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M. Barnes
Editor
Nortel Networks

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An Extension to the Session Initiation Protocol for Request History Information

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Abstract

This document defines a standard mechanism for capturing the history information associated with a SIP request. This capability enables many enhanced services by providing the information as to how and why a call arrives at a specific application or user. This document defines a new optional SIP header, History-Info, for capturing the history information in requests.

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Overview

Many services that SIP is anticipated to support require the ability to determine why and how the call arrived at a specific application. Examples of such services include (but are not limited to) sessions initiated to call centers via "click to talk" SIP Uniform Resource Locators (URLs) on a web page, "call history/logging" style services within intelligent "call management" software for SIP User Agents (UAs) and calls to voicemail servers. While SIP implicitly provides the redirect/retarget capabilities that enable calls to be routed to chosen applications, there is currently no standard mechanism within SIP for communicating the history of such a request. This "request history" information allows the receiving application to determine hints about how and why the call arrived at the application/user.

This document defines a new SIP header, History-Info, to provide a standard mechanism for capturing the request history information to enable a wide variety of services for networks and end users. The History-Info header provides a building block for development of new services.

Section 1 provides additional background motivation for the Request History capability. Section 2 identifies the requirements for a solution, with Section 3 providing an overall description of the solution.

Section 4 provides the details of the additions to the SIP protocol. Example uses of the new header are included in Section 4.5, with additional scenarios included in the Appendix.

Section 5 summarizes the application considerations identified in the previous sections. Section 6 summarizes the security solution.

Conventions used in this document

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 [RFC2119].

1.Background: Why define a Generic "Request History" capability?

SIP implicitly provides redirect/retarget capabilities that enable calls to be routed to specific applications as defined in [RFC3261]. The term 'retarget' will be used henceforth in this document to refer to the process of a Proxy Server/User Agent Client (UAC) changing a Uniform Resource Identifier(URI) in a request and thus changing the target of the request. This term is chosen to avoid associating this request history only with the specific SIP Redirect Server capability that provides for a response to be sent back to a UAC requesting that the UAC should retarget the original request to an alternate URI. The rules for determining request targets as described in section 16.5 of [RFC3261] are consistent with the use of the retarget term in this document.

The motivation for the request history is that in the process of retargeting old routing information can be forever lost. This lost

information may be important history that allows elements to which the call is retargeted to process the call in a locally defined, application specific manner. The proposal in this document is to provide a mechanism for transporting the request history. It is not proposing any application specific behavior for a Proxy or UA upon receipt of the information. Indeed, such behavior should be a local decision for the recipient application.

Current network applications provide the ability for elements involved with the call to exchange additional information relating to how and why the call was routed to a particular destination. The following are examples of such applications:

1. Web "referral" applications, whereby an application residing within a web server determines that a visitor to a website has arrived at the site via an "associate" site which will receive some "referral" commission for generating this traffic,

2. Email forwarding whereby the forwarded-to user obtains a "history" of who sent the email to whom and at what time

3. Traditional telephony services such as Voicemail, call-center "automatic call distribution", and "follow-me" style services.

Several of the aforementioned applications currently define application specific mechanisms through which it is possible to obtain the necessary history information.

In addition, request history information could be used to enhance basic SIP functionality by providing the following:

- Some diagnostic information for debugging SIP requests.

- A stronger security solution for SIP. A side effect is that each proxy which captures the "request history" information in a secure manner provides an additional means (without requiring signed keys) for the original requestor to be assured that the request was properly retargeted.

2. "Request History" Requirements

The following list constitutes a set of requirements for a "Request History" capability.

1) CAPABILITY-req: The "Request History" capability provides a capability to inform proxies and UAs involved in processing a request about the history/progress of that request. While this is inherently provided when the retarget is in response to a SIP redirect, it is deemed useful for non-redirect retargeting scenarios, as well.

2) OPTIONALITY-req: The "Request History" information is optional.

2.1) In many cases, it is anticipated that whether the history is added to the Request would be a local policy decision enforced by the specific application, thus no specific protocol element is needed.

2.2) Due to the capability being "optional" from the SIP protocol perspective, the impact to an application of not having the "Request History" must be described. Applicability guidelines to be addressed

by applications using this capability must be provided as part of the solution to these requirements.

3) GENERATION-req: "Request History" information is generated when the request is retargeted.

3.1) In some scenarios, it might be possible for more than one instance of retargeting to occur within the same Proxy. A proxy should also generate Request History information for the 'internal retargeting'.

3.2) An entity (UA or proxy) retargeting in response to a redirect or REFER should include any Request History information from the redirect/REFER in the new request.

4) ISSUER-req: "Request History" information can be generated by a UA or proxy. It can be passed in both requests and responses.

5) CONTENT-req: The "Request History" information for each occurrence of retargeting, shall include the following:

5.1) The new URI or address to which the request is in the process of being retargeted,

5.2) The URI or address from which the request was retargeted,

5.3) The reason for the Request-URI or address modification,

5.4) Chronological ordering of the Request History information.

6) REQUEST-VALIDITY-req: Request-History is applicable to requests not sent within an established dialog. (e.g. INVITE, REGISTER, MESSAGE, and OPTIONS).

7) BACKWARDS-req: Request-History information may be passed from the generating entity backwards towards the UAC. This is needed to enable services that inform the calling party about the dialog establishment attempts.

8) FORWARDS-req: Request-History information may also be included by the generating entity in the request, if it is forwarded onwards.

2.1 Security Requirements

The Request History information is being inserted by a network element retargeting a Request, resulting in a slightly different

problem than the basic SIP header problem, thus requiring specific consideration. It is recognized that these security requirements can be generalized to a basic requirement of being able to secure information that is inserted by proxies.

The potential security problems include the following:
1) A rogue application could insert a bogus Request History entry either by adding an additional entry as a result of retargeting or entering invalid information.

2) A rogue application could re-arrange the Request History information to change the nature of the end application or to mislead the receiver of the information.

Thus, a security solution for "Request History" must meet the following requirements:

1) SEC-req-1: The entity receiving the Request History must be able to determine whether any of the previously added Request History content has been altered.

2) SEC-req-2: The ordering of the Request History information must be preserved at each instance of retargeting.

3) SEC-req-3: The entity receiving the information conveyed by the Request History must be able to authenticate the source of the information.

4) SEC-req-4: To ensure the confidentiality of the Request History information, only entities which process the request should have visibility to the information.

It should be noted that these security requirements apply to any entity making use of the Request History information, either by retargeting and capturing the information, or as an application making use of the information received in either a Request or Response.

2.2 Privacy Requirements

Since the Request URI that is captured could inadvertently reveal information about the originator, there are general privacy requirements that MUST be met:

1) PRIV-req-1: The entity retargeting the Request must ensure that it maintains the network-provided privacy (as described in [RFC3323]) associated with the Request as it is retargeted.

2) PRIV-req-2: The entity receiving the Request History must maintain the privacy associated with the information.

In addition, local policy at a proxy may identify privacy requirements associated with the Request URI being captured in the Request History information.

3) PRIV-req-3: Request History information subject to privacy requirements shall not be included in outgoing messages unless it is protected as described in [RFC3323].

3. Request History Information Description

The fundamental functionality provided by the request history information is the ability to inform proxies and UAs involved in processing a request about the history or progress of that request (CAPABILITY-req). The solution is to capture the Request-URIs as a request is forwarded in a new header for SIP messages: History-Info (CONTENT-req). This allows for the capturing of the history of a request that would be lost with the normal SIP processing involved in the subsequent forwarding of the request. This solution proposes no changes in the fundamental determination of request targets or in the request forwarding as defined in sections 16.5 and 16.6 of the SIP protocol specification [RFC3261].

The History-Info header can appear in any request not associated with an established dialog (e.g. INVITE, REGISTER, MESSAGE, REFER and OPTIONS, PUBLISH and SUBSCRIBE, etc.) (REQUEST-VALIDITY-req) and any valid response to these requests. (ISSUER-req)

The History-Info header is added to a Request when a new request is created by a UAC or forwarded by a Proxy, or when the target of a request is changed. The term 'retarget' is introduced to refer to this changing of the target of a request and the subsequent forwarding of that request. It should be noted that retargeting only occurs when the Request-URI indicates a domain for which the processing entity is responsible. In terms of the SIP protocol, the processing associated with retargeting is described in sections 16.5, and 16.6 of [RFC3261]. As described in section 16.5 of [RFC3261], it is possible for the target of a request to be changed by the same proxy multiple times (referred to as 'internal retargeting' in section 2), as the proxy MAY add targets to the target set after beginning Request Forwarding. Section 16.6 of [RFC3261] describes Request Forwarding. It is during this process of Request Forwarding, that the History Information is captured as an optional, additional header field. Thus, the addition of the History-Info header does not impact fundamental SIP Request Forwarding. An entity (UA or proxy)

changing the target of a request in response to a redirect or REFER SHOULD also propagate any History-Info header from the initial Request in the new request (GENERATION-req, FORWARDS-req).

3.1 Optionality of History-Info

The History-Info header is optional in that neither UAs nor Proxies are required to support it. A new Supported header, "histinfo", is included in the Request to indicate whether the History-Info header is returned in Responses (BACKWARDS-req). In addition to the "histinfo" Supported header, local policy determines whether or not the header is added to any request, or for a specific Request-URI, being retargeted. It is possible that this could restrict the applicability of services which make use of the Request History Information to be limited to retargeting within domain(s) controlled by the same local policy, or between domain(s) which negotiate policies with other domains to ensure support of the given policy, or services for which complete History Information isn't required to provide the service. (OPTIONALITY-req) All applications making use of the History-info header MUST clearly define the impact of the information not being available and specify the processing of such a request.

3.2 Securing History-Info

This document defines a new header for SIP. The document strongly RECOMMENDs the use of the Transport Layer Security (TLS) protocol [RFC2246] as a mandatory mechanism to ensure the overall confidentiality of the History-Info headers (SEC-req-4). This results in History-Info having at least the same level of security as other headers in SIP which are inserted by intermediaries. If TLS is not available for the connection over which the request is being forwarded, then the request MUST not include the History-Info header or the request MUST be redirected to the client, including the History-Info header, so that the request can be retargeted by the client.

With the level of security provided by TLS (SEC-req-3), the information in the History-Info header can thus be evaluated to determine if information has been removed by evaluating the indices for gaps (SEC-req-1, SEC-req-2). It would be up to the application to define whether it can make use of the information in the case of missing entries.

3.3 Ensuring the Privacy of History-Info

Since the History-Info header can inadvertently reveal information about the requestor as described in [RFC3323], the Privacy header SHOULD be used to determine whether an intermediary can include the History-Info header in a Request that it receives and forwards (PRIV-req-2) or that it retargets (PRIV-req-1). Thus, the History-Info header SHOULD not be included in Requests where the requestor has indicated a priv-value of Session or Header level privacy.

In addition, the History-Info header can reveal general routing information, which may be viewed by a specific intermediary or network, to be subject to privacy restrictions. Thus, local policy MAY also be used to determine whether to include the History-Info header at all, whether to capture a specific Request-URI in the header, or whether it be included only in the Request as it is retargeted within a specific domain (PRIV-req-3). In the latter case, this is accomplished by adding a new priv-value, history, to the Privacy header [RFC 3323] indicating whether any or a specific History-Info header(s) SHOULD be forwarded.

It is recognized that satisfying the privacy requirements can impact the functionality of this solution by overriding the request to generate the information. As with the optionality and security requirements, applications making use of History-Info SHOULD address any impact this may have or MUST explain why it does not impact the application.

4 Request History Information Protocol Details

This section contains the details and usage of the proposed new SIP protocol elements. It also discusses the security aspects of the solution.

4.1 Protocol Structure of History-Info

History-Info is a header field as defined by [RFC3261]. It is an optional header field and MAY appear in any request or response not associated with a dialog or which starts a dialog. For example, History-Info MAY appear in INVITE, REGISTER, MESSAGE, REFER, OPTIONS, SUBSCRIBE and PUBLISH and any valid responses, plus NOTIFY requests which initiate a dialog.

This document adds the following entry to Table 2 of [RFC3261]. The additions to this table are also provided for extension methods at

the time of publication of this document. This is provided as a courtesy to the reader and is not normative in any way.

Header field	where	proxy	ACK	BYE	CAN	INV	OPT	REG	MSG
History-Info		amdr	-	-	-	o	o	o	o

		SUB	NOT	REF	INF	UPD	PRA	PUB
History-Info	amdr	o	o	o	-	-	-	o

The History-Info header carries the following information, with the mandatory parameters required when the header is included in a request or response:

- Targeted-to-URI (hi-targeted-to-uri): A mandatory parameter for capturing the Request URI for the specific Request as it is forwarded.

- Index (hi-index): A mandatory parameter for History-Info reflecting the chronological order of the information, indexed to also reflect the forking and nesting of requests. The format for this parameter is a string of digits, separated by dots to indicate the number of forward hops and retargets. This results in a tree representation of the history of the request, with the lowest level index reflecting a branch of the tree. By adding the new entries in order (i.e. following existing entries per the details in section 4.3.3.1), including the index and securing the header, the ordering of the History-info headers in the request is assured (SEC-req-2). In addition, applications may extract a variety of metrics (total number of retargets, total number of retargets from a specific branch, etc.) based upon the index values.

- Reason: An optional parameter for History-info, reflected in the History-Info header by including the Reason Header [RFC3326] escaped in the hi-targeted-to-uri. A reason is not included for a hi-targeted-to-uri when it is first added in a History-info header, but rather is added when the retargeting actually occurs. Note, that this does appear to complicate the security

problem, however, retargeting only occurs when the hi-targeted-to-uri indicates a domain for which the processing entity is responsible, thus it would be the same processing entity that initially added the hi-targeted-to-URI to the header that would be updating it with the Reason.

- o Privacy: An optional parameter for History-info, reflected in the History-Info header field values by including the Privacy Header [RFC3323] with a priv-value of "history" escaped in the hi-targeted-to-uri or by adding the Privacy header with a priv-value of "history" to the Request. The use of the Privacy Header with a priv-value of "history" indicates whether a specific or all History-Info headers should not be forwarded.

- o Extension (hi-extension): An optional parameter to allow for future optional extensions. As per the [RFC3261], any implementation not understanding an extension should ignore it.

The following summarizes the syntax of the History-Info header, based upon the standard SIP syntax [RFC3261]:

```
History-Info = "History-Info" HCOLON

                    hi-entry *(COMMA hi-entry)

hi-entry = hi-targeted-to-uri *( SEMI hi-param )

hi-targeted-to-uri= name-addr

hi-param = hi-index / hi-extension

 hi-index = "index" EQUAL 1*DIGIT *(DOT 1*DIGIT)

hi-extension = generic-param
```

4.2 Protocol Examples

The following provides some examples of the History-Info header. Note that the backslash and CRLF between the fields in the examples below are for readability purposes only.

```
History-Info:<sip:UserA@ims.example.com?Reason=SIP%3B\
  cause%3D302>;index=1;foo=bar

History-Info: <sip:UserA@ims.example.com?Reason=SIP%3B \
   cause%3D302>; index=1.1,
   <sip:UserB@example.com?Privacy=history&Reason=SIP%3B\
   cause%3D486>;index=1.2,
   <sip:45432@vm.example.com>;index=1.3
```

4.3 Protocol usage

This section describes the processing specific to UAs and Proxies for the History-Info header, the "histinfo" option tag and the priv-value of "history". As discussed in section 1, the fundamental objective is to capture the target Request-URIs as a request is forwarded. This allows for the capturing of the history of a request that would be lost due to subsequent (re)targeting and forwarding. To accomplish this for the entire history of a request, either the UAC must capture

the Request-URI in a History-Info header in the initial request or a proxy must add a History-Info header with both an hi-entry for the Request-URI in the initial request and an hi-entry for the target Request-URI as the request is forwarded. The basic processing is for each entity forwarding a request to add an hi-entry for the target Request-URI, updating the index and adding the Reason as appropriate for any retargeted Request-URI.

4.3.1 User Agent Client (UAC) Behavior

The UAC SHOULD include the "histinfo" option tag in the Supported header in any request not associated with an established dialog for which the UAC would like the History-Info header in the Response. In addition, the UAC SHOULD initiate the capturing of the History Information by adding a History-Info header, using the Request-URI of the request as the hi-targeted-to-uri and initializing the index to the RECOMMENDED value of 1 in the hi-entry.

In the case where the request is routed to a redirect server and the UAC receives a 3xx response with a Contact header, the UAC MAY maintain the previous hi-entry(s) in the request. In this case, the reason header SHOULD be associated with the hi-targeted-to-uri in the

previous (last) hi-entry, as described in section 4.3.3.1.2. A new hi-entry MAY then be added for the URI from the Contact header (which becomes the new Request-URI). In this case, the index is created by reading and incrementing the value of the index from the previous hi-entry, thus following the same rules as those prescribed for a proxy in retargeting, described in section 4.3.3.1.3. An example of this scenario can be found in Appendix D.

A UAC that does not want the History-Info header added due to privacy considerations SHOULD include a Privacy header with a priv-value(s) of "session", "header" or "history" in the request.

With the exception of the processing of a 3xx response described above, the processing of the History-Info header received in the Response is application specific and outside the scope of this document. However, the validity of the information SHOULD be ensured prior to any application usage. For example, the entries MAY be evaluated to determine gaps in indices, which could indicate that an entry has been maliciously removed or removed for privacy reasons. Either way, an application MAY want to be aware of potentially missing information.

4.3.2 User Agent Server (UAS) Behavior

The processing of the History-Info header by a UAS in a Request depends upon local policy and specific applications at the UAS which

might make use of the information. Prior to any application usage of the information, the validity SHOULD be ascertained. For example, the entries MAY be evaluated to determine gaps in indices, which could indicate that an entry has been maliciously removed or removed for privacy reasons. Either way, an application MAY want to be aware of potentially missing information.

If the "histinfo" option tag is received in a request, the UAS SHOULD include any History-Info received in the request in the subsequent response.

4.3.3 Proxy Behavior

The inclusion of the History-Info header in a Request does not alter

the fundamental processing of proxies for determining request targets as defined in section 16.5 of [RFC3261]. Whether a proxy adds the History-Info header or a new hi-entry as it forwards a Request depends upon the following considerations:

1. Whether the Request contains the "histinfo" option tag in the Supported header.
2. Whether the proxy supports the History-Info header.
3. Whether the Request contains a Privacy header with a priv-value of "session", "header" or "history".
4. Whether any History-Info header added for a proxy/domain should go outside that domain. An example being the use of the History-Info header within the specific domain in which it is retargeted, however, policies (for privacy, user and network security, etc.) would prohibit the exposure of that information outside that domain. To accommodate such a scenario, a proxy MAY insert the Privacy header with a priv-value of "history" when the request is being forwarded within the same domain. An example of such an application is provided in Appendix C.
5. Whether an hi-entry is added for a specific Request URI due to local privacy policy considerations. A proxy MAY add the Privacy header with a priv-value of "history" associated with the specific hi-targeted-to-uri.

An example policy would be a proxy that only adds the History-Info header if the "histinfo" option tag is in the Supported header. Other proxies may have a policy that they always add the header, but never forward it outside a particular domain, accomplishing this by adding a Privacy header with a priv-value of "history" to each hi-entry to allow the information to be collected for internal retargeting only.

Each application making use of the History-Info header SHOULD address the impacts of the local policies on the specific application (e.g.

what specification of local policy is optimally required for a specific application and any potential limitations imposed by local policy decisions).

Consistent with basic SIP processing of optional headers, proxies SHOULD maintain the History-Info header(s), received in messages being forwarded, independent of whether local policy supports History-Info.

The specific processing by proxies for adding the History-Info headers in Requests and Responses, to accommodate the considerations outlined above, is described in detail in the following sections.

4.3.3.1 Adding the History-Info header to Requests

Upon evaluation of the considerations under which the History-Info header is to be included in requests (e.g. no Privacy header overriding inclusion, local policy supports, etc.), detailed in section 4.3.3, a proxy SHOULD add an hi-entry as it forwards a Request. Section 16.6 of [RFC3261] defines the steps to be followed as the proxy forwards a Request. Step 5 prescribes the addition of optional headers. Although, this would seem the appropriate step for adding the History-info header, the interaction with Step 6 "Postprocess routing information" and the impact of a strict route in the Route header could result in the Request-URI being changed, thus adding the History-info header between steps 8 (adding Via header) and 9 (adding Content-Length) is RECOMMENDED. Note, that in the case of loose routing, the Request-URI does not change during the forwarding of a Request, thus the capturing of History-Info for such a request would result in duplicate Request-URIs with different indices. The hi-entry MUST be added following any hi-entry received in the request being forwarded. Additionally, if a request is received that doesn't include a History-Info header, the proxy MAY add a History-Info header with an hi-entry preceding the one being added for the current request being forwarded. The index for this hi-entry is RECOMMENDED to start at 1. The following subsections define the details of creating the information associated with each hi-entry.

4.3.3.1.1 Privacy in the History-Info header

If there is a Privacy header in the request with a priv-value of "session", "header" or "history", an hi-entry MAY be added, if the request is being forwarded to a Request URI associated with a domain for which the processing entity is responsible (and provided local policy supports the History-Info header, etc.). If a request is being forwarded to a Request URI associated with a domain for which the proxy is not responsible and there is a Privacy header in the request with a priv-value of "session", "header" or "history", the

proxy SHOULD remove any hi-entry(s) prior to forwarding, depending

upon local policy and whether the proxy might know a priori that it can rely on a downstream privacy service to apply the requested privacy.

For the scenario where there is no Privacy header in the request and the request is being forwarded to a Request URI associated with the domain(s) for which this entity is responsible, there are several additional considerations:

- o If there is no local policy associated with privacy, then an hi-entry MAY be added to the Request.

- o If the proxy's local policies, per consideration 4 in section 4.3.3, indicate that the History-Info header should not be forwarded beyond the domain for which this intermediary is responsible, then a Privacy header with a priv-value of "history" SHOULD be associated with each hi-entry added by that proxy in this scenario.

- o If the proxy's policy per consideration 5 in section 4.3.3, indicates that History-Info for a specific Request URI should not be forwarded beyond the domain for which this intermediary is responsible, then a Privacy header with a priv-value of "history" SHOULD be associated with the specific hi-entry, for that specific hi-targeted-to-uri, added by that proxy in this scenario.

If a request is being forwarded to a Request URI associated with a domain for which the proxy is not responsible and local policy requires privacy associated with any, or with specific hi-entries it has added, any hi-entry with a priv-value of "history" SHOULD be removed prior to forwarding.

4.3.3.1.2 Reason in the History-Info header

For retargets that are the result of an explicit SIP response, a Reason MUST be associated with the hi-targeted-to-uri. If the SIP response does not include a Reason header, the SIP Response Code that triggered the retargeting MUST be included as the Reason associated with the hi-targeted-to-uri that has been retargeted. If the response contains a non-SIP Reason header (e.g. Q.850), it MUST be captured as an additional Reason associated with the hi-targeted-to-uri that has been retargeted, along with the SIP Response Code. If the Reason header is a SIP reason, then it MUST be used as the Reason associated with the hi-targeted-to-uri rather than the SIP response code.

For retargets as a result of timeouts or internal events, a Reason MAY be associated with the hi-targeted-to-uri that has been retargeted.

The addition of the Reason should occur prior to the forwarding of the request (which may add a new hi-entry with a new hi-targeted-to-uri) as it is associated with the hi-targeted-to-uri that has been retargeted, since it reflects the reason why the Request to that specific URI was not successful.

4.3.3.1.3 Indexing in the History-Info header

In order to maintain ordering and accurately reflect the nesting and retargeting of the request, an index MUST be included along with the Targeted-to-URI being captured. Per the ABNF in section 4.1, the index consists of a dot delimited series of digits (e.g. 1.1.2). Each dot reflects a hop or level of nesting, thus the number of hops is determined by the total number of dots. Within each level, the integer reflects the number of peer entities to which the request has been routed. Thus, the indexing results in a logical tree representation for the history of the Request. It is recommended that for each level of indexing, the index start at 1. It is recommended that an increment of 1 is used for advancing to a new branch.

The basic rules for adding the index are summarized as follows:

1. Basic Forwarding: In the case of a Request that is being forwarded, the index is determined by adding another level of indexing since the depth/length of the branch is increasing. To accomplish this, the proxy reads the value from the History-Info header in the received request, if available, and adds another level of indexing by appending the DOT delimiter followed by an initial index for the new level RECOMMENDED to be 1. For example, if the index in the last History-Info header field in the received request is 1.1, this proxy would initialize its index to 1.1.1 and forward the request.

2. Retargeting within a Proxy - 1st instance: For the first instance of retargeting within a Proxy, the calculation of the index follows that prescribed for basic forwarding.

3. Retargeting within a Proxy - subsequent instance: For each subsequent retargeting of a request by the same proxy, another branch is added. With the index for each new branch calculated by incrementing the last/lowest digit at the current level, thus the

index in the next request forwarded by this same proxy, following the example above, would be 1.1.2.

4. Retargeting based upon a Response: In the case of retargeting due to a specific response (e.g. 302), the index would be calculated per rule 3. That is, the lowest/last digit of the index is incremented (i.e. a new branch is created), with the increment RECOMMENDED to be 1. For example, if the index in the History-Info header of the received request was 1.2, then the index in the History-Info header field for the new hi-targeted-to-URI would be 1.3.

5. Retargeting the request in parallel (forking): If the request forwarding is done in parallel, the index MUST be captured for each forked request per the rules above, with each new Request having a unique index. The only difference in the messaging for this scenario and the messaging produced per basic proxy retargeting in rules 2 and 3 is these forwarded requests do not have History-Info entries associated with their peers. The proxy builds the subsequent response (or request) using the aggregated information associated with each of those requests and including the header entries in the order indicated by the indexing. Responses are processed as described in section 16.7 of [RFC3261] with the aggregated History-Info entries processed similar to step 7 "Aggregate Authentication Header Field Values". Section 4.5 provides an example of a parallel request scenario, highlighting this indexing mechanism.

4.3.3.2 Processing History-Info in Responses

A proxy that receives a Request with the "histinfo" option tag in the Supported header, and depending upon a local policy supporting the capture of History-Info, SHOULD return captured History-Info in subsequent, provisional and final responses to the Request, subject to the following considerations for privacy:

- If the response is being forwarded to a Request URI associated with a domain for which the proxy is not responsible and there was a Privacy header, in the request received by the proxy, with a priv-value of "session", "header" or "history", the proxy MUST remove the History-Info header (i.e. all hi-entries) prior to forwarding.

- o If a request is being forwarded to a Request URI associated with a domain for which the proxy is not responsible and local policy requires privacy associated with any or all hi-entry(s) it has added, any hi-entry with a priv-value of "history" MUST be removed prior to forwarding.

- o If a proxy receives a response, from another intermediary associated with a domain for which it is responsible, including hi-entry(s) with privacy headers and that response is to be

forwarded to a domain for which it is not responsible, then those hi-entry(s) MUST be removed.

The processing of History-Info in responses follows the methodology described in section 16.7 of [RFC3261], with the processing of History-Info headers adding an additional step, just before step 9 "Forwarding the Response".

4.3.4 Redirect Server Behavior

A redirect server SHOULD NOT add any new History-Info, as that would be done by the entity receiving the 3xx response. However, a redirect server MAY include History-Info in responses by adding any History-Info headers received in a request to a subsequent response.

4.4 Security for History-Info

As discussed in Section 3, the security requirements are met by recommending the use of TLS (a basic SIP requirement per [RFC3261]) for hop by hop security. If TLS is not available on the connection over which a request, containing a History-Info header, is being forwarded, then either of the following two options MUST be implemented:

- o The History-Info header MUST be removed prior to forwarding the request, or
- o The request MUST be redirected, including the History-Info header in the response, to allow the UAC to securely issue the request, including the History-Info header.

4.5 Example Applications using History-Info

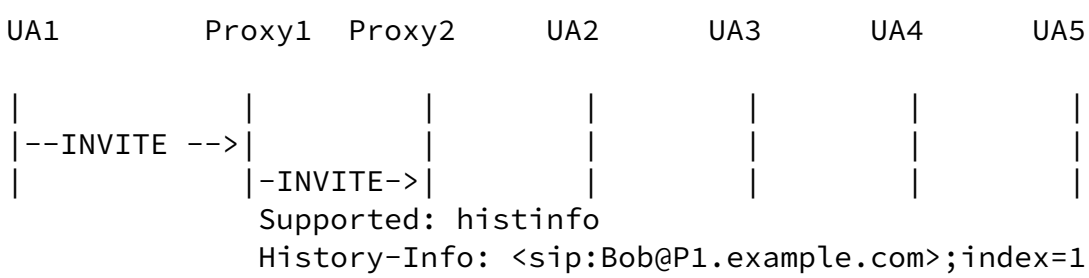
This scenario highlights an example where the History-Info in the response is primarily of use in not retrying routes that have already been tried by another proxy. Note, that this is just an example and that there may be valid reasons why a Proxy would want to retry the routes and thus, this would likely be a local proxy or even user specific policy.

UA 1 sends a call to "Bob" to proxy 1. Proxy 1 forwards the request to Proxy 2. Proxy 2 sends the requests in parallel and tries several places (UA2, UA3 and UA4) before sending a response to Proxy 1 that all the places are busy. Proxy 1, without the History-Info, would try several some of the same places (e.g. UA3) based upon registered contacts for "Bob", before completing at UA5. However, with the History-Info, Proxy 1 determines that UA3 has already received the invite, thus the INVITE goes directly to UA5.

Section 4.5.1 provides this same scenario using one of the privacy mechanisms, with Proxy2 adding the Privacy header indicating that the History-Info header is not to be propagated outside P2's domain. This scenario highlights the potential functionality lost with the use of "history" privacy in the Privacy header for the entire request and the need for careful consideration on the use of privacy for History-Info.

Section 4.5.2 also provides the same scenario using one of the privacy mechanisms, however, due to local policy at Proxy2, only one of the Request-URIs (UA4) in the History-Info contains a priv-value of "history", thus allowing some optimized functionality in the routing of the request, but still maintaining privacy for specific URIs.

Additional detailed scenarios are available in the appendix.



```
                              <sip:Bob@P2.example.com>; index=1.1
  |             |         |         |         |         |         |
  |             |         |-INVITE>|         |         |         |
                History-Info: <sip:Bob@P1.example.com>;index=1,
                              <sip:Bob@P2.example.com>;index=1.1,
                              <sip:User2@UA2.example.com>;index=1.1.1
  |             |         |         |         |         |         |
  |             |         |-----INVITE ---->|         |         |
                 History-Info:<sip:Bob@P1.example.com>;index=1,
                              <sip:Bob@P2.example.com>; index=1.1,
                              <sip:User3@UA3.example.com>;index=1.1.2
  |             |         |         |         |         |         |
  |             |         |-------INVITE------------>|         |
                 History-Info:<sip:Bob@P1.example.com>;index=1,
                              <sip:Bob@P2.example.com>;index=1.1,
                              <sip:User4@UA4.example.com>;index=1.1.3

  /* All Responses from the INVITEs indicate non-success/non-
  availability*/
  |             |         |         |         |         |         |
  |             |<-480 ---|         |         |         |         |
               History-Info: <sip:Bob@P1.example.com>;index=1,
                  <sip:Bob@P2.example.com>; index=1.1,
                  <sip:User2@UA2.example.com?Reason=SIP;\
```



```
                   cause=408;text="RequestTimeout">;index=1.1.1,
                  <sip:User3@UA3.example.com?Reason=SIP; \
                   cause=487;text="Request Terminated">; index=1.1.2,
                  <sip:User4@UA4.example.com?Reason=SIP;\
                   cause=603;text="Decline">; index=1.1.3
  |             |         |         |         |         |         |
 /* Upon receipt of the response, P1 determines another route for the
  INVITE, but finds that it matches a route already attempted
 (e.g. UA3, thus the INVITE is only forwarded to UA5, where
  the session is successfully established  */
  |             |         |         |         |         |         |
  |             |---------------INVITE ---------------------->|
               History-Info: <sip:Bob@P1.example.com>;index=1,
                  <sip:Bob@P2.example.com>; index=1.1,
                  <sip:User2@UA2.example.com?Reason=SIP;cause=408;\
                   text="RequestTimeout">;index=1.1.1,
                  <sip:User3@UA3.example.com?Reason=SIP;cause=487;\
                   text="Request Terminated">; index=1.1.2,
```

```
                 <sip:User4@UA4.example.com?Reason=SIP;cause=603;\
                  text="Decline">; index=1.1.3
                 <sip:User5@UA5.example.com>;index=1.2
|            |         |        |        |        |
|            |<-----200 OK-----------------------------|
|<--200 OK---|         |        |        |        |
|            |         |        |        |        |
|--ACK ------------------------------------------------>|
```

4.5.1 Example with Privacy header for entire request at Proxy2

```
UA1        Proxy1  Proxy2     UA2      UA3      UA4      UA5

|            |         |        |        |        |        |
|--INVITE -->|         |        |        |        |        |
|            |-INVITE->|        |        |        |        |
             Supported: histinfo
             History-Info: <sip:Bob@P1.example.com>;index=1,
                           <sip:Bob@P2.example.com>;index=1.1
|            |         |        |        |        |        |
|            |         |-INVITE>|        |        |        |
             Privacy: history
             History-Info:<sip:Bob@P1.example.com>;index=1,
                          <sip:Bob@P2.example.com>;index=1.1,
                          <sip:User2@UA2.example.com>;index=1.1.1
|            |         |        |        |        |        |
|            |         |-----INVITE ---->|        |        |
              Privacy: history
              History-Info:<sip:Bob@P1.example.com>;index=1,
                           <sip:Bob@P2.example.com>; index=1.1,
```



```
                           <sip:User3@UA3.example.com>;index=1.1.2
|            |         |        |        |        |
|            |         |-------INVITE------------>|        |
              Privacy: history
              History-Info:<sip:Bob@P1.example.com>;index=1,
                           <sip:Bob@P2.example.com>;index=1.1,
                           <sip:User4@UA4.example.com>;index=1.1.3

/* All Responses from the INVITEs indicate non-success/non-
availability and only the initial, received History-Info entries
are NOT returned to P1 due to the Privacy header value.*/
```

```
|            |         |        |        |        |        |
|            |<-480 ---|        |        |        |        |
            History-Info: <sip:Bob@P1.example.com>;index=1,
               <sip:Bob@P2.example.com>; index=1.1
|            |         |        |        |        |        |
/* Upon receipt of the response, P1 determines another route for the
INVITE, including UA3 which was attempted by P2, but due to
Privacy P1 is not aware of this, so UA3 is re-attempted prior to
forwarding the INVITE to UA5, where the session is successfully
established  */
|            |         |        |        |        |        |
|            |--------------INVITE ----->|        |        |
              History-Info: <sip:Bob@P1.example.com>;index=1,
                            <sip:Bob@P2.example.com>; index=1.1,
                            <sip:User3@UA3.example.com>; index=1.2
|            |         |        |        |        |        |
|            |<-- 486 -------------------|        |        |
              History-Info: <sip:Bob@P1.example.com>;index=1,
                            <sip:Bob@P2.example.com>; index=1.1,
                            <sip:User3@UA3.example.com>; index=1.2
|            |         |        |        |        |        |
|            |-----------------INVITE ---------------------->|
            History-Info: <sip:Bob@P1.example.com>;index=1,
               <sip:Bob@P2.example.com>; index=1.1,
               <sip:User3@UA3.example.com?Reason=SIP;cause=486;\
                text="Busy Here">;index=1.2,
               <sip:User5@UA5.example.com>;index=1.3
|            |         |        |        |        |        |
|            |<-----200 OK--------------------------------|
|<--200 OK---|         |        |        |        |        |
|            |         |        |        |        |        |
|--ACK ------------------------------------------------------>|
```

4.5.2 Example with Privacy header for specific URI (UA4) at Proxy2

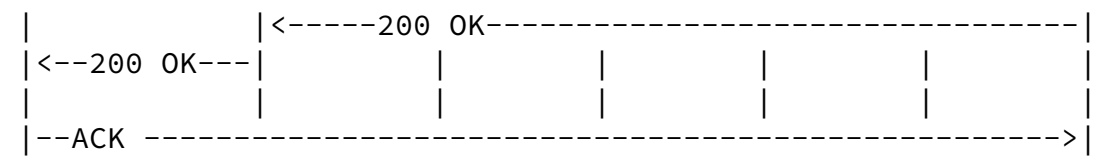
```
UA1        Proxy1  Proxy2     UA2      UA3      UA4      UA5
```



```
|            |         |        |        |        |        |
|--INVITE -->|         |        |        |        |        |
|            |-INVITE->|        |        |        |        |
              Supported: histinfo
```

```
                History-Info: <sip:Bob@P1.example.com>;index=1,
                              <sip:Bob@P2.example.com>; index=1.1
 |            |         |        |        |        |        |
 |            |         |-INVITE>|        |        |        |
                History-Info:<sip:Bob@P1.example.com>;index=1,
                             <sip:Bob@P2.example.com>;index=1.1,
                             <sip:User2@UA2.example.com>;index=1.1.1
 |            |         |        |        |        |        |
 |            |         |-----INVITE ---->|        |        |
                 History-Info:<sip:Bob@P1.example.com>;index=1,
                              <sip:Bob@P2.example.com>;index=1.1,
                              <sip:User3@UA3.example.com>;index=1.1.2
 |            |         |        |        |        |        |
 |            |         |-------INVITE------------>|        |
                 History-Info: <sip:Bob@P1.example.com>;index=1,
                               <sip:Bob@P2.example.com>;index=1.1,
                               <sip:User4@UA4.example.com?\
                                Privacy=history>; index=1.1.3

 /* All Responses from the INVITEs indicate non-success/non-
 availability.  The History-Info associated with UA4 is not returned
 in the response due to the privacy header associated with that URI */
 |            |         |        |        |        |        |
 |            |<-480 ---|        |        |        |        |
              History-Info: <sip:Bob@P1.example.com>;index=1,
                 <sip:Bob@P2.example.com>; index=1.1,
                 <sip:User2@UA2.example.com?Reason=SIP;\
                  cause=408;text="RequestTimeout">;index=1.1.1,
                 <sip:User3@UA3.example.com?Reason=SIP; \
                  cause=487;text="Request Terminated">; index=1.1.2,
 |            |         |        |        |        |        |
/* Upon receipt of the response, P1 determines another route for the
 INVITE, but finds that it matches a route already attempted
(e.g. UA3), thus the INVITE is only forwarded to UA5, where
 the session is successfully established  */
 |            |         |        |        |        |        |
 |            |-----------------INVITE ---------------------->|
              History-Info: <sip:Bob@P1.example.com>;index=1,
                 <sip:Bob@P2.example.com>; index=1.1,
                 <sip:User2@UA2.example.com?Reason=SIP;cause=408;\
                  text="RequestTimeout">;index=1.1.1,
                 <sip:User3@UA3.example.com?Reason=SIP;cause=487;\
                  text="Request Terminated">; index=1.1.2,
                 <sip:User5@UA5.example.com>;index=1.2
 |            |         |        |        |        |        |
```



5. Application Considerations

As seen by the example scenarios in the appendix, History-Info provides a very flexible building block that can be used by intermediaries and UAs for a variety of services. As such, any services making use of History-Info must be designed with the following considerations:

1) History-Info is optional, thus a service MUST define default behavior for requests and responses not containing History-Info headers.
2) History-Info may be impacted by privacy considerations. Applications requiring History-Info need to be aware that if Header, Session or History level privacy is requested by a UA (or imposed by an intermediary) that History-Info may not be available in a request or response. This would be addressed by an application in the same manner as the previous consideration by ensuring there is reasonable default behavior should the information not be available.
3) History-Info may be impacted by local policy. Each application making use of the History-Info header SHOULD address the impacts of the local policies on the specific application (e.g. what specification of local policy is optimally required for a specific application and any potential limitations imposed by local policy decisions). Note, that this is related to the optionality and privacy considerations identified in 1 and 2 above, but goes beyond that. For example, due to the optionality and privacy considerations, an entity may receive only partial History-Info entries; will this suffice? Note, that this would be a limitation for debugging purposes, but might be perfectly satisfactory for some models whereby only the information from a specific intermediary is required.
4) The security associated with the History-Info header requires the use of TLS. In the case of TLS not being available for a connection over which a request is being forwarded, the History-Info header may be removed from a request. The impact of lack of having the information depends upon the nature of the specific application (e.g. is the information something that appears on a display or is it processed by automata which could have negative impacts on the subsequent processing of a request?). It is suggested that the impact of an intermediary not supporting the security recommendations should be evaluated by the application

to ensure that the impacts have been sufficiently addressed by the application.

6. Security Considerations

The threat model and related security and privacy requirements for the History-Info header are described in section 2.1 and 2.2 of this document. Sections 3.2, 3.3 and 4.4 provide normative recommendations related to security and privacy fulfilling these requirements. The use of TLS is mandated between the entities (i.e. UAC to Proxy, Proxy to Proxy, and Proxy to UAS) which use the History-Info header. The appropriate handling of a request in the case that TLS is not available for a specific connection is described in section 5.

With TLS, History-Info headers are no less, nor no more, secure than other SIP headers, which generally have even more impact on the subsequent processing of SIP sessions than the History-Info header.

7. IANA Considerations

(Note to RFC Editor: Please fill in all occurrences of XXXX in this section with the RFC number of this specification).

7.1 Registration of new SIP History-Info header

This document defines a new SIP header field name: History-Info and a new option tag: histinfo.

The following changes should be made to http:///www.iana.org/assignments/sip-parameters

The following row should be added to the header field section:

Header Name	Compact Form	Reference
History-Info	none	[RFCXXXX]

The following should be added to the Options Tags section:

Name	Description	Reference

histinfo	When used with the Supported header, [RFCXXXX] this option tag indicates support for the History Information to be captured for requests and returned in subsequent responses. This tag is not used in a Proxy-Require or Require header field since support of History-Info is optional.

7.2 Registration of "history" for SIP Privacy header

This document defines a new priv-value for the SIP Privacy header: history

The following changes should be made to http://www.iana.org/assignments/sip-priv-values

The following should be added to the registration for the SIP Privacy header:

Name	Description	Registrant	Reference
history	Privacy requested for History-Info header(s)	Mary Barnes mary.barnes@nortelnetworks.com	[RFCXXXX]

Normative References

[RFC3261] J. Rosenberg et al, "SIP: Session initiation protocol," RFC 3261, June, 2002.

[RFC3326] H. Schulzrinne, D. Oran, G. Camarillo, "The Reason Header Field for the Session Initiation Protocol", RFC 3326, December, 2002.

[RFC3323] J. Peterson, "A Privacy Mechanism for the Session Initiation Protocol (SIP)", RFC 3323, November, 2002.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", RFC 2119, March 1997.

[RFC2234] Crocker, D. and P. Overell, "Augmented BNF for Syntax Specifications: ABNF", RFC 2234, November 1997.

[RFC2246] Dierks, T. and C. Allen, "The TLS Protocol Version 1.0", RFC 2246, January 1999.

Informational References

[SIPSVCEX] A. Johnson, "SIP Service Examples", draft-ietf-sipping-service-examples-07.txt, July, 2004.

[RFC3665] A. Johnson et al, "SIP Basic Call Flow Examples", RFC 3665, BCP 75, December, 2003.

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Contributors' Addresses

Cullen, Mark and Jon contributed to the development of the initial requirements.

Cullen and Mark provided substantial input in the form of email discussion in the development of the initial version of the individual solution document.

Cullen Jennings
Cisco Systems
170 West Tasman Dr

MS: SJC-21/3

Tel: +1 408 527 9132
Email: fluffy@cisco.com

Jon Peterson
NeuStar, Inc.
1800 Sutter Street, Suite 570
Concord, CA 94520
USA

Phone: +1 925-363-8720
EMail: Jon.Peterson@NeuStar.biz

Mark Watson
Nortel Networks (UK)
Maidenhead Office Park (Bray House)
Westacott Way
Maidenhead,
Berkshire
England

Tel: +44 (0)1628-434456

Email: mwatson@nortelnetworks.com

Author's Address

Mary Barnes
Nortel Networks
2380 Performance Drive
Richardson, TX USA

Phone: 1-972-684-5432
Email: mary.barnes@nortelnetworks.com

Appendix. Example Scenarios

The scenarios in Appendix A-D provide sample use cases for the History-Info header for informational purposes only. They are not intended to be normative and the formatting is for visual purposes,

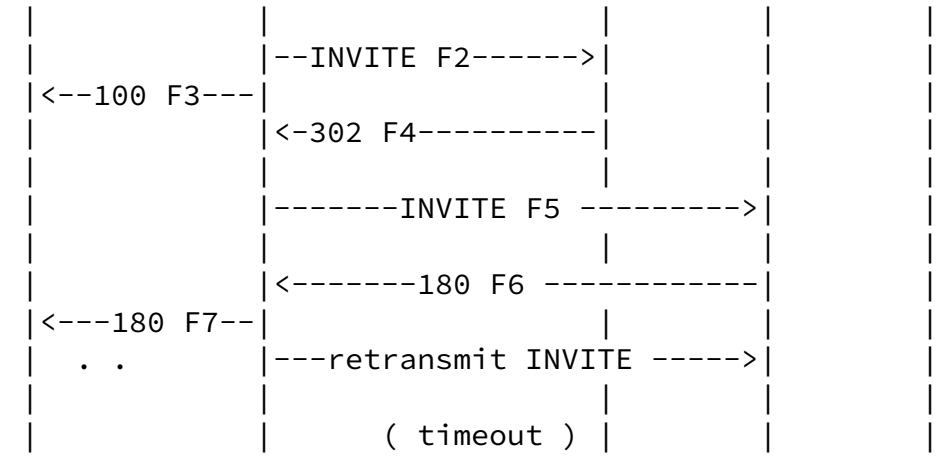
thus the headers in the URI are not shown properly formatted for escaping. Refer to section 4.2 examples with the proper formatting.

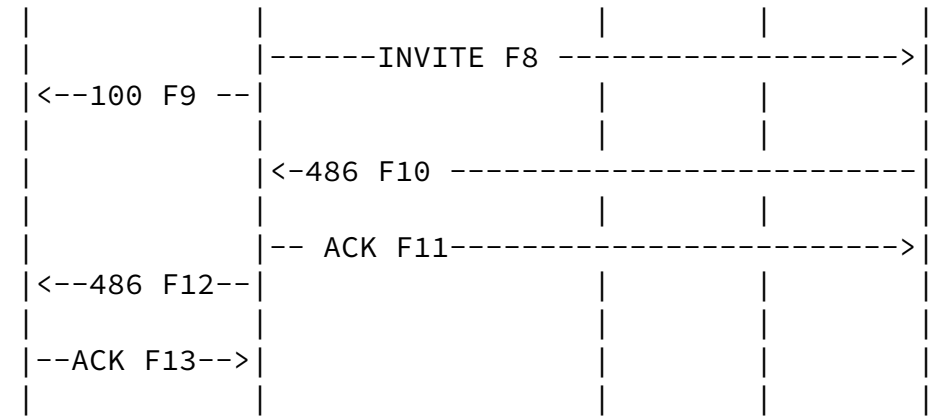
Appendix A. Sequentially forking (History-Info in Response)

This scenario highlights an example where the History-Info in the response is useful to an application or user that originated the request.

"Alice" at UA 1sends a call to "Bob" via proxy 1. Proxy 1 sequentially tries several places (UA2, UA3 and UA4) unsuccessfully before sending a response to "Alice".

This scenario is provided to show that by providing the History-Info to UA1, the end user or an application at UA1 could make a decision on how best to attempt finding "Bob". Without this mechanism UA1 might well attempt UA3 (and thus UA4) and then re-attempt UA4 on a third manual attempt at reaching "Bob". With this mechanism, either the end user or application could know that "Bob" is busy on his home phone and is physically not in the office. If there were an alternative address for "Bob" known to this end user or application, that hasn't been attempted, then either the application or the end user could attempt that. The intent here is to highlight an example of the flexibility of this mechanism that enables applications well beyond SIP as it is certainly well beyond the scope of this document to prescribe detailed applications.





Message Details

F1 INVITE UA1 ->Proxy1

```
INVITE sip:UserA@example.com SIP/2.0
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Contact: Alice <sip:User1@example.net>
Content-Type: application/sdp
Content-Length: <appropriate value>

v=0
o=UserA 2890844526 2890844526 IN IP4 client.example.net
s=Session SDP
c=IN IP4 192.0.2.3
t=0 0
m=audio 49170 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/*Client for UA1 prepares to receive data on port 49170
from the network. */
```


F2 INVITE Proxy1 ->UA2

```
INVITE sip:UserA@ims.example.com SIP/2.0
Via: SIP/2.0/UDP ims.example.com:5060;branch=1
```

```
  Via: SIP/2.0/UDP example.net:5060
Record-Route: <sip:UserA@example.com>
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 INVITE
History-Info: <sip:UserA@ims.example.com>; index=1
Contact: Alice <sip:User1@example.net>
Content-Type: application/sdp
Content-Length: <appropriate value>

v=0
o=UserA 2890844526 2890844526 IN IP4 client.example.net
s=Session SDP
c=IN IP4 192.0.2.3
t=0 0
m=audio 49170 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F3 100 Trying Proxy1 ->UA1

SIP/2.0 100 Trying
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Content-Length: 0


F4 302 Moved Temporarily UA2 ->Proxy1

SIP/2.0 302 Moved Temporarily
Via: SIP/2.0/UDP ims.example.com:5060;branch=1
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>;tag=3
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Contact: <sip:UserB@example.com>
Content-Length: 0


F5 INVITE Proxy1 -> UA3
```

```
INVITE sip:UserB@example.com SIP/2.0
Via: SIP/2.0/UDP ims.example.com:5060;branch=2
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
History-Info: <sip:UserA@ims.example.com?Reason=SIP;\
cause=302; text="Moved Temporarily">; index=1,
<sip:UserB@example.com>;index=2
CSeq: 1 INVITE
Contact: Alice <sip:User1@example.net>
Content-Type: application/sdp
Content-Length: <appropriate value>

v=0
o=User1 2890844526 2890844526 IN IP4 client.example.net
s=Session SDP
c=IN IP4 192.0.2.3
t=0 0
m=audio 49170 RTP/AVP 0
a=rtpmap:0 PCMU/8000

F6 180 Ringing UA3 ->Proxy1

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>;tag=5
Call-ID: 12345600@example.net
CSeq: 1 INVITE
Content-Length: 0

F7 180 Ringing Proxy1 -> UA1

SIP/2.0 180 Ringing
SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Content-Length: 0

/* User B is not available. INVITE is sent multiple
times until it times out. */

  /* The proxy forwards the INVITE to UA4 after adding the
additional History Information entry. */
```

F8 INVITE Proxy1 -> UA4

```
INVITE sip:UserC@example.com SIP/2.0
Via: SIP/2.0/UDP ims.example.com:5060;branch=3
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
History-Info:<sip:UserA@ims.example.com?Reason=SIP;\
cause=302; text="Moved Temporarily">;index=1,
<sip:UserB@example.com?Reason=SIP;cause=480;\
text="Temporarily Unavailable" >;index=2,
<sip:UserC@example.com>;index=3
CSeq: 1 INVITE
Contact: Alice <sip:User1@example.net>
Content-Type: application/sdp
Content-Length: <appropriate value>

v=0
o=User1 2890844526 2890844526 IN IP4 client.example.net
s=Session SDP
c=IN IP4 192.0.2.3
t=0 0
m=audio 49170 RTP/AVP 0
a=rtpmap:0 PCMU/8000
```

F9 100 Trying Proxy1 ->UA1

```
SIP/2.0 100 Trying
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Content-Length: 0
```

F10 486 Busy Here UA4 -> Proxy1

```
SIP/2.0  486 Busy Here
```

```
Via: SIP/2.0/UDP ims.example.com:5060;branch=3
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Content-Length: 0
```



```
F11 ACK Proxy1 -> UA4

ACK sip:UserC@example.com SIP/2.0
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 ACK
Content-Length: 0


 /* The proxy forwards the 486 to Alice after adding the
    associated History Information entries from the series of
    INVITES */

F12 486 Busy Here Proxy1 -> UA1

SIP/2.0  486 Busy Here
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
History-Info:<sip:UserA@ims.example.com?Reason=SIP;\
cause=302; text="Moved Temporarily">;index=1,
<sip:UserB@example.com?Reason=SIP;cause=480;\
text="Temporarily Unavailable" >;index=2,
<sip:UserC@example.com>;index=3
CSeq: 1 INVITE
Content-Length: 0

F13 ACK Alice -> Proxy 1

ACK sip:UserA@example.com SIP/2.0
```

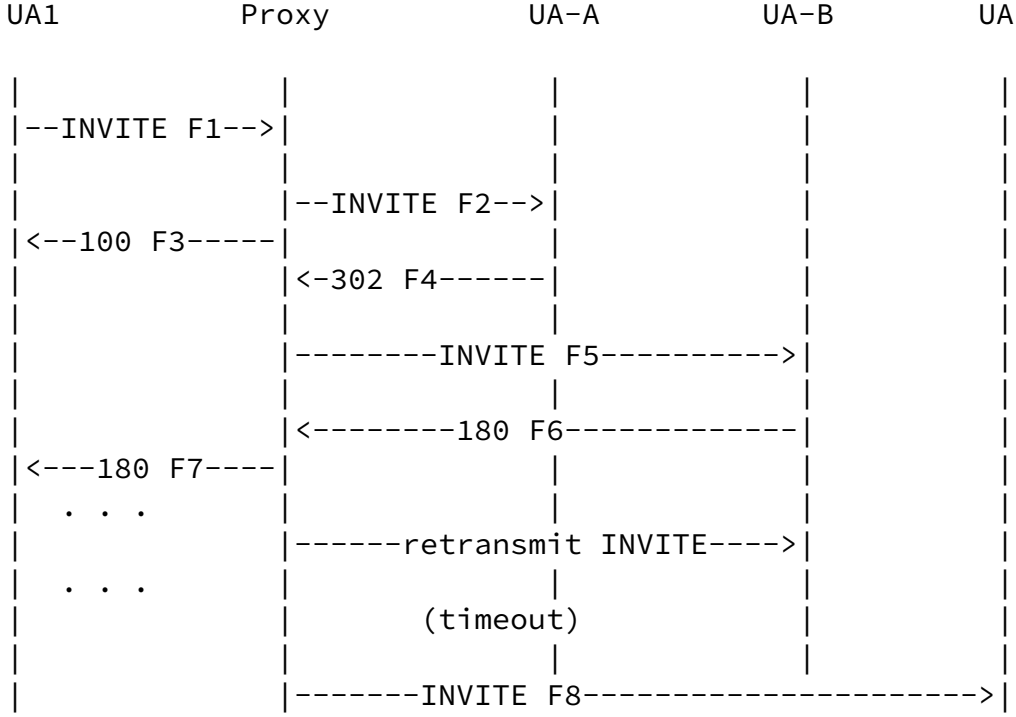
```
Via: SIP/2.0/UDP example.net:5060
From: Alice <sip:User1@example.net>
To: Bob <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 ACK
Content-Length: 0
```

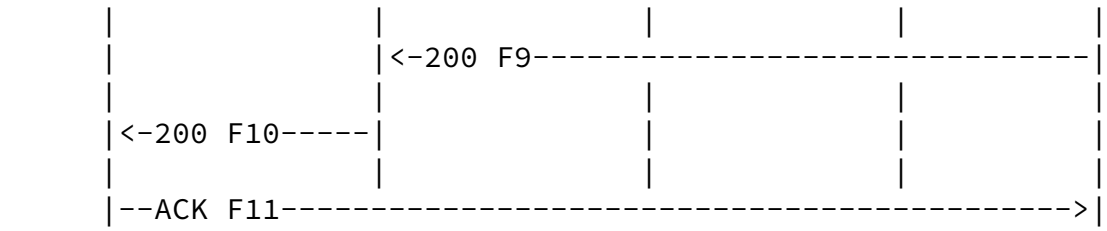
Appendix B. Voicemail

This scenario highlights an example where the History-Info in the request is primarily of use by an edge service (e.g. Voicemail Server). It should be noted that this isn't intended to be a complete specification for this specific edge service as it is quite likely

that additional information is needed by the edge service. History-Info is just one building block that this service makes use of.

UA 1 called UA A which had been forwarded to UA B which forwarded to a UA VM (voicemail server). Based upon the retargeted URIs and Reasons (and other information) in the INVITE, the VM server makes a policy decision about what mailbox to use, which greeting to play etc.





Message Details

INVITE F1 UA1->Proxy

```
INVITE sip:UserA@example.com SIP/2.0
Via: SIP/2.0/UDP example.net:5060
From: BigGuy <sip:User1@example.net>
To: LittleGuy <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Contact: BigGuy <sip:User1@example.net>
Content-Type: application/sdp
Content-Length: <appropriate value>
```



```
v=0
o=UserA 2890844526 2890844526 IN IP4 client.example.net
s=Session SDP
c=IN IP4 192.0.2.3
t=0 0
m=audio 49170 RTP/AVP 0
a=rtpmap:0 PCMU/8000

/*Client for UA1 prepares to receive data on port 49170
from the network. */

INVITE F2 Proxy->UA-A

INVITE sip:UserA@ims.example.com SIP/2.0
Via: SIP/2.0/UDPims.example.com:5060;branch=1
  Via: SIP/2.0/UDP example.net:5060
Record-Route: <sip:UserA@example.com>
From: BigGuy <sip:User1@example.net>
To: LittleGuy <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 INVITE
```

```
History-Info: <sip:UserA@ims.example.com>; index=1
Contact: BigGuy <sip:User1@example.net>
Content-Type: application/sdp
Content-Length: <appropriate value>

v=0
o=UserA 2890844526 2890844526 IN IP4 client.example.net
s=Session SDP
c=IN IP4 192.0.2.3
t=0 0
m=audio 49170 RTP/AVP 0
a=rtpmap:0 PCMU/8000

100 Trying F3 Proxy->UA1

SIP/2.0 100 Trying
Via: SIP/2.0/UDP example.net:5060
From: BigGuy <sip:User1@example.net>
To: LittleGuy <sip:UserA@example.com>
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Content-Length: 0


302 Moved Temporarily F4  UserA->Proxy
SIP/2.0 302 Moved Temporarily
Via: SIP/2.0/UDP ims.example.com:5060;branch=1
Via: SIP/2.0/UDP example.net:5060
```



```
From: BigGuy <sip:User1@example.net>
To: LittleGuy<sip:UserA@example.com>;tag=3
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Contact: <sip:UserB@example.com>
Content-Length: 0


INVITE F5 Proxy-> UA-B

INVITE sip:UserB@example.com SIP/2.0
Via: SIP/2.0/UDP ims.example.com:5060;branch=2
Via: SIP/2.0/UDP example.net:5060
From: BigGuy <sip:User1@example.net>
```

```
To: LittleGuy <sip:UserA@example.com>
Call-Id: 12345600@example.net
History-Info: <sip:UserA@ims.example.com?Reason=SIP;\
cause=302; text="Moved Temporarily">; index=1,
<sip:UserB@example.com>;index=2
CSeq: 1 INVITE
Contact: BigGuy <sip:User1@example.net>
Content-Type: application/sdp
Content-Length: <appropriate value>

v=0
o=User1 2890844526 2890844526 IN IP4 client.example.net
s=Session SDP
c=IN IP4 192.0.2.3
t=0 0
m=audio 49170 RTP/AVP 0
a=rtpmap:0 PCMU/8000

180 Ringing F6  UA-B ->Proxy

SIP/2.0 180 Ringing
Via: SIP/2.0/UDP example.net:5060
From: BigGuy <sip:User1@example.net>
To: LittleGuy <sip:UserA@example.com>;tag=5
Call-ID: 12345600@example.net
CSeq: 1 INVITE
Content-Length: 0

180 Ringing F7  Proxy-> UA1

SIP/2.0 180 Ringing
SIP/2.0/UDP example.net:5060
From: BigGuy <sip:User1@example.net>
To: LittleGuy <sip:UserA@example.com>
Call-Id: 12345600@example.net
```



```
CSeq: 1 INVITE
Content-Length: 0

/* User B is not available. INVITE is sent multiple
times until it times out. */

  /* The proxy forwards the INVITE to UA-VM after adding the
```

```
additional History Information entry. */


INVITE F8  Proxy-> UA-VM

INVITE sip:VM@example.com SIP/2.0
Via: SIP/2.0/UDP ims.example.com:5060;branch=3
Via: SIP/2.0/UDP example.net:5060
From: BigGuy <sip:User1@example.net>
   To: LittleGuy <sip:UserA@example.com>
Call-Id: 12345600@example.net
History-Info:<sip:UserA@ims.example.com?Reason=SIP;\
cause=302; text="Moved Temporarily">;index=1,
<sip:UserB@example.com?Reason=SIP;cause=480;\
text="Temporarily Unavailable" >;index=2,
<sip:VM@example.com>;index=3
CSeq: 1 INVITE
Contact: BigGuy <sip:User1@example.net>
Content-Type: application/sdp
Content-Length: <appropriate value>

v=0
o=User1 2890844526 2890844526 IN IP4 client.example.net
s=Session SDP
c=IN IP4 192.0.2.3
t=0 0
m=audio 49170 RTP/AVP 0
a=rtpmap:0 PCMU/8000


200 OK F9

SIP/2.0 200 OK UA-VM->Proxy

Via: SIP/2.0/UDP ims.example.com:5060;branch=3
Via: SIP/2.0/UDP example.net:5060
From: BigGuy <sip:User1@example.net>
To: LittleGuy <sip:UserA@example.com>;tag=3
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Contact: TheVoiceMail <sip:VM@example.com>
Content-Type: application/sdp
```

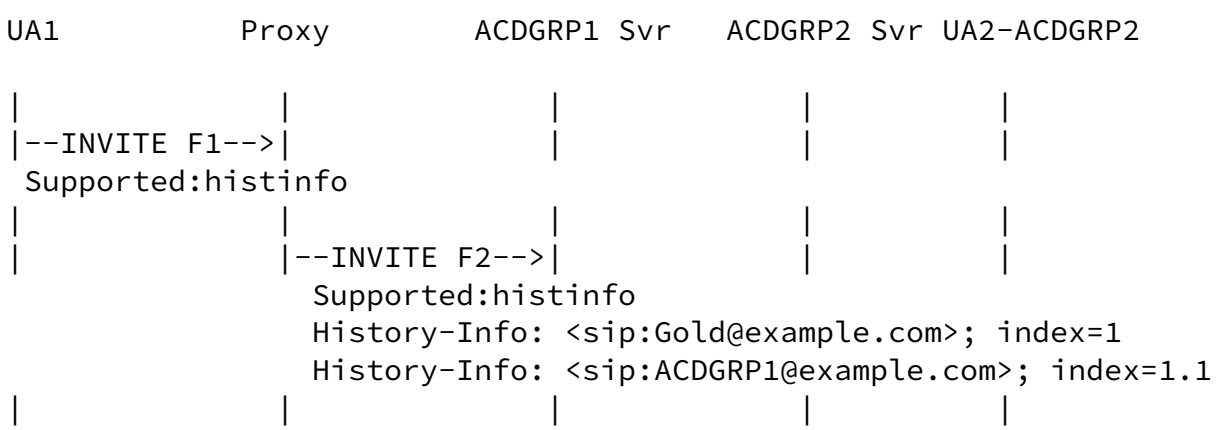
```
Content-Length: <appropriate value>

v=0
o=UserA 2890844527 2890844527 IN IP4 vm.example.com
s=Session SDP
c=IN IP4 192.0.2.4
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000


200 OK F10  Proxy->UA1

SIP/2.0 200 OK
Via: SIP/2.0/UDP ims.example.com:5060;branch=3
Via: SIP/2.0/UDP example.net:5060
From: BigGuy <sip:User1@example.net>
To: LittleGuy <sip:UserA@example.com>;tag=3
Call-Id: 12345600@example.net
CSeq: 1 INVITE
Contact: TheVoiceMail <sip:VM@example.com>
Content-Type: application/sdp
Content-Length: <appropriate value>

v=0
o=UserA 2890844527 2890844527 IN IP4 vm.example.com
s=Session SDP
c=IN IP4 192.0.2.4
t=0 0
m=audio 3456 RTP/AVP 0
a=rtpmap:0 PCMU/8000

ACK F11 UA1-> UA-VM

ACK sip:VM@example.com SIP/2.0
Via: SIP/2.0/UDP example.net:5060
From: BigGuy <sip:User1@example.net>
To: LittleGuy<sip:UserA@example.com>;tag=3
Call-Id: 12345600@example.net
CSeq: 1 ACK
Content-Length: 0

/* RTP streams are established between UA1 and
UA-VM. UA-VM starts announcement for UA1 */
```

Appendix C. Automatic Call Distribution Example

This scenario highlights an example of an Automatic Call Distribution service, where the agents are divided into groups based upon the type of customers they handle. In this example, the Gold customers are given higher priority than Silver customers, so a Gold call would get serviced even if all the agents servicing the Gold group (ACDGRP1) were busy, by retargeting the request to the Silver Group. Upon receipt of the call at the agent assigned to handle the incoming call, based upon the History-Info header in the message, the application at the agent can provide an indication that this is a Gold call, from how many groups it might have overflowed before reaching the agent, etc. and thus can be handled appropriately by the agent.

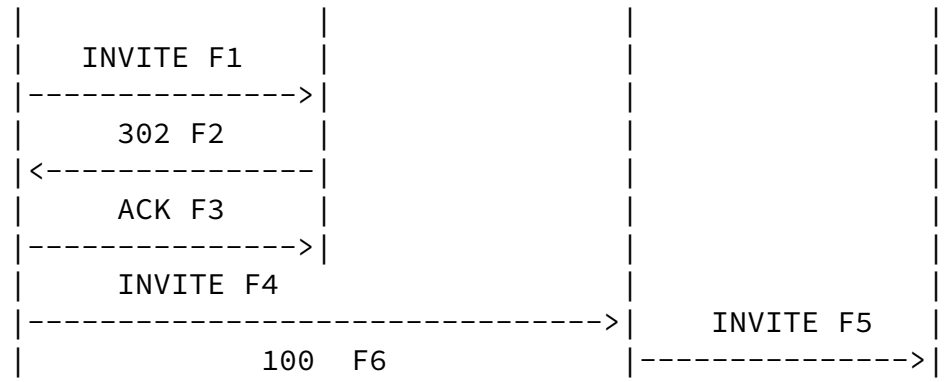
For scenarios whereby calls might overflow from the Silver to the Gold, clearly the alternate group identification, internal routing or actual agent that handles the call SHOULD not be sent to UA1, thus for this scenario, one would expect that the Proxy would not support the sending of the History-Info in the response, even if requested by the calling UA.

As with the other examples, this is not prescriptive of how one would do this type of service but an example of a subset of processing that might be associated with such a service. In addition, this example is not addressing any aspects of Agent availability, which might also be done via a SIP interface.



Appendix D. Session via Redirect and Proxy Servers

In this scenario, Alice places a call to Bob using first a Redirect server then a Proxy Server. The INVITE message is first sent to the Redirect Server. The Server returns a 302 Moved Temporarily response (F2) containing a Contact header with Bob's current SIP address. Alice then generates a new INVITE with Bob's current SIP address included in another History-Info entry. The INVITE is then sent to Bob via the Proxy Server, with Bob receiving the complete History information; the call then proceeds normally. The complete call flow for this scenario, without the use of History-Info is described in section 3.6 of the SIP Basic Call Flow Examples [RFC3665].



Message Details

F1 INVITE Alice -> Redirect Server

```
INVITE sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKbf9f44
Max-Forwards: 70
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
History-Info: <sip:bob@biloxi.example.com>; index=1
Contact: <sip:alice@client.atlanta.example.com>
Content-Length: 0
```

F2 302 Moved Temporarily Redirect Proxy -> Alice

```
SIP/2.0 302 Moved Temporarily
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKbf9f44
 ;received=192.0.2.1
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=53fHlqlQ2
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 INVITE
History-Info: <sip:bob@biloxi.example.com>; index=1
Contact: <sip:bob@chicago.example.com;transport=tcp>
Content-Length: 0
```

```
F3 ACK Alice -> Redirect Server

ACK sip:bob@biloxi.example.com SIP/2.0
Via: SIP/2.0/UDP client.atlanta.example.com:5060;branch=z9hG4bKbf9f44
Max-Forwards: 70
From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76sl
To: Bob <sip:bob@biloxi.example.com>;tag=53fHlqlQ2
Call-ID: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 1 ACK
Content-Length: 0


F4 INVITE Alice -> Proxy 3

INVITE sip:bob@chicago.example.com SIP/2.0
Via: SIP/2.0/TCP 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: 2xTb9vxSit55XU7p8@atlanta.example.com
CSeq: 2 INVITE
History-Info: <sip:bob@biloxi.example.com?Reason=SIP;cause=302>\
               text="Moved Temporarily">; index=1,
              <sip:bob@chicago.example.com>; index=2
Contact: <sip:alice@client.atlanta.example.com;transport=tcp>
Content-Length: 0


F5 INVITE Proxy 3 -> Bob

INVITE sip:bob@client.chicago.example.com SIP/2.0
Via: SIP/2.0/TCP ss3.chicago.example.com:5060;branch=z9hG4bK721e.1
Via: SIP/2.0/TCP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
 ;received=192.0.2.1
Max-Forwards: 69
Record-Route: <sip:ss3.chicago.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 INVITE
History-Info: <sip:bob@biloxi.example.com?Reason=SIP;cause=302>\
```

```
                 text="Moved Temporarily">; index=1,
                <sip:bob@chicago.example.com>; index=2,
                <sip:bob@client.chicago.example.com>; index=2.1
Contact: <sip:alice@client.atlanta.example.com;transport=tcp>
Content-Length: 0
```

Detailed Call Flow continues per section 6.3 in [RFC 3665].

Appendix E. Changelog

NOTE TO THE RFC-Editor: Please remove this section prior to publication as an RFC.

Changes from the 05 to 06 version:

- General changes to tidy document:
  - Change the term "this draft" to "this document".
  - Spell out first use of acronyms (ex: UA, UAC, UAS, URI, URL, TLS)
  - Change Histinfo to "histinfo"
- Abstract: delete last 2 sentences in Abstract
- Overview:
  - Insert paragraph break just before "This draft defined a new SIP header..."

  - 2nd to last paragraph of Overview, delete all but first sentence." (the other stuff on where examples would be further documented isn't really relevant to what this draft does and had been there for purposes of WG discussion during development of document).
- Background: Put "retarget" in single quotes when the term is introduced in the second sentence (consistent with reference in section 3.
- Section 3, 2nd para, add SUBSCRIBE and PUBLISH as appropriate methods (consistent with section 4.1)
- Section 3.2: Changed "RECOMMENDs the use of TLS" to "strongly RECOMMENDS the use of TLS".

- o Section 4.1, Privacy bullet item, clarified the first reference of "History-Info header" as "History-Info header field values".

- o Section 4.2:
  - oFor clarity in the examples, removed the text phrases escaped into the URI.
  - oChange capitalized "Cause" to LC "cause".

- o Section 6 (Security): deleted the last two paragraphs (on AIB, Body additions, Security of Inserted Info since those are not relevant to the security solution required for History-Info), and restated what security mechanisms are mandatory to implement, including references to the sections of the document dealing with those mechanisms.

- o References: Updated references: Added TLS and removed body-add, AIB, and sec-inserted.

Changes from the 04 to 05 version:

- o Section 3, 3rd paragraph: Clarified that the Proxy does not create the requests, but rather forwards. (SP - individual email Nov. 18)

- o Section 4.3.1:
  - 2nd paragraph: Added text for handling the reason, referring to section 4.3.3.1.2 for details(JRE-individual email Nov. 15)
  - last paragraph: Clarified that with the exception of 3xx responses, handling of responses is application specific.

- o Section 4.3.3.1.1, lst paragraph, last statment: changed "...the proxy MUST remove any hi-entry(s) prior to forwarding."

to:
"...the proxy SHOULD remove any hi-entry(s) prior to forwarding, depending upon local policy and whether the proxy might know apriori that it can rely on a downstream privacy service to apply the requested privacy." (WG mailing list - conclusion posted on Nov. 17)

- o Section 4.3.3.1.2, last paragraph : a "is" has been added

between "it" and "associated" in the phrase "as it associated with the hi-targeted-to-uri ..." (SP - individual email Nov. 18)

- Section 4.5 examples:
  - Fixed indexing (2 should have been 1.1, which affects the whole series). (WG mailing list response to TS posted on Nov. 3rd)
  - Fixed the 480 "timeouts" which should be 408s (note this error was introduced with changes made in this section in the 03 version. (NC-individual email Oct 31)
  - Fixed missing " on the "Busy Here" on the INVITE to UA5 in 4.5.1. (NC-individual email Oct 31)

Changes from the 03 to the 04 version:

- Editorial nits:
  - Removed second reference to "call center" in Overview section. (EB)
  - Changed square brackets on references to requirements to parenthesis so they wouldn't appear to be external references. (EB)
  - Moved the updates to table 2 in section 4.1, so that it appears right after the paragraph discussing in which messages the header can appear. (RM)
- Section 3.2:
  - Moved discussion of new security solution proposals per updated identity draft and rohan's body addition to section 6 as they're not relevant to the solution in this document (per (JRE-1)).
  - Per IETF-60 discussion and Rohan's input, added a statement that if TLS isn't available on the connection over which the History-info is being forwarded, either a redirection (per identity document) is required or the History-info is not forwarded.
- Section 3.3:
  - 2nd paragraph: adding clarification text "In the latter case,.." to the last sentence. (JRE-2)
  - Last paragraph: Clarified in the last sentence that if there is no impact on the application due to privacy

considerations, why that is so MUST also be explained by

that application. (EB)

- Section 4.1:
  - Added SUBSCRIBE and PUBLISH to the list of messages in which History-Info header may appear. (JRE-3/10)
  - Changed the wording in the text descriptions of the fields to be non-normative (i.e. not caps for the reserved words in RFC 2119). (KD)
  - In the text description for the Index, clarified that the entries are added in a specific order, with the indexing to ensure the proper ordering. (JRE-4)
  - In the text descriptions for the Reason and Privacy parameters, changed the references of "Request URI" to "hi-targeted-to-uri" to explicitly refer to the field in the header entry. (JRE-5)
  - In the ABNF syntax, changed the "hist-info" field name to "hi-entry". This is then used throughout the remainder of the document to refer to a "History-Info header entry". (Note, this impacted the text primarily in section 4.3 - specifically)(JRE-8/9)
- Section 4.2: Added appropriate hex characters for the escaped headers in the example (e.g. for ", = and ;). (LIST 10/15)
- Section 4.3.1: changed "notified" to "aware" in terms of application interface to be less specific about interface to application (consistent with 4.3.2)
- Section 4.3.2: same change as in 4.3.1. Capitalized "should" in last sentence. (EB)
- Section 4.3.3: Clarified item 4 to be specific that the privacy header may be used when the request is being forwarded within the same domain (accomodating the scenario which allows information to only be forwarded within the domain in which it was retargeted). (JRE-11)
- Section 4.3.3.1: rewording to include explicit references to hi-entry [JRE-8/9] and changed the "header should be added following..." to "the hi-entry MUST be added following..." (JRE-4)
- Section 4.3.3.1.1: Reworded privacy section for clarity. Basically, need to tag each of the entires with "privacy=history" for retargeting within the domain and strip out the entries when leaving the domain IF the request has a privacy header of Session, Header or History or local policy requires. (JRE-13)
- Section 4.3.3.1.2: Added the use of a Reason header in a response, as the Reason field associated with a retargeted URI. (LIST-10/5)
- Section 4.3.3.1.3:
  - Clarified that the number of hops is reflected by the total number of dots (and not the value of the digits) (JRE-14.1)

- Deleted last sentence of 1st paragraph as that was a holdover from a previous version. (JRE-14.2)
- Item 5: clarified that the referenced scenario is forking and that the response consists of the aggregated (rather than the word "amalgamated") information. (JRE-15)

o Section 4.3.3.2:

- Clarified that response processing for History-Info follows the general processing described in section 16.7 of RFC3261. (related to JRE-15)
- More detail added on the processing of responses with Privacy header. (LIST-8/18)

o Section 4.4: Added text addressing the security when TLS is not available, per Rohan's comment above.

o Section 5:

- Changed the "should" to a "MUST" in the 1st application consideration in terms of the requirement to define default behavior should the information not be available, due to History-Info being an optional header. (EB)
- Updated the 5th consideration for security to reflect the lack of information due to potential TLS inavailability for a connection, thus the potential for no History-Info header (per Rohan's comment).

oSection 6:

- Updated security considerations per TLS issue (Rohan) and to reference the new security solution proposals.
- Added discussion of new security solution proposals per updated identity document and rohan's body addition.

oAppendix:

- Added overview clarifying that flows are informational and not normative.
- Changed domains to appropriate example.com and example.net ones.
- A.1 Added message details
- A.2 Removed as this is redundant since this example is what is now in section 4.2.

Changes from the 02 to the 03 version:

- Editorial changes: Updating to the new template to reflect new IPR guidelines, ensuring that the normative text is complete and accurate in section 4.1, removing "Editor's Notes", etc.
- Section 4.5: Fixed error in cause (408 -> 480).
- Examples: changed the domain to "example.com", IP addresses to the 192.0.2.0/24 range, changed occurrences of "Reason:" to "Reason=", added use of Privacy header to examples.
- Added text to reflect WG consensus on Issue-1: Privacy indication for History-Info entries. Proposed an extension to

the priv-values defined in RFC 3323 in abstract and section 3.3, impacting the protocol structure in section 4.1 and processing in 4.3.3 (and 4.3.3.1 and 4.3.3.2). In addition,

the new priv-value needs to be registered with IANA, per section 7.

- Removed Open Issues section. For Issue-2, there was not WG consensus to define an algorithm for bounding the number of History-Info entries, but rather that is left as an implementation decision.
- Updated Security discussions to reflect WG consensus that TLS is mandatory and sufficient for general History-Info implementation. The e2m and m2m security solutions can be applied to History-Info when they become available to provide a more robust SIP solution.
- Section 4.1: Added additional text to ensure that all the information in the History-Info header is appropriately and normatively described (in text).
- Added text in section 4.3.1 and an example to the appendices to address the UAC having added multiple History-Info headers for the case where the 3xx response goes back to the UAC and it's the UAC that retargets the INVITE request.
- Clarified the addition of the Reason header in section 4.3.3.1.2.
- Further delineated the basic rules in section 4.3.3.1.3 for calculating the index for various scenarios, as this was still causing some confusion.

Changes from the 01 to the 02 version:

- Merged the SIPPING WG requirements draft into this document. Note that this increments the section references in the remainder of the document by 2 (and by 3 for Security and IANA considerations due to new section added). Also, removed redirect server from ISSUER-req since the solution identified this as not being required (or desirable).
- Added an explicit privacy requirement (PRIV-req-3) for the proxy's role in recognizing and maintaining privacy associated with a Request-URI being captured in History-Info due to local policy. (Note, that the text was already there, it just wasn't highlighted as an explicit requirement).
- Clarified the use of CRLF and spacing in the example headers in section 4.2.

- o Removed the compact form for the header since unknown headers with multiple entries would not be recognized (i.e. this may cause parsing problems).
- o Added a summary of Application Considerations to address concerns about the optional usage of History-Info.
- o Converted the references from numbers to labels to avoid the continual problem of renumbering.
- o Minor editorial changes (per NITS highlighted by Rohan and Eric and some minor rewording for clarity).

Changes from the 00 to the 01 version:

- o Attempted to be more explicit about the fundamental processing associated with the header. Removed definitions of new terms, only referencing the terms from the requirements in the context of the fundamental SIP processing implied by the terms.
- o Attempted to clarify the Index and the related processing.
- o Added more detail addressing the privacy requirements.
- o Added a bit more detail on security. The security solution remains in a separate document and this document will need updating once that is completed.
- o Updated the examples (in section 2.5 and appendix) and clarified the definition and the maintenance of the Index in sections 2.1 and 2.3.3.1.
- o Clarified the Reason description in section 2.1. There had been an error in the description of the processing that was a remnant of the change to include only a single URI for each History-Info header.
- o Miscellaneous editorial changes (i.e. HistInfo -> Histinfo, etc.)

Changes from individual draft-barnes-sipping-history-info-02 to the 00 WG version:

- o Updated references and added reference to Security solution draft.
- o Removed appendix D which included background on analysis of solution options.
- o Cleaned up the document format per rfc2223bis.
- o Strengthened the inclusion of the INDEX as a MUST (per discussion at IETF-56).

- Added text around the capturing of the Reason (SHOULD be captured for SIP responses and MAY be captured for other things such as timeouts).
- Clarified the response processing 2.3.3.2 to include provisional responses and the sending of a 183 to convey History-Info.

Added section 2.3.4 to address Redirect Server behavior.

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