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A Session Identifier for the Session Initiation Protocol (SIP)
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Status of this Memo

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Abstract

There is a need for having a globally unique session identifier for the same SIP session, which can be consistently maintained across Proxies, B2BUAs and other SIP middle-boxes, for the purpose of Troubleshooting. This draft proposes a new SIP header to carry such a value: Session-ID.

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1. Introduction

The SIP [RFC3261] Call-ID header value is a globally unique identifier, mandatory in all requests/responses, which identifies SIP messages belonging to the same dialog or registration. It provides a portion of the SIP message dialog-matching criteria, and

is used in such things as [Replaces] headers and [dialog-events]

package for matching to dialogs, and in [SIP-Identity] and [Connected-identity] as one of the inputs for signing.

In practice, the Call-ID is often changed by B2BUAs and other such middle-boxes in the logical end-to-end message path. A B2BUA logically represents a UAS and UAC, and as such generates a new Call-ID value for the dialog it creates on its UAC side; in fact for some B2BUA scenarios the Call-ID *must* be changed for SIP to function properly.

At the same time, there is a need for a unique, common, consistent end-to-end identifier to help troubleshoot SIP sessions and message-flows as they cross SIP nodes. Troubleshooting is more complicated if multiple legs of the session are on different sides of B2BUAs, due to the lack of a common identifier such as a Call-ID to tie the legs together. Proprietary mechanisms are currently used to achieve this goal.

Therefore, in order to provide an identifier that will not be modified/replaced by B2BUAs, this draft proposes a new SIP Header "Session-ID", and mandatory rules for the value of such a header. The rules are designed to be such that the value in the Session-ID header is not considered unsafe, private, or have any property that would cause B2BUAs to change it. The goal of this draft is to enable troubleshooting by providing a unique identifier for a given session which can successfully cross B2BUAs, such as Application Servers, Softswitches, PBXs, SBCs, Feature Servers, etc.

1.1. Requirements

The following requirements drive the need for Session-ID:

REQ1: It must be possible for an administrator to use the identifier to identify a set of dialogs which have a direct correlation with each other such that they represent the same SIP session, with as high a probability as possible.

REQ2: It must be possible to pass the identifier through SIP B2BUAs, with as high a probability as possible. This requirement drives the following requirements:

REQ2a: The identifier must not reveal any information related to any SIP device or domain identity, including IP Address, port, hostname, domain name, username, Address-of-Record, MAC address, IP address family, transport type, etc.

REQ2b: The identifier must not reveal to the receiver of it that the Call-ID, tags, or any other SIP header or body portion have been changed by middle-boxes, with as high a probability as possible.

REQ2c: The identifier must not be used for anything at a SIP layer to change the behavior of the SIP protocol.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119. The terminology in this document conforms to RFC 2828, "Internet Security Glossary".

This document uses the terms "header field" and "header field value" following the definition of those terms in [RFC3261], which are not interchangeable. The "header field" is the entire SIP header's contents, including any parameters. The "header field value" is only the field-value portion, which does not include header parameters.

3. Overview of Operation

The general concept is that the UAC generating an out-of-dialog request generates a new, pseudo-random, unique value which remains constant for the duration of the transaction, any dialog created from that request, or for a registration. The value is inserted in a new Session-ID header field defined in this draft. The UAC and UAS then reflect this header field value in all messages for the duration of the dialog. In other words, the Session-ID provides a value similar in nature to Call-ID, except one which crosses B2BUAs and which has no sensitive information in it.

To aid in migration of deployments, a B2BUA or Proxy MAY also generate and/or insert the value on behalf of a UAC or UAS, if one or the other does not support this document's mechanism.

Although the Session-ID concept is similar to the Call-ID, it is not used for message dialog-matching rules in RFC 3261, nor does it change the Call-ID usage, nor does it replace the Call-ID value. Instead this new header field provides an identifier for troubleshooting uses only.

The format of the Session-ID value is restricted, both to avoid detection of the system type which generated it, and to keep it a hexadecimal representation such that it can be stored as a 128-bit binary value in log records.

4. Session-ID Behavior

4.1. Generating a Session-ID value

This draft proposes the Session-ID header value be generated based on a defined hash mechanism for creating a 128-bit pseudo-random value, and encode it as its lower-case hex representation. The reason for specifying the mechanism is two-fold: to make it impossible to determine the manufacturer of the device which generated it by looking at its format or value, and to allow devices to generate the same value if they have the same private key.

The Session-ID value is generated by taking the Call-ID header value, and SHA-1 hashing it based on [RFC2104] HMAC using a locally generated pseudo-random 128-bit system secret key, to create a 128-bit resultant HMAC value. The secret key makes the resultant HMAC value not re-creatable by other parties, which is necessary to prevent detection of Call-IDs being changed, as required by Req-2b. Otherwise, middle-boxes may have motivation to remove the Session-ID in order to hide the fact that they changed the Call-ID.

Per [RFC2104], the algorithm is thus HMAC-SHA-1-128(Call-ID_value, secret_key), and the 128-bit result is encoded using lowercase alphanumeric hex representation, as defined in the ABNF section of this document.

In order to enable trouble-shooting of in-dialog messages, a generator needs to remember or re-create the same Session-ID value for the duration of a given dialog(s). This is described in more detail in following sections of this document.

4.2. UAC Behavior

The rules for when a UAC generates a new Session-ID value are similar as those for Call-ID value: a UAC supporting this document's mechanism MUST generate a new unique Session-ID value whenever it generates an out-of-dialog request, or for a new Registration. The exception to this rule is for out-of-dialog REFER requests, or INVITE with [RFC3891] Replaces header field, as described in section 5.

The UAC MUST re-use the same Session-ID value for in-dialog messages as that of the original dialog-creating request, and for any out-of-dialog request it retransmits or re-generates in response to a 3xx, or it re-formulates due to failure responses. This follows the rules in [RFC3261] for Call-ID generation.

Session-ID values in Registration "refreshes" - REGISTER requests which are used to update the expiry time but not to register a new

contact - MUST use the same Session-ID value as previous REGISTER requests. New Registrations, which add or change the Contact URI for the AoR, but not simply to delete them, MUST use a new Session-ID value. This follows the behavior of Call-ID per RFC 3261; it is re-iterated here because some devices incorrectly change their Call-ID value for every re-Registration, and MUST NOT do the same to the Session-ID.

The UAC MUST include the Session-ID header field in every SIP message it transmits.

4.3. UAS Behavior

A UAS compliant with this document MUST copy a received Session-ID header field in a request, into responses and subsequent upstream requests sent within the dialog.

If an out-of-dialog request is received without a Session-ID header field, the UAS SHOULD generate a new one for subsequent use in the transaction and dialog, as defined for a UAC, and use the same value in all responses and upstream in-dialog requests for the same dialog.

4.4. Proxy Behavior

A Proxy MUST NOT remove or modify the Session-ID header field it receives, if one is in the message. By definition, an RFC 3261 compliant Proxy would not modify or remove such a header.

If the Proxy forks a request, it MUST copy the same Session-ID header field into all the forked request copies. If the Proxy recurses requests due to 3xx redirection, or regenerates requests due to failures, it MUST use the same Session-ID header field as the original request, just as the UAC does.

If the Proxy locally generates any response or request based on a received request, including 100 Trying, it MUST insert any received Session-ID header field from the original request into the response message it locally creates. This is necessary for troubleshooting purposes.

A Proxy compliant with this draft MAY generate a new Session-ID or insert a previously saved one, if and only if none existed in a received message, following the rules for doing so as a B2BUA defined later.

4.5. B2BUA Behavior

A B2BUA compliant with this document MUST copy the Session-ID header field it receives in requests as a UAS into the related requests it generates as a UAC; and any Session-ID field it receives in responses as a UAC into the correlated responses it generates as a UAS.

If the B2BUA forks or creates multiple requests as a UAC, from a request it received as a UAS, the B2BUA MUST copy the same Session-ID header field it received into all the forks/requests. If the B2BUA recurses requests due to 3xx redirection, or regenerates requests due to failures, it MUST use the same Session-ID field, just as the UAC does.

If the B2BUA locally generates any response or request based on a received request, including 100 Trying, it MUST insert any received Session-ID field from the original request into the response message it locally creates.

A B2BUA MAY remember the received Session-ID value for the duration of the transaction and dialog, for the purpose of re-insertion, in case the far-end does not support this draft.

In all cases, if the SIP message received by a B2BUA contained a Session-ID header field, a B2BUA compliant with this document MUST NOT remove, modify or replace it as it "forwards" the message on the other logical UA "side" of itself.

4.5.1 B2BUA Generation of New Session-ID

If an out-of-dialog request is received by a B2BUA compliant with this document, and the request does *not* contain a Session-ID header field, the B2BUA MAY generate a new one. The new Session-ID value MUST be calculated based on the received Call-ID of the received request, even if the B2BUA uses a different Call-ID value for requests generated on its other "side(s)". It MUST then insert it in any requests or responses it generates, as if it had actually received the new Session-ID from the UAC, following the rules previously defined for a B2BUA. This allows for a B2BUA to provide a migration to Session-ID deployment, on behalf of upstream nodes that do not yet support it.

As defined previously, if any received message already had a Session-ID, a B2BUA compliant with this document would not replace it.

4.5.2 B2BUA Insertion of Saved Session-ID

If a Session-ID was received in an out-of-dialog request, or the B2BUA locally generated one because none existed, the B2BUA SHOULD insert the same Session-ID field into all responses and upstream in-dialog requests if and only if a Session-ID is not already in them. This allows for a B2BUA to provide a migration to Session-ID deployment, on behalf of downstream nodes that do not yet support it.

5. Handling SIP Transfer Scenarios

The transfer or movement of SIP sessions represents a complication for a Session-ID type mechanism. On the one hand, the replacement SIP session represents a new one, and could reasonably be expected to use a new Session-ID value; on the other hand, from a troubleshooting and human user perspective, it is clearly related to, if not just a continuation of, the previous session. Since the purpose of this document's mechanism is to aid monitoring and troubleshooting, and not used for actual SIP protocol mechanics, the behavior defined in this section is to re-use the same Session-ID value for the replacement SIP session.

In order to do so, the Session-ID of the "original" session is transferred as well, in the Refer-To URI of a [RFC3515] REFER request. Furthermore, out-of-dialog REFER and INVITE with [RFC3891] Replaces requests use the appropriate Session-ID values. This assumes, of course, that the UAs involved support the Session-ID mechanism. If they do not, then it is possible for the Session-ID to not be "carried forward" to the new SIP dialog. Unfortunately, this means troubleshooting such dialogs is not improved/aided by this document's mechanism; but it would not "break" anything at a SIP layer.

It should also be noted that using the same Session-ID for the transferred-to dialog means the same Session-ID now exists in two independent dialogs, because the original one may well continue due to the implicit Subscription usage created by a REFER - that implicit Subscription based usage will continue to use the same Session-ID as the new dialog created to the transferred-to party.

For the following sub-sections, the term "UA" is used for User Agent. The language applies to the SIP device which creates the request, whether it be a UA or B2BUA.

5.1. Out-of-Dialog REFER

A UA compliant with this document MUST use the same Session-ID header field value for an out-of-dialog REFER request it generates,

as the original dialog the REFER is targeted to (i.e., as if the REFER had been in-dialog). For example, if UA Bob has a SIP dialog X to Alice, and Bob sends an out-of-dialog REFER to Alice to refer her to Charlie, the Session-ID header field value of the REFER request would be the same as that used in dialog X.
[Open issue: an alternative is to insert the Session-ID as a new parameter in a [RFC4538] Target-Dialog header of the REFER]

5.2. Refer-To URI

A UA compliant with this document MUST add the Session-ID header field as an embedded header in the Refer-To header field URI of any REFER request it generates, using the value of the session it is referring to. For example, if UA Bob has a SIP dialog X to Alice and dialog Y to Charlie, and Bob sends a REFER request to Alice to refer her to Charlie, the Session-ID header field value embedded in the Refer-To URI of the REFER request would be the same as that used in dialog Y.

5.3. Out-of-Dialog INVITE with Replaces

When generating an out-of-dialog INVITE with [RFC3891] Replaces header field, a UA compliant with this document MUST use the same Session-ID header field value for the INVITE request as that used for the dialog it is replacing, if it knows the value. Typically it would know the value by having received it in the Refer-To header field of a REFER, as described previously. For example, if UA Bob has a SIP dialog X to Alice and dialog Y to Charlie, and Bob sends a REFER request to Alice to refer her to Charlie, the Session-ID header field value embedded in the Refer-To URI of the REFER request would be the one used in dialog Y, which Alice would use as the Session-ID header field value for her INVITE to Charlie.

If the UA does not know the Session-ID of the dialog it is replacing, for example because it is not embedded in the Refer-To URI of a received REFER, then it MUST use a new Session-ID value, calculated using the mechanism as defined in section 4.1 with the Call-ID of the INVITE.

6. Session-ID Migration and Failure Scenarios

SIP is already widely deployed on the Internet, and it is impractical to expect all UAs to be upgraded to support this document's mechanism in the near future. A solution for gradual migration is necessary, which this document provides by allowing B2BUAs or Proxies to perform the Session-ID generator and inserter role. Even within those device types, it is impractical to expect all B2BUAs to support this mechanism all at once, or any time in the

near future. Therefore, it is expected that some B2BUAs and/or UAs

will support generating and inserting Session-ID, while others will not support Session-ID at all.

Due to the varying types of B2BUAs, such as PBXs, SBCs, Application Servers, Feature Servers, and Softswitches of various flavors, and the numerous SIP deployment models in use, there are going to be cases in which Session-ID will fail to be a consistent value for all related dialogs, or fail to successfully match. The goal of this draft is to improve troubleshooting of current deployments as much as possible - and in this author's opinion that is the best that can be done given the constraints.

One example is for forked requests: if a UAC which does not support this mechanism sends a request to a Proxy or B2BUA which also does not support this mechanism, each fork could reach B2BUAs or UASs which *do* support this mechanism. In such a case, each of those forked-to B2BUA/UAS will generate unique Session-IDs and put them in their responses, temporarily leading to multiple, different Session-ID values for the same related early dialogs. Typically, the UAC would eventually only accept one of the dialogs, and only one Session-ID would remain.

7. New 'Session-ID' Header

This draft adds the "Session-ID" token to the definition of the element "message-header" in the SIP message grammar. The Session-ID header is a single-instance header.

7.1. Augmented BNF Definitions

```
Session-ID          =  "Session-ID" HCOLON sess-id
                       *( SEMI generic-param )
sess-id             =  32(DIGIT / %x61-66)  ;32 chars of [0-9a-f]
```

NOTE: The sess-id value is technically case-INSENSITIVE, but note that only lower-case characters are allowed.

See the Security Considerations section for discussion about using header parameters in Session-ID header fields.

8. Example Exchange

In the following example, Alice initiates a call to Bob. Alice generates a Session-ID header in the out-of-dialog INVITE.

Alice generates the following: (note: much has been left out for simplicity)

```
INVITE sip:bob@example.com SIP/2.0
Via: SIP/2.0/UDP 192.0.2.1:5060;branch=z9hG4bKnashds10
From: Alice <sip:alice@example.net>;tag=1234567
To: Bob <sip:bob@example.com>
Call-Id: 123456mcmxcix@1.2.3.4
Session-ID: f81d4fae7dec11d0a76500a0c91e6bf6
CSeq: 1 INVITE
Contact: <sip:alice@192.168.1.1>
```

9. Security Considerations

There are several security considerations surrounding this document's mechanism.

The Session-ID generation algorithm should provide a reasonably random 16-character Session-ID value, to avoid collisions, and would not let one re-create the original Call-ID.

There is no known security issue with viewing or modifying the Session-ID, other than to hamper troubleshooting efforts.

9.1. Security considerations for administrators

The requirement for the Session-ID is to be an identifier which cannot be used by a recipient to identify if the Call-ID has been changed by middle-boxes. As such, a UAS/UAC cannot detect the original Call-ID, nor whether it has been changed, and thus should not cause administrators concern to be "passed through".

9.2. Security considerations for Session-ID extensions

The Session-ID's value is created from the Call-ID using a hashing mechanism based on [RFC2104], using SHA-1 and a secret key known only to the system generating the Session-ID. Because the algorithm is defined in this document, it should be fairly secure from detecting the generator of the Session-ID, in terms of manufacturer or code base.

The Session-ID generation algorithm should provide a reasonably random 128-bit Session-ID value, to avoid collisions, and would not let one re-create the original Call-ID. The secret key MUST only be

used for the Session-ID mechanism, in case a weakness is found which reveals the key. One such weakness may be that a UAC generates one or more Call-IDs which have a property that makes determining the key more likely.

In general, B2BUA behavior cannot be dictated by standards. They do whatever their owners/operators wish them to do, or whatever is necessary to make their applications work. This document attempts to normatively specify some B2BUA behavior, by creating a SIP header value for which the properties are such that B2BUAs should have no legitimate reason to interfere. This effectively creates a "promise" that future uses of this Session-ID header field, including its value *and* any future defined parameters, maintain this benign property. Any future extensions to the Session-ID mechanism and header field MUST maintain this property, or else B2BUAs will begin to modify it again or remove it, and its value will be lost.

Manufacturers of SIP devices should note that there is no guarantee that a B2BUA will not inspect the Session-ID header field, and remove it if it does not comply with this document's value restrictions. Any Session-ID header parameters MUST be registered with IANA and documented in IETF RFCs, pursuant to the requirements of [RFC3968].

10. IANA Considerations

This document asks IANA to register a new SIP header field named 'Session-ID', pursuant to the registration policies for such in [RFC5727]. This is a single-instance header field, and is appropriate for any SIP message, of any Method type, in any request or response.

The ABNF rules for this new header allow for header parameters, however they must be registered following the rules of [RFC3968], as required by [RFC5727].

11. Acknowledgments

Thanks to Raphael Coeffic, Bob Penfield, Dale Worley, Paul Kyzivat, Ian Elz, Marco Stura, Martin Dolly, Martin Huelsemann, Laura Liess and Adam Roach for their input.

12. References

12.1. Normative References

[RFC3261] Rosenberg, J., Schulzrinne, H., Camarillo, G., Johnston, A., Peterson, J., Sparks, R., Handley, M., and E. Schooler, "SIP: Session Initiation Protocol", RFC 3261, June 2002.

[RFC3515] Sparks, R., "The Session Initiation Protocol (SIP) Refer Method", RFC 3515, April 2003.

[RFC3891] Mahy, R., Biggs, B., Dean, R., "The Session Initiation Protocol (SIP) "Replaces" Header", RFC 3891, September 2004.

[RFC3968] Camarillo, G., "The Internet Assigned Number Authority (IANA) Header Field Parameter Registry for the Session Initiation Protocol (SIP)", RFC 3968, December 2004.

[RFC4538] Rosenberg, J., "Request Authorization through Dialog Identification in the Session Initiation Protocol (SIP)", RFC 4538, June 2006.

[RFC5727] Peterson, J., Jennings, C., Sparks, R., "Change Process for the Session Initiation Protocol (SIP) and the Real-time Applications and Infrastructure Area", RFC 5727, March 2010.

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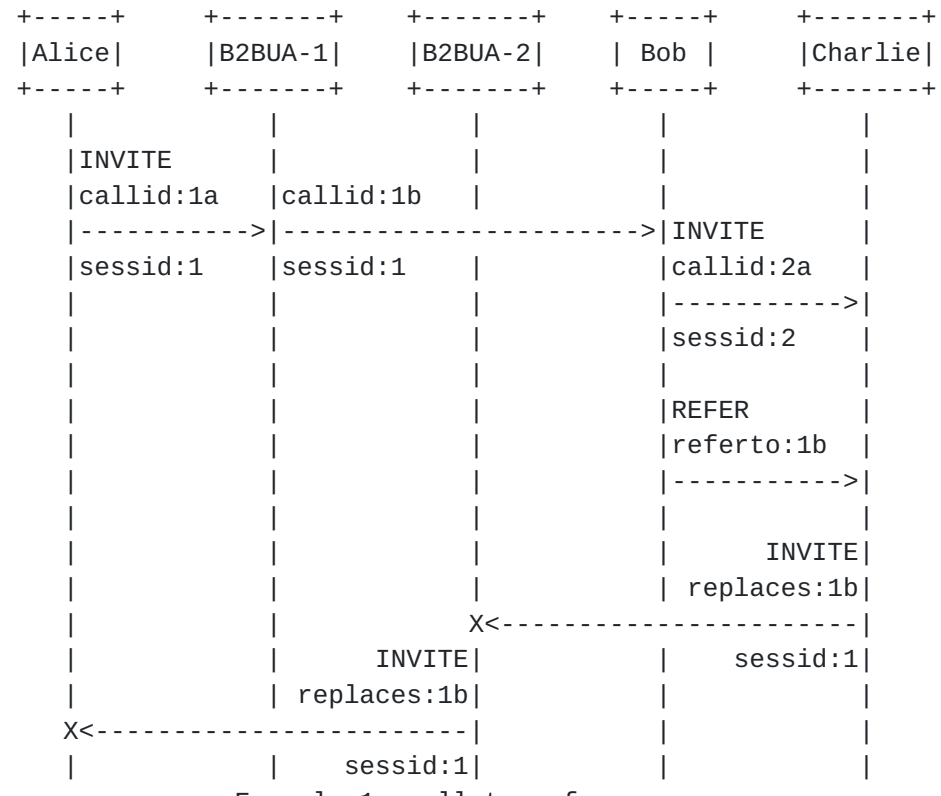
Appendix A. Use-cases not in scope for Session-ID

It is very tempting to use a header field value such as that provided by Session-ID, for other purposes than troubleshooting. In a previous draft for this same Session-ID concept, the proposal included other uses; but these were removed because any use-case other than troubleshooting can easily lead to a B2BUA needing to change the value, in certain cases. That would defeat the troubleshooting value of Session-ID. This section discusses such use-cases and explains why they are potentially harmful.

A.1. Dialog Correlation for SIP

Although Session-ID does provide a means to correlate separate SIP dialogs, messages, and transactions, it does so at a higher layer than SIP. It does not replace the mechanics of SIP using the Call-ID and To/From tags of SIP messages to correlate SIP dialogs, nor in other uses such as Replaces headers or dialog-event packages. It is tempting, however, to use it for exactly that purpose in certain cases.

For example, suppose a call transfer case where Alice calls Bob through B2BUA-1. Bob then calls Charlie, and sends Charlie a REFER with embedded Replaces, to make Charlie send an INVITE with Replaces header to Alice, to replace the Alice-Bob session. If Charlie uses a different B2BUA-2 to reach Alice, the INVITE with Replaces will fail, because the Call-ID/tags won't match anything B2BUA-2 or Alice knows about.



Example-1: call transfer case

If, on the other hand, Alice were to use the Session-ID value for correlation, she would see it matches her dialog with Bob (assuming the Session-ID were passed along in the Refer-To and Replaces info).

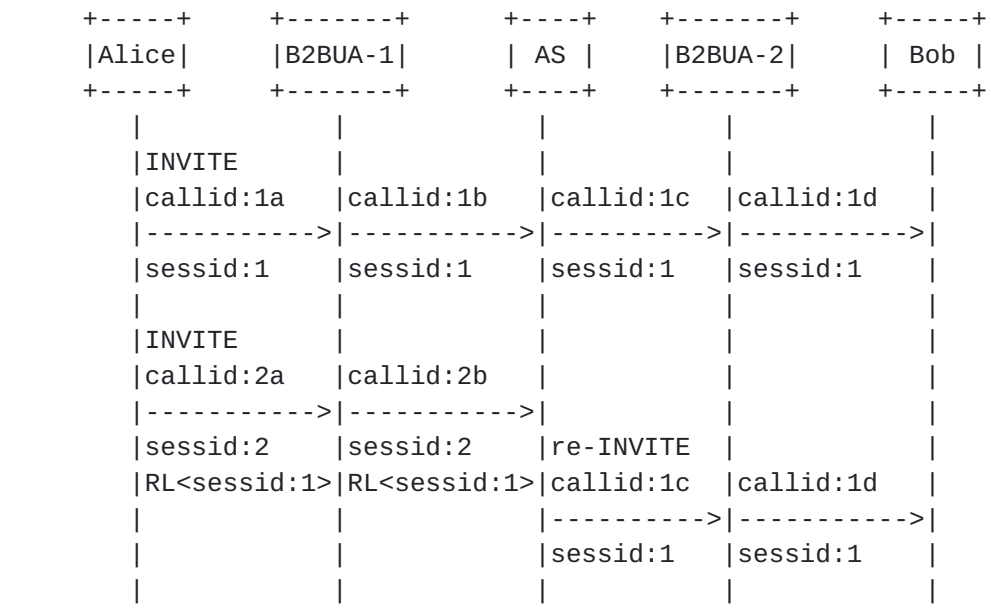
There are problems with this approach, however. The first problem

is, by not sending the INVITE with Replaces to B2BUA-1, B2BUA-1 is

in an incorrect state; the dialog is getting replaced, and the B2BUA doesn't know it.

A second issue is the Session-ID doesn't identify enough information to replace a dialog. Imagine there were a third B2BUA, such as a SoftSwitch, between Alice and B2BUA-1 and B2BUA-2, and the INVITE with Replaces reached the SoftSwitch before Alice. The SoftSwitch won't know which "side" the INVITE is replacing. The To/From tags no longer match anything the SoftSwitch knows about, so it can't figure out if the INVITE with Replaces is replacing the dialog from SoftSwitch to Alice, or the one to Bob. If we try to fix this by creating a tag-type value pair for Session-ID, we're back to devices changing those tag values and defeating the matching property.

Another example is based on 3GPP 24.605 annex A.2.2, shown in Example-2 below. Alice has a call with Bob through multiple B2BUA's and an Application Server. The dialogs of that call all have the same session-id, but unique call-id/tags.

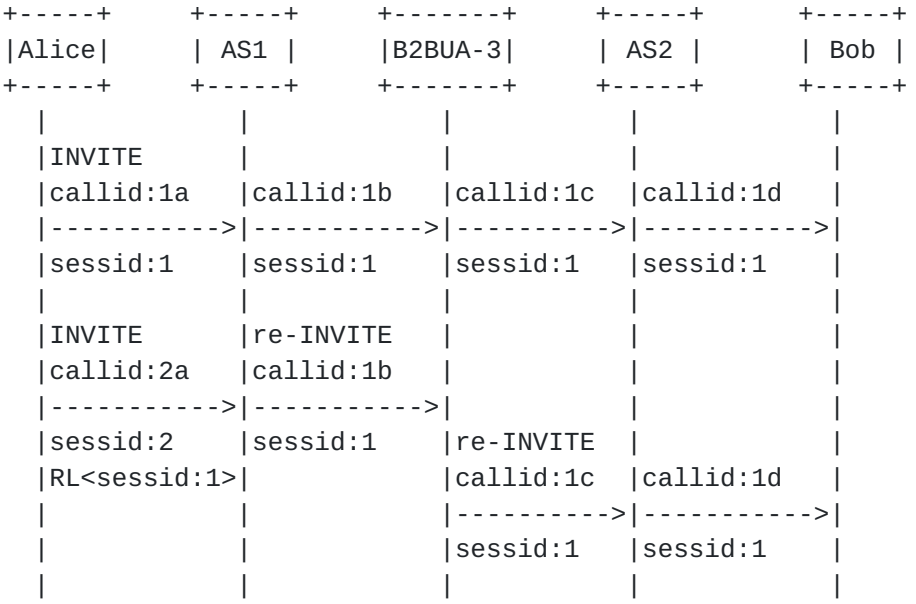


Example-2: Resource List

Alice wants to invoke a 3rd party conference facility in her AS, and reference the call she has with Bob for that. In this particular 3gpp scenario, to do that Alice sends a new INVITE to the AS with a resource-list body (a la RFC 5366) containing the call information for the original call. This is the "RL<sessid:1>" piece in the diagram. It has the call-id/tags as well, but they'll be wrong when received at the AS because they're not converted by B2BUA-1 to be for the dialog between B2BUA-1 and the AS.

The AS processes that list, can't match the callid/tags in the resource-lit, but *does* match the Session-ID, and thus sends a re-INVITE to party B within the original call's dialog.

The problem with using Session-ID for this type of scenario, other than that the B2BUA will be in an incorrect state, is the AS does not know which "side" or half-call the new INVITE is referring to. Is it the downstream Alice->Bob dialog, or upstream Bob->Alice dialog? Perhaps it could determine that by checking the To/From information and deciding party-A vs. party-B, but then suppose a modified example as shown in Example-3 below.



Example-3: Resource List with two AS'

In this case there are still B2BUA's between Alice and her AS1, and Bob and a new AS2, but they're not shown for simplification. The original call is from Alice to B2BUA-1 to AS1 to B2BUA-3 to AS2 to B2BUA-2 to Bob. Note the term being used is 'B2BUA', but this could be a P-CSCF or S-CSCF. Now suppose AS1 and AS2 are the *same* Application Server system. This is not unlikely in 3GPP scenarios in practice. How does the one and only AS decide which dilog leg the new INVITE is related to, since all dialogs on it are for Session-ID: 1, and it has two dialogs for Alice->Bob and two for Bob->Alice.

Ultimately, the right solution for this is to make the B2BUAs correctly modify the resource-list information, since they are B2BUAs and thus the UAS's and UAC's of the call.