

# IPWorks SCP SS7 Interface

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## INTERWORK DESCRIPTION

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# 1 Introduction

This document describes the interface between the IPWorks and the external SS7 nodes for Local Number Portability (LNP) and Toll Free functions.

## Scope

This document describes how IPWorks uses the SS7 protocol to communicate with the Service Control Point (SCP) nodes to perform the LNP and Toll-free queries. IPWorks simulates a Server-Server Protocol (SSP). Only Advanced Intelligent Networks (AIN) LNP and Toll Free related interfaces are covered in this document.

This document covers the following topics:

- Interface Overview
- Interface Role
- Services
- Encapsulation and Addressing
- Procedures
- Information Model
- Error Handling
- Related Standards

## Target Groups

This document is intended for the personnel needing to understand the logical entity, including interfaces and protocols, of the IPWorks.

## 1.1 Prerequisites

N/A

## 1.2 Related Information

Trademark information, typographic conventions, definition and explanation of acronyms and terminology can be found in the following documents:

- *Trademark Information*, Reference [1]



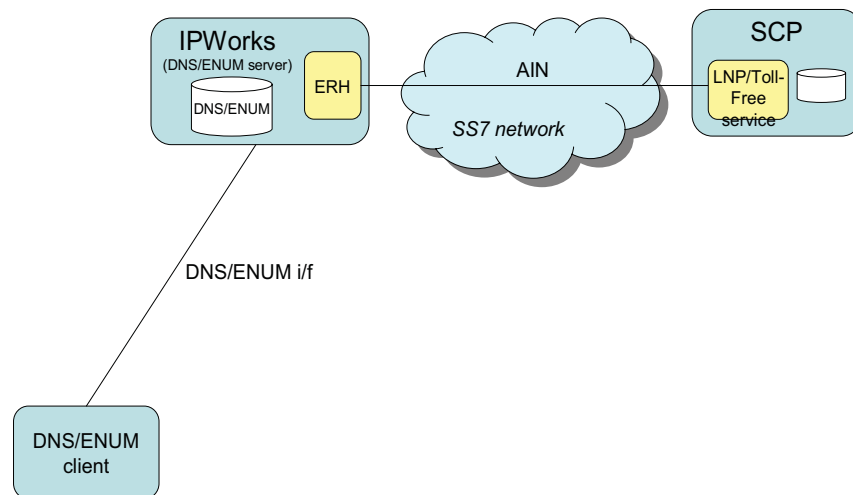
- *Glossary of Terms and Acronyms*, Reference [2]
- *Typographic Conventions*, Reference [3]

The standard, related to the SS7 interface, can be found in the section Reference List on page 37 .



## 2 Interface Overview

This section describes the interface between IPWorks and the external SS7 nodes as shown in Figure 1.



*Figure 1 IPWorks Interface with External SS7 Nodes*

IPWorks includes an External Resolution Handler (ERH) feature that is built into the ENUM server. This provides the possibility to resolve DNS requests in the ENUM zone with respect to number portability with the help of external SS7 legacy databases such as the SCP.

The IPWorks ERH interface with external SS7 nodes is based on Telcordia Specifications as well as some IPWorks specific implementation and deployment, especially regarding the optional parameters processing and some specific messages handling.

### 2.1 Interface Role

This section describes the role of the AIN in this (SCP)/Adjunct Interface.



AIN is using AINGR: Switch - Service Control Point (SCP)/Adjunct Interface GR-1299 CORE and GR-1298 CORE.

## 2.2 Services

This section describes the services the AIN uses in this (SCP)/Adjunct Interface.

*Table 1 Used Services*

Used Service	Description
LNP/Toll Free Analyze_Route within AIN	<p>The SCP provides routing instructions to the IPWorks by returning an AIN Analyze_Route message in the ANSI TCAP response message.</p> <p>IPWorks triggers the service request upon receiving Enum queries which fall into some pre-configured number series, and Analyze_Route reply will be used by IPWorks to compose the Enum response.</p>

## 2.3 Encapsulation and Addressing

For SCCP layer routing, both the Signaling Point Code (SPC) + Subsystem Number (SSN) and Global Title Translation (GTT) routing mechanisms are supported. If GTT routing is chosen, the TT default value is 0, but configurable.

This section describes what lower protocols the AIN interface uses:

- **TCAP and Signaling System No. 7.** For more information about the AIN being transported over TCAP and how the AIN operations make use of TCAP and lower layers of Signaling System No. 7, see Reference [13], Reference [15], Reference [14] and Reference [16].
- **SCCP.** For the SCCP layer routing, IPWorks supports both the below mechanisms:
  - Signaling Point Code (SPC) + Subsystem Number (SSN)
  - Global Title Translation (GTT) Routing

If GTT routing is chosen, the TT default value is 0 but configurable.
- **SIGTRAN and T1.** IPWorks supports SIGTRAN as the transport vehicle.

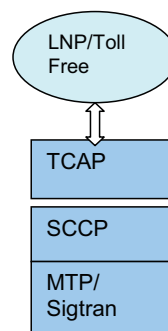




### 3 Procedures

This section describes the procedures used in connection with the used interfaces of SS7.

An overview of the dynamics is shown in Figure 2.



*Figure 2 Protocol Layers Used by IPWorks*

The Advanced Intelligent Network(AIN) is an application that uses the SS7 protocol. The AIN is not a part of the protocol, but relies on the SS7 protocol to provide appropriate capabilities to enable the AIN architecture both at the protocol level and the network architecture level.

As part of the services provided by AIN application, the LNP and Toll Free services depend on the SS7 transport without explicit knowledge of all the underlying levels. They interface directly with TCAP to pass information in the form of components and parameters between nodes.

The SS7 protocol procedures follow the specifications in Telcordia Technologies Research Specification of Signalling SystemNumber 7-GR-246-CORE, Reference [18].

For the SCCP routing procedure, IPWorks currently only support working as a SSP as specified in Local Number Portability Capability Specification: Service Provider Portability-GR-2936-CORE, Reference [13] and Switching and Signaling Generic Requirements for Toll-Free Service Using AIN-GR-2892-CORE, Reference [16].

The typical network configuration is that IPWorks connects to a STP pair and routes to SCPs based on GTT.

Figure 3 shows the typical IPWorks SS7 network configuration.

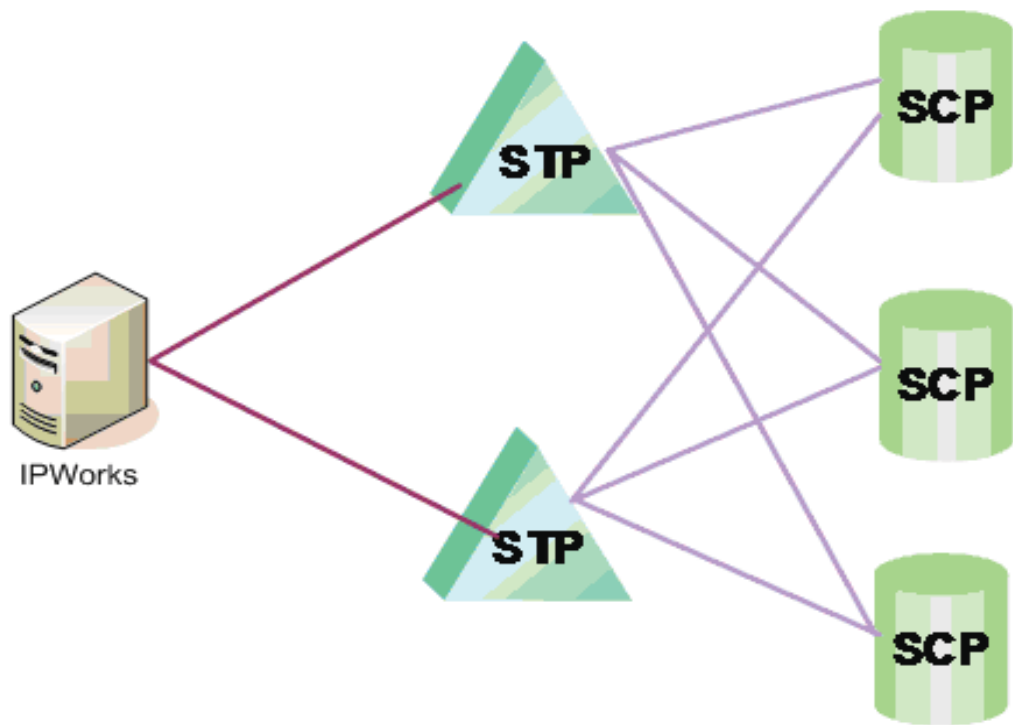


Figure 3 IPWorks SS7 Network Configuration

## 3.1 Procedures for LNP Related Query

### 3.1.1 Normal Procedures

#### 3.1.1.1 Successful Query with Database Response Routing

To perform a LNP service query for an ENUM query, perform the following steps:

1. IPWorks sends an AIN `Info_Analyzed` message to the SCP.

**Note:** The `Info_Analyzed` message is contained in ANSI TCAP Query with Permission message.

2. The SCP provides routing instructions to the IPWorks by returning an AIN `Analyze_Route` message in the ANSI TCAP response message.
3. IPWorks uses the information included in the `Analyze_Route` message to compose the ENUM response for its client.

Figure 4 shows a successful LNP query:

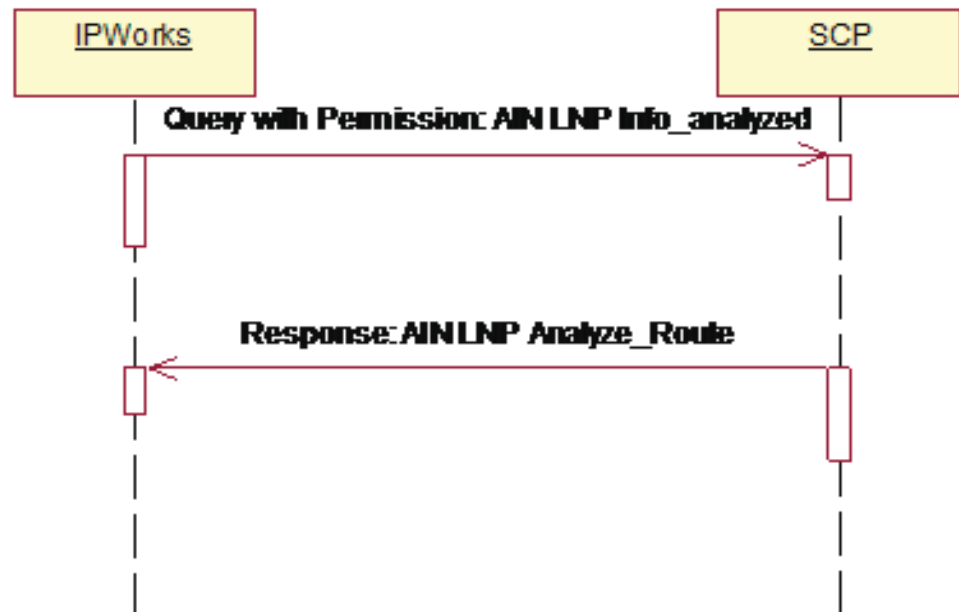


Figure 4 LNP Successful Query

### 3.1.2 Abnormal Procedures

This section describes the procedures to handle the messages not expected for the LNP query in a normal case.

#### 3.1.2.1 Unexpected Request\_Report\_BCM\_Event Message Received by IPWorks

When a response from the LNP Database contains an `Analyze_Route` message along with a `Request_Report_BCM_Event` message, both of which are contained in ANSI TCAP Conversation with Permission package, IPWorks performs the following steps:

1. IPWorks closes the transaction.
2. IPWorks sends a **Close** message with a `CloseCause` value of `unexpectedCommunication` to the SCP.
3. IPWorks continues the call processing as if the response only contained the `Analyze_Route` message.

Figure 5 shows the processing procedure for the `Request_Report_BCM_Event` message.



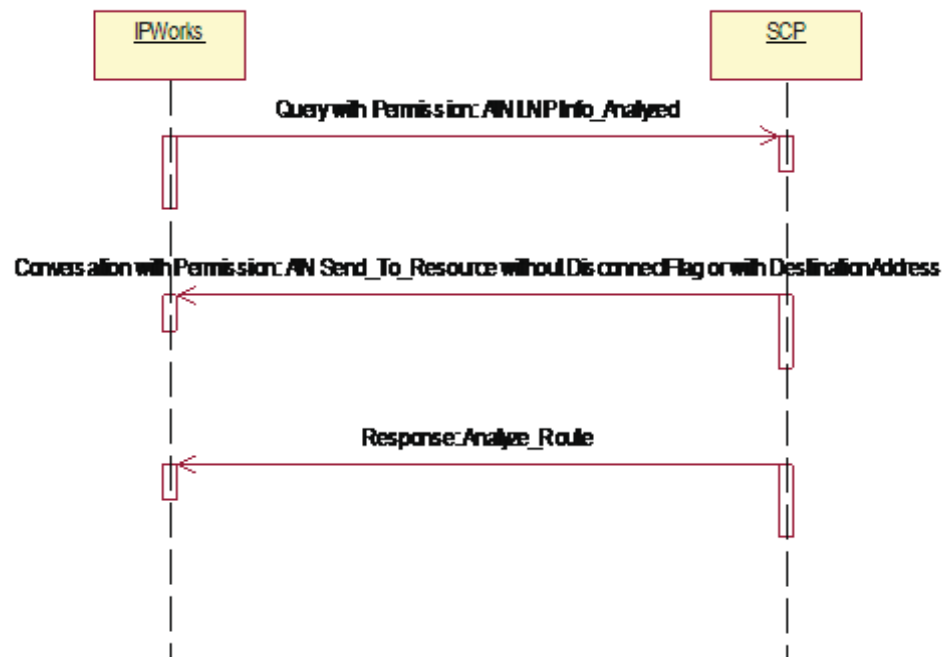
Figure 5 Request\_Report\_BCM\_Event Message Processing

### 3.1.2.2 Unexpected Send\_To\_Resource Message Received by IPWorks

A `Send_To_Resource` message is not expected to be returned from the LNP SCP.

When a `Send_To_Resource` message, IPWorks performs the following steps as shown in Figure 6:

1. IPWorks ignores the `Send_To_Resource` message.
2. IPWorks processes the `Analyze_Route` message that follows the same manner as it processes the `Analyze_Route` message without the intervening `send_To_Resource` message.



*Figure 6 Send\_To\_Resource Message Processing*

When both a `Send_To_Resource` and a `Request_Report_BCM_Event` are received with the `Analyze_Route` operation, IPWorks performs the following steps as shown in Figure 7:

1. IPWorks ignores the `Send_To_Resource` message.
2. IPWorks processes the `Analyze_Route` message as normal.
3. IPWorks sends a `Close` message with a `CloseCause` value of `unexpectedCommunication` to the SCP.

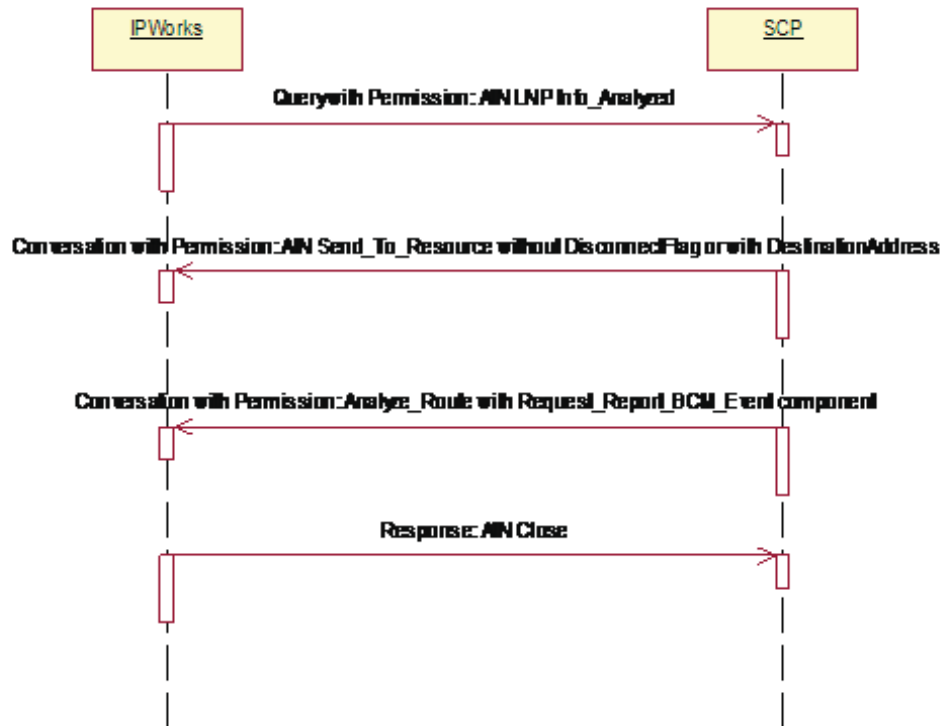
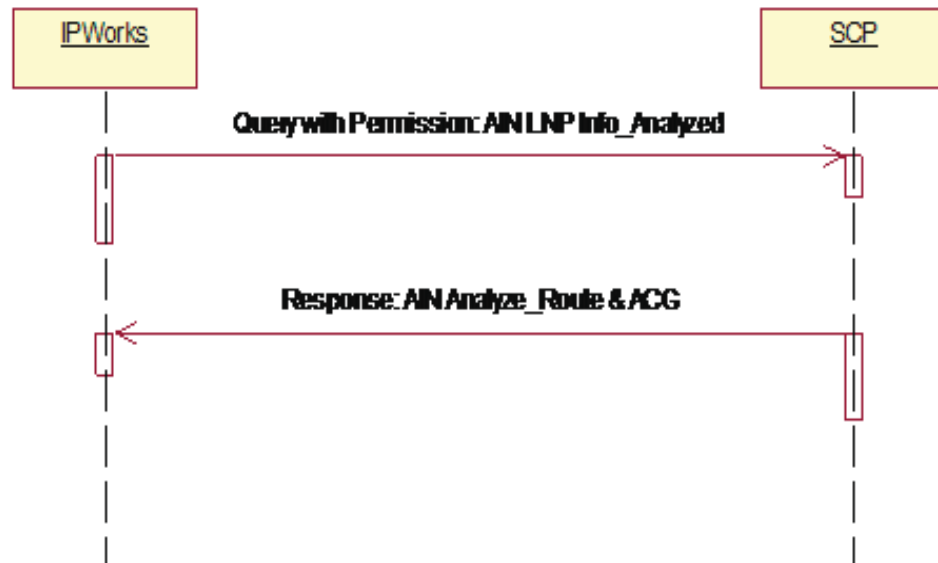


Figure 7 *Request\_Report\_BCM\_Event and Send\_To\_Resource Messages Processing*

### 3.1.2.3 ACG Message Received by IPWorks

The Automatic Call Gapping (ACG) message is a network management related message used to protect the SCP from overload.

When an overload occurs, an SCP sends the message to IPWorks. IPWorks does not implement the ACG feature and ignores the message simply.



*Figure 8 ACG Message Processing*

When a response from the LNP SCP contains an `Analyze_Route` message with an ACG message, IPWorks performs the following steps as shown in Figure 8:

1. IPWorks processes the `Analyze_Route` message as usual.
2. IPWorks ignores the ACG message.

**Note:** The ACG message has no impact on the processing of other messages, for example, `Send_To_Resource`, `Request_Report_BCM_Event` and so on.

#### 3.1.2.4 Send\_Notification Message Received by IPWorks

The `Send_Notification` message can come in any package with `Analyze_Route` (with or without `Request_Report_BCM_Event`) or `Send_To_Resource`.

When a call exists to the NULL PIC because it is disconnected, cleared or not completed, IPWorks performs the following steps as shown in Figure 9:

1. IPWorks receives the `Send_Notification` message.
2. IPWorks sends the `Termination_Notification` message to the SCP in ANSI TCAP Unidirectional message.
3. IPWorks ignores the ACG message if the ACG comes with the same `Send_Notification` message.

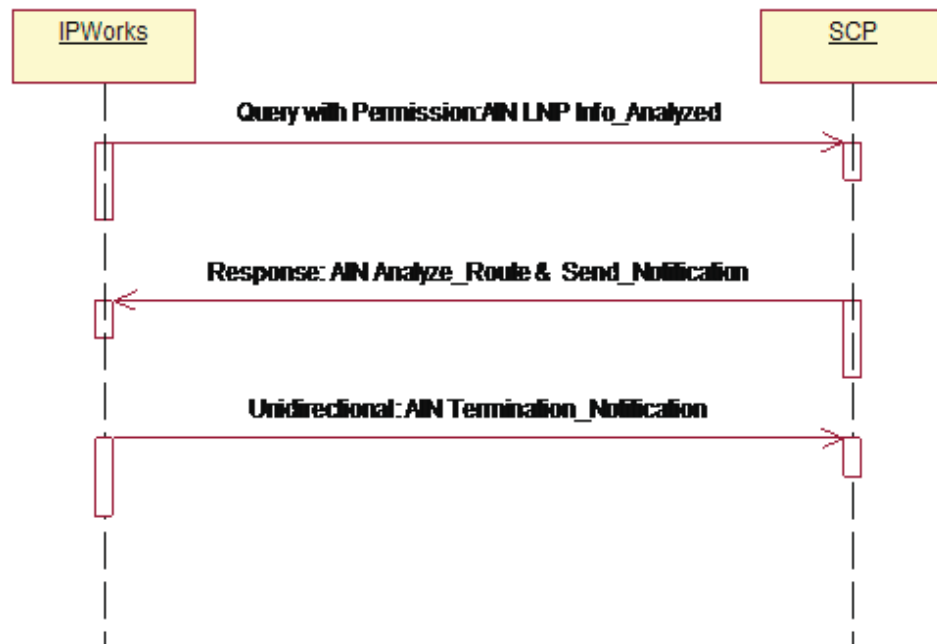


Figure 9 Send\_Notification Message Processing

When both the Request\_Report\_BCM\_Event and Send\_Notification messages are received by IPWorks, IPWorks performs the following steps as shown in Figure 10:

1. IPWorks sends both the AIN close and Termination\_Notification messages to the SCP.



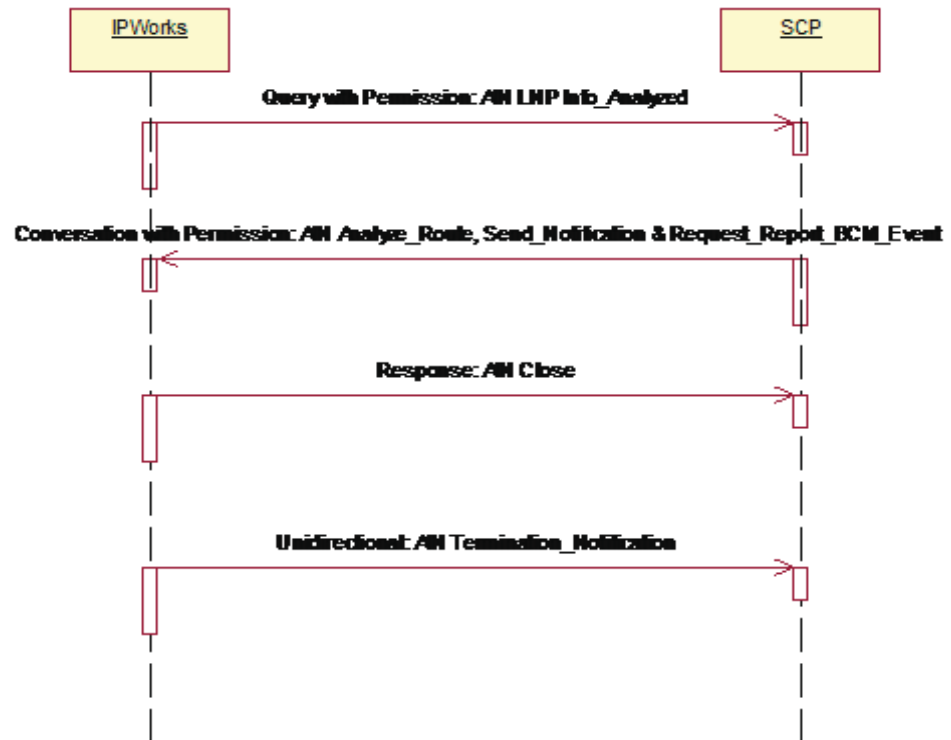


Figure 10 Send\_Notification and Request\_Report\_BCM\_Event Processing

### 3.1.2.5 Continue Message Received by SSP

When IPWorks receives a `Continue` response message, it implies that the DN is not ported and is similar to the case where IPWorks receives a `Analyze_Route` message with the dialled directory number in the `CalledPartyID` parameter.

**Note:** In a normal case, this message is not expected for a LNP query.

The `Continue` message can also be combined with `Request_Report_BCM_Event`, `Send_To_Resource`, `ACG` and `Send_Notification`.

If the `Continue` message is sent in an ANSI TCAP conversation message, IPWorks sends an `AIN_Application_Error` message to end the TCAP and AIN transaction as shown in Figure 11.

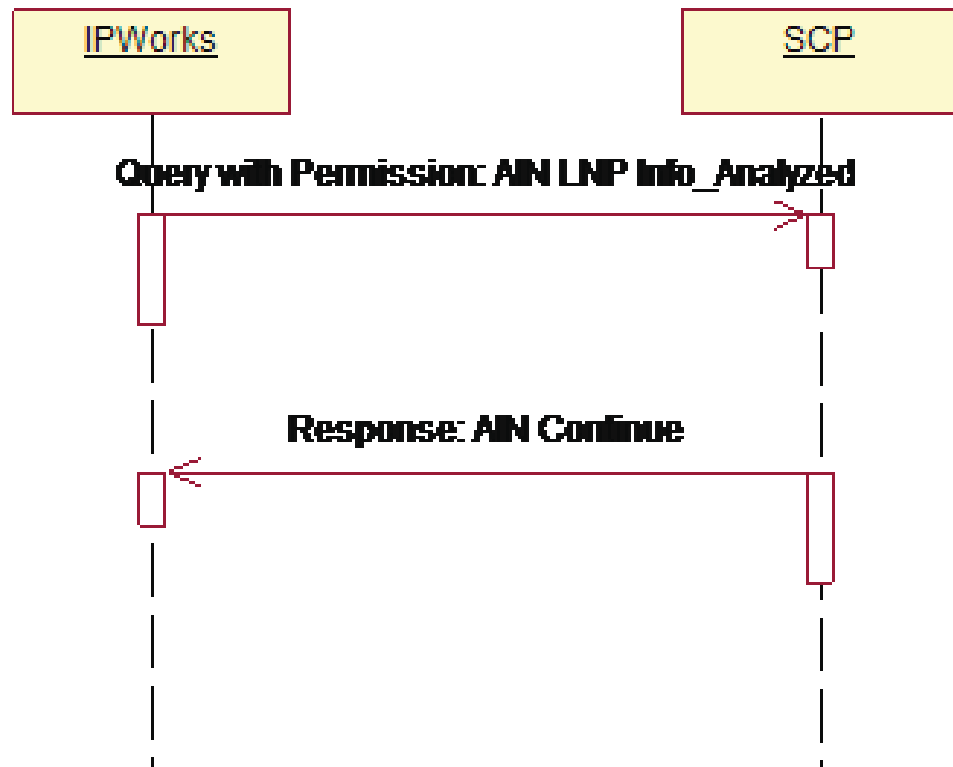


Figure 11 Continue Message Processing

### 3.1.2.6 Disconnect Message Received by SSP

When IPWorks receives a `Disconnect`, it implies that the call must be released and closed according to the AIN. IPWorks will release the call and close the dialogue.

If the disconnect message is sent in an ANSI TCAP conversation message while not in ANSI TCAP Response message, IPWorks send an AIN `Application_Error` message to end the TCAP and AIN transaction as shown in Figure 12.

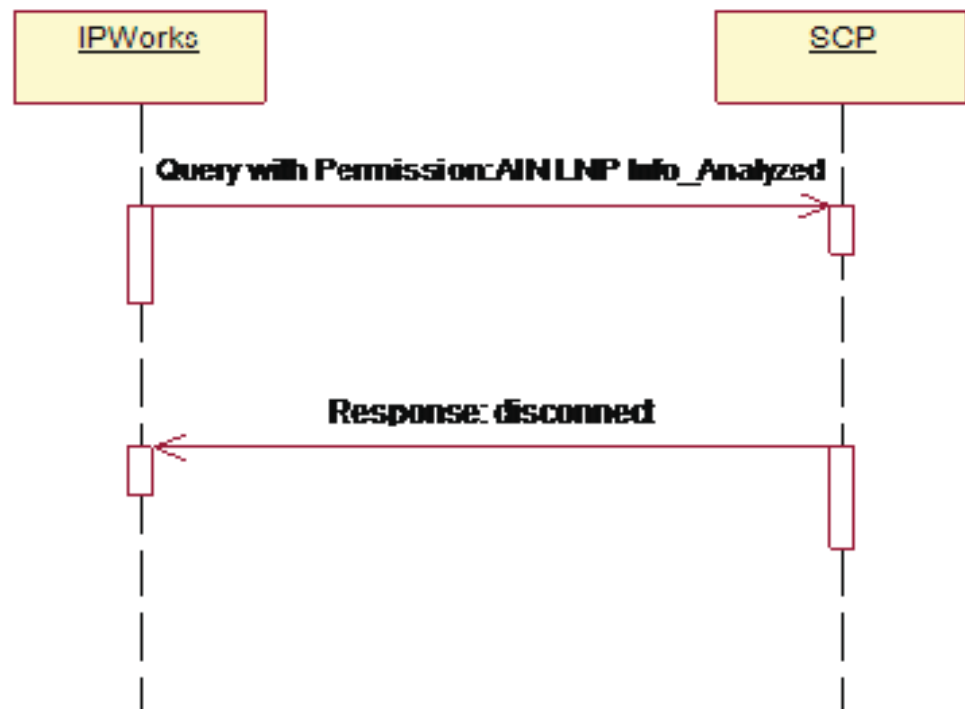


Figure 12 Disconnect Message Processing

## 3.2 Procedures for Toll Free Related Query

### 3.2.1 Normal Procedures

#### 3.2.1.1 Successful Query with Database Response Routing

To perform an Toll Free service query for an ENUM query, perform the following steps as shown in Figure 13:

1. IPWorks sends an Toll Free `Info_Analyzed` message to the SCP.
2. The SCP provides routing instructions to the SSP by returning an `Analyze_Route` response message.

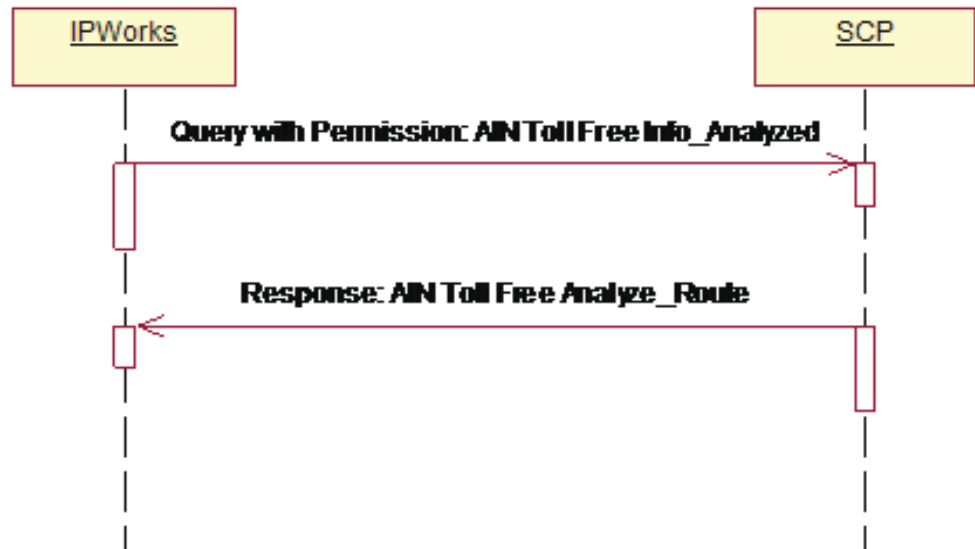


Figure 13 Toll Free Successful Query

The procedure is similar to that for LNP except for different parameters for Info\_Analyzed and Analyze\_Route.

## 3.2.2 Abnormal Procedures

This section describes the procedures to handle the messages not expected for the Toll Free query in a normal case.

### 3.2.2.1 Send\_To\_Resource Message Received by IPWorks

When the Toll-Free service is not able to respond with routing instructions due to some reasons (for example, the dialled Toll-Free number is unassigned) and instead provides IPWorks with the instructions to play an announcement using the Send\_To\_Resource message.

IPWorks releases the call and ends the dialogue as shown in Figure 14.

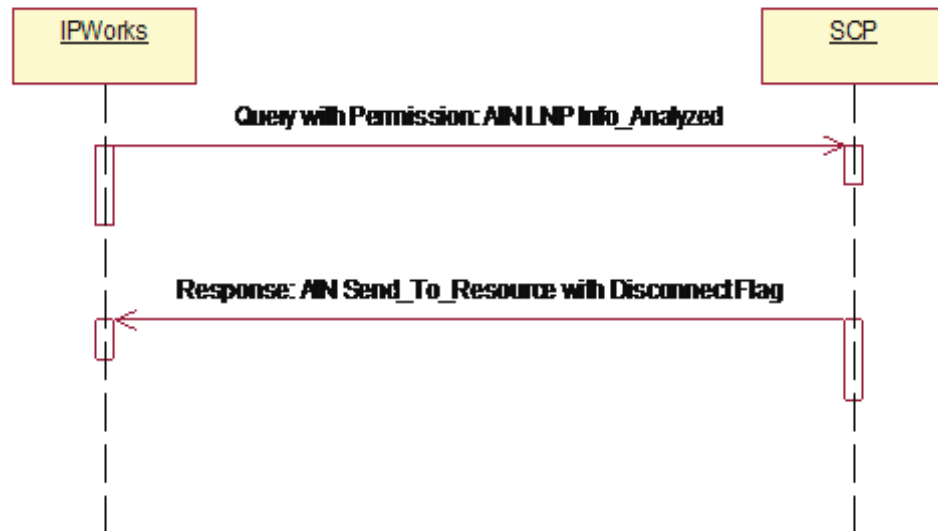


Figure 14 Toll Free Send\_To\_Resource Response Processing

### 3.2.2.2 Other Messages Received by IPWorks

When IPWorks receives the rest messages, it processes the messages exactly the same way as for the LNP query, for example,

- ACG
- Send\_Notification
- Request\_Report\_BCM\_Event
- Disconnect

## 3.3 General Abnormal Procedures for LNP and Toll Free

### 3.3.1 TCAP Protocol Error

If a protocol error, either fatal or non-fatal, occurs, it is in any of the following parts of a TCAP package:

- Transaction Portion
- Component Portion
- Dialogue Portion

IPWorks follows the ANSI TCAP protocol errors processing standard, refer to Reference [6].

### 3.3.2 Fatal Application Error

If the following fatal application errors exist, they are reported and indicated within the `ApplicationErrorString` parameter carried by the `Report_Error` message.

The errors are listed as follows:

- Response Message Timer Expired
- Unexpected Message
- Unexpected Message Sequence
- Unexpected Parameter Sequence
- Erroneous Data Value
- Unexpected Communication
- Missing Conditional Parameter

For detailed information about the AIN application layer processing, refer to Reference [7], Reference [8], Reference [9], and Reference [10].

#### 3.3.2.1 Application Error

The received AIN Message X is delivered as a to the TCAP user (IPWorks application). If a fatal application error is detected as listed in Section 3.3.2 on page 17 , IPWorks sends the error message to the remote SCP.

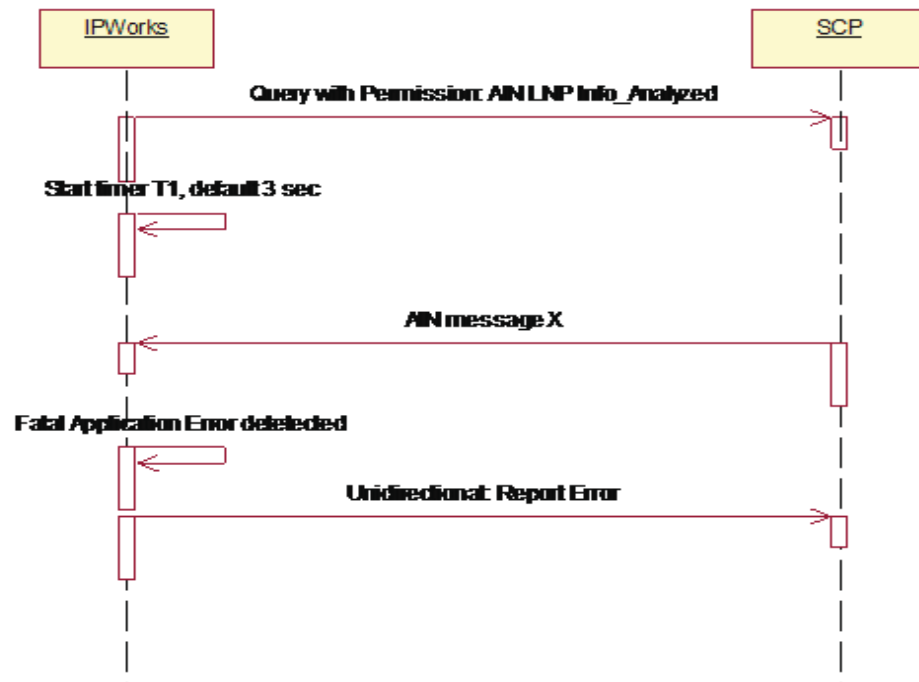


Figure 15 Application Error Processing

If any AIN message or messages combination meet the following requirements, the message is handled as an unexpected message:

- Any AIN message or AIN messages combination within a TCAP package that is not mentioned in Section 3.1 on page 6, even if the AIN message appears in a different ANSI TCAP message (for example, `Send_To_Resource` in a ANSI TCAP Response while not in Conversation with Permission)

The same rule applies to the Toll Free in Section 3.2 on page 15.

### 3.3.2.2 Timer T1 Expired

Timer T1 is managed by the TCAP user (The IPWorks application).

When the timer expires, IPWorks reports the error with error string "Response Message Timer Expired" to the SCP according to defined AIN procedures as shown in Figure 16.

**Note:** The default value for this timer is 3 seconds, and the configurable range is from 0.1 to 30 seconds, with 0.1-second increments.

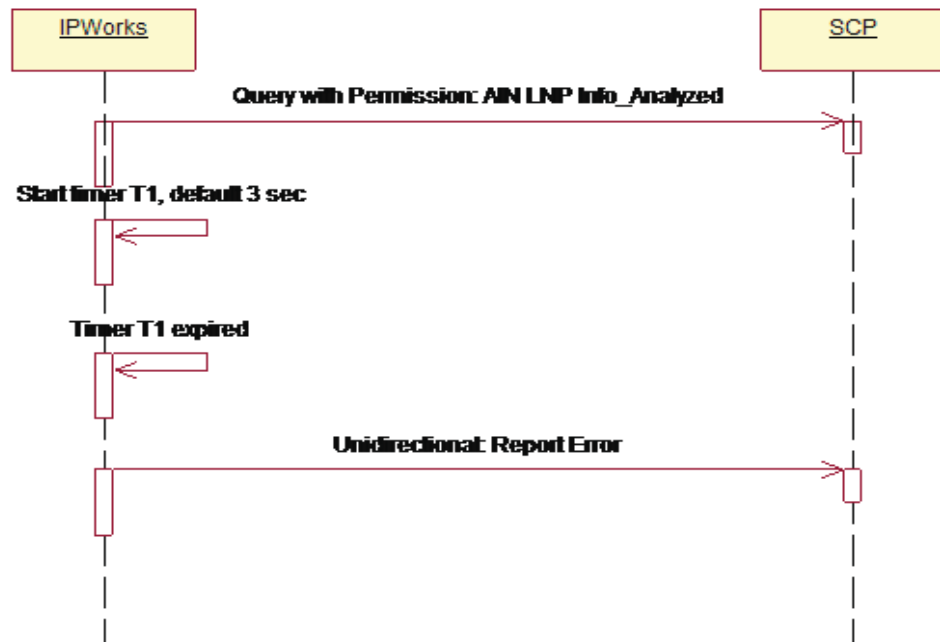


Figure 16 Timer T1 Expired



## 4 Information Model

This section describes the information model including mandatory and optional parameters of each service operation.

### 4.1 General

The presence of an information element is defined in the *P* column in the subsections as follows:

<b>M</b>	Mandatory
<b>C</b>	Conditional
<b>O</b>	Optional

### 4.2 Info\_Analyzed

When IPWorks decides that an LNP or Toll Free query need to be performed, an AIN *Info\_Analyzed* message is sent on a new TCAP dialogue to the LNP capable SCP.

For LNP and Toll Free, though they both use AIN *Info\_Analyzed* message to retrieve the required information, usually the message does not contain the same set of elements. For the specific definition of each element, refer to Reference [10] for detailed information.

#### 4.2.1 LNP Info\_Analyzed Message

Table 2 shows the information model of the LNP *Info\_Analyzed* message.

*Table 2 LNP Info\_Analyzed Message*

Element	Type	P	Comment
UserID	Refer to Reference [10]	M	Mandatory from AIN protocol point of view
BearerCapability	Refer to Reference [10]	M	Mandatory from AIN protocol point of view
CalledPartyID	Refer to Reference [10]	M	Required by LNP query
TriggerCriteriaType	Refer to Reference [10]	M	Required by LNP query
CallingPartyID	Refer to Reference [10]	O	All the three optional parameters shall be used in the LNP <i>Info_Analyzed</i> message, or none of them.

Element	Type	P	Comment
ChargeNumber	Refer to Reference [10]	O	Required by Toll Free query
JurisdictionInformation	Refer to Reference [10]	O	Required by Toll Free query

## 4.2.2 Toll Free Info\_Analyzed Message

Table 3 shows the information model of the Toll Free Info\_Analyzed message.

*Table 3 Toll Free Info\_Analyzed Message*

Element	Type	P	Comment
UserID	Refer to Reference [10]	M	Mandatory from AIN protocol point of view
BearerCapability	Refer to Reference [10]	M	Mandatory from AIN protocol point of view
CalledPartyID	Refer to Reference [10]	M	Required by Toll Free query
TriggerCriteriaType	Refer to Reference [10]	M	Required by Toll Free query
Lata	Refer to Reference [10]	M	Required by Toll Free query
ChargeNumber	Refer to Reference [10]	M	Required by Toll Free query
ChargePartyStationType	Refer to Reference [10]	M	Required by Toll Free query

## 4.2.3 Termination\_Notification Message

When receiving a Send\_Notification message from the SCP, IPWorks responds with a Termination\_Notification message.

Table 4 shows the information model of the Termination\_Notification message.

*Table 4 Termination\_Notification*

Element	Type	P	Comment
EchoData	Refer to Reference [10]	M	Mandatory from AIN protocol point of view
TerminationIndicator	Refer to Reference [10]	M	Mandatory from AIN protocol point of view
ConnectTime	Refer to Reference [10]	O	Mandatory from AIN protocol point of view



#### 4.2.4 Close

When receiving a message like `Request_Report_BCM_Event`, IPWorks sends a `AIN Close` message to SCP.

Table 5 shows the information model of the `Close` message.

*Table 5 Close Message*

Element	Type	P	Comment
CloseCause	Refer to Reference [10]	M	It is optional in AIN protocol, but IPWorks always fill the close message with <code>CloseCause = unexpectedCommunication</code> .

#### 4.2.5 Report\_Error

When an application error is detected in a closed TCAP transaction or in a `Response Message Timer Expired` condition, IPWorks reports the `Report_Error` message..

Table 6 shows the information model of the `Report_Error` message.

*Table 6 Report\_Error Message*

Element	Type	P	Comment
ApplicationErrorString	Refer to Reference [10]	M	Refer to [3]

#### 4.2.6 Application\_Error

When an application error is detected in an existing TCAP transaction to SCP, IPWorks reports the `Application_Error` message.

*Table 7 Application\_Error Message*

Element	Type	P	Comment
ApplicationErrorString	Refer to Reference [10]	M	Refer to Reference [10]

#### 4.2.7 Analyze\_Route and other messages from SCP

After sending out `Info_Analyzed` message, IPWorks is expected to receive the `Analyze_Route` message from the SCP normally. The format of this message and other abnormal messages from the SCP must comply with the definition in Reference [10].





## 5 Information Elements

For the detailed definition of the elements used in various LNP and Toll Free messages, refer to Reference [10].





## 6 Error Handling

### 6.1 AIN LNP/Toll Free Layer Error Handling

Refer to Section 3.3.2 on page 17 for the error handling at this layer.

### 6.2 TCAP Layer Error Handling

Refer to Section 3.3.1 on page 17 for the error handling at this layer.

### 6.3 Lower Layer Error Handling

Refer to Reference [11] and Reference [12] for the error handling at this layer.







## 7 Security Considerations

The interface between IPWorks and the external SS7 nodes uses the standard SS7 protocol. IPWorks does not provide any extra security enhancement for the SS7 protocol.





## 8 Formal Syntax

This section refers to specification where the formal syntax notation is defined. It also describes any deviations from the specification, if applicable.

For information about the formal syntax notation, see the following specification:

- AINGR: Switch - Service Control Point (SCP)/Adjunct Interface-GR-1299-CORE Issue 10, Reference [15]





## 9 Related Standards

Following standards state the related standards and explain any deviations from them:

- Local Number Portability (LNP) Capability Specification: Service Provider Portability - GR-2936-CORE, Issue 3
- AINGR: Switching Systems- GR-1298-CORE, Issue 10
- AINGR: Switch - Service Control Point (SCP)/Adjunct Interface- GR-1299-CORE, Issue 10
- Switching and Signaling Generic Requirements for Toll-Free Service Using AIN- GR-2892-CORE, Issue 1
- CCS Network Interface Specification (CCSNIS) Supporting toll-Free Service Using AIN - GR-2902-CORE, Issue 1
- Telcordia Technologies Research Specification of Signalling SystemNumber 7- GR-246-CORE, Issue 10





## 10 Standard Compliance Statement

Following Statement Of Compliances are related to the SS7 interface:

- IPWorks 6.0 SoC to GR-1298,Switching Systems
- IPWorks 6.0 SoC to GR-1299,Switch-SCP/Adjunct Interface
- Functional Specification SCCP
- Function Specification MTPL3&M3UA







## Reference List

### IPWorks Library Documents

- [1] *Trademark Information*
- [2] *Glossary of Terms and Acronyms*
- [3] *Typographic Conventions*

### PCAT and Other Ericsson Document

- [4] [IPWorks Statement of Compliance - Telcordia GR-246, Issue 10, T1.111, 18/174 02-AVA 901 16](#)
- [5] [IPWorks Statement of Compliance - Telcordia GR-246, Issue 10, T1.112, 19/174 02-AVA 901 16](#)
- [6] [IPWorks Statement of Compliance - Telcordia GR-246, Issue 10, T1.114, 20/174 02-AVA 901 16](#)
- [7] [IPWorks Statement of Compliance - Telcordia GR-2936, Issue 3, 22/174 02-AVA 901 16](#)
- [8] [IPWorks Statement of Compliance - Telcordia GR-2892, Issue 1, 21/174 02-AVA 901 16](#)
- [9] [IPWorks Statement of Compliance - Telcordia GR-1298, Issue 10, 16/174 02-AVA 901 16](#)
- [10] [IPWorks Statement of Compliance - Telcordia GR-1299, Issue 10, 17/174 02-AVA 901 16](#)
- [11] [Functional Specification SCCP, 155 17-CAA 901 437](#)
- [12] [Function Specification MTPL3&M3UA, 155 17-CAA 901 0180](#)

### Standards

- [13] *Local Number Portability (LNP) Capability Specification: Service Provider Portability- GR-2936-CORE Issue 3*
- [14] *AINGR: Switching Systems- GR-1298-CORE Issue 10*
- [15] *AINGR: Switch - Service Control Point (SCP)/Adjunct Interface- GR-1299-CORE Issue 10*
- [16] *Switching and Signaling Generic Requirements for Toll-Free Service Using AIN- GR-2892-CORE Issue 1*



- [17] *CCS Network Interface Specification (CCSNIS) Supporting toll-Free Service Using AIN- GR-2902-CORE Issue 1*
- [18] *Telcordia Technologies Research Specification of Signalling SystemNumber 7- GR-246-CORE Issue 10*