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SERIES Q: SWITCHING AND SIGNALLING

Specifications of Signalling System No. 7 – Q3 interface

Lower layer protocol profiles for the Q3 and X interfaces

ITU-T Recommendation Q.811

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION Q.811

LOWER LAYER PROTOCOL PROFILES FOR THE Q3 AND X INTERFACES

Summary

This Recommendation provides the lower layer protocol profiles for the Q3 and X interfaces as defined in Recommendation M.3010. It also provides a method for interworking.

Source

ITU-T Recommendation Q.811 was revised by ITU-T Study Group 11 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 5th of June 1997.

Keywords

DCN, ISDN, NSAP and Interworking, Protocol Profiles, Q3 Interface, TMN, X Interface, X.25.

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 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, the ITU had/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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LOWER LAYER PROTOCOL PROFILES FOR THE Q3 AND X INTERFACES

(revised in 1997)

1 Introduction

1.1 Scope

This Recommendation is a part of a series of Recommendations dealing with the transfer of information for the management of telecommunications systems. This Recommendation defines the requirements of lower layer protocol profiles for the Q3 and X interfaces[1], as defined in Recommendation M.3010 [1] and in other M.3000-Series Recommendations. The companion Recommendation Q.812 [2] defines the requirements of the upper layer protocol profiles for the Q3 and X interfaces. The Q3 and X interfaces will support bidirectional data transfer for the management of telecommunications systems.

The need for security functionality is recognized, but is not fully addressed in this Recommendation and is for further study. Users may need to use mechanisms outside this Recommendation in order to address their specific security needs. Security mechanisms chosen may depend on the network configuration being used.

If new operational requirements are developed that imply distinctions need to made here between the Q3 and X interfaces, future versions of this Recommendation, or possibly new Recommendations, will reflect these differences.

This Recommendation describes several Protocol Profiles that provide the Open Systems Interconnection (OSI) Connection-mode Transport Service (COTS) to the OSI upper layer protocols.

In addition, this Recommendation specifies OSI-based mechanisms for interworking (where they exist) among the Protocol Profiles defined in this Recommendation.

Specifically, this Recommendation defines:

– the layer service profiles for the defined supported networks;

– the layer protocol profiles for the defined supported networks;

– the requirements at the layer 3/layer 4 service boundary for any network used to support the Q3 and X interfaces of the TMN;

– the means of OSI-based interworking between the supported networks;

– an internetworking protocol that can be used for interworking if appropriate convergence functions exist or are defined.

This Recommendation conforms to the "T" profiles in framework for International Standardized Profiles (ISP) as specified in ISO/IEC TR 10000-1 [64] and ISO/IEC TR 10000-2 [65]. Profiles in this Recommendation align with equivalent ISPs (as specified in conformance clause) if available. It is the intention to align those profiles for which there are no equivalent ISPs at present to ISPs as they are standardized by ISO SGFS.

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[1] This protocol is also applicable to the Qx interface when a full seven layer stack is required.

1.2 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, all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendation and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] CCITT Recommendation M.3010 (1992), *Principles for a telecommunications management network.*

[2] ITU-T Recommendation Q.812 (1997), *Upper layer protocol profiles for the Q3 and X interfaces.*

[3] ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic reference model: The basic model.*

[4] ISO/IEC 8802-3:1996, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) – Access method and physical layer specifications.*

[5] ISO/IEC 8802-2:1994, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical link control.*

[6] CCITT Recommendation X.213 (1992) | ISO/IEC 8348:1993, *Information technology – Open Systems Interconnection – Network service definition.*

[7] ITU-T Recommendation X.233 (1993) | ISO/IEC 8473-1:1994, *Information technology – Protocol for providing the connectionless-mode network service: Protocol specification.*

[8] ISO/IEC 8473-2:1996, *Information technology – Protocol for providing the connectionless-mode network service, Part 2: Provision of the underlying service by an ISO/IEC 8802 subnetwork.*

[9] ITU-T Recommendation X.622 (1994) | ISO/IEC 8473-3:1995, *Information technology – Protocol for providing the connectionless-mode network service: Provision of the underlying service by an X.25 subnetwork.*

[10] ITU-T Recommendation X.623 (1994) | ISO/IEC 8473-4:1995, *Information technology – Protocol for providing the connectionless-mode network service: Provision of the underlying service by a subnetwork that provides the OSI data link service.*

[11] ITU-T Recommendation X.625 (1996) | ISO/IEC 8473-5:1996, *Information technology – Protocol for providing the connectionless-mode network service: Provision of the underlying service by ISDN circuit-switched B-channels.*

[12] ITU-T Recommendation X.25 (1996), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.*

[13] ISO/IEC 7776:1995, *Information technology – Telecommunications and information exchange between systems – High-level data link control procedures – Description of the X.25 LAPB-compatible DTE data link procedures.*

[14] ISO/IEC 8880-3:1990, *Information technology – Telecommunications and information exchange between systems – Protocol combinations to provide and support the OSI Network Service – Part 3: Provision and support of connectionless-mode Network Service.*

[15] ISO 8648:1988, *Information processing systems – Open Systems Interconnection – Internal organization of the Network Layer*.

[16] ISO/IEC 8208:1995, *Information technology – Data communications – X.25 Packet layer Protocol for Data Terminal Equipment*.

[17] CCITT Recommendation X.223 (1988), *Use of X.25 to provide the OSI connection-mode network service for CCITT applications*.

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

[19] ITU-T Recommendation X.121 (1996), *International numbering plan for public data networks*.

[20] CCITT Recommendation X.244 (1988), *Procedure for the exchange of protocol identification during virtual call establishment on packet switched public data networks*.

[21] ISO/IEC TR 9577:1996, *Information technology – Protocol identification in the network layer*.

[22] ITU-T Recommendation I.430 (1995), *Basic user-network interface – Layer 1 specification*.

[23] ITU-T Recommendation I.431 (1993), *Primary rate user-network interface – Layer 1 specification*.

[24] ITU-T Recommendation Q.921 (1993), *ISDN user-network interface – Data link layer specification*.

[25] ITU-T Recommendation X.31 (1995), *Support of packet mode terminal equipment by an ISDN*.

[26] ISO/IEC 8878:1992, *Information technology – Telecommunications and information exchange between systems – Use of X.25 to provide the OSI Connection-mode Network Service*.

[27] CCITT Recommendation Q.702 (1988), *Signalling data link*.

[28] ITU-T Recommendation Q.703 (1996), *Signalling link*.

[29] ITU-T Recommendation Q.704 (1996), *Signalling network functions and messages*.

[30] ITU-T Recommendation Q.711 (1996), *Functional description of the signalling connection control part*.

[31] ITU-T Recommendation Q.712 (1996), *Definition and function of signalling connection control part messages*.

[32] ITU-T Recommendation Q.713 (1996), *Signalling connection control part formats and codes*.

[33] ITU-T Recommendation Q.714 (1996), *Signalling connection control part procedures*.

[34] ITU-T Recommendation Q.716 (1993), *Signalling Connection Control Part (SCCP) performance*.

[35] ITU-T Recommendation V.24 (1996), *List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE).*

[36] ITU-T Recommendation V.28 (1993), *Electrical characteristics for unbalanced double-current interchange circuits.*

[37] CCITT Recommendation V.36 (1988), *Modems for synchronous data transmission using 60-108 kHz group band circuits.*

[38] ISO 2110:1989, *Information technology – Data communication – 25-pole DTE/DCE interface connector and contact number assignments.*

[39] ISO/IEC 2593:1993, *Information technology – Telecommunications and information exchange between systems – 34-pole DTE/DCE interface connector mateability dimensions and contact number assignments.*

[40] CCITT Recommendation X.612 (1992) | ISO/IEC 9574:1992, *Information technology – Provision of the OSI connection-mode network service by packet-mode terminal equipment connected to an Integrated Services Digital Network (ISDN).*

[41] ITU-T Recommendation X.214 (1995) | ISO/IEC 8072:1996, *Information technology – Open Systems Interconnection – Transport service definition.*

[42] ISO/IEC 8073:1992, *Information technology – Telecommunications and information exchange between systems – Open Systems Interconnection – Protocol for providing the connection-mode transport service.*

[43] ITU-T Recommendation X.224 (1993), *Protocol for providing the OSI connection-mode transport service.*

[44] ISO/IEC 8881:1989, *Information processing systems – Data communications – Use of the X.25 packet level protocol in local area networks.*

[45] ISO/IEC ISP 10608:1992, *Information technology – International Standardized Profile TAnnnn – Connection-mode Transport Service over Connectionless-mode Network Service.*

Part 1: General overview and subnetwork-independent requirements.

Part 2: TA51 profile including subnetwork-dependent requirements for CSMA/CD Local Area Networks (LANs).

Part 5: TA1111/TA1121 profiles including subnetwork-dependent requirements for X.25 packet-switched data networks using virtual circuits.

[46] ISO/IEC ISP 10609:1992, *Information technology - International Standardized Profiles TB, TC, TD, and TE – Connection-mode Transport service over Connection-mode Network Service.*

Part 1: Subnetwork-type independent requirements for Group TB.

Part 5: Definition of Profiles TB1111/TB1121.

Part 9: Subnetwork-type dependent requirements for Network Layer, Data Link Layer and Physical Layer concerning permanent access to a packet switched data network using virtual calls.

[47] ISO 9542:1988, *Information processing systems – Telecommunications and information exchange between systems – End system to Intermediate system routeing exchange protocol for use in conjunction with the Protocol for providing the connectionless-mode network service.*

[48] ISO/IEC 10589:1992, *Information technology – Telecommunications and information exchange between systems – Intermediate system to Intermediate system intra-domain*

routeing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service.

[49] ISO/IEC 10747:1994, *Information technology – Telecommunications and information exchange between systems – Protocol for exchange of inter-domain routeing information among intermediate systems to support forwarding of ISO 8473 PDUs.*

[50] ITU-T Recommendation X.75 (1993), *Packet-switched signalling system between public networks providing data transmission services.*

[51] CCITT Recommendation X.325 (1988), *General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs) and Integrated Services Digital Networks (ISDNs) for the provision of data transmission services.* (Same as Recommendation I.550.)

[52] CCITT Recommendation X.326 (1988), *General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs) and Common Channel Signalling Network (CCSN).*

[53] CCITT Recommendation X.327 (1988), *General arrangements for interworking between Packet Switched Public Data Networks (PSPDNs) and private data networks for the provision of data transmission services*.

[54] ITU-T Recommendation X.211 (1995) | ISO/IEC 10022:1996, *Information technology – Open Systems Interconnection – Physical service definition.*

[55] ISO/IEC 11570:1992, *Information technology – Telecommunications and information exchange between systems – Open Systems Interconnection – Transport protocol identification mechanism.*

[56] ISO/IEC 10177:1993, *Information technology – Telecommunications and information exchange between systems – Provision of the connection-mode Network internal layer service by intermediate systems using ISO/IEC 8208, the X.25 Packet Layer Protocol.*

[57] ISO/IEC 10028:1993, *Information technology – Telecommunications and information exchange between systems – Definition of the relaying functions of a Network layer intermediate system.*

[58] ITU-T Recommendation Q.708 (1993), *Numbering of international signalling point codes*.

[59] ITU-T Recommendation X.273 (1994) | ISO/IEC 11577:1995, *Information technology – Open Systems Interconnection – Network layer security protocol.*

[60] ISO/IEC 11575:1995, *Information technology – Telecommunications and information exchange between systems – Protocol mappings for the OSI Data Link service.*

[61] ITU-T Recommendation X.212 (1995) | ISO/IEC 8886:1996, *Information technology – Open Systems Interconnection – Data link service definition.*

[62] ITU-T Recommendation Q.931 (1993), *ISDN user-network interface layer 3 specification for basic call control*.

[63] ITU-T Recommendation I.320 (1993), *ISDN protocol reference model.*

[64] ISO/IEC TR 10000-1:1995, *Information technology – Framework and taxonomy of International Standardized Profiles – Part 1: General principles and documentation framework.*

[65] ISO/IEC TR 10000-2:1995 *Information technology – Framework and taxonomy of International Standardized Profiles – Part 2: Principles and Taxonomy for OSI Profiles*.

[66] ISO 4902:1989, *Information technology – Data communication – 37-pole DTE/DCE interface connector and contact number assignments.*

[67] ISO 4903:1989, *Information technology – Data communication – 15-pole DTE/DCE interface connector and contact number assignments.*

[68] CCITT Recommendation V.10 (or X.26) (1988), *Electrical characteristics for unbalanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications*.

[69] CCITT Recommendation V.11 (or X.27) (1988), *Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications*.

1.3 Abbreviations

This Recombination uses the following abbreviations.

AFI	Authority and Format Identifier
BIS	Border Intermediate System
CD	Collision Detection
CLNP	Connectionless-mode Network layer Protocol
CLNS	Connectionless-mode Network layer Service
Conf	Confirm
CONP	Connection-mode Network layer Protocol
CONS	Connection-mode Network layer Service
COTS	Connection-mode Transport Service
CSMA	Carrier Sense Multiple Access
DCN	Data Communication Network
DIS	Draft International Standard
DLC	Data Link Connection
DLS	Data Link Service
DSP	Domain Specific Part
ES	End System
HDLC	High-level Data Link Control
IDI	Initial Domain Identifier
IDP	Initial Domain Part
IDRP	Inter Domain Routing (or Routeing) Protocol
Ind	Indication
IP	Internetworking Protocol
IS	Intermediate System
ISO	International Organization for Standardization
ISP	International Standardized Profile

LLC	Logical Link Control
LME	Layer Management Entity
LSP	Link State Protocol Data Unit
MAC	Media Access Control
MD	Mediation Device
NDM	Normal Disconnect Mode
NE	Network Element
NLR	Network Layer Relay
NPDU	Network Protocol Data Unit
NS	Network Service
NSAP	Network Service Access Point
OS	Operations System
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
PhC	Physical Connection
Ph	Physical
PhS	Physical Service
PICS	Protocol Implementation Conformance Statement
PVC	Permanent Virtual Circuit
QA	Q Adapter
QOS	Quality of Service
Req	Request
Res	Result
RFC	Request For Comments
SGFS	Special Group on Functional Standards
SNDCF	Subnetwork Dependent Convergence Function
SNP	Sequence Numbers Protocol Data Unit
SNPA	Subnetwork Point of Attachment
SVC[2]	Switched Virtual Circuit
TCP	Transmission Control Protocol
TMN	Telecommunications Management Network

1.4 Terms

For further study.

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[2] Switched Virtual Circuit corresponds to “Virtual call” used in Recommendation X.25.

2 DCN model

Table 24 identifies the lower layer protocols for interfaces requiring interworking as well as the interworking method.

The following briefly describes the individual lower layer protocol profiles:

– CONS1: A connection-mode packet interface using X.25.

– CONS2: A connection-mode packet interface using X.31 on an ISDN D-channel.

– CONS3: A connection-mode packet interface using X.31 on an ISDN B-channel.

– CONS5: A connection-mode interface using Signalling System No. 7 MTP and SCCP[3].

– CONS6: A connection-mode packet interface X.25 over LAN.

– CLNS1: A connectionless-mode interface using ISO/IEC 8802-2 type LANs using CSMA/CD.

– CLNS2: A connectionless-mode interface using ISO CLNP over a connection-mode X.25 protocol.

– CLNS3: A connectionless-mode interface using ISO CLNP over ISDN B-channels (see 5.5).

– RFC1006/TCP/IP: Provision of OSI Transport class 0 over Internet TCP (see 5.6).

2.1 Protocol profiles

This subclause provides typical examples of the application of these profiles at the Q3 and X interfaces. Other fields of application are not precluded by this Recommendation.

2.1.1 CONS1

CONS1 is applied to the reference point between PSPDN and OS/MD/QA/NE which communicates with OS accommodated in PSPDN and ISDN.

2.1.2 CONS2, CONS3, CLNS3

CONS2 and CONS3 are applied to the reference point between ISDN and OS/MD/QA/NE which communicates with OS accommodated in PSPDN or ISDN.

2.1.3 CLNS1

CLNS1 is applied to the reference point between LAN and OS/MD/QA/NE which communicates with OS accommodated in LAN or PSPDN.

2.1.4 CLNS2

CLNS2 is applied to the reference point between PSPDN and OS/MD/QA/NE which communicates with OS accommodated in LAN.

2.1.5 CONS6

CONS6 is applied to OS/MD/QA/NE which is connected to the reference point on connection-mode oriented LAN.

2.1.6 RFC1006/TCP/IP

For further study.

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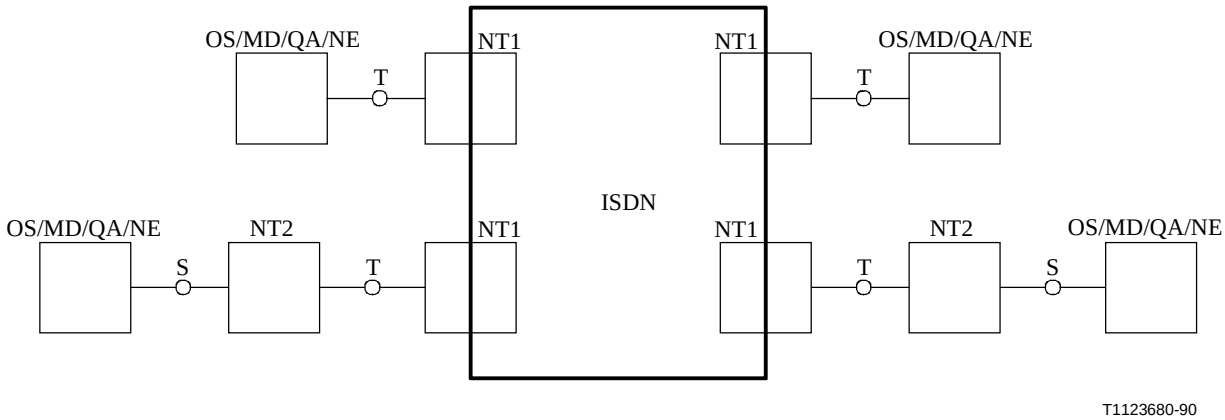
[3] The additions required to provide the connection mode network service by the SCCP are under study.

2.2 Relationship between ISDN model and Q3 and X interfaces

Figure 1 shows the location of Q3 and X interfaces in ISDN access. This figure shows that OSs accommodated in ISDN which serves as a DCN of TMN have Q3 and X interfaces over T point or S point.

NOTE – Figure 1/Q.811 (1993), **DCN model**, has been deleted.



NOTE – Circles indicate the location of Q3 interface.

Figure 1/Q.811 – Location of Q3 interface in ISDN access

3 Lower layer protocol profiles: Overview

The communication services and protocol referred to in this Recommendation are in accordance with the Open Systems Interconnection (OSI) reference model [3].

The protocols for the different layers are based on ITU-T (CCITT) Recommendations and/or ISO/IEC Standards.

The protocol profiles can be applied to DCN, as defined by Recommendation M.3010 [1].

Any Administration may use any existing network that meets the requirements at the layer 3/layer 4 service boundary.

For the Protocol Profiles defined in this Recommendation, interoperability mechanisms are to be defined as a part of this Recommendation. For networks not using these profiles, it is the responsibility of the individual Administration to solve any interoperability problems that may exist.

4 Requirements for network layer/transport layer interface

See clause 6 and its subclauses.

5 Defined protocol profiles

5.1 Connectionless-mode protocol profiles

5.1.1 **LAN** (see Figure 3)

NOTE – Figure 3/Q.811 (1993), **Protocol profile for network management**, has been deleted.

5.1.2 **WAN, LAN** (see Figure 3)

5.1.3 **ISDN** (see Figure 3)

5.2 Connection-mode protocol profiles

5.2.1 **X.25/LAPB** [see Figure 2 (1), (3), (2), (6), (5)]

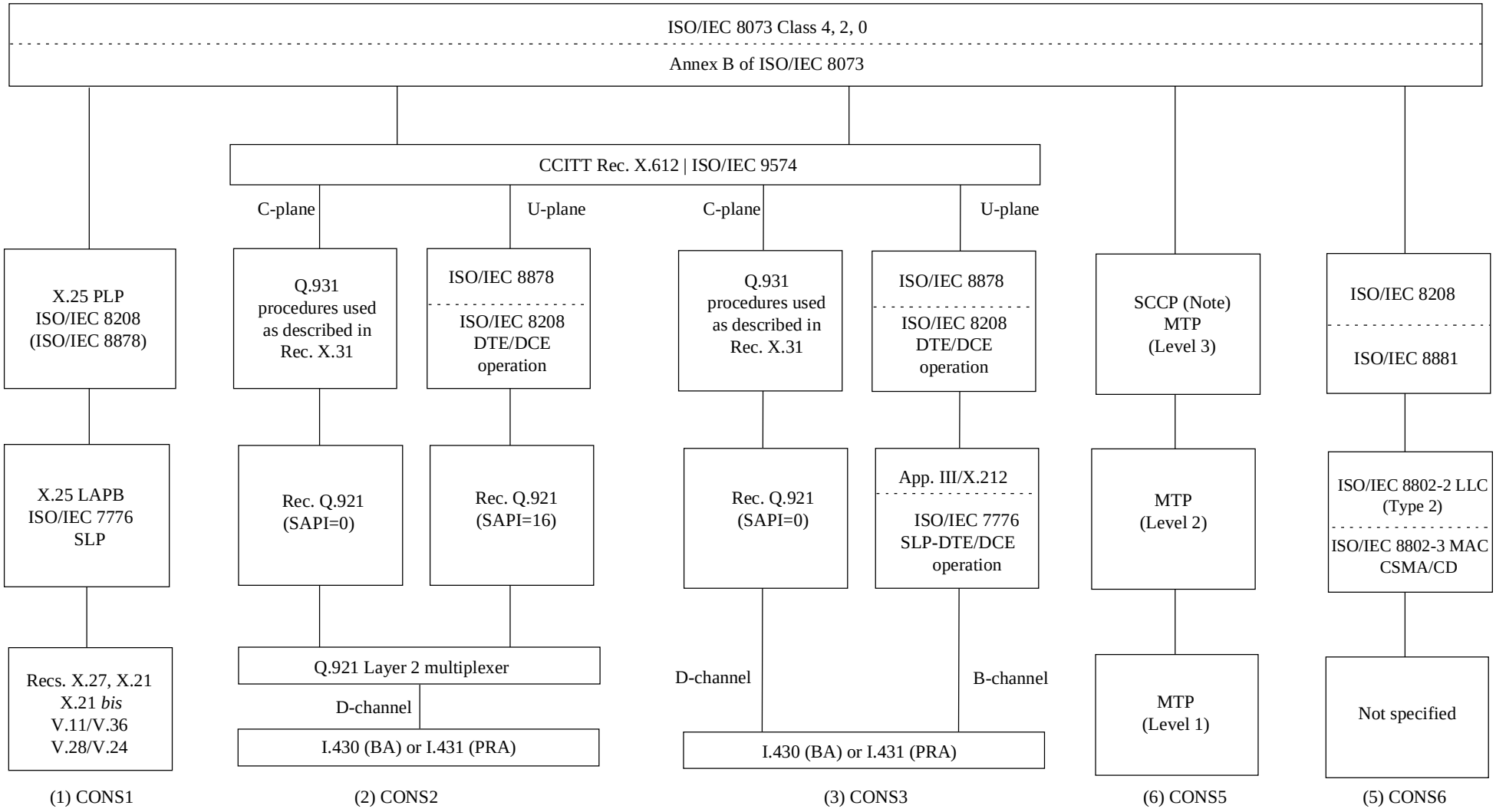
5.3 CL-LAN profile (CLNS1)

5.3.1 Physical layer profile

5.3.1.1 Service profile

The service definition for the Physical layer shall comply with that specified in clause 6 of ISO/IEC 8802-3 [4].

All of the primitives defined and listed in Table 1 are mandatory.



NOTE – Further study is needed for the function of SCCP at the boundary of Network layer and Transport layer.

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Figure 2/Q.811 – CONS protocol profiles

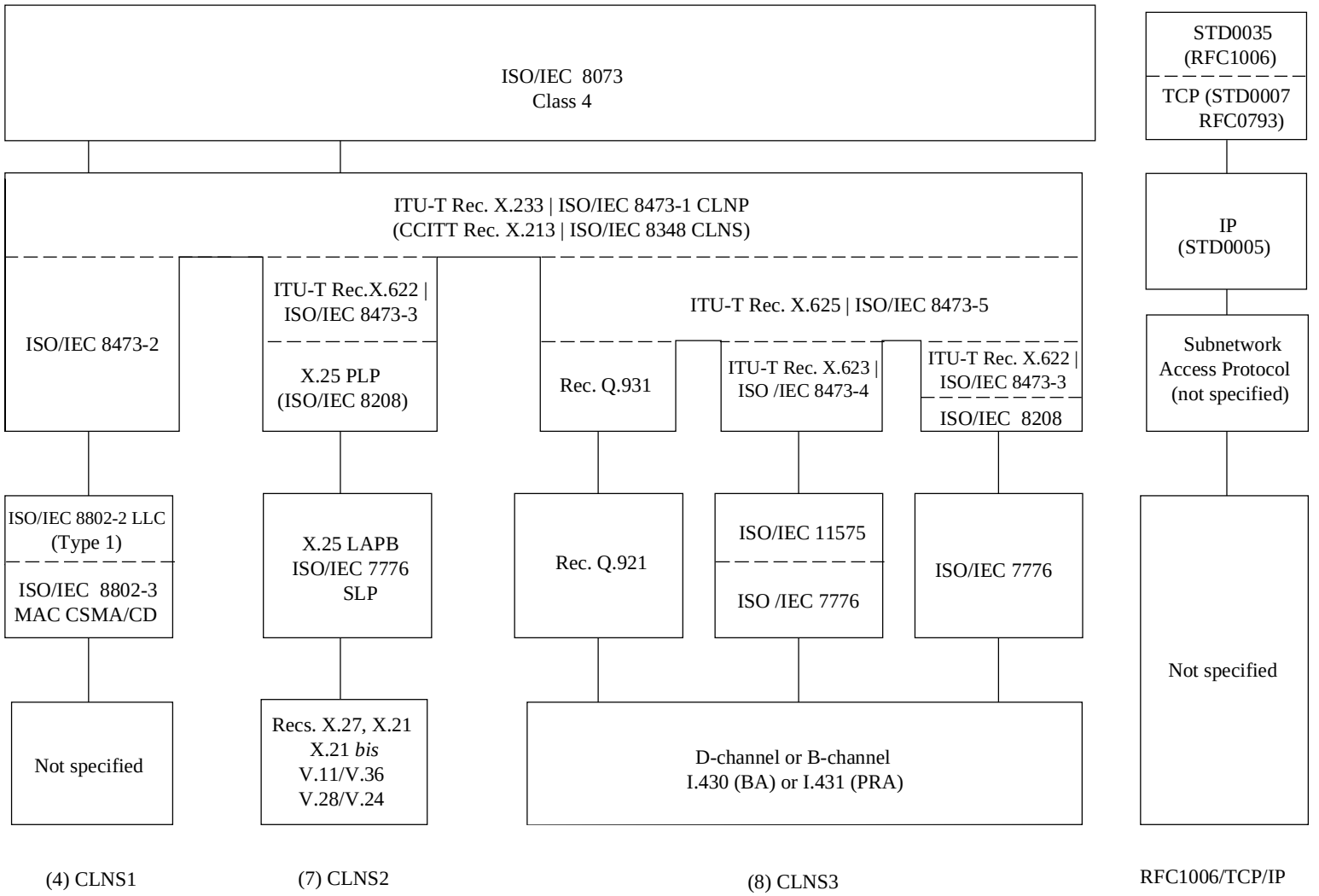

Figure 3/Q.811 – CLNS protocol profiles

Table 1/Q.811 – Primitives of the Physical layer

Primitive
PLS-DATA-request
PLS-DATA-indication
PLS-CARRIER-indication
PLS-SIGNAL-indication

5.3.1.2 Protocol profile

The possible bit rate will be 1 Mbit/s, 10 Mbit/s, or higher.

5.3.1.3 Physical interface

Administrations will select the appropriate physical medium, e.g. coaxial cable, screened pairs, optical fibre according to technological and operational requirements.

5.3.2 Data link layer profile

The Data Link layer provides the unacknowledged connectionless-mode service. The access method employed is Carrier Sense Multiple Access with Collision Detection (CSMA/CD).

5.3.2.1 Media Access Control (MAC) profile

The services and protocol of the CSMA/CD access method shall comply with those specified in ISO/IEC 8802-3 [4].

The address length used at the MAC sub-layer shall be 48 bits.

5.3.2.2 Logical Link Control (LLC) profile

The definition of the unacknowledged connectionless-mode LLC service shall comply with that specified in ISO/IEC 8802-2 [5]. All of the primitives defined for "Type 1" operation shall be supported.

The protocol used to provide the unacknowledged connectionless-mode LLC service shall be as specified in ISO/IEC 8802-2 [5]. All of the commands and responses defined for "Type 1" operation shall be supported.

5.3.3 Network layer profile

5.3.3.1 Services profile

The definition of the connectionless-mode Network service shall comply with that specified in CCITT Rec. X.213 | ISO/IEC 8348 [6]. Address formats supported shall also conform to CCITT Rec. X.213 | ISO/IEC 8348 [6].

The Network layer shall provide the N-UNITDATA service as specified in CCITT Rec. X.213 | ISO/IEC 8348 [6].

5.3.3.2 Protocol profile

The protocol shall be in accordance with the full protocol subset of category "Type 1" functions, as specified in ITU-T Rec. X.233 | ISO/IEC 8473-1 [7].

5.3.3.3 Network layer attributes

Characteristics of the connectionless-mode Network layer service and the connectionless-mode Network layer protocol shall be as shown in Table 2.

Table 2/Q.811 – Connectionless-mode network layer service/protocol parameters

a	Destination and Source Addresses used by this Protocol shall conform to one of the Network Service Access Points (NSAPs) address formats specified in CCITT Rec. X.213 | ISO/IEC 8348 [6]. The Destination and Source Addresses are of variable length. The Destination and Source Address fields shall be as Network Protocol Address Information using the preferred Binary Encoding specified in CCITT Rec. X.213 | ISO/IEC 8348 [6].
b	The setting of Error Reporting Flag (E/R) shall be a local matter (Note).
c	Partial Source Routing shall NOT be supported. A defect exists with this option which can cause PDUs to loop in the network until their lifetime expires.
d	Inactive Subset – Implementations shall not transmit PDUs encoded using the ITU-T Rec. X.233 | ISO/IEC 8473-1 inactive subset. Received PDUs encoded with the inactive subset shall be discarded.
e	Segmentation – The non-segmentation subset shall NOT be used. However, implementations shall be capable of receiving and correctly processing PDUs which do not contain the segmentation part.
f	Segmentation Permitted Flag – Implementations shall NOT generate data PDUs without a segmentation part, i.e. the Segmentation Permitted Flag (SP) shall be set to 1 and the segmentation part shall be included.
g	Lifetime Control – The lifetime parameter shall be used as specified in 6.4 of ITU-T Rec. X.233 | ISO/IEC 8473-1. This parameter shall have an initial value of at least three times the network span (number of network entities) or three times the maximum transmission delay (in units of 500 milliseconds), whichever is greater. The default initial PDU lifetime control shall be 10 seconds.
h	Quality of Service (QOS) – The use of the QOS Maintenance Parameter shall be dependent upon the QOS requirements of the subnetworks supporting an instance of OS-NE communications. When QOS is used, it shall comply with the specifications in 6.16, 6.19, and 7.5.6 of ITU-T Rec. X.233 | ISO/IEC 8473-1. It is recommended that Quality of Service Maintenance be supported and that the globally unique QOS format be used which includes the Congestion Experienced (CE) bit used by the Congestion Notification option.
i	Reassembly timer – The reassembly timer must be less than the largest value of all the lifetime parameters contained in all derived PDUs. The default Reassembly timer shall be 12 seconds.
j	Congestion Notification – The use of Congestion Notification option is recommended. The default value should be 0 when originating PDUs. For NEs and MDs that act as ISs, it is recommended that Congestion Notification be supported so that end systems can take appropriate action to avoid and recover from network congestion.
NOTE – The use of error Reporting and setting the E/R flag to 1 may lead to excessive network traffic.	

5.3.3.4 ES-IS routing

TMN entities that use the CLNP shall support the ISO 9542 [47] for ES-IS routing exchange. The ES-IS protocol is provisioned as either an End System (ES) role, or an Intermediate System (IS) role. The Data Communication Function (DCF) within the TMN entities must therefore be provisioned in accordance with their role(s).

The ES-IS protocol subsets: Configuration Information (CI) and Redirection Information (RI) shall be supported in accordance with the type of subnetwork, as shown in Table 3. Tables 4 and 5 give the timer values and options for the ES and IS roles respectively.

Table 3/Q.811 – ES-IS subsets

	Type of subnetwork		
Protocol subset	**Point-to-point (Note 1)**	**Broadcast (Note 2)**	**General topology (Note 3)**
Configuration Information (CI)	M	M	NS
Redirection Information (RI)	NS		M
M mandatory support NS not supported NOTE 1 – An example of a point-to-point subnetwork is the SDH DCC. NOTE 2 – An example of a broadcast subnetwork is a CSMA/CD LAN. NOTE 3 – An example of a general topology subnetwork is an X.25 packet network.			

Table 4/Q.811 – ES-IS protocol timers and options for the end system role

	Value/Range/Option	**Default**
Timers:		
Configuration Timer	1-200 secs.	(50 secs.)
Holding Timer	1-500 secs.	(105 secs.)
Functions:		
PDU Header Checksum Generation	Optional, use, non-use	(Non-use)
Configuration Notification (Notes 1, 3)	Optional, use, non-use	(Use)
Refresh Redirect (Note 2)	Use, non-use	(Use)
Address and SNPA Mask Processing (Note 2)	Optional, use, non-use	(Use)
Supplemental Functions per Annex B of ISO/IEC 9542:		
Optimization (Note 4)	Optional, use, non-use	(Use)
Rapid Configuration	Optional, use, non-use	–
NOTE 1 – Applies to Configuration Information (CI) subset. NOTE 2 – Applies to the Redirection Information (RI) subset. NOTE 3 – See recommendation in 6.7 of ISO/IEC 9542. NOTE 4 – See B.4 of ISO/IEC 9542.		

Table 5/Q.811 – ES-IS protocol timers and options for the intermediate system role

	Value/Range/Option	Default
Timers**:** Configuration Timer Holding Timer	 1-200 secs. 1-500 secs.	 (10 secs.) (25 secs.)
Functions**:** PDU Header Checksum Generation Configuration Notification (Notes 1, 3) Address and SNPA Mask Processing (Note 2)	 Optional, use, non-use Optional, use, non-use Optional, use, non-use	 (Non-use) (Use) (Use)
Supplemental Functions per Annex B of ISO/IEC 9542: Rapid Configuration	 Optional, use, non-use	 –
NOTE 1 – Applies to Configuration Information (CI) subset. NOTE 2 – Applies to the Redirection Information (RI) subset. NOTE 3 – See recommendation in 6.7 of ISO/IEC 9542.		

5.3.3.5 IS-IS Intra-Domain Routing

ISO/IEC 10589 [48], the IS-IS intra-domain protocol for use with the CLNP, shall be used by TMN entities that operate as Intermediate Systems for the purpose of routing connectionless NPDUs.

Each IS within the TMN must be capable of routing within their area and therefore must provide the functionality of a Level 1 IS. Additionally, an IS may be provisioned as a Level 2 IS, which provides the capability of routing from one area to another and therefore contains routing information about ISs outside a specific area. The functionality of a Level 2 IS is not needed in each IS within the TMN. An example of a Level 2 IS might be a gateway NE. Details for use of ISO/IEC 10589 for TMN applications are found in Tables 6 through 11.

Table 6/Q.811 – IS-IS general protocol functions

Protocol function	Value/Range/Option	Default
Authentication	Optional, use, non-use	(Non-use)
Delay Metric	Optional, use, non-use	(Non-use)
Expense Metric	Optional, use, non-use	(Non-use)
Error Metric	Optional, use, non-use	(Non-use)

Table 7/Q.811 – IS-IS general processes

Function	Value/Range/Option	Default
Decision Process: Equal Cost Paths Down Stream Paths	 Optional, use, non-use Optional, use, non-use	 (Non-use) (Non-use)

Table 8/Q.811 – IS-IS Level 1 specific functions

Function	Value/Range/Option	Default
Protocol Summary: Maximum Area Addresses (Note) Area IS Count (Note)	 0-12 1-512	 (3) (512)
NOTE – These numbers are preliminary and are subject for study and possible change.		

Table 9/Q.811 – IS-IS Level 2 specific functions

Function	Value/Range/Option	Default
Protocol Summary: L2 IS (Note 2) L2 IS Count (Note 1) IS Count (Note 3) Reachable Address Prefix External Metrics (Note 4) Partition Repair	 Optional, use, non-use 1-512 1-512 Optional, use, non-use Use, non-use Optional, use, non-use	 (Non-use) (256) (512) (Non-use) (Non-use) (Non-use)
Decision Process: L2 Attached Flag (Note 3) L2 Partition DIS Election (Note 5) L2 Partition Area Addresses Computation (Note 5) L2 DIS Partition Repair (Note 5)	 Optional, use, non-use Use, non-use Use, non-use Use, non-use	 (Non-use) (Non-use) (Non-use) (Non-use)
Forward/Receive Process L2 NPDU Encapsulation (Note 5) L2 NPDU Decapsulation (Note 5)	 Use, non-use Use, non-use	 (Non-use) (Non-use)
NOTE 1 – These numbers are preliminary and are subject for study and possible change. NOTE 2 – These functions only apply when the IS is a level 2 IS. NOTE 3 – This function is mandatory when the Level 2 functions are supported. NOTE 4 – This function is mandatory when Reachable Address Prefixes are supported. NOTE 5 – This function is mandatory when the Partition repair function is supported.		

Table 10/Q.811 – Level 2 subnetwork dependent functions

Function	Value/Range/Option	Default
ISO/IEC 8208 Dynamic Assignment: Call Establishment Metric Increment Reverse Path Cache	 Optional, use, non-use Optional, use, non-use	 (Non-use) (Non-use)

Table 11/Q.811 – IS-IS parameter values and timers

Type	Value/Range/Option	Default
Parameter Values:		
Default Metric	1-63	(20)
Max Path Metric	1023	–
Minimum LSP Receive Buffer Size	1492 octets	–
IS-IS Holding Multiplier	10	–
Max Path Splits	1-32	(2)
Max Virtual Adjacencies	0-32	(2)
Timers:		
Max Age	1200 secs	–
Zero Age Lifetime	60 secs.	–
IS-IS Hello Timer	0-3 secs.	(3 secs.)
Complete SNP Interval Timer	0-10 secs.	(10 secs.)
Max LSP Generation Interval Timer	0-15 mins.	(15 mins.)
Min LSP Generation Interval Timer	0-30 secs.	(30 secs.)
Min LSP Transmission Interval Timer	0-5 secs.	(5 secs.)
Partial SNP Interval Timer	0-2 secs.	(2 secs.)
Poll ES Hello Rate Timer	0-50 secs.	(50 secs.)
Waiting Timer	0-60 secs.	(60 secs.)
Reserve Timer	2-6 secs.	(6 Secs.)

5.3.3.6 IS-IS Inter Domain Routing

Border Intermediate Systems (BISs), using the ISO/IEC 10747 Inter Domain Routing Protocol (IDRP) [49], may be employed for routing ITU-T Rec. X.233 | ISO/IEC 8473-1 CLNP PDUs between Administrative Domains as defined in CCITT Rec. X.213 | ISO/IEC 8348.

5.3.4 Transport layer profile

5.3.4.1 Services profile

It is mandatory that for the connectionless-mode Network service, the Transport service shall conform to ITU-T Rec. X.214 | ISO/IEC 8072 [41].

5.3.4.2 Protocol profile

Operation of the Transport protocol over the connectionless-mode Network layer Service (CLNS), as described in CCITT Rec. X.213 | ISO/IEC 8348 [6], shall use the elements of ISO/IEC 8073 [42] and Recommendation X.224 [43], Class 4 operation over the CLNS. Provisions in 5.7.4.1.2, 5.7.4.1.3, 5.7.4.1.4, 5.7.4.2.4, 5.7.4.2.6, 5.7.4.2.7, and 5.7.4.2.8 of CONS1 profile Transport protocol also apply here.

5.3.4.2.1 Class of service

Support of Class 4 operation of ISO/IEC 8073 [42] and Recommendation X.224 [43] is mandatory.

5.3.4.2.2 Transport layer attributes

Transport layer attributes for Class 4 operation over the Connectionless-mode Network layer Service shall be as shown in Table 12.

Table 12/Q.811 – Transport layer attributes
[for use with Connectionless-mode Network layer Service (CLNS)]

	Value/Range/Option	Default
Maximum TPDU (Octets)	128, 256, 512, 1024 (2048, 4096, 8192 optional)	(128)
TSAP-ID (Note 1)	Up to 32 octets	–
Class of service	4	–
Preferred class	4	–
Alternative Class	None	–
Expedited Data	Non-use	–
Options:		
Security Parameters	Optional	–
Data TPDU numbering (Note 2)	Normal, extended	(Normal)
Checksum (Note 3)	Use, non-use	(Non-use)
Parameters:		
T1 – Retransmission time	0.25-64 seconds (Note 4)	(8)
N – Retransmissions	2-15	(2)
L – Bound on reference	1-256 seconds	(32)
I – Inactivity time	2-512 seconds	(64)

NOTE 1 – Some systems may require TSAP-IDs. However, all systems shall be capable of generating called TSAP-IDs in CR TPDUs and capable of receiving calling and called TSAP-IDs in received CR and CC TPDUs, respectively.

NOTE 2 – Extended format option shall be implemented. Non-use of this option shall be negotiable. The responder shall honour the initiator's request whenever possible. Negotiation to other than what has been requested shall only occur under abnormal conditions, for example, severe congestion, as determined by the implementor. Initiators shall be prepared to operate in the mode confirmed by the responder.

NOTE 3 – Use of checksum is required for the CR TPDU. An additional requirement is that all implementations shall support the negotiated "non-use" of the checksum. Initiators shall request and responders shall agree to "non-use" of the checksum.

NOTE 4 – The Transport layer T1 timer value should always be greater than the link layer T1 timer value.

5.4 CL-WAN profile (CLNS2)

5.4.1 Physical layer profile

5.4.1.1 Service profile

The Physical layer service shall be as defined in ITU-T Rec. X.211 | ISO/IEC 10022 [54].

5.4.1.2 Protocol profile

The protocol of the Physical layer of Protocol Profile CLNS2 shall comply with the following specifications:

– X.21 interface in accordance with 1.1/X.25 [12];

– X.21 *bis* interface in accordance with 1.2/X.25;

– V-Series interface in accordance with 1.3/X.25.

5.4.1.2.1 Bit rate

The supported bit rates are: 1200, 2400, 4800, 9600, 19 200, and 64 000 bit/s. The bit rates 48 000 bit/s and 56 000 bit/s may be used for an interim period (see Note 1 to Table 19).

5.4.1.3 Connector

Table 13 lists the connectors to be used in accessing the X.21 and X.21 *bis* interfaces. Tables 14, 15, and 16 list respectively the pin descriptions of ISO 2110 [38], ISO/IEC 2593 [39], ISO 4902 [66], and ISO 4903 [67].

Table 13/Q.811 – X.21/X.21 *bis* connectors

Data signalling rate	X.21 *bis*	X.21
2 400 bit/s	ISO 2110	ISO 4903
4 800 bit/s	ISO 2110	ISO 4903
9 600 bit/s	ISO 2110	ISO 4903
19 200 bit/s	ISO 2110	ISO 4903
48 000 bit/s	ISO/IEC 2593 ISO/IEC 4902	ISO 4903
56 000 bit/s	ISO/IEC 2593	ISO/IEC 2593
64 000 bit/s	ISO 4902	ISO 4903

Table 14/Q.811 – ISO 2110 [38] pin description (see Note 6)

Pin	V.24 [35] circuit	Description	Notes
1	101	Protective ground (Shield)	1
7	102	Signal Ground	2
2	103	Transmitted Data	2
3	104	Received Data	2
4	105	Request to Send	2
5	106	Clear to Send	2
6	107	Data Set Ready (DCE Ready)	2
20	108.2	Data terminal Ready (DTE Ready)	3
22	125	Ring Indicator	3
8	109	Received Line Signal Detector	2

Table 14/Q.811 – ISO 2110 [38] pin description (see Note 6) (*concluded*)

Pin	V.24 [35] circuit	Description	Notes
24 15	113 114	Transmitter Signal Element Timing (DTE to DCE) Transmitter Signal Element Timing (DCE to DTE)	4 5

NOTE 1 – Equipment: removable strap to frame ground or other equivalent grounding arrangement. Cable: connected to shield.

NOTE 2 – Basic interchange circuits, all systems.

NOTE 3 – Additional interchange circuits required for switched service.

NOTE 4 – Circuit 113 is not used in OS-MD/NE interfaces.

NOTE 5 – Additional interchange circuits required for synchronous channel.

NOTE 6 – Duplex, interface type D.

NOTE 7 – Circuits are grouped by function: ground, data, control, and timing.

NOTE 8 – For further information see Recommendations V.24 [35], V.28 [36], and ISO 2110 [38].

Table 15/Q.811 – V.36 [37], ISO/IEC 2593 [39] pin description (see Note 3)

Pin	Circuit	Description	Notes
A B	101 102	Protective Ground Signal Ground	1
P S R T	103 103 104 104	Transmitted Data A-wire Transmitted Data B-wire Received Data A-wire Received Data B-wire	2 2 2 2
C D E F	105 106 107 109	Request to Send Ready for Sending Data Set Ready Data Channel Receive Line Signal Detector	
Y AA V X	114 114 115 115	Transmitter Signal Element Timing A (DCE to DTE) Transmitter Signal Element Timing B (DCE to DTE) Receiver Signal Element Timing A (DCE to DTE) Receiver Signal Element Timing B (DCE to DTE)	2 2 2 2

NOTE 1 – Equipment: removable strap to frame ground or other equivalent grounding arrangement. Cable: connected to shield.

NOTE 2 – The electrical characteristics of the interchange circuits 103, 104, 114, and 115 shall be balanced double-current, conforming to Recommendation V.36 [37].

All other circuits shall conform to Recommendation V.28 [36].

NOTE 3 – The mode is synchronous at 64 000 bit/s.

Some countries may use 56 000 bit/s for an interim period of time.

NOTE 4 – Circuits are grouped by function: ground, data, control and timing.

NOTE 5 – For further information, see Recommendations V.36 [37], V.24 [35], V.28 [36], and ISO/IEC 2593 [39].

Table 16/Q.811 – ISO 4903 [67] pin description (see Note 2)

Pin	X.21 circuit	Description	Notes
1 8	– G	Protective ground Signal ground or common return	1
2 9 4 11	T T R R	Transmit A-wire Transmit B-wire Receive A-wire Receive B-wire	
3 10 5 12	C C I I	Control A-wire Control B-wire Indication A-wire Indication B-wire	
6 13	S S	Signal element timing A-wire Signal element timing B-wire	
NOTE 1 – Equipment: removable strap to frame ground or other equivalent grounding arrangement. Cable: connected to shield. NOTE 2 – Circuits are grouped by functions: ground, data, control and timing. NOTE 3 – For further information: see Recommendations V.10 [68], V.11 [69], X.21, and ISO 4903.			

5.4.2 Data link layer profile

It is mandatory that the Data Link layer conforms to LAPB as defined in Recommendation X.25 [12]. In addition, provision shall be made for connection between Data Terminal Equipment without an intervening packet switched network. The interface shall conform to ISO/IEC 7776 [13].

5.4.2.1 Service profile

The Data Link layer service shall be as defined in ITU-T Rec. X.212 | ISO/IEC 8886 [61].

5.4.2.2 Protocol profile

5.4.2.2.1 Equipment type during link set-up and reset

When a packet switched network is used to connect systems, they are each designated "Data Terminal Equipment" (DTE) and the network acts as a "Data Circuit-terminating Equipment" (DCE). When a dedicated or dial-up link is provided, other means must be used to supply the DCE role.

At the Physical layer the modems will provide the DCE interface, supplying bit synchronization.

At the link level, the procedures specified in ISO/IEC 7776 [13] shall be followed. A system must be able to start the set-up or reset of the link (a DCE function in Recommendation X.25 [12]). In addition, provision must be made for assignments of the A/B addresses. This mandatory option is to be field-settable and stored in non-volatile memory. Equipment which meets this requirement is compatible with connection to either a DCE or remote DTE.

5.4.2.2.2 Window

Support of modulo 8 is mandatory. The window for unacknowledged frames is to be optional between 1 and 7 frames and 1 to 127 with modulo 128. The standard default is 7. For efficient operation over satellite links modulo 128 operation is required, with a default window size of 35.

5.4.2.2.3 User information

The user information is to be arranged in an integral number of octets.

The maximum length of the user information shall be user settable, consistent with the range of values for the N1 parameter as shown in Table 17. Maximum information field lengths that shall be supported are 131 and 259 octets with 515, 1027, 2051, and 4099 octets optional. These values provide for three packet header octets and maximum length of User Data Field of 128, 256, 512, 1024, 2048, and 4096 octets, respectively.

5.4.2.2.4 Other frame parameters

Certain other frame parameters shall be set by the user to be consistent with the bit rate, frame size and characteristics of the connecting network. A system design should be sufficiently flexible to accommodate parameter sets for diverse networks, both as order options and later reconfigurations. The range of parameters is shown in Table 17. These options, like those of the Physical layer, are to be set at installation, changeable by the user, and non-volatile.

5.4.3 Network layer profile

5.4.3.1 Service profile

The connectionless-mode Network layer service shall be as specified in CCITT Rec. X.213 | ISO/IEC 8348.

5.4.3.2 Protocol profiles

The protocols for the Network layer shall be identical to the Network layer protocol of Protocol Profile CONS1 (see 5.7.3) with the inclusion of ITU-T Rec. X.233 | ISO/IEC 8473-1 [7] as specified in clause 4 of ISO/IEC 8880-3 [14], to provide the connectionless-mode Network service over the connection-mode Network service.

For those instances of communication requiring interworking between a connection-mode service (CONS) and a connectionless-mode service (CLNS), ITU-T Rec. X.200 | ISO/IEC 7498-1 [3] and ISO 8648 [15] provide an OSI compatible interworking capability. This capability is known as a Network Layer Relay (NLR) and utilizes the ITU-T Rec. X.233 | ISO/IEC 8473-1 [7] protocol to provide this service.

Table 17/Q.811 – LAPB Protocol – Octet aligned –
Single Link Procedure (SLP) – LAPB data link layer attributes

Parameter	Function	Range	Default
K	I-Frames Window	1 to 7 (with Modulo 8) 1 to 127 (with optional Modulo 128) 1 to 127 (Modulo 128 with satellite operations)	(7) (7) (35)
T1	Waiting Acknowledgment (Retry) timer[a)] For up to 9600 bit/s For 56 000 bit/s	 2 to 20 seconds 0.2 to 20 seconds	 (3) (3)
T2	Response delay par [a)]	Not greater than 0.3 seconds	
T3	Disconnect Timer	T3 >> T4[b)]	
T4	No activity Timer	4 to 120 seconds	(20)
N1	Bits per I-Frame, excluding flags and zero bit insertion for transparency [c)]	1080, 2104 (with Modulo 8) optional: 4152, 8248, 16440, 32824 (with Modulo 8)[d)] 1096, 2120 (with Modulo 128) optional: 4168, 8264, 16456, 32840 (with Modulo 128)[d)]	(2104) (2120)
N2	Retransmission Count	2 to 16	(7)
A/B	Address Assignment	Selectable by the user	

a) Further guidelines on the use of T1 and T2 can be found in Recommendation X.25 [12] and ISO/IEC 7776 [13]. The Transport layer T1 timer should always be greater than the link layer T1 timer.

b) The value of timer T3, the disconnect timer, is not critical for successful interworking of OSs and NEs. Therefore no value is specified.

c) In some cases, users may need to choose a maximum information field length of 259 octets (N1 = 2104 for Modulo 8 or N1 = 2120 for Modulo 128) with a 128 octets packet data unit in order to accommodate call request packets containing 128 octets user data fields in addition to the packet header and facility fields. These values are based on Modulo 8 or Modulo 128 operation at both link and packet layer.

d) Optional.

The default values shall be part of a vendor's offering. That is, unless otherwise specified by the user, the default parameters shall be the initial values supplied. They can be subsequently changed by the user within the specified range.

5.4.3.3 Network layer attributes

Characteristics of the connectionless-mode Network layer service, and the connectionless-mode Network layer protocol shall be as shown in Table 2.

5.4.4 Transport layer profile

The Transport layer profile specifications for this profile (CLNS2) is identical to the Transport layer profile specifications for CLNS1 in 5.3.4.

5.5 ISDN protocol profile (CLNS3)

5.5.1 ISDN protocol profile for connectionless-mode network service

This subclause defines a Protocol Profile for operation of ISO/IEC 8073 [42] and Recommendation X.224 [43] Transport layer protocol over ITU-T Rec. X.233 | ISO/IEC 8473-1 [7] CLNP over ISDN circuit switched B-channels. This profile is based on the Subnetwork Dependent Convergence Function (SNDCF) defined in ITU-T Rec. X.625 | ISO/IEC 8473-5 [11].

5.5.2 Transport layer

Requirements for the Transport layer are identical with those defined for the CLNS1 and CLNS2 Protocol Profile cases in 5.3.4 (and its subclauses).

5.5.3 Network layer

5.5.3.1 B-channel

Requirements for the topmost sub-layer (ITU-T Rec. X.233 | ISO/IEC 8473-1) of the Network layer in the B-channel are identical with those defined in 5.3.3 (and its subclauses) for the CLNS1 and CLNS2 Protocol Profile cases.

5.5.3.1.1 Subnetwork dependent convergence function

On the B-channel a connection may be provisioned to provide either an OSI Data Link service, or an X.25 packet service.

5.5.3.1.1.1 B-channel OSI data link service

For B-channels providing the OSI Data Link service defined in ITU-T Rec. X.212 | ISO/IEC 8886 [61], the SNDCF shall be as defined in ITU Rec. X. 623 | ISO/IEC 8473-4 [10] and ITU-T Rec. X.625 | ISO/IEC 8473-5.

5.5.3.1.1.2 B-Channel X.25 packet service

For B-channels providing the X.25 packet service defined in ISO/IEC 8208 [16], the SNDCF shall be as defined in ITU-T Rec. X. 622 | ISO/IEC 8473-3 [9] and ITU-T Rec. X.625 | ISO/IEC 8473-5.

5.5.3.2 D-channel

Recommendation Q.931 [62] shall be used over the D-channel for the purpose of ISDN connection establishment.

5.5.4 Data link layer

5.5.4.1 B-channel

ISO/IEC 7776 [13], used in accordance with ITU-T Rec. X.273 | ISO/IEC 11577 [59], shall be used in the B-channel.

5.5.4.2 D-channel

Recommendation Q.921 [24] shall be used in the D-channel.

5.5.5 Physical layer

Either Recommendation I.430 [22] (basic rate) or Recommendation I.431 [23] (primary rate) shall be used in the Physical layer.

5.6 RFC1006/TCP/IP protocol profile

This subclause defines an additional protocol profile for use as TMN lower layer protocols. This profile is based on the use of Internet Protocols defined by the Internet Architecture Board (IAB). The way these documents can be referenced in this Recommendation is for further study. The protocol stack is shown in Figure 3 and uses the following:

- For the top of Layer 4 – STD0035 "ISO Transport Service on top of the TCP (Version: 3)." May 1987. (Includes RFC1006). This document defines how to provide the TP0, ISO Transport Services over TCP.
- For the bottom of Layer 4 – STD0007 "Transmission Control Protocol", J. September 1981. (Includes RFC0793.)
- For Layer 3 – STD0005 "Internet Protocol", J. September 1981. (Includes RFC0791, RFC0950, RFC0919, RFC0922, RFC792, RFC1112). In addition, when larger addresses are required RFC1752 (reference RFC1752 "The Recommendation for the IP Next Generation Protocol", January 1995) should be used when approved.

  NOTE – Currently, RFC1752 is at the Proposed Standard status.
- The lower layers are not specified.

It should be noted that STD0035 (RFC1006) implements the ISO TP0 protocol on top of TCP/IP, not on top of the ISO/CCITT Network protocol. Since the Transport class 0 protocol is used over the TCP/IP connection, it achieves identical functionality as Transport Class 4. Hence, ISO/CCITT higher level layers (all session, presentation, and application entities) can operate fully without knowledge of the fact that they are running on a TCP/IP internetwork.

5.7 X.25/LAPB protocol profile (CONS1)

5.7.1 Physical layer profile

See 5.4.1.

5.7.2 Data link layer profile

See 5.4.2.

5.7.3 Network layer profile

It is mandatory that the packet layer conforms to Recommendation X.25 [12]. In addition, the packet layer must provide for connection of data terminal equipments without an intervening packet network; the required interface for this purpose conforms to ISO/IEC 8208 [16]. In addition, the provisions of ISO/IEC 8878 [26] and Recommendation X.223 [17] shall apply.

The attributes which must be supported are summarized in Tables 18 and 19. Note in particular that these tables show the different attributes needed to support PVCs [the X.25 Permanent Virtual Circuit (PVC) procedures] and Switched Virtual Circuits (SVCs) (the X.25/SVC procedures).

Table 18/Q.811 – X.25 [12] packet layer attributes for permanent virtual circuits

Feature	Range	Default
Extended Packet Sequence Numbering	Modulo 128 optional	
Packet size (octets)	128, 256 512, 1024, 2048, 4096 optional	(128)
Window size	1-7 (with Modulo 8)	(2)
Extended Sequence Number option	1-127 (with optional Modulo 128)	(2)
Interrupt packets	Optional	
NOTE 1 – The default values shall be part of a vendor's offering. That is, unless otherwise specified by the user, the default parameters shall be the initial values supplied. They can be subsequently changed by the user within the specified range. NOTE 2 – The attributes which are not marked optional are mandatory. NOTE 3 – The ranges specified for negotiated parameters in no way affect the normal negotiation rules specified in the International Standards.		

5.7.3.1 Numbering plans

To support communications over public networks, public numbering plans may be used on the packet-switched network between OSs and MDs/QAs/NEs. The 1988 versions of Recommendations E.164 [18] and X.121 [19] specify public numbering plans. Equipment may be assigned numbers in accordance with either of these international Recommendations. The escape code values of "0" and "9" shall be supported as specified in Table 2/X.121. Where a public numbering plan is not necessary, a private numbering plan may be used.

Network layer addressing as specified in CCITT Rec. X.213 | ISO/IEC 8348 [6] shall be supported.

Additional numbering plans, such as Q.708 for SS7 [58], may be supported in the future as the evolution of new subnetwork technologies require.

5.7.3.1.1 CLNP (ITU-T Rec. X.233 | ISO/IEC 8473-1) communication

When an instance of data communications involves use of the ITU-T Rec. X.233 | ISO/IEC 8473-1 CLNP, a Network Service Access Point (NSAP) address scheme shall be used. For examples of possible NSAP structures, refer to Appendix I.

5.7.3.2 Services profile

5.7.3.2.1 Expedited data negotiation

The initiator shall be capable of proposing the non-use of the expedited data service. Responders shall be capable of receiving requests for the expedited data service, but shall be capable of responding with non-use of the service. The expedited data service is neither required nor precluded by this Recommendation.

Table 19/Q.811 – X.25 [12] packet layer attributes for switched virtual circuits

Feature	Range	Default
Flow Control Parameter Packet size (octets)	128, 256 512 optional	128
Window size	1-7 (with Modulo 8)	2
Extended Sequence Number Option	1-127 (with optional Modulo 128)	2 (Note 5)
Throughput Class (Note 1) Bit rate (bit/s)	1200, 2400, 4800, 9600, 19 200 and 64 000	2400
Expedited Data Negotiation		
Closed User Group		
Closed User Group Selection Basic Format	2 decimal digits	
Bilateral Closed User Group Selection	**Optional**	
Fast Select Fast Select Acceptance	128 octets	
Hunt Group	Optional	
Transit Delay Selection and Indication		
Calling Address Extension		
Called Address Extension		
Minimum Throughput Class Negotiation		
End-to-End Transit Delay Negotiation		

NOTE 1 – Some countries may use 56 000 bit/s for an interim period of time. In addition to the codes specified in the Table in 7.2.2.2/X.25, 56 000 bit/s shall be encoded as binary 1 100. 48 000 bit/s is encoded as binary 1 100 in that table, but when 56 000 bit/s is supported, the code shall stand for 56 000 bit/s.

NOTE 2 – The default values shall be part of a vendor's offering. That is, unless otherwise specified by the user, the default parameters shall be the initial values supplied. They can be subsequently changed by the user within the specified range.

NOTE 3 – The attributes which are not marked optional are mandatory.

NOTE 4 – The ranges specified for negotiated parameters in no way affect the normal A negotiation rules specified in the International Standards.

NOTE 5 – The default window size for satellite operations is 35.

5.7.3.2.2 Receipt confirmation negotiation

The initiator shall be capable of setting bit 7 of the General Format Identifier to 0. Responders shall be capable of receiving bit 7 set to 1, but shall be capable of responding with bit 7 set to 0. The Receipt Confirmation Service is neither required nor precluded by this Recommendation.

5.7.3.2.3 Throughput class

When the end system requires only one Network layer connection on a physical access port, support of throughput classes up to the access line transmission rate is required. When multiple Network layer connections are required, support of the throughput class equal to the access line transmission rate is optional. Further study of Throughput Class range and default values at various access line rates is needed.

5.7.3.2.4 Packet size negotiation

Interoperability is achieved by having the initiator propose a packet size from the set specified in Tables 18 and 19 and by the responder selecting the most appropriate packet size between 128 and the proposed packet size. The rules for negotiation of the size of the packet to be used in a given instance of communication are specified in ISO/IEC 8208 [16].

The choice of packet size is a local issue which can depend on, for example, the overall Quality of Service requested or needed by the user or Application Layer, and the subnetwork characteristics.

5.7.3.3 Protocol profile

5.7.3.3.1 Equipment type during restart

When the packet level X.25 interface is used, automatic selection of the DCE/DTE role during restart is required, as specified in ISO/IEC 8208 [16].

5.7.3.3.2 Other features and parameters

The packet layer attributes are summarized in Tables 18 and 19.

5.7.3.3.3 User data field

When layers above X.25 are used, the initial octets of (N)-DATA primitive and the corresponding user data field are used for peer-to-peer protocol data for those layers.

In following the procedures of Recommendation X.244 [20], ISO/IEC TR 9577 [21], and Annex B of ISO/IEC 8073 [42] and Recommendation X.224 [43], the initial octets of the user data field of the call request packet may only be used for protocol identification. For those cases in which the fast select feature is used, the call request packet may contain a call user data field of up to 128 octets.

5.7.4 Transport layer profile

5.7.4.1 Services profiles

The Protocol Profiles described in this Recommendation provide the Connection-mode Transport Service (COTS) to the OSI upper layers that is defined in ITU-T Rec. X.214 | ISO/IEC 8072 [41].

5.7.4.1.1 Splitting

Responders may refuse Network connections which could impose an unnecessary restriction on the ability to establish outgoing Network connections. To prevent repeated ineffective attempts during splitting, initiators shall refrain from immediately requesting additional Network connections for a Transport connection after a Network connection has been refused. The time delay before requesting additional Network connections is for further study.

5.7.4.1.2 Quality of Service negotiation

Quality of Service negotiation is outside the scope of this Recommendation. If Quality of Service negotiation is not supported, receipt of the parameters "throughput", "residual error rate", "priority", and "transit delay" in the CR and CC TPDUs shall be ignored.

5.7.4.1.3 TPDU size negotiation

Interoperability is achieved by having the initiator propose a TPDU size from the set specified in Table 20 and by the responder selecting the most appropriate TPDU size between 128 and the proposed TPDU size. The rules for negotiation of the size of the TPDU to be used in a given instance of communication are specified in ISO/IEC 8073 [42] and Recommendation X.224 [43].

The choice of TPDU size is a local implementation issue.

5.7.4.1.4 Negotiation of protection

Negotiation of protection is outside the scope of this Recommendation. If negotiation of protection is not supported, receipt of the protection parameters in any CR TPDU and any CC TPDU shall be ignored.

5.7.4.2 Protocol profile

It is mandatory that for the connection-mode Network service, the Transport protocol shall conform to Recommendation X.224 [43] and to those provisions of ISO/IEC 8073 [42] and Recommendation X.224 [43] that apply to the use of the Connection-Mode Network layer Service (CONS).

5.7.4.2.1 Class of service

Classes 4, 2, and 0 shall be supported as shown in Table 20 in countries requiring the features of Transport layer Class 4. The conformance rules of Recommendation X.224 [43] require that Classes 0 and 2 be supported as well when Class 4 is specified. For existing equipment and in countries not requiring Class 4, support of Class 0 is mandatory and Class 2 is optional.

The default values shall be part of a vendor's offering. That is, unless otherwise specified by the user, the default parameters shall be the initial values supplied. They can be subsequently changed by the user within the specified range.

In addition to the requirements specified in Recommendation X.224 [43], equipment shall meet the following requirement: if a responder receives an alternate class of "none", it shall respond with the preferred class. Rules for responders are specified in Table 21.

User options shall be provided to designate the preferred and alternate classes (see Table 3/X.224 [43]). When all of the classes are supported, the preferred class for connection is Class 4.

Table 20/Q.811 – Transport layer attributes
[for Connection-mode Network layer Service (CONS)]

Attribute	Range	Default
Maximum TPDU (octets)	128, 256, 512, 1024 (2048, 4096, 8192 optional)	(128)
Class of Service	4, 2, 0	
Preferred Class	4, 2, 0	(4)
Alternative Class	4, 2, 0, none	(None)
Expedited Data	Non-use	
Options for Class 4		
Data TPDU numbering (Note 2)	Normal, extended	(Normal)
Options for Class 2		
Data TPDU numbering (Note 2)	Normal, extended	(Normal)
Flow control	Explicit	
Parameters for Class 4		
T1 – Retransmission time	0.25-64 seconds (Note 4)	(8)
N – Retransmissions	2 (other values for further study)	
L – Bound on reference	1-256 seconds	(32)
I – Inactivity time	2-512 seconds	(64)

NOTE 1 – Some systems may require TSAP-IDs. However, all systems shall be capable of generating called TSAP-IDs in CR TPDUs and capable of receiving calling and called TSAP-IDs in received CR and CC TPDUs, respectively.

NOTE 2 – Extended format option shall be implemented. Non-use of this option shall be negotiable. The responder shall honour the initiator's request whenever possible. Negotiation to other than what has been requested shall only occur under abnormal conditions, for example, severe congestion, as determined by the implementor. Initiators shall be prepared to operate in the mode confirmed by the responder.

NOTE 3 – Use of the checksum is required for the CR TPDU. An additional requirement is that all implementations shall support the negotiated "non-use" of the checksum. Initiators shall request and responders shall agree to "non-use" of the checksum.

NOTE 4 – The Transport layer T1 timer should always be greater than the link layer T1 timer.

Table 21/Q.811 – Valid response corresponding to preferred and any alternative class proposed in the CR TPDU

Preferred class	Alternative class			
	0	**2**	**4**	**None**
0	Not valid	Not valid	Not valid	Class 0
2	Classes 0, 2	Class 2	Not valid	Class 2
4	Classes 0, 2, 4	Classes 2 or 4	Class 4	Classes 2 or 4

5.7.4.2.2 Protocol identification

For the purpose of Transport layer protocol identification, the procedures specified in Annex B of ISO/IEC 8073 [42] and Recommendation X.224 [43] and ISO/IEC 11570 [55] shall be used. The

conventions for protocol identification given in ISO/IEC TR 9577 [21] should be followed. Selection of codes not specified in the referenced standards is for further study. The absence of call user data in a call request or call accept packet of Recommendation X.25 [12] and ISO/IEC 8208 [16] indicates the operation of the Transport layer procedures of ISO/IEC 8073 [42] and Recommendation X.224 [43].

5.7.4.2.3 Attributes

Attributes of the Transport layer for use with CONS are summarized in Table 20. The selection of values within required and optional ranges depends on characteristics of the messages.

NOTE – The need to support high priority messages that require low transit delay on a given Transport connection must be reflected in the Quality of Service parameters requested when the Transport connection is established. A properly implemented Transport entity should not multiplex high priority messages that require low transit delay if it cannot provide the requested Quality of Service. Since this is an implementation detail, it is not subject to standardization.

5.7.4.2.4 User data in connection request and connection confirm TPDUs

User data in the connection request and connection confirm TPDUs are optional in Recommendation X.224 [43]. No Transport service user shall send it: all protocol implementations shall be prepared to receive it and all implementations may ignore it, i.e. it shall not cause a disconnect.

5.7.4.2.5 Class 0 Error-TPDU

When Transport Class 0 has been negotiated, the Error Transport Protocol Data Unit (ER-TPDU) may be used at any time and upon receipt requires that the recipient disconnect the network connection and, by extension, the Transport connection.

5.7.4.2.6 Unknown CR TPDU parameters

An unknown parameter in any received CR TPDU shall be ignored.

When all of the classes are supported, the preferred class, when initiating a CR TPDU, shall be Class 4.

If a responder receives an alternative class of "none", implicit negotiation is enforced.

5.7.4.2.7 Invalid values of known CR TPDU

Known parameters with valid lengths but with invalid values in a CR TPDU shall be handled as depicted in Table 22.

Table 22/Q.811 – TPDU parameters

Parameter	Action
TSAP id	Send DR TPDU
TPDU size	Ignore parameter, use default
Version	Ignore parameter, use default
Checksum	Discard CR TPDU
Alternate protocol classes	Protocol error

5.7.4.2.8 Additional options parameter

Unrecognized or not applicable bits of the "additional options" shall be ignored.

5.7.4.2.9 Network Connection Management Subprotocol (NCMS)

The use of the NCMS, as specified in Annex B of ISO/IEC 8073 [42] and Recommendation X.224 [43], is optional. Implementations that support the NCMS shall be able to communicate with implementations that do not support the NCMS.

5.8 Packet mode bearer service on the D-channel (CONS2)

5.8.1 Physical layer profile

The Physical layer conforms to Recommendations I.430 [22] for basic rate access and I.431 [23] for primary rate access.

5.8.2 Link layer C-plane profile

The link layer C-plane conforms to Recommendation Q.921 [24] with the default parameters specified for links within the SAP identified by SAPI = 0.

5.8.3 Network layer C-plane profile

The Network layer C-plane conforms to Recommendation Q.931 [62]. Q.931 procedures are used as described in Recommendation X.31 [25] with encodings for information elements according to Recommendation X.31.

5.8.4 Link layer U-plane profile

The link layer U-plane profile conforms to Recommendation Q.921 [24] with the default parameters specified for links within the SAP identified by SAPI = 16.

5.8.5 Network layer U-plane profile

The Network layer U-plane conforms to International Standard ISO/IEC 8208 for DTE-DCE operation. The throughput class corresponds to the access-line bit rate of the D-channel which is 16 kbit/s. The Network layer attributes are specified in Table 19.

5.8.6 Provision of OSI-CONS

CCITT Rec. X.612 | ISO/IEC 9574 [40] provides the connection-mode Network service to packet mode terminal equipment connected to ISDN.

5.8.7 Transport layer profile

Same as Transport layer profile for CONS1 in 5.7.4.

5.9 Packet mode bearer service on the B-channel (CONS3)

5.9.1 Physical layer profile

The Physical layer conforms to Recommendations I.430 [22] for basic rate access and I.431 [23] for primary rate access.

5.9.2 Link layer C-plane profile

The link layer C-plane conforms to Recommendation Q.921 with the default parameters specified for links within the SAP identified by SAPI = 0.

5.9.3 Network layer C-plane profile

The Network layer C-plane conforms to Recommendation Q.931. Q.931 procedures are used as described in Recommendation X.31 with encodings for information elements according to Recommendation X.31.

5.9.4 Link layer U-plane profile

The link layer U-plane conforms to International Standard ISO/IEC 7776 for Single Link Procedures (SLPs) in DTE-DCE operation. The link layer attributes are specified in Table 17.

5.9.5 Network layer U-plane profile

The Network layer U-plane conforms to International Standard ISO/IEC 8208 for DTE-DCE operation. The throughput class corresponds to the access-line bit rate of the B-channel which is 64 kbit/s. The Network layer attributes are specified in Table 19.

5.9.6 Provision of OSI-CONS

CCITT Rec. X.612 | ISO/IEC 9574 [40] provides the connection-mode Network service to packet mode terminal equipment connected to ISDN.

5.9.7 Transport layer profile

Same as Transport layer profile for CONS1 in 5.7.4.

5.10 Signalling System No. 7 networks (CONS5)

- Layer 1 conforms to MTP (Level 1) [27].
- Layer 2 conforms to MTP (Level 2) [28].
- Layer 3 conforms to MTP (Level 3) [29] and SCCP [30] to [34].

  NOTE – Further study is needed for the function of SCCP at the boundary of Network layer and Transport layer.
- Layer 4 – OSI Transport layer per ITU-T Rec. X.214 | ISO/IEC 8072 [41], ISO/IEC 8073 [42] and Recommendation X.224 [43].

5.11 Connection oriented LAN (CONS6)

5.11.1 Physical layer profile

See 5.3.1.

5.11.2 Data link layer profile

See 5.3.2, and *replace* "Type 1" by "Type 2".

5.11.3 Network layer profile

For further study.

5.11.4 Transport layer profile

Same as Transport layer profile for CONS1 in 5.7.4.

5.12 Conformance requirements

This subclause specifies the conformance requirements for each profile by reference to its equivalent ISP (when it exists).

The default values shall be part of a vendor's offering. That is, unless otherwise specified by the user, the default parameters shall be the initial values supplied. They can be subsequently changed by the user within the specified range.

The attributes that are not marked optional are mandatory. See Table 23.

Table 23/Q.811 – Summary of ISP-based protocol profile conformance requirements

Protocol profile	Protocol layer	Requirements	Q.811 references	
			Subclause/Figure	Table
CONS1 (TP4/ X.25/ LAPB)			2.1.1, Fig. 2, 5.7, 5.12.3	Table 24
	Transport	ISO/IEC ISP 10609-1 [46] Subnetwork Independent Requirements for Group B as modified by Table II.1.	5.7.4 and subclauses	Tables 20, 21, 22 and II.1
	Network ISO/IEC 8208 X.25 PLP	ISO/IEC ISP 10609-9 [46] Subnetwork Dependent Requirements (TB1111/TB1121) as modified by Table II.2.	5.7.3 and subclauses	Tables 18, 19 and II.2
	Data Link	ISO/IEC ISP 10609-9 Subnetwork Dependent Requirements (TB1111/TB1121) as modified by Table II.3.	5.7.2 (5.4.2)	Tables 17 and II.3
	Physical	ISO/IEC ISP 10609-9 Subnetwork Dependent Requirements (TB1111/TB1121).	5.7.1 (5.4.1 and subclauses)	Tables 13, 14, 15 and 16
CLNS1 (CL-LAN)			2.1.3, Fig. 3, 5.3, 5.12.1	Table 24
	Transport	ISO/IEC ISP 10608-1 [45] Subnetwork Independent Requirements.	5.3.4, 5.7.4.1.2 to 5.7.4.1.4, 5.7.4.2.4, 5.7.4.2.6 to 5.7.4.2.8	Table 12
	Network ISO/IEC 8473 CLNP	ISO/IEC ISP 10608-1 Subnetwork Independent Requirements as modified by Table II.5.	5.3.3	Table 2, Tables 3 to 11 (where applicable), Table II.5
	Data Link	ISO/IEC ISP 10608-2 (TA51) [45].	5.3.2	
	Physical	ISO/IEC ISP 10608-2 (TA51).	5.3.1	Table 1
CLNS2 (TP4/ CLNS/ X.25)			2.1.4, Fig. 3, 5.4, 5.12.2	Table 24
	Transport	ISO/IEC ISP 10608-1 Subnetwork Independent Requirements.	5.4.4, 5.7.4.1.2 to 5.7.4.1.4, 5.7.4.2.4, 5.7.4.2.6 to 5.7.4.2.8	Table 12
	Network ISO/IEC 8473 CLNP	ISO/IEC ISP 10608-1 Subnetwork Independent Requirements as modified by Table II.5.	5.4.3, 5.4.3.2, 5.4.3.3	Table 2, Tables 3 to 11 (where applicable)
	Network ISO/IEC 8208 X.25 PLP	ISO/IEC ISP 10608-5 (TA1111/TA1121) as modified by Tables II.2 and II.4.	5.4.3.2 (5.7.3 and subclauses)	Tables II.2 and II.4
	Data Link	ISO/IEC ISP 10608-5 (TA1111/TA1121) as modified by Table II.3.	5.4.2	Tables 17 and II.3
	Physical	ISO/IEC ISP 10608-5 (TA1111/TA1121).	5.4.1	Tables 13, 14, 15 and 16
CLNS1/ CLNS2 Int'work	Network	ISO/IEC ISP 10613-7, 10613-8, 10613 -9 (RA51.11x1).		

5.12.1 CL-LAN profile (CLNS1)

Transport layer shall conform to ISO/IEC ISP 10608-1 [45] Subnetwork Type Independent requirements. Network layers shall conform to ISO/IEC ISP 10608, Part-1, as modified by Table II.5. Physical and Data link layers shall conform to ISO/IEC ISP 10608, Part-2 (TA51).

5.12.2 CL-WAN profile (CLNS2)

Transport layer shall conform to ISO/IEC ISP 10608-1. Network (CLNP) layers shall conform to ISO/IEC ISP 10608, Part-1, as modified by Table II.5. Packet layer shall conform to ISO/IEC ISP 10608-5 as modified by Tables II.2 and II.4. Physical and Data link layers shall conform to ISO/IEC ISP 10608, Part-5 (TA1111/TA1121).

5.12.3 ISDN profile (CLNS3)

Transport layer shall conform to ISO/IEC ISP 10608-1 [45] Subnetwork Type Independent requirements.

Network and lower layers are under study.

5.12.4 RFC1006/TCP/IP profile

For further study.

5.12.5 X.25/LAPB profile (CONS1)

Transport layer shall conform to ISO/IEC ISP 10609-1 [46] as modified by Table II.1. Packet layer shall conform to ISO/IEC ISP 10609-9, as modified by Table II.2. Data link and Physical layer profiles shall conform to ISO/IEC ISP 10609-9 (TB1111/TB1121), as modified by Table II.3.

5.12.6 Packet mode bearer on ISDN D-channel profile (CONS2)

For further study.

5.12.7 Packet mode bearer on ISDN B-channel profile (CONS3)

For further study.

5.12.8 Signalling System No. 7 profile (CONS5)

For further study.

5.12.9 Connection oriented LAN (CONS6)

Transport layer shall conform to ISO/IEC ISP 10609-1.

Network shall conform to ISO/IEC ISP 10609-9.

Data link (LLC and MAC) and Physical layers shall conform to ISO/IEC ISP 10609-10.

6 Network layer service

6.1 Network layer profiles

The following subclauses will describe three ways in which the lower three layers of the Protocol Profiles may be viewed as transparent to the Transport (layer 4) and the upper layers (5, 6 and 7).

NOTE – Table 10/Q.811 (1993), **Homogeneous lower layer protocol profiles**, has been deleted.

6.1.1 Existing lower layer profiles

The group of subnetworks described in clause 5 have been chosen so that the services provided by the respective Network layer protocols will ensure operation of the OSI Transport protocol. The services of the Transport layer, in turn, are those required for operation of the higher OSI layers (i.e. layers five to seven).

6.1.2 Network layer service description for new subnetworks

On a forward going basis, any subnetwork developed must meet the criteria provided for the Network layer service as viewed by the Transport layer. There are two services provided by the Network layer, the Connection-mode Network layer Service (CONS), and the Connectionless-mode Network layer Service (CLNS).

These services are described in CCITT Rec. X.213 | ISO/IEC 8348.

6.1.3 Non-conforming Network layer profile

For a subnetwork which does not, by itself, provide the CLNS, the addition of ITU-T Rec. X.233 | ISO/IEC 8473-1 with the proper choice of SNDCP will provide a combination that will meet the Network layer service description.

Subnetwork Dependent Convergence Protocols (SNDCPs) are described for the use of ITU-T Rec. X.233 | ISO/IEC 8473-1 over ISO/IEC 8208/X.25 networks, ISO/IEC 8802-2 subnetworks [5], subnetworks that provide the OSI Data Link service [10], and ISDN circuit-switched B-channels [11].

6.1.4 Security

ITU-T Rec. X.273 | ISO/IEC 11577 [59] specifies security features for the OSI Network layer, and some security capabilities are available in the Network layer protocols [e.g. mandatory Closed User Groups (CUGs) and optional bilateral CUGs in the X.25 packet protocol].

6.2 Internetworking

This subclause describes the technical principles for interworking between DCNs within a TMN, and between TMNs using different protocol stacks. In some cases interworking units have to be supplied between the different DCNs. It is the responsibility of the two TMN Administrations to determine which Administration shall provide the IWU. This interworking procedure is known as Network Layer Relay (NLR).

When networks of different types, such as connection-mode and connectionless-mode, wish to transfer information across the boundary, internetworking principles are stated in ITU-T Rec. X.200 | ISO/IEC 7498-1 [3] and ISO 8648 [15]. These standards state that internetworking should occur within the Network layer. The Transport layer and higher layers operate on a peer-to-peer basis between the communicating end systems. A family of subnetwork dependent convergence protocols has been developed [8] to [11] that provide for the operation of ITU-T Rec. X.233 | ISO/IEC 8473-1 over different subnetworks. Thus, in the example above, ITU-T Rec. X.233 | ISO/IEC 8473-1 would operate over both the connection-mode subnetworks and over the connectionless-mode subnetworks. The Transport layer, ISO/IEC 8073 [42] and Recommendation X.224 [43], would provide for operation over both the connection-mode subnetworks and the connectionless-mode subnetworks. In this example, the Transport layer would operate in the Class 4 mode. Thus, the internetworking between dissimilar subnetworks would be achieved and the Transport layer and higher layers of the end systems would operate on a peer-to-peer basis.

There are three basic principles to be followed in adopting interworking solutions between Q3/X protocol stacks.

The three principles are:

1) interworking should be done in the Network layer;

2) existing standards should be applied for interworking functions; e.g. X.300-Series Recommendations should be applied for interworking between certain types of CONS-based networks; and NLR using ITU-T Rec. X.233 | ISO/IEC 8473-1 and associated SNDCFs should be used for interworking between CLNS-based networks;

3) new interworking functions should be specified only if existing standards for interworking cannot meet requirements of new network capabilities.

Definition of the relaying functions of a CONS-CONS Network layer intermediate system is given in ISO/IEC 10028 [57]. How the Network internal layer service is provided for relaying between X.25 packet systems is given in ISO/IEC 10177 [56].

A general guide to interworking between the various Transport profile groups is given is ISO/IEC TR 10000-2 [65].

How relaying is performed between CLNS-based subnetworks is defined in ITU-T Rec. X.233 | ISO/IEC 8473-1 [7].

Table 24 shows Protocol Profiles which are to be applied to a reference point which has interworking, and defines internetworking methods.

NOTE – Table 11/Q.811 (1993), **Internetworking functions for Q3 lower layers**, has been deleted.

Table 24/Q.811 – Interworking between protocol profiles

Protocol Profile	CONS1 X.25 LAPB	CONS2 ISDN X.25 (D)	CONS3 ISDN X.25 (B)	CONS5 SS7	CONS6 CO-LAN	CLNS1 LAN	CLNS2 WAN	CLNS3 ISDN	RFC1006 TCP/IP
CONS1	Rec. X.75 [50]	Rec. X.325 [51]	Rec. X.325 [51]	Rec. X.326 [52]	Rec. X.327 [53]	Non-OSI	Non-OSI	Non-OSI	Non-OSI
CONS2		OSI (CONS)	OSI (CONS)	OSI (CONS)	OSI (CONS)	Non-OSI	Non-OSI	Non-OSI	Non-OSI
CONS3			OSI (CONS)	OSI (CONS)	OSI (CONS)	Non-OSI	Non-OSI	Non-OSI	Non-OSI
CONS5				OSI (CONS)	OSI (CONS)	Non-OSI	Non-OSI	Non-OSI	Non-OSI
CONS6					OSI (CONS)	Non-OSI	Non-OSI	Non-OSI	Non-OSI
CLNS1						OSI (CLNS)	OSI (CLNS)	OSI (CLNS)	Non-OSI
CLNS2							OSI (CLNS)	OSI (CLNS)	Non-OSI
CLNS3								OSI (CLNS)	Non-OSI
RFC1006									NLR (IP-IP)

Non-OSI	Interworking above the Network layer may be required.
OSI	Interworking is either connectionless-mode (CLNS) or connection-mode (CONS) within the Network layer.
NLR	Interworking is within the Internet Network layer (i.e. the IP layer).

ANNEX A

Protocol stack for information transfer over ISDN transparent B-channel

A.1 Introduction

This Annex describes a protocol stack for connection between data terminal equipment without an intervening packet switched network. End systems are making use of the 64 kbit/s unrestricted circuit-mode bearer service offered by an ISDN. The OSI connection-mode service (OSI-CONS) over ISDN transparent B-channel defined in this Annex is identified as CONS4 at the Q3 and X interfaces.

The CONS4 lower layer protocol profile provides for a connection-mode interface using ISDN transparent B-channel.

A.2 Protocol stack for CONS4 over ISDN transparent B-channel

Figure A.1 depicts the protocol stack CONS4 for network management.

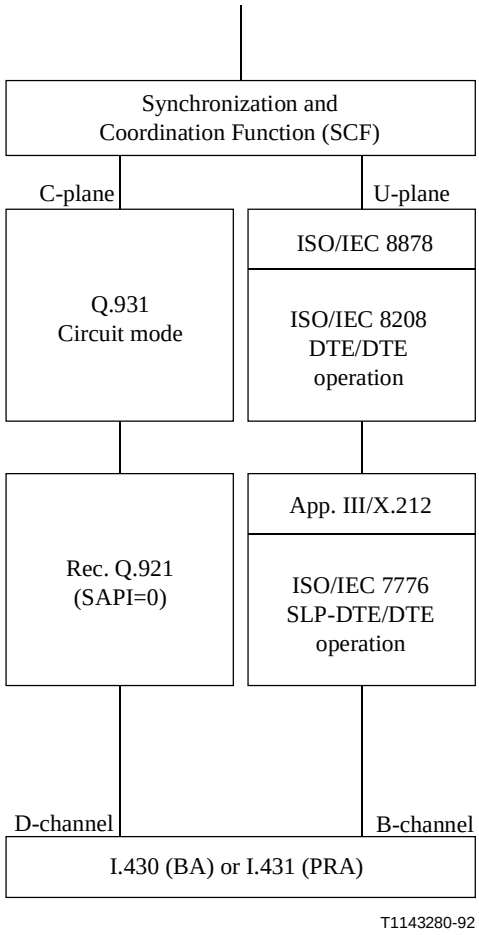

Figure A.1/Q.811 – Protocol profile on ISDN for network management

A.3 Network profile CONS4

A.3.1 Physical layer profile

The Physical layer conforms to Recommendations I.430 for basic rate access and I.431 for primary rate access.

A.3.2 Link layer C-plane profile

The link layer C-plane conforms to Recommendation Q.921 with the default parameters specified for links within the SAP identified by SAPI = 0.

A.3.3 Network layer C-plane profile

The Network layer C-plane conforms to Recommendation Q.931 for circuit-switched call control procedures using codings of information element as in Table A.1.

Table A.1/Q.811 – Q.931 Information element encodings in support of CONS4

Bearer Capability (BC) information element codings	
Coding standard (octet 3)	CCITT
Information transfer capability (octet 3)	Unrestricted digital information
Transfer mode (octet 4)	Circuit mode
Information transfer rate (octet 4)	64 kbit/s
Called party number information element codings	
Type of number (octet 3)	International/national/subscriber
Numbering plan identification (octet 3)	ISDN/telephony numbering plan (Rec. E.164)
Called/calling party subaddress information element codings	
Type of number (octet 3)	NSAP
Low Layer Compatibility (LLC) information element codings	
Coding standard (octet 3)	CCITT
Information transfer capability (octet 3)	Unrestricted digital information
Transfer mode (octet 4)	Circuit mode
Information transfer rate (octet 4)	64 kbit/s
User information Layer 1 protocol	Not applicable (omit octet 5)
User information Layer 2 protocol (octet 6)	ISO/IEC 7776 DTE-DTE operation
– Mode of operation (octet 6a)	Normal/extended (selectable by user whereby normal is a mandatory mode while extended is an optional mode)
– Window size (k) (octet 6b)	1-7 (for modulo 8) (default 7) 1-127 (for modulo 128) (default 7) 1-127 (for modulo 128) (default 35 for satellite operations) ISO/IEC 8208 DTE-DTE operation
User information layer 3 protocol (octet 7)	Normal (modulo 8)/extended (modulo 128)
– Mode of operation (octet 7a)	128, 256, 512 octets (default 128)
– Default packet size (octet 7b)	1-7 (for modulo 8)(default 2)
– Packet window size (k) (octet 7c)	1-127 (for modulo 128)(default 2)

A.3.4 Supplementary services

The supplementary service Sub-addressing (SUB) is required in order to convey the called and calling NSAP address in the called and calling party subaddress information element, respectively. In addition, the supplementary service Closed User Group (CUG) may be used to restrict, in a public Data Communication Network (DCN), access of endsystems which are the members of a TMN.

A.3.5 Link layer U-plane profile

The link layer U-plane conforms to International Standard ISO/IEC 7776 for Single Link Procedures (SLPs) in DTE-DTE operation. The link layer attributes are specified in Table 17.

A.3.6 Network layer U-plane profile

The Network layer U-plane conforms to International Standard ISO/IEC 8208 for DTE-DTE operation over circuit-switched connections.

Determining "DTE" or "DCE" characteristics is based on restart procedure:

a) acts as "DCE" when receiving RESTART INDICATION packet with the restarting cause field "DTE originated" and no restart collision occurred;

b) acts as "DTE" when a RESTART REQUEST packet is subsequently confirmed with a RESTART CONFIRMATION packet (no restart collision occurred);

c) re-initiates a restart procedure when a randomly-chosen time has elapsed following the detection of a restart collision.

The Network layer attributes specified in Table 19 apply with the additions contained in Table A.2.

Table A.2/Q.811 – Additional U-plane network layer attributes and parameters in support of CONS4

–	The throughput class corresponds to the access-line bit rate of the B-channel which is 64 kbit/s.	
–	The Network layer parameters which apply are:	
T20	Restart requires response timer	180 seconds
T21	Call request response timer	200 seconds
T22	Reset request response timer	180 seconds
T23	Clear request response timer	180 seconds
T24	Window status transmission timer	Not applicable
T25	Window rotation timer	Not applicable
T26	Interrupt response timer	180 seconds
T27	Reject response timer	Not applicable
T28	Registration request response timer	Not applicable
R20	Restart request retransmission count	1
R22	Reset request retransmission count	1
R23	Clear request retransmission count	1
R25	Data packet retransmission count	Not applicable
R27	Reject retransmission count	Not applicable
R28	Registration request retransmission count	Not applicable

A.3.7 Provision of OSI-CONS

The Synchronization and Coordination Function (SCF) (see Recommendation I.320 [63]) provides the connection-mode Network service to the Network service user.

APPENDIX I

Examples of NSAP structures for CLNP

This Appendix summarizes four examples of NSAP structure. Figures I.1, I.2, and I.3 show NSAP structures based on ISO-DCC. Figure I.4 shows an NSAP structure based on ISO-ICD.

	IDP		DSP			
	AFI	IDI				
	39	a)	JDI#	AREA	SYSTEM	SEL
Number of octets	1	2	3	n	6	1

a) ISO DCC (value of 392 as Japan).

\# JDI (value of 100009 as NTT)

n Range of value = 1-7

Figure I.1/Q.811 – DCC type NSAP address format in Japan Standard

	IDP		DSP			
	AFI	IDI				
	39	a)	ORG	AREA	SYSTEM	SEL
Number of octets	1	2	3	2	0-6	1

a) ISO DCC.

ORG Organization Identifier
AREA Subnetwork Identifier
SYSTEM Subnetwork address

Figure I.2/Q.811 – ECMA 117 NSAP format

	IDP		DSP						
	AFI	IDI	DFI						
	39	a)	128	org	res	rd	AREA	SYSTEM	SEL
Number of octets	1	2	1	3	2	2	2	6	1

a) ISO DCC.

DFI The DSP Format Identifier
org Organization Identifier
res Reserved
rd Routing domain prefix

Figure I.3/Q.811 – ANSI NSAP address format

	IDP		DSP			
	AFI	IDI				
	47	a)	DI	FI	TI	SEL
Number of octets	1	2	3	1	12	1

a) ISO ICD.

DI Domain Identifier
FI Format Identifier
TI Terminal Identifier
SEL NSAP selector

Figure I.4/Q.811 – ICD type NSAP address format for AOTC-Australia

APPENDIX II

Changes to ISP Conformance requirements
(Normative)

The "Identifier", "Feature", and "Status" fields under "Base Reference Standard" refer to the PICS for the particular base standard protocol; whereas the "Clause" field refers to the base protocol specification.

Notation:

a) *Base standard status notation*

1) Base standard type or range:

M	Mandatory.
O	Optional.
–	Not applicable.
O.<n>	Optional, but support of at least one of the group of options labelled by the same numeral <n> is required.
<index>:	This predicate symbol means that the status following applies only when the PICS states that one or more of the items identified by the index is supported. In the simplest case, <index> is the identifying tag of a single PICS item. <index> may also be a Boolean expression composed of several indices.
<index>::	When this group predicate is true the associated clause should be completed.

b) *Q.811 status notation*

The status column in Tables 16 and 17 uses either a one-or two-character notation. The one-character notation indicates the static requirements only. For the two-character notation, the first character is the static requirements and the second character is the dynamic requirements.

1) Static:

m	Mandatory, mandatory to be implemented.
i	Out of scope. Not relevant to this profile.
o	Optional, optional to be implemented.
&	Same as Base Standard.

2) Dynamic:

m	Mandatory (use is mandatory).
x	Excluded (use is prohibited within the context of this profile).
–	Not applicable.

Table II.1/Q.811 – Transport layer

Base Standard				ISP	Rec. Q.811	
Ident.	**Feature**	**Subclause**	**Status**	**Status**	**Subclause**	**Status**
NAC2	Class 2	6.5.4.h)	NC2: None 0,1,2	NC2: at least 0		TBD
NAC4	Class 4	6.5.4.h)	NC4: None 0,1,2,3,4	NC4: at least 0	Table 20	NC4: None, 0,2
NEF2	Class 2	6.5.4.k)	I2R2, T2F14:O	I2R2, T2F14:oo	Table 20	mo
NEF5	Class 3	6.5.4.k)	I3R2, T3F14:O	I0R2, T0F14:oo I2R2, T2F14:oo		
NEF6	Class 4	6.5.4.k)	I4R2, T4F14:OO	I2R2, T2F14:oo I4R2, T4F14:oo		
RC4	What classes can you respond with if CR proposes only Class 4?	6.5.4.h) Table 3	I4R2 or I2R2:4 or 2	I2R2:2, I4R2:4	Table 21	I4R2:4
RC4a	What classes can you respond with if CR proposes Class 4 as preferred class and the alternative class parameter is present?	6.5.4.h) Table 3	I4R2:4, I2R2:2, I0R2:0 depending on coding of alternative class	I4R2:4, I2R2:2, I0R2:0 depending on coding of alternative class	Table 21	Only I4R2:4
S2	Support of NCMS function	Annex B	O	oi		oo
S3	Support of Class 4 over CLNS		O	oi	5.3.4	C4L:mm
TED6	Class 2	6.5.4.r)	I2R2, T2F15:O	I2R2, T2F15:oo	Table 20	ox
TED8	Class 4	6.5.4.r)	I4R2, T4F15:O	I0R2, T0F15:ox	Note 3 of Table 20	o
NUC1	Is "Non-use of checksum" proposed in CR?	6.5.4.m)	I4R1:mo	I4R1:mo	Note 3 of Table 20	I4R1:mm
NUC2		6.5.4.m)	I4R2:O	I4R2:mo	Table 20	I4R2:mm

Table II.2/Q.811 – Packet layer

Base Standard				ISP	Rec. Q.811	
Ident.	**Feature**	**Subclause**	**Status**	**Status**	**Subclause**	**Status**
Et/d	DTE/DTE with dynamic role selection	4.5	Vs: O.2	oi	5.7.3.3.1	mm
M128	Modulo 128 (extended)	13.2, 12.1.1, Table 3	O.3	ox	Table 19	oo
V2s	Default window sizes supported, sending	16.2.2.6	M8: 1-7 M128: 1-127	M8: 1-7 M128: o-	Table 19 Table 19	M8: 2 M128: 2
V2r	Default window sizes supported, receiving	16.2.2.6	M8: 1-7 M128: 1-127	M8: 1-7 M128: o-	Table 19 Table 19	M8: 2 M128: 2
V10s	Window sizes supported, sending	15.2.2.1.2	M128: 1-127	M128: o-	Table 19	M128: 1-127
V10r	Window sizes supported, receiving	15.2.2.1.2	M128: 1-127	M128: o-	Table 19	M128: 1-1
T24	Window Status Transmission Timer		O	ox	Table 19	oo
T25	Window Rotation Timer		O	ox	Table 19	oo
FS5 FR5	Bilateral Closed User Group Selection	13.15 15.2.2.5	O		Table 19	oo

Table II.3/Q.811 – Data link layer

Base Standard				ISP	Rec. Q.811	
Ident.	**Feature**	**Subclause**	**Status**	**Status**	**Subclause**	**Status**
Ii	DTE/DTE Interworking	0	O	oi	5.4.2.2.1	m
T2	Parameter T2 procedure	5.7.1.2, 5.7.1.1	O		Table 17	m
T3	Parameter T3 procedure	5.7.1.3	O		Table 17	m
T4	Parameter T4 procedure	5.7.1.4, 5.3.2	O		Table 17	m
SP8	If Modulo 8 was checked with SLP (N1>=1080)	5.7.3	M		Table 17	m
SP128	If Modulo 128 was checked with SLP (N1>=1088)		M		Table 17	m

NOTE for Tables II.1, II.2 and II.3 – The referenced ISP is ISO/IEC ISP 10609, Parts 1 and 9 (TB1111/TB1121) [46].

Table II.4/Q.811 – CLNS2 protocol case – Packet layer

Base Standard				ISP	Rec. Q.811	
Ident.	**Feature**	**Subclause**	**Status**	**Status**	**Subclause**	**Status**
Vp	PVC		O.1	i		&
Vs	VC		O.1	mm		&
Et/d	DTE/DTE with dynamic role selection	4.5	Vs: O.2	Vs: i	5.5.3	mm

Table II.5/Q.811 – CLNS2 and CLNS1 protocol cases – ITU-T Rec. X.233 | ISO/IEC 8473-1 CLNP

Base Standard				ISP	Rec. Q.811	
Ident.	**Feature**	**Subclause**	**Status**	**Status**	**Subclause**	**Status**
	QOS Maintenance	7.5.6	O	i	Table 2	mm

NOTE for Tables II.4 and II.5 – Reference is to ISO/IEC ISP 10608, Parts 1, 2 (TA51), and Part 5 (TA1111/TA1121) [45].

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