Session Initiation Protocol Exceptional Procedure Examples
draft-hasebe-sipping-exceptional-procedure-example-03

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Abstract

This document gives examples of Session Initiation Protocol (SIP) call flows in race condition. Call flows in race conditions are confusing and this document shows the best practices to handle them. The elements in these call flows include SIP User Agents and SIP Proxies. Call flow diagrams and message details are shown.
1. Overview

The call flows shown in this document were derived in the design of a SIP IP communications network. These examples are difficult to interpret the behaviors of user agent based on RFCs.

In various situations which may happen when SIP is implemented, especially, when a situation which serves as a norm of implementing in RFC is not illustrated, by showing operation of a terminal or a server...
as an example, it will be a help to a SIP implementors.

For example, the sequence which CANCEL and 200 OK for INVITE cross each other is possible. INVITE transaction obviously exists from UAC’s point of view, when the UAC sends a CANCEL message. However, when the UAS sends a 200 OK response for INVITE and then receives CANCEL message, there is not INVITE transaction anymore from UAS’s point of view. In such a case, it’s not easy to specify the response from the UAS in RFCs.

This document clarifies SIP UA behaviors when messages cross each other as race conditions. By clarifying operation under race conditions, different interpretations between implementations are avoided and interoperability is expected to be promoted.

It is the hope of the authors that this document will be useful for SIP implementors, designers, and protocol researchers and will help them achieve the goal of a standard implementation of RFC 3261 [1].

These call flows are based on the current version 2.0 of SIP in RFC 3261 [1] with SDP usage described in RFC 3264 [2].

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 [4].

1.1 General Assumptions

A number of architecture, network, and protocol assumptions underlie the call flows in this document. Note that these assumptions are not requirements. They are outlined in this section so that they may be taken into consideration and help in understanding of the call flow examples.

These flows do not assume specific underlying transport protocols such as TCP, TLS, and UDP. See the discussion in RFC 3261 for details on the transport issues for SIP.

1.2 Legend for Message Flows

Dashed lines (---) and slash lines (/\,) represent signaling messages that are mandatory to the call scenario.(X) represents crossover of signaling messages. Arrow indicate the direction of message flow.

Double dashed lines (===) represent media paths between network elements.

Messages with parentheses around their name represent optional
messages.

Messages are identified in the Figures as F1, F2, etc. These numbers are used for references to the message details that follow the Figure. Comments in the message details are shown in the following form:

/* Comments. */

1.3 SIP Protocol Assumptions

This document does not prescribe the flows precisely as they are shown, but rather illustrates the principles for best practice. They are best practice usages (orderings, syntax, selection of features for the purpose, or handling of error) of SIP methods, headers and parameters. NOTE: The flows in this document must not be copied as they are by implementors because additional characteristics were incorporated into the document for ease of explanation. To sum up, the procedures described in this document represent well-reviewed examples of SIP usage, which are best common practice according to IETF consensus.

For simplicity in reading and editing the document, there are a number of differences between some of the examples and actual SIP messages. Examples are: Call-IDs are often repeated; CSeq often begins, at 1; header fields are usually shown in the same order; usually only the minimum required header field set is shown; and and Accept, Allow, etc are not shown.

Actors:

<table>
<thead>
<tr>
<th>Element</th>
<th>Display Name</th>
<th>URI</th>
<th>IP Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Agent</td>
<td>Alice</td>
<td>sip:<a href="mailto:alice@atlanta.example.com">alice@atlanta.example.com</a></td>
<td>192.0.2.101</td>
</tr>
<tr>
<td>User Agent</td>
<td>Bob</td>
<td>sip:<a href="mailto:bob@biloxi.example.com">bob@biloxi.example.com</a></td>
<td>192.0.2.201</td>
</tr>
<tr>
<td>User Agent</td>
<td>Carol</td>
<td>sip:<a href="mailto:carol@chicago.example.com">carol@chicago.example.com</a></td>
<td>192.0.2.202</td>
</tr>
<tr>
<td>Proxy Server</td>
<td></td>
<td>ss.atlanta.example.com</td>
<td>192.0.2.111</td>
</tr>
</tbody>
</table>

2. The Dialog State Machine(for Race Condition)

Race conditions are generated when the dialog state of the receiving side differs from the dialog state of the sending side. Thus race conditions are generated on both UAs when caller’s signal and callee’s signal are intersected in the network. For instance, a race condition occurs when UAC (User Agent Client) sends a CANCEL on Early state while UAS (User Agent Server) is transitting from Early state to Confirmed state by sending a
200 OK to ini-INVITE.
The dialog state machine (DSM) is represented as follows to help the understanding of UA’s behavior in such race conditions.
Figure 1 shows a DSM for race conditions.

This document clarifies UA’s behavior by subdividing some internal states showed on FSM (Finate State Machine) for dialog state of the dialog-package[7], without changing the states of the dialog, "early", "confirmed", and "terminated" shown in RFC3261.

Preparative state is put before the Ealy state, which includes Trying and Proceeding. Moreover, Confirmed state is devided into two sub-states, Moratorium and Established. In addition, Terminated state is subdivided into two states, Mortal and Morgue.

The following is UA’s behaviors in each state.

Preparative: Preparative is a state until the Early dialog is established by sending and receiving a provisional response with To-tag after an ini-INVITE is sent and received. The dialog has not existed yet in Preparative state. The dialog state transit from the Preparative to the Early by sending or receiving a provisional response with To-tag. Moreover, the dialog state transit to Moratorium which is a substate of Confirmed state, if UA sends or receives a 2xx response. In addition, the dialog state transit to Morgue state which is a substate of Terminated state, if UA sends or receives a 3xx-6xx response. Sending an ACK to a 3xx-6xx response and retransmissions of 3xx-6xx are not expressed on this DSM because they are sent by INVITE transactions.

Trying: Trying is substate of Preparative and inherits the behavior of Preparative. Trying is started by sending and receiving an ini-INVITE. It transits to Proceeding by sending or receiving a 1xx (usually 100 trying) without To-tag. UAC may retransmit an INVITE on transaction layer and UAC must not send a CANCEL request. UAS may send a 1xx-6xx response.

Proceeding: Proceeding is substate of Preparative and inherits the behavior of Preparative. Dialog becomes Proceeding state if dialogs in Trying state send or receive a 1xx without To-tag (usually 100 trying). UAC may send a CANCEL, and UAS may send a 1xx-6xx response in Proceeding state.

Early: The early dialog is established by sending or receiving a provisional response with To-tag. The early dialog exists though the dialog has not existed in this state yet. The dialog state transits from Early to Moratorium, substate of Confirmed by sending or receiving a 2xx response. In addition, the dialog state transits to the Morgue subdivided internally in the Terminated by sending and receiving a 3xx-6xx response.
Sending an ACK to a 3xx-6xx response and retransmissions of 3xx-6xx are not expressed on this DSM because they are sent by INVITE transactions. UAC may send CANCEL in Proceeding state. UAC may send BYE (although it is not recommended.) UAS may send a 1xx-6xx response.

Confirmed: Sending or receiving 2xx final response establishes a dialog. Dialog exists in this state. BYE message changes state from Confirmed to Mortal, substate of Terminated. Confirmed has two substates, Moratorium and Established, they are different in messages UA are allowed to send.

Moratorium: Moratorium is a substate of Confirmed and inherits the behavior of Confirmed. Moratorium transits to Established by sending or receiving an ACK request. UAC may send an ACK and UAS may send a 2xx final response.

Established: Established is a substate of Confirmed and inherits the behavior of Confirmed. Both caller and callee may send various messages which influences a dialog. Caller supports the transmission of ACK to a retransmission of a 2xx response to an ini-INVITE.

Terminated: Terminated state is devided into two substates, Mortal and Morgue, to consider a behavior when a dialog is being terminated. In this state, UAs hold information about the dialog which is being terminated. Confirmed transits to Mortal, a substate of Terminated, by sending or receiving a BYE request.

Mortal: Caller and callee becomes Mortal state by sending or receiving a BYE. Only a BYE or its response can be handled in this state, and no other messages can be received. This is because the use case is taken into consideration that a BYE message are sent by both a caller and a callee to exchange reports about the session when it is being terminated. Therefore, UA possesses dialog information for internal process but dialog shouldn’t exist outwardly. UA stops managing dialog state and changes it to Morgue state, when the BYE transaction is done by timer. (Timer F or Timer K for UAC. Timer J for UAS.)

Morgue: Dialog doesn’t exist any more in this state. Sending or receiving a signal which influences a dialog is not performed. (It is literally terminated.)

3. Race condition

This section details race condition between two SIP User Agents (UAs): Alice and Bob. Alice (sip:alice@atlanta.example.com)
and Bob (sip:bob@biloxi.example.com) are assumed to be SIP phones or SIP-enabled devices.

In case that CANCEL and 200 OK to INVITE intersect, INVITE transaction obviously exists in UAC. On the other side, there is not INVITE transaction anymore in UAS when it sends a 200 OK response to the INVITE and then receives a CANCEL request. This is an example of UA's behavior in Moratorium state, a substate of Confirmed.

Examples of such race conditions are shown below.

### 3.1 Receiving message in the Moratorium State

This section shows some examples of call flow in race condition when receiving the message from other states in the Moratorium state.

#### 3.1.1 Receiving Initial INVITE retransmission(Trying state) in Moratorium state

```
Alice                                Bob

<table>
<thead>
<tr>
<th>ini-INVITE F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>------------------------------------</td>
</tr>
<tr>
<td>180 F2(Packet loss)</td>
</tr>
<tr>
<td>X&lt;-----------------------------</td>
</tr>
<tr>
<td>ini-INVITE F4    200 F3</td>
</tr>
<tr>
<td>------------------------------------</td>
</tr>
<tr>
<td>\ /</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>/ \</td>
</tr>
<tr>
<td>&lt;----------------------=&gt;</td>
</tr>
<tr>
<td>ACK F5</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
</tbody>
</table>
```

In this scenario, all provisional responses to the initial INVITE (ini-INVITE) are lost, and UAC retransmits an ini-INVITE. At the same time as retransmission, UAS generates a 200 OK to the ini-INVITE and it terminate an INVITE server transaction. (RFC3261, 13.3.1.4) After sending a 200 OK, a TU of UAS processes ACK and retransmission of 200 OK. (RFC3261, 17.1) A TU of UAS processes a retransmitted ini-INVITE, but it doesn’t have a To-tag, therefore the TU cannot use a mechanism to recognize the dialog by From-tag, Call-ID and To-tag. However, it must recognize a retransmitted ini-INVITE correctly by From-tag and Call-ID. (It must not construct a new dialog in response to a retransmitted
ini-INVITE regarding it as a request outside dialog.)
Since TU of UAS retransmits a 200 OK according to the timer during it waits for ACK, it doesn’t need to retransmit 200 OK for the retransmitted ini-INVITE.

Message Details

F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Type: application/sdp
Content-Length: 151

v=0
o=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

/* A 180 response is lost and does not reach Alice. */

F3 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/* Bob sends a 200 OK and terminates the INVITE transaction at the same time. TU performs retransmitting of a 200 OK directly. */

F4 INVITE(retransmission) Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 151

v=0
o=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/* Since F2 is lost, Alice retransmits an ini-INVITE. The retransmitted INVITE does not match any existing transaction because Bob has already sent a 200 OK. Moreover, the retransmitted ini-INVITE does not have a To-tag, so it doesn’t match any existing dialog. Therefore, Bob have to recognize the retransmitted INVITE correctly, without treating with the new INVITE. */
F5 ACK Alice -> Bob

ACK sip:alice@atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@client.biloxi.example.com>;tag=832134356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

3.1.2 Receiving CANCEL(Trying state)
in Moratorium state

Alice                     Bob
|                        |
|       INVITE F1        |
|----------------------->|
| 180 Ringing F2        |
|<----------------------|
| CANCEL F3  200 OK F4  |
|<----------------------|
|ack F6  481 F5         |
|<----------------------|
Both Way RTP Media

In this scenario, Alice sends a CANCEL and Bob sends a 200 OK response to the initial INVITE message at the same time. Then Bob sends a 481 response in response to the CANCEL from Alice. UAC can terminate the session by sending a BYE immediately after receiving 200 OK for INVITE.
By transmitting a BYE after 200 OK, "it just means that the software in his phone needs to maintain state for a short while in order to clean up properly." (RFC3261, 15)
In this sequence, it is recommended that caller terminates the session by sending a BYE.

Message Details

F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 151

v=0
c=IN IP4 192.0.2.101
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

F3 CANCEL Alice -> Bob

CANCEL sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 CANCEL
Content-Length: 0

/* When Alice sends a CANCEL, INVITE transaction exists. */

F4 200 OK Bob -> Alice
SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
c=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/* Alice sends a CANCEL and Bob sends a 200 OK response to the initial INVITE message at the same time. From Bob’s point of view, an INVITE transaction is completed by sending of the final response (200 OK). A 200 OK and a CANCEL crossed each other and inconsistency has arisen in the state of INVITE transaction of Alice and Bob. */

F5 481 Call/Transaction Dose Not Exist Bob -> Alice
SIP/2.0 481 Call/Transaction Dose Not Exist
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 CANCEL
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

/* The final respons to INVITE transaction has already sent while
CANCEL request targeting this INVITE transaction is received, so Bob returns a 481 response. */

F6 ACK Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76s1
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

/* Bob has sent the final response, and a CANCEL becomes invalid.
RTP streams are established.*/

F7 BYE Alice -> Bob

BYE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76s1
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

F8 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76s1
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

3.1.3 Receiving CANCEL(Trying state) via a stateful proxy in Moratorium state
If a CANCEL crosses a 200 OK to an INVITE between Bob and a stateful proxy, the UAC may receive a 200 OK to the INVITE after receiving 200 OK to the CANCEL. TU must manage a CANCEL transaction and an INVITE transaction independently, and even if a CANCEL is successful, TU cannot terminate an INVITE transaction, as described on 9.1 of RFC3261. Like "3.1.2 Receiving CANCEL(Trying state)", the UAC may send a BYE and terminate the session immediately after receiving 200 OK to an INVITE.

Message Details

F1 INVITE Alice -> Proxy

INVITE sip:alice@example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:alice@example.com>
Call-ID: 2xTb9vxSit55XU7p@atlanta.example.com
CSeq: 1 INVITE
Content-Type: application/sdp
Content-Length: 151
F2 INVITE Proxy -> Bob

INVITE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
 ;received=192.0.2.101
Max-Forwards: 69
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Content-Type: application/sdp
Content-Length: 151

v=0
c=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F3 100 Trying Proxy -> Alice

SIP/2.0 100 Trying
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
 ;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

F4 180 Ringing Bob -> Proxy

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.1 ;received=192.0.2.233
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9 ;received=192.0.2.101
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bot@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bot@client.biloxi.example.com;transport=udp>
Content-Length: 0

F5 180 Ringing Proxy -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9 ;received=192.0.2.101
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bot@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bot@client.biloxi.example.com;transport=udp>
Content-Length: 0

F6 CANCEL Alice -> Proxy

CANCEL sip:bot@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bot@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 CANCEL
Content-Length: 0

F7 CANCEL Proxy -> Bob

CANCEL sip:bot@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.2
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bot@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 CANCEL
Content-Length: 0

/* Proxy sent a 200 OK to the CANCEL and Bob sent INVITE at the same time. */
F8 200 OK(INVITE) Bob -> Proxy

SIP/2.0 200 OK
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.1 ;received=192.0.2.233
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9 ;received=192.0.2.101
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 148

v=0
c=IN IP4 192.0.2.100
m=audio 3456 RTP/AVP 0

F9 200 OK(CANCEL) Proxy -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 CANCEL
Content-Length: 0

/* Since CANCEL requests are hop-by-hop, the proxy answers with a 200 OK to the CANCEL of Alice. Note that the 200 OK doesn't mean the success of the CANCEL to the INVITE. */

F10 200 OK(INVITE) Proxy -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9 ;received=192.0.2.101
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 148

v=0
c=IN IP4 192.0.2.100
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F11 481 Call/Transaction Does Not Exist Bob -> Proxy

SIP/2.0 481 Call/Transaction Does Not Exist
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.2
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 CANCEL
Content-Length: 0

/* Since Bob has already sent 200 OK to INVITE, CANCEL fails with 481 response. */

F12 ACK Alice -> Proxy

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bq9
Max-Forwards: 70
Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

F13 ACK Proxy -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bq9
;received=192.0.2.101
Max-Forwards: 69
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

F14 BYE Alice -> Proxy

BYE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74be5
Max-Forwards: 70
Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

/* Alice may send a BYE and terminate the sessin immediately on
receipt of a 200 OK after the CANCEL. */

F15 BYE Proxy -> Bob

BYE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK739578.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74be5;
  ;received=192.0.2.101
Max-Forwards: 69
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

F16 200 OK Bob -> Proxy

SIP/2.0 200 OK
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK739578.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74be5;
  ;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

F17 200 OK Proxy -> Alice
SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74be5
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

3.1.4 Receiving BYE (Early state)
in Moratorium state

Alice

<table>
<thead>
<tr>
<th>ini-INVITE F1</th>
<th>Bob</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 F2</td>
<td></td>
</tr>
<tr>
<td>200(INVITE) F3</td>
<td></td>
</tr>
<tr>
<td>\ /</td>
<td></td>
</tr>
<tr>
<td>/ \</td>
<td></td>
</tr>
<tr>
<td>200(BYE) F5</td>
<td></td>
</tr>
</tbody>
</table>

In this scenario, Alice sends a BYE on the early dialog and Bob sends a 200 OK response to the initial INVITE message at the same time. Bob receives a BYE on the Confirmed dialog though Alice sended a BYE on the Early dialog. A BYE functions normally even if it is received after the INVITE transaction terminates because a BYE differs from a CANCEL, and is sent to not request but the dialog. Alice gets into a Mortal state on receiving the BYE response, and remains Mortal until the Timer K timeout occurs. Therefore, UA don’t send an ACK if it receives a 200 to INVITE.

Message Details

F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxc67ed76s1
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 151

v=0
o=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxc67ed76s1
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

F3 200 OK(ini-INVITE) Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxc67ed76s1
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F4 BYE Alice -> Bob

BYE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

F5 200 OK(BYE) Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

3.1.5 Receiving re-INVITE (Established state)
in Moratorium state

<table>
<thead>
<tr>
<th>Alice</th>
<th>Bob</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ini-INVITE F1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>180 F2</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>200 F3</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>ACK F4(packet loss)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>re-INVITE F6</td>
</tr>
<tr>
<td></td>
<td>200 F5</td>
</tr>
<tr>
<td></td>
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<td>X</td>
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<td>/ \</td>
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<tr>
<td></td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>ACK F7</td>
</tr>
<tr>
<td></td>
<td>200 F8</td>
</tr>
</tbody>
</table>
In this scenario, UAS receives a re-INVITE before receiving an ACK to ini-INVITE. UAS sends a 200 OK to the re-INVITE (F8) because it has sent a 200 OK to the ini-INVITE (F3, F5) and the dialog has already been confirmed. However, if a 200 OK to the ini-INVITE has an offer and the answer would be in the ACK, UA should return by a 491 to the re-INVITE. If UAS doesn’t receive an ACK for a long time, it should send a BYE and terminate the dialog.

Editor’s Note:
In this sequence, UAS comes to know that UAC receives a 200 OK to the ini-INVITE, when UAS receives a re-INVITE on the dialog. Therefore, it’s believed that UA may view an ACK to be received already if it has received a mid-dialog request such as a re-INVITE even though it hasn’t actually received an ACK. (However, only provided an ACK plays a role to transmit that UAC receives the 200 OK. In other words, in case that an ACK doesn’t have an answer.)

It is a difficult problem if UAS in Moratorium state accepts the message generated by Established state.
Therefore, this example may be corrected.

Message Details
F1 INVITE Alice -> Bob
INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 151

v=0
c=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

F3 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F4 ACK Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

/* A ACK request is lost. */

F5 200 OK Bob -> Alice (retransmission)

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/* UAS retransmits a 200 OK to an ini-INVITE since it didn’t receive a ACK. */

F6 re-INVITE Alice -> Bob

INVITE sip:sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 INVITE
Content-Length: 151

v=0
o=alice 2890844526 2890844527 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000
a=sendonly
F7 ACK Alice -> Bob (retransmission)

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

F8 200 OK(re-INVITE) Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9.1
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 INVITE
Content-Length: 151

v=0
o=bob 2890844527 2890844528 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000
a=recvonly

F9 ACK Alice -> Bob

ACK sip:sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK230f2.1
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 ACK
Content-Length: 0

3.1.6 Receiving BYE (Established state)
in Moratorium state
In this scenario, a ACK request to a 200 OK response is lost (or delay), immediately after Bob sends the retransmitted 200 OK to ini-INVITE and Alice sends a BYE at the same time. Depending on the implement of a SIP user agent, Alice may start a session again by reception of the retransmitted 200 OK with SDP since she has already terminated a session by sending a BYE. In that case, if UAC receives a retransmitted 200 OK after sending a BYE, you should not start a session again since the session which is not associated with dialog remains. Moreover, in the case where UAS sends an offer with a 200 OK, if UAS receives a retransmitted ACK after receiving a BYE, UAS should not start a session again for the same reason.

Message Details

F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 151

v=0
c=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

F3 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
c=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F4 ACK Alice -> Bob
ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0
/* A ACK request is lost. */

F5 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
 ;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
c=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000
/* UAS retransmits a 200 OK to an ini-INVITE since it didn’t receive
a ACK. */

F6 BYE Alice -> Bob

BYE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0
/* Bob retransmits a 200 OK and Alice sends a BYE at the same time. */
F7 200 OK(BYE) Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds9 ;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76s1
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

/* Bob sends a 200 OK to a BYE. */

Editor's Note
In the old version, Alice responds with an ACK when she have sent an
ACK to the first 200 OK once. However, this version was modified
that TU don't send an ACK to the retransmited 200 because TU
understands oneself is in Mortal state.

3.2 Receiving message in the Mortal State

This section shows some examples of call flow in race condition
when receiving the message from other states in the Mortal state.

3.2.1 Receiving BYE(Establish state)
in Mortal state

<table>
<thead>
<tr>
<th>Alice</th>
<th>Bob</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVITE F1</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>180 Ringing F2</td>
<td></td>
</tr>
<tr>
<td>&lt;------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>200 OK F3</td>
<td></td>
</tr>
<tr>
<td>&lt;------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>ACK F4</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Both Way RTP Media</td>
<td></td>
</tr>
<tr>
<td>&lt;------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>BYE F5</td>
<td>BYE F6</td>
</tr>
<tr>
<td>&lt;--------------</td>
<td>&lt;------------------</td>
</tr>
<tr>
<td>\ /</td>
<td>X</td>
</tr>
<tr>
<td>/ \</td>
<td></td>
</tr>
<tr>
<td>&lt;------------------------</td>
<td>-------------------</td>
</tr>
</tbody>
</table>
In this scenario, Alice and Bob send a BYE at the same time. A session is ended shortly after a BYE request is passed to a client transaction. According to 15.1.1 of RFC3261, a dialog seems to be completed by a response or timeout of a BYE. As shown in section 2, UA remains in Mortal state after sending a BYE until sending a BYE to actually terminating the dialog. (Any requests or responses which influence dialogs or sessions are invalid even though the dialog exists.) UAs in Mortal state return error responses to the requests that operate dialog or session, such as re-INVITE, or REFER. Exception is a BYE message. UA shall return 200 OK to the BYE because it can give the dialog in Mortal State a finishing stroke and send it to the Morgue.

Message Details

F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 151

v=0
o=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

F3 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
c=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F4 ACK Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

/* RTP streams are established between Alice and Bob */

/* Bob hangs up. Note that the CSeq is NOT 2, since Alice and Bob maintain their own independent CSeq counts. */
(The INVITE was request 1 generated by Alice, and the BYE is
request 1 generated by Bob) */

F5 BYE Alice -> Bob

BYE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

/* The session is terminated at the moment Alice sends a BYE. 
The dialog still exists then, but it is certain to be 
terminated in a short period of time. The dialog is 
completely terminated when the timeout of the BYE request 
occurs. */

F6 BYE Bob -> Alice

BYE sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 BYE
Content-Length: 0

/* Bob has also transmitted a BYE simultaneously with Alice. 
Bob terminates a session and a dialog. */

F7 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
;received=192.0.2.201
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

/* Since the dialog is Moratorium state, Bob responds with 
a 200 to the BYE. */
Editor’s Note:
In the old version, UA sends a 481 since the dialog is terminated by sending a BYE request.

(draft-hasebe-sipping-exceptional-procedure-example-02.txt)
In this draft, UA’s behavior in the example is modified to return 200 OK. It is an advantage of returning of 200 over 481 that information when the dialog is terminated can be passed on by the BYE response.

F8 200 OK Alice -> Bob

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
;received=192.0.2.201
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 BYE
Content-Length: 0

/* Since Alice has transited from the established state to Mortal state by sending a BYE, Alice responds with a 200 to a BYE. */

3.2.2 Receiving re-INVITE(Establish state)
in Mortal state

<table>
<thead>
<tr>
<th>Alice</th>
<th>Bob</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVITE F1</td>
<td>-----------</td>
</tr>
<tr>
<td>180 Ringing F2</td>
<td>&lt;--------</td>
</tr>
<tr>
<td>200 OK F3</td>
<td>&lt;--------</td>
</tr>
<tr>
<td>ACK F4</td>
<td>&lt;----------</td>
</tr>
<tr>
<td>Both Way RTP Media</td>
<td>&lt;-------------</td>
</tr>
<tr>
<td>BYE F5 re-INVITE F6</td>
<td>&lt;---------</td>
</tr>
<tr>
<td>\ /</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
| / \
|<--------|
| 481 F8 | 200 F7 |
In this scenario, Bob sends a re-INVITE, and Alice sends a BYE at the same time. The re-INVITE of Bob is returned by a 481, since TU of Alice has transited from Established state to Mortal state by sending a BYE. Bob sends an ACK to a 481 response, because a client transaction of a re-INVITE remains still.

Message Details

F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Supported: timer
Session-Expires: 300
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 151

v=0
o=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9

;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

F3 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Require: timer
Session-Expires: 300;refresher=uas
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
c=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/* In this sequence, Bob sets refresher=uas since there was no
specification of refresher. */

F4 ACK Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

/* RTP streams are established between Alice and Bob */

F5 BYE Alice -> Bob

BYE sip:bob@client.biloxi.example.com SIP/2.0
/* Alice sends a BYE and terminates a session, and transits from the confirmed state to the terminated state. */

F6 re-INVITE Bob -> Alice

INVITE sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

/* Alice sends a BYE, and Bob sends a re-INVITE at the same time. The state of dialog transits to Mortal state at the moment Alice sends a BYE, but Bob doesn’t know it until he receives the BYE. Therefore, the dialog is Terminated state from Alice’s point of view, but the dialog is Confirmed state from Bob’s point of view. A race condition occurs. */

F7 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
;received=192.0.2.201
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

F8 481 Call/Transaction Does Not Exist Alice -> Bob

SIP/2.0 481 Call/Transaction Does Not Exist
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
;received=192.0.2.201
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

/* Since Alice is in Mortal state, she responds with a 481 to the
re-INVITE. */

F9 ACK Bob -> Alice
ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

3.2.3 Receiving REFER(Establish state)
in Mortal state

<table>
<thead>
<tr>
<th>Alice</th>
<th>Bob</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVITE F1</td>
<td></td>
</tr>
<tr>
<td>180 Ringing F2</td>
<td></td>
</tr>
<tr>
<td>200 OK F3</td>
<td></td>
</tr>
<tr>
<td>ACK F4</td>
<td></td>
</tr>
<tr>
<td>Both Way RTP Media</td>
<td></td>
</tr>
<tr>
<td>BYE F5</td>
<td>REFER F6</td>
</tr>
<tr>
<td>\ /</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td></td>
</tr>
<tr>
<td>/ \</td>
<td></td>
</tr>
<tr>
<td>481 F8</td>
<td>200 F7</td>
</tr>
<tr>
<td>\ /</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td></td>
</tr>
<tr>
<td>/ \</td>
<td></td>
</tr>
</tbody>
</table>
In this scenario, Bob sends a REFER, and Alice sends a BYE at the same time. Bob sends a REFER in the same dialog. Alice sends an error response to request like a REFER which operates the dialog (or session), because Alice is in Mortal state by sending a BYE.

Message Details

F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Supported: timer
Session-Expires: 300
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Type: application/sdp
Content-Length: 151

v=0
o=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Type: application/sdp
Content-Length: 0
F3 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
 ;received=192.0.2.101
Require: timer
Session-Expires: 300;refresher=uas
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F4 ACK Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

/* RTP streams are established between Alice and Bob */

F5 BYE Alice -> Bob

BYE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0
/* Alice sends a BYE and terminates a session, and transits from Confirmed state to Terminated state. */

F6 REFER Bob -> Alice

REFER sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
Refer-To: sip:carol@cleveland.example.org
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
CSeq: 1 REFER
Content-Length: 0

/* Alice sends a BYE, and Bob sends a REFER at the same time. Bob sends a REFER on the INVITE dialog. The state of dialog transits to Mortal state at the moment Alice sends a BYE, but Bob doesn’t know it until he receives the BYE. A race condition occurs. */

F7 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

F8 481 Call/Transaction Does Not Exist Alice -> Bob

SIP/2.0 481 Call/Transaction Does Not Exist
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
;received=192.0.2.201
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 REFER
Content-Length: 0

/* Since Alice is in Mortal state, she responds with a 481 to the REFER. */
3.2.4 Receiving 200OK for re-INVITE(Establish state) in Mortal state

<table>
<thead>
<tr>
<th>Alice</th>
<th>Bob</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVITE F1</td>
<td></td>
</tr>
<tr>
<td>180 Ringing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>200 OK F3</td>
</tr>
<tr>
<td></td>
<td>ACK F4</td>
</tr>
<tr>
<td></td>
<td>Both Way RTP Media</td>
</tr>
<tr>
<td></td>
<td>re-INVITE F5</td>
</tr>
<tr>
<td></td>
<td>200 F7</td>
</tr>
<tr>
<td></td>
<td>BYE F6</td>
</tr>
<tr>
<td></td>
<td>\ /</td>
</tr>
<tr>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>/ \</td>
</tr>
<tr>
<td></td>
<td>200 OK F8</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In this scenario, Bob sends a BYE immediately after sending a re-INVITE, (A user is not conscious that refresher sends a re-INVITE automatically. For example, in the case of a telephone application, it is possible that a user places a receiver immediately after refresher.) When Alice receives a BYE other than ACK, she stops retransmitting of 200 OK. Since ACK for 2xx responses is not a server transaction, it is that UAS core transmits directly. With UAS core, since the dialog which matches 200 OK received is terminated, 200 OK is ignored, without sending ACK.

Message Details

F1 INVITE Alice -> Bob

INVITE sip:Bob@Biloxi.example.com SIP/2.0
F2 180 Ringing Bob → Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0
Content-Type: application/sdp

F3 200 OK Bob → Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Require: timer
Session-Expires: 300;refresher=uas
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147
v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F4 ACK Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

/* RTP streams are established between Alice and Bob */

F5 re-INVITE Bob -> Alice

INVITE sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds7
Session-Expires: 300;refresher=uac
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

F6 BYE Bob -> Alice

BYE sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

/* Bob sends a BYE immediately after sending of a re-INVITE. Bob terminates a session and transits from Established state to Mortal state. */
F7 200 OK (re-INVITE) Alice -> Bob

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds7
    ;received=192.0.2.201
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

/* Bob sends a BYE, and Alice responds with a 200 OK to re-INVITE. A race condition occurs. */

F8 200 OK (BYE) Alice -> Bob

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds8
    ;received=192.0.2.201
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

/* The UAC core of Bob does not send a ACK after receiving 200 OK to a re-INVITE. (Bob has terminated the dialog by sending of a BYE.) The UAS core of Alice does not retransmit 200 OK to a re-INVITE. (Since the dialog is terminated by reception of BYE, Alice does not retransmit 200 OK even if she does not receive ACK from Bob.) */

3.2.5 Receiving ACK (Moratorium state)
    in Mortal state

[Diagram of message flow]
In this scenario, Alice sends an ACK and Bob sends a BYE at the same time. When the offer is in a 2xx, and the answer is in an ACK, this example is in a race condition. Do not begin the session by receiving an ACK because Bob has already terminated the session by sending the BYE. The answer of ACK is just ignored.

F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Supported: timer
Session-Expires: 300
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 151

v=0
c=IN IP4 192.0.2.101
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

F3 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Require: timer
Session-Expires: 300;refresher=uas
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
c=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F4 ACK Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

/* RTP streams are established between Alice and Bob */

F5 BYE Alice -> Bob

BYE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
/* Alice sends a BYE and terminates a session and dialog. */

F6 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds8
;received=192.0.2.201
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

3.3 Other race condition

Here, examples in race condition that doesn’t relate directly to the dialog state transition are shown. In this section, it is shown that how to treat the race condition which generated when UAs treat "What is established by SIP" which related closely with dialog.

3.3.1 Early Dialog

<table>
<thead>
<tr>
<th>Alice</th>
<th>Proxy</th>
<th>Bob</th>
<th>Carol</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVITE(sdpl)</td>
<td>INVITE(sdpl)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>F2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;-------------</td>
<td>----------------</td>
<td>---------------</td>
<td>----------------</td>
</tr>
<tr>
<td>100 Trying F3</td>
<td>183(sdpl)To-tag=1 F4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;-------------</td>
<td>----------------</td>
<td>---------------</td>
<td>----------------</td>
</tr>
<tr>
<td>183(sdpl)To-tag=1 F5</td>
<td>PRACK F6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;-------------</td>
<td>----------------</td>
<td>---------------</td>
<td>----------------</td>
</tr>
<tr>
<td>PRACK F6</td>
<td>PRACK F7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;-------------</td>
<td>----------------</td>
<td>---------------</td>
<td>----------------</td>
</tr>
<tr>
<td>200(PRACK) F9</td>
<td>200(PRACK) F8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;-------------</td>
<td>----------------</td>
<td>---------------</td>
<td>----------------</td>
</tr>
<tr>
<td>RTP Media====</td>
<td>CANCEL F10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>=============</td>
<td>----------------</td>
<td>---------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>200(CANCEL) F11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>487(INVITE) F12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ack(INVITE) F13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In this scenario, a proxy is forking to another address (Carol), if Bob don’t return final response. When a proxy sends INVITEs to two or more addresses, two or more early dialogs may be established at UAC. At UAC, all early dialogs are released when the final response of ini-INVITE is received. (RFC3261, 13.2.2.4) Only the confirmed dialog continues after a 200 OK reception. Even if Bob is replaced by Media Server, you have the result appear to UAC just as this call flow. In this sequence, Bob can terminate the early media when he receives CANCEL, but Alice does not have the trigger to terminate the early dialog. When Bob stops sending RTP by the CANCEL from Proxy, it seems to Alice that RTP breaks off suddenly.

Message Details

F1 INVITE Alice -> Proxy

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxcde76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Supported: 100rel
Content-Type: application/sdp
Content-Length: 151

v=0
INVITE sip:alice@atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Max-Forwards: 69
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Supported: 100rel
Content-Type: application/sdp
Content-Length: 151

v=0
o=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 INVITE Proxy -> Bob

INVITE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Max-Forwards: 69
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Supported: 100rel
Content-Type: application/sdp
Content-Length: 151

v=0
o=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F3 100 Trying Proxy -> Alice

SIP/2.0 100 Trying
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

F4 183 Session Progress Bob -> Proxy

SIP/2.0 183 Session Progress
F5 183 Session Progress Proxy -> Alice

SIP/2.0 183 Session Progress
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:alice@atlanta.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
RSeq: 1
Contact: <sip:alice@atlanta.example.com;transport=udp>
Require: 100rel
Content-Type: application/sdp
Content-Length: 148
v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.100
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/* Early dialog is established between Alice and Bob, and early media is also established at the same time. */
F6 PRACK Alice -> Proxy

PRACK sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 2 PRACK
RAck: 1 1 INVITE
Content-Length: 0

F7 PRACK Proxy -> Bob

PRACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.2
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 2 PRACK
RAck: 1 1 INVITE
Content-Length: 0

F8 200 OK(PRACK) Bob -> Proxy

SIP/2.0 200 OK
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.2
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 2 PRACK
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

F9 200 OK(PRACK) Proxy -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 2 PRACK
Content-Length: 0
F10 CANCEL Proxy -> Bob

CANCEL sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.2
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 CANCEL
Content-Length: 0

/* The proxy cancels the INVITE to Bob, and sends an INVITE to Carol. Although the continuation of early media after CANCEL reception depends on the implementation of the user agent, Alice does not know that the proxy cancels the INVITE, therefore, when Bob stops early media after CANCEL reception, it seems to her that the sound stops suddenly. */

F11 200 OK(CANCEL) Bob -> Proxy

SIP/2.0 200 OK
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.2
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 CANCEL
Content-Length: 0

F12 487 Request Terminated(INVITE) Bob -> Proxy

SIP/2.0 487 Request Terminated
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

F13 ACK(INVITE) Proxy -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.1
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=314159
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
F14 INVITE Proxy -> Carol

INVITE sip:carol@client.chicago.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK83749a.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Max-Forwards: 69
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Supported: 100rel
Content-Type: application/sdp
Content-Length: 151

v=0
o=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F15 180 Ringing Carol -> Proxy

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK83749a.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=456654
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:carol@client.chicago.example.com>
Content Length:0

F16 180 Ringing Proxy -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=456654
Call-ID: 2xTb9vxxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:carol@client.chicago.example.com>
Content Length: 0

/* Proxy and Alice establish the second Early dialog when they receive a 180 response from Carol. */

F17 200 OK Carol -> Proxy

SIP/2.0 200 OK
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK83749a.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9 ;received=192.0.2.101
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=456654
Call-ID: 2xTb9vxxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:carol@client.chicago.example.com>
Content Length: 151

v=0
o=carol 2890844922 2890844922 IN IP4 client.chicago.example.com
s=Session SDP
c=IN IP4 client.chicago.example.com
t=3034423619 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F18 200 OK Proxy -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9 ;received=192.0.2.101
Record-Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=456654
Call-ID: 2xTb9vxxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:carol@client.chicago.example.com>
Content Length: 151
v=0
c=carol 2890844922 2890844922 IN IP4 client.chicago.example.com
s=Session SDP
c=IN IP4 client.chicago.example.com
t=3034423619 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/* By 200 OK response, all early dialogs are terminated except for one that was confirmed. */

F19 ACK Alice -> Proxy

ACK sip:carol@client.chicago.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bq9
Max-Forwards: 70
Route: <sip:ss.atlanta.example.com;lr>
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=456654
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

F20 ACK Proxy -> Carol

ACK sip:carol@client.chicago.example.com SIP/2.0
Via: SIP/2.0/UDP ss.atlanta.example.com:5060;branch=z9hG4bK721e.1
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bq9
;received=192.0.2.101
Max-Forwards: 69
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=456654
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

3.3.2 A BYE on the early dialog

Alice                      Bob
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>INVITE F1</td>
</tr>
<tr>
<td>_______________________</td>
</tr>
<tr>
<td>180 Ringing F2</td>
</tr>
<tr>
<td>_______________________</td>
</tr>
<tr>
<td>BYE F3</td>
</tr>
</tbody>
</table>
In this scenario, Alice establishes an early dialog with the receiving 180 response. Alice sends a BYE on the early dialog. According to Section 15 of RFC3261, callee’s UA MUST NOT send a BYE on early dialogs, but the caller’s UA MAY send a BYE on early dialogs.

Message Details

F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Type: application/sdp
Content-Length: 151

v=0
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

/* Alice forms an early dialog by receiving a 180 response to ini-INVITE.
   However Bob is not sure that Alice received the 180 response. */

F3 BYE Alice -> Bob

BYE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

/* Alice sends a BYE on the early dialog and Alice terminates
   a session (if any). */

F4 200 OK(BYE) Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds9;
received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 BYE
Content-Length: 0

/* Bob sends a 200 OK to a BYE of Alice, and Bob terminates
   a session (if any). */

F5 487 Request Terminated(INVITE) Bob -> Alice

SIP/2.0 487 Request Terminated
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5;
received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

/* Bob should terminate the early dialog when he receives a BYE. */
Bob sends a 487 response to terminate a INVITE transaction in the similar way to handle a CANCEL from Alice, because the INVITE transaction remains after terminating the early dialog. */

F6 ACK Alice -> Bob

ACK sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Length: 0

/* Alice sends an ACK to a 487 response as processing of the ini-INVITE transaction. (The dialog has been already terminated, but the ini-INVITE transaction remains) */

3.3.3 re-INVITE crossover

<table>
<thead>
<tr>
<th>Alice</th>
<th>Bob</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>INVITE F1</td>
<td></td>
</tr>
<tr>
<td>180 Ringing F2</td>
<td></td>
</tr>
<tr>
<td>200 OK F3</td>
<td></td>
</tr>
<tr>
<td>ACK F4</td>
<td></td>
</tr>
<tr>
<td>Both Way RTP Media</td>
<td></td>
</tr>
<tr>
<td>re-INVITE F5</td>
<td>re-INVITE F6</td>
</tr>
</tbody>
</table>
In this scenario, Alice and Bob send a re-INVITE at the same time. When two re-INVITEs cross in the same dialog, they resend re-INVITEs after different intervals. (RFC3261, 14.1) When Alice sends an initial INVITE, an INVITE will be sent again after 2.1-4.0 seconds because she generated the Call-ID (owner of the Call-ID). Bob will send an INVITE again after 0.0-2.0 seconds, because Bob isn’t the owner of the Call-ID. Therefore, each user agent must remember whether they has generated the Call-ID of the dialog or not, in case INVITEs may be crossed by another INVITE.

Message Details

F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Supported: timer
Session-Expires: 300
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 151

v=0
c=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Length: 0

F3 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Require: timer
Session-Expires: 300;refresher=uas
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
c=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000
F4 ACK Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

/* RTP streams are established between Alice and Bob */

F5 re-INVITE Alice -> Bob

INVITE sip:sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 INVITE
Content-Length: 151

v=0
c=alice 2890844526 2890844527 IN IP4 client.atlanta.example.com
s=
profile
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000
a=sendonly

F6 re-INVITE Bob -> Alice

INVITE sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
Session-Expires: 300;refresher=uac
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

/* A case where a re-INVITE for a session refresh and a re-INVITE for
hold are sent at the same time. */

F7 491 Request Pending Bob -> Alice

SIP/2.0 491 Request Pending
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 INVITE
Content-Length: 0

/* Since an INVITE is in progress, a 491 response are returned. */

F8 491 Request Pending Alice -> Bob

SIP/2.0 491 Request Pending
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

F9 ACK(INVITE) Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 ACK
Content-Length: 0

F10 ACK(INVITE) Bob -> Alice

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

F11 re-INVITE Bob -> Alice
INVITE sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7.1
Session-Expires: 300;refresher=uac
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 INVITE
Content-Type: application/sdp
Content-Length: 147

v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/* Since Bob is not the owner of Call-ID, Bob sends an INVITE again after 0.0-2.0 seconds. */

F12 200 OK Alice -> Bob

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7.1
Session-Expires: 300;refresher=uac
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 INVITE
Content-Type: application/sdp
Content-Length: 151

v=0
o=alice 2890844526 2890844526 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F13 ACK Bob -> Alice

ACK sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bK74b44
Session-Expires: 300; refresher=uac
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>; tag=8321234356
To: Alice <sip:alice@atlanta.example.com>; tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 ACK
Content-Length: 0

F14 re-INVITE Alice -> Bob

INVITE sip:sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060; branch=z9hG4bK74bf9.1
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>; tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>; tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 3 INVITE
Content-Length: 151

v=0
c=alice 2890844526 2890844527 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000
a=sendonly

/* Since Alice is the owner of Call-ID, Alice sends an INVITE again after 2.1-4.0 seconds. */

F15 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060; branch=z9hG4bK74bf9.1
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>; tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>; tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 3 INVITE
Content-Length: 151

v=0
c=bob 2890844527 2890844528 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000
a=recvonly

F16 ACK Alice -> Bob

ACK sip:sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK230f2.1
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 3 ACK
Content-Length: 0

3.3.4 UPDATE and re-INVITE crossover

```
<table>
<thead>
<tr>
<th>Alice</th>
<th>Bob</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVITE F1</td>
<td></td>
</tr>
<tr>
<td>180 Ringing F2</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>------------------</td>
</tr>
<tr>
<td>200 OK F3</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>------------------</td>
</tr>
<tr>
<td>ACK F4</td>
<td>Both Way RTP Media</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------</td>
</tr>
<tr>
<td>UPDATE F5</td>
<td>re-INVITE F6</td>
</tr>
<tr>
<td>491 F8</td>
<td>491 F7</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

Hasebe
In this scenario, the UPDATE contains SDP offer, therefore UPDATE and re-INVITE are returned error response (491) as in the case of "re-INVITE crossover". When an UPDATE for refresher which doesn’t contain a session description and the re-INVITE crossed each other, both request don’t fail by 491 and succeed with 200 because 491 means that UA have a pending request. Moreover, the same is equally true of UPDATE crossover, in case that either UPDATE contains a session description fail with 491, other cases succeed with 200.

Editor’s Note:
A 491 response is considered a result that UA judged the effectiveness of request to "What is established by SIP". Therefore, it is considered that 491 will be used in all the requests that demand operation to "What is established by SIP".

Message Details
F1 INVITE Alice -> Bob

INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Supported: timer
Session-Expires: 300
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:alice@client.atlanta.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 151
F2 180 Ringing Bob -> Alice

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

F3 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
;received=192.0.2.101
Require: timer
Session-Expires: 300;refresher=uas
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Contact: <sip:bob@client.biloxi.example.com;transport=udp>
Content-Type: application/sdp
Content-Length: 147

v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F4 ACK Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bd5
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

/* RTP streams are established between Alice and Bob */

F5 UPDATE Alice -> Bob

UPDATE sip:sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 UPDATE
Content-Length: 151

v=0
o=alice 2890844526 2890844527 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000
a=sendonly

F6 re-INVITE Bob -> Alice

INVITE sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
Session-Expires: 300;refresher=uac
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

/* A case where a re-INVITE for a session refresh and a re-INVITE for hold are sent at the same time. */

F7 491 Request Pending Bob -> Alice

SIP/2.0 491 Request Pending
F8 491 Request Pending Alice -> Bob

SIP/2.0 491 Request Pending
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 INVITE
Content-Length: 0

F9 ACK(INVITE) Alice -> Bob

ACK sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0

F10 re-INVITE Bob -> Alice

INVITE sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7.1
Session-Expires: 300;refresher=uac
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 INVITE
Content-Type: application/sdp
Content-Length: 147

v=0
o=bob 2890844527 2890844527 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/* Since Bob is not the owner of Call-ID, Bob sends an INVITE again
   after 0.0-2.0 seconds. */

F11 200 OK Alice -> Bob

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7.1
Session-Expires: 300;refresher=uaC
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 INVITE
Content-Type: application/sdp
Content-Length: 151

v=0
c=sip:bob@biloxi.example.com
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F12 ACK Bob -> Alice

ACK sip:alice@client.atlanta.example.com SIP/2.0
Via: SIP/2.0/UDP client.biloxi.example.com:5060;branch=z9hG4bKnashds7.1
Session-Expires: 300;refresher=uaC
Max-Forwards: 70
From: Bob <sip:bob@biloxi.example.com>;tag=8321234356
To: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 2 ACK
Content-Length: 0

F13 UPDATE Alice -> Bob

UPDATE sip:bob@client.biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKnashds7.1
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 3 UPDATE
Content-Length: 151

v=0
c=alice 2890844526 2890844527 IN IP4 client.atlanta.example.com
s=-
c=IN IP4 192.0.2.101
t=0 0
m=audio 49172 RTP/AVP 0
a=rtpmap:0 PCMU/8000
a=sendonly

/* Since Alice is the owner of Call-ID, Alice sends an INVITE again after 2.1-4.0 seconds. */

F14 200 OK Bob -> Alice

SIP/2.0 200 OK
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bK74bf9.1
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
Call-ID: 3848276298220188511@atlanta.example.com
CSeq: 3 INVITE
Content-Length: 151

v=0
c=bob 2890844527 2890844528 IN IP4 client.biloxi.example.com
s=-
c=IN IP4 192.0.2.201
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000
a=recvonly

4. References


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6. Authors’ Addresses

All listed authors actively contributed large amounts of text to this document.

Miki Hasebe
NTT-east Corporation
19-2 Nishi-shinjuku 3-chome Shinjuku-ku Tokyo 163-8019 Japan

EMail: hasebe.miki@east.ntt.co.jp
Jun Koshiko
NTT-east Corporation
19-2 Nishi-shinjuku 3-chome Shinjuku-ku Tokyo 163-8019 Japan
EMail: j.koshiko@east.ntt.co.jp

Yasushi Suzuki
NTT-east Corporation
19-2 Nishi-shinjuku 3-chome Shinjuku-ku Tokyo 163-8019 Japan
EMail: suzuki.yasushi@east.ntt.co.jp

Tomoyuki Yoshikawa
NTT-east Corporation
19-2 Nishi-shinjuku 3-chome Shinjuku-ku Tokyo 163-8019 Japan
EMail: tomoyuki.yoshikawa@east.ntt.co.jp

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