
# N-Squared Software N2IVR
# INAP Protocol Conformance Statement

Version 2024-06

# 1 Document Information

## 1.1 Scope and Purpose

This document describes the implementation of the INAP (including CAMEL variants) protocols for real-time flows for voice interaction control using the N-Squared (N2) SIP Interactive Voice Response Platform (N2IVR) when it is acting as an INAP Intelligent Peripheral (IP) or INAP Specialized Resource Platform (SRP) under the guidance of an INAP Service Control Platform (SCP).

This document should be read in conjunction with the N2IVR Technical Guide [R-1].

This document assumes a working knowledge of the relevant INAP and other telephony concepts, including the standard INAP interactions between an SCP, an SSP, and an SRP or IP. A familiarity with SIP call control is also assumed.

## 1.2 Definitions, Acronyms, and Abbreviations

| Term | Meaning |
|---|---|
| AC | Application Context (in TCAP) |
| ARI | Assist Request Instructions |
| AS | Application Server |
| ASP | Application Server Process |
| ASPAC | ASP Active |
| ASPTM | ASP Traffic Maintenance |
| ASN.1 | Abstract Syntax Notation One |
| CAMEL | Customized Applications for Mobile Network Enhanced Logic |
| CAP | CAMEL Application Part |
| DTMF | Dual Tone Multi-Frequency |
| ETSI | European Telecommunications Standards Institute |
| GT | Global Title |
| GTI | Global Title Indicator |
| IETF | Internet Engineering Task Force |
| INAP | Intelligent Networking Application Part |
| IP | Internet Protocol |
| ITU-T | International Telecommunication Union Telecommunication Standardization Sector |
| M3UA | MTP3 User Adaption Layer |
| MTP3 | Message Transfer Part Level 3 |
| N2 | N-Squared |
| OCNCC | Oracle Communications Network Charging & Control |
| PA | Play Announcement |
| PACUI | Prompt And Collect User Information |
| PC | Point Code |
| RFC | Request For Comments |
| RI | Routing Indicator |
| RTP | Real-Time Transport Protocol |

| Term | Meaning |
|---|---|
| SCCP | Signalling Connection Control Part |
| SCP | Service Control Platform |
| SCTP | Stream Control Transmission Protocol |
| SIP | Session Initiation Protocol |
| SLC | Service Logic Controller |
| SRP | Specialized Resource Platform |
| SRR | Specialized Resource Report |
| SSN | Sub-System Number |
| SSP | Service Switching Platform |
| SUA | SCCP User Adaption Layer |
| TCAP | Transaction Capabilities Application Part |
| TS | Technical Specification |

## 1.3 References

The following documents are referenced within this document:

| Reference | Document |
|---|---|
| [R-1] | N2SIP Technical Guide (IVR configuration sections) |
| [R-2] | N2SVCD Technical Guide |
| [R-3] | N2SIP SIP-SDP-RTP PCS |
| [R-4] | N2SVCD SIGTRAN-TCAP PCS |
| [R-10] | ETS 300 374-1<br>Intelligent Network (IN);<br>Intelligent Network Capability Set 1 (CS1);<br>Core Intelligent Network Application Protocol (INAP);<br>Part 1: Protocol specification |

## 1.4 Ownership and Usage



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# 2 Contents

# 3 Introduction

## 3.1 N2IVR Overview

The N-Squared Interactive Voice Response Platform (N2IVR) is a software system for playing audio announcements and collecting DTMF digits over a SIP/RTP session, under various control mechanisms.

One of the supported control mechanisms in the INAP-controlled mode, in which the N2IVR platform operates under the control of an INAP/CAMEL Service Control Platform (SCP).

The N2IVR deployment in this mode has the following integration points:

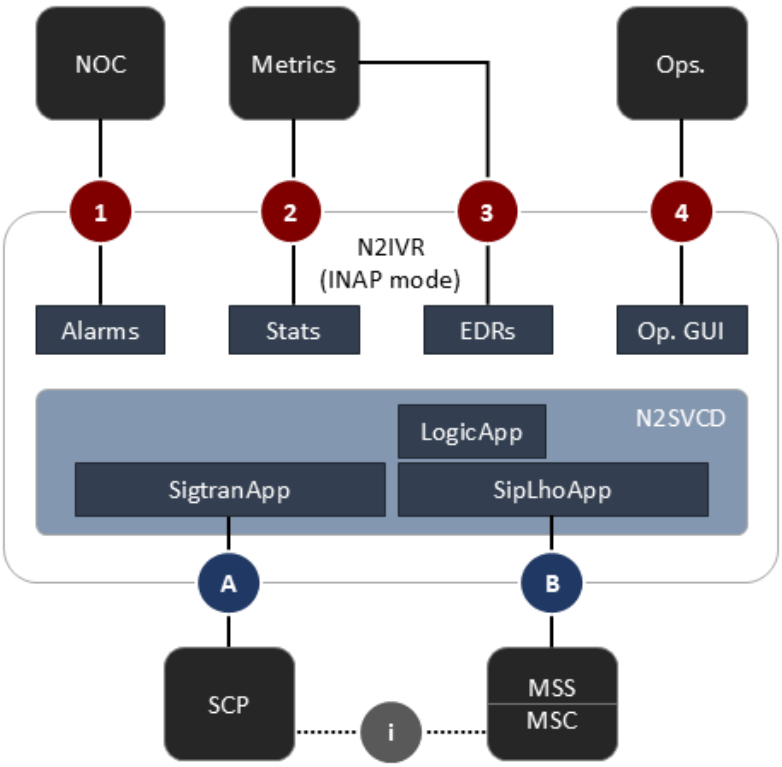


*Figure A: N2IVR Integration in INAP-controlled mode*

This protocol conformance document relates specifically to the N2IVR Compliance for the INAP (or CAP) layer of Interface "A", which has the following stack:

- **INAP (or CAP)**
- TCAP
- SCCP
- SIGTRAN M3UA
- SCTP/IP

This document describes only the uppermost INAP (or CAP) layer. The common N2SVCD Conformance for TCAP and the lower layers of the stack are described in the separate document [R-4].

Conformance is based on the referenced standards or other non-standard functionality 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 INAP Compliance

## 4.1 INAP Overview

N2IVR (operating in INAP mode) communicates with an INAP SCP to receive instructions for playing announcements and collecting DTMF input. In the mobile environment, the protocol for announcement control may nominally be CAP, although in practical terms there is little difference between CAP and INAP.

N2IVR to SCP interface compliance is formally based on ETSI document "ETS 300 374-1 Intelligent Network (IN); Intelligent Network Capability Set 1 (CS1); Core Intelligent Network Application Protocol (INAP); Part 1: Protocol specification" [R-10]. The N2IVR also supports a small subset of CAMEL-specific parameters and some vendor-proprietary extensions as described herein.

Note that ASN.1 is not a backwards-compatible format. Other non-listed fields received in INAP operations will cause a decode error.

## 4.2 INAP Operation Support

The N2IVR product supports only the following INAP operations when communicating with the SCP.

| Operation | Direction |
|---|---|
| AssistRequestInstructions | To SCP |
| AssistRequestInstructions / ReturnError | From SCP |
| PlayAnnouncement | From SCP |
| PlayAnnouncement / ReturnError | To SCP |
| SpecializedResourceReport | To SCP |
| PromptAndCollectUserInformation | From SCP |
| PromptAndCollectUserInformation / ReturnResult | To SCP |
| PromptAndCollectUserInformation / ReturnError | To SCP |

*Table 1: INAP Operations, Results, and Errors*

## 4.3 AssistRequestInstructions

The INAP AssistRequestInstructions (ARI) operation is sent by an INAP-configured N2IVR to the SCP when it receives a valid inbound SIP session request.

N2IVR supports sending the following attributes in ARI:

| Attribute | Type | Notes |
|---|---|---|
| correlationID | Generic Number | Supported as below |
| .digits | Hex Digits | Extracted from inbound SIP INVITE called party address |
| .noa | Integer | Nature of Address<br>Set to 2 (unknown) |
| .nqi | Integer | Number Qualifier Indicator<br>Set to 0 (reserved, dialed digits) |
| .ni | Integer | Number Incomplete Indicator<br>Set to 0 (complete) |
| .npi | Integer | Numbering Plan Indicator<br>Set to 1 (ITU-T E.164) |
| .pri | Integer | Presentation Restricted Indicator<br>Set to 1 (restricted) |
| .si | Integer | Screening Indicator<br>Set to 0 (user provided, not verified) |
| iPAvailable | Octet String | Never Present |
| iPSSPCapabilities | Octet String | Never Present |
| Extensions | Extensions | Never Present |

*Table 2: INAP ARI Attributes*

N2IVR will extract the called party address from the SIP INVITE, as described in [R-3], expecting a called party in one of the following formats:

- *[fixed-length-routing-prefix]**<scp-id>**[optional-variable-length-filler]**<correlation-id>***
- *[variable-length-routing-prefix]**<scp-id><correlation-id>***
- *[variable-length-routing-prefix] **<correlation-id><scp-id>***

The *<scp-id>* and *<correlation-id>* values are fixed-length decimal digit values (leading-padded with zero if necessary).

N2IVR will use the *<scp-id>* to determine the SCCP called party address (GT, PC, SSN) as described in the SCCP compliance section. N2IVR will pass the *<correlation-id>* as the ARI *correlationID.digits* parameter. All other ARI operation fields are set to the indicated defaults in *Table 2: INAP ARI Attributes* and are not configurable.

### 4.3.1 ReturnError

The SCP may send a ReturnError for the ARI. In this case, N2IVR will tear down the call.

## 4.4 PlayAnnouncement

The INAP PlayAnnouncement (PA) operation is sent from the SCP to N2IVR to request N2IVR to play an announcement without digit collection. When the PA is complete, N2IVR will return a SpecializedResourceReport.

N2IVR supports receiving the following attributes in PA:

| Attribute | Type | Notes |
|---|---|---|
| informationToSend | Choice | Supported |
| .inbandInfo | Sequence | Supported |
| .messageID | Choice | Supported |
| .elementaryMessageID | Integer | Supported |
| .text | - | Not Supported |
| .elementaryMessageIDs | Array*Integer | Supported |
| .variableMessage | Sequence | Supported |
| .elementaryMessageID | Integer | Supported |
| .variableParts | Sequence Of | Supported |
| .integer | Integer | Supported |
| .number | Octet String | Supported |
| .time | Octet String | Not Supported |
| .date | Octet String | Supported |
| .price | Octet String | Supported |
| .numberOfRepetitions | Integer | Supported |
| .duration | Integer | Supported |
| .interval | Integer | Supported |
| .tone | - | Not Supported |
| .displayInformation | - | Not Supported |
| disconnectFromIPForbidden | Boolean | Must be TRUE (or absent) |
| requestAnnouncementComplete | Boolean | Must be TRUE (or absent) |
| extensions | Array/Sequence | As per 4.4.1: Language ID Extension |
| connectedParty | ConnectedParty | Ignored |

*Table 3: INAP PA Attributes*

### 4.4.1 Language ID Extension

N2IVR supports receipt of a "Language ID" extension for PlayAnnouncement and for PromptAndCollectUserInformation. This mechanism is not part of the ETSI/CAMEL standards, and so the implementation may vary from site to site.

The supported extension container attributes are:

| Attribute | Type | Notes |
|---|---|---|
| .type | Integer | Supported |
| .criticality | Enumerated | Ignored |
| .value | - | Encoding is specified by the individual SCP vendor |

*Table 4: INAP PA Language ID Extension Attributes*

At this time, the only supported encoding is the "NAP" encoding implemented by the Oracle OCNCC SLC (SCP) platform, which is encoded as follows:

- SEQUENCE (Universal)
  - **LanguageID** (Tag=0/Context, Implicit Integer, Mandatory)
  - **Extras** (Tag=1/Context, Implicit Sequence, Mandatory)
    - **Extra0** (Tag=0/Context, Implicit Integer, Optional)
    - **Extra1** (Tag=1/Context, Implicit Integer, Optional)
    - **Extra2** (Tag=2/Context, Implicit Integer, Optional)
    - **Extra3** (Tag=3/Context, Implicit Integer, Optional)

*LanguageID* is mapped to a Language Name internally in N2IVR. The *Extra* fields are ignored.

### 4.4.2 ReturnError

The N2IVR supports sending ReturnError for PlayAnnouncement as follows:

| Value | Error | Supported |
|---|---|---|
| 7 | Missing Parameter | Used when no supported parameter alternatives are present in the PlayAnnouncement |
| 11 | System Failure | Used when N2IVR cannot load base configuration |
| 13 | Unavailable Resource | Used when the requested message ID or the requested language is unknown, misconfigured, or missing audio |

*Table 5: INAP PA ReturnError Attributes*

## 4.5 SpecializedResourceReport

N2IVR does not support sending any attributes in SpecializedResourceReport (SRR) operations.

## 4.6 PromptAndCollectUserInformation

The SCP sends INAP PromptAndCollectUserInformation (PACUI) operations to N2IVR to request an announcement with digit collection.

N2IVR supports receiving the following attributes in PACUI, in addition to those supported for PA:

| Attribute | Type | Notes |
|---|---|---|
| collectedInfo | Sequence | Supported |
| .collectedDigits | Sequence | Supported |
| .minimumNbOfDigits | Integer | Supported |
| .maximumNbOfDigits | Integer | Supported |
| .endOfReplyDigit | Octet String | Supported |
| .cancelDigit | Octet String | Supported |
| .startDigit | Octet String | Ignored |
| .firstDigitTimeout | Integer | Supported |
| .interDigitTimeout | Integer | Supported |
| .errortreatment | Enumerated | Ignored |
| .interruptableAnnInd | Boolean | Supported |
| .voiceInformation | Boolean | Ignored |
| .voiceBack | Boolean | Ignored |

*Table 6: INAP PACUI Attributes*

### 4.6.1 ReturnResult

The N2IVR supports sending ReturnResult for PACUI as follows:

| Attribute | Type | Notes |
|---|---|---|
| digitsResponse | Generic Digits | Digits entered by end-user. |
| .digits | Hex Digits | Digits. Any "*" or "#" has been converted to hex. |
| .scheme | Integer | Numbering Scheme<br>Set to 0 or 1 (BCD even or odd) |
| .type | Integer | Type of Digits<br>Set to 0 (reserved, account code) |

*Table 7: INAP PCAUI ReturnResult Attributes*

### 4.6.2 ReturnError

The N2IVR supports sending ReturnError for PACUI as follows:

| Value | Error | Supported |
|---|---|---|
| 4 | Improper Caller Response | Used when collected DTMF digit string is missing/invalid. |
| 7 | Missing Parameter | Used when none of our supported parameter alternatives are present in the PromptAndCollectUserInformation. |
| 11 | System Failure | Used when the N2IVR cannot load base configuration. |
| 13 | Unavailable Resource | Used when the requested message ID or the requested language is unknown, misconfigured, or missing audio. |

*Table 8: INAP PCAUI ReturnError Attributes*

# 5 INAP Message Flows

In all flows in this section, note that N2IVR may perform call shutdown using TCAP Abort in the case of non-recoverable call error.

## 5.1 INAP Call Set-Up

The following diagram shows the standard INAP operation flow for call setup when the N2IVR is operating in INAP-controlled mode.

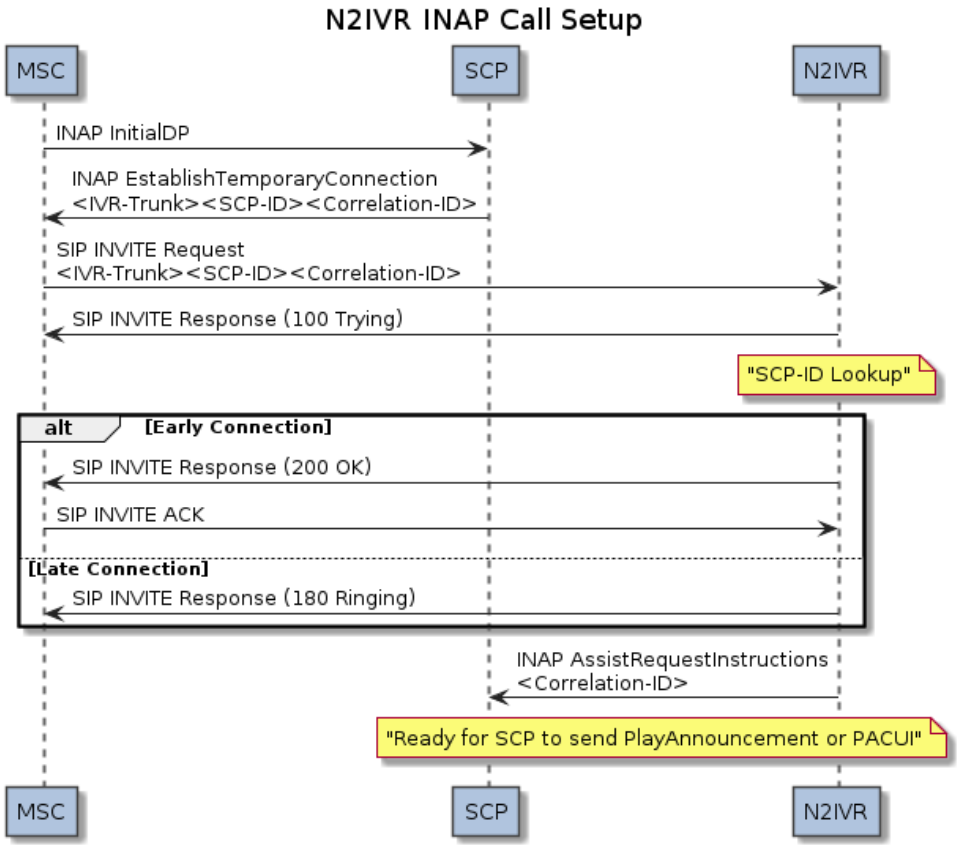


*Figure B: N2IVR (INAP Mode) Call Setup (AssistRequestInstructions)*

## 5.2 INAP PlayAnnouncement

The following diagram shows the INAP operation flow for PlayAnnouncement, after Setup is complete for N2IVR operating in INAP-controlled mode.

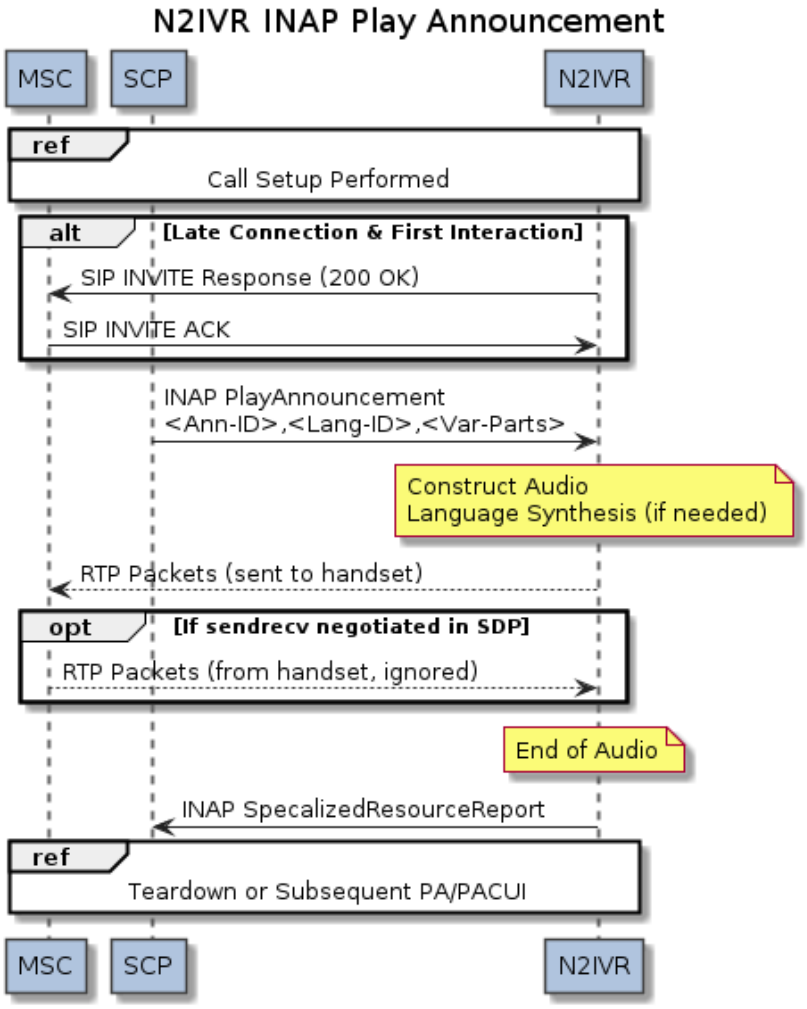


*Figure C: INAP Play Announcement (PA & SRR)*

## 5.3 INAP PromptAndCollectUserInformation

The following diagram shows the INAP operation flow for PromptAndCollectUserInformation after Setup is complete for N2IVR operating in INAP-controlled mode.

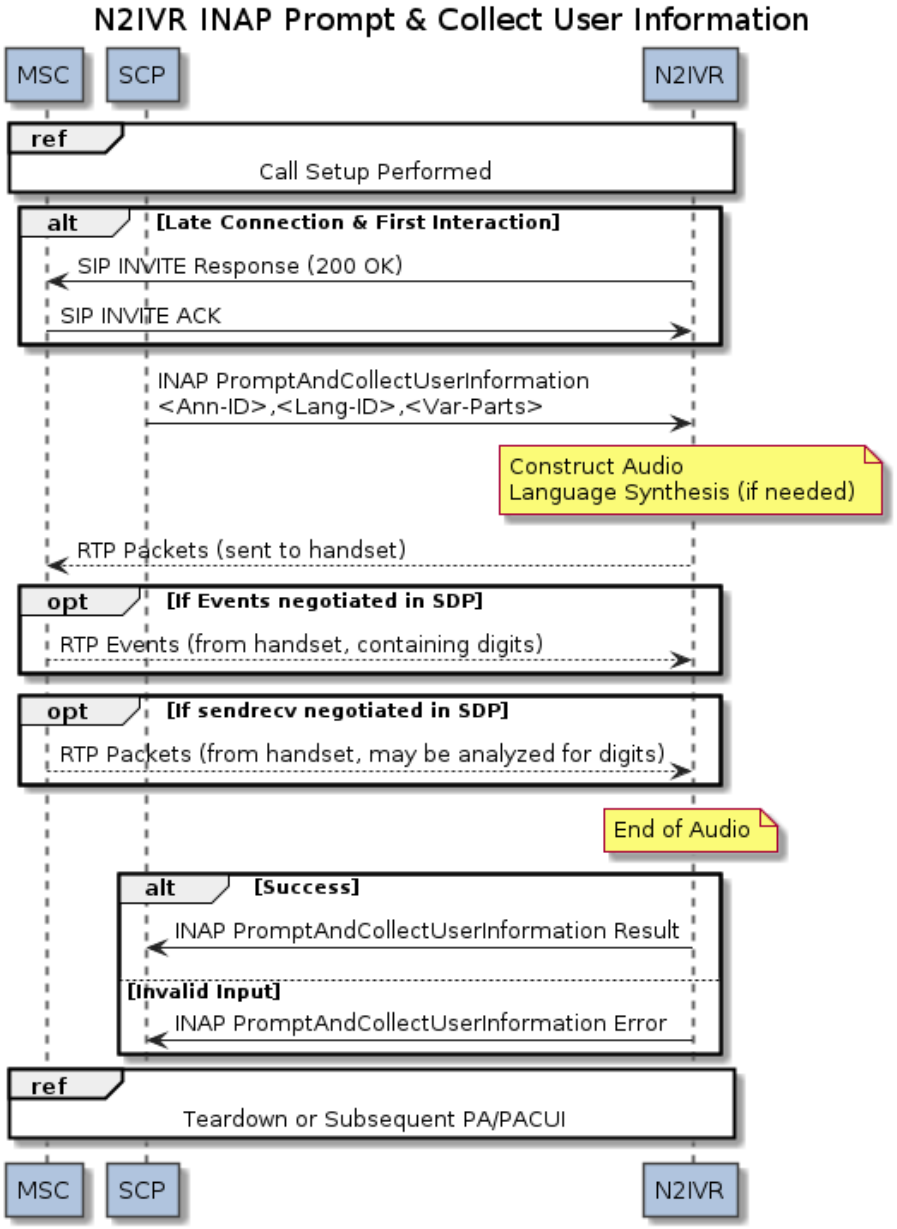


*Figure D: INAP Prompt & Collect (PACUI)*

## 5.4 INAP Call Tear-Down (Caller Hangup)

When the call is terminated by a caller hangup during interaction, clean call tear-down of the INAP dialog is typically performed by pre-arranged end, although TCAP ABORT or empty TCAP END are also possible (not shown).

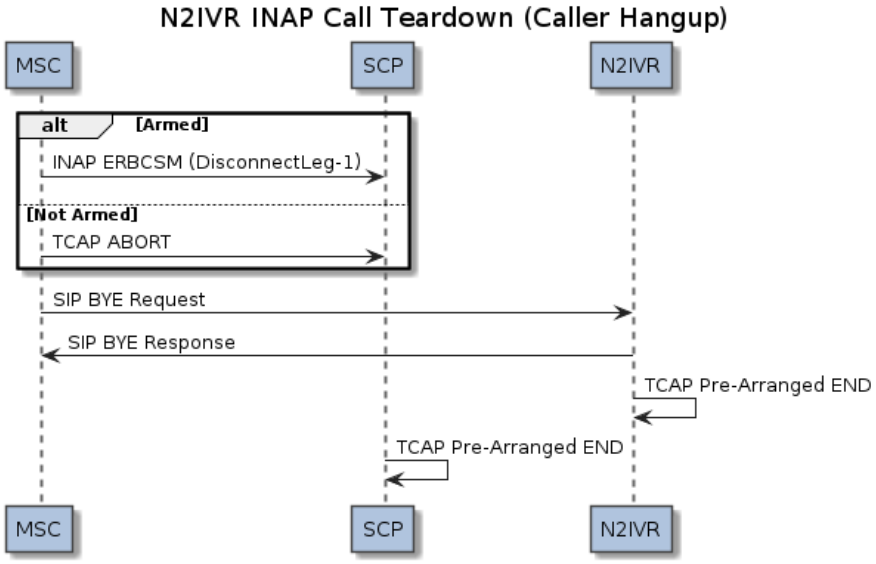


*Figure E: INAP Call Tear-Down (Caller Hangup)*

## 5.5 INAP Call Tear-Down (SCP Initiated)

When the call is terminated by the SCP deciding that no more interaction is required, clean call tear-down of the INAP dialog is typically performed by pre-arranged end, although TCAP ABORT or empty TCAP END are also possible (not shown).

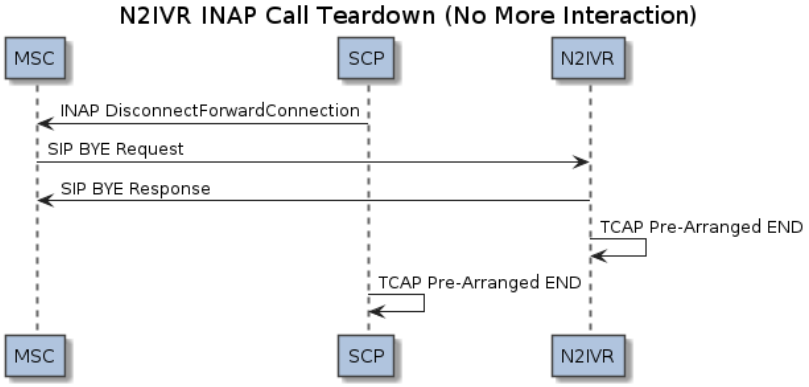


*Figure F: INAP Call Tear-Down (No More Interaction)*

## 5.6 Exception Scenarios

Various exception scenarios may occur in which TCAP-ABORT and/or SIP BYE are used to terminate all open connections. These scenarios are not shown individually.

Note that like any situation which involves a three-party simultaneous shutdown, race conditions are likely in which one or more end-points may generate an alarm for shutdown of an already terminated (or unknown) connection.