N-Squared Software SIP Specialized Resource Platform
SIP-SDP-RTP Protocol Conformance Statement

Version 2.3

1   Document Information

1.1   Scope and Purpose

This document describes the implementation of the SIP, SDP, and RTP protocols for real-time SRP flows for voice interaction control using the N-Squared (N2) SIP Specialized Resource Platform (SRP) when used in conjunction with a SIP-capable soft-switch. It should be read in conjunction with the N2 SRP Technical Guide [R-1].

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. a SRP (or Intelligent Peripheral).

1.2   Definitions, Acronyms, and Abbreviations

Term	Meaning
AC	Application Context (in TCAP)
API	Application Programming Interface
ARI	Assist Request Instructions
ASN.1	Abstract Syntax Notation One
BER	Basic Encoding Rules
CAMEL	Customized Applications for Mobile Network Enhanced Logic
CAP	CAMEL Application Part
GT	Global Title
IETF	Internet Engineering Task Force
INAP	Intelligent Networking Application Part
IP	Intelligent Peripheral
M3UA	MTP3 User Adaption Layer
MTP3	Message Transfer Part Level 3
N2	N-Squared
PA	Play Announcement
PACUI	Prompt And Collect User Information
PC	Point Code
RFC	Request For Comments
RTCP	RTP Control Protocol
RTP	Real-time Transport Protocol
SCCP	Signalling Connection Control Part
SCP	Service Control Platform
SCTP	Stream Control Transmission Protocol
SDP	Session Description Protocol
SIP	Session Initiation Protocol
SRP	Specialized Resource Platform
SRR	Specialized Resource Report
SSN	Sub-System Number

Term	Meaning
SSP	Service Switching Platform
SUA	SCCP User Adaption Layer
TCAP	Transaction Capabilities Application Part
TCP	Transmission Control Protocol
TS	Technical Specification

1.3   References

The following documents are referenced within this document:

Reference	Document
[R-1]	N2 SRP Technical Guide
[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

1.4   Ownership and Usage

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2   Contents

3   Introduction

3.1   N2 SRP Overview

The N-Squared SIP Specialized Resource Platform (SRP) 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).

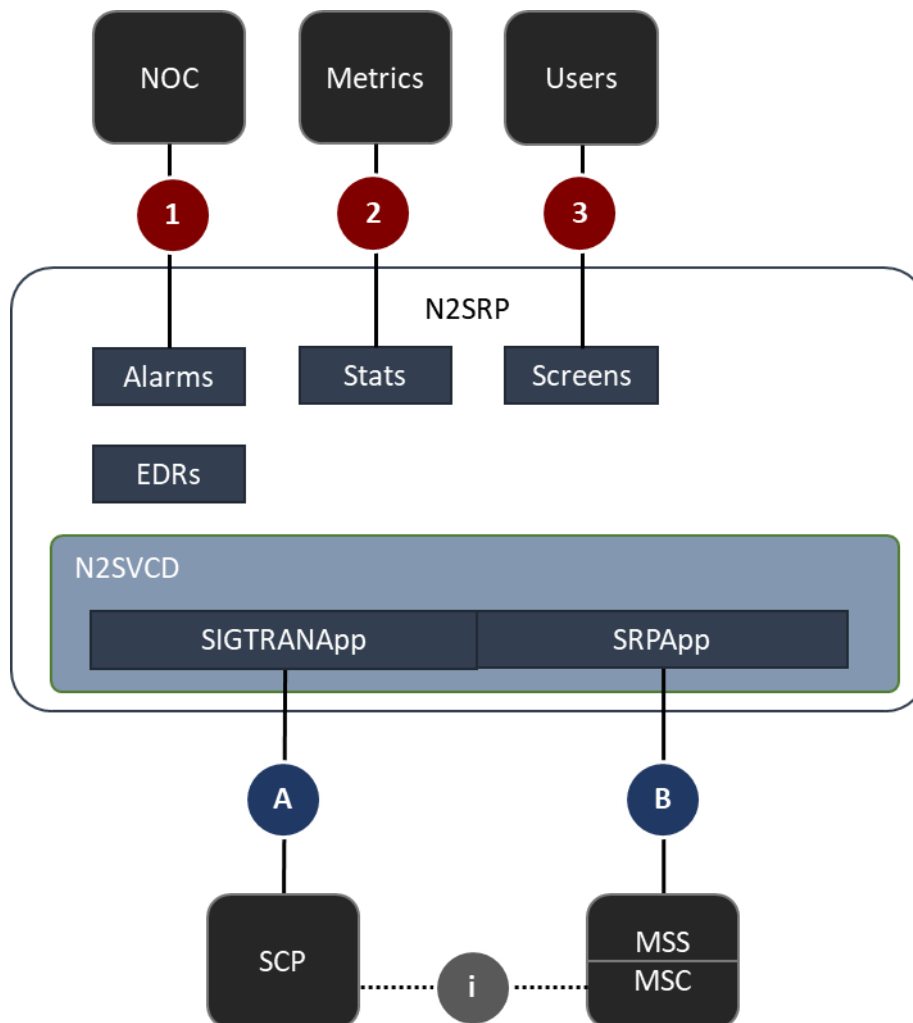A standard N2SRP deployment contains several integration points:

Figure A: N2 SRP Overview

This document describes the N2SRP Compliance for Interface "B", which has the following stack:

- SIP
- SDP
- RTP
- UDP/IP

4   SIP Compliance

4.1   SIP Overview

The N2SRP communicates with a core network soft-switch to set-up and tear-down 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.

N2SRP to soft-switch SIP interface compliance is formally based on the following standards:

- IETF RFC 3261 "SIP: Session Initiation Protocol" [R-10].
- IETF RFC 3581 "An Extension to the Session Initiation Protocol (SIP) for Symmetric Response Routing" [R-13]

Solution compliance to the above is limited to the extent expressly described herein.

The following standards are referenced but are not supported:

- IETF RFC 2967 "The SIP INFO Method"
- IETC RFC 3262 "Reliability of Provisional Responses in the Session Initiation Protocol (SIP)"

4.2   SIP Request Methods

The N2SRP supports the following SIP Request Methods when communicating with the soft-switch.

Request	Inbound (to SRP Server)	Outbound (from SRP Client)
REGISTER	Supported	Not Used
OPTIONS	Supported	Not Used
INVITE (new session)	Supported	Not Used
INVITE (existing session)	Not Supported	Not Used
CANCEL	Supported	Not Used
BYE	Supported	Supported
ACK	Supported	Supported

Table 1: SIP Requests

4.3   Global SIP Request Handling

The following compliance applies to all inbound SIP Requests.

4.3.1   Header Compact Form

The N2SRP does not support receiving inbound compact form headers for SIP Requests and does not send any compact form headers for SIP Requests or SIP Responses.

4.3.2   SIP Transport

The N2SRP supports UDP transport only for SIP and does not support any signalling encryption or signing/authentication mechanism.

Specifically:

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

4.3.3   Global Inbound SIP Request Headers

All inbound SIP Requests must be well-formed according to [RFC 3261 section 27.1 Option Tags] (including Method and URI) and must also have the following headers present:

Request Header	Type	Notes
Call-Id	String	Most be present.
Via	String	Must be present.
.sent-protocol	String	"SIP/2.0/UDP"
.sent-by	String	Must include host. May include port.
.via-branch	String	Must be present.
.rport	Integer	Supported.
From	String	Must be present.
To	String	Must be present.
CSeq	String	Must be present.
.Number	Integer	Must be present.
.Method	String	Must be present.
Content-Length	Integer	May be present.

Table 2:   Global Mandatory Inbound SIP Request Headers

4.3.4   Unrecognized Inbound Header Parameters

As per [RFC 3261 section 20 Header Fields], the N2SRP will ignore all inbound header parameters (see [RFC 3261 section 7.3 Header Fields]) which are not understood.

4.3.5   Global Response to Misformatted Inbound SIP Request

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"

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 1: Global SIP Response for Misformatted SIP Request

Note that N2SRP handling for Misformatted Inbound SIP Requests does not create or correlate to any SIP Transaction, does not set timers and does not create any Transaction state machine. In case of failure, no attempt will be made to re-send this SIP Response.

4.3.6   Global Response to Well-Formatted Inbound SIP Request

In the general case, all SIP Responses sent by N2SRP to well-formatted Inbound SIP Requests will be well-formed SIP Responses according to [RFC 3261 section 7.2 Responses] (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".
.sent-by	String	Will include host. Include port from Request if present.
.via-received	String	Present if requested by inbound "rport" or if inbound Via Sent By host was not numeric.
.via-branch	String	Always present.
.rport	String	Present if requested by inbound "rport".
From	String	Always present, will include remote "tag" if provided.
To	String	Always present, will include local "tag" if relevant.
User-Agent	String	Set to configurable value, default "N-Squared SIP".
CSeq	String	Always present.
Error-Info	String	Free-form error message present iff Status Code != 2xx.
Content-Length	Integer	Always present.

Table 1: Global Outbound SIP Response Headers

4.4   REGISTER (Server/Inbound)

The N2SRP SIP Server supports inbound SIP REGISTER Requests and will indicate Success. However, the N2SRP does not store the registration Request or perform any processing for registrations.

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

Request Attribute	Type	Notes
Request Method	String	REGISTER
Request Header	**Type**	**Notes**
Global Mandatory Inbound Headers, Plus…		
From		Must be present.
.URI	URI	Must be present and = To URI.
To		Must be present.
.URI	URI	Must be present and = From URI.
Contact	String	Must be present.
.Address	String	Must be present.
.expires	Integer	Optional. Default value 3600 seconds.

Table 2:   Inbound SIP REGISTER Request

Any content body for the REGISTER Request is ignored.

4.4.1   REGISTER Server Transaction

The N2SRP will create a SIP Server non-INVITE Transaction for the SIP REGISTER Request as described by [RFC 3261 section 17.2.2 Non-INVITE Server Transaction, also Figure 8] and will obey the timers and retransmission rules defined by this state machine.

4.4.2   REGISTER Response (Declined)

If a well-formed REGISTER Request is declined, then N2SRP will send a SIP Response with Status Code != 2xx and constructed according to the rules defined in [4.3.6 Global Response to Well-Formatted Inbound SIP Request].

The following is a list of the supported Status Codes, along with the most common Error-Info strings used when declining a well-formatted REGISTER Request. The list of errors 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
500	Received REGISTER with From URI != To URI.
500	Received REGISTER with no 'Contact'.
500	<Any other exception string generated internally during processing>

Table 3:   Indicative List of REGISTER Codes and Error-Info Strings

4.4.3   REGISTER Response (Accepted)

If the REGISTER Request is accepted, then N2SRP will generate a SIP Response with status 200 OK.

Response Header	Type	Notes
Global Mandatory Outbound Headers, Plus…		
Allow	String	"INVITE, ACK, BYE, CANCEL, OPTIONS, REGISTER"
Accept	String	"application/sdp"
Contact Address	String	Copy of received Contact Address.
Contact "expires"	Integer	Always present.

Table 4:   Outbound SIP REGISTER Response Headers

The N2SRP implements the non-INVITE Server Transaction timers and re-transmission mechanism for this response as described in RFC 3261.

4.5   OPTIONS (Server/Inbound)

The N2SRP SIP Server supports inbound SIP OPTIONS Requests.

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

Request Attribute	Type	Notes
Request Method	String	OPTIONS
Request Header	**Type**	**Notes**
Global Mandatory Inbound Headers Only		

Table 5:   Inbound SIP OPTIONS Request

Any content body for the OPTIONS Request is ignored.

4.5.1   OPTIONS Server Transaction

The N2SRP will create a SIP Server non-INVITE Transaction for the SIP OPTIONS Request as described by [RFC 3261 section 17.2.2 Non-INVITE Server Transaction, also Figure 8] and will obey the timers and retransmission rules defined by this state machine.

4.5.2   OPTIONS Response (Accepted)

All well-formed OPTIONS requests are accepted. The N2SRP will generate a SIP Response with status 200 OK.

Response Header	Type	Notes
Global Mandatory Outbound Headers, Plus…		
Allow	String	"INVITE, ACK, BYE, CANCEL, OPTIONS, REGISTER"
Accept	String	"application/sdp"

Table 6:   Outbound SIP OPTIONS Response Headers

The N2SRP implements the non-INVITE Server Transaction timers and re-transmission mechanism for this response as described in RFC 3261.

4.6   INVITE (Server/Inbound)

The N2SRP SIP Server supports inbound SIP INVITE Requests for creating inbound voice sessions, being the primary function of the N2SRP platform.

Note: The N2SRP supports only INVITE for creating a new session/dialog. The N2SRP does not support the re-INVITE functionality of [RFC 3261 section 14 Modifying an Existing Session].

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

Request Attribute	Type	Notes
Request Method	String	INVITE
Request Header	**Type**	**Notes**
Global Mandatory Inbound Headers, Plus…		
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 INAP-controlled SRP, the N2SRP does not use the "From" address. When operating as an independent (internal logic) IVR, the N2SRP service logic may use this From URI in processing logic.
.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, the 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, the N2SRP service logic may use this To URI in processing logic.
.tag	String	Must not be present, as this would indicate re-INVITE which is not supported by N2SRP.
Content-Type	String	Must be = "application/sdp".
Request Content	**Type**	**Notes**
SDP Session "Offer", See Separate SDP Section		

Table 7:   Inbound SIP INVITE Request

See the SDP Section of this document for the N2SRP SDP conformance statement.

4.6.1   INVITE Server Transaction

If the INVITE Transaction is accepted, the N2SRP will create a SIP Server INVITE Transaction for the SIP INVITE Request as described by [RFC 3261 section 17.2.1 INVITE Server Transaction, also Figure 7] and will obey the timers and retransmission rules defined by this state machine.

4.6.2   INVITE Response (Declined)

If a well-formed INVITE Request is declined, then N2SRP will send a SIP Response with non-2xx Status Code and constructed according to the rules defined in [4.3.6 Global Response to Well-Formatted Inbound SIP Request].

The following is a list of the supported Status Codes, along with the most common Error-Info strings used when declining a well-formatted INVITE Request. The list of errors 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	Invite has 'To' (local) tag but does not match a known Dialog. <Will occur if re-INVITE is used. N2SRP 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 8:   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.

The N2SRP implements the INVITE Server Transaction timers and re-transmission mechanism for this response as described in RFC 3261.

4.6.3   INVITE Response (Provisional)

If the INVITE Request is accepted, then N2SRP will immediately generate a provisional SIP Response with status 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**
Global Mandatory Outbound Headers Only		

Table 9:   Outbound SIP INVITE Provisional Response Headers

Note that provisional ACK for this response is not implemented at this time.

4.6.4   INVITE Response (Early Media)

Depending on configuration, the N2SRP platform may use Early Media for some interactions, in which case the following INVITE Response structure is used.

Response Attribute	Type	Notes
Response Status Code	Integer	183
Response Status Message	String	"Session Progress"
Response Header	**Type**	**Notes**
Global Mandatory Outbound Headers, plus…		
Content-Type	String	"application/sdp"
Response Content	**Type**	**Notes**
SDP Session "Answer", See Separate SDP Section		

Table 10: Outbound SIP INVITE Early Media Response Headers

Note that provisional ACK for this response is not implemented at this time, and for this reason Early Media is not recommended as an approach.

4.6.5   INVITE Response (OK)

If Early Media is not enabled, the N2SRP 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
Response Status Message	String	"OK"
Response Header	**Type**	**Notes**
Global Mandatory Outbound Headers, plus…		
Content-Type	String	"application/sdp"
Response Content	**Type**	**Notes**
SDP Session "Answer", See Separate SDP Section		

Table 11: Outbound SIP INVITE Acceptance Response Headers

The N2SRP waits for the ACK on this response and implements the transport layer re-transmission for INVITE 200 OK as described in [RFC 3261 section 17.2.1 INVITE Server Transaction].

4.7   ACK (Server/Inbound)

The N2SRP SIP Server supports inbound SIP ACK Requests:

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

4.7.1   ACK Request (Within INVITE Transaction)

The SRP supports receiving the following attributes and headers in inbound ACK in the context of an existing INVITE Inbound Server Transaction for which N2SRP responded with Status Code 300-699.

Request Attribute	Type	Notes
Request Method	String	ACK
Request Header	**Type**	**Notes**
Global Mandatory Inbound Headers, Plus…		
CSeq		Present
.Method	String	INVITE
.Number	Integer	= INVITE CSeq Number
Via		*Global Mandatory Inbound "Via" Header, plus…*
.via-branch	String	Must match existing INVITE Transaction.

Table 12: Inbound SIP ACK Request for INVITE Response 300-699

Any content body for the ACK Request is ignored.

4.7.2   ACK Request (New Transaction Within INVITE Dialog)

The N2SRP SIP Server supports receiving the following attributes and headers in inbound ACK as a new Transaction in the context of an existing INVITE Inbound Server dialog for which N2SRP responded to the initial INVITE Transaction with Status Code 2xx.

Request Attribute	Type	Notes
Request Method	String	ACK
Request Header	**Type**	**Notes**
Global Mandatory Inbound Headers, Plus…		
CSeq		Present
.Method	String	ACK
.Number	Integer	= INVITE CSeq Number
From		*Global Mandatory Inbound "From" Header, plus…*
.tag	String	Must be present as the remote Dialog tag.
To		*Global Mandatory Inbound "To" Header, plus…*
.tag	String	Must be present as the local Dialog tag.

Table 13: Inbound SIP ACK Request for INVITE Response 300-699

Any content body for the ACK Request is ignored.

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

4.8   CANCEL (Server/Inbound)

The N2SRP SIP Server supports inbound SIP CANCEL Requests as part of an INVITE Transaction.

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

Request Attribute	Type	Notes
Request Method	String	CANCEL
Request Header	**Type**	**Notes**
Global Mandatory Inbound Headers, Plus…		
CSeq		Present
.Method	String	CANCEL
.Number	Integer	= INVITE CSeq Number
Via		Global Mandatory Inbound "Via" Header, plus…
.via-branch	String	Must match existing INVITE Transaction.

Table 14: Inbound SIP CANCEL Request for INVITE

Any content body for the CANCEL Request is ignored.

4.8.1   CANCEL Response (Declined)

If a well-formed CANCEL Request is declined, then N2SRP will send a SIP Response with Status Code != 2xx and constructed according to the rules defined in [4.3.6 Global Response to Well-Formatted Inbound SIP Request].

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 errors 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 15: Indicative List of CANCEL Codes and Error-Info Strings

4.8.2   CANCEL Response (Accepted)

If the CANCEL Request is accepted, then N2SRP will generate a SIP Response with status 200 OK.

Response Header	Type	Notes
Global Mandatory Outbound Headers Only		

Table 16: Outbound SIP CANCEL Response Headers

The N2SRP implements the non-INVITE Server Transaction timers and re-transmission mechanism for this response as described in RFC 3261.

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

4.9   BYE (Server/Inbound)

The N2SRP SIP Server supports inbound SIP BYE Requests in the context of an existing, confirmed SIP Dialog. This is the normal mechanism for clean shutdown of a SIP session in standard N2SRP usage.

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

Request Attribute	Type	Notes
Request Method	String	BYE
Request Header	**Type**	**Notes**
Global Mandatory Inbound Headers, Plus…		
From URI	String	Must be present and = To URI.
From "tag"	String	Must be present as the remote Dialog tag.
To URI	String	Must be present and = From URI.
To "tag"	String	Must be present as the local Dialog tag.

Table 17: Inbound SIP BYE Request

Any content body for the BYE Request is ignored.

4.9.1   BYE Server Transaction

The N2SRP will create a SIP Server non-INVITE Transaction for the SIP BYE Request as described by [RFC 3261 section 17.2.2 Non-INVITE Server Transaction, also Figure 8] and will obey the timers and retransmission rules defined by this state machine.

4.9.2   BYE Response (Declined)

If a well-formed BYE Request is declined, then N2SRP will send a SIP Response with Status Code != 2xx and constructed according to the rules defined in [4.3.6 Global Response to Well-Formatted Inbound SIP Request].

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 errors 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 BYE does not match a known INVITE transaction>
500	<Any other exception string generated internally during processing>

Table 18: Indicative List of BYE Codes and Error-Info Strings

4.9.3   BYE Response (Accepted)

If the BYE Request is accepted, then N2SRP will generate a SIP Response with status 200 OK.

Response Header	Type	Notes
Global Mandatory Outbound Headers Only		

Table 19: Outbound SIP BYE Response Headers

The N2SRP implements the non-INVITE Server Transaction timers and re-transmission mechanism for this Response as described in RFC 3261.

4.10 BYE (Client/Outbound)

The N2SRP SIP Server supports sending outbound SIP BYE Requests in the context of an existing, confirmed SIP Dialog. Note that this mechanism is generally used only in exception/abort cases, in normal operation the SIP session will be shutdown by the soft-switch.

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

Request Attribute	Type	Notes
Request Method	String	BYE
Request Header	**Type**	**Notes**
Global Mandatory Inbound Headers, Plus…		
From URI	String	Present and = To URI.
From "tag"	String	Present as the local Dialog tag.
To URI	String	Present and = From URI.
To "tag"	String	Present as the remote Dialog tag.

Table 20: Outbound SIP BYE Request

No content body is created for the BYE Request.

4.10.1 BYE Client Transaction

The N2SRP will create a SIP Client non-INVITE Transaction for the SIP BYE Request as described by [RFC 3261 section 17.1.2 Non-INVITE Client Transaction, also Figure 6] and will obey the timers and retransmission rules defined by this state machine.

4.10.2 BYE Response

The N2SRP accepts well-formatted SIP Responses to the BYE Request and expects a 200 OK Response. Other responses are logged as warnings, but the SIP session will be terminated in any case.

5   SIP Message Flows

5.1   Introduction

The following SIP message flows are supported by the N2SRP.

Note that re-transmission and timer management for SIP Transactions is performed according to the state machines and timers defined in [RFC 3261 Figure 5, Figure 6, Figure 7, and Figure 8]. Re-transmission scenarios are too numerous to depict here and are not shown.

The N2SRP does not support any flow sequences other than those (including their RFC 3261 re-transmission variants) shown herein. For other sequences, the behavior of N2SRP will be to reject (or ignore) the unexpected request/response, and/or to tear-down the in-progress session.

5.2   Inbound SIP REGISTER

The N2SRP supports inbound SIP REGISTER but does not actually store registrations.

If possible, the use of SIP REGISTER should be disabled on the soft-switch to save resources.
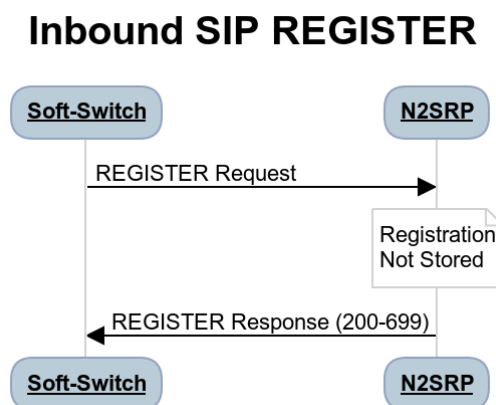

Figure 1: Inbound SIP REGISTER

The client may re-use the Via "branch" for subsequent registrations, however the N2SRP will not retain an open transaction in this case and will discard REGISTER transaction context at the expiry of Timer J in RFC 3261 Figure 8.

5.3   Inbound SIP OPTIONS

The N2SRP supports inbound SIP OPTIONS. The set of options returned is static.

If possible, the use of SIP OPTIONS should be disabled on the soft-switch to save resources.
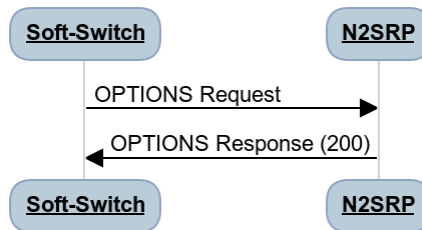
Inbound SIP OPTIONS

Figure 2: Inbound SIP OPTIONS

5.4 Inbound SIP INVITE (including ACK, BYE, and CANCEL)

5.4.1 Inbound SIP INVITE (Declined)
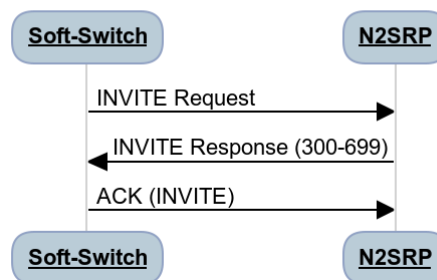
A SIP INVITE may be immediately declined by N2SRP.

Figure 3: Inbound SIP INVITE (immediate decline)

A SIP INVITE may be declined by N2SRP after sending Response with Status Code 100.
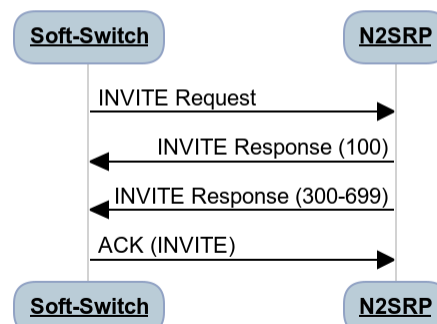

Figure 4: Inbound SIP INVITE (decline after 100 Status)

5.4.2   Inbound SIP INVITE (Early CANCEL)

The following flow shows the client terminating a SIP Session prior to establishment. Note that the lack of "ring time" means this scenario will typically be subject to race conditions.
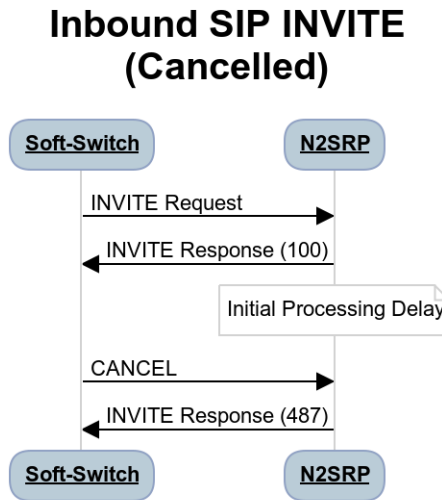
Inbound SIP INVITE (Cancelled)

Figure 5: Inbound SIP INVITE (Early CANCEL)

5.4.3   Inbound SIP INVITE (Early Media)

When using 183 Early Media, the following message flow applies, including CANCEL:
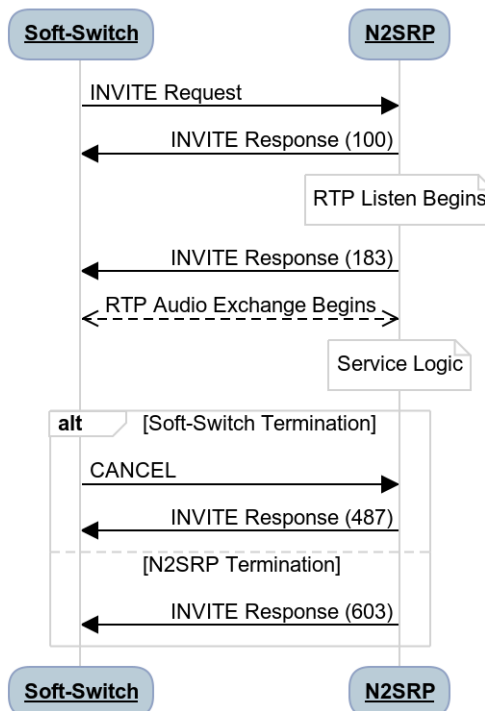
Inbound SIP INVITE (Early Media)

Figure 6: Inbound SIP INVITE (early media)

5.4.4   Inbound SIP INVITE (Session Estabilished)

The standard "Session Established" flow is as follows.
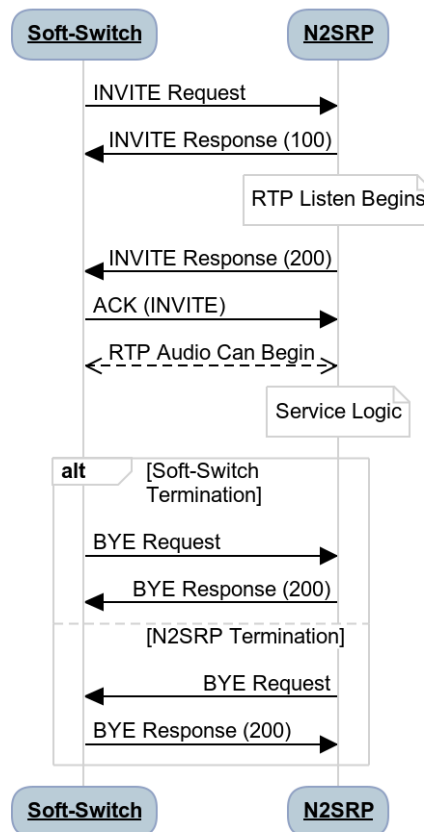
Inbound SIP INVITE & BYE

Figure 7: Inbound SIP INVITE (session established, tear-down with BYE)

Note that the initiating party for the BYE tear-down will depend on the service logic mechanism and the reason for session termination.

- For INAP call-control scenarios, the SCP typically uses the INAP DisconnectForwardConnect operation to request the soft-switch to tear-down the call.
- For internal service logic, the N2SRP will make the decision to tear-down the call.
- When the A-Party abandons the session, the soft-switch will tear-down the call.

6   SDP Compliance

The N2SRP INVITE Transaction uses the SDP "Offer"/"Answer" model to negotiate the RTP stream using "application/sdp" SIP Content.

N2SRP to soft-switch SDP interface compliance is formally based on the following standards:

- IETF RFC 4566 "SDP: Session Description Protocol" [R-11].

Solution compliance to the above is limited to the extent expressly described herein.

6.1   SDP Transport

The SDP Offer from the soft-switch must be provided to the N2SRP Server as "application/sdp" in the inbound SIP INVITE Request. N2SRP 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.

The N2SRP does not support encryption or signing of the SDP content in any form.

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

6.2   SDP Fields

The following compliance is implemented for SDP Fields.

Field	Inbound Offer	Outbound Answer
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 IP for RTP Multicast Not Supported TTL Not Supported	N2SRP IP for RTP Multicast Not Present TTL Not Present
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.
.Media	Ignore all except "audio".	"audio"
.Port	Far-End UDP Port for RTP	N2SRP UDP Port for RTP
.Proto	Must be "RTP/AVP"	"RTP/AVP"
.Format	Ignore all except: • 0 (PCMU/8000), and • "telephone-event"	Answer with Acceptance: • 0 (µLaw), and • "telephone-event" (if offered)
a (SDP Attributes)	Ignore all except: • 0 (PCMU/8000), and • "telephone-event"	
.rtpmap	Must be present for PCMU/8000. May be present for "telephone-event".	Present for 0 (PCMU/8000). Present for "telephony-event" if offered and N2SRP is configured for DTMF in RTP. Not Present for all others.
.fmtp	Ignored	Specify "0-11" for "telephony-event" if offered and if N2SRP is configured to accept DTMF in out-of-band RTP. 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 21: SDP Field Compliance

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

7   RTP Compliance

The N2SRP uses uncompressed, unencrypted, unsigned RTP for Audio Streaming.

N2SRP to soft-switch RTP interface compliance is formally based on the following standards:

- IETF RFC 3550 "RTP: A Transport Protocol for Real-Time Applications" [R-12].

Solution compliance to the above is limited to the extent expressly described herein.

7.1   RTP Transport

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

The N2SRP supports:

- RTP over UDP
- RTP PCMU/8000 (uLaw 8Khz Mono).
- RTP a=sendonly (mono-directional: N2SRP to soft-switch) or a=sendrecv (bi-directional).
- RTP telephony event (out-of-band DTMF detection, mono-directional: soft-switch to N2SRP).

The N2SRP does not support encryption or signing of the RTP content in any form and does not support underlying transports other than UDP.

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

The N2SRP does not support monitoring of call quality:

- RTCP is not supported.

RTCP functionality should be disabled on the soft-switch to avoid confusion and waste of resources.

7.2   RTP Packets

The following compliance is implemented for RTP packets:

RTP Field	Receive	Send
Version	Must = 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 = • 0 (G711 PCMU/8000), or • Dynamic Telephony Event	0 (G711 PCMU/8000)

Table 22: RTP Packet Compliance