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Amendment 1
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SERIES Q: SWITCHING AND SIGNALLING

Broadband ISDN – Signalling ATM adaptation layer
(SAAL)

B-ISDN ATM adaptation layer – Service specific
connection oriented protocol in a multilink and
connectionless environment (SSCOPMCE)

Amendment 1

ITU-T Recommendation Q.2111 – Amendment 1

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B-ISDN ATM adaptation layer – Service specific connection oriented protocol in a multilink and connectionless environment (SSCOPMCE)

AMENDMENT 1

Summary

Recommendation Q.2111 provides assured data delivery between AAL connection endpoints in a multilink or a connectionless environment. This amendment has been prepared to allow operation over additional types of connectionless lower layer protocols and is designed to be compatible with implementations conforming to that first edition of Recommendation Q.2111 (1999).

The changes from Recommendation Q.2111 (1999) specify operation of SSCOPMCE over additional connectionless lower layers than the original publication of Q.2111 (1999). Specifically, the additional connectionless environments are:

- IP, as modified by Differentiated Services in IETF RFC 2474; and
- Ethernet, as defined in ISO/IEC 8802.3.

This amendment supersedes the Implementor's Guide published in December 2000.

Source

Amendment 1 to ITU-T Recommendation Q.2111 was prepared by ITU-T Study Group 11 (2001-2004) and approved under the WTSA Resolution 1 procedure on 13 July 2001.

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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ITU-T Recommendation Q.2111

B-ISDN ATM adaptation layer – Service specific connection oriented protocol in a multilink and connectionless environment (SSCOPMCE)

AMENDMENT 1

Replace clauses 2 and C.1 and modify clauses 5 and 7.3.3 with the text presented in this Amendment. The differences from ITU-T Recommendation Q.2111 (1999) for these sections are marked to emphasize the compatibility of this Amendment with the original publication of this Recommendation.

Enhance clause 4 with the additional abbreviations presented in this Amendment.

Add new Annexes D (Convergence function for SSCOPMCE above IP or UDP with Differentiated Services) and E (Convergence Function for SSCOPMCE Above Ethernet)

Replace Appendix I by the Appendix I provided in this amendment.

The additional and modified text follows.

1) Clause 2

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.

- [1] ITU-T X.200 (1994), *Information technology – Open Systems Interconnection – Basic Reference Model: The basic model.*
- [2] ITU-T X.210 (1993), *Information technology – Open Systems Interconnection – Basic Reference Model: Conventions for the definition of OSI services.*
- [3] ITU-T I.150 (1999), *B-ISDN asynchronous transfer mode functional characteristics.*
- [4] ITU-T I.361 (1999), *B-ISDN ATM layer specification.*
- [5] ITU-T I.363.5 (1996), *B-ISDN ATM Adaptation Layer specification: Type 5 (AAL).*
- [6] ITU-T Q.2110 (1994), *B-ISDN ATM adaptation layer – Service specific connection oriented protocol (SSCOP).*
- [7] IETF RFC 768 (1980), *User Datagram Protocol.*
- [8] IETF RFC 791 (1981), *Internet Protocol.*
- [9] IETF RFC 792 (1981), *Internet Control Message Protocol.*
- [10] IETF RFC 1122 (1989), *Requirements for Internet Hosts – Communication Layers.*
- [10 bis] IETF RFC 2474 (1998), *Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers.*

[10 ter] ISO/IEC 8802-3:2000, Information technology – Telecommunications and information exchange between systems – Local metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection CSMA/CD access method and physical layer specifications.

2.2 Bibliography

The documents listed in this clause provide informative background information for the reader and are not normative within this Recommendation.

- [11] ITU-T Q.2100 (1994), *B-ISDN signalling ATM adaptation layer (SAAL) – Overview description.*
- [12] ITU-T Q.2130 (1994), *B-ISDN signalling ATM adaptation layer – Service specific coordination function for support of signalling at the user-to-network interface (SSCF at UNI).*
- [13] ITU-T Q.2140 (1995), *B-ISDN ATM adaptation layer – Service specific coordination function for signalling at the network node interface (SSCF at NNI).*
- [14] ITU-T I.365.2 (1995), *B-ISDN ATM adaptation layer sublayers: Service-specific coordination function to provide the connection-oriented network service.*
- [15] ITU-T I.365.3 (1995), *B-ISDN ATM adaptation layer sublayers: Service-specific coordination function to provide the connection-oriented transport service.*
- [16] ITU-T I.363.2 (2000), *B-ISDN ATM Adaptation Layer specification: Type 2 AAL.*
- [17] ITU-T I.366.1 (1998), *Segmentation and Reassembly Service Specific Convergence Sublayer for the AAL Type 2.*
- [18] ITU-T Q.2119 (1996), *B-ISDN ATM adaptation layer – Convergence function for SSCOP above the frame relay core service.*
- [19] IETF RFC 2475 (1998), An Architecture for Differentiated Services.
- [20] ISO/IEC 8802-2:1998, Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical link control.
- [21] ISO/IEC 15802-3:1998, Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Common specifications – Part 3: Medium Access Control (MAC) Bridges.
- [22] IEEE 802.1Q (1998), IEEE Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks.

2) Clause 4

4 Abbreviations

Add the following list of abbreviations, alphabetically, to those already contained in clause 4:

CFI	Canonical Format Indicator
CPCS-CI	Common Part Convergence Sublayer Congestion Indication
CPCS-LP	Common Part Convergence Sublayer Loss Priority
CPCS-RS	Common Part Convergence Sublayer Reception Status
CPCS-UU	Common Part Convergence Sublayer User-to-User Indication
CPI	Common Part Indicator

CRC	Cyclic Redundancy Check
CSMA/CD	Carrier Sense Multiple Access with Collision Detection
CU	Currently Unused
DF	Don't Fragment
DS	Differentiated Services
DSCP	Differentiated Services Codepoint
FCS	Frame Check Sequence
FO	Fragment Offset
ICMP	Internet Control Message Protocol
ID	Identification
IDU	Interface Data Unit
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IHL	Internet Header Length
ISO	International Organization for Standardization
LAN	Local Area Network
LLC	Logical Link Control
LSRR	Loose Source and Record Route
MAC	Medium Access Control
MF	More Fragments
NCFI	Non-Canonical Format Indicator
PROT	Protocol
PVID	Port Virtual LAN identifier
RFC	Request For Comment
RIF	Routing Information Field
RR	Record Route
SFD	Start Frame Delimiter
SNAP	Sub-Network Access Protocol Identifier
SSRR	Strict Source and Record Route
TCI	Tag Control Information
TCP	Transmission Control Protocol
TL	Total Length
TOS	Type Of Service
TTL	Time To Live
VID	Virtual LAN Identifier
VLAN	Virtual LAN

3) **Clause 5.3**

5 General

Modify the paragraph immediately following Figure 2 as follows:

A representation of SSCOPMCE operating in a connectionless environment is shown in Figure 3. In this mode the SSCOPMCE entity operates more like a transport layer protocol and is clearly outside the scope of an AAL. Through the lower Service Access Point (SAP), a connectionless service, such as IP (IETF RFC 791 [8]) or UDP (IETF RFC 768 [7]), delivers SSCOPMCE PDU payload fragments for delivery to the user of the SSCOPMCE entity and accepts SSCOPMCE PDUs for transfer to the peer user. ~~Annex C describes the mapping of primitives across this SAP with IP and UDP.~~ Annexes C and D describe the mapping of primitives across this SAP with IP and UDP; Annex C covers legacy IP networks while Annex D covers IP networks that support differentiated services. Annex E covers operation over an Ethernet databus.

...

4) **Clause 7.3.3**

Modify as follows:

7.3.3 Connectionless environment

The signals defined in this subclause were originally defined for the ATM adaptation layer environment; they bear little resemblance to any known connectionless environment. For such environments a convergence function is needed (this is to a large extent a modelling artifact). Such functions for IP or UDP based communications ~~is~~are defined in Annexes C and D ~~to this recommendation.~~

5) **Clause C.1**

Modify as follows:

C.1 General description

The convergence function for SSCOPMCE above IP provides for the possibility to deploy SSCOPMCE on top of the connectionless service provided by IP. The IP service utilises protocol defined in IETF RFCs 791 [8] and 1122 [10]. Alternatively, UDP service, as defined in IETF RFC 768 [7], may be used. Both alternatives are discussed in this annex.

All protocol stacks that include SSCOPMCE can, therefore, also be used in an IP-based networks. A particular application of this arrangement is a protocol stack for SS No. 7 signalling.

NOTE – The convergence function of this annex, being based upon IETF RFC 791 [8], is designed specifically for operation with IPv4. If use is desired of an application, e.g. the "Differentiated Services" defined in IETF RFC 2475 [19], which IETF defined "DIFFSERV", that is not compatible with IETF RFC 791 [8], then this annex is not applicable; ~~for the application of "Differentiated Services" see Annex D;~~ for the application of "Differentiated Services" see Annex D.

6) Annexes D and E

Add new Annexes D and E:

ANNEX D

Convergence function for SSCOPMCE above IP or UDP with Differentiated Services

D.1 General description

The convergence function for SSCOPMCE above IP provides for the possibility to deploy SSCOPMCE on top of the connectionless service provided by IP. The IP service utilizes protocol defined in IETF RFCs 791 [8] and 1122 [10]. In addition, the Differentiated Services Field is defined in IETF RFC 2474 [10 *bis*]. Alternatively, UDP service, as defined in IETF RFC 768 [7], may be used. Both alternatives are discussed in this annex.

NOTE – The architecture of the differentiated service is described in IETF RFC 2475 [19].

All protocol stacks that include SSCOPMCE can, therefore, also be used in IP-based networks that deploy the differentiated service. A particular application of this arrangement is a protocol stack for SS No. 7 signalling.

D.2 Functions of the convergence function

The purpose of the convergence function is to map information between SSCOPMCE and IP (or UDP) PDUs. Appropriate headers must be created as is customarily done in the IP (or UDP) environment.

D.3 Specification of the convergence function

Clause 7.3 defines the primitives and parameters used at the lower boundary of the SSCOPMCE protocol entity. It shows that the parameters of the CPCS-UNITDATA.invoke primitive are used to model the transfer of information from SSCOPMCE protocol entity to the entity serving it. It also shows that the parameters of the CPCS-UNITDATA.signal primitive are used to model the transfer of information from the entity serving the SSCOPMCE protocol entity to that SSCOPMCE protocol entity.

D.3.1 The IP interface to its users

D.3.1.1 Description of the IP upper interface

The user interface to the IP is described by example in IETF RFC 791 [8] in a quasi-formal way through the exchange of "SEND" and "RECEIVE" primitives (although the language is modelled on descriptions of function calls in an operating system). All IP implementations must provide a certain minimum set of services to guarantee that all IP implementations can support the same protocol hierarchy.

Since Internet protocol is a datagram protocol, there is minimal memory or state maintained between datagram transmissions, and each call on the Internet protocol module by the user supplies all information necessary for the IP to perform the service requested.

When the user sends a datagram, it transmits the SEND primitive, supplying all the arguments. The Internet protocol module, on receiving this primitive, checks the arguments and prepares and sends the message. If either the arguments are bad, or the network does not accept the datagram, a reasonable report must be made to the user as to the cause of the problem, but the details of such reports are up to individual implementations.

When a datagram arrives at the Internet protocol module from the network, the information contained in the datagram is passed from the datagram to the user. If the user addressed does not

exist, an ICMP error message is returned to the sender and the data is discarded, as described in IETF RFCs 792 [9] and 1122 [10].

IETF RFC 791 [8] defines the contents of the IP packet header as shown in Figure D.1.

0										1										2										3									
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1								
Version				IHL			Type of Service								Total length																								
Identification															Flags			Fragment Offset																					
Time to Live								Protocol								Header Checksum																							
Source Address																																							
Destination Address																																							
Options																								Padding															

Figure D.1/Q.2111 – Example Internet Datagram Header

The fields of the header shown in Figure D.1 are defined in RFC 791 [8] as follows:

Version (4 bits)

The Version field indicates the format of the Internet header.

IHL (4 bits)

Internet Header Length is the length of the Internet header in 32 bit words, and thus points to the beginning of the data. Note that the minimum value for a correct header is 5.

Type of Service (8 bits)

When IPv4 is deployed on a network supporting the differentiated services, this field is used as the differentiated services field (DS field) as defined in IETF RFC 2474 [10 *bis*]. The DS field structure is defined as follows:

0	1	2	3	4	5	6	7
DSCP						CU	

DSCP: Differentiated Services Codepoint

Six bits of the DS field are used as a codepoint (DSCP) to select the per-hop behaviour a packet experiences at each node.

CU: Currently Unused

A two-bit currently unused (CU) field is reserved and its definition and interpretation are outside the scope of this Recommendation. The value of the CU bits are ignored by differentiated services-compliant nodes when determining the per-hop behaviour to apply to a received packet.

A specification of the packet forwarding treatments selected by the DS field values of "xxx000|xx", or DSCP = "xxx000" and CU subfield unspecified, are reserved as a set of Class Selector Codepoints. per-hop behaviours which are mapped to by these codepoints MUST satisfy the Class Selector per-hop behaviour requirements in addition to preserving the default per-hop behaviour requirement on codepoint "000000". In IETF RFC 2474 [10 *bis*], the meaning of the "Class Selector Codepoint" is defined as follows:

To preserve partial backwards compatibility with known current uses of the IP Precedence field without sacrificing future flexibility, we have taken the approach of describing minimum requirements on a set of per-hop behaviours that are compatible with most of the deployed forwarding treatments selected by the IP Precedence field. In addition, we give a set of codepoints that **MUST** map to per-hop behaviours meeting these minimum requirements. The per-hop behaviours mapped to by these codepoints **MAY** have a more detailed list of specifications in addition to the required ones stated here. Other codepoints **MAY** map to these same per-hop behaviours. We refer to this set of codepoints as the Class Selector Codepoints, and the minimum requirements for per-hop behaviours that these codepoints may map to are called the Class Selector per-hop behaviour Requirements.

The Precedence Field is defined in IETF RFC 791 [8] as follows:

Precedence

111	Network Control
110	Internetwork Control
101	CRITIC/ECP
100	Flash Override
011	Flash
010	Immediate
001	Priority
000	Routine

Total Length (16 bits)

Total Length is the length of the datagram, measured in octets, including Internet header and data. This field allows the length of a datagram to be up to 65 535 octets.

NOTE – The maximal Internet header is 60 octets, and a typical Internet header is 20 octets.

Identification (16 bits)

An identifying value assigned by the sender to aid in assembling the fragments of a datagram.

Flags (3 bits)

Various Control Flags.

- Bit 0 reserved, must be zero
- Bit 1 (DF) 0 = May Fragment, 1 = Don't Fragment.
- Bit 2 (MF) 0 = Last Fragment, 1 = More Fragments.

Fragment Offset (13 bits)

This field indicates where in the datagram this fragment belongs. The fragment offset is measured in units of 8 octets (64 bits). The first fragment has offset zero.

Time to Live (8 bits)

This field indicates the maximum time the datagram is allowed to remain in the Internet system. If this field contains the value zero, then the datagram must be destroyed by an intermediate host (but not by the destination host). This field is modified in Internet header processing. The time is measured in units of seconds, but since every module that processes a datagram must decrease the TTL by at least one, even if it processes the datagram in less than a second, the TTL must be thought of only as an upper bound on the time a datagram may exist. The intention is to cause undeliverable datagrams to be discarded, and to bound the maximum datagram lifetime.

Protocol (8 bits)

This field indicates the next level protocol used in the data portion of the Internet datagram. The values for various protocols are specified by the IETF. The numeric value for SSCOPMCE is "128".

Header Checksum (16 bits)

A checksum on the header only. Since some header fields change (e.g. time to live), this is recomputed and verified at each point that the Internet header is processed.

The checksum field is the 16 bit one's complement of the one's complement sum of all 16 bit words in the header. For purposes of computing the checksum, the value of the checksum field is zero.

Source Address (32 bits)

The source address. See 3.2/IETF RFC 791 [8].

Destination Address (32 bits)

The destination address. See 3.2/IETF RFC 791 [8].

Options (variable)

The options may appear or not in datagrams. They must be implemented by all IP modules (host and gateways). What is optional is their transmission in any particular datagram, not their implementation.

In some environments the security option may be required in all datagrams.

The option field is variable in length. There may be zero or more options. The specific coding of the options field may be found in IETF RFC 791 [8].

D.3.1.2 Transmitter Side Mapping

Figure D.2 shows the Service Data Unit and Parameters passed between the SSCOPMCE/Convergence Function and the IP layer at the transmitting side. In this figure, it can be seen that the relevant fields of the IP packet header should be coded as shown in Table D.1.

D.3.1.3 Receiver Side Mapping

Figure D.3 shows the Service Data Unit and Parameters passed between SSCOPMCE/Convergence Function and the IP layer at the receiving side.

Table D.1/Q.2111 – Transmitter side mapping

Version	(Note 1)	
Internet Header Length (IHL)	(Note 1)	
Differentiated Services Field (Note 5)	00000000	If "Cell Loss Priority" = 1
	(Note 6)	If "Cell Loss Priority" = 0
Total Length (TL)	(Note 1)	
Identification	(Note 2)	
Flags	000	May fragment; last fragment
	001	May fragment; more fragments
Fragment Offset	(Note 1)	
Time to Live (TTL)	(Note 2)	
Protocol (PROT)	(Note 2)	"128"
IP Header Checksum	(Note 1)	
Source Address	(Note 2)	the IP address of the source node
Destination Address	(Note 2)	the IP address of the destination node
Options	(Note 1)	(Note 4)
Data	(Note 3)	1 to (65 535 – IHL)
NOTE 1 – Coding of this parameter is handled by the IP module using guidance provided in IETF RFC 791 [8]. NOTE 2 – Coding of this parameter is handled by the convergence function using the rules specified in IETF RFC 791 [8]. NOTE 3 – The SSCOP-PDU is appended with the CPCS-PDU trailer, coded as specified in ITU-T I.363.5 [5]. NOTE 4 – For the purpose of this Recommendation, the user options "Loose Source and Record Route," "Strict Source and Record Route," "Record Route," and "~~Timestamp~~ <u>Timeshare</u>" apply. Other user options shall not be used and shall be silently ignored when received (see IETF RFC 1122 [10] section 3.2.1.8). It should be noted that the options "No Operation" (Type 1) and "End of List" (Type 0) are to be handled within the IP module; therefore, they are not passed to the transport layer. NOTE 5 – A replacement header field, called the DS field, is defined, which is intended to supersede the existing definitions of the IPv4 TOS octet (see RFC 791 [8]). NOTE 6 – This field should be set to a value representing the quality equal to "Cell Loss Priority = 0". Therefore, the first three bits should be greater than "000", e.g. "11100000" in a network where it is appropriate.		