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**SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
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Digital terminal equipments – Operations, administration
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**SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE
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Distributed Call and Connection Management: Signalling mechanism using GMPLS RSVP-TE

ITU-T Recommendation G.7713.2/Y.1704.2

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ITU-T Recommendation G.7713.2/Y.1704.2

Distributed Call and Connection Management: Signalling mechanism using GMPLS RSVP-TE

Summary

This Recommendation meets the requirements of ITU-T Rec. G.7713/Y.1704 and is functionally similar to ITU-T Recs G.7713.1/Y.1704.1 and G.7713.3/Y.1704.3. This Recommendation covers the areas associated with the signalling aspects of automatic switched transport network (ASTN). Specifically it provides the signalling protocol based on the GMPLS RSVP-TE. This Recommendation focuses on the UNI and E-NNI interface specification. While these protocol specifications are generally applicable to the I-NNI as well, the I-NNI interface specification is for further study. This Recommendation encompasses support for Soft Permanent Connection (SPC) services. This version also includes support for Switched Connection (SC) services for intra-carrier application. As such, name translation/directory services and call capability sets are not included. This signalling protocol is used for the communications of call controller, connection controller and link resource manager. Areas covered include:

- message specifications;
- attribute specifications;
- signal flows.

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

Source

ITU-T Recommendation G.7713.2/Y.1704.2 was prepared by ITU-T Study Group 15 (2001-2004) and approved under the WTS 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	
Issue	Notes
0.1	Version 0.1 of G.7713.2/Y.1704.2
0.2	Modifications based on WD40 of 2/02 Q.14/15 meeting
0.3	Editorial modifications to provide clarifications in some sections of the Recommendation
0.4	Included new text on SPC, Call, Recovery
0.5	Modifications to text for call processing
0.6	Modification based on comments received at 10/02 Q.14/15 meeting
0.7	Accept the revision mark of version 0.6
0.8	Editorial changes to align with IANA codepoint assignments

Keywords

Automatic switched optical network, Automatic switched transport network, Distributed call and connection management, Exterior network-node interface, GMPLS RSVP-TE, User network interface.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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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.7713.2/Y.1704.2

Distributed Call and Connection Management: Signalling mechanism using GMPLS RSVP-TE

1 Scope

This Recommendation covers the areas associated with the signalling aspects of automatic switched transport network (ASTN). Specifically it provides the signalling protocol based on the GMPLS RSVP-TE. This Recommendation focuses on the UNI and E-NNI interface specification. While these protocol specifications are generally applicable to the I-NNI as well, the I-NNI interface specification is for further study. This Recommendation encompasses support for Soft Permanent Connection (SPC) services. This version also includes support for Switched Connection (SC) services for intra-carrier application. As such, name translation/directory services and call capability sets are not included. This signalling protocol is used for the communications of call controller, connection controller and link resource manager. Areas covered include:

- message specifications;
- attribute specifications;
- signal flows.

This Recommendation provides the attribute and message specification, and signalling exchange that allow support for hierarchical, source and step-by-step routing. Other areas of ASTN such as routing mechanism, parameters associated with routing mechanisms, discovery, and naming and addressing are not in the scope of this Recommendation.

This Recommendation uses the control plane architectural requirements in ITU-T Rec. G.8080/Y.1304 and the protocol neutral requirements as outlined in ITU-T Rec. G.7713/Y.1704 as the basis for the specification.

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.

- ITU-T Recommendation E.360.1 (2002), *Framework for QoS routing and related traffic engineering methods for IP-, ATM- and TDM-based multiservice networks*.
- ITU-T Recommendation G.703 (2001), *Physical/electrical characteristics of hierarchical digital interfaces*.
- ITU-T Recommendation G.707/Y.1322 (2000), *Network node interface for the Synchronous Digital Hierarchy (SDH)*.
- ITU-T Recommendation G.709/Y.1331 (2003), *Interfaces for the Optical Transport Network (OTN)*.
- ITU-T Recommendation G.7713/Y.1704 (2001), *Distributed Call and Connection Management (DCM)*.
- ITU-T Recommendation G.803 (2000), *Architecture of transport networks based on the Synchronous Digital Hierarchy (SDH)*.

- ITU-T Recommendation G.805 (2000), *Generic functional architecture of transport networks*.
- ITU-T Recommendation G.807/Y.1302 (2001), *Requirements for Automatic Switched Transport Network (ASTN)*.
- ITU-T Recommendation G.872 (2001), *Architecture of optical transport networks*.
- ITU-T Recommendation G.8080/Y.1304 (2001), *Architecture for Automatic Switched Optical Network (ASON)*.
- IETF RFC 2205 (1997), *Resource ReSerVation Protocol (RSVP) – Version 1 Functional Specification*.
- IETF RFC 2747 (2000), *RSVP Cryptographic Authentication*.
- IETF RFC 2750 (2000), *RSVP Extensions for Policy Control*.
- IETF RFC 2961 (2001), *RSVP Refresh Overhead Reduction Extensions*.
- IETF RFC 3097 (2001), *RSVP Cryptographic Authentication – Updated Message Type Value*.
- IETF RFC 3209 (2001), *RSVP-TE: Extensions to RSVP for LSP Tunnels*.
- IETF RFC 3471 (2003), *Generalized Multi-Protocol Label Switching (GMPLS) – Signalling Functional Description*.
- IETF RFC 3473 (2003), *Generalized Multi-Protocol Label Switching (GMPLS) Signalling – Resource Reservation Protocol – Traffic Engineering (RSVP-TE) Extensions*.
- OIF UNI-01.0 (2001), *User Network Interface (UNI) 1.0 signalling specification*.

3 Terms and definitions

The following terms are defined in ITU-T Rec. G.805:

- administrative domain;
- layer network;
- link connection;
- management domain;
- subnetwork;
- subnetwork connection.

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

- agent;
- component;
- call controller;
- connection controller;
- connection admission control;
- route controller;
- neighbour discovery;
- link resource manager;
- policy;
- protocol controller;

- subnetwork point;
- subnetwork point pool.

The following terms are defined in ITU-T Rec. G.807/Y.1302:

- soft permanent connection;
- switched connection.

4 Abbreviations

This Recommendation uses the following abbreviations:

ASON	Automatic Switched Optical Network
ASTN	Automatic Switched Transport Network
CallC	Call Controller
CC	Connection Controller
CCC	Calling/Called Party Call Controller
DCM	Distributed Call and Connection Management
E-NNI	Exterior NNI
GMPLS	Generalized Multi-Protocol Label Switching
I-NNI	Interior NNI
LRM	Link Resource Manager
NCC	Network Call Controller
NNI	Network Node Interface
RSVP-TE	Resource reSerVation Protocol – Traffic Engineering
SC	Switched Connection
SNP	Subnetwork Point
SNPP	Subnetwork Point Pool
SPC	Soft Permanent Connection
UNI	User Network Interface

5 Conventions

In this Recommendation, the acronym GMPLS is used to denote the signalling protocol portion of GMPLS based on the GMPLS RSVP-TE and should be read as synonymous to GMPLS RSVP-TE.

6 Assumptions

This Recommendation assumes the messages and objects defined by RFC 2205, RFC 2961, RFC 3209, [RFC 3471 GMPLS-SIG], [RFC 3473 GMPLS-RSVP-TE], and OIF UNI-01.0 as the basis for the protocol specification for the ASON network.

ITU-T Rec. G.8080/Y.1304 defines a UNI Transport Resource Addresses for the bearer links at the UNI reference point. For this Recommendation, an instantiation of those addresses will follow the OIF Transport Network Address (TNA) from OIF UNI-01.0 which complies with the G.8080/Y.1304 architecture. Allowable address formats in the OIF TNA are IPv4, IPv6, and NSAP addresses.

Call routing services are assumed to be available that associate a UNI Transport Resource Addresses with internal routable addresses. This is not within the scope of this Recommendation.

Addressing of transport resources in the protocol is done by SNPP identifiers. A pair of these would 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 Overview and application of GMPLS RSVP-TE to distributed connection management

Figure 1 shows an overall view of control plane partition.

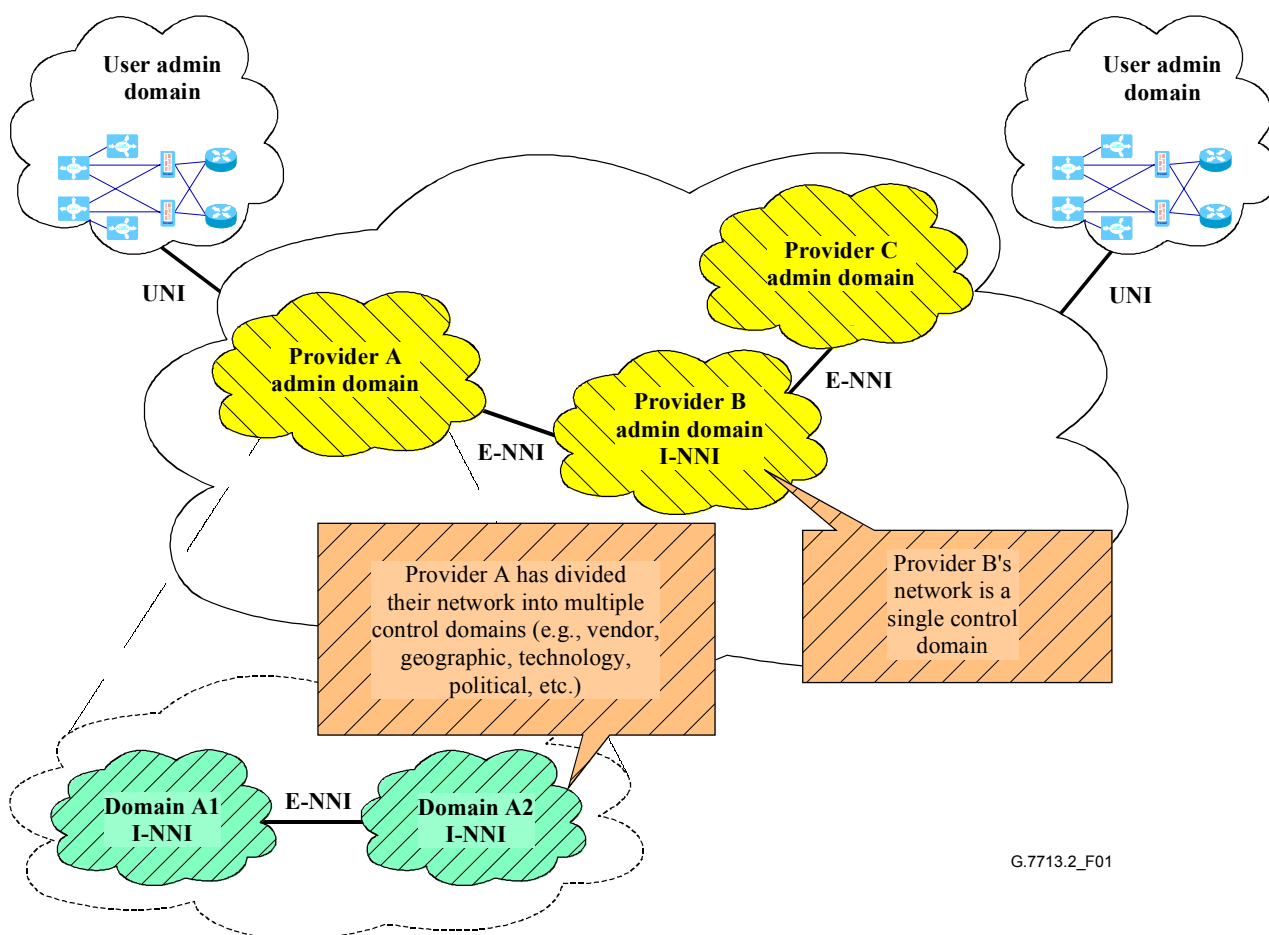


Figure 1/G.7713.2/Y.1704.2 – Overall view of control plane partition

7.1 Overview of GMPLS RSVP-TE

The Resource reSerVation Protocol (RSVP) is an IETF-defined protocol [RFC 2205] for establishing network resources for IP datagram sessions (or "flows"). The definition of RSVP consists of basic procedures, message and object formats for signalling in an IP network. RSVP with Traffic Engineering extensions (RSVP-TE) [RFC 3209] has been defined for establishing connections subject to routing constraints in an MPLS network. The RSVP-TE definition includes

additional procedures, message and object formats over the base RSVP definition. Generalized MPLS (GMPLS) signalling extends basic MPLS signalling procedures and abstract messages to cover different types of switching applications such as time-division-multiplexing (TDM) switching, port switching, wavelength switching, etc. Figure 2 shows the message flow for the relevant messages defined for GMPLS RSVP-TE. See below for a detailed description of these messages.

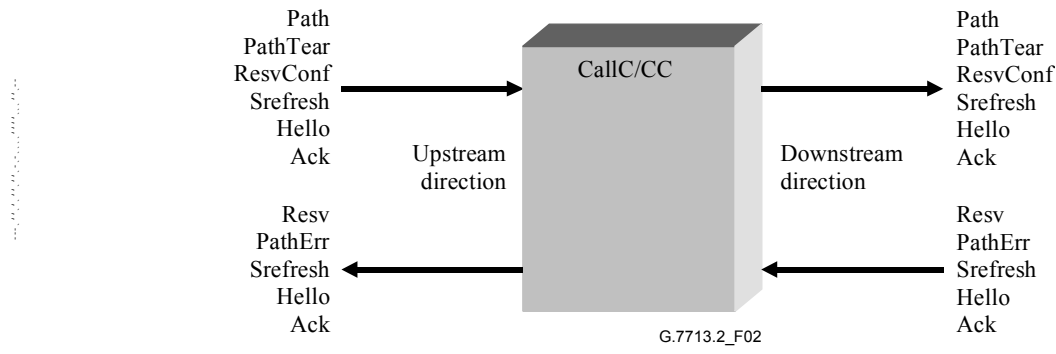


Figure 2/G.7713.2/Y.1704.2 – GMPLS RSVP-TE message flow directions

The GMPLS RSVP-TE is extended to support the requirements as specified in ITU-T Rec. G.7713/Y.1704. The GENERALIZED_UNI object is defined to encapsulate the A-end and Z-end names, as well as the CoS and GoS specifications to support the service requests at the UNI interface. See OIF UNI-01.0 for a definition of the GENERALIZED_UNI object. This information is also summarized as part of Annex A. In addition to this object, extensions are also made to support the basic call concept and to support the soft permanent connection service.

7.1.1 Support for basic call identifier

GMPLS RSVP-TE may be extended to support the basic call model as specified in ITU-T Rec. G.7713/Y.1704. This call model assumes that a request message handles both a call and its associated connections within the same message between the calling party call controller and the network call controller, as well as between the network call controller and the called party call controller. Addition or release of connections from an existing call is considered a call modify procedure, i.e., modification of specific connection attributes. As such, a call session remains constant across call modification operations. An established call may be identified via a call identifier object, CALL_ID. The format and structure of the CALL_ID information is:

- CALL_ID Class = 230, C-Type = 1

0	1	2	7	8	15	16	23	24	31																				
Length					Class-Num					C-type																			
...										Call identifier										...									

Where the following C-types are defined:

- C-Type = 1 (operator specific): The call identifier contains operator specific identifier.
- C-Type = 2 (globally unique): The call identifier contains globally unique part plus an operator specific identifier.

The following structures are defined for the call identifier:

- Call identifier: generic [Length*8-32] bit identifier. The number of bits for call identifier must be multiples of 32 bits, with minimum size of 32 bits.

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.

The format of the Call identifier field for C-Type = 1:

0	1	2	7	8	15	16	23	24	31	
Length					Class-Num				C-type	
Type			Reserved							
Source transport network element address										
...										
Local Identifier										

The format of the Call identifier field for C-Type = 2:

0	1	2	7	8	15	16	23	24	31
Length					Class-Num			C-type	
Type			IS (3 bytes)						
NS (12 bytes)									
Source transport network element address									
...									
Local Identifier									

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 = 0x01, the source transport network element address is 4 bytes;
- For Type = 0x02, the source transport network element address is 16 bytes;
- For Type = 0x03, the source transport network element address is 20 bytes;
- For type = 0x04, the source transport network element address is 6 bytes;
- For type = 0x7f, the source transport network element address has the length defined by the vendor.

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.

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.

The following processing rules are applicable to the CALL_ID object:

- For initial calls, the calling/originating party call controller must set the CALL_ID's C-Type and call identifier value to all-zeros.
- For a new call request, the source network call controller (SNCC) sets the appropriate C-type and value for the CALL_ID.
- For an existing call (in case CALL_ID is non-zero) the SNCC verifies existence of the call.
- The CALL_ID object on all messages MUST be sent from ingress call controller to egress call controller by all other (intermediate) controllers without altering.
- The destination user/client receiving the request uses the CALL_ID value as reference to the requested call between the source user and itself. Subsequent actions related to the call uses the CALL_ID as the reference identifier.

7.1.2 Support for Soft permanent connection

GMPLS RSVP-TE may be extended to support SPC services. An SPC service assumes that both source and destination user-to-network connection segments are provisioned while the network connection segment is set up via the control plane. For example, when an initial request is received from an external source (e.g., from management system), there is an implicit assumption that the control plane has adequate information to determine the specific destination (network-to-user) link connection to use. Support for SPC is provided via the SPC_LABEL object.

The SPC_LABEL is a sub-object of the GENERALIZED_UNI object, and has the same format and structure as the EGRESS_LABEL sub-object of the GENERALIZED_UNI object. The SPC_LABEL information is:

- SPC_LABEL (Type = 4, Sub-type = 2).

Note that to support the case of SPC, the GENERALIZED_UNI object is used. This object is used to support the SPC label information as well as service level and diversity specifications that are relevant to the SPC connection request. For a SPC request, the source and destination TNA addresses contain the addresses of the transport network elements controlled by the source the destination network call controllers, respectively. Thus the source TNA contains the address of the transport network element controlled by the source network call controller and the destination

TNA contains the address of the transport network element controlled by the destination network call controller.

7.2 Defect handling of GMPLS RSVP-TE

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 entering into a self-refresh state, 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. Note that although the restart mechanism allows neighbour control plane nodes to automatically recover (and thus infer) the states of calls/connections, this mechanism can also be used for verification of neighbour states while the persistent storage provides the local recovery of lost state. In this case, if during the Hello synchronization the restarting node determines that a neighbour does not support state recovery (i.e., local state recovery only), and the restarting node maintains its state on a per neighbour basis, the restarting node should immediately consider the Recovery as completed.
- 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 un-recovered 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).