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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		
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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.

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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

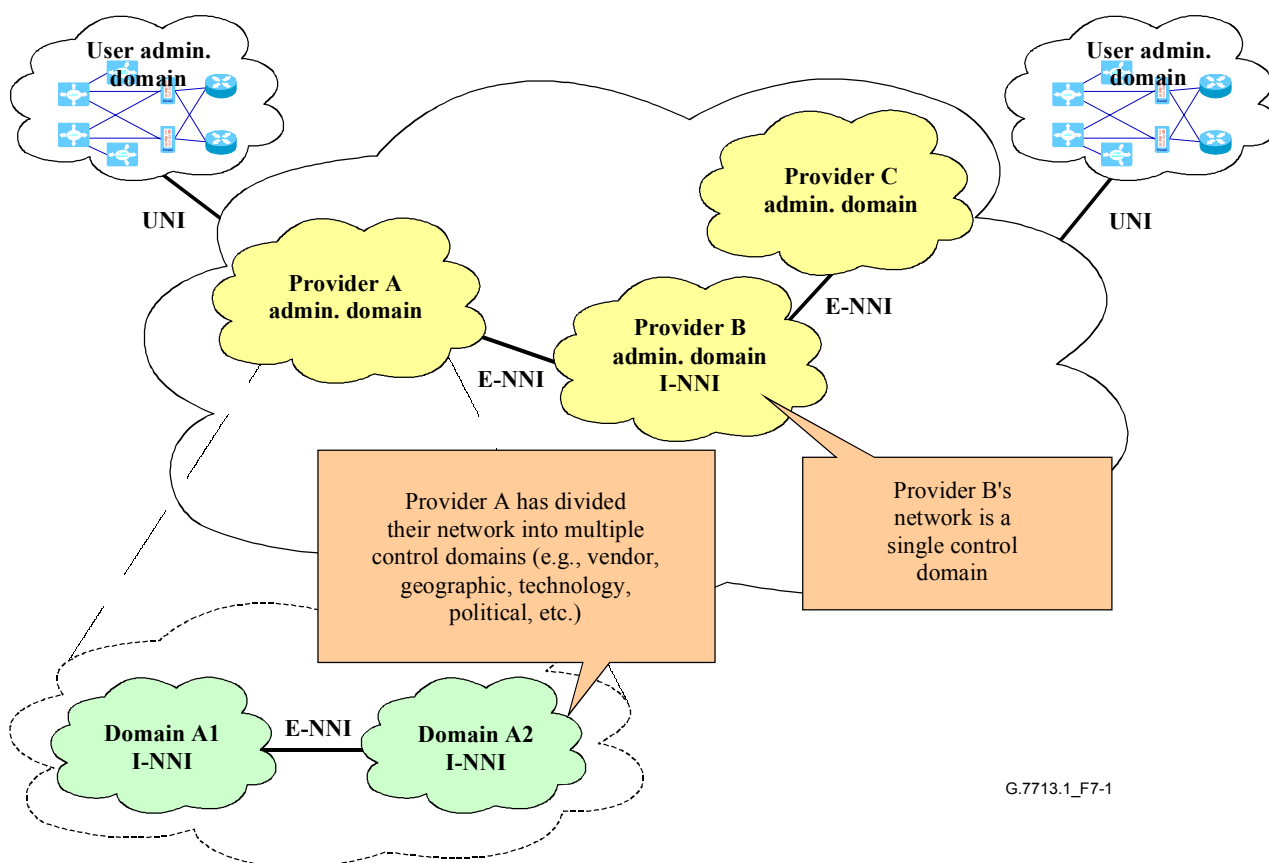
This Recommendation assumes a subset of the messages and information elements defined by the PNNI [5] as the basis for the protocol specification for the Automatic Switched Transport Network (ASTN). Signalling procedures defined by the PNNI are assumed to apply except for the modifications identified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



G.7713.1_F7-1

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.

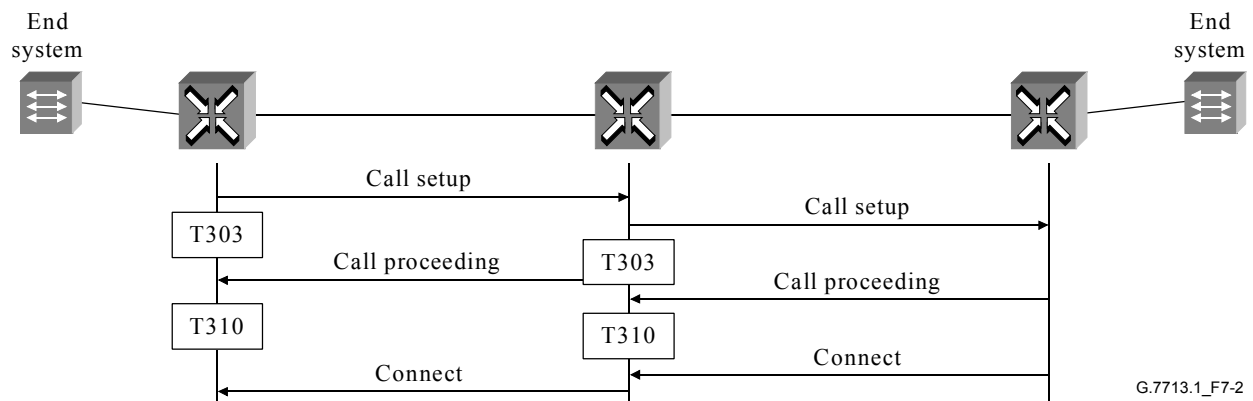


Figure 7-2/G.7713.1/Y.1704.1 – Call setup scenario with no monitoring

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.

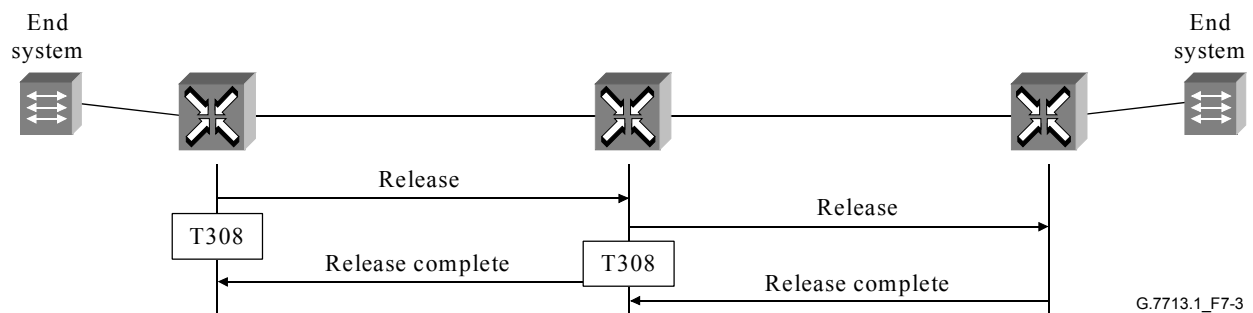


Figure 7-3/G.7713.1/Y.1704.1 – Call release scenario with no monitoring

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