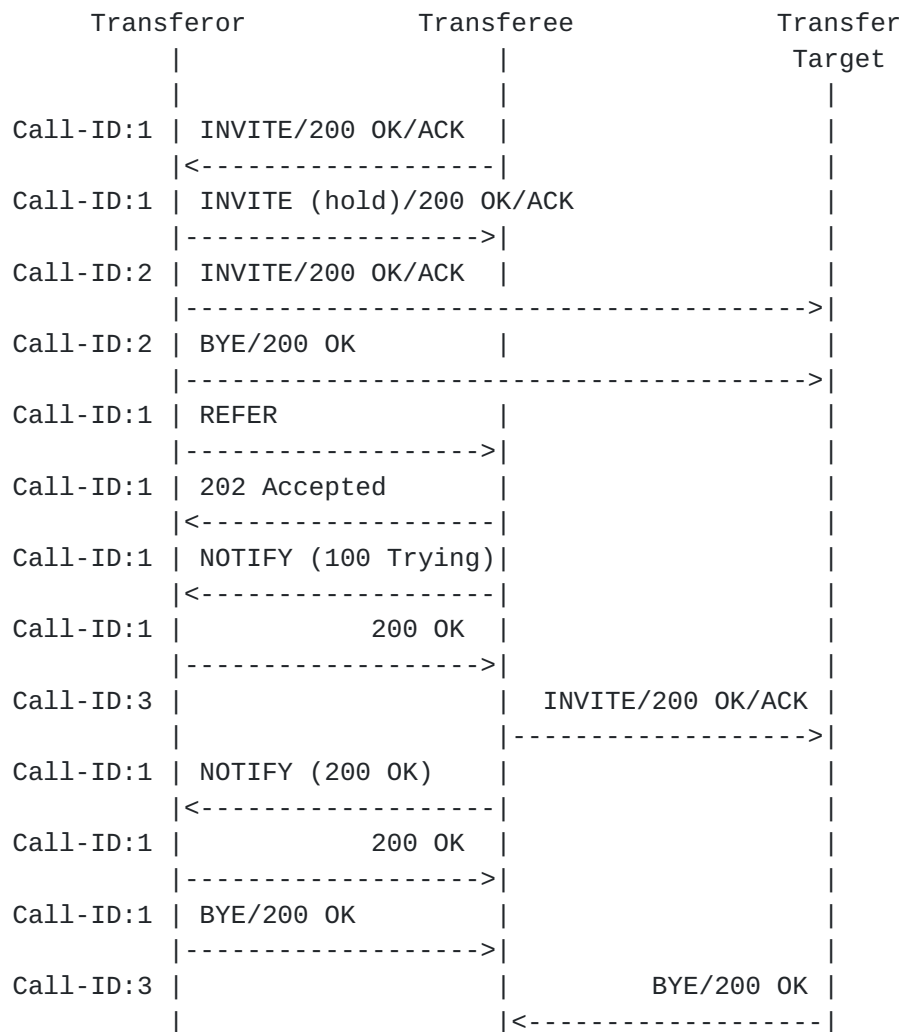


Figure 4. Transfer with Consultation Hold - Exposing Transfer Target.

[6.2](#) Protecting transfer target

The transferor places the transferee on hold, establishes a call with the transfer target and then reverses their roles, transferring the original transfer target to the original transferee. This has the advantage of hiding information about the original transfer target from the original transferee. On the other hand, the Transferee's experience is different than in current systems. The Transferee is effectively "called back" by the Transfer Target.

One of the problems with this simplest implementation of a target protecting transfer is that the transferee is receiving a new call from the transfer-target. Unless the transferee's agent has a reliable way to associate this new call with the call it already has with the transferor, it will have to alert the new call on another appearance. If this, or some other call-waiting-like UI were not available, the transferee might be stuck returning a Busy-Here to the transfer target, effectively preventing the transfer. There are many ways that that correlation could be provided. The dialog parameters could be provided directly as header parameters in the Refer-To: URI for example. The Replaces mechanism [\[3\]](#) uses this approach and solves this problem nicely.

For the flow below, dialog1 means dialog identifier 1, and consists of the parameters of the Replaces header for dialog 1. In [\[3\]](#) this is the Call-ID, To-tag and From-tag.

Note that the transferee's agent emits a BYE to the transferor's agent as an immediate consequence of processing the Replaces header.

The Transferor knows that both the Transferee and the Transfer Target support the Replaces header from the Supported: replaces header contained in the 200 OK responses from both.

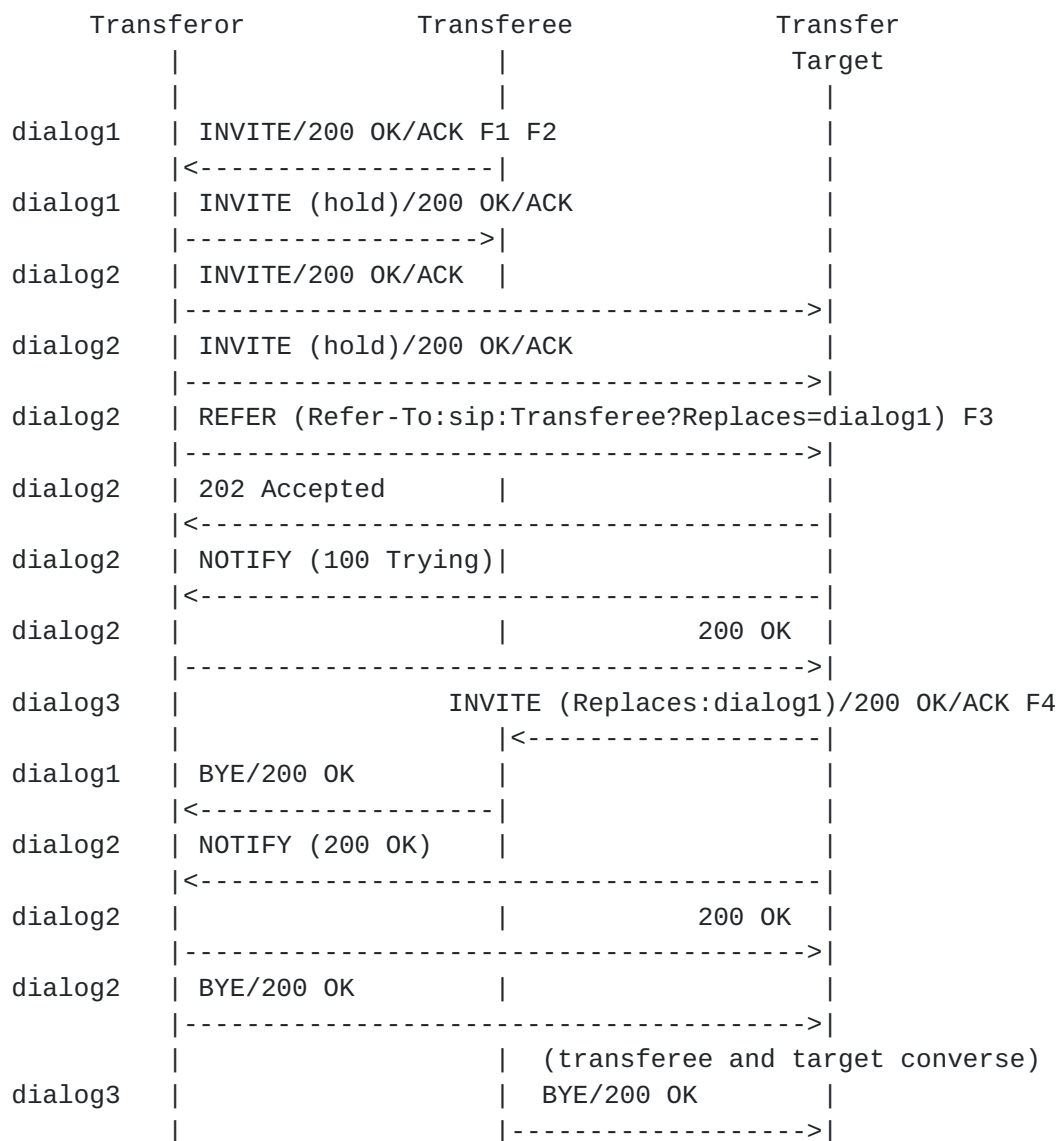


Figure 5. Transfer Protecting Transfer Target.

F1 INVITE Transferee -> Transferor

```

INVITE sip:transferor@atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP 192.0.2.4;branch=z9hG4bKnas432
Max-Forwards: 70
To: <sip:transferor@atlanta.example.com>
From: <sip:transferee@biloxi.example.com>;tag=7553452
Call-ID: 090459243588173445
CSeq: 29887 INVITE
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces, gruu

```


Contact: <sip:transferee@92.0.2.4>
Content-Type: application/sdp
Content-Length: ...

F2 200 OK Transferor -> Transferee

SIP/2.0 200 OK
Via: SIP/2.0/UDP 192.0.2.4;branch=z9hG4bKnas432
To: <sip:transferor@atlanta.example.com>;tag=31431
From: <sip:transferee@biloxi.example.com>;tag=7553452
Call-ID: 090459243588173445
CSeq: 29887 INVITE
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Contact: <sip:transferor@pc33.atlanta.example.com>
Content-Type: application/sdp
Content-Length: ...

F3 REFER Transferor -> Transfer Target

REFER sip:transfertarget@client.chicago.com SIP/2.0
Via: SIP/2.0/UDP pc33.atlanta.example.com;branch=z9hG4bKnashds9
Max-Forwards: 70
To: <sip:transfertarget@chicago.example.com>;tag=a6c85cf
From: <sip:transferor@atlanta.example.com>;tag=1928301774
Call-ID: a84b4c76e66710
CSeq: 314159 REFER
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Refer-To: <sip:transferee@192.0.2.4;Replaces=
090459243588173445%3Bto-tag%3D31431%3Bfrom-tag%3D7553452>
Contact: <sip:transferor@pc33.atlanta.example.com>
Content-Length: 0

F4 INVITE Transfer Target -> Transferee

INVITE sip:transferee@192.0.2.4 SIP/2.0
Via: SIP/2.0/UDP client.chicago.com;branch=z9hG4bKnaslu84
Max-Forwards: 70
To: <sip:transferee@biloxi.example.com>
From: <sip:transfertarget@chicago.example.com>;tag=341234
Call-ID: kmzwdle3dl3d08
CSeq: 41 INVITE
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY

Supported: replaces
Contact: <sip:transfertarget@client.chicago.com>
Replaces: 090459243588173445;to-tag=31431;from-tag=7553452
Content-Type: application/sdp
Content-Length: ...

6.3 Attended Transfer

The transferor places the transferee on hold, establishes a call with the transfer target to alert them to the impending transfer, places the target on hold, then proceeds with transfer using an escaped Replaces header field in the Refer-To header. This is another common service expected by current PBX and Centrex users.

In order to be sure that triggered INVITE (message F4) reaches the Transfer Target, the Contact URI is used as the Refer-To URI. The presence of a Supported: gruu header field in the 200 OK (message F3) from the Transfer Target to the Transferee guarantees that this Contact URI is a GRUU [\[5\]](#) (Globally Routable User Agent URI) and will be routable outside this dialog. Without an indication that the Contact URI is a GRUU, the Transferee should still use the Contact URI as the Refer-To URI. However, the Transferee needs to be prepared in the event that the transfer fails, as described in [Section 6.5](#).

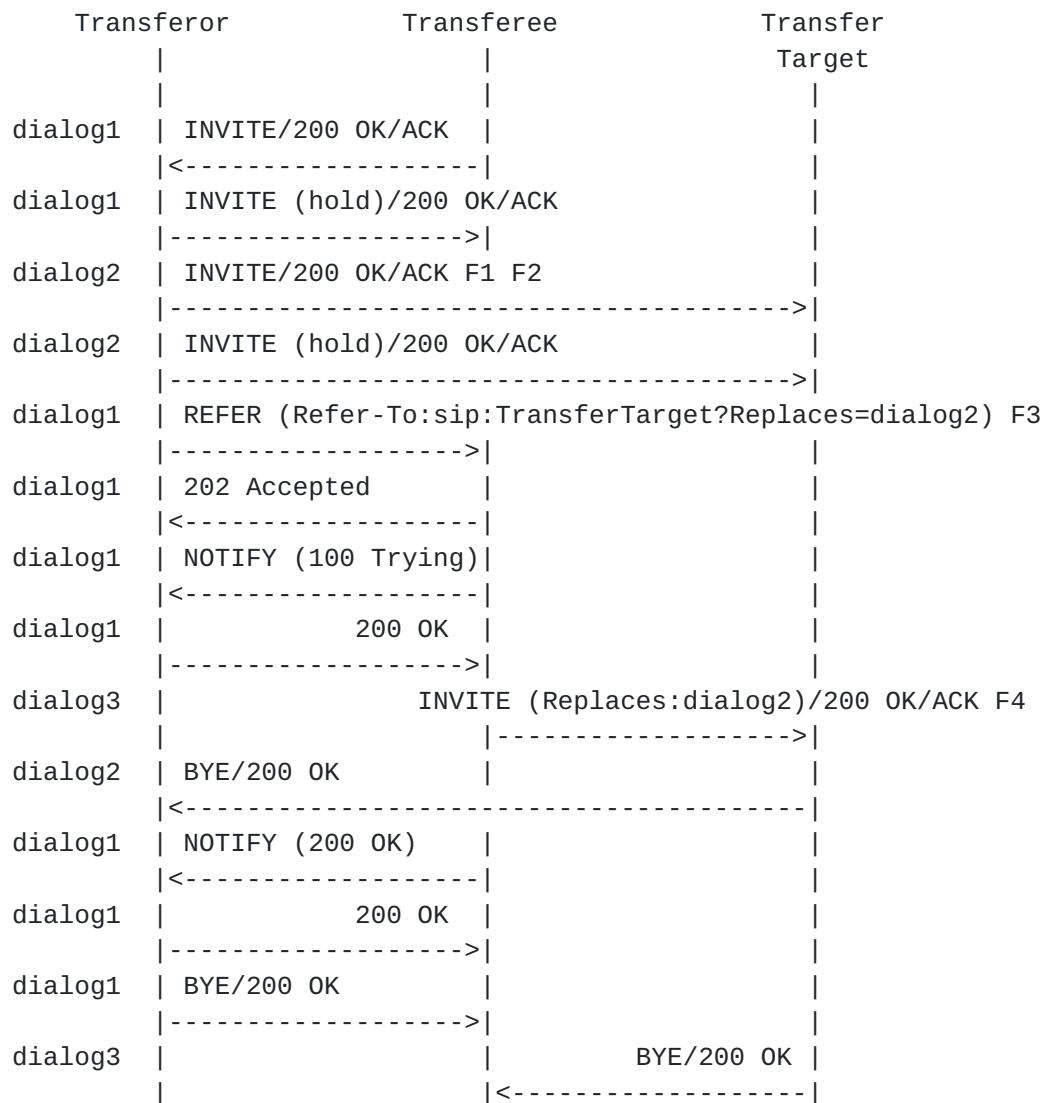


Figure 6. Attended Transfer Call Flow.

F1 INVITE Transferor -> Transfer Target

```

INVITE sip:transfertarget@chicago.example.com SIP/2.0
Via: SIP/2.0/UDP pc33.atlanta.example.com;branch=z9hG4bKnas432
Max-Forwards: 70
To: <sip:transfertarget@chicago.example.com>
From: <sip:transferor@atlanta.example.com>;tag=763231
Call-ID: 090459243588173445
CSeq: 29887 INVITE
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Contact: <sip:transferor@pc33.atlanta.example.com>
Content-Type: application/sdp

```


Content-Length: ...

F2 200 OK Transfer Target -> Transferee

SIP/2.0 200 OK

Via: SIP/2.0/UDP pc33.atlanta.example.com;branch=z9hG4bKnas432
;received=192.0.2.1

To: <sip:transfertarget@chicago.example.com>;tag=9m2n3wq

From: <sip:transferor@atlanta.example.com>;tag=763231

Call-ID: 090459243588173445

CSeq: 29887 INVITE

Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY

Supported: replaces, gruu

Contact: <sip:transfertarget@client.chicago.example.com>

Content-Type: application/sdp

Content-Length: ...

F3 REFER Transferor -> Transferee

REFER sip:transferee@192.0.2.4 SIP/2.0

Via: SIP/2.0/UDP pc33.atlanta.example.com;branch=z9hG4bKnashds9

Max-Forwards: 70

To: <sip:transferee@biloxi.example.com>;tag=a6c85cf

From: <sip:transferor@atlanta.example.com>;tag=1928301774

Call-ID: a84b4c76e66710

CSeq: 314159 REFER

Refer-To: <sip:transfertarget@client.chicago.example.com;Replaces=
090459243588173445%3Bto-tag%3D9m2n3wq%3Bfrom-tag%3D763231>

Contact: <sip:transferor@pc33.atlanta.example.com>

Content-Length: 0

F4 INVITE Transferee -> Transfer Target

INVITE sip:transfertarget@client.chicago.example.com SIP/2.0

Via: SIP/2.0/UDP 192.0.2.4;branch=z9hG4bKnaslu82

Max-Forwards: 70

To: <sip:transfertarget@chicago.example.com>

From: <sip:transferee@biloxi.example.com>;tag=954

Call-ID: kmzwdle3dl3d08

CSeq: 41 INVITE

Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY

Supported: replaces

Contact: <sip:transferee@192.0.2.4>

Replaces: 090459243588173445;to-tag=9m2n3wq;from-tag=763231

Content-Type: application/sdp

Content-Length: ...

6.4 Recovery when one party does not support REFER

If protecting or exposing the transfer target is not a concern, it is possible to complete a transfer with consultation hold when only the transferor and one other party support REFER. Note that a 405 Method Not Allowed might be returned instead of the 501 Not Implemented response.

	Transferor	Transferee	Transfer Target
dialog1	INVITE/200 OK/ACK		
	<-----		
dialog1	INVITE (hold)/200 OK/ACK		
	----->		
dialog2	INVITE/200 OK/ACK		
	----->		
dialog2	INVITE (hold)/200 OK/ACK		
	----->		
dialog1	REFER (Refer-To:sip:TransferTarget?Replaces=dialog2)		
	----->		
dialog1	501 Not Implemented		
	<-----		
dialog2	REFER (Refer-To:sip:Transferee?Replaces=dialog1)		
	----->		
dialog2	202 Accepted		
	<-----		
dialog2	NOTIFY (100 Trying)		
	<-----		
dialog2		200 OK	
	----->		
dialog3		INVITE (Replaces:dialog1)/200 OK/ACK	
		<-----	
dialog2	NOTIFY (200 OK)		
	<-----		
		200 OK	
	----->		
dialog1	BYE/200 OK		
	<-----		
dialog2	BYE/200 OK		
	----->		
dialog3		BYE/200 OK	
		----->	

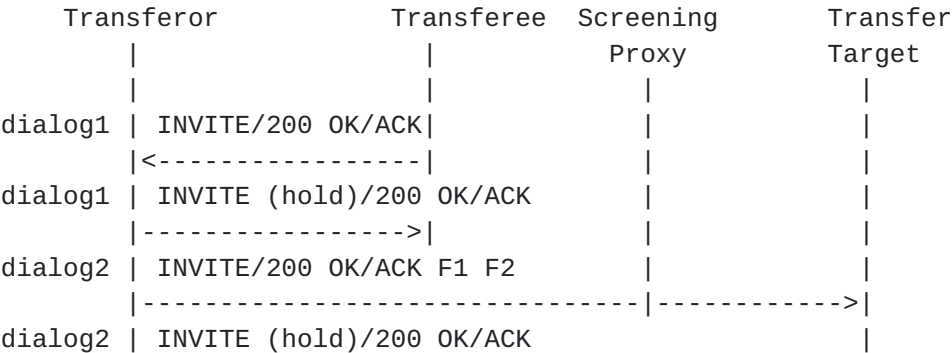
Figure 7. Recovery when one party does not support REFER.

6.5 Attended Transfer when Contact URI is Not Globally Routable

It is a requirement of [RFC3261](#) that a Contact URI be globally routable even outside the dialog. However, due to [RFC2543](#) User Agents and some architectures (NAT/Firewall traversal, screening proxies, ALGs, etc.) this will not always be the case. As a result, the method of Attended transfer shown in Figures 6 and 7 may fail since they use the Contact URI in the Refer-To header field. Participants in transfer scenarios should indicate if their Contact URIs are GRUUs using the Supported: gruu header field.

Figure 8 shows such a scenario involving a Screening Proxy in which the transfer initially fails but succeeds on a second try. The failure (403 Forbidden, 404 Not Found, or a timeout after no response) response is communicated back to the Transferor. Since this may be caused by routing problems with the Contact URI, the Transferor retries the REFER this time with Refer-To containing the Address of Record (AOR) of the Target (the same URI the Transferor used to reach the Target). However, the use of the AOR URI may result in routing features being activated such as forking or sequential searching which may result in the triggered INVITE reaching the wrong UA. To prevent an incorrect UA answering the INVITE, a Require: replaces header field is included in the Refer-To. This ensures that only the UA which matches the Replaces dialog will answer the INVITE, since any incorrect UA which supports Replaces will reply with a 481 and a UA which does not support Replaces will reply with a 420.

Note that there is still no guarantee that the correct endpoint will be reached, and the result of this second REFER may also be a failure. In that case, the Transferor could fall back to unattended transfer or give up on the transfer entirely. Since two REFERs are sent within the dialog creating two distinct subscriptions, the Transferee uses the 'id' parameter in the Event header field to distinguish notifications for the two subscriptions.




```

|----->|
dialog1 | REFER (Refer-To:sip:TargetContact?Replaces=dialog2) F3
|----->|
dialog1 | 202 Accepted
|<-----|
dialog1 | NOTIFY (100 Trying)
|<-----|
dialog1 | 200 OK
|----->|
dialog3 | INVITE (Replaces:dialog2)/403/ACK
|----->|
dialog1 | NOTIFY (403 Forbidden) F4
|<-----|
dialog1 | 200 OK
|----->|
dialog1 | REFER(Refer-To:sip:TargetAOR?Replaces=dialog2&Require=replaces) F5
|----->|
dialog1 | 202 Accepted
|<-----|
dialog1 | NOTIFY (100 Trying)
|<-----|
dialog1 | 200 OK
|----->|
dialog4 | INVITE (Replaces:dialog2, Require:replaces)/200 OK/ACK F6
|----->|----->|
dialog2 | BYE/200 OK
|<-----|<-----|
dialog1 | NOTIFY (200 OK) F7
|<-----|
dialog1 | 200 OK
|----->|
dialog1 | BYE/200 OK
|----->|
dialog3 | BYE/200 OK
|<-----|-----|

```

Figure 8. Attended Transfer Call Flow with non-routable Contact URI

F1 INVITE Transferor -> Transfer Target

```

INVITE sip:transfertarget@chicago.example.com SIP/2.0
Via: SIP/2.0/UDP pc33.atlanta.example.com;branch=z9hG4bK76
Max-Forwards: 70
To: <sip:transfertarget@chicago.example.com>
From: <sip:transferor@atlanta.example.com>;tag=763231
Call-ID: 090459243588173445
CSeq: 29887 INVITE

```


Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Contact: <sip:transferor@pc33.atlanta.example.com>
Content-Type: application/sdp
Content-Length: ...

F2 200 OK Transfer Target -> Transferee

SIP/2.0 200 OK
Via: SIP/2.0/UDP pc33.atlanta.example.com;branch=z9hG4bKnas432
;received=192.0.2.1
To: <sip:transfertarget@chicago.example.com>;tag=9m2n3wq
From: <sip:transferor@atlanta.example.com>;tag=763231
Call-ID: 090459243588173445
CSeq: 29887 INVITE
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Contact: <sip:transfertarget@client.chicago.example.com>
Content-Type: application/sdp
Content-Length: ...

F3 REFER Transferor -> Transferee

REFER sip:transferee@192.0.2.4 SIP/2.0
Via: SIP/2.0/UDP pc33.atlanta.example.com;branch=z9hG4bKnashds9
Max-Forwards: 70
To: <sip:transferee@biloxi.example.com>;tag=a6c85cf
From: <sip:transferor@atlanta.example.com>;tag=1928301774
Call-ID: a84b4c76e66710
CSeq: 314159 REFER
Refer-To: <sip:transfertarget@client.chicago.example.com;Replaces=
090459243588173445%3Bto-tag%3D9m2n3wq%3Bfrom-tag%3D763231>
Contact: <sip:transferor@pc33.atlanta.example.com>
Content-Length: 0

F4 NOTIFY Transferee -> Transferor

NOTIFY sip:transferor@pc33.atlanta.com SIP/2.0
Via: SIP/2.0/UDP 192.0.2.4;branch=z9hG4bKnas432
Max-Forwards: 70
To: <sip:transferor@atlanta.example.com>;tag=1928301774
From: <sip:transferee@biloxi.example.com>;tag=a6c85cf
Call-ID: a84b4c76e66710
CSeq: 74 NOTIFY
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY

Supported: replaces
Event: refer;id=3112
Subscription-State: terminated;reason=noresource
Content-Type: message/sipfrag
Content-Length: ...

SIP/2.0 403 Forbidden

F5 REFER Transferor -> Transferee

REFER sip:transferee@192.0.2.4 SIP/2.0
Via: SIP/2.0/UDP pc33.atlanta.example.com;branch=z9hG4bKnashds9
Max-Forwards: 70
To: <sip:transferee@biloxi.example.com>;tag=a6c85cf
From: <sip:transferor@atlanta.example.com>;tag=1928301774
Call-ID: a84b4c76e66710
CSeq: 314160 REFER
Refer-To: <sip:transfertarget@chicago.example.com;Replaces=
090459243588173445%3Bto-tag%3D9m2n3wq%3Bfrom-tag%3D763231&Require=replaces>
Contact: <sip:transferor@pc33.atlanta.example.com>
Content-Length: 0

F6 INVITE Transferee -> Transfer Target

INVITE sip:transfertarget@chicago.example.com SIP/2.0
Via: SIP/2.0/UDP 192.0.2.4;branch=z9hG4bKnaslu82
Max-Forwards: 70
To: <sip:transfertarget@chicago.example.com>
From: <sip:transferee@biloxi.example.com>;tag=954
Call-ID: 20482817324945934422930
CSeq: 42 INVITE
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Contact: <sip:transferee@192.0.2.4>
Replaces: 090459243588173445;to-tag=9m2n3wq;from-tag=763231
Require: replaces
Content-Type: application/sdp
Content-Length: ...

F7 NOTIFY Transferee -> Transferor

NOTIFY sip:transferor@pc33.atlanta.com SIP/2.0
Via: SIP/2.0/UDP 192.0.2.4;branch=z9hG4bKnas432
Max-Forwards: 70
To: <sip:transferor@atlanta.example.com>;tag=1928301774


```
From: <sip:transferee@biloxi.example.com>;tag=a6c85cf
Call-ID: a84b4c76e66710
CSeq: 76 NOTIFY
Allow: INVITE, ACK, CANCEL, OPTIONS, BYE, REFER, NOTIFY
Supported: replaces
Event: refer;id=98873867
Subscription-State: terminated;reason=noresource
Content-Type: message/sipfrag
Content-Length: ...
```

```
SIP/2.0 200 OK
```

To prevent this scenario from happening, the Transfer Target should obtain a GRUU and use it in the Contact header field, which will result in the call flow of Figure 6.

6.6 Aborting a Consultation Hold

In any of the consultation hold flows above, the Transferor may decide to terminate its attempt to contact the Transfer target before that session is established. Most frequently, that will be the end of the scenario, but in some circumstances, the transferor may wish to proceed with the transfer action. For example, he may wish to complete the transfer knowing that the transferee will end up eventually talking to the transfer-target's voice-mail service. Some PBX systems support this feature, sometimes called "semi-attended transfer", that is effectively a hybrid between a fully attended transfer and an unattended transfer. A true implementation of this feature requires a short ad-hoc conference between all parties, which ensures that no media clipping occurs. This flow is outside the scope of this document.

For flows that expose the transfer target, this simply becomes a basic transfer.

This scenario is far more complicated for flows that protect the transfer target. Since no session is established between the transferor and the transfer target, the transfer target's agent would have to honor out-of-session REFERS, and somehow indicate what's happening via its user interface (this scenario is most likely to occur when the transfer-target is away from his agent).

6.7 Attended Transfer Fallback to Basic Transfer

In this flow, an attempted attended transfer fails so the transferor falls back to basic transfer. The use of OPTIONS is shown when the Transferee and Transfer Target do not explicitly indicate support for

the REFER method and Replaces header fields in Allow and Supported header fields. In dialog1, the Transferor determines using OPTIONS that the Transferee does support REFER and Replaces. As a result, the Transferor begins the attended transfer by placing the Transferee on hold and calling the Transfer Target. Using an OPTIONS in dialog2, the Transferor determines that the Target does not support either REFER or Replaces, making attended transfer impossible. (Note that the same information could have been determined by including a Require: replaces in the initial INVITE in dialog2, which would have failed with a 421 response.) The Transferor then ends dialog2 by sending a BYE then sends a REFER to the Transferee using the AOR URI of the Transfer Target.

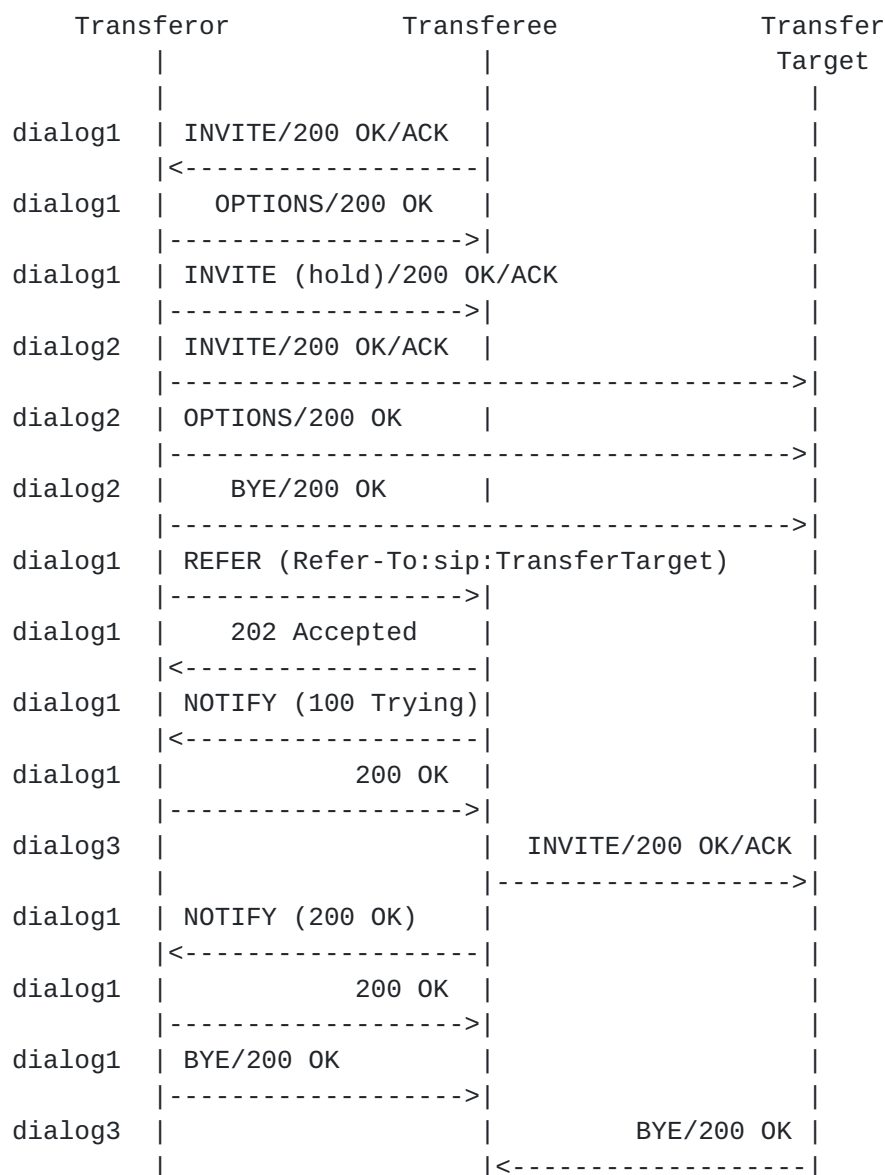


Figure 9. Attended Transfer Fallback to Basic Transfer.

7. Transfer with Referred-By

In the previous examples, the Transfer Target does not have definitive information about what party initiated the transfer, or, in some cases, even that transfer is taking place. The Referred-By mechanism [4] provides a way for the Transferor to provide the Transferee with a way to let the Transfer Target know what party initiated the transfer.

The simplest and least secure approach just involves the inclusion of the Referred-By header field in the REFER which is then copied into the triggered INVITE. However, a more secure mechanism involving the Referred-By security token which is generated and signed by the Transferor and passed in a message body to the Transferee then to the Transfer Target.

The call flow would be identical to Figure 6. However, the REFER and triggered INVITE messages for this flow showing the Referred-By mechanism are shown below. Note that the conventions used in the SIP Torture Test Messages [7] document are reused, specifically the `<thex>` and `<allOneLine>` tags.

F3 REFER Transferor -> Transferee

```
REFER sip:transferee@192.0.2.4 SIP/2.0
Via: SIP/2.0/UDP pc33.atlanta.example.com;branch=z9hG4bK392039842
Max-Forwards: 70
To: <sip:transferee@biloxi.example.com>;tag=a6c85cf
From: <sip:transferor@atlanta.example.com>;tag=1928301774
Call-ID: a84b4c76e66710
CSeq: 314160 REFER
<allOneLine>
Refer-To: <sip:transfertarget@chicago.example.com;Replaces=
090459243588173445%3Bto-tag%3D9m2n3wq%3Bfrom-
tag%3D763231&Require=replaces>
</allOneLine>
Referred-By: <sip:transferor@atlanta.example.com>
;cid="20398823.2UWQFN309shb3@atlanta.example.com"
Contact: <sip:transferor@pc33.atlanta.example.com>
Content-Type: multipart/mixed; boundary=unique-boundary-1
Content-Length: 3267

--unique-boundary-1
Content-ID: <20398823.2UWQFN309shb3@atlanta.example.com>

Content-Length: 2961
Content-Type: multipart/signed;
```



```
protocol="application/pkcs-7-signature";
micalg=sha1;
boundary="----590F24D439B31E08745DEF0CD9397189"
```

-----590F24D439B31E08745DEF0CD9397189

Content-Type: message/sipfrag

Date: Thu, 18 Sep 2003 13:07:43 GMT

<allOneLine>

Refer-To: <sip:transfertarget@chicago.example.com;

Replaces=090459243588173445%3B

to-tag%3D9m2n3wq%3Bfrom-tag%3D763231&Require=replaces>

</allOneLine>

Referred-By: <sip:transferor@atlanta.example.com>

;cid="20398823.2UWQFN309shb3@atlanta.example.com"

-----590F24D439B31E08745DEF0CD9397189

Content-Type: application/pkcs-7-signature; name="smime.p7s"

Content-Transfer-Encoding: binary

Content-Disposition: attachment; filename="smime.p7s"

<hex>3082088806092A86

4886F70D010702A082087930820875020101310B300906052B0E03021A050030
0B06092A864886F70D010701A082067A30820339308202A2A003020102020800
90008902240001300D06092A864886F70D01010505003070310B300906035504
0613025553311330110603550408130A43616C69666F726E69613111300F0603
550407130853616E4A6F7365310E300C060355040A1305736970697431293027
060355040B135369706974546573744365727469666963617465417574686F72
697479301E170D3033313032313134343332355A170D31333130313831343433
32355A3062310B3009060355040613025553311330110603550408130A43616C
69666F726E69613111300F0603550407130853616E4A6F7365310E300C060355
040A13057369706974311B30190603550403141273656E646572406578616D70
6C652E6F726730819F300D06092A864886F70D0101050003818D0030818902
818100CB8302060F12C8FA2D1786922CA173DCEB80BF1B1B8AF74A310C6975A5
56A7630FB6E044D9E994DCD49AFF7976C462D7A8E74ECBF98723AEBF2796EDDD
6263577C6C2B77DC7C300B533DEDB5FB8EB3827FD6FC9B37B9A0DE829F1B1081
D632A8AD9FB00A860928E88F87E0B979BA65294AC7D6D2D18A78C86B4FA73387
4E230203010001A381E93081E6301D0603551D1104163014811273656E646572
406578616D706C652E6F726730090603551D1304023000301D0603551D0E0416
041440FF1C0C1BB8684CA917839D70E97DF8DD5B60D130819A0603551D230481
9230818F80146B461714EA94762580546E1354DAA1E35414A1B6A174A4723070
310B3009060355040613025553311330110603550408130A43616C69666F726E
69613111300F0603550407130853616E4A6F7365310E300C060355040A130573
6970697431293027060355040B13536970697454657374436572746966696361
7465417574686F72697479820100300D06092A864886F70D0101050500038181
006FFE1A3B5CE807C3DD2CFDF6E9787F491C84DBF7DCD11DB2D6A8887D2FE3F2
2E9C6894994282E50AA0DFFE1CBD4EC2C20217831FC2AD360FF1C0DE1DE1E870
102CFA99EE504C7DC0D8752A63294AC748DDDEFAD55C6D051F1CD54CFE7C153

278962A53CEF61B875C1FD3C74E972242CBA0131B3B8C607BF95B378212CA9A7
5E30820339308202A2A00302010202080090008902240001300D06092A864886
F70D01010505003070310B300906035504061302555331133011060355040813
0A43616C69666F726E69613111300F0603550407130853616E4A6F7365310E30
0C060355040A1305736970697431293027060355040B13536970697454657374
4365727469666963617465417574686F72697479301E170D3033313032313134
343332355A170D3133313031383134343332355A3062310B3009060355040613
025553311330110603550408130A43616C69666F726E69613111300F06035504
07130853616E4A6F7365310E300C060355040A13057369706974311B30190603
550403141273656E646572406578616D706C652E6F726730819F300D06092A86
4886F70D010101050003818D0030818902818100CB8302060F12C8FA2D178692
2CA173DCEB80BF1B1B8AF74A310C6975A556A7630FB6E044D9E994DCD49AFF79
76C462D7A8E74ECBF98723AEBF2796EDDD6263577C6C2B77DC7C300B533DEDB5
FB8EB3827FD6FC9B37B9A0DE829F1B1081D632A8AD9FB00A860928E88F87E0B9
79BA65294AC7D6D2D18A78C86B4FA733874E230203010001A381E93081E6301D
0603551D1104163014811273656E646572406578616D706C652E6F7267300906
03551D1304023000301D0603551D0E0416041440FF1C0C1BB8684CA917839D70
E97DF8DD5B60D130819A0603551D2304819230818F80146B461714EA94762580
546E1354DAA1E35414A1B6A174A4723070310B30090603550406130255533113
30110603550408130A43616C69666F726E69613111300F060355040713085361
6E4A6F7365310E300C060355040A1305736970697431293027060355040B1353
69706974546573744365727469666963617465417574686F7269747982010030
0D06092A864886F70D0101050500038181006FFE1A3B5CE807C3DD2CFDF6E978
7F491C84DBF7DCD11DB2D6A8887D2FE3F22E9C6894994282E50AA0DFFE1CBD4E
C2C20217831FC2AD360FF1C0DE1DE1E870102CFA99EE504C7DC0D8752A63294A
C748DDDEFAD55C6D051F1CD54CFE7C153278962A53CEF61B875C1FD3C74E972
242CBA0131B3B8C607BF95B378212CA9A75E318201D6308201D2020101307C30
70310B3009060355040613025553311330110603550408130A43616C69666F72
6E69613111300F0603550407130853616E4A6F7365310E300C060355040A1305
736970697431293027060355040B135369706974546573744365727469666963
617465417574686F7269747902080090008902240001300906052B0E03021A05
00A081B1301806092A864886F70D010903310B06092A864886F70D010701301C
06092A864886F70D010905310F170D3034303132363139313831345A30230609
2A864886F70D01090431160414408CCA5772916A968204FD24CC24EDAEAD3943
95305206092A864886F70D01090F31453043300A06082A864886F70D0307300E
06082A864886F70D030202020080300D06082A864886F70D0302020140300706
052B0E030207300D06082A864886F70D0302020128300D06092A864886F70D01
010105000481807795329BB23B8BB9F72526AB9CC22D93B9A37A2E69A0171D3C
C417DD394F0A5FD4F8B082733CD9F2E26F6991031F7FF2EAD31640718502FB4C
822771211E6228C793DA4DBBA2159227C221030FE9088CD659578EB862568087
8E63D306487A740A197A3970594CF47DD385643B1DC49FF767A3D2B428388966
79089AAD95767F</hex>

-- --590F24D439B31E08745DEF0CD9397189--

--unique_boundary-1

F4 INVITE Transferee -> Transfer Target

INVITE sip:transfertarget@chicago.example.com SIP/2.0
Via: SIP/2.0/UDP referee.example;branch=z9hG4bKffe209934aac
To: <sip:transfertarget@chicago.example.com>
From: <sip:transferee@biloxi.example.com>;tag=2909034023
Call-ID: fe9023940-a3465@referee.example
CSeq: 889823409 INVITE
Max-Forwards: 70
Contact: <sip:transferee@192.0.2.4>
Referred-By: <sip:transferor@atlanta.example.com>
;cid="20398823.2UWQFN309shb3@atlanta.example.com"
Replaces:090459243588173445;to-tag=9m2n3wq;from-
tag=76323
Require:replaces
Content-Type: multipart/mixed; boundary=my-boundary-9
Content-Length: 3432

--my-boundary-9
Content-Type: application/sdp
Content-Length: 156

v=0
o=referee 2890844526 2890844526 IN IP4 referee.example
s=Session SDP
c=IN IP4 referee.example
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

--my-boundary-9
Content-Length: 2961
Content-Type: multipart/signed;
protocol="application/pkcs-7-signature";
micalg=sha1;
boundary="----590F24D439B31E08745DEF0CD9397189"

-----590F24D439B31E08745DEF0CD9397189
Content-Type: message/sipfrag

Date: Thu, 18 Sep 2003 13:07:43 GMT
<allOneLine>
Refer-To: <sip:transfertarget@chicago.example.com;
Replaces=090459243588173445%3B
to-tag%3D9m2n3wq%3Bfrom-tag%3D763231&Require=replaces>
</allOneLine>
Referred-By: <sip:transferor@atlanta.example.com>
;cid="20398823.2UWQFN309shb3@atlanta.example.com"

-----590F24D439B31E08745DEF0CD9397189

Content-Type: application/pkcs-7-signature; name="smime.p7s"

Content-Transfer-Encoding: binary

Content-Disposition: attachment; filename="smime.p7s"

<hex>3082088806092A86

4886F70D010702A082087930820875020101310B300906052B0E03021A050030
0B06092A864886F70D010701A082067A30820339308202A2A003020102020800
90008902240001300D06092A864886F70D01010505003070310B300906035504
0613025553311330110603550408130A43616C69666F726E69613111300F0603
550407130853616E4A6F7365310E300C060355040A1305736970697431293027
060355040B135369706974546573744365727469666963617465417574686F72
697479301E170D3033313032313134343332355A170D31333130313831343433
32355A3062310B3009060355040613025553311330110603550408130A43616C
69666F726E69613111300F0603550407130853616E4A6F7365310E300C060355
040A13057369706974311B30190603550403141273656E646572406578616D70
6C652E6F726730819F300D06092A864886F70D010101050003818D0030818902
818100CB8302060F12C8FA2D1786922CA173DCEB80BF1B1B8AF74A310C6975A5
56A7630FB6E044D9E994DCD49AFF7976C462D7A8E74ECBF98723AEBF2796EDDD
6263577C6C2B77DC7C300B533DEDB5FB8EB3827FD6FC9B37B9A0DE829F1B1081
D632A8AD9FB00A860928E88F87E0B979BA65294AC7D6D2D18A78C86B4FA73387
4E230203010001A381E93081E6301D0603551D1104163014811273656E646572
406578616D706C652E6F726730090603551D1304023000301D0603551D0E0416
041440FF1C0C1BB8684CA917839D70E97DF8DD5B60D130819A0603551D230481
9230818F80146B461714EA94762580546E1354DAA1E35414A1B6A174A4723070
310B3009060355040613025553311330110603550408130A43616C69666F726E
69613111300F0603550407130853616E4A6F7365310E300C060355040A130573
6970697431293027060355040B13536970697454657374436572746966696361
7465417574686F72697479820100300D06092A864886F70D0101050500038181
006FFE1A3B5CE807C3DD2CFDF6E9787F491C84DBF7DCD11DB2D6A8887D2FE3F2
2E9C6894994282E50AA0DFFE1CBD4EC2C20217831FC2AD360FF1C0DE1DE1E870
102CFA99EE504C7DC0D8752A63294AC748DDDEFAD55C6D051F1CD54CFE7C153
278962A53CEF61B875C1FD3C74E972242CBA0131B3B8C607BF95B378212CA9A7
5E30820339308202A2A00302010202080090008902240001300D06092A864886
F70D01010505003070310B300906035504061302555331133011060355040813
0A43616C69666F726E69613111300F0603550407130853616E4A6F7365310E30
0C060355040A1305736970697431293027060355040B13536970697454657374
4365727469666963617465417574686F72697479301E170D3033313032313134
343332355A170D3133313031383134343332355A3062310B3009060355040613
025553311330110603550408130A43616C69666F726E69613111300F06035504
07130853616E4A6F7365310E300C060355040A13057369706974311B30190603
550403141273656E646572406578616D706C652E6F726730819F300D06092A86
4886F70D010101050003818D0030818902818100CB8302060F12C8FA2D178692
2CA173DCEB80BF1B1B8AF74A310C6975A556A7630FB6E044D9E994DCD49AFF79
76C462D7A8E74ECBF98723AEBF2796EDDD6263577C6C2B77DC7C300B533DEDB5
FB8EB3827FD6FC9B37B9A0DE829F1B1081D632A8AD9FB00A860928E88F87E0B9
79BA65294AC7D6D2D18A78C86B4FA733874E230203010001A381E93081E6301D
0603551D1104163014811273656E646572406578616D706C652E6F7267300906


```

03551D1304023000301D0603551D0E0416041440FF1C0C1BB8684CA917839D70
E97DF8DD5B60D130819A0603551D2304819230818F80146B461714EA94762580
546E1354DAA1E35414A1B6A174A4723070310B30090603550406130255533113
30110603550408130A43616C69666F726E69613111300F060355040713085361
6E4A6F7365310E300C060355040A1305736970697431293027060355040B1353
69706974546573744365727469666963617465417574686F7269747982010030
0D06092A864886F70D0101050500038181006FFE1A3B5CE807C3DD2CFDF6E978
7F491C84DBF7DCD11DB2D6A8887D2FE3F22E9C6894994282E50AA0DFFE1CBD4E
C2C20217831FC2AD360FF1C0DE1DE1E870102CFA99EE504C7DC0D8752A63294A
C748DDDEFAD55C6D051F1CD54CFE7C153278962A53CEF61B875C1FD3C74E972
242CBA0131B3B8C607BF95B378212CA9A75E318201D6308201D2020101307C30
70310B3009060355040613025553311330110603550408130A43616C69666F72
6E69613111300F0603550407130853616E4A6F7365310E300C060355040A1305
736970697431293027060355040B135369706974546573744365727469666963
617465417574686F7269747902080090008902240001300906052B0E03021A05
00A081B1301806092A864886F70D010903310B06092A864886F70D010701301C
06092A864886F70D010905310F170D3034303132363139313831345A30230609
2A864886F70D01090431160414408CCA5772916A968204FD24CC24EDAEAD3943
95305206092A864886F70D01090F31453043300A06082A864886F70D0307300E
06082A864886F70D030202020080300D06082A864886F70D0302020140300706
052B0E030207300D06082A864886F70D0302020128300D06092A864886F70D01
010105000481807795329BB23B8BB9F72526AB9CC22D93B9A37A2E69A0171D3C
C417DD394F0A5FD4F8B082733CD9F2E26F6991031F7FF2EAD31640718502FB4C
822771211E6228C793DA4DBBA2159227C221030FE9088CD659578EB862568087
8E63D306487A740A197A3970594CF47DD385643B1DC49FF767A3D2B428388966
79089AAD95767F</hex>

```

```

-----590F24D439B31E08745DEF0CD9397189--

```

```

--my-boundary-9--

```

8. Transfer with multiple parties

In this example the Originator places call to the Facilitator who reaches the Recipient through the Screener. The Recipient's contact information is exposed to the Facilitator and the Originator. This example is provided for clarification of the semantics of the REFER method only and should not be used as the design of an implementation.

Originator	Facilitator	Screener	Recipient
Call-ID			
1	INVITE/200 OK/ACK		"Get Fred for me!"
	----->		"Right away!"
1	INVITE (hold)/200 OK/ACK		
	<-----		


```

2 | | INVITE/200 OK/ACK | "I have a call
  | | -----> | from Mary for Fred"
2 | | INVITE (hold)/200 OK/ACK | "Hold please"
  | | <----- |
3 | | | INVITE/200 OK/ACK
  | | | -----> | "You have a call
  | | | | from Mary"
  | | | | "Put her through"
3 | | | INVITE (hold)/200 OK/ACK
  | | | -----> |
2 | | REFER |
  | | <----- |
2 | | 202 Accepted |
  | | -----> |
2 | | NOTIFY (100 Trying) |
  | | -----> |
2 | | 200 OK |
  | | <----- |
2 | | INVITE/200 OK/ACK |
  | | -----> | "This is Fred"
2 | | NOTIFY (200 OK) | "Please hold for
  | | -----> | Mary"
2 | | 200 OK |
  | | <----- |
2 | | BYE/200 OK |
  | | <----- |
3 | | | BYE/200 OK |
  | | | -----> |
2 | | INVITE (hold)/200 OK/ACK
  | | -----> |
1 | REFER |
  | | <----- |
1 | 202 Accepted |
  | | -----> |
1 | NOTIFY (100 Trying) |
  | | -----> |
1 | 200 OK |
  | | <----- |
1 | INVITE/200 OK/ACK |
  | | -----> | "Hey Fred"
1 | NOTIFY (200 OK) | "Hello Mary"
  | | -----> |
1 | 200 OK |
  | | <----- |
1 | BYE/200 OK |
  | | <----- |
2 | | BYE/200 OK |
  | | -----> |

```



```
1  |BYE/200 OK |           |           |  
   |<-----| "See you later"
```

Figure 10. Transfer with Multiple Parties Example.

9. Changes from [draft-sipping-cc-transfer-01](#)

- o Added example S/MIME messages in Referred-By section.
- o Added reference and discussion of GRUUs

10. Changes from [draft-sipping-cc-transfer-00](#)

- o Added section on use of Referred-By header.
- o Added selected message details.
- o Added flow for attended transfer with non-globally routable Contact URI.
- o Added flow for attended transfer fallback to unattended transfer.
- o Added Security Considerations Section.

11. IANA Considerations

None.

12. Security Considerations

The call transfer flows shown in this document are implemented using the REFER and Replaces call control primitives in SIP. As such, the attacks and security approaches are those detailed in the REFER and Replaces documents which are briefly summarized in the following paragraphs. This document addresses the issue of protecting the Address of Record URI of a transfer target in Sections [6.1](#) and [6.2](#).

Any REFER request must be appropriately authenticated and authorized using standard SIP mechanisms or calls may be hijacked. A user agent may use local policy or human intervention in deciding whether or not to accept a REFER. In generating NOTIFY responses based on the outcome of the triggered request, care should be taken in constructing the message/sipfrag body to ensure that no private information is leaked.

An INVITE containing a Replaces header field should only be accepted if it has been properly authenticated and authorized using standard SIP mechanisms, and the requestor is authorized to perform dialog replacement.

13. Acknowledgments

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

Thanks to Rohan Mahy for his input on the use of Replaces in transfer.

Normative References

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Informative References

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