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SERIES Q: SWITCHING AND SIGNALLING

Broadband ISDN – Common aspects of B-ISDN
application protocols for access signalling and network
signalling and interworking

IP connection control signalling protocol – Capability Set 1

ITU-T Recommendation Q.2631.1

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ITU-T Recommendation Q.2631.1

IP connection control signalling protocol – Capability Set 1

Summary

This Recommendation specifies the inter-node protocol and nodal functions that support the dynamic establishment, modification and release of individual IP connections.

The IP connection control signalling protocol specified in this Recommendation can operate in public or private networks over a range of signalling transport protocol stacks.

It also provides maintenance capabilities, carriage of user-plane protocol stack information and carriage of an identifier to link the connection control protocol with other higher layer control protocols.

Source

ITU-T Recommendation Q.2631.1 was approved by ITU-T Study Group 11 (2001-2004) under the ITU-T Recommendation A.8 procedure on 14 October 2003.

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IP connection control signalling protocol – Capability Set 1

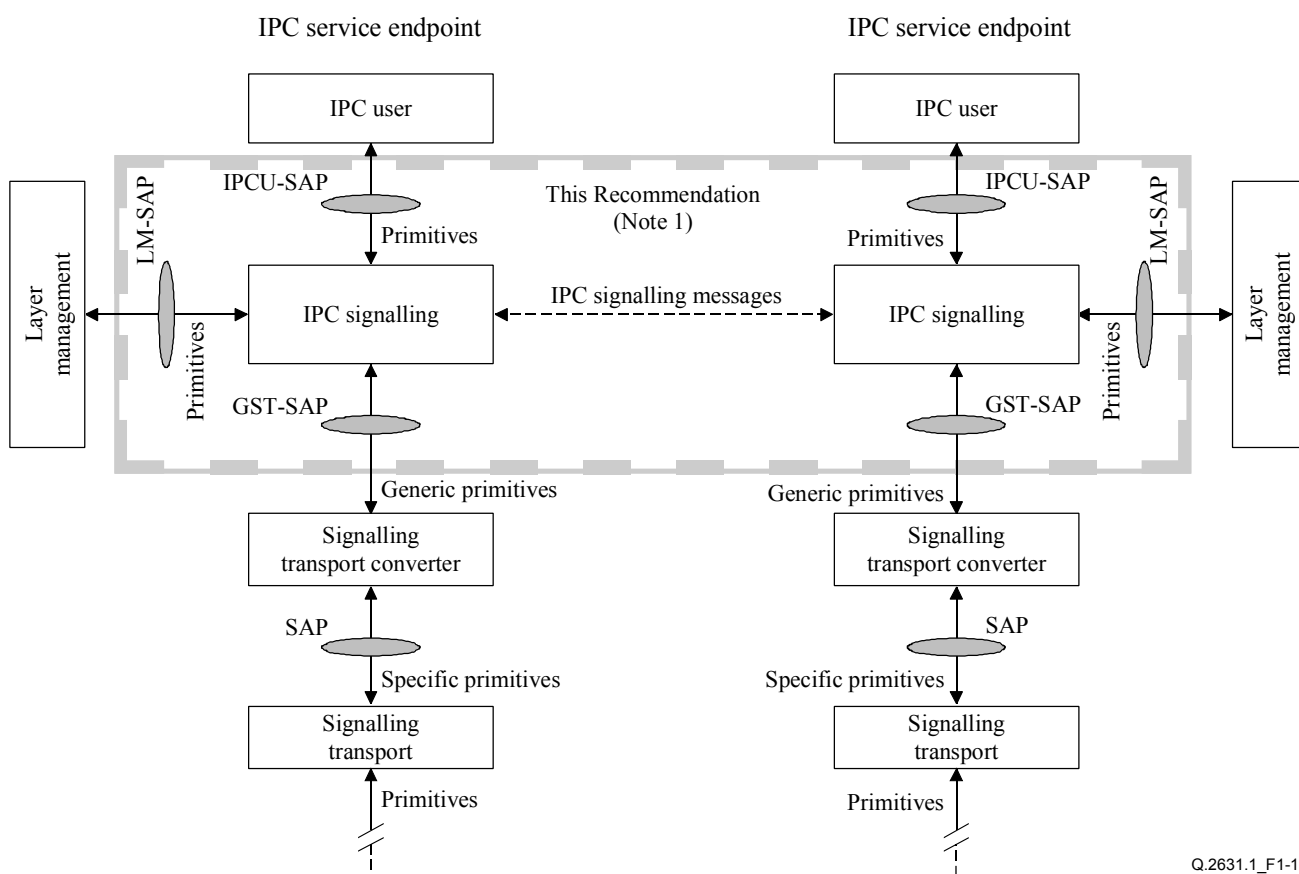
1 Scope

This Recommendation describes the IP connection control signalling protocol that supports the dynamic establishment, modification and release of individual IP connections. It also describes the maintenance procedures, the framework of the protocol, and the interactions between an IPC signalling entity and:

- the signalling protocol user;
- a signalling transport converter; and
- layer management.

The scope of this Recommendation is illustrated in Figure 1-1. The IPC signalling protocol can be deployed over a range of signalling transport protocol stacks.

This Recommendation is based on the requirements defined in ITU-T Technical Report TRQ.2415 [25] "Signalling requirements for IP connection control in radio access networks Capability Set 1".



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NOTE 1 – The entities and Service Access Points (SAP) bounded by the grey broken line indicate the extent of the definitions specified in this Recommendation.

Figure 1-1/Q.2631.1 – Functional architecture of IPC signalling

2 References

2.1 Normative 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 X.200 (1994), *Information technology – Open Systems Interconnection – Basic Reference Model: The basic model*.
- [2] ITU-T Recommendation X.210 (1993), *Information technology – Open Systems Interconnection – Basic Reference Model: Conventions for the definition of OSI services*.
- [3] ITU-T Recommendation Q.2150.0 (2001), *Generic signalling transport service*.
- [4] IETF RFC 791 (1981), *Internet Protocol*.
- [5] IETF RFC 2460 (1998), *Internet Protocol, Version 6 (IPv6) Specification*.
- [6] IETF RFC 768 (1980), *User Datagram Protocol*.
- [7] IETF RFC 3550 (2003), *RTP: A Transport Protocol for Real-Time Applications*.
- [8] IETF RFC 2474 (1998), *Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers*.
- [9] IETF RFC 2597 (1999), *Assured Forwarding PHB Group*.
- [10] IETF RFC 3246 (2002), *An Expedited Forwarding PHB (Per-Hop Behaviour)*.
- [11] IETF RFC 3513 (2003), *Internet Protocol Version 6 (IPv6) Addressing Architecture*.
- [12] ITU-T Recommendation Q.850 (1998), *Usage of cause and location in the Digital Subscriber Signalling System No. 1 and the Signalling System No. 7 ISDN user part*.
- [13] ITU-T Recommendation Q.2610 (1999), *Usage of cause and location in B-ISDN user part and DSS2*.
- [14] ITU-T Recommendation E.164 (1997), *The international public telecommunication numbering plan*.
- [15] ITU-T Recommendation X.213 (2001), *Information Technology – Open Systems Interconnection – Network service definition*.
- [16] ITU-T Recommendation Q.542 (1993), *Digital exchange design objectives – Operations and maintenance*.
- [17] ITU-T Recommendation Y.1221 (2002), *Traffic control and congestion control in IP-based networks*.

2.2 Informative references

- [20] ITU-T Recommendation Q.2630.1 (1999), *AAL type 2 signalling protocol – Capability Set 1*.
- [21] ITU-T Recommendation Q.2630.2 (2000), *AAL type 2 signalling protocol – Capability Set 2*.

- [22] ITU-T Recommendation Q.2150.1 (2001), *Signalling transport converter on MTP3 and MTP3b*.
- [23] ITU-T Recommendation Q.2150.2 (2001), *Signalling Transport Converter on SSCOP and SSCOPMCE*.
- [24] ITU-T Recommendation Q.2150.3 (2002), *Signalling Transport Converter on SCTP*.
- [25] ITU-T Q-series Recommendations – Supplement 43 (2003), *Technical Report TRQ.2415: Transport control signalling requirements – Signalling requirements for IP connection control in radio access networks Capability Set 1*.
- [26] ITU-T Q-series Recommendations – Supplement 44 (2003), *Technical Report TRQ.2800: Transport control signalling requirements – Signalling requirements for AAL type 2 to IP interworking, Capability Set 1*.
- [27] IETF RFC 3260 (2002), *New Terminology and Clarifications for Diffserv*.
- [28] 3GPP TS 25.414, *3rd Generation Partnership Project, Technical Specification Group Radio Access Network, UTRAN Iu interface data transport and transport signalling (Release 5)*.
- [29] 3GPP TS 25.426, *3rd Generation Partnership Project, Technical Specification Group Radio Access Network, UTRAN Iur and Iub interface data transport & transport signalling for DCH data streams (Release 5)*.

3 Definitions

This Recommendation is based upon the concepts developed in ITU-T Recs X.200 [1] and X.210 [2].

In addition, this Recommendation defines the following terms:

- 3.1 IP connection:** The logical user plane communication facility between two IPC nodes, which is controlled by the IPC signalling protocol. An IP connection is designated by a pair of IP address/port number combinations.
- 3.2 IPC node:** A physical entity that contains an IPC signalling entity.
- 3.3 IPC user:** The user of the IPC signalling protocol. An IPC user resides at an IPC service endpoint.
- 3.4 IPC signalling protocol:** Control plane functions for establishing, modifying and releasing IP connections and the maintenance functions associated with the IPC signalling.
- 3.5 IPC signalling transport:** A facility for carrying IPC signalling messages.
- 3.6 IPC signalling endpoint:** The termination point of IPC signalling transport.
- 3.7 IPC service endpoint:** A functional entity which includes the IPC signalling endpoint and the IPC user.
- 3.8 IP transfer capability:** Information that describes the attributes of the IP connection.
- 3.9 IP transport type:** Information that describes the IP transport protocol stack used for the IP connection.
- 3.10 field:** Information carried in a parameter in a message. A field can have fixed or variable length data.
- 3.11 generic signalling transport:** The function that enables an IPC signalling entity to communicate with a peer IPC signalling entity independently of the underlying signalling transport.
- 3.12 local IP address:** IP address to be used by the peer IPC node to direct the user traffic.

3.13 local UDP port number: UDP port number to be used by the peer IPC node to direct the user traffic.

3.14 parameter: Information carried in a message. A parameter has a fixed, defined set of fields.

3.15 signalling association: A signalling capability that exists between two adjacent IPC nodes to control the IP connections. There may be one or more signalling associations between two adjacent IPC nodes.

3.16 signalling transport: A signalling link or network that connects two IPC nodes.

3.17 signalling transport converter: A function that converts the services provided by a particular signalling transport to the services required by the generic signalling transport.

3.18 subfield: The smallest unit of information in a field that has its own functional meaning.

4 Abbreviations

This Recommendation uses the following abbreviations:

ACC	Automatic Congestion Control
ANI	Adjacent IPC Node Identifier
CAU	Cause Parameter
CFN	ConFusioN message
DEA	Destination Endpoint Address
DEAE	Destination Endpoint E.164 Address
DEAX	Destination Endpoint X.213 Address
DS	Differentiated Services
DSaid	Destination Signalling Association Identifier
DSCP	Differentiated Services Code Point
ECF	Establish Confirm Message
ERQ	Establish Request Message
GST	Generic Signalling Transport
ID	Identifier
IP	Internet Protocol
IPC	IP Connection Control
IPCU	IPC User
IPQoS	IP Quality of Service
IPTA	IP Transport Sink Address
IPTT	IP Transport Type
LM	Layer Management
LSB	Least Significant Bit
M	Mandatory
MOA	Modification Acknowledge message

MOD	Modification Request message
MOR	Modification Reject message
MSB	Most Significant Bit
MSTC	Modify Support for Transfer Capability
O	Optional
OSAID	Originating Signalling Association Identifier
PHB	Per-Hop forwarding Behaviour
PTC	Preferred Transfer Capability
PTC-DBW	Dedicated Bandwidth Preferred Transfer Capability
PTC-SBW	Statistical Bandwidth Preferred Transfer Capability
QoS	Quality of Service
REL	Release Request Message
RES	Reset Request Message
RLC	Release Confirm Message
RSC	Reset Confirm Message
RTP	Real-Time Protocol
SAID	Signalling Association Identifier
SAP	Service Access Point
SDU	Service Data Unit
STC	Signalling Transport Converter
SUGR	Served User Generated Reference
SUT	Served User Transport
TC	Transfer Capability
TC-DBW	Dedicated Bandwidth Transfer Capability
TCI	Test Connection Indication
TC-SBW	Statistical Bandwidth Transfer Capability
UDP	User Datagram Protocol

5 General framework of the IPC signalling protocol

The IP connection control signalling protocol provides the signalling capability to establish, modify and release virtual connections in an IP environment. These services are accessible via the IPC User Service Access Point (IPCU-SAP).

The IPC signalling protocol also provides maintenance functions associated with the IPC signalling. These functions are accessible via the Layer Management Service Access Point (LM-SAP).

Two peer IPC signalling entities rely on the generic signalling transport service to provide assured data transfer between them and service availability indications. These services are accessible via the Generic Signalling Transport Service Access Point (GST-SAP).

NOTE – Primitives over the IPCU-SAP, GST-SAP and LM-SAP are used for descriptive purpose only. They do not imply a specific implementation.

Both peer IPC signalling entities provide the same set of services.

IPC signalling messages are analysed only in IPC service endpoints (see Figure 1-1).

IPC signalling messages are exchanged between peer protocol entities using the generic signalling transport service. The IPC signalling is independent of the signalling transport, although an assured data transport is required and a message size limit applies. The generic signalling transport service used is defined in ITU-T Rec. Q.2150.0 [3]. To adapt the generic signalling transport services to a specific signalling transport service, a signalling transport converter may be needed. The specification of signalling transport converters is beyond the scope of this Recommendation (see ITU-T Recs Q.2150.1 [22], Q.2150.2 [23], and Q.2150.3 [24]).

5.1 Interface between the IPC signalling entity and the IPC user

5.1.1 Service provided by the IPC signalling entity

The IPC signalling entity provides the following services to the IPC user across the IPCU-SAP:

- Establishment of IP connections;
- Release of IP connections; and
- Modification of IP connection resources.

The IPC signalling entity is independent of the IPC user.

5.1.2 Primitives between IPC signalling entity and the IPC user

The IPCU-SAP primitives are used:

- 1) by the originating IPC user to initiate IP connection establishment and by either of the IPC users to initiate the release of a connection;
- 2) by the terminating IPC signalling entity to indicate an incoming IP connection establishment request to the terminating IPC user and by either of the IPC signalling entities to notify its corresponding IPC user of the release of a connection;
- 3) by either IPC user to initiate an IP connection resource modification and by the modification terminating IPC user to respond to a modification request;
- 4) by either IPC signalling entity to indicate a modification of the IP connection resource to its corresponding IPC user and to notify the modification initiating IPC user of the successful or unsuccessful modification.

NOTE – When sending a primitive between the signalling protocol and its user, the primitive needs to be associated with a particular IP connection instance. The mechanism used for this binding is considered to be an implementation detail and, therefore, is outside the scope of this Recommendation.

The services are provided through the transfer of primitives, which are summarized in Table 5-1, and are defined after the table.

The IPC user passes information in parameters in the primitives. Some of those parameters are mandatory and some are optional; the appropriate usage of the parameters is described in clause 8.

**Table 5-1/Q.2631.1 – Primitives and parameters exchanged
between the IPC signalling entity and the IPC user**

Primitive Generic name	Type			
	Request	Indication	Response	Confirm
ESTABLISH	DEA, SUGR, SUT, MSTC, TC, PTC, IPQOS, IPTT, CP	SUGR, SUT, MSTC, TC, PTC, IPQOS, IPTT, CP	MSTC	MSTC
RELEASE	Cause	Cause	Not defined	Cause
MODIFY	TC	TC	–	–
MODIFY-REJECT	Not defined	Not defined	Cause	Cause
– This primitive has no parameters.				

a) **ESTABLISH.request:**

This primitive is used by the originating IPC user to initiate the establishment of a new IP connection and optionally request the capability for subsequent modification to be performed on this IP connection.

b) **ESTABLISH.indication:**

This primitive is used by the terminating IPC signalling entity to indicate an incoming IP connection establishment request to the terminating IPC user and optionally indicate that subsequent modification may be performed on this IP connection.

c) **ESTABLISH.response:**

This primitive is used by the terminating IPC user to indicate to the terminating IPC signalling entity that the establishment request has been successful.

d) **ESTABLISH.confirm:**

This primitive is used by the originating IPC signalling entity to indicate to the originating IPC user that the IP connection (which was previously requested by the originating IPC user) has successfully been established and optionally indicate that the established connection is capable of subsequent modification.

e) **RELEASE.request:**

This primitive is used by the IPC user to initiate clearing of an IP connection.

f) **RELEASE.indication:**

This primitive is used by the IPC signalling entity to indicate that an IP connection has been released.

g) **RELEASE.confirm:**

This primitive is used by the originating IPC signalling entity to indicate to the originating IPC user that an establishment request has been unsuccessful.

h) **MODIFY.request:**

This primitive is used by either IPC user to initiate the modification of the IP connection resource.

i) **MODIFY.indication:**

This primitive is used by the modify receiving IPC signalling entity to indicate that modification of the IP connection resource has been requested.

- j) **MODIFY.response:**
This primitive is used by the modify receiving IPC user to indicate to the IPC signalling entity that the modification request has been successful.
- k) **MODIFY.confirm:**
This primitive is used by either IPC signalling entity to indicate that the IP connection resource modification (which was previously requested by the IPC user) has successfully been performed
- l) **MODIFY-REJECT.response:**
This primitive is used by the modify receiving IPC user to indicate to the IPC signalling entity that the IP connection resource modification has been rejected.
- m) **MODIFY-REJECT.confirm:**
This primitive is used by the modify sending IPC signalling entity to indicate that the IP connection resource modification (which was previously requested by the IPC user) has been rejected.

5.1.3 Parameters between IPC signalling entity and the IPC user

- a) **Destination Endpoint Address (DEA)**
This parameter carries the endpoint address of the destination. It can have the form of an E.164 [14] address or an X.213 [15] address, and is transported unmodified to the destination IPC user.
- b) **Served User Generated Reference (SUGR)**
This parameter carries a reference provided by the originating IPC user and this reference is transported unmodified to the destination IPC user.
- c) **Served User Transport (SUT)**
This parameter carries the user data that is transported unmodified to the destination IPC user.
- d) **Transfer Capability (TC)**
This parameter gives an indication of the resources required for the IP connection. This parameter can have the form of either:
- Dedicated Bandwidth Transfer Capability (see ITU-T Rec. Y.1221 [17]); or
 - Statistical Bandwidth Transfer Capability (see ITU-T Rec. Y.1221 [17]).
- e) **Cause**
This parameter describes the reason for the release of the IP connection. It also may indicate the reason why an IP connection could not be established or why a modification of an IP connection was rejected.
- f) **Modify Support for Transfer Capability (MSTC)**
This parameter gives an indication that the transfer capability of the IP connection may need to be modified during the lifetime of the IP connection (ESTABLISH.request) or is permitted to be modified (ESTABLISH.indication and ESTABLISH.confirm).
- g) **Preferred Transfer Capability (PTC)**
This parameter gives an indication that the Transfer Capability shall be set as indicated in this parameter if the modification of the Transfer Capability is permitted. This parameter can have the form of either:
- Dedicated Bandwidth Transfer Capability (see ITU-T Rec. Y.1221 [17]); or
 - Statistical Bandwidth Transfer Capability (see ITU-T Rec. Y.1221 [17]).

- h) **Quality of Service (IPQoS)**
This parameter indicates a request for an IP connection with a specified Quality of Service.
- i) **IP Transport Type (IPTT)**
This parameter indicates a request for an IP connection with a specified IP transport protocol stack.
- j) **Connection Priority (CP)**
This parameter carries information to indicate the priority level of the connection request.

5.2 Interface between the IPC signalling entity and the generic signalling transport

5.2.1 Service provided by the generic signalling transport service

The generic signalling transport service is specified in ITU-T Rec. Q.2150.0 [3]. For convenience, a summary of the primitives for accessing the service is reproduced in Table 5-2. In the event of any difference between this table and the definitions in ITU-T Rec. Q.2150.0 [3], the definitions in ITU-T Rec. Q.2150.0 [3] take precedence.

Table 5-2/Q.2631.1 – Primitives and parameters of the generic signalling transport sublayer

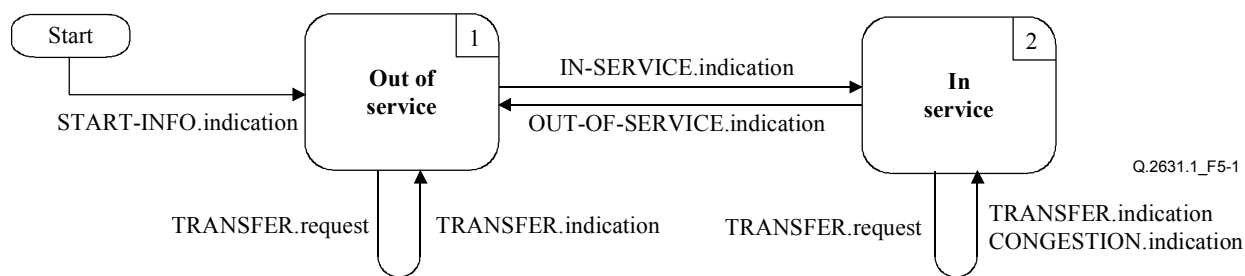
Primitive Generic name	Type			
	Request	Indication	Response	Confirm
START-INFO	not defined	Max_Length CIC_Control	not defined	not defined
IN-SERVICE	not defined	Level	not defined	not defined
OUT-OF-SERVICE	not defined	(Note 1)	not defined	not defined
CONGESTION	not defined	Level	not defined	not defined
TRANSFER	Sequence Control STC User Data Priority (Note 2)	STC User Data Priority (Note 2)	not defined	not defined
NOTE 1 – This primitive has no parameters.				
NOTE 2 – This parameter is a national option (and the use of this parameter is not supported by all signalling transports).				

On the establishment of a signalling transport converter entity and the associated signalling transport converter user entity, for example at power up, the initial conditions are the same as if an OUT-OF-SERVICE.indication primitive had been conveyed across this SAP. Also, at this time the START-INFO.indication is sent to the signalling entity.

NOTE – The CIC_Control parameter of the START-INFO.indication is ignored by the IPC signalling entity.

5.2.2 State transition diagram for sequences of primitives of the generic signalling transport service

This clause defines the constraints on the sequences in which the primitives may occur at the layer boundaries of the generic signalling transport service. The sequences are related to the states at one generic signalling transport endpoint between the generic signalling transport service provider and its user. The possible overall sequences of primitives are shown in the state transition diagram, Figure 5-1.



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Figure 5-1/Q.2631.1 – State transition diagram for sequences of primitives between the GST and its user

This model assumes that a request primitive is never issued at the same time as an indication primitive. The model also assumes that the primitives are serviced immediately and in zero time.

5.3 Interface between the IPC signalling entity and layer management

5.3.1 Service provided by layer management

This interface provides the internal interface to the network management system.

5.3.2 Primitives between IPC signalling entity and layer management

The primitives are summarized in Table 5-3 and are defined after the table.

Table 5-3/Q.2631.1 – Primitives and parameters exchanged between the IPC signalling entities and layer management

Primitive Generic name	Type			
	Request	Indication	Response	Confirm
RESET	ANI, IPTA	ANI, IPTA	Not defined	–
STOP-RESET	ANI, IPTA	Not defined	Not defined	Not defined
ERROR	Not defined	ANI, IPTA, Cause	Not defined	Not defined
– This primitive has no parameters.				

NOTE – When sending a primitive between the IPC signalling entity and layer management, the primitive needs to be associated with a particular management action instance. The mechanism used for this binding is considered to be an implementation detail and, therefore, is outside the scope of this Recommendation.

a) **RESET.request:**

A primitive to request either IPC signalling entity to reset a particular IP connection, or all IP connections associated with a signalling association to the "Idle" state, and to indicate this to the peer IPC signalling entity.

b) **RESET.indication:**

A primitive indicating that the IPC signalling entity has reset a particular IP connection, or all IP connections associated with a signalling association to the "Idle" state on the request of the peer IPC signalling entity.

c) **RESET.confirm:**

A primitive indicating that the IPC signalling entity has successfully informed the peer IPC signalling entity of the resetting of a particular IP connection, or all IP connections associated with a signalling association.

- d) **STOP-RESET.request:**
A primitive to request the IPC signalling entity to stop a reset procedure.
- e) **ERROR.indication:**
A primitive to indicate any operational errors in the IPC signalling procedures.

5.3.3 Parameters between IPC signalling entity and layer management

- a) **IP Transport Address (IPTA)**
This parameter allows for the identification of:
- all IP connections associated with a signalling association; or
 - a particular IP connection.
- b) **Cause**
This parameter gives the reason of an operational error.
- c) **Adjacent IPC Node Identifier (ANI)**
This parameter is used to unambiguously indicate an adjacent IPC node.

6 Forward and backward compatibility

The compatibility mechanism remains unchanged for all capability sets and/or subsets of the IPC protocol defined in this Recommendation. It is based on forward compatibility information associated with all signalling information.

The compatibility method eases the network operation, for example:

- For the typical case of an IPC signalling protocol mismatch during a network upgrading.
- To interconnect two networks on a different functional level.
- For networks using a different subset of the same IPC protocol, etc.

NOTE – An IPC node may be at a different functional level due to having implemented a different capability set or another subset of the protocol specified in this Recommendation.

The forward compatibility mechanism specified in 6.2 and 8.1 applies to this and future capability sets of this Recommendation.

6.1 Backward compatibility rules

Compatible interworking between IPC protocol capability sets should be optimized by adhering to the following rules when specifying a new capability set (release):

- 1) Existing protocol elements, i.e., procedures, messages, parameters and subfield values, should not be changed unless a protocol error needs to be corrected, or it becomes necessary to change the operation of the service that is being supported by the protocol.
- 2) The semantics of a message, a parameter, or of a field and subfield within a parameter should not be changed.
- 3) Established rules for formatting and encoding messages and parameters should not be modified.

6.2 Forward compatibility mechanism

Compatibility between this and future capability sets will be guaranteed, in the sense that any two capability sets can be interconnected directly with each other, if the following requirements are fulfilled: