



N-Squared Software N2SIP
SIP-SDP-RTP Protocol Conformance Statement

Version 2023-05.1

1 Document Information

1.1 Scope and Purpose

This document describes the implementation of the SIP, SDP, and RTP protocols for real-time flows for voice interaction control using the N-Squared Specialized Resource Platform (N2SRP) and N-Squared SIP Application Server (N2AS) solutions via a SIP-capable soft-switch or similar SIP end-point.

Collectively, the N2SIP components are packaged and installed as “N2SIP”. This document should be read in conjunction with the resp Technical Guide [R-1] or [R-2] as applicable.

This document assumes a working knowledge of the relevant SIP, SDP, RTP and other telephony concepts, including the standard SIP interactions between a soft-switch and a SIP-connected resource platform, i.e. an SRP (or Intelligent Peripheral), SIP IVR, or SIP Application Server.

1.2 Definitions, Acronyms, and Abbreviations

Term	Meaning
AVP	Audio Video Profile
B2BUA	Back-to-Back User Agent
BER	Basic Encoding Rules
DTMF	Dual Tone Multi-Frequency
ETSI	European Telecommunications Standards Institute
IETF	Internet Engineering Task Force
INAP	Intelligent Networking Application Part
IP	Intelligent Peripheral
MIME	Multipurpose Internet Mail Extensions
N2	N-Squared
N2AS	The N-Squared SIP platform acting independently with internal service logic scripting.
N2SRP	The N-Squared SIP platform acting as an INAP-controlled Specialized Resource Platform.
N2SIP	The N-Squared SIP platform in the role of N2SRP or N2AS.
PCMU	Pulse Code Modulation mu-law
PGP	Pretty Good Privacy
RFC	Request For Comments
RTCP	RTP Control Protocol
RTP	Real-time Transport Protocol
SCP	Service Control Point
SCTP	Stream Control Transmission Protocol
SDP	Session Description Protocol
SIP	Session Initiation Protocol
S/MIME	Secure/Multipurpose Internet Mail Extensions
SRF	Specialized Resource Function
SRP	Specialized Resource Platform
SRTP	Secure RTP
TCP	Transmission Control Protocol

Term	Meaning
TLS	Transport Layer Security
UDP	User Datagram Protocol
URL	Uniform Resource Locator

1.3 References

The following documents are referenced within this document:

Reference	Document
[R-1]	N2SRP Technical Guide https://www.nsquared.co.nz/product/n2sip.html
[R-2]	N2IV Technical Guide https://www.nsquared.co.nz/product/n2sip.html
[R-10]	IETF RFC 3261 SIP: Session Initiation Protocol
[R-11]	IETF RFC 4566 SDP: Session Description Protocol
[R-12]	IETF RFC 3550 RTP: A Transport Protocol for Real-Time Applications
[R-13]	IETF RFC 3581 An Extension to the Session Initiation Protocol (SIP) for Symmetric Response Routing
[R-14]	IETF RFC 2967 The SIP INFO Method
[R-15]	IETF RFC 3262 Reliability of Provisional Responses in the Session Initiation Protocol (SIP)
[R-16]	IETF RFC 4733 RTP Payload for DTMF Digits, Telephony Tones, and Telephony Signals
[R-17]	IETF RFC 3263 Session Initiation Protocol (SIP): Locating SIP Servers
[R-18]	IETF RFC 3326 The Reason Header Field for the Session Initiation Protocol (SIP)
[R-19]	draft-kaplan-dispatch-info-dtmf-package-00 A Session Initiation Protocol (SIP) INFO Package for Dual-Tone Multi-Frequency (DTMF) Events
[R-20]	IETF RFC 4733 RTP Payload for DTMF Digits, Telephony Tones, and Telephony Signals
[R-21]	IETF RFC 3323 A Privacy Mechanism for the Session Initiation Protocol (SIP)
[R-22]	IETF RFC 3325 Private Extensions to the Session Initiation Protocol (SIP) for Asserted Identity within Trusted Networks
[R-23]	IETF RFC 2616 Hypertext Transfer Protocol -- HTTP/1.1

1.4 Ownership and Usage

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3 Introduction

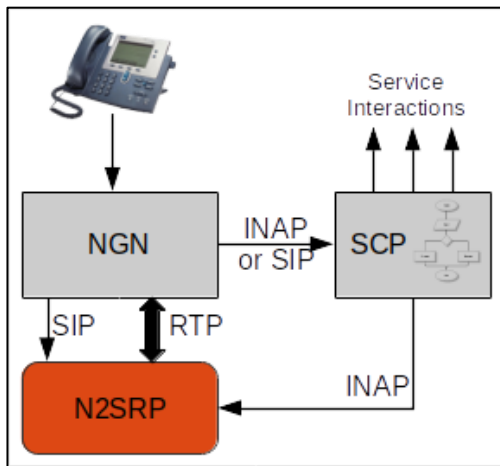
3.1 N2SRP & N2AS Overview

N-Squared offers two separate variants of their SIP/RTP Interaction & control platform:

N-Squared Specialized Resource Platform

The N-Squared Specialized Resource Platform (N2SRP) is a software system for playing audio announcements and collecting DTMF digit input over a SIP/RTP session, under the control of an INAP Service Control Platform (SCP).

The SRP model supports only a limited feature subset. It cannot perform any logic processing decisions.

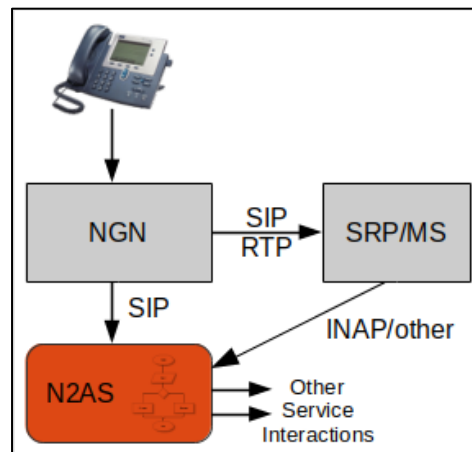


N-Squared SIP Application Server

The N-Squared Interactive Voice Response (N2AS) solution performs standalone logic based on locally defined service logic flows.

An N2AS deployment provides a far more complete set of SIP features, e.g. redirection, call screening, B-Leg termination, and internal/external announcements.

The N2AS service logic can also perform complex service logic via protocols including Diameter, SOAP, REST, and access to local or remote Databases.



An AS deployment may directly generate internal announcements or may redirect to an external SRP.

For both products, the SIP/RTP integration support is identical. This document describes the shared conformance for the SIP and RTP interfaces of both deployment models - N2SRP and N2AS. Within this document, the term “N2SIP” indicates an N-Squared SIP node which is deployed either as an “N2SRP node” or as an “N2AS node.”

The layers in scope are:

- SIP
- SDP
- RTP
- UDP/IP

Conformance is based on the referenced standards (or other generally accepted industry practice) but noting that solution conformance to the above is limited to the extent expressly described herein. I.e. statement of conformance to a standard in no way implies conformance to or compliance with the complete standard.

4 SIP Compliance

4.1 SIP Overview

N2SIP communicates with a core network soft-switch to set-up and teardown SIP audio sessions, as well as for transferring audio signal (and out-of-band information such as DTMF telephony events) over RTP. The core network soft-switch will trunk these audio sessions to other network elements over circuit-switched, SIP/RTP, radio network or other channels, although this is not generally visible to the SRP.

4.2 SIP Request Methods

N2SIP supports the following SIP Request Methods for the various SIP interactions.

Request	Inbound (to N2SIP Server)	Outbound (from N2SIP Client)
REGISTER	Supported	Used
OPTIONS	Supported	Used
INVITE (new session)	Supported	Used
re-INVITE (existing session)	Not Supported	Used
CANCEL	Supported	Used
BYE	Supported	Used
ACK	Supported	Used
PRACK	Supported	Used
INFO	Supported	Not Used

Table 1: SIP Request Methods

4.3 Common SIP UAS Notes

The following compliance notes apply generally to the N2SIP framework when it is operating as a User Agent Server (UAS). I.e. when it is processing transactions initiated by an inbound SIP Request, and the associated subsequent outbound SIP Responses, and inbound ACK (if applicable).

4.3.1 Transport Layer

N2SIP supports UDP and TCP transport for INVITE and non-INVITE UAS SIP Transactions. Specifically, N2SIP supports:

- Inbound (connectionless) UDP, and
- Inbound permanent TCP connections, and
- Inbound transient TCP connections.

Outbound transient TCP connections are not supported.

N2SIP does not support any signalling encryption or signing/authentication mechanism at the connection level. Specifically:

- SCTP transport is not supported.
- The TLS encryption mechanism is not supported.

N2SIP can be configured to challenge inbound requests using Digest Authentication, as described in 4.5.4 , Digest Authentication. No other signing/authentication is supported at the message level. Specifically:

- The "sips:" URI scheme is not supported.
- The PGP mechanism for encrypting or signing content body is not supported.
- The S/MIME signing or encrypting mechanism for content body is not supported.

4.3.2 SIP Message Codec

As noted in RFC 3261, SIP is “HTTP-like” in its encoding but it is not an extension of HTTP.

The N-Squared SIP Message encode/decode and transmit/receive functions are purpose-built for SIP, and do not include any HTTP functionality except as expressly required for SIP.

Specifically:

- Decoding of inbound SIP messages is not tolerant of LF-terminated lines, as optionally specified in section 19.3 of RFC 2616 [R-23]. All inbound messages must have their header lines terminated with the full CR LF sequence.

4.3.3 Inbound SIP Requests

All inbound SIP Requests must be well-formed according to section 27.1: *Option Tags* of [R-10] (including Method and URI). The following base headers apply to all requests:

Request Header	Type	Notes
Call-Id	String	Must be present.
Via	String	Must be present.
[sent-protocol]	String	"SIP/2.0/UDP" or "SIP/2.0/TCP"
[sent-by]	String	Must include host. May include port.
.branch=	String	Must be present.
.received	String	Supported.
.rport	Integer	Supported.
.*	Various	Unrecognised Via parameter tags are ignored.
From	String	Must be present.
.tag	String	Must be present.
To	String	Must be present.
CSeq	String	Must be present.
Max-Forwards	Integer	Must be present.
Content-Length	Integer	May be present for UDP. Must be present for TCP.
Require	String	May be present. Rejected except where indicated.
Supported	String	May be present. Ignored except where indicated.

Table 2: Common Inbound SIP Request Headers

As per section 20: *Header Fields* of [R-10], N2SIP will ignore all inbound header parameters (see [R-10] section 7.3: *Header Fields*) that are not understood. These may be used by site-specific service logic and/or configuration.

4.3.4 Malformed SIP Request Handling

An inbound SIP Request which is missing any of the mandatory SIP Request attributes or SIP Request headers will be considered misformatted, and a 500 Error Response will immediately be sent as follows without further processing:

Response Attribute	Type	Notes
Response Status Code	Integer	500
Response Status Message	String	"Internal Server Error"

Table 1: Common SIP Response Attributes for Misformatted SIP Request

Request Header	Type	Notes
Call-Id	String	Copy of received Call-Id (if present).
Via	String	Copy of received Via (if present).
From	String	Copy of received From (if present).
To	String	Copy of received To (if present).
CSeq	String	Copy of received CSeq (if present).
Contact	String	Copy of received Contact (if present).
Content-Length	Integer	0

Table 2: Common SIP Response Headers for Misformatted SIP Request

Note that N2SIP handling for Misformatted Inbound SIP Requests does not create or correlate to any SIP transaction and does not create any Transaction state machine or associated retry timers. In case of failure, no attempt will be made to re-send this SIP Response.

4.3.5 Compact Form (Short) Headers

When processing inbound received SIP Requests, N2SIP will *accept* the compact form of the following inbound headers from RFC 3261.

Header	Short Form	Notes
Content-Type	c	
From	f	
Call-ID	i	
Supported	k	
Content-Length	l	
Contact	m	
To	t	
Via	v	

Table 3: Compact Form (Short) Headers

Additionally, custom SIP INVITE headers may be configured, with long and compact form names, either of which will be accepted for inbound SIP INVITE Requests. Depending on configuration, these SIP headers may also be replicated into:

- a. Specific SIP INVITE Response messages, and/or
- b. The corresponding B-Leg outbound SIP INVITE Request when N2SIP acts as a B2BUA.

Note that when processing compact form headers for SIP Requests and Responses:

- It is supported that one header use compact form, and another header use long form within a single Request or Response. E.g. it is permitted that the From header be represented as compact form “f: ...” while the Contact header be specified in full as “Contact: ...”.
- It is not supported to mix compact and long forms for a single repeated header. E.g. it is not permitted that a repeated Via header be present as both “Via: ...” and “v: ...” forms within a single Request or Response. In any such case, only the long form header will be used.

N2SIP does not transmit compact form headers in any outbound SIP Requests or Responses. When replicating inbound SIP INVITE Request headers outbound in a SIP Request or Response, N2SIP will always use the long form header name.

4.3.6 Outbound SIP Responses

All SIP Responses sent by N2SIP to well-formatted Inbound SIP Requests will be well-formed SIP Responses according to section 7.2: *Responses* of [R-10] (including Status Code and Status Message), and will include at least the following mandatory Headers:

Response Header	Type	Notes
Call-Id	String	Always present.
Via	String	Always present.
[sent-protocol]	String	"SIP/2.0/UDP" or "SIP/2.0/TCP".
[sent-by]	String	Will include host. Include port from Request if present.
.received=	String	Present if requested by inbound "rport" or if inbound Via Sent By host was not numeric.
.branch=	String	Always present.
.rport=	String	Present if requested by inbound "rport".
From	String	Always present.
.tag	String	Always present.
To	String	Always present.
.tag	String	Present if dialog is being formed.
CSeq	String	Always present.
Content-Length	Integer	Always present.
User-Agent	String	Set to configurable value.

Table 4: Common SIP Response Headers

Note that custom site-specific service logic and/or configuration may implement (add or accept) additional Response headers not listed in this document.

4.4 Common SIP UAC Notes

The following compliance notes apply generally to the N2SIP framework when it is operating as a User Agent Client (UAC). I.e. when it is creating transactions initiated by an outbound SIP Request, and the associated subsequent inbound SIP Responses, and outbound ACK (if applicable).

4.4.1 Transport Layer

N2SIP supports UDP and TCP transport for INVITE and non-INVITE UAC SIP Transactions. Specifically, N2SIP supports:

- Outbound (connectionless) UDP, and
- Outbound permanent TCP connections.
- Re-use of inbound transient TCP connections.

Note specifically that the current version of N2SIP has limited support for transient TCP connections when sending outbound SIP Responses. It will re-use the inbound transient TCP connection on which the corresponding inbound SIP Request arrived. However it will never create an outbound transient TCP connection.

N2SIP does not support any signalling encryption or signing/authentication mechanism at the connection level. Specifically:

- SCTP transport is not supported.
- The TLS encryption mechanism is not supported.

N2SIP can be configured to retry outbound SIP Requests that were challenged with Digest Authentication, as described in 4.5.4 , Digest Authentication. No other signing/authentication is supported at the message level. Specifically:

- The "sips:" URI scheme is not supported.
- The PGP mechanism for encrypting or signing content body is not supported.
- The S/MIME signing or encrypting mechanism for content body is not supported.

4.4.2 Outbound SIP Requests

The N2SIP framework will generate well-formed outbound SIP Requests according to section 27.1: *Option Tags* of [R-10] (including Method and URI). The following base headers apply to all requests:

Request Header	Type	Notes
Call-Id	String	Always present.
Via	String	Always present.
[sent-protocol]	String	"SIP/2.0/UDP" or "SIP/2.0/TCP"
[sent-by]	String	Must include host. May include port.
.branch=	String	Always present.
.received	String	Not Used.
.rport	Integer	Not Used.
From	String	Always present.
.tag	String	Always present.
To	String	Always present.
CSeq	String	Always present.
Max-Forwards	Integer	Always present.
Content-Length	Integer	Always present.
Require	String	May be present.
Supported	String	May be present.
User-Agent	String	Set to configurable value.

Table 1: Common Outbound SIP Request Headers

4.4.3 Compact Form (Short) Headers

N2SIP does not transmit compact form headers in any outbound SIP Responses. When replicating inbound SIP INVITE Request headers outbound in a SIP Request or Response, N2SIP will always use the long form header name.

Note that custom site-specific service logic and/or configuration may always implement (add or accept) additional custom Request headers not listed in this document.

4.4.4 Inbound SIP Responses

All inbound SIP Response must be well-formed according to section 27.1: *Option Tags* of [R-10] (including Method and URI). The following base headers apply to all inbound SIP Responses:

Request Header	Type	Notes
Call-Id	String	Must be present.
Via	String	Must be present.
[sent-protocol]	String	"SIP/2.0/UDP" or "SIP/2.0/TCP"
[sent-by]	String	Must include host. May include port.
.branch=	String	Must be present.
.received	String	Supported.
.rport	Integer	Supported.
.*	Various	Unrecognised Via parameter tags are ignored.
From	String	Must be present.
To	String	Must be present.
CSeq	String	Must be present.
Max-Forwards	Integer	Must be present.
Content-Length	Integer	May be present for UDP. Must be present for TCP.
Require	String	May be present. Rejected except where indicated.
Supported	String	May be present. Ignored except where indicated.

Table 1: Common Inbound SIP Request Headers

As per section 20: *Header Fields* of [R-10], N2SIP will ignore all inbound header parameters (see [R-10] section 7.3: *Header Fields*) that are not understood. These may be used by site-specific service logic and/or configuration.

4.5 Other Common SIP Notes

4.5.1 Multicast

The N2SIP framework has no support for multicast.

The “maddr” parameter is silently ignored if it appears in any URI parameter.

The “ttl” parameter is silently ignored if it appears in any URI parameter.

4.5.2 SIP-I

The current release of N2SIP does not support SIP-I.

Specifically, the use of Content-Type = multipart/mixed is not supported.

4.5.3 SIP-T

The current release of N2SIP does not support SIP-T.

Specifically, the use of Content-Type = multipart/mixed is not supported.

4.5.4 Digest Authentication

The N2SIP supports Digest Authentication for both inbound and outbound Requests using the standard mechanisms defined in RFC 3261 [R-10]. Standard headers are used in both directions.

For Requests:

Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
Authorization	String	Present when using Digest authentication.

Table 2: Digest Authentication Request Headers

For Responses:

Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
WWW-Authenticate	String	Present when using Digest authentication.

Table 3: Digest Authentication Response Headers

Within N2SIP, Digest Authentication can be applicable to the following method types.

Request	Inbound (to SRP Server)	Outbound (from SRP Client)
REGISTER	Applicable	Applicable
OPTIONS	Applicable	Not Used
INVITE (new session)	Applicable	Applicable
CANCEL	Not Applicable	Not Applicable
BYE	Applicable	Applicable
ACK	Not Applied	Not Applied
PRACK	Not Applied	Not Used
INFO	Applicable	Not Used

Table 4: SIP Requests Applicable to Digest Authentication

The following SIP Response codes and strings are specific to Digest Authorization and can be present in the Response to any Inbound method SIP Request listed as “Applicable” in the preceding table.

Status Code	Error-Info
401	<none> (Used to indicate that authorization is required).
403	Authorization Failure (Nonce).
403	Authorization Failure (Username).
403	Authorization Failure (Password).
404	Subscriber domain not known here.
404	Subscriber not known at this domain.
500	<various>

Table 5: Digest Authorization Common Response Codes

4.6 REGISTER (Server/Inbound)

4.6.1 Message Flow

N2SIP supports inbound SIP REGISTER Requests for pre-configured subscriptions. If the registration is accepted, N2SIP will retain the registered Contact information and will use it for initiating subsequent outbound INVITE requests to that address.

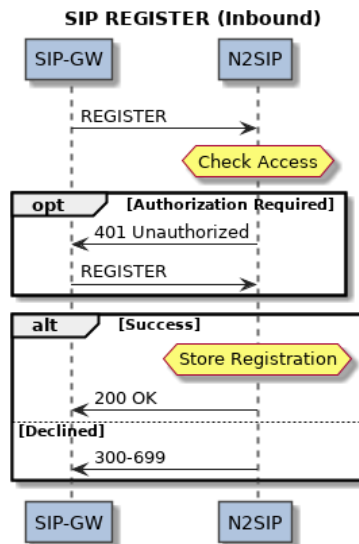


Figure A - Inbound SIP REGISTER

Note that in addition to dynamically registered Contact addresses, N2SIP also supports static configuration of Contacts for outbound INVITE requests.

4.6.2 REGISTER Inbound Request

The SRP supports receiving the following attributes and headers in inbound REGISTER.

Request Attribute	Type	Notes
Request Method	String	REGISTER
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
Content of Table 2: Digest Authentication Request Headers, plus...		
From		Must be present.
.URI	URI	Must be present and set to To URI.
To		Must be present.
.URI	URI	Must be present and set to From URI.
Contact	String(s)	Must be present. Only the first Contact header will be registered (no multi-home). Only one Contact per header line is supported. The "*" form of the Contact header from RFC 3261 [R-10] 10.2.2 Removing Bindings is not supported.
.Address	String	Must be present.
.expires	Integer	Optional. Default value 3600 seconds.

Table 6: Inbound SIP REGISTER Request

Any content body for the REGISTER Request is ignored.

4.6.3 REGISTER Server Transaction

The client may re-use the REGISTER Via "branch" for subsequent registrations, however N2SIP will not retain an open transaction in this case and will discard REGISTER transaction context at the expiry of Timer J as per [R-10] *Figure 8*. The re-REGISTER will be treated as a new transaction.

N2SIP will create a SIP Server non-INVITE Transaction for the SIP REGISTER Request as described by [R-10] section 17.2.2: *Non-INVITE Server Transaction* and [R-10] *Figure 8* and will obey the timers and retransmission rules defined by this state machine.

4.6.4 REGISTER Response (Declined)

If a well-formed REGISTER Request is declined, then N2SIP will send a SIP Response with Status Code that is not 2xx and constructed according to the rules defined in section 4.3.6: *Outbound SIP Response*.

The following is a list of the possible Status Codes, along with the most common Error-Info strings used, when declining a well-formatted REGISTER Request. The list of strings is only indicative, and other Error-Info strings may be returned. The spelling and formatting of these strings may change without notice.

Status Code	Error-Info
Any Response from Table 5: Digest Authorization Common Response Codes, plus...	
420	A Require option is not supported.
500	Received REGISTER with From URI that is not To URI.
500	Received REGISTER with no 'Contact'.
500	<Any other exception string generated internally during processing>

Table 7: Indicative List of REGISTER Codes and Error-Info Strings

4.6.5 REGISTER Response (Accepted)

If the REGISTER Request is accepted, N2SIP will generate a SIP Response with Status Code 200 OK.

Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Allow	String	"INVITE,ACK,BYE,CANCEL,OPTIONS,REGISTER,INFO,PRACK"
Accept	String	"application/sdp"
Contact Address	String	Copy of received Contact Address.
Contact "expires"	Integer	Always present.

Table 8: Outbound SIP REGISTER Response Headers

4.7 REGISTER (Client/Outbound)

4.7.1 Message Flow

N2SIP Server supports sending outbound SIP REGISTER to a configured SIP peer. This will be done for any local "endpoint" addresses which the N2SIP is configured to manage. Refer to the Technical Guide for information on configuring managed endpoints.

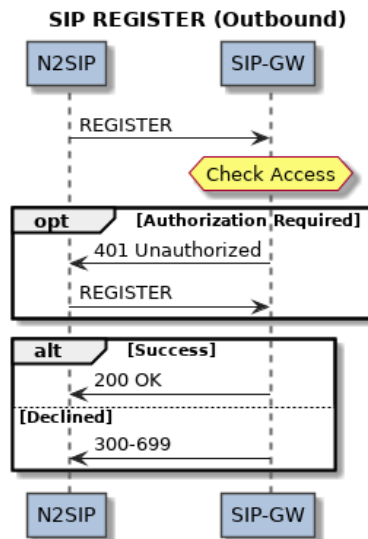


Figure B - Outbound SIP REGISTER

4.7.2 REGISTER Outbound Request

The N2SIP supports sending the following attributes and headers in outbound REGISTER.

Request Attribute	Type	Notes
Request Method	String	REGISTER
Request Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Content of Table 3: Digest Authentication Response Headers, plus...		
From URI	String	sip:<pstn-digits>@<sip-peer-domain>
To URI	String	sip:<pstn-digits>@<sip-peer-domain>
Contact URI	String	sip:<pstn-digits>@<sip-public-host>[:<port>]
Expires	Integer	Configured value, or 0 when we de-REGISTER.

Table 9: Outbound SIP REGISTER Request

No content body is created for the REGISTER Request.

4.7.3 REGISTER Client Transaction

N2SRP does not re-use the REGISTER Via "branch" for subsequent registrations. Each outbound REGISTER request is a new transaction.

N2SIP will create a SIP Client non-INVITE Transaction for the SIP REGISTER Request as described in [R-10] section 17.1.2: Non-INVITE Client Transaction and [R-10] Figure 6 and will obey the timers and retransmission rules defined by this state machine.

4.7.4 REGISTER Response

N2SIP accepts well-formatted SIP Responses to the REGISTER Request and expects a 200 OK Response.

A 401 response will cause a re-try using Digest Authentication. This requires that a username and password be configured within the N2SIP for the far-end SIP Peer associated with the endpoint.

4.8 OPTIONS (Server/Inbound)

4.8.1 Message Flow

N2SIP SIP Server supports inbound SIP OPTIONS Requests.

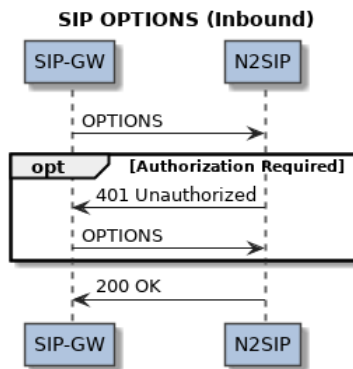


Figure C - Inbound SIP OPTIONS

4.8.2 OPTIONS Inbound Request

N2SIP supports receiving the following attributes and headers in inbound OPTIONS.

Request Attribute	Type	Notes
Request Method	String	OPTIONS
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
Content of Table 2: Digest Authentication Request Headers, plus...		

Table 10: Inbound SIP OPTIONS Request

Any content body for the OPTIONS Request is ignored.

4.8.3 OPTIONS Server Transaction

N2SIP will create a SIP Server non-INVITE Transaction for the SIP OPTIONS Request as described by [R-10] section 17.2.2: *Non-INVITE Server Transaction* and [R-10] Figure 8 and will obey the timers and retransmission rules defined by this state machine.

4.8.4 OPTIONS Response (Declined)

If a well-formed OPTIONS Request is declined, then N2SIP will send a SIP Response with Status Code that is not 2xx and constructed according to the rules defined in section 4.3.6: *Outbound SIP Response*.

The following is a list of the possible Status Codes, along with the most common Error-Info strings used, when declining a well-formatted OPTIONS Request. The list of strings is only indicative, and other Error-Info strings may be returned. The spelling and formatting of these strings may change without notice.

Status Code	Error-Info
Any Response from Table 5: Digest Authentication Common Response Codes, plus...	
420	A Require option is not supported.
500	<Any other exception string generated internally during processing>

Table 11: Indicative List of OPTIONS Codes and Error-Info Strings

4.8.5 OPTIONS Response (Accepted)

All well-formed OPTIONS requests are accepted, assuming they pass any applicable authorization checks. N2SIP will generate a SIP Response with Status Code 200 OK.

Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Content of Table 3: Digest Authentication Response Headers, plus...		
Allow	String	"INVITE,ACK,BYE,CANCEL,OPTIONS,REGISTER,INFO,PRACK"
Accept	String	"application/sdp"

Table 12: Outbound SIP OPTIONS Response Headers

4.9 INVITE (Server/Inbound)

4.9.1 Message Flow

N2SIP supports inbound SIP INVITE Requests for creating incall voice sessions, including:

- PRACK for reliable provisional responses.
- Audio sessions using 183 Early Media, without use of 200 OK.

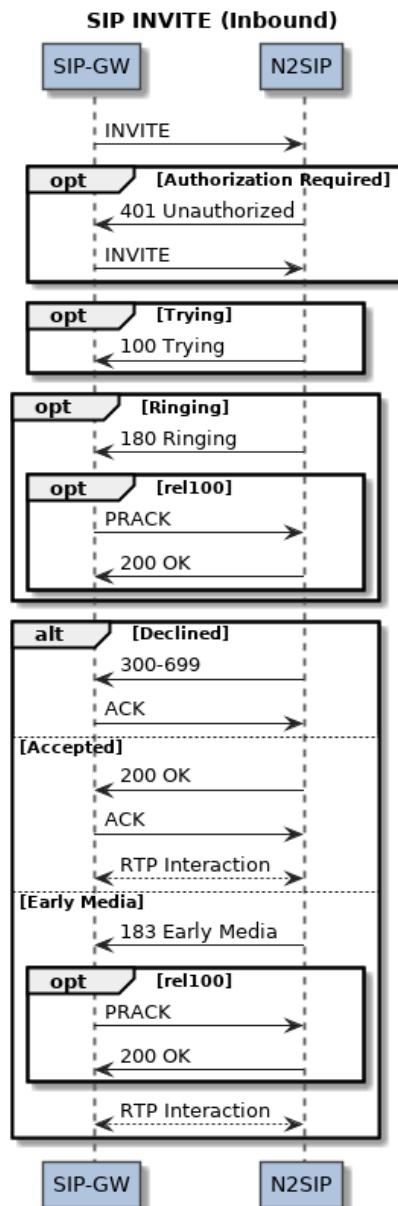


Figure D - Inbound SIP INVITE

N2SIP supports only INVITE for creating a new session/dialog. N2SIP does not support the re-INVITE functionality of [R-10] section 14: *Modifying an Existing Session*.

4.9.2 INVITE Inbound Request

N2SIP supports receiving the following attributes and headers in inbound INVITE.

Request Attribute	Type	Notes
Request Method	String	INVITE
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
Content of Table 2: Digest Authentication Request Headers, plus...		
Record-Route	String(s)	Copied into the 2XX INVITE Response.
From		Must be present.
.URI	String	Must be "sip:" URI scheme. May be used by service logic as the "Calling Party Address" to determine what interactions to perform during the session. When operating as an independent (internal logic), N2AS service logic may use this From URI in processing.
.tag	String	Must be present as the remote Dialog tag.
To		Must be present.
.URI	String	Must be "sip:" URI scheme. May be used by service logic as the "Called Party Address" to determine what interactions to perform during the session. When operating as an INAP-controlled SRP, N2SRP will extract the SCP ID and Correlation ID from the "To" address to construct and address the INAP AssistRequestInstructions operation to send to the external INAP SCP. When operating as an independent (internal logic) IVR, N2AS service logic may use this To URI in processing.
.tag	String	Must not be present.
Contact	String(s)	Must be present. Only the first Contact header will be used (no multi-home). Only one Contact per header line is supported.
Content-Type	String	Must be "application/sdp".
Require	String	"100rel" is accepted. Other entries are rejected.
Supported	String	"100rel" is accepted. Other entries are ignored.
P-Asserted-Identity	String	The topmost "P-Asserted-Identity" header is accepted and parsed according to RFC 3323 [R-21] and RFC 3325 [R-22], with details made available to service logic.
P-Preferred-Identity	String	The topmost "P-Preferred-Identity" header is accepted and parsed according to RFC 3323 [R-21] and RFC 3325 [R-22], with details made available to service logic.
Privacy	String	The topmost "Privacy" header is accepted and parsed according to RFC 3323 [R-21] and RFC 3325 [R-22], with details made available to service logic.
Request Content	Type	Notes
SDP Session "Offer" as per section 5 SDP Compliance.		

Table 13: Inbound SIP INVITE Request

4.9.3 INVITE Server Transaction

If the INVITE Transaction is accepted, N2SIP will create a SIP Server INVITE Transaction for the SIP INVITE Request as described by [R-10] section 17.2.1: *INVITE Server Transaction* and [R-10] *Figure 7* and will obey the timers and retransmission rules defined by this state machine.

4.9.4 INVITE Response (Declined)

If a well-formed INVITE Request is declined, then N2SIP will send a SIP Response with non-2xx Status Code and constructed according to the rules defined in section 4.3.6: *Outbound SIP Response*.

Note that the use of a 300-699 Response Code is a valid processing scenario and does not necessarily indicate that a processing “error” has occurred. Many “normal” business-cases use this mechanism in SIP, including:

- Subscriber not available (Did Not Answer, Busy).
- Subscriber has moved (Number Ported).
- Call deliberately declined (Missed Call Attempt).
- Insufficient Funds, or Call Black-Listed.
- Natural End of IVR Interaction using Early Media.

The following Response content may present.

Response Attribute	Type	Notes
Response Status Code	Integer	300-699
Response Status Message	String	<Associated Status Message>
Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Contact	String	Optional. Redirection Contact, e.g. for 302 Response.
Reason	String	Optional. Reason as per RFC 3326 [R-18].
.protocol	String	“SIP”, “Q.850” or other value.
.cause	Integer	16 or other value.
.text	String	“Terminated” or other value.

Table 14: Outbound SIP INVITE 300-699 Response Headers

The following is a list of the standard “declined” Status Codes, along with common Error-Info strings (if applicable) used when declining a well-formatted INVITE Request. The list of strings is only indicative, and other Error-Info strings may be returned. The spelling and formatting of these strings may change without notice.

Status Code	Error-Info
Any Response from Table 5: Digest Authorization Common Response Codes, plus...	
ANY	Any Status Code in the range 300-699 chosen by custom service logic.
480	<none> (Natural conclusion of an IVR interaction with clean call teardown).
481	Invite has 'To' (local) tag but does not match a known Dialog. (Will occur if re-INVITE is used. N2SIP does not support re-INVITE.)
487	<none> (Used when INVITE is terminated by CANCEL)

500	Missing Content-Type header for INVITE.
500	Unsupported Content-Type header '<content-type>' for INVITE.
500	Missing 'application/sdp' Content on INVITE.
500	Missing remote tag on From header for initial INVITE.
500	Failure on A-Leg Invite Handler: <extended-reason>
500	<Any other exception string generated internally during processing>
603	Server forced clean shutdown at end of INVITE processing.

Table 15: Indicative List of INVITE Codes and Error-Info Strings

Note that an error SIP Response on initial processing may occur before or after the sending of the 100 Trying Response - see section 4.9.5: *INVITE Response (Provisional, Trying)*.

4.9.5 INVITE Response (Provisional, Trying)

If the INVITE Request is accepted, then N2SIP will (if configured to do so) immediately generate a provisional SIP Response with Status Code 100 Trying to indicate that the Request has been accepted and service logic will now be performed to determine the appropriate call handling.

Response Attribute	Type	Notes
Response Status Code	Integer	100
Response Status Message	String	"Trying"
Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers only		

Table 16: Outbound SIP INVITE 100 Trying Response Headers

Note that according to RFC 3262 [R-15], Reliable Provisional Response is not applicable to 100 "Trying" Responses.

4.9.6 INVITE Response (Provisional, Early Media)

Depending on configuration, N2SIP platform may use Early Media for interactions, in which case the following INVITE Response structure is used.

Response Attribute	Type	Notes
Status Code	Integer	183
Status Message	String	"Session Progress"
Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Require	String	"100rel" if PRACK is required.
RSeq	Integer	Response sequence number if PRACK is required
Contact	String	May be present to indicate Contact for PRACK.
Content-Type	String	"application/sdp"
Response Content	Type	Notes
SDP Session "Answer", as per section 4.20: NOTIFY N2SIP does not provide any support for SIP NOTIFY. SDP Compliance		

Table 17: Outbound SIP INVITE Early Media Response Headers

Contact information is provided (if configured) for PRACK routing as per RFC 3263 [R-17].

4.9.7 INVITE Response (Provisional, Other)

Depending on configuration, N2SIP platform may use other provisional codes (e.g. 180 Ringing) in which case the following INVITE Response structure is used.

Response Attribute	Type	Notes
Status Code	Integer	180 or other 101-199 status code
Status Message	String	"Ringing" or other status message
Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Require	String	"100rel" if PRACK required.
RSeq	Integer	Response sequence number if PRACK required.
Contact	String	May be present to indicate Contact for PRACK.
Response Content	Type	Notes
<none>		

Table 18: Outbound SIP INVITE Ringing Response Headers

Contact information is provided (if configured) for PRACK routing as per RFC 3263 [R-17].

4.9.8 INVITE Response (OK)

If Early Media is not being used, N2SIP platform will accept and connect the SIP session, in which case the following INVITE Response structure is used.

Response Attribute	Type	Notes
Response Status Code	Integer	200 or 201-299
Response Status Message	String	"OK" or other associated status message
Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Record-Route	String(s)	Copied from SIP INVITE Request.
Allow	String	"INVITE,ACK,BYE,CANCEL,OPTIONS,REGISTER,INFO,PRACK"
Content-Type	String	"application/sdp"
Contact	String(s)	Specifies contact address for other dialog transactions.
Response Content	Type	Notes
SDP Session "Answer", as per section 4.20: NOTIFY N2SIP does not provide any support for SIP NOTIFY. SDP Compliance		

Table 19: Outbound SIP INVITE Acceptance Response Headers

N2SIP waits for the ACK on this response and implements the transport layer re-transmission for INVITE 200 OK as described in [R-10] section 17.2.1: INVITE Server Transaction.

Contact information is provided for ACK, BYE routing as per RFC 3263 [R-17].

4.10 ACK (Server/Inbound)

4.10.1 Message Flow

N2SIP supports inbound SIP ACK Requests:

- As part of an inbound INVITE Transaction, initiated by INVITE Response Status Code 300-699.
- As an associated ACK pseudo-Transaction tied to the inbound INVITE dialog, initiated by our sending of INVITE Response 2xx.

Refer to the Message Flow diagram for INVITE (Server/Inbound).

4.10.2 ACK Request (Within INVITE Transaction)

N2SIP supports receiving the following attributes and headers in inbound ACK in the context of an existing INVITE Inbound Server Transaction for which N2SIP responded with Status Code 300-699.

Request Attribute	Type	Notes
Request Method	String	ACK
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
CSeq		Present
.Method	String	INVITE
.Number	Integer	INVITE CSeq Number
Via		Content of Table 2: Common Inbound SIP Request Headers "Via" Header, plus...
.via-branch	String	Must match existing INVITE Transaction.

Table 20: Inbound SIP ACK Request for INVITE Response 300-699

Any content body for the ACK Request is ignored.

4.10.3 ACK Request (New pseudo-Transaction Within INVITE Dialog)

N2SIP supports receiving the following attributes and headers in inbound ACK as a new pseudo-Transaction in the context of an existing INVITE Inbound Server dialog for which N2SIP responded to the initial INVITE Transaction with Status Code 2xx.

Request Attribute	Type	Notes
Request Method	String	ACK
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
CSeq		Present
.Method	String	ACK
.Number	Integer	ACK CSeq Number
From		Content of Table 2: Common Inbound SIP Request Headers "From" Header, plus...
.tag	String	Must be present as the remote Dialog tag.
To		Content of Table 2: Common Inbound SIP Request Headers "To" Header, plus...
.tag	String	Must be present as the local Dialog tag.

Table 21: Inbound SIP ACK Request for INVITE Response 200-299

Any content body for the ACK Request is ignored.

No response is generated for this ACK Request and no Transaction state model is created.

4.11 PRACK (Server/Inbound)

4.11.1 Message Flow

N2SIP supports inbound SIP PRACK Requests:

- As an associated ACK pseudo-Transaction tied to the INVITE dialog, initiated by INVITE Response 101-199.

Refer to the Message Flow diagram for INVITE (Server/Inbound).

4.11.2 PRACK Request (New pseudo-Transaction Within INVITE Dialog)

N2SIP supports receiving the following attributes and headers in inbound PRACK as a new pseudo-Transaction in the context of an existing INVITE Inbound Server dialog for which N2SIP responded to the initial INVITE Transaction with Status Code 101-199 and where PRACK is applicable.

Request Attribute	Type	Notes
Request Method	String	PRACK
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
CSeq		Present
.Method	String	PRACK
.Number	Integer	PRACK CSeq Number
From		Content of Table 2: Common Inbound SIP Request Headers "From" Header, plus...
.tag	String	Must be present as the remote Dialog tag.
To		Content of Table 2: Common Inbound SIP Request Headers "To" Header, plus...
.tag	String	Must be present as the local Dialog tag.
RAck	String	Formed as per RFC 3262 [R-15].

Table 22: Inbound SIP PRACK Request for INVITE Response 101-199

Any content body for the PRACK Request is ignored.

No response is generated for this PRACK Request and no Transaction state model is created.

Note that in the INVITE passthrough scenario, the PRACK handling for the inbound and outbound INVITE call legs are entirely independent from each other.

4.12 CANCEL (Server/Inbound)

4.12.1 Message Flow

N2SIP supports inbound SIP CANCEL Requests as part of an inbound INVITE Transaction.

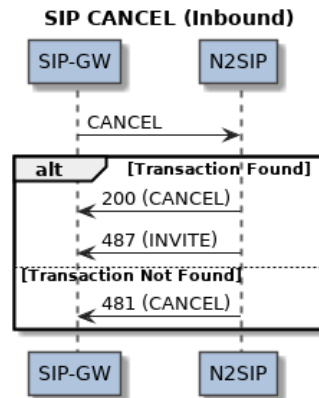


Figure E - Inbound SIP CANCEL

4.12.2 CANCEL Inbound Request

N2SIP supports receiving the following attributes and headers in inbound CANCEL.

Request Attribute	Type	Notes
Request Method	String	CANCEL
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
CSeq		Present
.Method	String	CANCEL
.Number	Integer	INVITE CSeq Number
Via		"Via" Header from Table 2: Common Inbound SIP Request Headers, plus...
.via-branch	String	Must match existing INVITE Transaction.

Table 23: Inbound SIP CANCEL Request for INVITE

Any content body for the CANCEL Request is ignored.

Note that as per RFC 3261 [R-10], Digest Authentication is not applicable to CANCEL Requests.

4.12.3 CANCEL Server Transaction

N2SIP will create a SIP Server non-INVITE Transaction for the SIP CANCEL Request as described by [R-10] section 17.2.2: *Non-INVITE Server Transaction* and [R-10] Figure 8 and will obey the timers and retransmission rules defined by this state machine.

4.12.4 CANCEL Response (Declined)

If a well-formed CANCEL Request is declined, then N2SIP will send a SIP Response with Status Code that is not 2xx and constructed according to the rules defined in section 4.3.6: *Outbound SIP Response*.

The following is a list of the supported Status Codes, along with the most common Error-Info strings used when declining a well-formatted CANCEL Request. The list of strings is only indicative, and other Error-Info strings may be returned. The spelling and formatting of these strings may change without notice.

Status Code	Error-Info
481	<none – used when CANCEL does not match a known INVITE transaction>
500	<Any other exception string generated internally during processing>

Table 24: Indicative List of CANCEL Codes and Error-Info Strings

4.12.5 CANCEL Response (Accepted)

If the CANCEL Request is accepted, N2SIP will generate a SIP Response with status 200 OK.

Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers only		

Table 25: Outbound SIP CANCEL Response Headers

The corresponding INVITE transaction will be terminated with a 487 Status Code.

4.13 INVITE (Client/Outbound)

4.13.1 Message Flow

An outbound INVITE is used in two distinct cases:

- A passthrough INVITE (e.g. Application Server performing pre-paid call charging, post-call announcements, or other Value-Added Service). In this case, the Application Server is controlling an A-Leg inbound INVITE with a back-to-back B-Leg outbound INVITE.
- A locally initiated INVITE, i.e. an IVR outcall scenario.

In either case, N2SIP will initiate an outbound SIP INVITE with the following message flow:

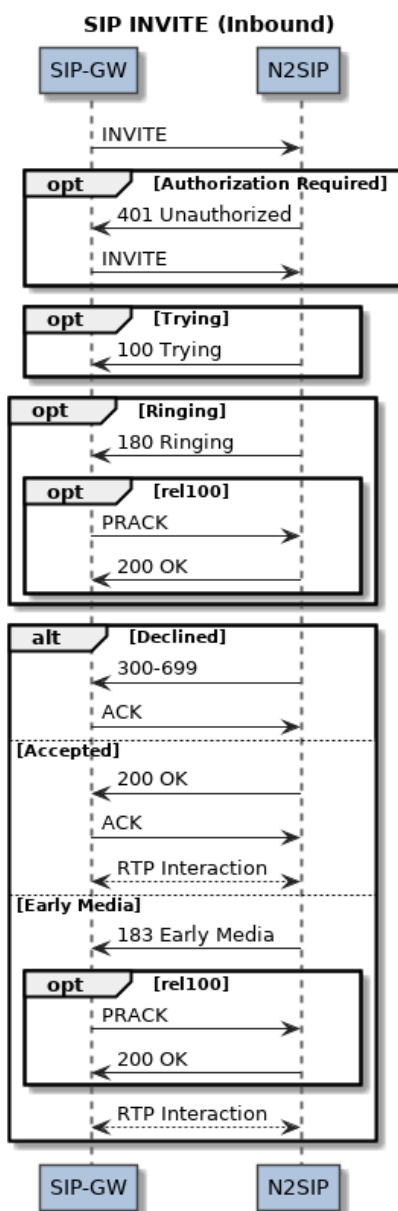


Figure F - Inbound SIP INVITE

N2SIP supports only INVITE for creating a new session/dialog. N2SIP does not support the re-INVITE functionality of [R-10] section 14: *Modifying an Existing Session*.

Note that for outbound calling, the decision to use 200 OK or 183 Early Media for RTP audio stream setup is made by the terminating SIP-GW, not by N2SIP.

4.13.2 INVITE Outbound Request

N2SIP supports sending the following attributes and headers in inbound INVITE.

Request Attribute	Type	Notes
Request Method	String	INVITE
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
Content of Table 2: Digest Authentication Request Headers, plus...		
From		Always present.
.URI	String	Always "sip:" URI scheme. Determined from service logic-provided "Calling Party Address" with configured public host/domain.
.tag	String	Always present as the local Dialog tag.
To		Always present.
.URI	String	Always "sip:" URI scheme. Determined from service logic-provided "Called Party Address" with configured public host/domain.
.tag	String	Never present.
Contact	String	Must be present. May be repeated. Only one Contact per header line is supported.
Content-Type	String	Always "application/sdp".
Require	String	"100rel" may be used, depending on configuration.
Supported	String	"100rel" may be used, depending on configuration.
P-Asserted-Identity	String	The topmost inbound A-Leg INVITE "P-Asserted-Identity" header according to RFC 3323 [R-21] and RFC 3325 [R-22] may be copied to the B-Leg outbound INVITE, depending on configuration.
P-Preferred-Identity	String	The topmost inbound A-Leg INVITE "P-Preferred-Identity" header according to RFC 3323 [R-21] and RFC 3325 [R-22] may be copied to the B-Leg outbound INVITE, depending on configuration.
Privacy	String	The topmost inbound A-Leg INVITE "Privacy" header according to RFC 3323 [R-21] and RFC 3325 [R-22] may be copied to the B-Leg outbound INVITE, depending on configuration.
Request Content	Type	Notes
SDP Session "Offer" as per section 5 SDP Compliance.		

Table 26: Outbound SIP INVITE Request

4.13.3 INVITE Client Transaction

N2SIP will create a SIP Client INVITE Transaction for the SIP INVITE Request as described in [R-10] section 17.1.1: *INVITE Client Transaction* and [R-10] *Figure 5* and will obey the timers and retransmission rules defined by this state machine.

4.13.4 INVITE Response (Declined)

N2SIP will accept a well-formatted SIP Response with Status Code 300-699.

A 401 response will cause a re-try using Digest Authentication. This requires that a username and password be configured within the N2SIP for the far-end SIP Peer associated with the endpoint.

For other values:

- For passthrough INVITE, the Status Code will be passed through to the originating client.
- When performing locally initiated outcall, the status code will be returned to the service logic.

The following Response content may present.

Response Attribute	Type	Notes
Response Status Code	Integer	300-699
Response Status Message	String	<Associated Status Message>
Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Contact	String	Optional. Redirection Contact, e.g. for 302 Response.
Reason	String	Optional. Reason as per RFC 3326 [R-18].
.protocol	String	"SIP", "Q.850" or other value.
.cause	Integer	16 or other value.
.text	String	"Terminated" or other value.
<Any>	String	Used for passthrough or custom service logic.

Table 27: Inbound SIP INVITE 300-699 Response Headers

4.13.5 INVITE Response (Provisional, Trying)

N2SIP will accept a provisional 100 Trying response. It is not processed.

- For passthrough INVITE, it is not relayed to the originating client.
- It is not passed to the service logic for locally initiated outcall INVITE.

Note that according to RFC 3262 [R-15], Reliable Provisional Response is not applicable to 100 "Trying" Responses.

4.13.6 INVITE Response (Provisional, Early Media)

N2SIP platform will accept 183 Early Media for interactions.

- For passthrough INVITE, it is relayed to the original client. The originating and terminating endpoints will initiate an RTP stream. N2SIP remains in the call control path but is not part of the RTP stream.
- For locally initiated outcall INVITE, the RTP audio interaction will begin.

The following INVITE Response structure is accepted for this purpose.

Response Attribute	Type	Notes
Status Code	Integer	183
Status Message	String	"Session Progress"
Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Require	String	"100rel" indicates if PRACK is required.
RSeq	Integer	Response sequence number if PRACK is required
Contact	String	May be present to indicate Contact for PRACK.
Content-Type	String	"application/sdp"
<Any>	String	Used for passthrough or custom service logic.
Response Content	Type	Notes
SDP Session "Answer" as per section 5 SDP Compliance.		

Table 28: Inbound SIP INVITE Early Media Response Headers

Contact information (if provided) is used for PRACK routing as per RFC 3263 [R-17].

4.13.7 INVITE Response (Provisional, Other)

Depending on configuration, N2SIP platform may use Ringing for some interactions, in which case the following INVITE Response structure is used.

Response Attribute	Type	Notes
Status Code	Integer	180 or other 101-199 status code
Status Message	String	"Ringing" or other status message
Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Require	String	"100rel" indicates if PRACK is required.
RSeq	Integer	Response sequence number if PRACK is required
Contact	String	May be present to indicate Contact for PRACK.
<Any>	String	Used for passthrough or custom service logic.
Response Content	Type	Notes
<none>		

Table 29: Inbound SIP INVITE Ringing Response Headers

Contact information is provided (if configured) for PRACK routing as per RFC 3263 [R-17].

4.13.8 INVITE Response (OK)

The N2SIP platform accepts 200 or other successful response to confirm the INVITE dialog.

- For passthrough INVITE, it is relayed to the original client. The originating and terminating endpoints will initiate an RTP stream. N2SIP remains in the call control path but is not part of the RTP stream.
- For locally initiated outcall INVITE, the RTP audio interaction will begin.

Response Attribute	Type	Notes
Response Status Code	Integer	200 or 201-299
Response Status Message	String	"OK" or other associated status message
Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
Allow	String	"INVITE,ACK,BYE,CANCEL,OPTIONS,REGISTER,INFO,PRACK"
Content-Type	String	"application/sdp"
Contact	String	Specifies contact address for other dialog transactions.
<Any>	String	Used for passthrough or custom service logic.
Response Content	Type	Notes
SDP Session "Answer" as per section 5 SDP Compliance. SDP Session "Offer" in Response to outbound INVITE is not supported.		

Table 30: Inbound SIP INVITE Acceptance Response Headers

Contact information (if provided) is used for ACK, BYE routing as per RFC 3263 [R-17].

4.14 ACK (Client/Outbound)

4.14.1 Message Flow

N2SIP will send outbound SIP ACK Requests:

- As part of outbound INVITE Transaction, on receipt of INVITE Response Status Code 300-699.
- As an associated ACK pseudo-Transaction tied to the outbound INVITE dialog, initiated by our receipt of INVITE Response 2xx.

Refer to the Message Flow diagram for INVITE (Client/Outbound).

4.14.2 ACK Request (Within INVITE Transaction)

N2SIP sends the following attributes and headers in inbound ACK in the context of an INVITE Outbound Client Transaction for which N2SIP received Status Code 300-699.

Request Attribute	Type	Notes
Request Method	String	ACK
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
CSeq		Present
.Method	String	INVITE
.Number	Integer	INVITE CSeq Number
Via		Content of Table 2: Common Inbound SIP Request Headers "Via" Header, plus...
.via-branch	String	Must match existing INVITE Transaction.

Table 31: Outbound SIP ACK Request for INVITE Response 300-699

No content body is created for the ACK Request.

4.14.3 ACK Request (New pseudo-Transaction Within INVITE Dialog)

N2SIP sends ACK as a new pseudo-Transaction in the context of an existing INVITE Outbound Client dialog for which N2SIP received Status Code 2xx.

Request Attribute	Type	Notes
Request Method	String	ACK
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
CSeq		Present
.Method	String	ACK
.Number	Integer	ACK CSeq Number
From		Content of Table 2: Common Inbound SIP Request Headers "From" Header, plus...
.tag	String	Must be present as the local Dialog tag.
To		Content of Table 2: Common Inbound SIP Request Headers "To" Header, plus...
.tag	String	Must be present as the remote Dialog tag.
Request Content	Type	Notes
Sending of SDP "Answer" in outbound INVITE ACK is not supported.		

Table 32: Outbound SIP ACK Request for INVITE Response 200-299

No content body is created for the ACK Request.

No response is expected for this ACK Request and no Transaction state model is created.

4.15 PRACK (Client/Outbound)

4.15.1 Message Flow

N2SIP supports outbound SIP PRACK Requests:

- As an associated ACK pseudo-Transaction tied to the INVITE dialog, initiated by received INVITE Response 101-199.

Refer to the Message Flow diagram for INVITE (Client/Outbound).

4.15.2 PRACK Request (New pseudo-Transaction Within INVITE Dialog)

Where PRACK is applicable, N2SIP sends the following attributes and headers in outbound PRACK as a new pseudo-Transaction in the context of an existing INVITE Outbound Client dialog for which N2SIP Status Code 101-199.

Request Attribute	Type	Notes
Request Method	String	PRACK
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
CSeq		Present
.Method	String	PRACK
.Number	Integer	PRACK CSeq Number
From		Content of Table 2: Common Inbound SIP Request Headers "From" Header, plus...
.tag	String	Must be present as the local Dialog tag.
To		Content of Table 2: Common Inbound SIP Request Headers "To" Header, plus...
.tag	String	Must be present as the remote Dialog tag.
RAck	String	Formed as per RFC 3262 [R-15].

Table 33: Outbound SIP PRACK Request for INVITE Response 101-199

No content body is created for the PRACK Request.

No response is expected for this PRACK Request and no Transaction state model is created.

Note that in the INVITE passthrough scenario, the PRACK handling for the inbound and outbound INVITE call legs are entirely independent from each other.

4.16 CANCEL (Client/Outbound)

4.16.1 Message Flow

N2SIP supports outbound SIP CANCEL Requests as part of an outbound INVITE Transaction.

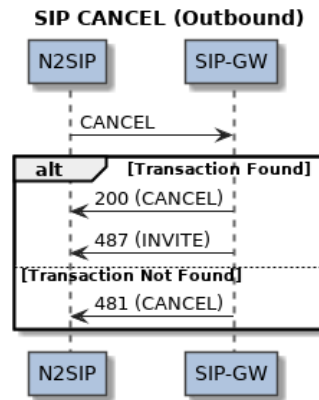


Figure G - Outbound SIP CANCEL

4.16.2 CANCEL Outbound Request

N2SIP uses the following attributes and headers in outbound CANCEL.

Request Attribute	Type	Notes
Request Method	String	CANCEL
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
CSeq		Present
.Method	String	CANCEL
.Number	Integer	INVITE CSeq Number
Via		"Via" Header from Table 2: Common Inbound SIP Request Headers, plus...
.via-branch	String	Must match existing INVITE Transaction.

Table 34: Outbound SIP CANCEL Request for INVITE

No content body is created for the CANCEL Request.

Note that as per RFC 3261 [R-10], Digest Authentication is not applicable to CANCEL Requests.

4.16.3 CANCEL Client Transaction

N2SIP will create a SIP Client non-INVITE Transaction for the SIP REGISTER Request as described in [R-10] section 17.1.2: *Non-INVITE Client Transaction* and [R-10] Figure 6 and will obey the timers and retransmission rules defined by this state machine.

4.16.4 CANCEL Response (Declined)

N2SIP accepts a SIP Response with Status Code that is not 2xx. This is an error case and will result in forced teardown of the INVITE transaction.

Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers only		

Table 1: Inbound SIP CANCEL Response Headers

4.16.5 CANCEL Response (Accepted)

N2SIP accepts a SIP Response with status 200 OK as clean teardown of the INVITE transaction.

Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers only		

Table 2: Inbound SIP CANCEL Response Headers

The corresponding INVITE transaction is expected to be terminated with a received 487 Status Code Response.

4.17 BYE (Server/Inbound)

4.17.1 Message Flow

N2SIP supports inbound SIP BYE Requests in the context of an existing, confirmed SIP Dialog, which may have arisen from either incall or outcall scenarios.

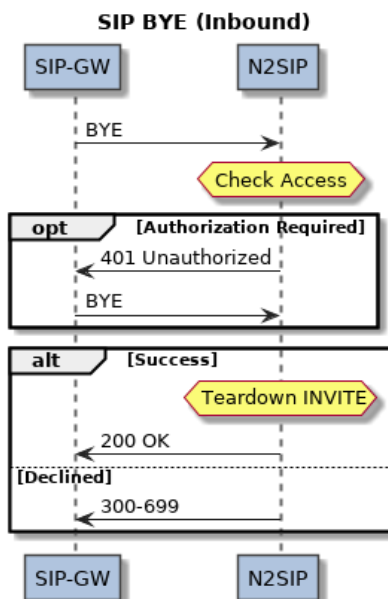


Figure H - Inbound SIP BYE

4.17.2 BYE Inbound Request

The SRP supports receiving the following attributes and headers in inbound BYE.

Request Attribute	Type	Notes
Request Method	String	BYE
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
From		Content of Table 2: Common Inbound SIP Request Headers "From" Header, plus...

.tag	String	Must be present as the remote Dialog tag.
To		Content of Table 2: Common Inbound SIP Request Headers "To" Header, plus...
.tag	String	Must be present as the local Dialog tag.

Table 3: Inbound SIP BYE Request

Any content body for the BYE Request is ignored.

4.17.3 BYE Server Transaction

N2SIP will create a SIP Server non-INVITE Transaction for the SIP BYE Request as described in [R-10] section 17.2.2: *Non-INVITE Server Transaction* and [R-10] *Figure 8* and will obey the timers and retransmission rules defined by this state machine.

4.17.4 BYE Response (Declined)

If a well-formed BYE Request is declined, then N2SIP will send a SIP Response with Status Code that is not 2xx and constructed according to the rules defined in section 4.3.6: *Outbound SIP Response*.

The following is a list of the supported Status Codes, along with the most common Error-Info strings used when declining a well-formatted BYE Request. The list of strings is only indicative, and other Error-Info strings may be returned. The spelling and formatting of these strings may change without notice.

Status Code	Error-Info
Any Response from Table 5: Digest Authorization Common Response Codes, plus...	
481	<none – used when BYE does not match a known INVITE transaction>
500	<Any other exception string generated internally during processing>

Table 4: Indicative List of BYE Codes and Error-Info Strings

4.17.5 BYE Response (Accepted)

If the BYE Request is accepted, then N2SIP will generate a SIP Response with status 200 OK.

Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers Only		

Table 5: Outbound SIP BYE Response Headers

4.18 BYE (Client/Outbound)

4.18.1 Message Flow

N2SIP may initiate an outbound SIP BYE Request in the context of an existing, confirmed SIP Dialog, which may have arisen from either incall or outcall scenarios.

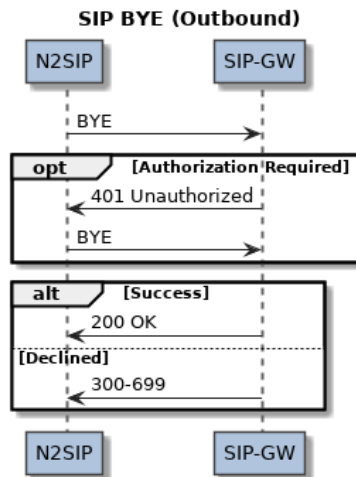


Figure 1 - Outbound SIP BYE

4.18.2 BYE Outbound Request

The SRP supports sending the following attributes and headers in outbound BYE.

Request Attribute	Type	Notes
Request Method	String	BYE
Request Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		
From		Present.
.URI	URI	Present and set to To URI from the INVITE.
.tag	String	Present as the remote Dialog tag.
To		Present.
.URI	URI	Present and set to From URI from the INVITE.
.tag	String	Present as the local Dialog tag.

Table 6: Outbound SIP BYE Request

No content body is created for the BYE Request.

4.18.3 BYE Client Transaction

N2SIP will create a SIP Client non-INVITE Transaction for the SIP BYE Request as described in [R-10] section 17.1.2: Non-INVITE Client Transaction and [R-10] Figure 6 and will obey the timers and retransmission rules defined by this state machine.

4.18.4 BYE Response

N2SIP accepts well-formatted SIP Responses to the BYE Request and expects a 200 OK Response.

4.19 INFO (Server/Inbound)

4.19.1 Message Flow

N2SIP supports inbound SIP INFO Requests as a new transaction within an existing INVITE dialog, for the purpose of receiving DTMF digit information when RTP telephony-event as per RFC 4733 [R-16] is not available.

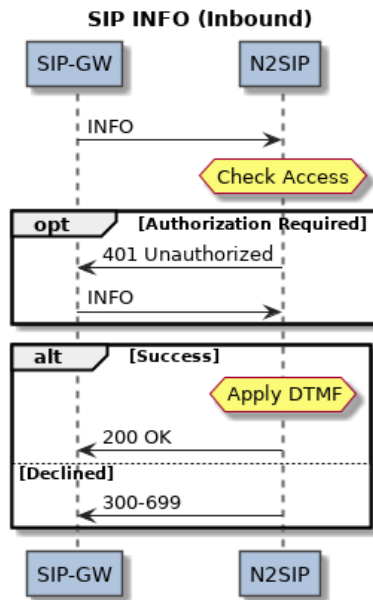


Figure J - Inbound SIP INFO

4.19.2 INFO Inbound Request

The SRP supports receiving the following attributes and headers in inbound INFO.

Request Attribute	Type	Notes
Request Method	String	INFO
Request Header	Type	Notes
Content of Table 2: Common Inbound SIP Request Headers, plus...		
Content of Table 2: Digest Authentication Request Headers, plus...		
From		Content of Table 2: Common Inbound SIP Request Headers "From" Header, plus...
.tag	String	Must be present as the remote Dialog tag.
To		Content of Table 2: Common Inbound SIP Request Headers "To" Header, plus...
.tag	String	Must be present as the local Dialog tag.
Content-Type	String	Must be "application/dtmf-relay".

Table 7: Inbound SIP INFO Request

The following attributes of the content body are accepted as per Draft RFC [R-19].

Body Attribute	Type	Notes
Signal	Character	DTMF input type.
Duration	Integer	Ignored.

All other event lines are ignored in the body of the Content.

4.19.3 INFO Server Transaction

N2SIP will create a SIP Server non-INVITE Transaction for the SIP INFO Request as described by [R-10] section 17.2.2: *Non-INVITE Server Transaction* and [R-10] *Figure 8* and will obey the timers and retransmission rules defined by this state machine.

4.19.4 INFO Response (Declined)

If a well-formed INFO Request is declined, then N2SIP will send a SIP Response with Status Code that is not 2xx and constructed according to the rules defined in section 4.3.6: *Outbound SIP Response*.

The following is a list of the possible Status Codes, along with the most common Error-Info strings used, when declining a well-formatted INFO Request. The list of strings is only indicative, and other Error-Info strings may be returned. The spelling and formatting of these strings may change without notice.

Status Code	Error-Info
Any Response from Table 5: Digest Authorization Common Response Codes, plus...	
420	A Require option is not supported.
481	<none – used when INFO does not match a known INVITE transaction>
500	<Any other exception string generated internally during processing>

Table 8: Indicative List of INFO Codes and Error-Info Strings

4.19.5 INFO Response (Accepted)

If the INFO Request is accepted, then N2SIP will generate a SIP Response with Status Code 200 OK.

Response Header	Type	Notes
Content of Table 4: Common SIP Response Headers, plus...		

Table 9: Outbound SIP REGISTER Response Headers

4.20 NOTIFY

N2SIP does not provide any support for SIP NOTIFY.

5 SDP Compliance

The N2SIP INVITE Transaction uses the SDP "Offer"/"Answer" model to negotiate the RTP stream using "application/sdp" SIP Content when acting as the RTP stream endpoint for audio/DTMF interaction.

Note that when performing passthrough INVITE call control, N2SIP is not involved in the SDP session negotiation, and does not examine or modify the passed-through SDP session descriptors. This chapter does not apply in the INVITE passthrough scenario.

5.1 SDP Transport

The SDP Offer from the soft-switch must be provided to N2SIP as "application/sdp" in the inbound SIP INVITE Request. N2SIP will return its "application/sdp" SDP Answer in the SIP Content of outbound SIP INVITE Response which is sent back with Status Code 183 (for Early Media) or 200 for full SIP session.

N2SIP does not support encryption or signing of the SDP content in any form. Specifically:

- SRTP is not supported.
- Encryption Keys (k=) are not supported.
- SIP S/MIME encapsulation of SDP is not supported.
- SIP TLS is not supported.

5.2 SDP Fields

The following compliance is implemented for SDP Fields.

Field	Inbound Offer/Answer	Outbound Answer/Offer
v (Version)	Must be 0	0
o (Origin)	Must be Present	Present
.Username	Ignored	"nsquared"
.Session ID	Ignored	Auto-Generated Value
.Session Version	Ignored	Auto-Generated Value
.Net Type	Must be "IN"	"IN"
.Address Type	Must be "IP4"	"IP4"
.Unicast Address	Ignored	Same as connection IP Address
s (Session Name)	Ignored	"N-Squared SIP SRF"
i (Session Info)	Ignored	Not Present
u (URI)	Ignored	Not Present
e (Email Address)	Ignored	Not Present
p (Phone Number)	Ignored	Not Present
c (Connection Data)	Must be Present	Present
.Net Type	Must be "IN"	"IN"
.Address Type	Must be "IP4"	"IP4"
.Connection Address	Far-End URL for RTP Multicast Not Supported TTL Not Supported	Local URL for RTP Multicast Not Present TTL Not Present

Field	Inbound Offer/Answer	Outbound Answer/Offer
b (Bandwidth)	Ignored	Not Present
t (Start Time)	Ignored	0
t (End Time)	Ignored	0
r (Repeat Times)	Ignored	Not Present
z (Time Zones)	Ignored	Not Present
k (Encryption)	Ignored	Not Present
m (Media Descriptions)	A media description must exist for media "audio". Other media descriptions are ignored.	A single media description is present, as below.
.Media	Ignore all except "audio".	"audio"
.Port	Far-End UDP Port for RTP	Local UDP Port for RTP
.Proto	Must be "RTP/AVP"	"RTP/AVP"
.Format	Ignore all except: <ul style="list-style-type: none"> 0 (PCMU/8000), and "telephone-event" 	Answer with Acceptance: <ul style="list-style-type: none"> 0 (μLaw), and "telephone-event" (if offered)
a (SDP Attributes)	Ignore all except: <ul style="list-style-type: none"> 0 (PCMU/8000), and "telephone-event" 	
.rtptime	Must be present for PCMU/8000. May be present for "telephone-event".	Present for 0 (PCMU/8000). Present for "telephony-event" if offered and N2SIP is configured for DTMF in RTP. Not Present for all others.
.fmtp	"telephone-event": Event codes 0-15 are accepted and useable. Events 16+ are accepted but silently discarded. "PCMU/8000": Offered attributes are silently discarded.	"telephone-event": The inbound attribute will be returned unchanged if this event type is used. Not Present for all others.
.sendonly	Ignored	Configurable option when using DTMF in out-of-band RTP.
.sendrecv	Ignored	Present when not using "sendonly".

Table 10: SDP Field Compliance

All other non-recognised fields or SDP Attributes are ignored.

6 RTP Compliance

N2SIP uses uncompressed, unencrypted, unsigned RTP for Audio Streaming.

6.1 RTP Transport

The RTP stream is negotiated in the Offer/Answer SDP interaction described above.

N2SIP supports:

- RTP over UDP
- RTP a=sendonly (mono-directional: N2SIP to soft-switch) or a=sendrecv (bi-directional).
- RTP audio payloads.
- RTP telephony event payloads.

N2SIP does not support encryption or signing of the RTP content in any form and does not support underlying transports other than UDP. Specifically:

- SRTP is not supported.
- RTP over TLS is not supported.
- RTP over TCP or SCTP is not supported.

N2SIP does not support monitoring of call quality:

- RTCP is not supported.

RTCP functionality may be disabled on the soft-switch to save resources.

6.2 RTP Packets

The following compliance is implemented for RTP packets:

RTP Field	Receive	Send
Version	Must be set to 2.	2
Padding	Supported	0 (Not Used)
Extension	Not Supported	0 (Not Used)
# CSRC	Ignored	0 (Not Used)
Marker	Ignored	0 (Not Used)
Payload Type	Must be one of: <ul style="list-style-type: none"> • 0 (G711 PCMU/8000), or • Dynamic Telephony Event 	0 (G711 PCMU/8000)
Telephony Event Code	0-15 (Digits) – accepted and processed. 16 (Flash) – accepted and ignored. Other values – accepted and ignored.	Not Present

Table 11: RTP Packet Compliance

6.2.1 Audio Payloads

Audio packets are sent out for playing announcements.

Audio packets are received in, and are either:

- Discarded (when DTMF detection uses telephony events or SIP INFO), or
- Decoded and analyzed in real-time for DTMF audio events.

Supported audio payload types are:

- PCMU/8000 (uLaw 8Khz Mono)

6.2.2 Event Payloads

Inbound event payloads are supported as per RFC 4733 [R-20].

- Event volume is ignored.

Outbound event payloads are not used.

7 Deployment - N2SRP

This chapter describes the use of the N2SIP framework when deployed as the N-Squared Specialized Resource Platform (N2SRP) product.

The N2SRP is a SIP-trunked, INAP-controlled announcement platform. It does not perform internal service logic— all interaction control is performed by an external INAP Service Control Platform (SCP).

7.1 SIP Functional Scope

The N2SRP offers a greatly reduced functional deployment of N2SIP.

N2SRP uses the following SIP Request Methods for the various SIP interactions.

Request	Inbound (to N2SRP)	Outbound (from N2SRP)
REGISTER	Supported	Not Applicable
OPTIONS	Supported	Not Applicable
INVITE (new session)	Supported	Not Applicable
re-INVITE (existing session)	Not Applicable	Not Applicable
CANCEL	Supported	Not Applicable
BYE	Supported	Used
ACK	Not Applicable	Used
PRACK	Supported	Used
INFO	Supported	Not Applicable

Table 1: SIP Request Methods (N2SRP)

In summary:

- a) All inbound SIP INVITE is accepted with 200 OK, except in the case of overload or error.
- b) All legs are inbound A-Legs. No B-Leg is established. Outbound A-Leg is not used.
- c) SIP re-INVITE is not used. The SDP is negotiated once at setup and not modified.
- d) Inbound SIP INFO may be used for DTMF digit relay.

7.2 RTP Functional Scope

Note that N2SRP is only ever an RTP end point.

N2SRP does not ever transcode or transit RTP packets.

7.3 Scenario: SRP Announcement

The only “standard” N2SRP scenario is for the SRP to play an announcement as directed by INAP/CAP PlayAnnouncement (without DTMF collection) or PromptAndCollectUserInformation (with DTMF collection).

The flow shows the “with DTMF” case.

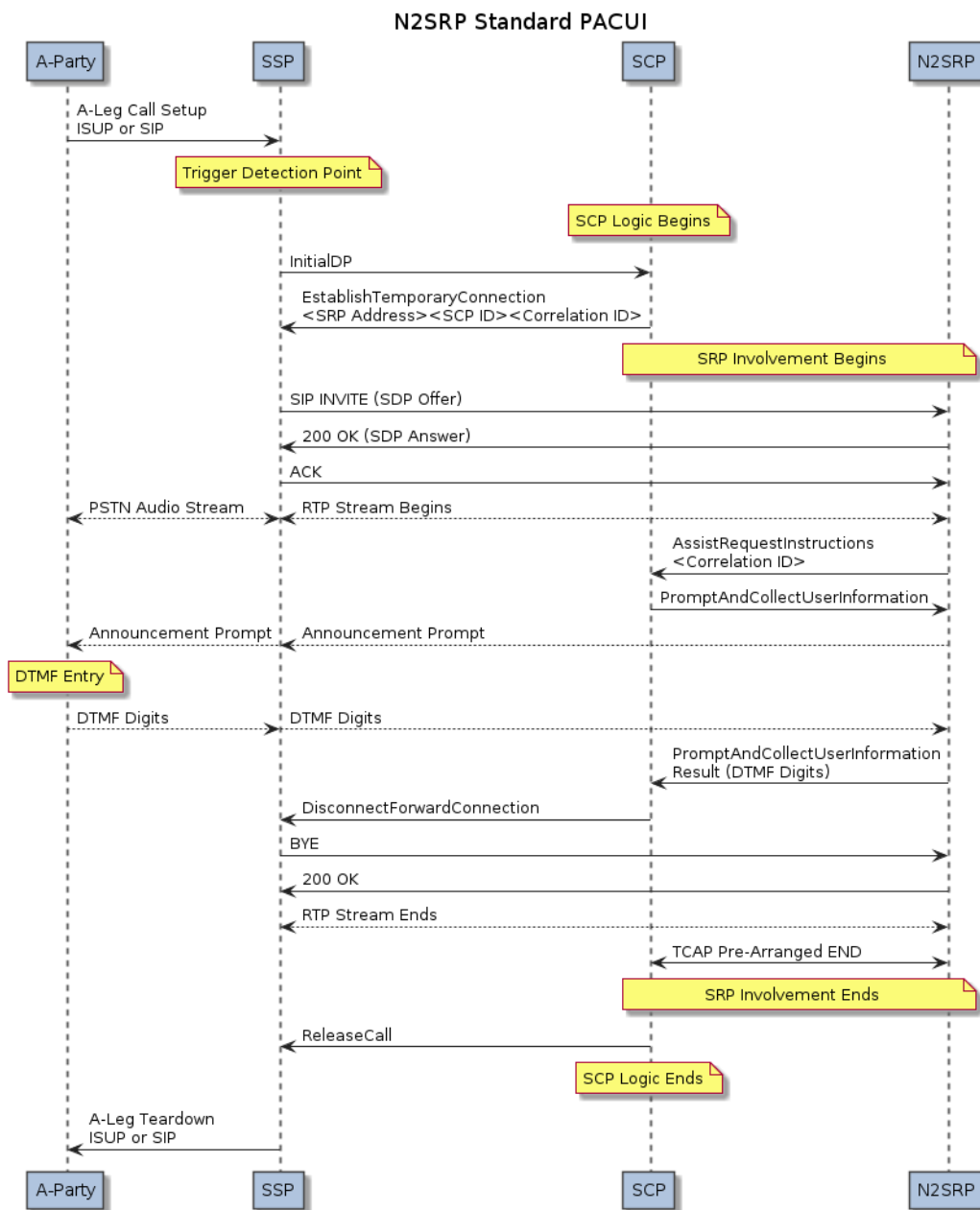


Figure K – N2SRP Flow (Standard PACUI)

Note: The N2SRP will never use 183 Early Media when playing announcements under the direction of the SCP. All SCP-controlled announcements will fully connect the call using SIP INVITE Response with status code 200 OK.

Note: All N2SRP announcements and interactions are with the A-Leg only. The N2SRP will never establish a B-Leg.

8 SIP Deployment - N2AS

This chapter describes the use of the N2SIP framework when deployed as the N-Squared Application Server (N2AS) product. N2AS locally executes service scripts written in the Lua scripting language.

8.1 SIP Functional Scope

The N2AS provides access to the complete functional deployment of N2SIP.

Request	Inbound (to N2SIP Server)	Outbound (from N2SIP Client)
REGISTER	Supported	Used
OPTIONS	Supported	Used
INVITE (new session)	Supported	Used
re-INVITE (existing session)	Not Supported	Used
CANCEL	Supported	Used
BYE	Supported	Used
ACK	Supported	Used
PRACK	Supported	Used
INFO	Supported	Not Used

Table 1: SIP Request Methods (N2AS)

The key Inbound A-Leg INVITE scenarios are:

- a) Inbound A-Leg is declined (possibly with redirection).
- b) Inbound A-Leg is provisionally accepted with 183 Session Progress for internal announcement.
- c) Inbound A-Leg is accepted with 200 OK for internal announcement.
- d) Inbound A-Leg is terminated to a B-Leg to an external INAP media server.
- e) Inbound A-Leg is terminated to a B-Leg (subscriber B-Party).

In addition, the outbound A-Leg INVITE scenarios are:

- f) Outbound A-Leg is established, then internal announcement is played.
- g) Outbound A-Leg is established and terminated to a B-Leg to an external INAP media server.
- h) Outbound A-Leg is established and terminated to a B-Leg (other endpoint).

The initial B-Leg is established with 200 OK. Subsequent B-Leg modification uses outbound re-INVITE.

In all cases, when connecting a B-Leg to the A-Leg, the N2AS acts as a Back-to-Back User Agent (B2BUA). This means that:

1. N2AS controls both legs independently.
2. N2AS copies the relevant SDP fields between the A-Leg and B-Leg Offer/Answer.
3. N2AS remains in the call for the entire talk-time, in order to coordinate the BYE sequence.

8.2 RTP Functional Scope

When playing internal announcements, N2AS is an RTP end point.

In all other scenarios, N2AS is not involved in the RTP path *at all*.

N2AS does not ever transcode or transit RTP packets.

8.3 Scenario: A-Leg Redirection

In this case, the service logic executing on the N2AS determines that the called party should be simply “translated” to another number – e.g. in the number portability lookup case. It sends a SIP Invite Response with status code 302.

The Response Contact header indicates the new (translated or prefixed) called party address.

The call is no longer under control of the N2AS. The SSP will perform call redirection,.

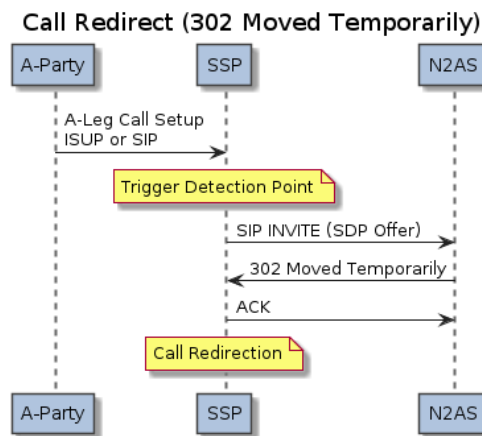


Figure L – N2AS Flow (Redirect)

8.4 Scenario: A-Leg Screening

In this case, the service logic executing on the N2AS determines that the call is not permitted and should be dropped. It sends a SIP Invite Response with status code 470, or any other appropriate status code as may be desired.

The call is no longer under control of the N2AS. The SSP will perform call release,.

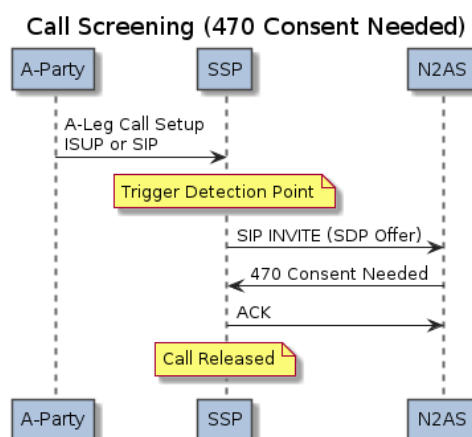


Figure M – N2AS Flow (Screening)

8.5 Scenario: Internal Announcement (200 OK)

The N2AS may be configured with internal announcement support. This allows the service logic to play announcements (to the A-Leg only), with optional DTMF collection.

The flow shows the use of the internal media service, with SIP INVITE Response 200 OK.

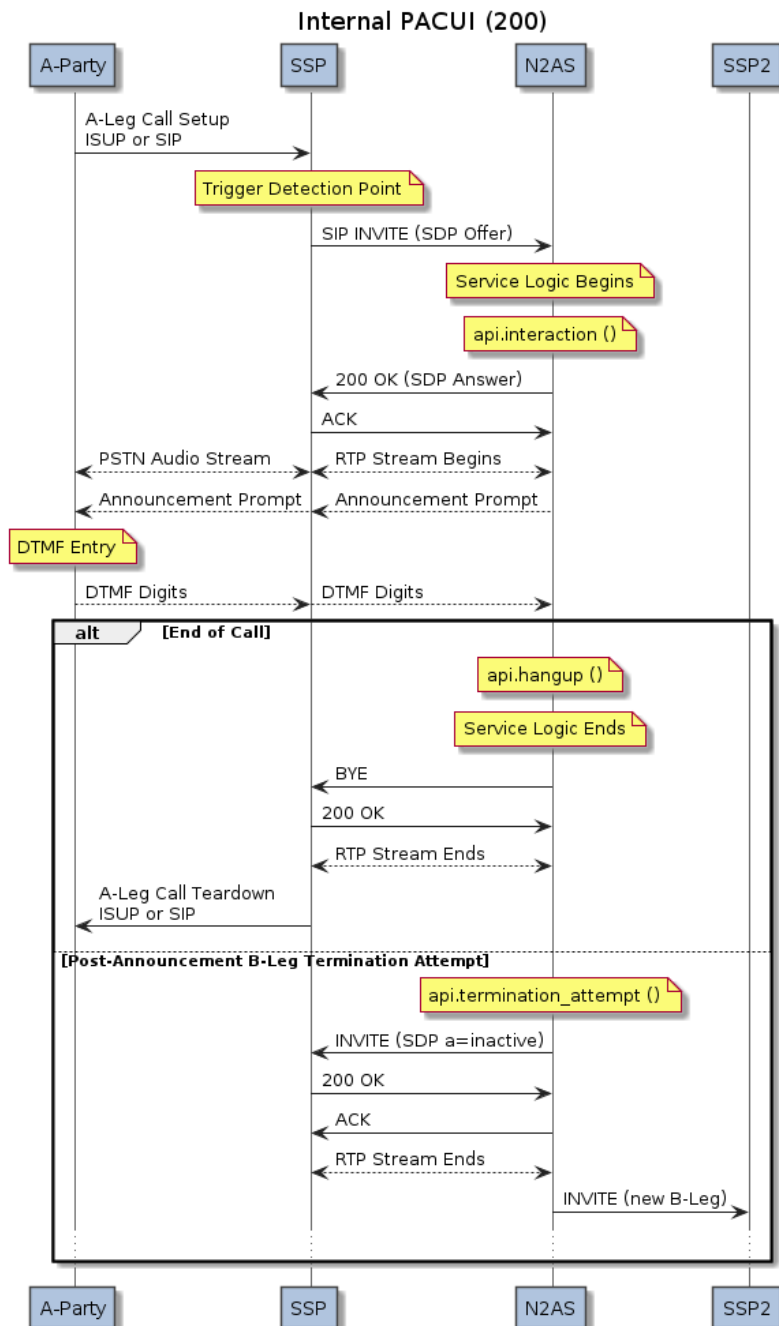


Figure N – N2SRP Flow (Internal PACUI with 200 OK)

The service logic may subsequently perform any other valid SIP call control action, e.g.

- Hangup (SIP BYE)
- Termination Attempt (B-Leg INVITE to B-Party, re-INVITE to A-Party)
- External Announcement (B-Leg INVITE to SRP, re-INVITE to A-Party)

8.6 Scenario: Internal Announcement (183 Session Progress)

The N2AS may be configured with internal announcement support. This allows the service logic to play announcements (to the A-Leg only), with optional DTMF collection.

The N2AS supports the option for using 183 Session Progress (early media) for announcements.

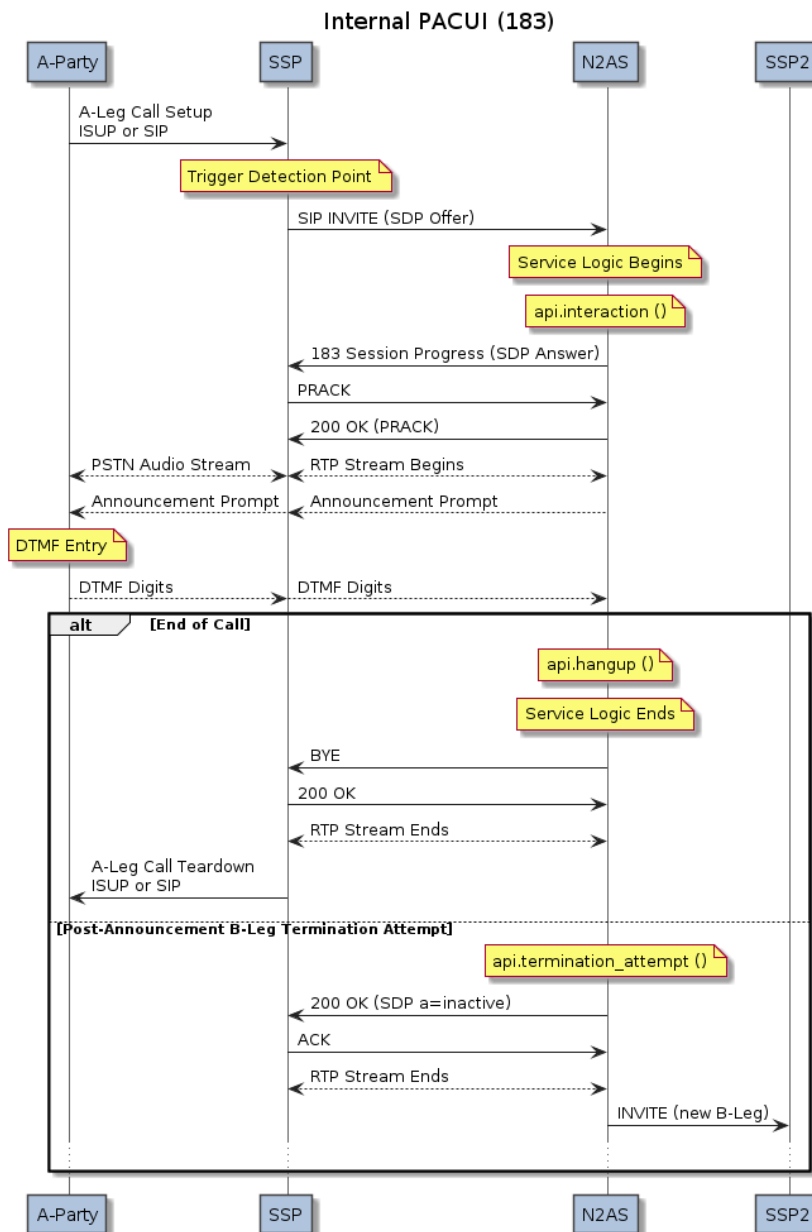


Figure O – N2SRP Flow (Internal PACUI with Early Media)

The service logic may subsequently perform any other valid SIP call control action, e.g.

- Final SIP INVITE Response with status code 300-699.
- Hangup (SIP BYE, if dialog is established)
- Termination Attempt (B-Leg INVITE to B-Party)
- External Announcement (B-Leg INVITE to SRP)

8.7 Scenario: External Announcement

Service logic in N2AS may play announcements using an external INAP-controlled SRP such as N2SRP. The SRP B-Leg is established with SIP INVITE. The A-Leg and B-Legs are joined with re-INVITE.

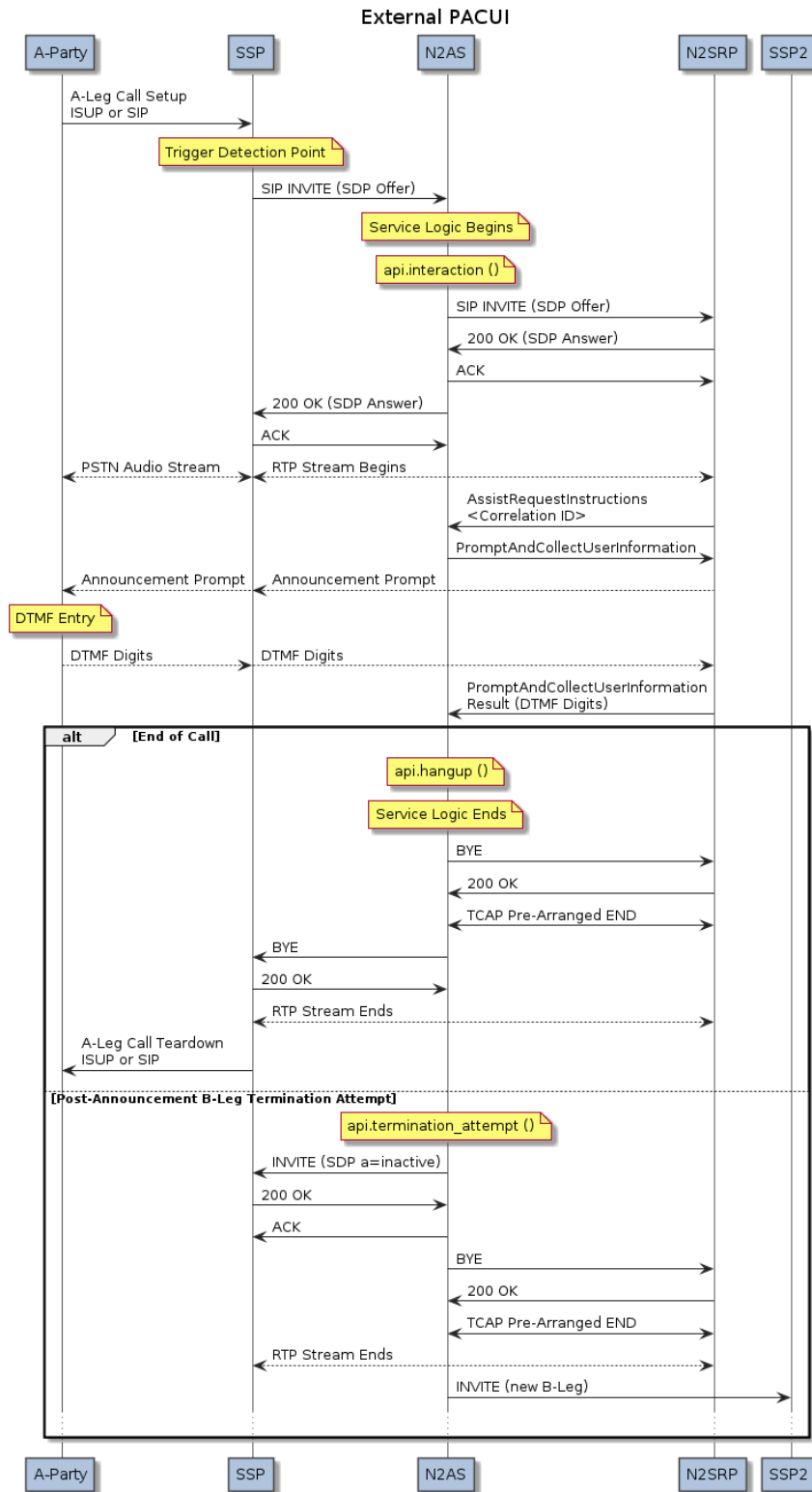


Figure P – N2SRP Flow (External INAP-controlled SRP)

Post-announcement B-Leg termination attempts are supported, using re-INVITE.

8.8 Scenario: B-Leg Termination Attempt

Service logic in N2AS may play announcements using an external INAP-controlled SRP such as N2SRP. The SRP B-Leg is established with SIP INVITE. The A-Leg and B-Legs are joined with re-INVITE.

This flow shows a B-Leg hunting sequence with three attempts to terminate the B-Leg.

This Part 1 shows (a) a Busy result, and then (b) a No Answer where the N2AS no-answer timer expires before the B-Leg returns a final response. The B-Leg is cancelled.

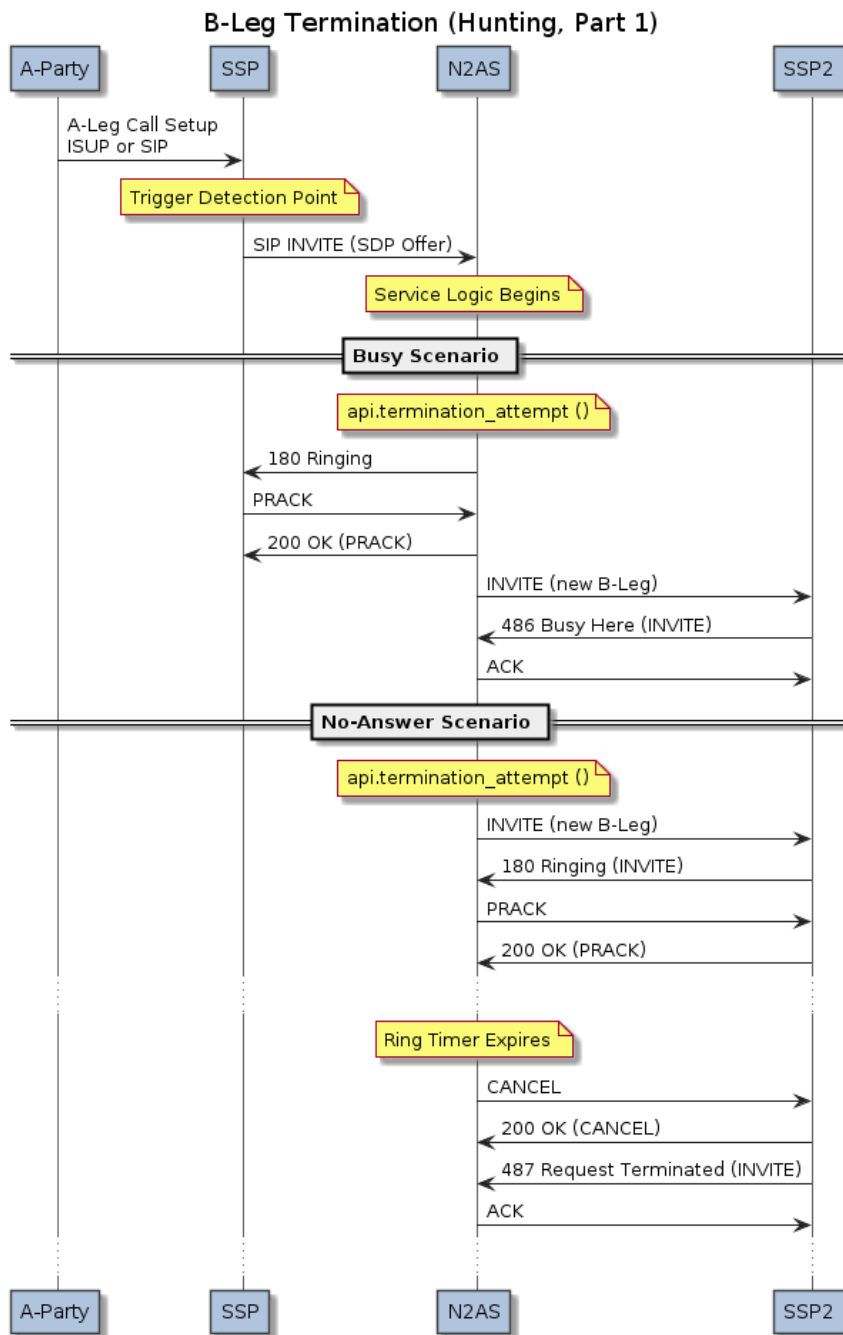


Figure Q – N2SRP Flow (B-Leg Termination, Part 1)

This final Part 2 shows the successful B-Leg termination attempt and the end-of-call cleanup.

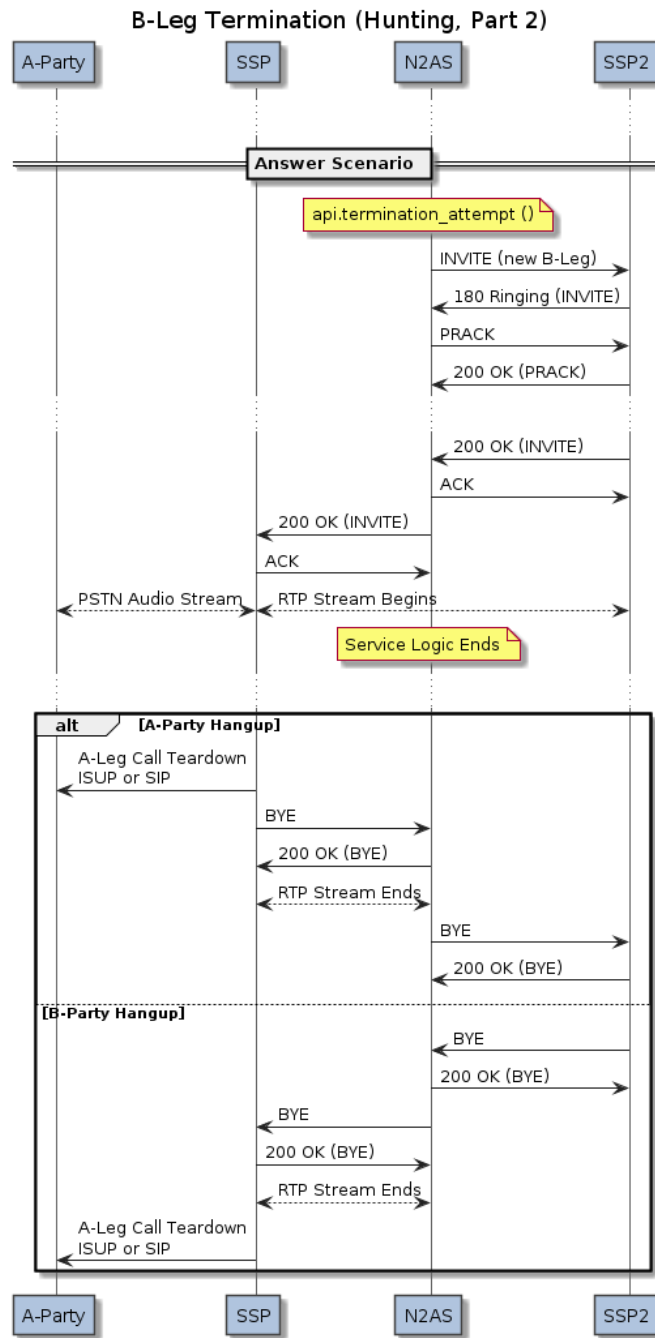


Figure R – N2SRP Flow (B-Leg Termination, Part 2)

Note that after the successful B-Leg termination attempt, the service logic no longer has any control over the call flow. However the underlying N2SIP framework must remain in the SIP path in order to coordinate the end-of-call cleanup.