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Reliable Signaling Gateway Protocol (RSGP)
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Status of this Memo

Abstract

This memo describes a combined message set and function set for the Control Protocol used between a Network Access Server (NAS) and a Signaling Gateway (SG), based on the ASP and RSGCP drafts previously submitted [asp, rsgcp]. The Control Protocol supports Call Control, Circuit Maintenance and Resource Management.

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1.0 Overview

This document defines a protocol for interface between a Signaling Gateway (SG) and Network Access Server (NAS), which serves to integrate Internet access and the Public Switched Telephone Network (PSTN) using Signaling System 7 (SS7).
The SG has two fundamental interfaces. One is to the SS7 network speaking standard SS7 protocols as defined in the ITU-T Q.700 series.

The other interface is TCP/IP speaking to the SG's defined NAS population. This document describes the protocol that is carried between the SG and the NAS.

Since there is no existing protocol that fits the requirements completely, a new protocol has been derived from the ITU-T protocol Q.931. Q.931 has the following advantages:
-- it is a very reliable protocol that has been used for many years for ISDN call control, and is used for call control in H.323
-- Q.931 has well defined procedures and a message set that is extensible to allow additional functionality to be added easily.
-- Q.931 has already been incorporated into NAS's to support ISDN, minimizing the modifications required to implement a new Control Protocol. A subset is also used in H.323 for call setup between voice or multimedia over IP systems.

The following diagram shows the use of the SS7 Gateway and the RSGP for interworking of SS7 and Internet.

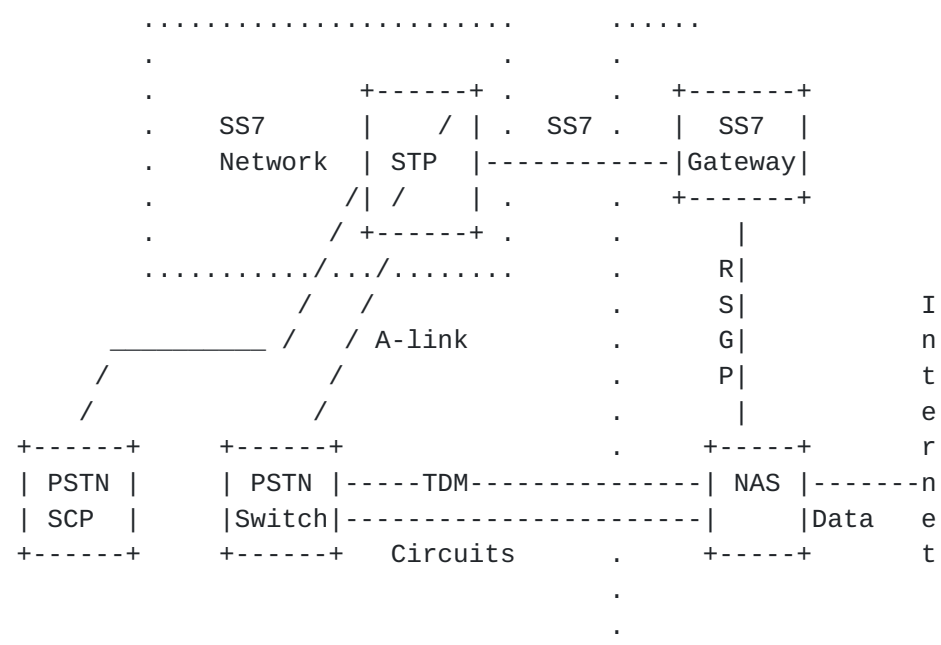


Figure 1: SS7-Internet Interworking for Call Setup

It is assumed that the implementer has access to the Q.931 protocol specification as well as an understanding of SS7 messages.

2.0 Bearer Services

The following describes the bearer services and interface configurations that are supported from the Q.931 specification.

Bearer Services

Four (4) bearer services are supported in the Control Protocol:

1. Circuit Mode, 64-kbps, 8-khz structured, Speech
2. Circuit Mode, 64-kbps, 8-khz structured, 3.1-khz, Audio
3. Circuit Mode, 64-kbps, 8-khz structured, Unrestricted Digital Transmission-Rate Adapted from 56-kbps
4. Circuit Mode, 64-kbps, 8-khz structure, Unrestricted Digital Transmission

Circuit Mode, 64-kbps, 8-khz structured, Speech The speech present at the inter-machine trunk is coded by the standardized Mu-law or a-law pulse code modulation (PCM) technique specified by CCITT Recommendation G.711.

Circuit Mode, 64-kbps, 8-khz structured, 3.1-khz, Audio The 3.1-khz audio signal present at the inter-machine trunk is coded by the standardized Mu-law or a-law PCM technique specified by CCITT Recommendation G.711.

Circuit Mode, 64-kbps, 8-khz structured, Unrestricted Digital Transmission-Rate Adapted from 56-kbps An information transfer rate of 56-kbps over a B channel is possible by rate adapting the user data rate of 56-kbps to 64-kbps. The transmitting side shall set bit eight (8) of each byte on the B-channel to a binary one, while the other bits are populated from the 56 kbps data stream. Conversely, the receiving side shall ignore the eighth bit of each byte.

Circuit Mode, 64-kbps, 8-khz structured, Unrestricted Digital Transmission This bearer service is used to originate and terminate circuit-mode data calls at 64-kbps.

Interface Configuration: The Control Protocol is considered non-facility associated signaling, where the signaling for specific B-channels occur over a different physical facility. The bearer channels are carried over inter machine trunks which are connected between NAS units and central office exchanges. The control channel is carried over an IP network.

3. Messages and Coding

3.1 Message Set

This section defines the messages the SG and NAS use for call processing, maintenance, and management. Messages for call processing are based on the ITU-T Recommendation Q.931 message set, and in most cases use the standard Q.931 information elements and codings. The call processing message set consists of:

Function	Message	Value
setup confirm	CONNECT	0x07
optional	CONNECT ACKNOWLEDGE	0x0f
optional	DISCONNECT	0x45
release request	RELEASE	0x4d
release confirm	RELEASE COMPLETE	0x5a
call reset request	RESTART	0x46
call reset confirm	RESTART ACKNOWLEDGE	0x4e
setup request	SETUP	0x05

status confirm	STATUS	0x7d
status request	STATUS ENQUIRY	0x73
data request/confirm	FACILITY	0x62

The following messages are required for supporting voice connections, in addition to connections for remote access:

call progress	ALERTING	0x01
tones and announcements	PROGRESS	0x03

New messages have been added to support registration and resource management functions between the SG and NAS. These messages are sent with Protocol Discriminator set to 0x43 (Maintenance). The new messages are as follows:

Function	Message	Value
initialize request	NAS STATUS	0x7f
initialize confirm	NAS STATUS ACKNOWLEDGE	0x7f
continuity result	CONTINUITY	0x11
result confirm	CONTINUITY ACKNOWLEDGE	0x13
resource register req	RESOURCE STATUS	0x1f
resource register conf	RESOURCE STATUS ACKNOWLEDGE	0x17
action request	SERVICE	0x0f
action confirm	SERVICE ACKNOWLEDGE	0x07

3.2 Message Contents

Contents of standard Q.931 call control messages used in RSGP are not shown in this document for brevity. The contents are a subset of those used in the ITU-T Recommendation Q.931 specification.

The locking shift procedure of Q.931 is used with new information elements in order to indicate an information element not defined in ITU-T Recommendation Q.931.

3.2.1 CONTINUITY

The CONTINUITY message shall be formatted as shown:

Information Element	Direction	Inclusion Condition	Length
Protocol Discriminator	NAS -> SG	Mandatory	1
Call Reference	NAS -> SG	Mandatory	3
Message Type	NAS -> SG	Mandatory	1
Channel Identification	NAS -> SG	Mandatory	4-*
Locking Shift (codeset 7)	NAS -> SG	Mandatory	1
Continuity Indicator	NAS -> SG	Mandatory	3

The CONTINUITY message is used by the NAS to indicate the outcome of a continuity test.

3.2.2 CONTINUITY ACKNOWLEDGE

Information Element	Direction	Inclusion Condition	Length
Protocol Discriminator	SG -> NAS	Mandatory	1
Call Reference	SG -> NAS	Mandatory	3
Message Type	SG -> NAS	Mandatory	1
Channel Identification	SG -> NAS	Mandatory	4-*

The CONTINUITY ACKNOWLEDGE message is used by the SG to acknowledge the receipt of a CONTINUITY message from the NAS.

3.2.3 RESOURCE STATUS

The RESOURCE STATUS message shall be formatted as shown below:

Information Element	Direction	Inclusion Cond.	Length
Protocol Discriminator	NAS -> SG	Mandatory	1
Call Reference	NAS -> SG	Mandatory	3
Message Type	NAS -> SG	Mandatory	1
Locking Shift (codeset 7)	NAS -> SG	Mandatory	1
Interface Status	NAS -> SG	Optional	7+
Resource	NAS -> SG	Optional	7+

The RESOURCE STATUS message is sent by the NAS to register associated interface and user port resources with the SG.

3.2.4 RESOURCE STATUS ACKNOWLEDGE

The RESOURCE STATUS ACKNOWLEDGE message shall be formatted as shown below:

Information Element	Direction	Inclusion Cond.	Length
Protocol Discriminators	SG -> NAS	Mandatory	1
Call Reference	SG -> NAS	Mandatory	3
Message Type	SG -> NAS	Mandatory	1

The RESOURCE STATUS ACKNOWLEDGE message is sent by the SG to acknowledge confirmation of a resource registration. The RESOURCE STATUS ACKNOWLEDGE message is not part of the basic Q.931 message set.

3.2.5 SERVICE

The SERVICE message shall be formatted as shown below:

Information Element	Direction	Inclusion Cond.	Length
Protocol Discriminator	BOTH	Mandatory	1

Call Reference	BOTH	Mandatory	3
Message Type	BOTH	Mandatory	1
Channel Identification	BOTH	Mandatory	4-*
Locking Shift (codeset 7)	BOTH	Mandatory	1
Change Status	BOTH	Mandatory	3

The SERVICE message is sent by the SG or to request a change in interface or channel status.

3.2.6 SERVICE ACKNOWLEDGE

The SERVICE ACKNOWLEDGE message shall be formatted as shown below:

Information Element	Direction	Inclusion Cond.	Length
Protocol Discriminator	BOTH	Mandatory	1
Call Reference	BOTH	Mandatory	3
Message Type	BOTH	Mandatory	1
Channel Identification	BOTH	Mandatory	4-*
Locking Shift (codeset 7)	BOTH	Mandatory	1
Change Status	BOTH	Mandatory	3

The SERVICE ACKNOWLEDGE message is sent by either the SG or the NAS to indicate that the state of the specified interface or channel has been changed.

The Change Status and Channel Identification IE's should be equivalent to the corresponding values sent in the SERVICE Message.

3.2.7 NAS STATUS

The NAS STATUS message shall be formatted as shown below:

Information Element	Direction	Inclusion Cond.	Length
Protocol Discriminator	BOTH	Mandatory	1
Call Reference	BOTH	Mandatory	3
Message Type	BOTH	Mandatory	1
Locking Shift (codeset 7)	BOTH	Mandatory	1
NAS Status	BOTH	Mandatory	3

The NAS STATUS message is used to notify the remote end of a change in status, such as NAS logon from a cold start, or NAS shutdown. The receiving end replies with NAS STATUS ACKNOWLEDGE.

3.2.8 NAS STATUS ACKNOWLEDGE

The NAS STATUS ACKNOWLEDGE message shall be formatted as shown below:

Information Element	Direction	Inclusion Cond.	Length
Protocol Discriminator	BOTH	Mandatory	1
Call Reference	BOTH	Mandatory	3
Message Type	BOTH	Mandatory	1
Cause	BOTH	Mandatory	1

The NAS STATUS ACKNOWLEDGE message is sent to confirm receiving the NAS STATUS message.

3.3 Information Element Coding

Information Elements unchanged from ITU-T Q.931 are not re-defined here for brevity.

The following new Information Elements are defined:

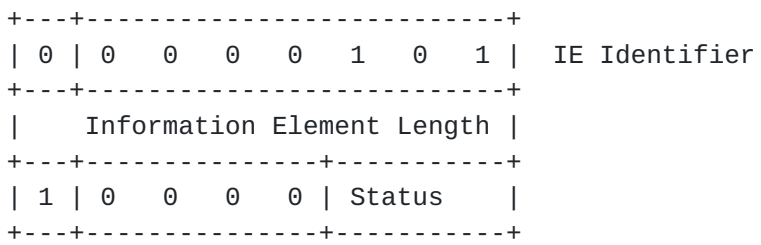
Information Element	IE Identifier
Change Status	05
Continuity Indicator	07
Interface Status	04
NAS Status	02
Resource	03

The following existing Information Elements have additional codepoints allocated:

Cause

3.3.1 Change Status

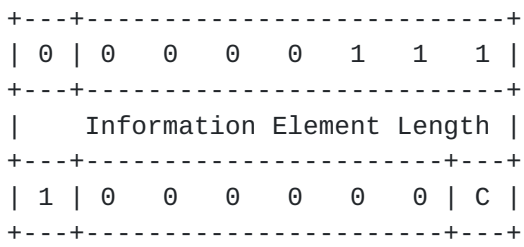
The format of the Change Status information element is as follows:



```
   Status:
   000  In Service
   001  Loop Back
   010  Out of Service
   011  Request Continuity Check
   100  Graceful Shutdown
   else spare
```

3.3.2 Continuity Indicator

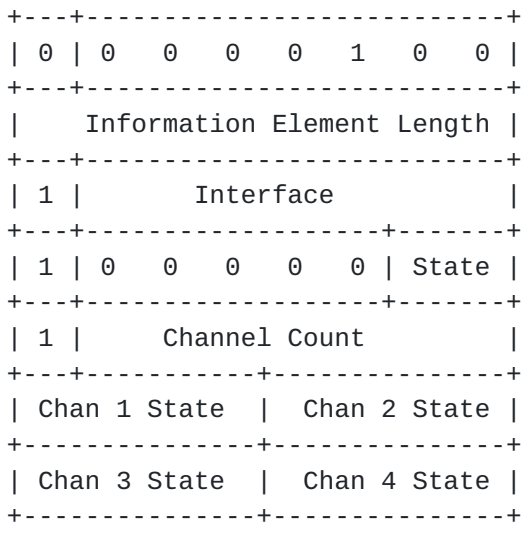
The format of the Continuity Indicator information element is as follows:



C: Continuity Result
0 Continuity Check failed
1 Continuity Check successful

3.3.3 Interface Status

The format of the Resource information element is as follows:



Interface:
Binary Interface number

State:
00 reserved
01 Maintenance (loopback)
10 Out of service (down)
11 In service (up)

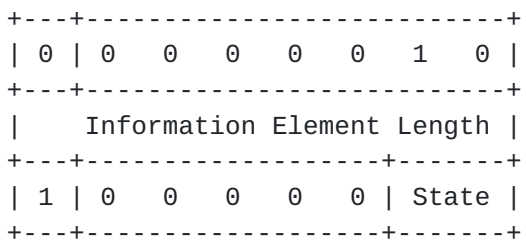
Channel Count:
Binary count of channels supported by this interface

Channel State:

```
0000 Reserved/Filler
0001 Unavailable - blocked
0010 Call in progress
0011 Idle - no existing calls
other        spare
```

3.3.4 NAS Status

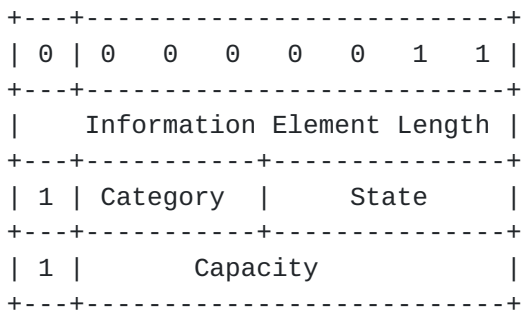
The format of the NAS Status information element is as follows:



State:
00 Cold start: NAS reboot
01 Warm start: NAS reestablishing connectivity to SG
10 Hot shutdown: NAS will disconnect abruptly, terminate all calls
11 Soft shutdown: NAS will shutdown when all calls have terminated

3.3.5 Resource

The format of the Resource information element is as follows:



Category:
001 Modems
010 HDLC Channels
other spare

State:
0001 Available
other spare

Capacity:
Binary count of resources

3.3.6 Cause

The following new Cause information element codings are included:

125 NAS registered for calls

126 NAS registered for incoming and outgoing calls
127 NAS registration rejected

4. Protocol Procedures

This section describes the protocol procedures required for call processing and resource management in RSGP.

Timers are defined in ITU-T Q.931 and are not re-defined here for brevity.

4.1 Call Scenarios

The call scenarios defined in this section provide examples of the main procedures used in the protocol, but do not describe all possible cases. For more detailed information, see ITU-T Recommendation Q.699.

4.1.1 Network Initiated Call Origination

4.1.1.1 IAM Initiated with No COT Required

This scenario describes the signaling that proceeds when a call is initiated by the reception of an IAM from the SS7 network and a continuity test is not required.

* When the SG receives an IAM from the SS7 network, the Nature of Connection indicators shall be examined to determine if COT is required on the specified circuit. If COT is not required, the SG shall send a SETUP message to the NAS.

* Once the NAS has determined that the call can be completed and the specified channel has been connected to the called party, it shall send a CONNECT message to the SG.

* Upon receipt of the CONNECT message, the SG shall send an ANM message to the SS7 network, and may optionally send a CONNECT ACKNOWLEDGE message to the NAS.

4.1.1.2 IAM Initiated with Continuity Check Required

This scenario describes the signaling that proceeds when a call is initiated by the reception of an IAM from the SS7 network and a continuity test is required.

* When the SG receives an IAM from the SS7 network, the Nature of Connection indicators shall be examined to determine if COT is required on the specified circuit. If COT is required, the SG shall send a SERVICE message to the NAS indicating that the specified circuit should be placed in a loopback mode, and start timer Tserv.

* When the NAS receives the SERVICE message indicating the specified circuit should be placed in loopback mode, the circuit shall be marked as busy, placed in a loopback mode, and a SERVICE ACKNOWLEDGE message indicating the circuit was successful placed in a loopback mode, shall be sent to the SG.

* When the SG receives the SERVICE ACKNOWLEDGE message indicating the circuit was successfully placed in a loopback mode, timer Tserv shall be stopped.

* When the SG receives a COT message from the SS7 network indicating the continuity test was successful, the SG shall send a SETUP message to the NAS.

* Once the NAS has determined that the call can be completed and the specified channel has been connected to the called party, it shall send a CONNECT message to the SG.

* Upon receipt of the CONNECT message, the SG shall send an ANM message to the SS7 network, and may optionally send a CONNECT ACKNOWLEDGE message to the NAS.

4.1.1.3 IAM Initiated with Continuity Check on Previous Circuit Required

This scenario describes the signaling that proceeds when a call is initiated by the reception of an IAM from the SS7 network that specifies a continuity test on a previous circuit is required.

* When the SG receives an IAM from the SS7 network, the Nature of Connection indicators shall be examined to determine if continuity check is required. If continuity check is required on a previous circuit, then the SG does not send a SETUP message until a COT is received indicating continuity check successful.

* Once the NAS has determined that the call can be completed and the specified channel has been connected to the called party, it shall send a CONNECT message to the SG. The NAS shall start timer T313 when the CONNECT message is sent.

* Upon receipt of the CONNECT message, the SG shall send a CONNECT ACKNOWLEDGE message to the NAS.

* Upon receipt of the CONNECT ACKNOWLEDGE message, the NAS shall stop timer T313.

4.1.2 Call Clearing

4.1.2.1 Network Initiated Call Clearing

This scenario describes the signaling that proceeds when a call clearing is initiated by the SS7 network.

* Call clearing is initiated by the SS7 network when a REL is received by the SG from the SS7 network. When the SG receives a REL from the SS7 network, a corresponding RELEASE message shall be sent to the NAS, and timer T308 shall be initiated.

* When the NAS receives a RELEASE message the associated circuit shall be disconnected, and a RELEASE COMPLETE shall be sent to the SG.

* When the SG receives the RELEASE COMPLETE message timer T308 shall be stopped, the channel shall be released, and the call reference shall be released.

* The NAS shall also be capable of receiving a DISCONNECT message from the SG, in which case the procedures in Section 4.1.2.2 are followed.

4.1.2.2 NAS Initiated Call Clearing

This scenario describes the signaling that proceeds when a call clearing is initiated by the NAS.

* When the NAS detects that an active call has been terminated by the local subscriber, the NAS shall disconnect the associated circuit, send a RELEASE message to the SG, and initiate timer T308.

* When the SG receives the RELEASE message, a RLS message shall be sent out to the SS7 network, the circuit and call reference shall be released, and a RELEASE COMPLETE shall be sent to the NAS.

* When the NAS receives the RELEASE COMPLETE message timer T308 shall be stopped.

* The SG shall be capable of receiving a DISCONNECT message from the NAS, in which case the procedures in section 4.1.2.1 are followed.

4.1.3 Call Failures and CCR

* message timer Tserv shall be stopped and a RLC shall be sent out to the SS7 network.

4.1.3.1 IAM Initiated with Continuity Check on Previous Circuit Failed

This scenario describes the signaling that proceeds when a call is initiated by the reception of an IAM from the SS7 network that specifies a continuity test on a previous circuit is required and consequently the continuity test fails.

* When the SG receives an IAM from the SS7 network, the Nature of Connection indicators shall be examined to determine if COT is required on the specified circuit, or on a previous circuit. If COT is required on a previous circuit, the SG delays sending SETUP out to the NAS.

* When the SG receives a REL message from the SS7 network, which indicates the continuity test failed, the SG releases the circuit and call without sending an indication to the NAS.

4.2 Management Procedures

4.2.1 Registration

This scenario describes the message flow that proceeds when a NAS unit registers the available hardware interfaces.

* When the NAS detects that a resource has changed operational states, a RESOURCE STATUS message is sent to the SG and Timer T350 shall be initiated. Multiple RESOURCE STATUS messages may be send to carry information about the interface status and resource status.

* When the SG receives the RESOURCE STATUS message, the indicated resource states are updated and a RESOURCE STATUS ACKNOWLEDGE is sent to the NAS. The Resource information elements in the RESOURCE STATUS ACKNOWLEDGE must be identical to those received in the original RESOURCE STATUS message.

* When the NAS receives the RESOURCE STATUS ACKNOWLEDGE message, timer T350 shall be stopped.

4.2.2 Registration - T350 Timeout

This scenario describes the message flow that proceeds when a timeout of Timer T350 occurs after the NAS has initiated registration of the available hardware interfaces. It is important to note that the NAS should continue to re-send the RESOURCE STATUS message and restart Timer T350 until a corresponding RESOURCE STATUS ACKNOWLEDGE is received.

* When the NAS detects that a resource has changed operational states, a RESOURCE STATUS message is sent to the SG and Timer T350 shall be initiated.

* When Timer T350 expires on the NAS, the NAS shall re-send the RESOURCE STATUS message and restart timer T350.

* When the SG receives the RESOURCE STATUS message, the indicated resource states are updated and a RESOURCE STATUS ACKNOWLEDGE is sent to the NAS.

* When the NAS receives the RESOURCE STATUS ACKNOWLEDGE message, timer T350 shall be stopped.

4.2.3 SG Initiated Restart

This scenario describes the message flow that proceeds when a Restart Request is initiated by the SG.

* When the SG initiates restart, it sends a RESTART message to the NAS and timer T317 is initiated.

* When the NAS receives a RESTART message from the SG, the specified interface or channel shall be restarted and a RESTART ACKnowledgment shall be sent to the SG.

* When the SG Control Protocol receives a RESTART ACKNOWLEDGE from the NAS, timer T317 shall be stopped.

4.2.4 NAS Initiated Restart

This scenario describes the message flow that proceeds when a RESTART message is received by the SG Control Protocol from the NAS.

* If the NAS determines that a restart of a single DS0, or an entire interface is necessary, a RESTART message shall be sent to the SG and timer T317 shall be initiated.

* When the SG Control Protocol receives a RESTART message from the NAS, a Restart Indication primitive shall be sent to the call control and a RESTART ACKNOWLEDGE shall be sent to the NAS.

* When the NAS receives a RESTART ACKNOWLEDGE from the SG, timer T317 shall be stopped, and the associated equipment shall be restarted.

4.2.5 Service Message Procedures

The Service message is used to initiate circuit management procedures at the NAS or Gateway for functions such as circuit blocking and loop back (prior to remote continuity check). The procedures are as follows:

* When the SG or NAS initiates a Service procedure, it sends the Service message and initiates timer Tserv.

* When the initiating SG or NAS receives the Service Acknowledge message, timer Tserv is stopped.

* The following tables describe the detailed procedures for the NAS in response to receipt of a Service message from the SG:

	Interface Specified	Channel Specified
In Service	The NAS will attempt to bring the T1/E1 into service. The NAS will respond with 'Out of Service' if the T1/E1 is down (not framing).	The NAS will mark the channel as available. Established calls will not be affected.
Loop Back	The T1/E1 will be placed into loopback. All established calls will be torn down.	The NAS will place the DS0 into loopback state if there is no established call. The NAS will respond with 'In Service' if a call is in progress.
Out of Service	The NAS will place the T1/E1 into this state. All established calls will be torn down.	The NAS will mark the DS0 and tear down any if there is no established calls.
Request Continuity Check	The NAS will reject this message and send STATUS message.	The NAS will execute the continuity check if there is no established call. The NAS will respond with 'In Service' if a call is in progress
Graceful Shutdown (Blocking)	The NAS will mark the T1/E1. It will not tear down any established calls.	The NAS will mark the DS0, but will not tear down any established calls.

* Upon completion of the action specified, the NAS responds to the SG with a Service Acknowledge message.

* The following table describes the procedures at the SG upon receipt of a Service message from the NAS:

	Interface Specified	Channel Specified
In Service	The NAS will send this message when the T1/E1 framing is achieved. The Gateway should not change the state of any established call.	The NAS can send this request for Channels it previously took "Out of Service". The Gateway should not change the state of any established call.
Loop Back	The NAS will not generate this request. The Gateway should respond with STATUS.	The NAS will not generate this request. The Gateway should respond with STATUS.
Out of Service	The NAS will place the T1/E1 into this state if T1/E1 framing is lost or if requested by the operator. All established calls will be torn down.	The NAS will send this message in the case of modem failure. Any established call will be torn down.
Request Continuity Check	The NAS will not send this message. The Gateway should respond with STATUS.	The NAS will use this request as a result of an operator request.
Graceful Shutdown (Blocking)	The NAS will issue this request as a result of an operator request. Any call in progress should not be affected.	The NAS will not issue this message. The Gateway should reject this message using the STATUS message.

* Upon completion of the action specified, the SG responds to the NAS with the Service Acknowledge message.

5. Detailed Procedures

This section provides detailed information that describes the operation of the SG Control Protocol. A call progresses through different states as various events occur, and this section describes

how the SG and NAS should process calls in each state. The table below shows the call states that apply to the SG Control Protocol.

State Name	Value
Null	0
Call Initiated	1
Call Present	6
Connect Request	8
Active	10
Disconnect Request	11
Disconnect Indication	12
Release Request	19

Additional procedures to be provided.

6. Transport

Detailed procedures to be provided.

Additional procedures may be added, for example, in order to monitor performance of the connection between NAS and SG, and initiate recovery procedures if it is determined that the connection has failed.

7. Security Considerations

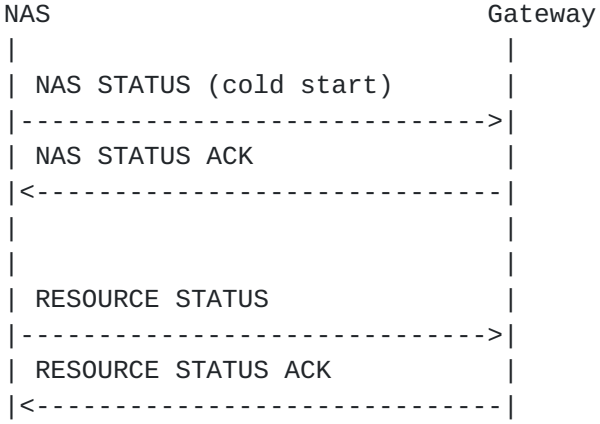
SS7 protocol does not support internal authentication and encryption functions. This is taken into consideration in current SS7 networks. Signaling gateways should be designed to protect the SS7 network and should employ thoughtful thresholds to make sure a NAS or malicious intermediate entity cannot adversely affect the SS7 network or any SS7 connected nodes.

If the network operator wishes to add IP level security functions it is recommended but not required that the TCP/IP link from the NAS to the SG be protected by IPsec AH and ESP [RFC 1826, 1827]. In the case that the physical network between the NAS and SG is private, such security techniques are optional. In the case that the network used is shared with other applications and/or nodes, IPsec security is strongly recommended. This is to prevent Denial of Service attacks and false message attacks.

8. Message Flow Examples

8.1 NAS Registers with Gateway for Service

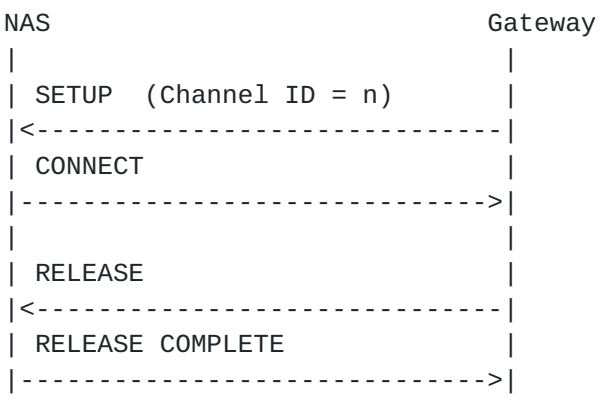
The following timing diagram shows the message flow during initial NAS registration with the SG.



Note: multiple Resource Statue messages may be sent and acknowledged.

8.2 Gateway Originated Normal Call Setup and Release

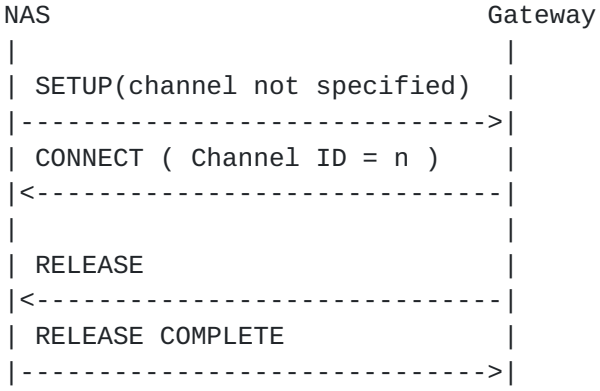
The following diagram shows successful Call establishment and tear down for a gateway originated call.



Note: The tear down sequence can be initiated by either the NAS or by the gateway to hang-up the call.

8.3 NAS Originated Normal Call Setup

The following diagram shows successful Call establishment and tear down for NAS originated calls. For NAS originated calls, the Gateway selects the channel to be used in the call.



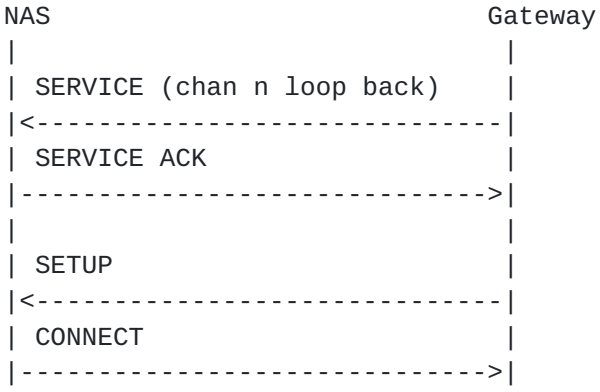
Note: The tear down sequence can be initiated by either the NAS or by the gateway to hang-up the call. Disconnection can be initiated by either the DISCONNECT or RELEASE message.

8.4 Unsuccessful Call Establishment Sequence

The following sequence illustrates when a call is rejected by the NAS.

8.5 Continuity check test as part of Incoming Call Setup - Success

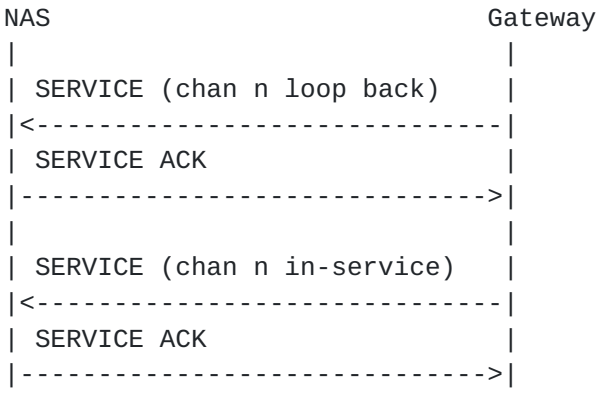
The following sequence illustrates when the gateway receives an IAM message indicating that a continuity test should be performed on the circuit prior to the call establishment.



Per Q.699 (3.1.18) continuity checking should be performed before the SETUP is sent to the terminating end-point. SERVICE message from the gateway to the NAS is used to initiate the loopback. If the remote end-point indicates to the gateway that the continuity check succeeded, the gateway proceeds with SETUP.

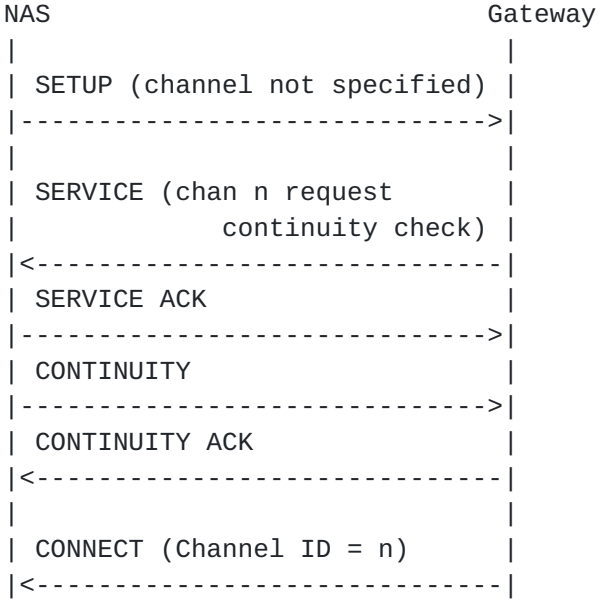
8.6 Continuity check test as part of Incoming Call Setup - Failure

If the remote end indicates failure, the gateway will send SERVICE message to the NAS requesting that the channel be placed into the in-service state.



8.7 Continuity check test as part of Outgoing Call Setup - Success

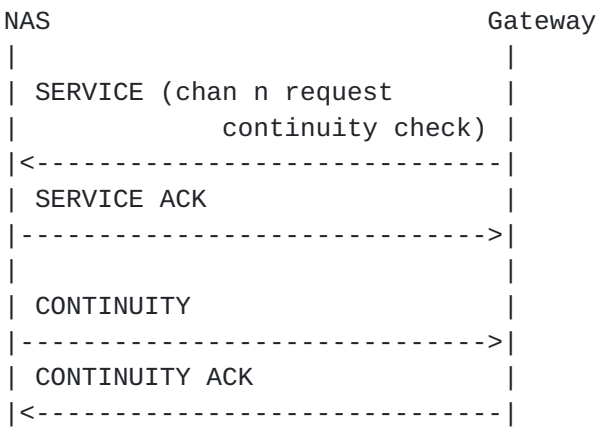
The following sequence illustrates when the NAS initiates call setup and the SS7 Gateway determines that continuity test should be performed on the circuit prior to the call establishment.



8.8 Continuity check test initiated by the SG operator

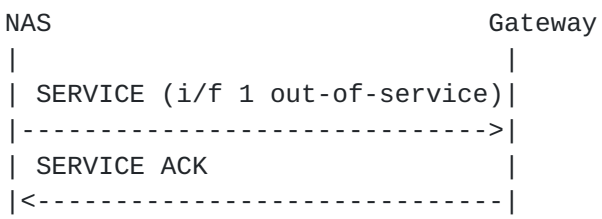
The gateway sends a SERVICE message to initiate the continuity check. The NAS performs continuity check and reports the result using the CONTINUITY message.

Not shown in this diagram is the corresponding action of the SG. Upon receipt of the Service Ack from the NAS, the SG generates a CCR message into the SS7 network, initiating loopback at the remote switch.

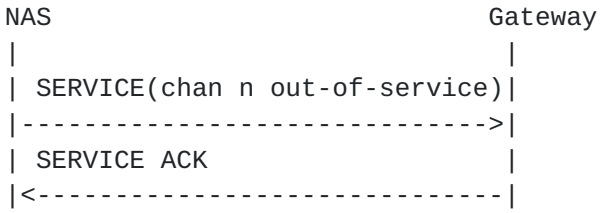


8.7 NAS detects bearer T1/E1 line down (LOS, Red Alarm)

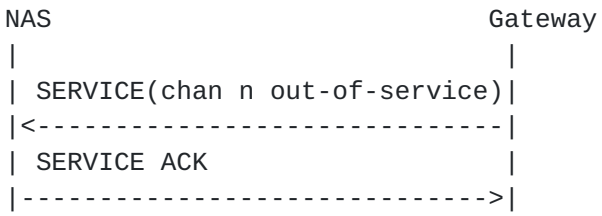
If the NAS detects that a particular T1/E1 line failed, it sends a SERVICE message to the gateway. Established calls will be torn down as part of normal processing - i.e the NAS modems will detect loss of connection and the NAS will disconnect the call. The gateway will request blocking of CICs associated with the particular T1/E1 using an SS7 Blocking or Circuit Group Blocking Message.



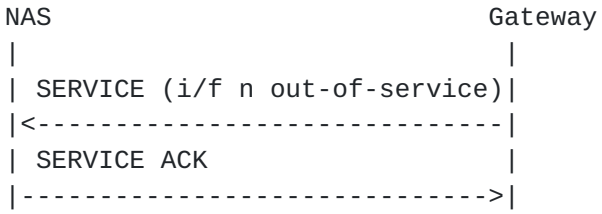
8.8 Individual bearer channel taken out-of-service by NAS



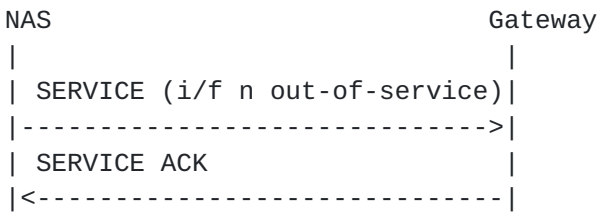
8.9 Individual bearer channel taken out-of-service by Gateway operator



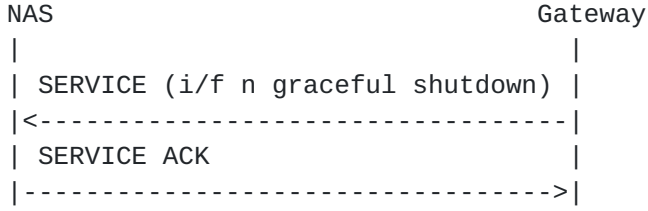
8.10 Bearer T1/E1 trunk abrupt shutdown initiated by Gateway operator



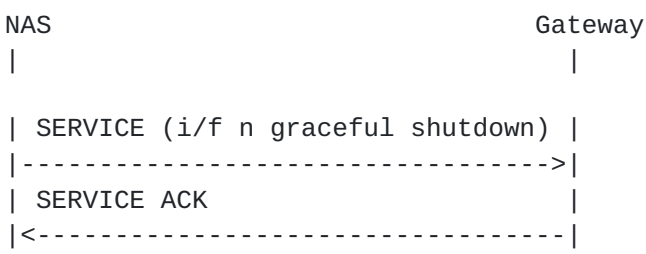
8.11 Bearer T1/E1 trunk abrupt shutdown initiated by NAS



8.12 Bearer T1/E1 trunk graceful shutdown initiated by Gateway operator



8.13 Bearer T1/E1 trunk graceful shutdown initiated by NAS



9. Acronyms

ANM	Answer Message
SG	Signaling Gateway
CCR	Continuity Check Request
COT	Continuity
CPE	Customer Premises Equipment
IAM	Initial Address Message
IE	Information Element
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ISUP	ISDN User Part
MTP	Message Transfer Part
NAS	Network Access Server
PCM	Pulse Code Modulation
PSTN	Public Switched Telephone Network
SCP	Service Control Point
STP	Signal Transfer Point
SS7	Signaling System Number 7
UL	Upper Layer

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[rsgcp] Reliable Signaling Gateway Control Protocol (RSGCP), <draft-rfced-info-holdrege-00.txt>, work in progress

Q.931 **ITU-T Recommendation Q.931 DIGITAL SUBSCRIBER SIGNALLING SYSTEM** No. 1 (DSS 1) - ISDN USER-NETWORK INTERFACE LAYER 3 SPECIFICATION FOR BASIC CALL CONTROL

Q.699 **ITU-T Recommendation Q.699 Interworking between ISDN access and** non-ISDN access over ISDN User Part of Signalling System No. 7

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