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SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

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Distributed call and connection management (DCM) based on PNNI

ITU-T Recommendation G.7713.1/Y.1704.1

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ITU-T Recommendation G.7713.1/Y.1704.1

Distributed call and connection management (DCM) based on PNNI

Summary

This Recommendation provides the protocol specifications for distributed call and connection management based on PNNI/Q.2931. This Recommendation meets the requirements of ITU-T Rec. G.7713/Y.1704 and is functionally similar to other ITU-T Recommendations in the G.7713 series. The protocol specification in this Recommendation specifies the communications across interfaces to effect automated call operations and connection operations. This version of the Recommendation is concerned with the specification for soft permanent connections. Items covered in this Recommendation include:

– message functional definition and content;

– general message format and information element coding;

– call/connection control procedures.

This Recommendation does not cover any aspects related to routing, or automatic discovery.

Source

ITU-T Recommendation G.7713.1/Y.1704.1 was prepared by ITU-T Study Group 15 (2001-2004) and approved under the WTSA Resolution 1 procedure on 16 March 2003.

History

This Recommendation forms part of a suite of Recommendations covering the full functionality of the automatic switched transport network (ASTN).

Document History		
Version		**Approval**
0.1	G.7713.1/Y.1704.1	2003-03-16

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Automatic switched optical network, Automatic switched transport network, Distributed call and Connection management, Exterior network-node interface, PNNI, Q.2931, User network interface.

FOREWORD

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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ITU-T Recommendation G.7713.1/Y.1704.1

Distributed call and connection management (DCM) based on PNNI

1 Scope

This Recommendation provides the protocol specifications for distributed call and connection management based on PNNI/Q.2931, developed within the context of G.7713/Y.1704 DCM requirements. The protocol specifications in this Recommendation specify the communications across interfaces to effect automated call operations and connection operations. This version of the Recommendation is concerned with the specification for soft permanent connections. As such the call model is based on the concept of a null call as described in ITU-T Rec. G.8080/Y.1304. By providing a call identifier in the soft permanent connection model, the specification can be extended in later versions to include switched connections. As such, name translation/directory services and call capability sets are not included. Items covered in this Recommendation include:

– message functional definition and content;

– general message format and information element coding;

– call/connection control procedures.

This Recommendation does not cover any aspects related to routing, or automatic discovery.

This Recommendation does not specify the use of the PNNI routing algorithm, nor does it restrict the use of PNNI to an ATM transport implementation, indeed PNNI can be transported using protocols other than ATM, e.g., Internet Protocol.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[1] ITU-T Recommendation Q.931 (1998), *ISDN user-network interface layer 3 specification for call control*.

[2] ATM Forum af-cs-0125.000 (1999), *ATM Inter-Network (ANNI) Specification*.

[3] ATM Forum af-pnni-0055.002 (2002), *Private Network-Network Interface Specification v.1.1*.

[4] ITU-T Recommendation Q.2111 (1999), *B-ISDN ATM adaptation layer – Service specific connection oriented protocol in a multi-link and connectionless environment (SSCOPMCE)*.

[5] ITU-T Recommendation Q.2931 (1995), *Digital Subscriber Signalling System No. 2 (DSS2) – User-Network Interface (UNI) layer 3 specification for basic call/connection*.

[6] ATM Forum af-cs-0127.000 (1999), *PNNI SPVC Addendum Version 1.0*.

[7] ITU-T Recommendation Q.2610 (1999), *Usage of cause and location in B-ISDN user part and DSS2*.

[8] ATM Forum af-sig-0140.000 (2000), *Network Call Correlation Identifier v.1.0*.

[9] ATM Forum af-sig-0061.000 (1996), *UNI Signalling v.4.0*.

[10] ATM Forum af-cs-0141.000 (2000), *PNNI Addendum for Path and Connection Trace, Version 1.0*.

[11] ATM Forum af-cs-0148.000 (2000), *Modification of Traffic Descriptor for an Active Connection, Addendum to UNI 4.0/PNNI 1.0/AINI*.

[12] ATM Forum af-cs-0173.000 (2001), *Domain-based rerouting for active point-to-point calls, Version 1.0*.

[13] ITU-T Recommendation G.807/Y.1302 (2001), *Requirements for automatic switched transport networks (ASTN)*.

[14] ITU-T Recommendation G.7712/Y.1703 (2003), *Architecture and specification of data communication network*.

[15] ITU-T Recommendation G.7713/Y.1704 (2001), *Distributed call and connection management (DCM)*.

[16] ITU-T Recommendation G.7714/Y.1705, (2001), *Generalized automatic discovery techniques*.

[17] ITU-T Recommendation G.8080/Y.1304 (2001), *Architecture for the automatically switched optical networks (ASON)*.

[18] ITU-T Recommendation E.360.1 (2002), *Framework for QoS routing and related traffic engineering methods for IP-, ATM-, and TDM-based multiservice networks*.

[19] ITU-T Recommendation G.707/Y.1322 (2000), *Network node interface for the synchronous digital hierarchy (SDH)*.

[20] ITU-T Recommendation G.709/Y.1331 (2003), *Interfaces for the Optical Transport Network (OTN)*.

3 Terms and Definitions

The following terms are defined in ITU-T Rec. G.8080/Y.1304:

– connection controller;

– link resource manager;

– subnetwork point;

– subnetwork point pool.

The following term is defined in ITU-T Rec. G.807/Y.1302:

– soft permanent connection.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

AESA ATM End System Address

ASON Automatic Switched Optical Network

ASTN Automatic Switched Transport Network

CC Connection Controller

DTL Designated Transit List

IE Information Element

LCI	Link Connection Identifier
LRM	Link Resource Manager
M	Mandatory
NCCI	Network Call Correlation Identifier
O	Optional
PNNI	Private Network-Network Interface
SNP	Subnetwork Point
SNPP	Subnetwork Point Pool
SPC	Soft Permanent Connection
TLV	Type, Length, Value

5 Conventions

In this Recommendation, the acronym PNNI is used to refer to the signalling protocol portion of PNNI [5], together with a number of extension specifications.

6 Assumptions

This Recommendation assumes a subset of the messages and information elements defined by the PNNI [5] as the basis for the protocol specification for the Automatic Switched Transport Network (ASTN). Signalling procedures defined by the PNNI are assumed to apply except for the modifications identified in clause 10.

This Recommendation supports the NSAP address format for addressing information. Other address formats such as IP version 4 and IP version 6 can be supported through conversion to NSAP format. Addressing of transport resources in the protocol is done via Subnetwork Point Pool (SNPP) identifiers. A pair of these SNPP identifiers identify an SNPP link. SNPP names are defined from transport name spaces (see clause 10/G.8080/Y.1304) and it is important to note that control plane names/addresses are not used for these. For example, neither routing controller nor connection manager identifiers are used for bearer link names.

The terms Quality of Service (QoS), Class of Service (CoS), and Grade of Service (GoS) with respect to the transport plane are used in this Recommendation in the sense of ITU-T Rec. E.360.1. It is expected that ASON specific characteristics and parameters will be associated with these terms in later versions of this Recommendation.

7 Applications

Figure 7-1 provides an overall view of control plane partitioning and the main interfaces of the control plane that pertain to signalling.

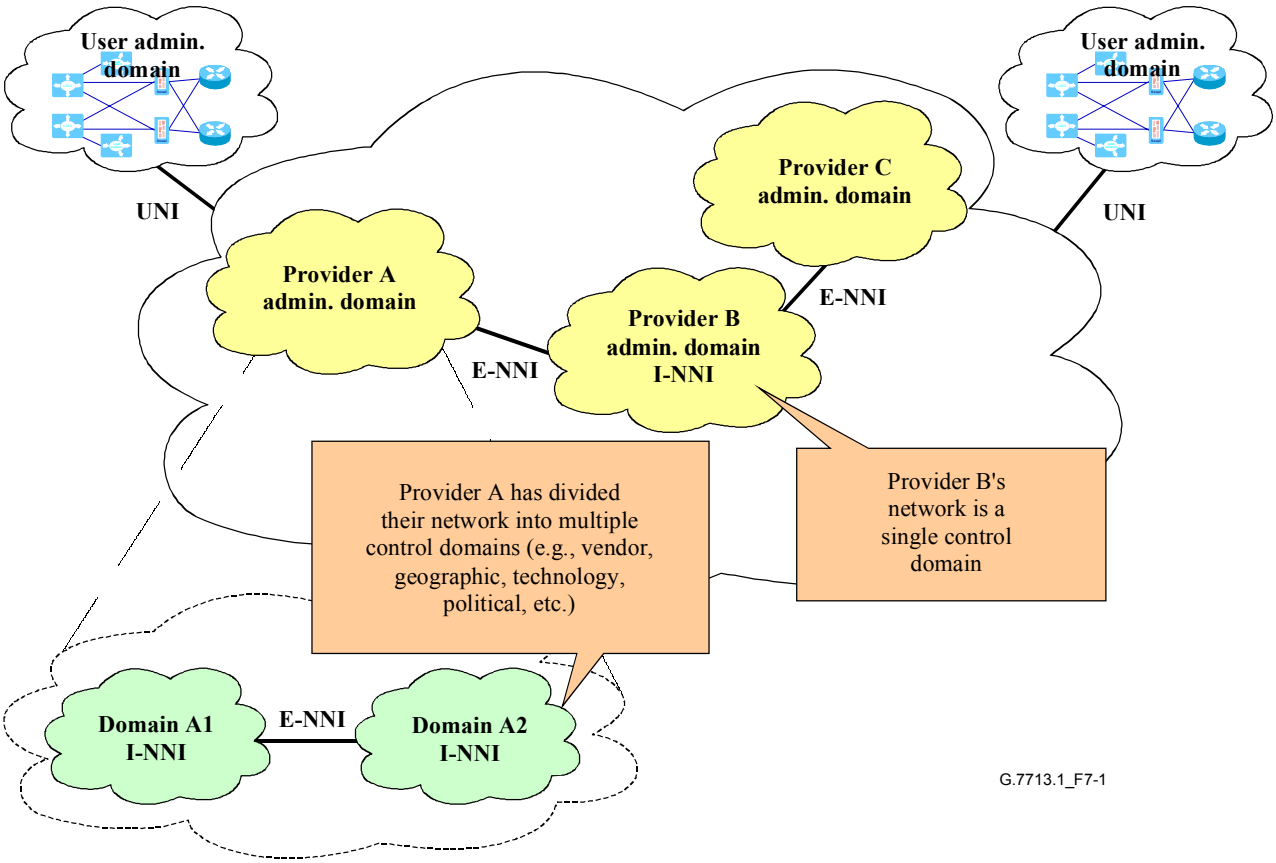

Figure 7-1/G.7713.1/Y.1704.1 – Overall view of control plane partition

7.1 Overview of PNNI

The ATM Forum's PNNI [3] signalling specifications provide a scalable network-network interface. It is based on ATM Forums UNI specification [9] and on ITU-T Rec. Q.2931 signalling protocol specification [5] and related extension documents. Minor modifications are defined in this specification to allow the signalling protocol to be applied to the distributed call and connection management of an Automatic Switched Optical Network (ASON) transport networks.

7.1.1 New formats for transport networks

A new Connection Identifier Information Element (IE) format is defined for use with transport networks allowing the specification of new connection types, and to include the concepts of Subnetwork Point (SNP) and Subnetwork Point Pool (SNPP). A new Traffic Descriptors IE format is defined for use with transport networks allowing the specification of traffic descriptor attributes suitable for transport networks.

7.2 Defect handling

There are different types of defects that may affect the control plane. These defects may range from a simple signalling channel failure to multiple control plane node failures. The control plane needs to support appropriate behaviours to recover from these defects, initially attempting to recover from failures based on local control plane mechanisms, local interaction with the transport plane, and subsequently attempting to recover based on control plane interactions with external components. General guidelines for defect handling include:

– Control plane failures are notified to the management plane. The management plane may direct the control plane to take certain actions due to the failure. These actions may include

cleaning up of partial connections, release of certain connections, or other protocol-specific actions for state maintenance and recovery.

– A control plane node may provide a persistent storage of relevant information, such as call and connection state information, configuration information, and control plane neighbour information.

– After repair if connection/call states cannot be recovered, the control plane node may communicate with an external component to attempt state information recovery. External components may include neighbour control plane nodes or a persistent storage provided by a centralised (e.g., management plane) component.

– A control plane node notifies the management plane of the inability to recover (subset of) relevant information (e.g., inability to synchronize state of connections). The management plane may respond with the following actions (the default control plane action should be to retain the connections):

  • release the impacted connections;

  • retain the impacted connections. In this case, a connection may remain non-synchronized from the control plane perspective; however, the connection may remain valid.

– A control plane node (after recovering from node failure) may not be able to recover neighbour connection state from its local persistent storage and thus may lose information on connections. In this case the control plane node should request an external controller (e.g., the management system) for information to recover the connections. Similarly call state may be unrecovered and require management intervention to resolve. Specifics of the interactions between the control plane and management plane are beyond the scope of this Recommendation.

Thus, as a general rule:

– A control plane failure must not result in the release of established connections. Setup requests in the process of been completed may be removed (either during the failure or after recovery from failure). Established connections associated with a pending release request must be released (either during the failure or after recovery from failure).

– Additional actions by the control plane may be dependent on provisioned default behaviour for a particular type of connection.

However, a transport plane node failure may result in the release of established connections. This depends on the type of connection and the service level associated with each connection. For example, a "best-effort unprotected" connection may be released during a transport plane node failure while a "protected" connection must be restored (or maintained) based on the service level specification associated with that connection. Note that even in the case of a protected connection, the original connection may be released while a new connection is set up (this also depends on the type of protection used for the particular connection).

7.3 Example signalling flows

The following example signalling flows illustrate the basic operation of the signalling protocol for simple setup and release scenarios.

7.3.1 Setup with no monitoring

Figure 7-2 illustrates call setup with no monitoring. T303 and T310 are timers as described in ITU-T Rec. Q.2931.

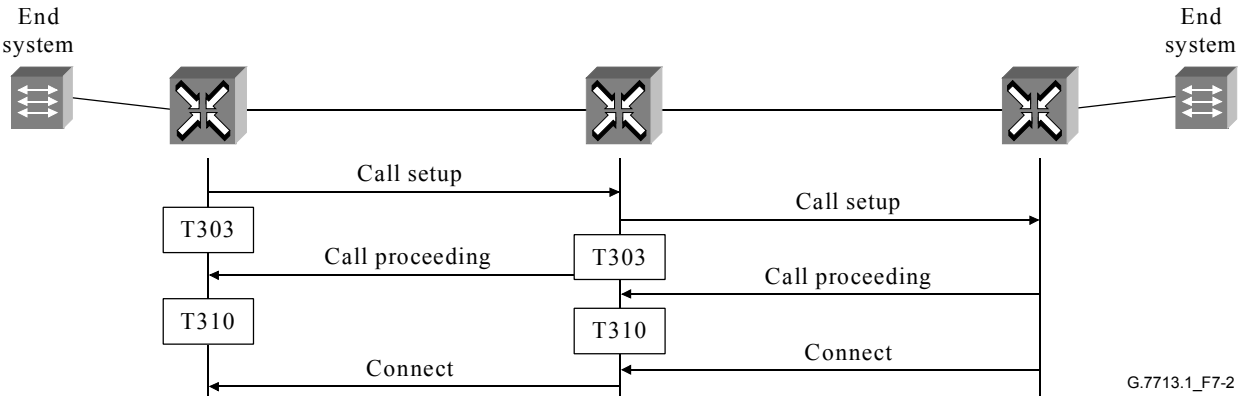

Figure 7-2/G.7713.1/Y.1704.1 – Call setup scenario with no monitoring

7.3.2 Call Release with no monitoring

Figure 7-3 illustrates call release with no monitoring. T308 is a timer as defined in ITU-T Rec. Q.2931.

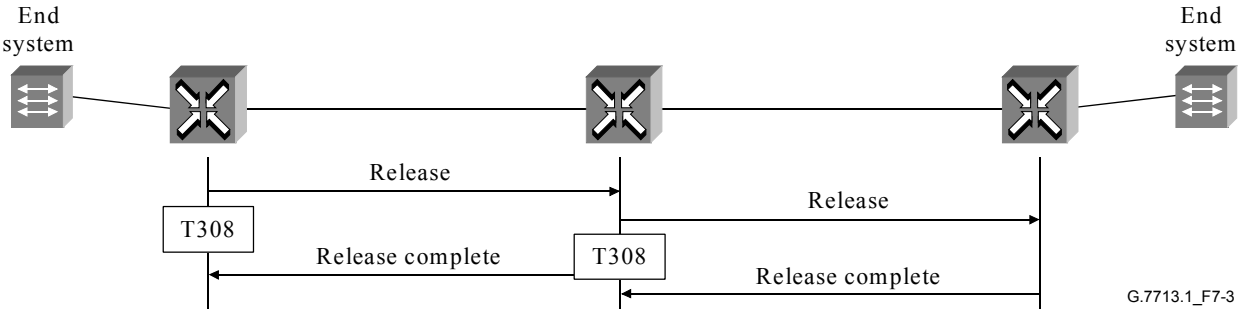

Figure 7-3/G.7713.1/Y.1704.1 – Call release scenario with no monitoring

8 Message functional definition and content

8.1 Messages for distributed connection management

Table 8-1 summarizes the messages for point-to-point call and connection control.

Table 8-1/G.7713.1/Y.1704.1 – Messages for distributed connection management

Message	Reference af-pnni-0055.002 (unless otherwise indicated)
Call establishment messages:	
CALL PROCEEDING	6.3.1.2
CONNECT	6.3.1.3
SETUP	6.3.1.6
Call clearing messages:	
RELEASE	6.3.1.4
RELEASE COMPLETE	6.3.1.5

Table 8-1/G.7713.1/Y.1704.1 – Messages for distributed connection management

Message	Reference af-pnni-0055.002 (unless otherwise indicated)
Miscellaneous messages:	
CONNECTION AVAILABLE	6.3.1.10
MODIFY ACKNOWLEDGE (Note)	2.1.2.2 of [11]
MODIFY REJECT (Note)	2.1.2.3 of [11]
MODIFY REQUEST (Note)	2.1.2.1 of [11]
NOTIFY	6.3.1.9
STATUS	6.3.1.7
STATUS ENQUIRY	6.3.1.8
TRACE CONNECTION	5.2 of [10]
TRACE CONNECTION ACKNOWLEDGE	5.2 of [10]
NOTE – Detailed format and procedures for further study.	

8.1.1 Call proceeding message

This message is sent by the Succeeding side to indicate that call establishment has been initiated and no more call establishment information will be accepted. Table 8-2 describes the CALL PROCEEDING message content.

Message type: CALL PROCEEDING

Direction: Succeeding to Preceding

Significance: Local

Table 8-2/G.7713.1/Y.1704.1 – CALL PROCEEDING message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Connection identifier	M	5-*

8.1.2 Connect message

This message is sent by the Succeeding and delivered to the Preceding side to indicate call/connection acceptance by the called user. Table 8-3 describes the CONNECT message content.

Message type: CONNECT

Direction: Succeeding to Preceding

Significance: Global

Table 8-3/G.7713.1/Y.1704.1 – CONNECT message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Broadband low layer information	O (Note 1)	5-20
Called party SPC	O (Note 2)	8-*
Notification indicator	O (Notes 1 and 3)	5-*
Rerouting	O (Note 1)	11-80
Rerouting Services	O	8
NOTE 1 – Included if the received connect indication contains this information. NOTE 2 – Included in case of soft permanent connection setup. NOTE 3 – May be present up to three times.		

8.1.3 Release message

This message is sent by a network node to an adjacent network node to indicate that it has cleared the connection (if any) and is waiting to release the call reference. Table 8-4 describes the RELEASE message content.

Message type: RELEASE

Direction: Both

Significance: Global

Table 8-4/G.7713.1/Y.1704.1 – RELEASE message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Cause	M (Note 1)	6-34
Crankback	O (Note 2)	7-72
Notification indicator	O	5-*
Rerouting cause	O	5
NOTE 1 – This information element may appear twice in the message. NOTE 2 – Included to indicate crankback.		

8.1.4 Release complete message

This message is sent by a network node to an adjacent network node to indicate that it has cleared internally the connection (if any) and released the call reference. Table 8-5 describes the RELEASE COMPLETE message content.

Message type: RELEASE COMPLETE

Direction: Both

Significance: Local (Note 1)

Table 8-5/G.7713.1/Y.1704.1 – RELEASE COMPLETE message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Cause	O (Note 2)	6-34
Crankback	O (Note 3)	7-72
Rerouting cause	O	5
NOTE 1 – This message has local significance; however, it may carry information of global significance when used as the first call-clearing message. NOTE 2 – Mandatory in the first call-clearing message; including when the RELEASE COMPLETE message is sent as a result of an error condition. This information element may appear twice in the message. NOTE 3 – Included to indicate crankback.		

8.1.5 Setup message

This message is sent by the Preceding side to the Succeeding side to initiate call/connection establishment. Table 8-6 describes the SETUP message content.

Message type: SETUP

Direction: Preceding to Succeeding

Significance: Global

Table 8-6/G.7713.1/Y.1704.1 – SETUP message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Traffic descriptor	M	13-19
Broadband bearer capability	M	6-7
Broadband high layer information	O (Note 1)	5-13
Broadband low layer information	O (Note 1)	5-20
Broadband repeat indicator	O (Note 3)	5
Broadband report type	O (Notes 1 and 6)	5

Table 8-6/G.7713.1/Y.1704.1 – SETUP message content

Information Element	Type	Length
Called party number	M	(2)
Called party soft permanent connection	O	5-30
Calling party number	O (Note 1)	6-26
Calling party soft permanent connection	O (Note 2)	6-29
Connection Identifier	O	5-*
Designated transit list	M (Note 4)	33-546
Network call correlation identifier (NCCI)	O (Note 5)	33-73
Notification indicator	O (Note 1)	5-*
Extended QoS parameter	O	6
Rerouting services	O	8
Rerouting	O	11-80
Trace transit list	O (Note 1)	38-1466

NOTE 1 – Included if the received setup indication contains this information.

NOTE 2 – May be included in case of soft permanent connection setup, when the calling endpoint wants to inform the destination network interface of the values used for the soft permanent segment at the calling end.

NOTE 3 – When the Broadband Repeat Indicator Information Element immediately precedes the Designated Transit List (DTL) information element, it indicates the order of Designated Transit List information elements in the DTL stack. This information element is mandatory, even when there is only one Designated Transit List Information Element. When the Broadband Repeat Indicator Information Element immediately precedes any other information element, it is included if the received setup indication contains this information.

NOTE 4 – Included by the source node to indicate the hierarchical source route for the call. Included by the node at the entry to a hierarchical level to indicate the path through that hierarchical level. This information element may be repeated up to 10 times (so a connection can traverse 10 logical groups).

NOTE 5 – Included by the source node, to uniquely identify a call across various hops in the network. It is also needed to correlate various connections that correspond to the same call, at various nodes in the network.

NOTE 6 – May be present twice.

8.1.6 Status message

This message is sent by either side in response to a STATUS ENQUIRY message or at any time to report certain error conditions. Table 8-7 describes the STATUS message content.

Message type: STATUS

Direction: Both

Significance: Local

Table 8-7/G.7713.1/Y.1704.1 – STATUS message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Call state	M	5
Cause	M	6-34
Connection identifier	O	5-*

8.1.7 Status enquiry

The STATUS ENQUIRY message may be sent by either side at any time to solicit a STATUS message from the peer entity. Sending a STATUS message in response to a STATUS ENQUIRY message is mandatory. Table 8-8 describes the STATUS ENQUIRY message content.

Message type: STATUS ENQUIRY

Direction: Both

Significance: Local

Table 8-8/G.7713.1/Y.1704.1 – STATUS ENQUIRY message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Connection identifier	O	5-*

8.1.8 Notify message

This message is sent to indicate information pertaining to a call/connection. Table 8-9 describes the NOTIFY message content.

Message type: NOTIFY

Direction: Both

Significance: Access

Table 8-9/G.7713.1/Y.1704.1 – NOTIFY message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Notification indicator	M	5-*

8.1.9 Connection Available message

This message is passed without change by PNNI to confirm the availability of a connection from the calling user to the called user. Table 8-10 describes the CONNECTION AVAILABLE message content.

Message type: CONNECTION AVAILABLE

Direction: Preceding to Succeeding

Significance: Global

Table 8-10/G.7713.1/Y.1704.1 – CONNECTION AVAILABLE message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Notification indicator	M	5-*
Broadband report type	O (Note)	5
NOTE – May be present twice.		

8.2 Messages used with the global call reference

Table 8-11 summarizes the messages for point-to-point call and connection control.

Table 8-11/G.7713.1/Y.1704.1 – Messages Used with the Global Call Reference

Message	Reference af-pnni-0055.002
RESTART	6.3.3.1
RESTART ACKNOWLEDGE	6.3.3.2
STATUS	6.3.1.7
STATUS ENQUIRY	18.3.1.2

8.2.1 Restart message

This message is sent by either side to request the recipient to restart (i.e., release all resources associated with) the indicated connection controlled by the signalling channel. Table 8-12 describes the RESTART message content.

Message type: RESTART

Direction: Both

Significance: Local

Table 8-12/G.7713.1/Y.1704.1 – RESTART message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Connection identifier	M	5-*
Restart indicator	M	5

8.2.2 Restart Acknowledge message

This message is sent to acknowledge the receipt of a RESTART message and to indicate that the requested restart is complete. Table 8-13 describes the RESTART ACKNOWLEDGE message content.

Message type: RESTART ACKNOWLEDGE

Direction: Both

Significance: Local

Table 8-13/G.7713.1/Y.1704.1 – RESTART ACKNOWLEDGE message content

Information Element	Type	Length
Protocol discriminator	M	1
Call reference	M	4
Message type	M	2
Message length	M	2
Connection identifier	M	5-*
Restart indicator	M	5

9 General message format and Information Element coding

The figures and text in this clause describe message contents.

9.1 Overview

Within the signalling protocol, every message shall consist of the following:

a) protocol discriminator;

b) call reference;

c) message type;

d) variable length information elements as required.

The format of 4-1/Q.2931 applies with the following change:

The last sentence of the paragraph immediately below Figure 4-1/Q.2931 does not apply.

9.2 Protocol discriminator

This (one octet) IE is used to distinguish messages of different ATM Forum and ITU-T Recommendations and other standards. The format shall be as in 4.2/Q.2931. The value assigned for this Recommendation is 0000 1011.

9.3 Call Reference

The Call Reference is used to identify the call/connection at the local interface to which the particular message applies. The format shall be as in 4.3/Q.2931.

9.4 Message type and length

The format for message type and message length shall be as in 4.4/Q.2931.

The following message types are used for G.7713.1/Y.1704.1 Distributed Connection Management. See Table 9-1.

Table 9-1/G.7713.1/Y.1704.1 – Message type (Octet 1)

Bits 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Escape to nationally specific message type (Note)
0 0 0 – – – – –	CALL ESTABLISHMENT MESSAGES:
0 0 0 1 0	Call Proceeding
0 0 1 1 1	Connect
0 0 1 0 1	Setup
0 1 0 – – – – –	CALL CLEARING MESSAGES:
0 1 1 0 1	Release
1 1 0 1 0	Release Complete
0 0 1 1 0	Restart
0 1 1 1 0	Restart Acknowledge
0 1 1 – – – – –	MISCELLANEOUS MESSAGES:
0 1 1 1 0	Notify
1 1 1 0 1	Status
1 0 1 0 1	Status Enquiry
1 0 0 0 1 0 1 1	Connection Available
1 0 0 0 1 0 0 1	Modify Acknowledge
1 0 0 0 1 0 1 0	Modify Reject
1 0 0 0 1 0 0 0	Modify Request
1 0 0 0 1 1 0 0	Trace Connection
1 0 0 0 1 1 0 1	Trace Connection Acknowledge

NOTE – When used, the message type (excluding the message compatibility instruction indicator) is defined in Octet 10 of the message, and the contents follow in the subsequent octets, both according to the national specification.

9.5 Variable length Information Elements

The coding rules for Information Elements shall be as in 4.5/Q.2931. See Tables 9-2 and 9-3.

Table 9-2/G.7713.1/Y.1704.1 – Information element identifiers adopted from ITU-T Rec. Q.2931

Bits 8 7 6 5 4 3 2 1	
0 1 1 1 0 0 0 0	Called party number
0 1 1 0 0 0 1 1	Broadband repeat indicator
0 1 1 0 1 1 0 0	Calling party number
0 1 0 1 1 0 0 1	Traffic descriptor
0 1 0 1 1 0 1 0	Connection identifier
0 1 0 1 1 1 1 0	Broadband bearer capability
0 1 0 1 1 1 1 1	Broadband Low Layer Information (B-LLI)
0 1 0 1 1 1 0 1	Broadband High Layer Information (B-HLI)
0 0 1 0 0 1 1 1	Notification indicator
0 0 0 1 0 1 0 0	Call state
0 0 0 0 1 0 0 0	Cause
1 1 1 0 1 1 0 0	Extended Quality of Service parameter
0 1 1 0 0 0 0 0	Broadband locking shift
0 1 1 0 0 0 0 1	Broadband non-locking shift
0 1 1 0 0 0 1 1	Broadband repeat indicator
0 1 1 1 1 0 0 0	Transit network selection
0 1 1 1 1 0 0 1	Restart indicator

Table 9-3/G.7713.1/Y.1704.1 – Information element identifiers adopted from PNNI or other documents

Bits 8 7 6 5 4 3 2 1	
1 1 1 0 0 0 0 0	Called party soft permanent connection
1 1 1 1 0 0 1 1	Calling party soft permanent connection
1 1 1 0 0 0 0 1	Crankback
1 1 1 0 1 1 1 1	Network Call Correlation Identifier
1 0 0 0 1 0 0 1	Broadband report type
1 1 1 0 0 0 1 0	Designated Transit List (DTL)
1 1 1 0 0 1 1 0	Transported address
1 1 1 0 1 1 1 0	Trace transit list
1 1 1 1 0 0 1 0	Rerouting services
1 1 1 1 0 0 1 0	Rerouting
1 1 1 1 0 1 0 0	Rerouting cause
1 1 1 1 0 1 0 1	Reference list

9.5.1 Broadband Bearer Capability Information Element

This Information Element is used to indicate what kind of network connection is required. The format is as specified in 4.5.7/Q.2931 with the following indications:

– bearer class: unspecified (00000);

– susceptibility to clipping: not susceptible (00);

– user-plane connection configuration: point-to-point or point-to-multipoint as required.

9.5.2 Broadband High Layer Information (B-HLI) Information Element

This Information Element is used to indicate the protocol type carried in the connection. The format shall be based on 4.5.8/Q.2931. The definition of new protocol types is for further study.

9.5.3 Broadband Low Layer Information (B-LLI) Information Element

This Information Element is used to indicate the protocol type carried in the connection. The format shall be based on 4.5.9/Q.2931.

Broadband low layer information								
0	1	0	1	1	1	1	1	1
ext. 1	Coding standard		IE instruction field					2
IE length								3
IE length (continued)								4
ext. 1	Layer id. 0 0		User information layer protocol					5*
Generalized Protocol ID								5a*
Layer 1 id								6* (Note)
Layer 2 id								7* (Note)
Layer 3 id								8* (Note)

NOTE – Octet groups 6, 7 and 8 correspond to octet groups 5, 6 and 7, respectively, in 4.5.9/Q.2931.

Figure 9-1/G.7713.1/Y.1704.1 – B-LLI Information element

The format of the User Information Layer Protocol field (contained in Octet 5) is shown in Figure 9-2.

Bits	
5 4 3 2 1	
1 1 1 1 1	Generalized Protocol ID

Other values are reserved.

Figure 9-2/G.7713.1/Y.1704.1 – Format of User Information Layer Protocol

The values and types of the Generalised Protocol ID in octet 5a are as follows:

Value	Type
0	Unknown
1	Reserved
2	Reserved

Value	Type
3	Reserved
4	Reserved
5	Asynchronous mapping of 139 264 kbit/s (P4x) into VC-4
6	Asynchronous mapping of 44 736 kbit/s (P32x) into VC-3
7	Asynchronous mapping of 34 368 kbit/s (P31x) into VC-3
10	Asynchronous mapping of 6 312 kbit/s (P21x) into VC-2
11	Bit synchronous mapping of 6 312 kbit/s (P21x) into VC-2
13	Asynchronous mapping of 2 048 kbit/s (P12x) into VC-12
14	Byte synchronous mapping of 2 048 kbit/s (P12s) into VC-12
15	Byte synchronous mapping of 31 * 64 kbit/s (P0) into VC-12
16	Asynchronous mapping of 1 544 kbit/s (P11x) into VC-11
17	Bit synchronous mapping of 1 544 kbit/s (P11x-bit) into VC-11
18	Byte synchronous mapping of 1 544 kbit/s (P11s) into VC-11
25	Multiplexing of SDH LOVC via TUG-2 into a VC-3
26	Multiplexing of SDH LOVC via TUG-3s into a VC-4
27	Multiplexing of SDH HOVC into STM-N
28	POS – No Scrambling, 16-bit CRC
29	POS – No Scrambling, 32-bit CRC
30	POS – Scrambling, 16-bit CRC
31	POS – Scrambling, 32-bit CRC
41	FDDI mapping into VC-4
42	DQDB mapping into VC-4

NOTE – The reference to the particular mapping schemes may be found in ITU-T Rec. G.707/Y.1322.

Other values are reserved.

9.5.4 Broadband Repeat Indicator Information Element

The purpose of this Information Element is to indicate how repeated information elements shall be interpreted, when included in a message. The Broadband repeat indicator information element is included before the first occurrence of the information element which will be repeated in a message. The format of the Broadband Repeat Indicator Information Element IE shall be as in 4.5.19/Q.2931.

9.5.5 Call State Information Element

The purpose of the Call State Information Element is to describe the current status of a call at the PNNI or a global interface.

The format of the Call State Information Element shall be as in 4.5.10/Q.2931.

9.5.6 Called Party Number IE

The formats of the Called Party Number IE shall be as in 4.5.11/Q.2931.

9.5.7 Calling Party Number IE

The formats of the Called Party Number IE shall be as in 4.5.13/Q.2931.

9.5.8 Called party soft permanent connection (SPC)

The Called party SPC information element indicates the connection identifier values of a permanent segment between the called connecting point and the user of a permanent connection respectively. These values are conveyed to the called connecting point transparently. See Figure 9-3.

Called party SPC								
1	1	1	0	0	0	0	0	1
ext. 1	Coding standard		IE instruction field					2
IE length								3
IE length (continued)								4
Selection type								5
Link ID								6 etc.
Link connection identifier(s)								7 etc.

Figure 9-3/G.7713.1/Y.1704.1 – Called party SPC Information element

The format of the Selection type field (octet 5) is shown in Figure 9-4.

Bits	
8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Any value
0 0 0 0 0 0 1 0	Required value
0 0 0 0 0 1 0 0	Assigned value

Figure 9-4/G.7713.1/Y.1704.1 – Format of Selection type field

For the Link Connection Identifier format, see the Connection Identifiers Information Element coding.

9.5.9 Calling party soft permanent connection

This information element may be included in the case of soft permanent connection setup, to indicate the values of the permanent connection segment at the calling end. This information may be used, e.g., for consistency checking at the called endpoint. See Figure 9-5.

Calling party SPC								
1	1	1	0	0	0	1	1	1
ext. 1	Coding standard		IE instruction field					2
IE length								3
IE length (continued)								4
Link ID								5 etc.
Link connection identifier(s)								6 etc.

Figure 9-5/G.7713.1/Y.1704.1 – Calling party SPC Information element

9.5.10 Cause Information Element

The Cause Information Element describes the reason for generating certain messages, providing diagnostic information in the event of procedural errors, and indicates the location of the cause originator. The Cause Information Element and diagnostic may be repeated in a message.

The format of the Cause Information Element shall be as in ITU-T Rec. Q.2610.

The following values in Table 9-4 apply in this Recommendation.

Table 9-4/G.7713.1/Y.1704.1 – Cause Information values

Number	Meaning
1	Unallocated (unassigned number)
3	No route to destination
16	Normal call clearing
18	No user responding
21	Call rejected
22	Number changed
27	Destination out of order
28	Invalid number format (address incomplete)
30	Response to STATUS ENQUIRY
31	Normal, unspecified
34	Requested called party soft permanent connection not available
37	Requested bandwidth unavailable
38	Network out of order
41	Temporary failure
43	Access information discarded
47	Resource unavailable, unspecified
81	Invalid call reference value
82	Identified channel does not exist
88	Incompatible destination
89	Invalid endpoint reference
96	Mandatory IE is missing
97	Message type non-existent or not implemented
99	Information element/parameter non-existent or not implemented
101	Message not compatible with call state
102	Recovery on timer expiry
111	Protocol error, unspecified

The originator of the release message in non-crankback situations will include a 2-octet blocked transit pointer in the first diagnostic. This information can be used by the originator if it attempts to reroute the call right away.

9.5.11 Connection Identifier Information Element

The Connection Identifier identifies the local connection resources on an interface. This information element is optionally present (mandatory for some technologies) in the SETUP message, and mandatory in the first response to the SETUP message.

The Connection Identifier information element is coded as shown in Figure 9-6 and Tables 9-5 to 9-7.

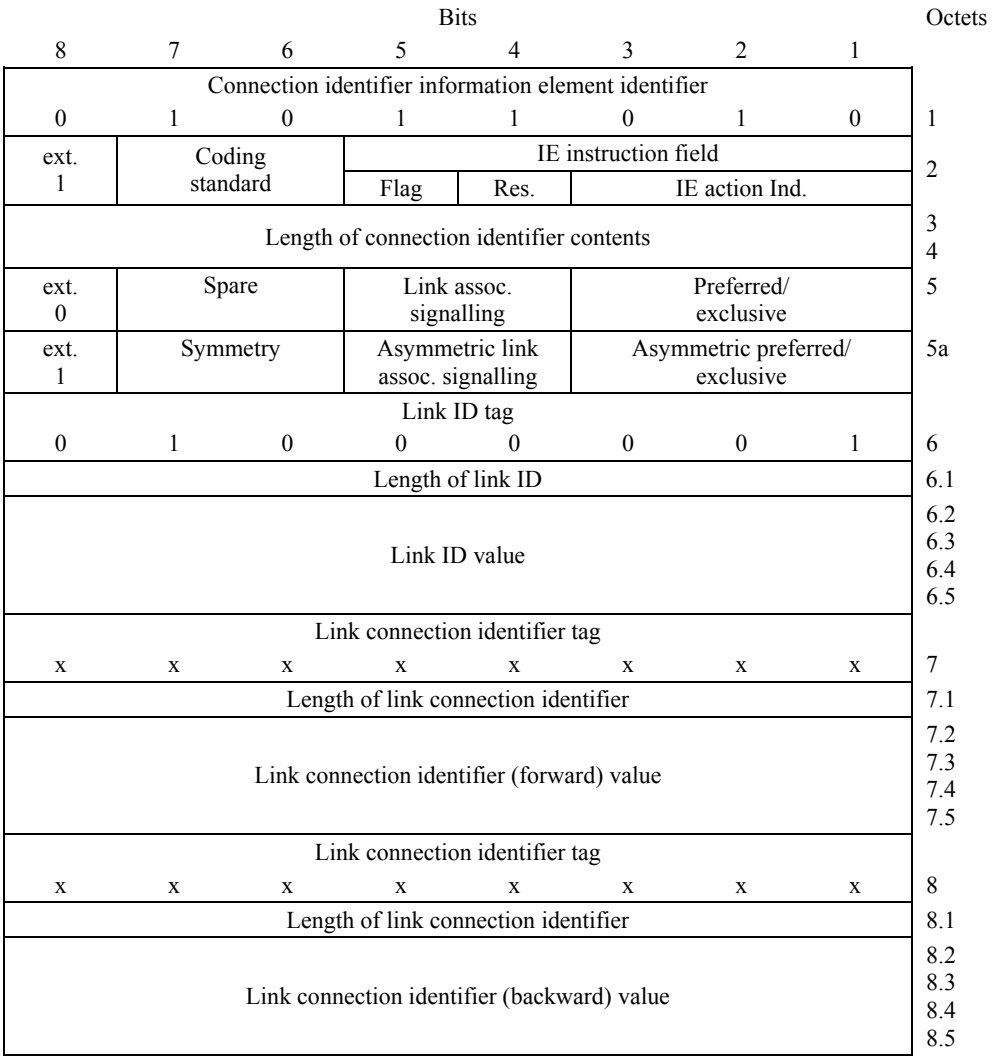

Figure 9-6/G.7713.1/Y.1704.1 – Connection identifier information element

The link associated signalling field format (bits 5 and 6 of octet 5) has the following values:

Table 9-5/G.7713.1/Y.1704.1 – Asymmetric link associated signalling field format

Bits	
5 4	
0 0	Link-associated signalling
0 1	Explicit Indication of link ID

The Pre/Ex (preferred/exclusive) field format (bits 1, 2 and 3 of octet 5) has the following values:

Table 9-6/G.7713.1/Y.1704.1 – Pre/Ex field format

Bits 3 2 1	
0 0 0	Exclusive Link ID; Exclusive LCI
0 0 1	Exclusive Link ID; Any LCI
0 1 0	Any Link ID, Exclusive LCI (note this is not used in this Recommendation)
0 1 1	Any Link ID; any LCI

The Symmetry field format (bits 6 and 7 of octet 5a) has the following values:

Table 9-7/G.7713.1/Y.1704.1 – Symmetry field format

Bits 5 4	
0 0	Bidirectional, symmetrical
0 1	Bidirectional, asymmetrical
1 0	Unidirectional, downstream
1 1	Unidirectional, upstream

The Asymmetric Link Associated signalling field format (bits 5 and 4 of octet 5a) is not used. It is reserved for technologies that require asymmetric assignment of identifiers (e.g., preceding assigns the backward direction and succeeding assigns the forward direction).

The Asymmetric Preferred/Exclusive field format (bits 1, 2 and 3 of octet 5a) is not used. It is reserved for technologies that require asymmetric assignment of identifiers (e.g., preceding assigns the backward direction and succeeding assigns the forward direction).

The Link ID Tag (octet 6) identifies the Link ID TLV.

The Length of Link ID field (octet 6.1) indicates the length of the Identifier Group, including the Identifier Tag and Identifier length octets.

The Link ID value (octets 6.2 to 6.n) identifies the link.

The Identifier octet group may be repeated. The number of times this appears is to be defined on a per connection technology basis.

For use of the Link ID see 10.1.3. The range of Link ID values will be determined at subscription time.

The value of the LCI field is technology dependent. See below for defined codings.

Some values of the LCI may not be available for user-plane connections.

The SDH Link Connection Identifier TLV has the format shown in Figure 9-7

SDH link connection identifier tag								
0	1	0	0	0	0	1	0	7
SDH identifier length								7.1
S								7.2 7.3
U				K				7.4
L				M				7.5

Figure 9-7/G.7713.1/Y.1704.1 – SDH link connection identifier format (1)

The values (S, U, K, L, M) are set from the (E, D, C, B, A) (K, L, M) numbering scheme.

S indicates the first column in which the AU-4 or AU-4-Xc signal can be found. It is calculated as follows:

S = 64(E – 1) + 16(D – 1) + 4(C – 1) + B
If E, D, C or B is not used then that term is 0
If VC-4-Xc then S = S + 1
U = A
K = K
L = L
M = M + 2 (VC12)
M = M + 5 (VC11)

To calculate (E,D,C,B) from S:

S = S – 1
E = (S mod 64) +1 R = S – 64(E – 1)
D = (R mod 16) + 1 R = R – 16(D – 1)
C = (R mod 4) + 1 R = R – 4(C – 1)
B = R
If VC-4 then B = B + 1
If VC-4-4c then C = C + 1
If VC-4-16c then D = D + 1
If VC-4-64c then E = E + 1

Examples for S using (E, D, C, B, A) where A = 0 for VC-4:

Type	**Link**	**G.707/Y.1322 number**	**S**
VC-4	STM-256	(1,1,1,1,0)	1
VC-4	STM-256	(1,1,3,1,0)	9
VC-4	STM-256	(3,4,4,4,0)	192
VC-4	STM-256	(4,1,1,1,0)	193
VC-4	STM-256	(4,4,4,4,0)	256
VC-4-4c	STM-256	(1,1,1,0,0)	1
VC-4-4c	STM-64	(1,3,0,0)	9
VC-4-4c	STM-256	(1,1,3,0,0)	9
VC-4-64c	STM-256	(4,0,0,0,0)	193

The Link Connection Pool Identifier format is shown in Figure 9-8. It is proposed to allow SNP Pool identification through the inclusion of a Link Connection Pool Identifier TLV as a sub-element of the Connection Identifier Information Element when it is intended to specify a set or range of allowed or excluded values.

Link connection pool identifier tag								
0	1	0	0	0	0	0	0	7
Element length								7.1
0	0	0	0	0	0	A/E	R/S	7.2
Link connection identifier TLVs								7.3 7.n

Figure 9-8/G.7713.1/Y.1704.1 – Link connection pool identifier format

The Allowed/Excluded (A/E) field values are:

0 Allowed Values

1 Excluded Values

The Range/Set (R/S) field values are:

0 Range (only 2 LCI TLVs are allowed)

1 Set

9.5.12 Crankback Information Element

The purpose of the Crankback Information Element is to indicate that crankback procedures have been initiated. It also indicates the node or link where the call/connection or party cannot be accepted, and the level of hierarchy at which hierarchy is being carried out. The format of the IE shall be as in 6.4.6.3 of [3] with the following exceptions:

– The need to introduce an ITU rather than an ATM Forum coding standard is for further study.

– Crankback cause 37 "User cell rate not available" to be replaced with "Requested bandwidth not available".

– The need or modification of crankback causes 2, 35, 45, 49, 57, 58, 65, 73 is for further study.

9.5.13 DTL Information Element

A sequence of nodes and links that specifies the chosen end-to-end path is placed in this IE. It is used in SETUP messages. The format of the DTL IE shall be as in 6.4.6.4 of [3]. It is assumed that the path is determined using configuration, management system input or a routing protocol.

9.5.14 Notification Indicator Information Element

The format of the Notification Indicator IE shall be as in 4.5.23/Q.2931. The following value is used to indicate graceful release in progress:

Notification description 1010001 = deletion in progress.

Notification description 1010010 = ready for deletion.

9.5.15 Network Call Correlation Identifier (NCCI) Information Element

This IE is included by the source node, to uniquely identify a call across various hops in the network. It is also needed to correlate various connections that correspond to the same call, at various nodes in the network. It contains an additional identifier, which is used by the management system to transport a user specified name (string) for each connection. This id is optional and is of variable length. The format is adopted from [8].

The following Identifier types are defined:

– Identifier type = 0000 0001 – AESA-based NCCI.

– Identifier type = 1000 0001 – Operator-specific ASON call identifier.

– Identifier type = 1000 0010 – Globally unique ASON call identifier.

– Other values are reserved.

The AESA-based NCCI format is defined in [8].

The Operator-specific ASON identifier format and Globally unique ASON identifier format are defined in Annex D.

9.5.16 Extended Quality of Service (Service Level)

The Extended Quality of Service parameter information element is coded as shown in Figure 9-9. The length of this information element is 6 octets

Extended QoS parameter								
1	1	1	0	1	1	0	0	1
ext. 1	Coding standard		IE instruction field					2
IE length								3
IE length (continued)								4
Origin								5
Transport service level identifier								
0	1	0	0	0	0	0	1	6
Element length								6.1
Transport service level								6.2 6.3

Figure 9-9/G.7713.1/Y.1704.1 – Extended QoS parameter Information Element

The Origin field (octet 5) indicates the origin of this information element. If the origin is the calling party, then the called party can assume that the received cumulative values are end-to-end values. Otherwise, the received cumulative values do not represent end-to-end values. The bit assignment and meaning is as shown in Figure 9-10.

Bits	
8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Originating user
0 0 0 0 0 0 0 1	Intermediate network

Figure 9-10/G.7713.1/Y.1704.1 – Bit assignment and meaning of Origin field

The use of the Transport Service Level value is defined by the individual network operator. The operator may specify a range of different classes of service with predefined characteristics, corresponding to different types of network restoration, setup and hold priority, reversion strategies, persistence, etc. The Transport Service Level is then used to request a particular class of service for a connection entering that operator's network, e.g., through a UNI or E-NNI interface.

9.5.17 Rerouting information element

The Rerouting information element contains information exchanged between the source and destination nodes to initialize the rerouting mechanism. It is also used between the rerouting node and the rendezvous node to control a rerouting operation. The Rerouting information element is present in both the SETUP and the CONNECT messages during the initial connection establishment and in the SETUP message during the rerouting connection establishment. The content of the Rerouting information element depends on the context in which it is used. The context (signalling message, rerouting state) in which a Rerouting information element is used determines which octet groups are included and their significance. Format modifications for ASTN are for further study.

9.5.18 Rerouting services information element

The Rerouting services information element is used to negotiate the set of rerouting services requested/activated for the call and to exchange the availability of rerouting services between the

source node and the destination node of a rerouting domain. The Rerouting services information element is present in both the SETUP and the CONNECT messages during the initial call establishment. Format modifications for ASTN are for further study.

9.5.19 Rerouting cause information element

The Rerouting cause information element is used to convey the cause of the RELEASE message that is specifically related to a rerouting operation.

9.5.20 Traffic descriptor

The purpose of the Traffic Descriptor Information Element is to specify the set of traffic parameters, which, together, specify a traffic control capability. (The original ATM traffic descriptor described forward and backward cell rates for an ATM connection.)

A new format for Traffic Descriptor is defined to carry parameters applying to distributed connection management of connection types covered by this Recommendation.

Traffic descriptors								
0	1	0	1	1	0	0	1	1
ext. 1	Coding standard		IE instruction field					2
IE length								3
IE length (continued)								4
Recovery/protection tag								
0	1	0	0	0	0	0	1	5
Element length								5.1
P/S	Link protection type							5.2
Forward SDH descriptor tag								
0	1	0	0	0	0	1	0	6
Element length								6.1
Elementary signal type								6.2
Number of contiguously concatenated components								6.3 6.4
Transparency								6.5
Backward SDH descriptor tag (Note)								
0	1	0	0	0	0	1	1	7
Element length								7.1*
Elementary signal type								7.2*
Number of contiguously concatenated components								7.3* 7.4*
Transparency								7.5*

NOTE – Omitted if bidirectional symmetric connection.

Figure 9-11/G.7713.1/Y.1704.1 – Traffic Descriptors Information Element

The Recovery/Protection TLV identifies the link protection attributes that are required from the local transport link supporting the connection, and whether the connection will be used as a primary or secondary connection. If secondary is indicated, then the connection is being used as backup for a separate primary connection, and its allocated resources will not be used until the related primary connection fails.

The Primary/Secondary – (P/S) field values and types are:

0 – Primary connection.

1 – Secondary connection.

The Link Protection Type field values and types are:

Value	*Indication*
0	No indication.
1	Extra traffic – link is used for protection of primary links and its use may be preempted in case of failure of the primary link.
2	Unprotected – link has no protection.
4	Shared – link uses a shared (e.g., 1:N) protection scheme.
8	Dedicated 1:1 – link uses a dedicated 1:1 protection scheme.
16	Dedicated 1+1 – link uses a dedicated 1+1 protection scheme.
32	Enhanced – link uses a more redundant scheme than 1+1, e.g., 4-Fiber MS-SPring.

Other values are reserved

The Forward and Backward SDH Descriptor TLVs identify SDH traffic descriptor information for the forward and backward directions, respectively.

The Elementary Signal Type field values and types are:

Value	**Type**
1	VC-11
2	VC-12
3	Reserved
4	VC-2
5	VC-3
6	VC-4
7	STM-0
8	STM-1
9	STM-4
10	STM-16
11	STM-64
12	STM-256

The Number of Contiguously Concatenated Components field specifies the number of elementary signals to be contiguously concatenated.

The use of the Transparency field is for further study. Values defined are as follows:

Bit 1: 0 – no indication; 1 – Regenerator Section layer.

Bit 2: 0 – no indication; 1 – Multiplex Section layer.

Other bits are reserved.

10 Updated procedures

NNI signalling procedures

The procedures in [3] apply with the changes specified in this clause.

10.1 Link Connection Identifier allocation/selection

Two cases exist:

i) Link associated signalling: The layer 3 signalling entity exclusively controls the channels in the Link which carries its signalling channel.

ii) Non-Link associated signalling: The layer 3 signalling entity controls channels which may or may not be in the Link which carries the signalling channel.

When a network node receives a Connection Identifier information element with the Link associated signalling field coded with a value not supported by this network node, the call shall be rejected with cause No. 29 "Link rejected".

The following identifiers must be present in the specified order for the indicated symmetries:

Bidirectional, symmetric – Link ID, LCI

Bidirectional, asymmetric – Link ID, LCI (forward), LCI (backward)

Unidirectional, downstream – Link ID, LCI (forward)

Unidirectional, upstream – Link ID, LCI (backward)

10.1.1 Link associated signalling

For Link associated signalling, a connection is requested in the Link carrying the signalling connection. The Link carrying the signalling connection is implicitly indicated.

In the Connection Identifier information element, the Link-associated signalling field is coded as "Link associated signalling", and one of the following values is indicated in the preferred/exclusive field based on the symmetry:

a) Exclusive Link ID; any LCI; or

b) Exclusive Link ID; exclusive LCI.

In case a) the succeeding side selects any available LCI within the Link carrying the signalling channel.

In case b), if the indicated LCI within the Link carrying the signalling channel is available, the succeeding side selects it for the call.

The selected LCI value is indicated in the Connection Identifier information element in the first message returned in response to the SETUP message (e.g., CALL PROCEEDING message). The Link associated signalling field is coded as "Link-associated signalling". The preferred/exclusive field is coded as "exclusive Link ID; exclusive LCI".

In case a), if no LCI is available, a RELEASE COMPLETE message with cause No. 34 "No circuit/channel available" is sent by the network. If Crankback is supported on the signalling channel, a Crankback information element is included with crankback cause No. 34.

In case b), if the indicated LCI is not available, a RELEASE COMPLETE message with cause No. 44 "Requested circuit/channel not available" is sent by the network. If Crankback is supported on the signalling channel, a Crankback information element is included with crankback cause No. 44.

Call collision can occur when both sides of an interface simultaneously transfer SETUP messages indicating the same exclusive Link ID and LCI. For PNNI interfaces, in order to avoid call collision, the side which has the higher node identifier shall allocate the Link Connection Identifier value. The node identifiers used for this comparison shall be the lowest-level node identifiers used on each side of the interface. These node identifiers are the ones indicated in the Node ID field (octets 11 to 32) in PNNI Hellos transmitted and received over the same interface. A preceding side which has a higher node identifier shall include a Connection Identifier information element in the

SETUP message with option (b) (exclusive Link ID and exclusive LCI). A SETUP message from a preceding side which has a lower node identifier shall use option (a).

10.1.2 Non-Link Associated signalling

In the request for a connection in the SETUP message, the preceding side shall indicate one of the following:

a) Exclusive Link ID; any LCI;

b) Exclusive Link ID; exclusive LCI; or

c) Any Link ID; any LCI

In cases a), and b) the Link associated signalling field is coded as either "explicit indication of Link ID".

In cases a) and b), if the indicated Link ID is available, the succeeding side selects it for the call. In case a), the succeeding side selects any available LCI in the Link. In case b), if the indicated LCI is available within the Link, the succeeding side selects it for the call.

In cases c) the succeeding side selects any available Link ID and LCI.

The selected Link ID and LCI values are indicated in the Connection Identifier information element in the first message returned by the succeeding side in response to the SETUP message (i.e., CALL PROCEEDING message). The Link associated signalling field is coded as "explicit indication of Facility". The Preferred/exclusive field is coded as "exclusive Link ID; exclusive LCI".

In cases a) and b), if the specified Link ID is not available, a RELEASE COMPLETE message with cause No. 29, "Link ID rejected", is sent by the succeeding side. If Crankback is supported on the signalling channel, a Crankback information element is included with crankback cause No. 29.

In case a), if no LCI is available, a RELEASE COMPLETE message with cause No. 34, "No circuit/channel available", is sent by the succeeding side. If Crankback is supported on the signalling channel, a Crankback information element is included with crankback cause No. 34.

In case b), if the LCI in the indicated Link is not available, a RELEASE COMPLETE message with cause No. 34, "No circuit/channel available", is sent by the succeeding side. If Crankback is supported on the signalling channel, a Crankback information element is included with crankback cause No. 34.

In case c), if the succeeding side is not able to allocate a LCI any Link, a RELEASE COMPLETE message with cause No. 44, "Requested circuit/channel not available", is sent by the succeeding side. If Crankback is supported on the signalling channel, a Crankback information element is included with crankback cause No. 44.

Call collision can occur when both sides of an interface simultaneously transfer SETUP messages indicating the same exclusive Link ID and LCI. For PNNI interfaces, in order to avoid call collision, the side which has the higher node identifier shall allocate the Link Connection Identifier (Link ID, LCI) values. A preceding side which has a higher node identifier shall include a Connection Identifier information element in the SETUP message with option (b) (exclusive Link ID and exclusive LCI). A SETUP message from a preceding side which has a lower node identifier shall use options (a) or (c).

10.1.3 Use of the Link ID

The LinkID provides the capability for a signalling channel to control connections over multiple links. Two possible configurations exist:

1) Link associated signalling: The layer 3 signalling entity exclusively controls the channels in the Link which carries its signalling channel.

2) Non-Link associated signalling: The layer 3 signalling entity controls channels which may or may not be in the Link which carries the signalling channel.

The LinkID is an opaque value with no pre-defined format. It is a logical pointer to the link over which the connection is to be established.

In case (1) above, the LinkID has no significance and is coded as zero.

In case (2) above, the LinkID contains a reference to the link over which the connection is to be established.

The case where the control plane element is physically separate from the transport node is equivalent to case (2). In this case the LinkID contains a reference to the node/link over which the connection is to be established.

The default value for the LinkID in case (2) is the concatenation of the two node IDs, lower value first, and the SNP identifier.

10.1.4 Link ID Ranges

The default length of the Link ID is four (4) octets and shall be supported. Other lengths may optionally be supported. If the succeeding side receives a Connection Identifier Information Element with an unsupported Link ID length, it shall treat the specified Link ID as unavailable.

There are no reserved values for the Link ID.

10.1.5 LCI ranges and values

10.1.5.1 SDH specific values

The identifier contents use the numbering plan specified in clause 7/G.707/Y.1322. The high order payload columns are addressed using S. The location of the column is indicated using values starting at 1. A value of zero indicates the number is not used.

10.1.6 Service category, traffic parameter and QoS selection procedures

The QoS shall be indicated in the Extended QoS information element.

If the network is able to provide the requested QoS class, the network shall progress the call to the called user. If the network is not able to provide the requested QoS class, the network shall reject the call, returning a RELEASE COMPLETE message with cause No. 49, "Quality of Service not available".

The connection type shall be indicated in the Traffic Descriptor information element.

If the network is able to provide the requested connection, the network shall progress the call to the called user. If the network is not able to provide the requested connection, the network shall reject the call, returning a RELEASE COMPLETE message with one of the following cause codes:

– No. 57 "bearer capability not authorized";

– No. 58 "bearer capability not presently available";

– No. 65 "bearer capability not implemented".

If the Recovery/Protection information element is included, if the network is able to provide the requested service, the network shall progress the call to the called user. If the network is not able to provide the requested service, the network shall reject the call, returning a RELEASE COMPLETE message with cause No. 63, "Service or option not available, unspecified".

10.2 Connection clearing for non-persistent connections

These procedures only apply to connections that have not indicated any type of connection persistence.

The procedures of PNNI 1.1 in 6.5.3 are used.

10.3 Procedures for connections persistent across signalling failures

These procedures only apply to connections that have indicated persistence across control plane failures either implicitly through the service class or through configuration.

10.3.1 Connection clearing for persistent connections

The procedures in 10.2 are used with the following modifications.

Delete the sentences:

"If no RELEASE COMPLETE message is received from the succeeding side before timer T308 expires a second time, the preceding side shall; release the call reference; and return to the Null state. Additional recovery procedures, such as initiating restart, are implementation dependent"

And replace them with:

"If no RELEASE COMPLETE message is received from the succeeding side before timer T308 expires a second time, the preceding side shall remain in the Release Request (NN11) state. The preceding side shall periodically re-attempt the connection clearing procedures. The frequency of these attempts are implementation dependent."

10.3.2 Signalling AAL connection reset for persistent connections

Whenever a Q.2931 entity is informed of a spontaneous Signalling AAL reset by means of the AAL-ESTABLISH-indication primitive, the following procedures apply:

a) for calls in the clearing phase (states N11, N12), no action shall be taken;

b) calls in the establishment phase (states N1, N3, N4, N6, N7, N8, N9) shall be maintained. Optionally, the status enquiry procedure in 10.3.4 may be invoked;

c) calls in the Active state shall be maintained, and the entity shall invoke the status enquiry procedures described in 10.3.4.

10.3.3 Signalling AAL connection release for persistent connections

When a Q.2931 entity is notified by its Signalling AAL connection release by means of the AAL-RELEASE-indication primitive, the following procedures shall apply:

a) any calls not in the Active state shall be cleared locally;

b) for calls in the Active state, no action shall be taken.

The Q.2931 entity shall request Signalling AAL re-establishment by sending an AAL-ESTABLISH-request primitive.

When informed of Signalling AAL re-establishment by means of the AAL-ESTABLISH-confirm primitive, the following procedure shall apply:

– perform the status enquiry procedure according to 10.3.4.

10.3.4 Status Enquiry Procedures

The procedures in 6.5.6.11 of PNNI 1.1 shall apply with the following addition:

Additional procedures for Signalling state recovery:

Connections that require restoration of connection state shall include the Connection Identifier Information Element in the STATUS ENQUIRY message. The Link ID and LCI shall be set to the

values associated with the indicated Call Reference. The Link-associated signalling field shall indicate "explicit in indication of Link ID". The preferred/exclusive field shall indicate "exclusive link ID; exclusive LCI". A node that has lost state information, but verifies the existence of the indicated connection identifier shall respond with a STATUS message with the state indicated as Null with cause No.30, "Response to STATUS ENQUIRY".

A node that has lost state information and cannot verify the existence of the indicated connection identifier shall respond with a STATUS message with the state indicated as Null with cause No. 101, "Message not compatible with call state".

A node that has lost state information, but is capable of performing local state recovery, shall respond with a STATUS message with the state indicated as Active with cause No. 30, "Response to STATUS ENQUIRY".

10.3.5 Receiving a STATUS message

The procedures in 6.5.6.12 of PNNI 1.1 shall apply with the following additions.

For connections in the Active state requiring Persistence Across Control Channel Failures:

1) If the received state is Release Request, no action shall be taken.

For connections requiring recovery of state information, the received STATUS message shall include a Connection Identifier information element and the following procedures shall apply:

1) If the received state is Null with cause No. 30, "Response to STATUS ENQUIRY", the state recovery procedures in 10.3.6 shall be invoked.
2) If the received state is Null with cause No. 101, "Message not compatible with call state", connection clearing procedures shall be initiated.

10.3.6 Enhanced Status Enquiry

The procedures in Annex R of PNNI 1.1 shall apply with the following exceptions:

Procedures for point-to-multipoint connections are not supported.

10.3.7 Recovery of signalling state for persistent connections

The procedures for recovering the state of a connection, including the use of the Connection Identifier in STATUS and STATUS ENQUIRY messages, are for further study.

10.3.8 Processing of messages during failure of the control channel

These procedures apply to connections that remain persistent across signalling channel failures when the control channel has notified Q.2931 of a failure by means of the AAL-RELEASE-indication primitive.

These procedures apply to messages which should be progressed across the failed control channel.

Messages other than RELEASE and RELEASE COMPLETE messages shall be rejected back towards the source with cause No. 101, "Message not compatible with call state".

RELEASE and RELEASE COMPLETE messages should be retained until recovery of the control channel. Upon recovery of the control channel, normal processing for these messages apply.

10.4 Bearer Plane failures

When a notification is received indicating the failure of the bearer transport link ID containing the bearer channel, the following actions shall be taken:

If the connection supports Persistence Across Bearer Plane failures, no action shall be taken.

Otherwise, normal connection clearing procedures shall be followed.

10.5 Receipt of NOTIFY messages

NOTIFY messages provide information about a connection and do not affect the state of the connection. A node receiving a NOTIFY message shall take the following actions:

- If the node is an endpoint for the connection, it shall issue a notify indication primitive and take no further action.
- If the node is an intermediate node for the connection, it shall issue a notify indication primitive and continue to progress the NOTIFY message in the direction of transmission. No other action shall be taken.

Annex A

Transport of G.7713.1/Y.1704.1 messages over DCN network

A.1 Introduction

The signalling protocol defined in this Recommendation must be capable of operating over any of the Data Communications Network (DCN) technologies defined by ITU-T Rec. G.7712/Y.1703. The DCN provides network elements a general communication capability for transporting application messages. Examples of applications include management, signalling and software downloads.

The DCN is defined using Layer 3 connectionless protocols (i.e., OSI/CLNP and IP) for the transport of all messages. The choice of Layer 3 protocol, and the underlying Layer 2 protocol is made on a per-interface basis. A network element may be required to support both OSI/CLNP and IP simultaneously.

The SSCOP protocol currently used by Q.2931 assumes that the data link is a single point-to-point connection providing in-sequence delivery. The DCN uses connectionless protocols, which do not guarantee in-sequence delivery. The DCN may also use multiple links for added reliability.

ITU-T Rec. Q.2111 (SSCOPMCE), as updated by Amendment 1, extends the original capabilities of SSCOP to include support for connectionless networks and multiple links for each signalling channel.

The major differences between SSCOP and SSCOPMCE are:

1) independent of underlying transport (e.g., ATM, IP, OSI/CLNP, Ethernet, HDLC);
2) connectionless transport of signalling connections;
3) multi-link transport of signalling connections;
4) re-sequencing of arriving packets to ensure in-sequence delivery to upper layers;
5) active monitoring of all configured links;
6) addition/removal of links during active operation;
7) compatibility mode with SSCOP.

A.2 Differences in boundary interfaces

The SSCOPMCE protocol provides almost identical boundary interfaces to the SSCF and to Layer management when compared to what is provided by the SSCOP protocol. This allows SSCOPMCE to be substituted for SSCOP without changing the SSCF or Q.2931 protocols or implementation.

The differences in the boundary interfaces are:

1) *Boundary to SSCF*

   a) Addition of the Out-of-Sequence delivery (OoS) parameter to AA-DATA primitive. For the Request signal, this parameter indicates if out-of-sequence delivery of the message unit is permitted. For the Indication Signal, this parameter indicates the message unit may be out-of-sequence.

   b) Absence of the OoS parameter indicates in-sequence delivery is required. This allows complete compatibility with the existing SSCOP/SSCF boundary interface.

2) *Boundary to Layer Management*

   a) Addition of the MAA-SET-TIMER primitive. This primitive supports only the Request signalling. It allows layer management to change the value of Timer_RESEQ during operation. This timer determines how long SSCOPMCE will wait for the arrival of out-of-sequence messages before requesting a retransmission.

   b) Addition of the MAA-ADD-LINK primitive. This primitive supports only the Request signal. It is used to add a new link to the link set for a SSCOPMCE connection. A link may be added anytime after SSCOPMCE first initializes.

   c) Addition of the MAA-REMOVE-LINK primitive. This primitive supports the Request and Indication signals. The Request signal is used to remove an active link from the current link set. A link may be removed at any time. The Indication signal is used to notify layer management of a successful remove operation, or in response to an add request to indicate the requested link was not added.

A.3 Overview of SSCOPMCE link management process

A.3.1 SSCOPMCE initialization

SSCOPMCE differs from SSCOP during initialization by adding State 0 (Guard). Timer_GUARD is started as the first step in the initialization process. The Guard state waits for this timer to expire prior to continuing with the initialization. The purpose of the Guard state is to provide sufficient time for any outstanding messages from a previous instance of SSCOPMCE to be cleared from the transport network.

After Timer_GUARD expires, the initialization process is completed and SSCOPMCE goes into the Idle state. All states, except for the Guard state, are identical to SSCOPMCE.

A.3.2 Link activation

SSCOPMCE maintains an array of active links, referred to as a LinkSet. It also maintains a counter of the number of active links. Layer Management may request to add a link anytime after entering the Guard state using the MAA-ADD-LINK.Request signal. The SSCOPMCE process adds the link to the LinkSet and increments the number of active links.

The request to add a link may fail either because the maximum number of links supported by an implementation has been exceeded. It may also fail because the operating mode is SSCOP compatibility mode, which allows only one active link. A failure will be reported using the MAA-REMOVE-LINK.Indication signal

After successfully adding the new link to the LinkSet, Timer_NO-RESPONSE is set for the link. This timer is used to detect a failure of the link.

A new link is immediately available for use after being added to the LinkSet.

NOTE – If the new link is not configured at the remote end, this will be detected as a link failure and reported using MAA-REMOVE-LINK.Indication. The link will be removed from the LinkSet. It is the responsibility of Layer Management to attempt to retry the link by issuing another add request.

A.3.3 Link removal

Layer Management may request the removal of a link at anytime during operation using the MAA-REMOVE-LINK.Request signal. The SSCOPMCE process removes the link from the LinkSet and decrements the number of active links. Layer Management is notified the process is complete by using the MAA-REMVOE-LINK.Indication signal.

The remote end will detect the removal of the link as a link failure, and will remove the link from its LinkSet. It will also notify its Layer Management using he MAA-REMOVE-LINK.Indication signal.

If the removal of the link causes the number of active links to become zero, the SSCOPMCE process will release the SSCOPMCE connection and send an AA-RELEASE.Indication signal to the SSCF.

A.3.4 Link keep alive

SSCOPMCE uses the same basic procedures used by SSCOP to detect a link failure. POLL and STAT messages are sent on each individual link. The frequency at which POLL and STAT messages are sent follow the same procedures used by SSCOP and depends on whether it is in the *active*, *transient*, *idle* or *connection control* phase.

A.3.5 Link failure

Timer-NO-RESPONSE is used to detect the failure of a link. The procedures are similar to SSCOP, except that detection is performed separately for each link. When the SSCOPMCE process determines that a link has failed, it will remove the link from the LinkSet and decrement the number of active links. It will then send a MAA-REMOVE-LINK.Indication signal to Layer Management.

SSCOPMCE does not try to recover failed links. It is up to Layer Management to decide if it should attempt to add the failed link back into the LinkSet.

If the removal of the link causes the number of active links to become zero, the SSCOPMCE process will release the SSCOPMCE connection and send an AA-RELEASE.Indication signal to the SSCF.

A.3.6 Link connectivity verification

SSCOPMCE does not perform link connectivity verification. This is the responsibility of the underlying transport layer.

NOTE – In a Connectionless environment, a successful exchange of POLL and STAT messages on the link implies proper link connectivity. A connectionless link is defined as a source/destination address pair. The source and destination addresses also identify the network element. Arriving messages that do not match a configured source/destination address pair will be discarded. A successful POLL and STAT exchange can only occur if both sides are properly configured.

A.3.7 SSCOPMCE connection establishment

The establishment of the SSCOPMCE connection follows the same procedures used for SSCOP. The SSCF sends an AA-ESTABLISH.Request signal to SSCOPMCE. The SSCOPMCE process follows the same procedures used by SSCOP to establish the connection.

The exception to this process is that if the number of active links is zero, SSCOPMCE will immediately indicate a failure by sending a AA-RELEASE.Indication signal to the SSCF.

A.3.8 SSCOPMCE connection release

Releasing a SSCOPMCE connection may be requested by the SSCF following the same procedures used for SSCOP. When the connection is successfully released, SSCOPMCE will notify the SSCF using the AA-RELEASE.Indication signal. The SSCOPMCE process will not make any changes to the LinkSet or number of active links.

The failure of a link when there were more than two active links is not reported to the SSCF. The SSCOPMCE connection remains established and message processing continues normally.

The failure of a link when there was only one active link remaining causes the number of active links to go to zero. The SSCOPMCE process will notify the SSCF of a SSCOPMCE connection failure using the AA-RELEASE.Indication signal.

A.3.9 Message transmission

Message Units are passed from the SSCF to SSCOPMCE following the same procedures found in SSCOP. The SSCOPMCE process may transmit the message over any active link. The procedure for choosing the link is an implementation issue.

A.4 Changes required to ITU-T Rec. Q.2931

The use of ITU-T Rec. Q.2111 does not require changes to ITU-T Rec. Q.2931. The interface to the SSCF (ITU-T Rec. Q.2130) remains unchanged.

A.5 Changes required to the SSCF (ITU-T Rec. Q.2130)

The use of SSCOPME in place of SSCOP is almost completely transparent. The only difference is the inclusion of an Out-of-Sequence delivery (OoS) parameter in the AA-DATA.Request and AA-DATA. Indication signals at the boundary between SSCF and SSCOPMCE.

The OoS parameter is used to indicate for each message unit (MU) whether out-of-sequence delivery is permitted. The value of zero, or the absence of parameter, indicates in-sequence delivery of the MU is required. The value of one indicates that out-of-sequence delivery of the MU is allowed.

Implementations may continue to use the same boundary interface to the SSCF defined by SSCOP. If an implementation updates the boundary interface to the SSCF to include the OoS parameter, the value of this parameter must be zero.

Use of out-of-sequence delivery is not supported.

A.6 Applicability of SSCOPMCE specific parameters and timers

The following additional parameters and timers, and their default values, are defined as shown in Table A.1.

Table A.1/G.7713.1/Y.1704.1 – SSCOPMCE parameters and timers

SSCOPMCE parameter	Default value
Timer_GUARD	22 seconds (Note 3)
Timer_RESEQ	250 ms (Note 4)
Mode	"B"
NOTE 3 – The value for Timer_GUARD is based on the formula in 8.6/Q.2111. NOTE 4 – The value for Timer_RESEQ is based on the guidelines in 8.6/Q.2111 using the value of *k* (Maximum SSCOP SDU size) and a transmission rate of 128 kbits/s.	

A.7 Layer management boundary

A.7.1 Link activation at SSCOPMCE initialization

SSCOPMCE requires that at least one link has been added prior to the SSCF issuing an AA-ESTABLISH.Request signal. If the number of active links is zero, SSCOPMCE will return the AA-RELEASE.Indication signalling indicating an error.

The SSCOPMCE process will queue any signals issued during the guard time when in the Guard state. These signals will be processed immediately after SSCOPMCE goes into the Idle state.

Layer Management should request the addition of at least one link during the guard time. It may request the addition of multiple links, if the implementation supports queuing multiple signals. If only one link is requested, Layer Management on both network elements attempting to establish a link must request the same link.

A.7.2 Retries after link failure

Layer Management is responsible for deciding when to attempt to establish a failed link. A retry is attempted by requesting to add the link to the LinkSet. To prevent excessive overhead when trying to retry a failed link, Layer Management should wait for at least 15 seconds after a failure indication before attempt to retry the link. Note that SSCOPMCE will attempt to verify the link using POLL and STAT messages prior to indicating a failure.

For persistent failures lasting more than 5 minutes, Layer Management should change the retry delay to 5 minutes. Layer management may also stop retrying, awaiting administrative action.

A.7.3 Value of LinkID

The value and format of the parameter LinkID used in the MAA-ADD-LINK and MAA-REMOVE-LINK primitives is implementation dependent. Possible values are the concatenated source/destination address for the link, or an index into a table.

A.7.4 Value of Tval

The value and format of the parameter Tval used in the MAA-SET-TIMER primitive is implementation dependent.

A.8 Link types

A.8.1 IP based DCN links

The encapsulation for IP-based networks is defined in ITU-T Rec. Q.2111, Amendment 1.

The default encapsulation shall be the IP interface as defined in D.3.1/Q.2111 Amendment 1. A link is defined as an IPv4 source/destination address pair using protocol ID "128".

Implementations may also support the UDP interface as defined in D.3.2/Q.2111 Amendment 1. A link is defined as the source/src_port/destination/dst_port tuple. The value of the src_port and dst_port must be administratively agreed.

Procedures for the auto discovery of neighbouring network elements are for further study.

Encapsulations using IPv6 are for further study.

A.8.2 OSI/CLNP based DCN links

ITU-T Rec. Q.2111 and ITU-T Rec. Q.2111, Amendment 1, do not define the encapsulation for OSI/CLNP networks. It is defined here to provide support for all interface types defined in ITU-T Rec. G.7712/Y.1703. Future amendments to ITU-T Rec. Q.2111 that include the definition of OSI/CLNP encapsulations will supersede the encapsulation defined in this Recommendation.

An OSI/CLNP link is defined as an NSAP source/destination address pair.

NOTE – Encapsulation for OSI/CLNP is for further study.

A.8.3 Ethernet based DCN links

The encapsulation for Ethernet networks is defined Annex E/Q.2111 Amendment 1. Support for the Ethernet interface is for further study.

Annex B

Graceful deletion

B.1 Introduction

Graceful deletion provides a warning that a connection is about to be cleared. This allows affected nodes to take appropriate actions, such as the suppression of alarm indications.

To ensure all nodes have received the warning, two types of notifications are used: "deletion in progress" and "ready for deletion".

The procedures defined in this annex occur outside of the connection control function. NOTIFY messages are sent and received using the notify request and notify indication primitives, respectively.

The transmission and receipt of NOTIFY messages do not affect the state of the call.

B.2 Sending deletion notification

A node that desires to use graceful deletion shall send a notify request with "deletion in progress". No other action shall be taken.

If the node performing the graceful deletion is not one of the endpoints for the connection, it shall send a notify request in both the preceding and succeeding directions.

The node should then wait for a notify indication with "ready for deletion" before requesting the initiation of connection clearing procedures. The amount of time to wait is outside the scope of this Recommendation.

If a notify indication with "ready for deletion" is not received within the determined amount of time, the node may re-issue the notify indication. If no response is received to the second attempt, the node shall proceed with requesting the initiation of connection clearing procedures.

B.3 Receiving deletion notification

Upon the receipt of a notify indication with "deletion in progress", the following actions shall be taken:

- The node should perform any actions necessary to prepare for the eventual deletion of the connection (i.e., alarm suppression).
- If the node is an endpoint for the connection, it shall send a notify request with "ready for deletion".
- If the node is not an endpoint for a connection, but progressing the notify request is not possible due to a signalling channel failure, the node may send a notify request "ready for deletion" in the direction from which the message was received.
- Otherwise, no action is taken.

B.4 Receiving ready for deletion

Upon the receipt of a notify indication with "ready for deletion", the following actions shall be taken:

- If the node sent a notify request with "deletion in progress", it shall proceed by sending a release request primitive to connection control.
- If the node did not send a notify request with "deletion in progress", it should take any actions necessary (e.g., suppression of alarms) needed to prepare for the eventual deletion of the connection.

Annex C

DTL processing in the absence of routing protocols

The PNNI signalling specification assumes the presence of the PNNI routing protocol when processing the Designated Transit List (DTL) in signalling messages. The DTL contains the PNNI Node Identifier for the next hop.

A normal PNNI node learns the identity and location of neighbouring PNNI nodes through PNNI Hello messages.

A node not running PNNI routing must use some other mechanism for determining the identity and location of neighbouring nodes. This may be through manual configuration or via G.7714/Y.1705 based discovery procedures. If G.7714/Y.1705 procedures are used, it will be necessary for the node to map this to a PNNI Node ID suitable for use in a DTL.

The actual procedures for determining the PNNI Node ID for neighbouring nodes are outside the scope of this Recommendation.

If the DTL used by the network always includes the logical port identifier, neighbour discovery procedures are not required. The SETUP message is forwarded on the signalling control channel responsible for the indicated logical port identifier.

When receiving a SETUP messages, the node shall always validate the current PNNI Node ID indicated by the DTL is this node as required by normal DTL processing procedures.

Annex D

ASON call identifier

The ASON call identifier is a generic identifier with length being a multiple of 32 bits, and a minimum length of 32 bits.

The format of the Operator Specific ASON Call identifier is shown below:

Type	1
reserved	2
reserved	3
reserved	4
Source transport network element address	5 etc.
Local identifier	6 etc.

The format of the Globally Unique ASON Call Identifier is shown below:

Type	1
IS ...	2 etc.
NS ...	3 etc.
Source transport network element address	4 etc.
Local identifier	5 etc.

In both cases, a "Type" field is defined to indicate the type of format used for the source transport network element address.

The Type field has the following meaning:

For Type = 1, the source transport network element address is 4 bytes.

For Type = 2, the source transport network element address is 16 bytes.

For Type = 3, the source transport network element address is 20 bytes.

For Type = 4, the source transport network element address is 6 bytes.

For Type = 127, the source transport network element address has the length defined by the vendor.

Other values are reserved.

Source transport network element address:

An address of the transport network element (SSN) controlled by the source network.

Local identifier:

A 64-bit identifier that remains constant over the life of the call.

The structure for the globally unique call identifier (to guarantee global uniqueness) is to concatenate a globally unique fixed ID (composed of country code, carrier code, unique access point code) with an operator specific ID (where the operator specific ID is composed of a source transport network element address – and a local identifier).

Therefore, a generic CALL_ID with global uniqueness includes <global ID> (composed of <country code> plus <carrier code> plus <unique access point code>) and <operator specific ID> (composed of <source transport network element address> plus <local identifier>). For a CALL_ID that only requires operator specific uniqueness only the <operator specific ID> is needed, while for a CALL_ID that requires to be globally unique both <global ID> and <operator specific ID> are needed.

The <global ID> shall consist of a three-character International Segment (the <country code>) and a twelve-character National Segment (the <carrier code> plus <unique access point code>). These characters shall be coded according to ITU-T Rec. T.50. The International Segment (IS) field provides a 3-character ISO 3166 Geographic/Political Country Code. The country code shall be based on the three-character uppercase alphabetic ISO 3166 Country Code (e.g., USA, FRA).

The National Segment (NS) field consists of two sub-fields: the ITU Carrier Code followed by a Unique Access Point Code. The ITU Carrier Code is a code assigned to a network operator/service provider, maintained by the ITU-T Telecommunication Standardization Bureau in association with ITU-T Rec. M.1400. This code shall consist of 1-6 left-justified characters, alphabetic, or leading alphabetic with trailing numeric. The unique access point code shall be a matter for the organization to which the country code and ITU carrier code have been assigned, provided that uniqueness is guaranteed. This code shall consist of 6-11 characters, with trailing NULL, completing the 12-character National Segment.

Note that if the source transport network element address is assigned from an address space that is globally unique, then the operator-specific CALL_ID may also be used to represent a globally unique CALL_ID. However, this is not guaranteed since this address may be assigned from an operator-specific address space.

Appendix I

Mapping of G.7713/Y.1704 UNI attributes to Q.2931/PNNI

Table I.1 describes the mapping of G.7713/Y.1704 UNI attributes to Q.2931/PNNI.

NOTE – Q.2931 [4] and ATM UNI [8] already define a UNI form of the protocol.

Table I.1/G.7713.1/Y.1704.1 – Mapping of G.7713/Y.1704 UNI attributes to Q.2931/PNNI

	Attributes	Format	Scope	Q.2931/PNNI
Identity Attributes	A-end user name	String	End-to-end	Calling Party Number
	Z-end user name	String	End-to-end	Called Party Number
	Initiating CC/ CallC name			Implicit
	Terminating CC/ CallC name			Implicit
	Connection name		Local	Connection ID
	Call name			Network Call Correlation ID
Service	SNP ID			Connection ID
	SNPP ID			Connection ID + Link Connection Pool
	Directionality			Connection ID
Policy Attributes	CoS			Extended QoS parameters
	GoS			Traffic Descriptors and Extended QoS parameters
	Security			Security Services

Appendix II

Mapping of G.7713/Y.1704 E-NNI Attributes to Q.2931/PNNI

Table II.1 describes the mapping of G.7713/Y.1704 E-NNI attributes to Q.2931/PNNI.

Table II.1/G.7713.1/Y.1704.1 – Mapping of G.7713/Y.1704 UNI attributes to Q.2931/PNNI

	Attributes	Format	Scope	Q.2931/PNNI
Identity Attributes	A-end user name	String	End-to-end	As in UNI
	Z-end user name	String	End-to-end	As in UNI
	Initiating CC/ CallC name			As in UNI
	Terminating CC/ CallC name			As in UNI
	Connection name		Local	As in UNI
	Call name			As in UNI

Table II.1/G.7713.1/Y.1704.1 – Mapping of G.7713/Y.1704 UNI attributes to Q.2931/PNNI

	Attributes	Format	Scope	Q.2931/PNNI
Service	SNP ID			As in UNI
	SNPP ID			As in UNI
	Directionality			As in UNI
Policy Attributes	CoS			As in UNI
	GoS			As in UNI
	Explicit resource list			Designated Transit List
	Recovery			Traffic Descriptors

Appendix III

Link connection scope

III.1 Scope of the link connection identifier

Link connection identifiers provide information that is useful only to the CC/LRM using them. Link connection identifiers may have an associated structure imposed on them for local use. Once the link connection identifiers are transmitted to another CC or LRM, the structure of a link connection identifier should no longer be important. This issue does not present a problem in a simple point-to-point connection between two control plane-enabled nodes. However, once a subnetwork is introduced between these nodes (where the subnetwork provides rearrangement capability for the signals) link connection identifier scoping becomes an issue. Figure III.1 illustrates the case of a connection traversing a non-control-plane rearrangeable subnetwork (e.g., link connection identifier rearrangement may be performed via a management system). There is an implicit assumption that the non-control-plane connection already exists prior to any connection request.

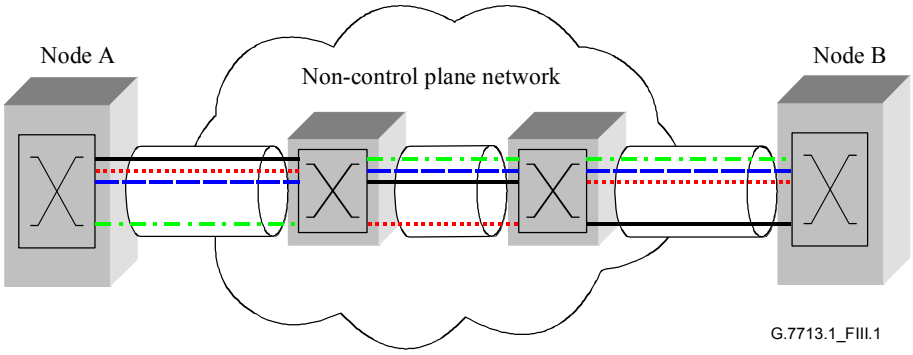

Figure III.1/G.7713.1/Y.1704.1 – Example link where link connection identifiers are rearranged via non-control plane network

The only characteristic of a link connection identifier that is important once it is transmitted is the format of the link connection identifier and the uniqueness of the link connection identifier values. Characteristics such as the structure of the link connection identifier are no longer important or

useful. In fact, imposing structure of a link connection identifier outside of the local space may result in restrictions to the architecture of a network.

III.2 A link connection identifier association function

In order to support the capability to map a received link connection identifier value to a locally significant link connection identifier value, an additional function is needed as part of the local process: that of link connection identifier association. This function takes as input a received link connection identifier value and provides as output a locally significant link connection identifier value. As such, this function may be considered generally to provide a table look-up function.

The information necessary to allow mapping from received link connection identifier value to a locally significant link connection identifier value may be derived in several ways:

– via manual provisioning of the association;

– via automatic discovery of the association.

Either method may be used. In the case of automatic discovery of the association, this implies that the discovery mechanism operates at the SNP level, as per ITU-T Rec. G.7714/Y.1705. Note that in the simple case where two NEs may be directly connected, no association may be necessary. In such instances, the link connection identifier association function provides a one-to-one mapping of the input-to-output link connection identifier values.

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