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SERIES Q: SWITCHING AND SIGNALLING

Technical Report TRQ.2415: Transport control signalling requirements – Signalling requirements for IP connection control in radio access networks Capability Set 1

ITU-T Q-series Recommendations – Supplement 43

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Supplement 43 to ITU-T Q-series Recommendations

Technical Report TRQ.2415: Transport control signalling requirements – Signalling requirements for IP connection control in radio access networks Capability Set 1

Summary

This Supplement to the Q-series of ITU-T Recommendations contains a Technical Report that specifies the general aspects of IP signalling requirements for the development of IP connection control Capability Set 1 (CS-1) in radio access networks.

This Technical Report identifies what can be viewed as the capabilities for IP signalling. In addition, it describes the essential features and models useful for the development of functional entity actions in support of IP signalling.

Source

Supplement 43 to ITU-T Q-series Recommendations was agreed on 12 September 2003 by ITU-T Study Group 11 (2001-2004).

FOREWORD

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1 Scope

This Supplement contains the signalling requirements for the IP connection signalling for the capability set 1 (CS-1) in radio access networks. They support the establishment, maintenance and clearing of virtual connections in an IP network with a common protocol, operating over the NNI signalling bearer protocol stacks. The shaded area of Figure 1 shows the scope of this Supplement.

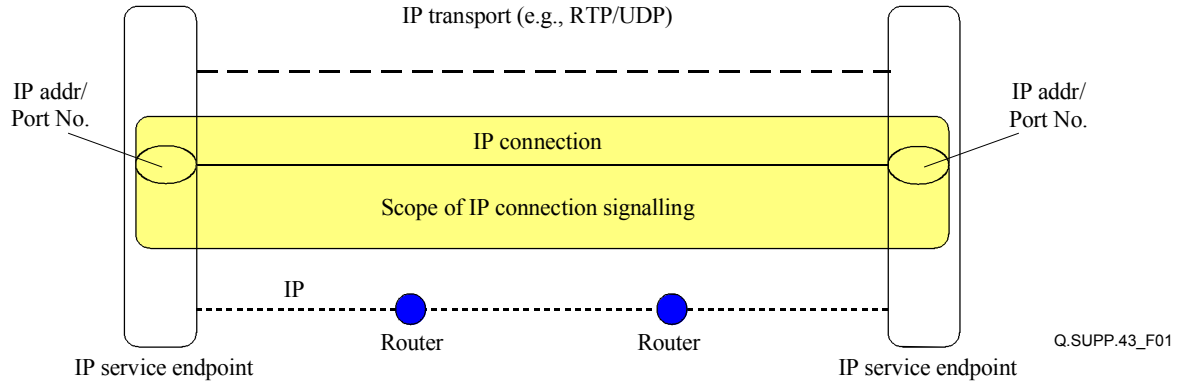

Figure 1 – Scope and definition of terms used in IP connection signalling

2 References

[1] ITU-T Q-series Recommendations – Supplement 8 (1999), *Technical Report TRQ.2400: Transport control signalling requirements – Signalling requirements for AAL Type 2 link control capability set 1*.

[2] ITU-T Q-series Recommendations – Supplement 33 (2000), *Technical Report TRQ.2401: Transport control signalling requirements – Signalling requirements for AAL Type 2 link control capability set 2*.

[3] ITU-T Recommendation I.255.4 (1990), *Community of interest supplementary services: Priority service*.

[4] IETF RFC 791 (1981), *Internet Protocol*.

[5] IETF RFC 2460 (1998), *Internet Protocol, Version 6 (IPv6) Specification*.

[6] ITU-T Recommendation X.213 (2001) | ISO/IEC 8348:2002, *Information technology – Open Systems Interconnection – Network service definition*.

[7] ITU-T Recommendation E.164 (1997), *The international public telecommunication numbering plan*.

[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 2598 (1999), *An Expedited Forwarding PHB*.

[11] IETF RFC 768 (1980), *User Datagram Protocol*.

[12] IETF RFC 3550 (2003), *RTP: A Transport Protocol for Real-Time Applications*.

[13] IETF RFC 2960 (2000), *Stream Control Transmission Protocol*.

[14] IETF RFC 3332 (2002), *SS7 MTP3-User Adaptation Layer (M3UA)*.

[15] ITU-T Recommendation Q.1902.4 (2001), *Bearer Independent Call Control protocol (Capability Set 2): Basic call procedures*.

[16] ITU-T Recommendation Q.2630.3 (2003), *AAL type 2 signalling protocol – Capability Set 3*.

[17] ITU-T Recommendation Y.1221 (2002), *Traffic control and congestion control in IP-based networks*.

3 Definitions

This Supplement defines the following terms:

3.1 IP connection: A bidirectional user plane association between two IP signalling endpoints.

3.2 IP transport protocol: A transport protocol or a combination of transport protocols operating over IP such as UDP, RTP on UDP.

3.3 IP transport packet size: Length of the payload of the topmost IP transport protocol contained in an IP packet.

3.4 IP service endpoint: A functional entity which includes the IP signalling endpoint and the IP served user.

3.5 IP served user: A user of the IP signalling protocol.

3.6 IP signalling endpoint: The termination point of an IP signalling bearer.

3.7 IP signalling protocol: Control plane functions for establishing, modifying and releasing IP connections and the associated maintenance functions.

3.8 IP sink address: Contains the IP address and port number, where the sender expects to receive U-plane information.

3.9 QoS class: A set of QoS attributes of the received and transmitted U-plane information.

4 Abbreviations

This Supplement uses the following abbreviations:

Bp	Peak Token Bucket Size associated with Rp
Bs	Sustainable Token Bucket Size associated with Rs
DBW	Dedicated Bandwidth Transfer Capability
DSCP	Differentiated Services Code Point
IP	Internet Protocol
IPTC	IP Transfer Capability
M	Maximum allowed Packet Size
M3UA	SS7 MTP3-User Adaptation Layer
NNI	Network Node Interface
QoS	Quality of Service
Rp	Peak bit rate

Rs	Sustainable bit rate
RTP	Real time Transport Protocol
SBW	Statistical Bandwidth Transfer Capability
SCTP	Stream Control Transmission Protocol
SS7 MTP-3	Signalling System No. 7, Message Transfer Part Level 3
UDP	User Datagram Protocol

5 Requirements

The IP signalling endpoint shall include mechanisms for the establishment, modification, maintenance and clearing of IP connections.

In CS-1, the IP signalling protocol shall be based on the AAL Type 2 signalling protocol CS-3 [16].

The IP signalling requirements for capability set 1 (CS-1) are provided in this clause.

5.1 IP served user generated reference

The IP signalling endpoint shall provide the transparent transfer of the IP served user generated reference to the IP served user in the forward direction in the establishment phase.

NOTE – The IP served user generated reference may include, for example, a reference to an access channel or radio link.

5.2 Called endpoint address transport

The IP signalling shall support transparent transport of the Called Address of the IP service endpoint. The IP signalling shall support multiple address formats including E.164 [7] and X.213 [6]. The IP signalling protocol shall carry an explicit indication of the address format being used.

5.3 Performance

For reasons of signalling performance in environments where mobile handovers are supported:

a) the number of messages required to establish, modify, maintain and clear IP connections should be kept to a minimum;

b) the format of information transferred between served users shall be the same as that defined in ITU-T Rec. Q.2630.3 [16];

c) the format of the IP signalling protocol information should be chosen to minimize message processing delays at the IP signalling endpoints.

5.4 Symmetry of connection control

The IP signalling protocol and procedures shall reflect a peer-to-peer (rather than a master/slave) relationship among the IP signalling endpoints. For example, both ends may request connections with the same protocol procedures.

5.5 Connection configuration

The IP signalling endpoint shall support handling of single, point-to-point IP connections.

5.6 Symmetry of information transfer capability

The IP signalling endpoint shall support asymmetric IP connections. That is, the end-to-end connections shall be bidirectional where the information transfer capability, for example, in each

direction might be different. Unidirectional IP connections can, therefore, be provided, i.e. connections, which provide zero bandwidth in one direction.

5.7 Essential features of the underlying signalling bearer

The IP signalling requirements provided in this Supplement are based upon a dependence that an underlying signalling bearer supports:

a) assured (error free) data transfer;

b) in-sequence delivery of PDUs; and

c) an indication of flow control.

5.8 Flow control

Upon receipt of a flow control indication, the IP signalling protocol shall reduce/allow increase of the connection establishment requests towards the identified signalling association.

5.9 Independence from underlying signalling bearer

The IP signalling protocol design shall be independent from the underlying signalling bearer. As an example, it shall be possible to carry the IP signalling messages over NNI signalling bearer protocol stacks. As a minimum both SCTP [13] and M3UA [14] shall be supported.

5.10 Independence from the IP served user

The IP signalling protocol and procedures shall be independent from the IP served user.

5.11 Extent of control

The scope of IP signalling responsibility is restricted to control of IP connections. In particular, the appropriate IP resources must be present before an IP connection can be established.

5.12 Information transfer capability and QoS requirements

An IP connection is characterized by its information transfer capability and its QoS class. A default information transfer capability and default QoS class shall be supported. The definition of IP information transfer capability and QoS classes are beyond the scope of this Supplement.

5.13 Contention resolution

The IP signalling endpoint shall be able to resolve all contentions with respect to resource allocation and collisions when establishing and modifying IP connections.

5.14 Error reporting

The IP signalling endpoint shall include mechanisms for detecting and reporting signalling procedural errors or other failures detected by the IP signalling endpoint to IP management. Service failures may also be reported to the IP served user.

5.15 Unrecoverable failures

The IP signalling endpoint shall include mechanisms for returning the IP protocol instance to a stable state after detection of unrecoverable failures.

5.16 Forward and backward compatibility

The IP signalling protocol shall include a forward compatibility mechanism and backward compatibility rules.

5.17 Parameters and values for IP connections

IP signalling endpoint shall support IP address and port number as specified in IP V4 [4] and V6 [5], additionally IP QoS according to Differentiated Services Code Point (DSCP) values as specified in RFC 2474 [8], RFC 2597 [9] and RFC 2598 [10].

5.18 IP transfer capabilities

Signalling support for IP transfer capabilities shall be included.

Signalling of an IP transfer capability shall be mandatory at set-up for each IP connection.

The IP transfer capabilities (IPTC) with their respective set of parameters, as identified in Tables 5-1 and 5-2, shall be supported.

Table 5-1 – Dedicated Bandwidth (DBW) transfer capability

Parameter	Semantics	Maximum value
Rp (Note)	Peak bit rate in bits per second	16 Mbit/s
Bp (Note)	Peak token bucket size associated with Rp in octets	1500 octets
M (Note)	Maximum allowed packet size in octets	1500 octets
NOTE – The total length of the IP packet, i.e. including all header bytes, has to be taken into account for the computation of this value.		

Table 5-2 – Statistical Bandwidth (SBW) transfer capability

Parameter	Semantics	Maximum Value
Rp (Note 1)	Peak bit rate in bits per second	16 Mbit/s
Bp (Note 1)	Peak token bucket size associated with Rp in octets	1500 octets
Rs (Notes 1 and 2)	Sustainable bit rate in bits per second	16 Mbit/s
Bs (Note 1)	Sustainable token bucket size associated with Rs in octets	3200 octets
M (Note 1)	Maximum allowed packet size in octets	1500 octets
NOTE 1 – The total length of the IP packet, i.e. including all header bytes, has to be taken into account for the computation of this value. NOTE 2 – Rs is always less than or equal to Rp.		

Modification of IP transfer capabilities shall be supported with respect to the IP transfer capability that is used initially at connection set-up.

5.19 Served user transport information

The IP signalling endpoint shall transport served user transport information between originating and terminating IP served users during the connection establishment phase. If the originating IP served user generates this information optionally it may be conveyed transparently to the terminating IP served user.

5.20 Support of IP transport types

The IP signalling endpoints shall support at least one of the following IP transport types:

- UDP [11];
- RTP [12] on UDP [11].

The same IP transport type shall apply to both forward and backward IP flows within an IP connection. The IP signalling protocol shall carry an explicit indication of the IP transport type being used.

5.21 Connection resource modification

Either IP served user may be able to modify the resources associated with an active IP connection, represented by the information contained in the IP connection characteristics.

Modification shall be performed with no loss of IP transport contents.

The use of the preferred IP transfer capability is to avoid the need of a subsequent modification of the connection resources immediately after the connection establishment.

The support/lack of support of the capability to modify IP connection characteristics, for an IP connection, must be indicated by the originating IP service endpoint. The terminating IP service endpoint must indicate the support/lack of support of the modification capability of the IP connection characteristics. Only when both endpoints indicate support, can the capability be supported.

This capability uses the following objects:

– IP transfer capability modification support request;

– IP transfer capability modification support response.

5.22 Priority service

The priority service specified in ITU-T Rec. I.255.4 [3] shall be supported. Five levels of priority are required to be supported.

5.23 Automatic congestion control

Signalling support for the automatic congestion control function shall be included.

The same functionality as supported in 12.8/Q.1902.4 [15] shall be supported.

6 Architecture of IP signalling

A generic "Signalling Bearer Converter" has been defined as a base upon which the IP signalling can be deployed. This "Signalling Bearer Converter" entity maps a set of generic service layer-to-layer service primitives into one of the sets of layer-to-layer service primitives supported by the underlying signalling bearer. These relations are depicted in Figure 2.

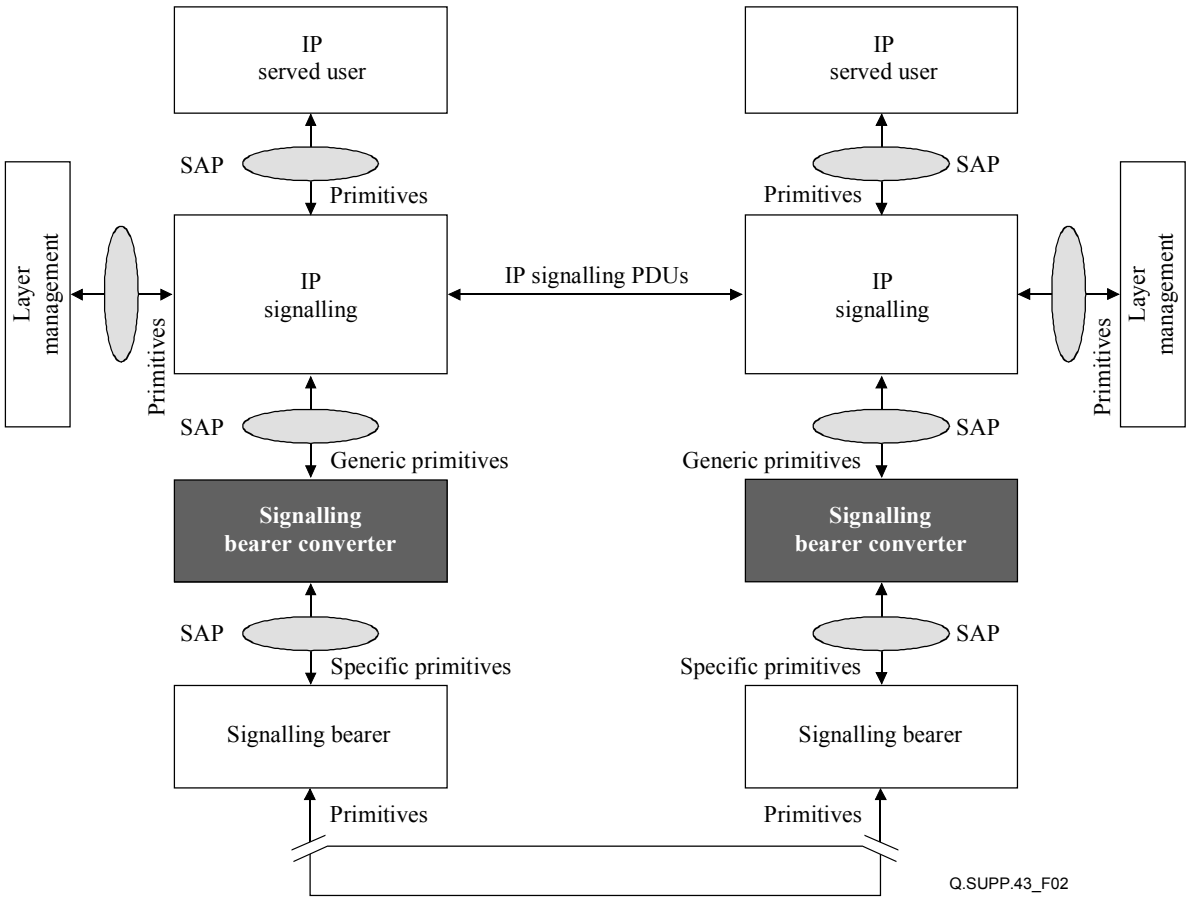

Figure 2 – Generic signalling bearer protocol stack

In Figure 3, the situation with various signalling bearer options is shown. The IP signalling endpoint relies on a generic signalling bearer service (represented with the generic primitives). Any protocol stack that provides this generic signalling bearer service is allowed.

"Signalling Bearer Converter" operations may include:

- Passing parameters from the generic primitives to the specific primitives and vice versa;
- Adding parameters to specific primitives issued and ignoring parameters from specific primitives received;
- Issuing specific primitives upon receiving specific primitives without any action on the generic interface, etc.

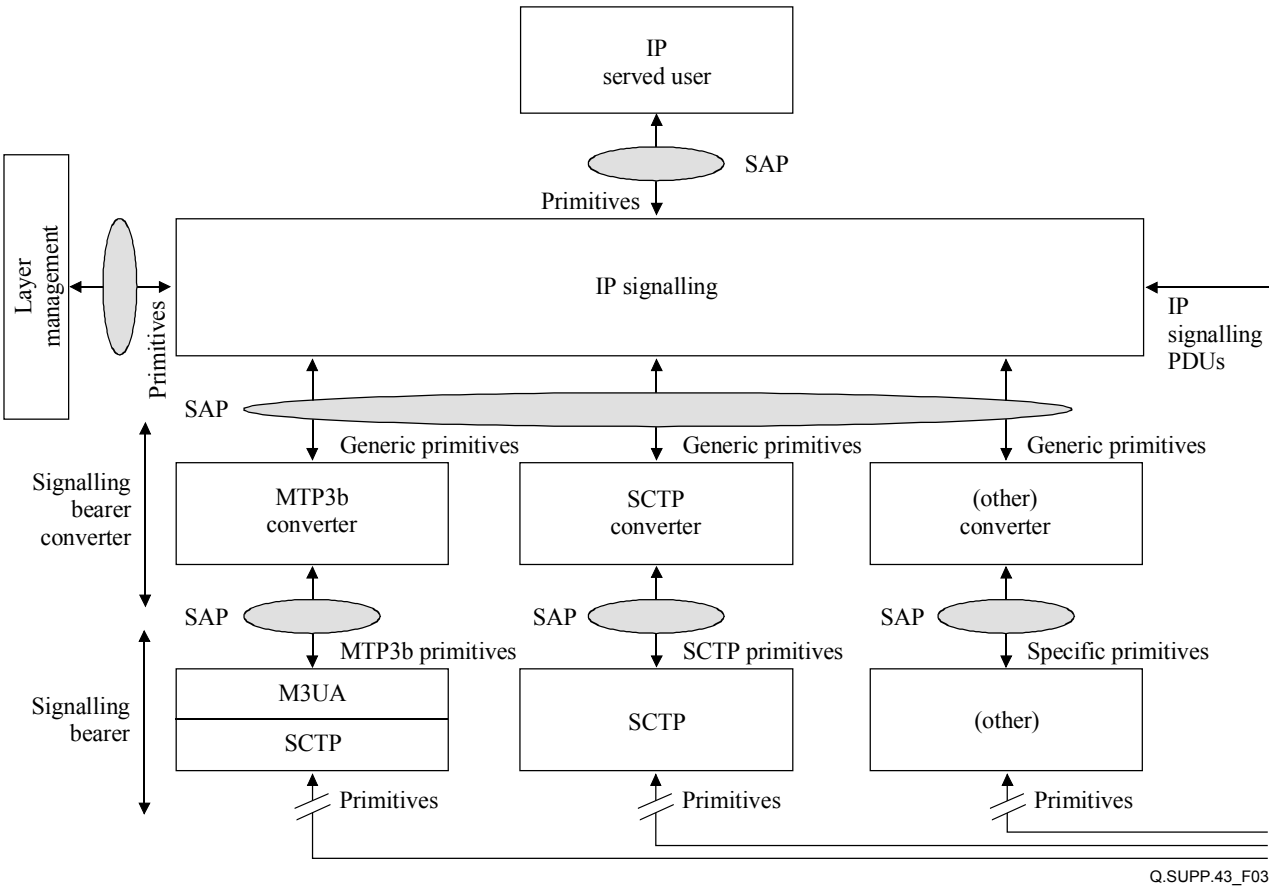

Figure 3 – IP signalling bearer protocol stack options

7 IP signalling flows

The following diagrams illustrate the establishment (successful and unsuccessful), connection resource modification (successful and unsuccessful) and release of an IP connection.

7.1 Successful IP connection establishment information flows

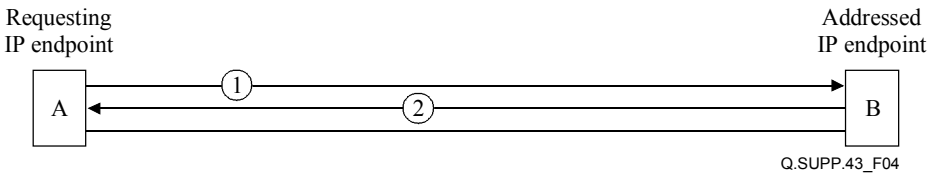

Figure 4 – Successful IP connection establishment information flows

The flows illustrated in Figure 4 are as follows:

1	**IP Setup-Request.ready**	**Requesting endpoint to addressed endpoint**
	User information	**Connection information**
	Served user generated reference	IP Transfer Capability
	Served user transport information	IP Preferred Transfer Capability (optional)
	Called Endpoint Address Transport	IP Transfer Capability Modification Support Request
		QoS Class
		IP Transport Type
		IP Sink Address of A
		Priority Indicator

Initiation of information flow: The requesting IP service endpoint starts to establish an IP network connection.

Processing upon receipt: The addressed IP service endpoint assures that enough resources in the IP service endpoint remain for the new IP network connection. It then issues Information Flow 2 to confirm the establishment. Finally, the IP served user is informed about the establishment of the new IP network connection.

2	**IP Setup-Request.commit**	**Addressed endpoint to requesting endpoint**
	User information	**Connection information**
	(none)	IP Transfer Capability Modification Support Response
		IP Sink Address of A
		IP Sink Address of B

Processing upon receipt: The requesting IP service endpoint informs the IP served user about the completion of the requested IP network connection establishment.

7.2 Unsuccessful IP connection establishment information flows

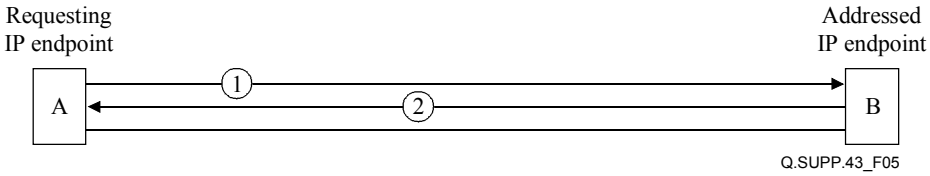

Figure 5 – Unsuccessful IP connection establishment information flows

The flows illustrated in Figure 5 are as follows:

1	**IP Setup-Request.ready**	**Requesting endpoint to addressed endpoint**
	User information	**Connection information**
	Served user generated reference = 1	IP Transfer Capability
	Served user transport information	IP Preferred Transfer Capability (optional)
	Called Endpoint Address Transport	IP Transfer Capability Modification Support Request
		QoS Class
		IP Transport Type
		IP Sink Address of A
		Priority Indicator

Initiation of information flow: The requesting IP service endpoint starts to establish an IP network connection.

Processing upon receipt: The addressed IP service endpoint fails to secure enough resources to carry the IP network connection to be established: the establishment has to be cancelled. The addressed IP service endpoint then releases all resources already committed to the new IP network connection and issues Information Flow 2 informing the requesting IP service endpoint that the congestion threshold has been reached (if applicable).

2	**IP Setup-Request.cancel**	**Addressed endpoint to requesting endpoint**
	User information	**Connection information**
	(none)	IP Sink Address of A
		Congestion Indication

Processing upon receipt: The requesting IP service endpoint releases all resources already committed to the new IP network connection and informs the IP served user about the cancellation of the requested IP network connection establishment; it also notes that the congestion threshold has been reached (if applicable) in the addressed IP service endpoint and reduces the number of new connection establishment requests sent to that IP service endpoint.

7.3 IP connection release information flows

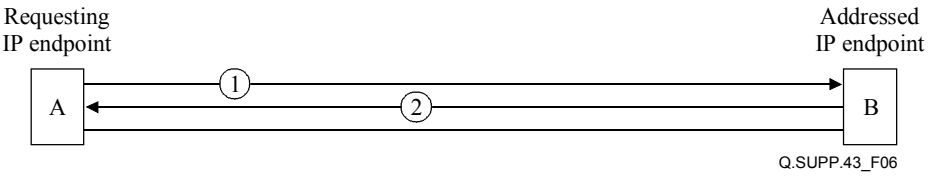

Figure 6 – IP connection release information flows

The flows illustrated in Figure 6 are as follows:

1	**IP Release-Request.ready**	**Requesting endpoint to addressed endpoint**
	User information	**Connection information**
	(none)	IP Sink Address of A
		Congestion Indication

Initiation of information flow: The requesting IP service endpoint starts to release an IP network connection and informs the addressed IP service endpoint that the congestion threshold has been reached (if applicable).

Processing upon receipt: The addressed IP service endpoint releases all resources committed to the IP network connection, issues Information Flows 2 to confirm the release, and informs the IP served user about the release of the IP network connection. It also notes that the congestion threshold has been reached (if applicable) in the requesting IP service endpoint and reduces the number of new connection establishment requests sent to that IP service endpoint.

2	**IP Release-Request.commit**	**Addressed endpoint to requesting endpoint**
	User information	**Connection information**
	(none)	IP Sink Address of A

Processing upon receipt: The requesting IP service endpoint releases all remaining resources committed to the IP network connection and confirms the release to the IP served user.

7.4 Successful IP connection resource modification information flows

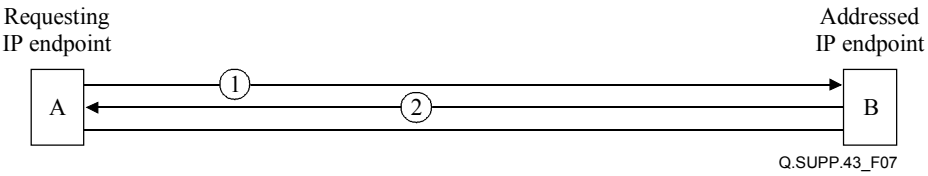

Figure 7 – Successful IP connection resource modification information flows

The flows illustrated in Figure 7 are as follows:

1	**IP Modify-Request.ready**	**Requesting endpoint to addressed endpoint**
	User information	**Connection information**
	(none)	IP Sink Address of A
		IP Connection Characteristics

Initiation of information flow: The requesting IP service endpoint starts to modify the IP connection characteristics.

Processing upon receipt: The addressed IP service endpoint assures that the resources for the modified IP transfer capability are available, and allocate the resources. It then issues Information Flow 2 to confirm the modification. Finally, the IP served user is informed about the modification of the IP connection characteristics.

2	**IP Modify-Request.commit**	**Addressed endpoint to requesting endpoint**
	User information	**Connection information**
	(none)	IP Sink Address of A

Processing upon receipt: The requesting IP service endpoint allocates the reserved resources and then informs the IP served user about the completion of the requested IP connection resource modification.

7.5 Unsuccessful IP connection resource modification information flows

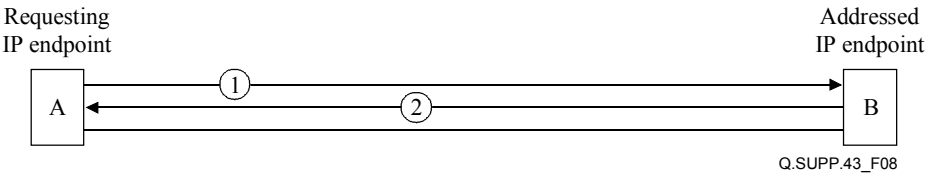

Figure 8 – Unsuccessful IP connection resource modification information flows

The flows illustrated in Figure 8 are as follows:

1	**IP Modify-Request.ready**	**Requesting endpoint to addressed endpoint**
	User information	**Connection information**
	(none)	IP Sink Address of A
		IP Connection Characteristics

Initiation of information flow: The requesting IP service endpoint starts to modify the IP connection characteristics.

Processing upon receipt: The addressed IP service endpoint attempts to reserve enough resources for the modified IP connection characteristics; however, enough resources to carry the modified IP connection are not available: the modification has to be cancelled. The switching node then retains the IP connection as it was, and issues Information Flow 2.

2	**IP Modify-Request.cancel**	**Addressed endpoint to requesting endpoint**
	User information	**Connection information**
	(none)	IP Sink Address of A

Processing upon receipt: The requesting IP service endpoint cancels all resources reserved for the modification request, retains the IP connection as it was, and informs the IP served user about the unsuccessful requested IP connection resource modification.

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