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Foreword

This ETSI Technical Report (ETR) has been produced by the Network Aspects (NA) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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This ETR describes the encapsulation methods for carrying network interconnect traffic over Asynchronous Transfer Mode (ATM) based subnetworks.

The proposed methods use the Logical Link Control / Sub Network Access Protocol (LLC/SNAP) encapsulation scheme as developed originally by IEEE 802.6i [1], later on adopted by the Internet Engineering Task Force (IETF) of the Internet Society or the Network Layer Protocol Identifier (NLPID) scheme for the specific case of Frame Relay (FR) over ATM. The encapsulation methods cover aspects of bridging and routeing.

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1 Scope

This ETSI Technical Report (ETR) proposes the encapsulation methods that should be applied for carrying network interconnect traffic over Asynchronous Transfer Mode (ATM) based subnetworks. Three examples are detailed:

- multiprotocol interconnect over Connectionless Network Access Protocol (CLNAP) as defined in ITU-T Recommendation I.364 [12];

- multiprotocol interconnect over ATM Adaptation Layer type 5 (AAL type 5) with empty "Service Specific Convergence Sublayer (SSCS)" as defined in ITU-T Recommendation I.363 [11];

- multiprotocol interconnect over Frame Relay (FR) SSCS as defined in ITU-T Recommendation I.365.1 [13].

2 References

This ETR incorporates by dated and undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETR only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] IEEE 802.6i: "Media Access Control (MAC) Bridges: IEEE 802.6 Distributed Queue Dual Bus (DQDB) Subnetwork of a Metropolitan Area Network (MAN)".

[2] IEEE 802.1: "Local and Metropolitan Area Networks".

[3] IEEE 802.3: "Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".

[4] IEEE 802.4: "Token-Passing Bus Access Method and Physical Layer Specifications".

[5] IEEE 802.5: "Token Ring Access Method and Physical Layer Specifications".

[6] ISO/IEC IS 8802-6 (1994): "Information technology - Telecommunications and information exchange between systems - Local and Metropolitan Area Networks - Specific requirements - Part 6: Distributed Queue Dual Bus (DQDB) access method and physical layer specifications".

[7] ISO/IEC IS 8802-2 (1989): "Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements -- Part 2: Logical link control".

[8] ISO/IEC TR 11802-1 (1995): "Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Technical reports and guidelines -- Part 1: The structure and coding of Logical Link Control addresses in Local Area Networks".

[9] ISO/IEC TR 8802-1: "Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements -- Part 1: Overview of Local Area Network Standards".

[10] ISO/IEC TR 9577 (1993): "Information technology -- Telecommunications and information exchange between systems -- Protocol identification in the network layer".

[11] ITU-T Recommendation I.363 (1993): "B-ISDN ATM adaptation layer (AAL) specification".

[12] ITU-T Recommendation I.364 (1993): "Support of broadband connectionless data service on B-ISDN".

[13] ITU-T Recommendation I.365.1 (1993): "Frame relaying service specific convergence sublayer (FR-SSCS)".

[14] ITU-T Recommendation Q.922: "ISDN data link layer specification for frame mode bearer services".

[15] RFC 1042 (1988): "A standard for the transmission of IP datagrams over IEEE 802 networks".

[16] RFC 1188 (1990): "A Proposed Standard for the Transmission of IP Datagrams over FDDI Networks".

[17] RFC 1209: "The Transmission of IP Datagrams over the SMDS Service".

[18] RFC 1294: "Multiprotocol Interconnect over Frame Relay".

[19] RFC 1356 "Multiprotocol Interconnect on X.25 and ISDN in the Packet Mode".

[20] RFC 1483: "Multiprotocol Encapsulation over ATM Adaptation Layer 5".

3 Abbreviations

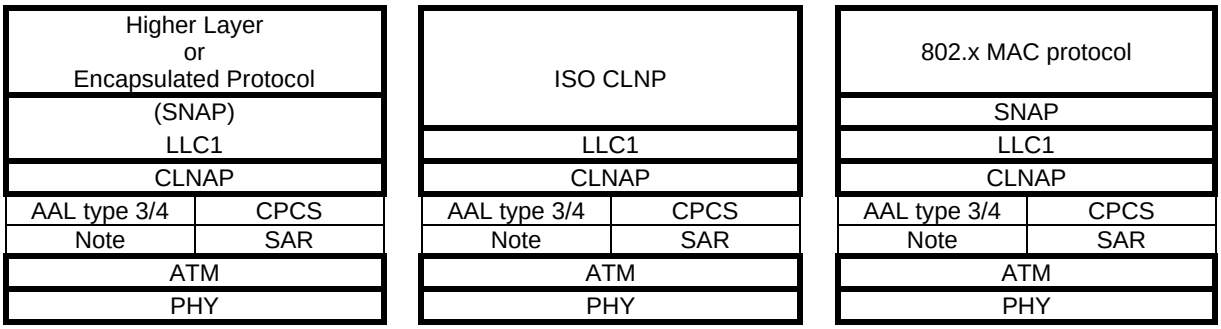
For the purposes of this ETR, the following abbreviations apply:

AAL	ATM Adaptation Layer
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband Integrated Services Digital Network
BPDU	Bridge Protocol Data Unit
CIB	CRC Indication Bit
CLNAP	ConnectionLess Network Access Protocol
CLNP	Connectionless Network Protocol
CPCS	Common Part Convergence Sublayer
DA	Destination Address
DSAP	Destination Service Access Point
FCS	Frame Check Sequence
FR	Frame Relay
HE	Header Extension
HEL	Header Extension Length
HLPI	Higher Layer Protocol Identifier
IDP	Internet Datagram Protocol
IETF	Internet Engineering Task Force
IP	Internet Protocol
LAN	Local Area Network
LLC	Logical Link Control
MAC	Medium Access Control
NLPID	Network Layer Protocol Identifier
OUI	Organizationally Unique Identifier
PL	Pad Length
PDU	Protocol Data Unit
PHY	Physical layer
PID	Protocol Identifier
QoS	Quality of Service
RFC	Request For Comments
SA	Source Address
SAR	Segmentation And Reassembly
SMDS	Switched Multimegabit Data Service
SNAP	Sub Network Access Protocol
SSAP	Source Service Access Point
SSCS	Service Specific Convergence Sublayer

4 Encapsulation scheme

In the following, the protocol stacks for the three cases mentioned above, and the resulting Protocol Data Unit (PDU) formats are depicted. These proposals are in line with existing multiprotocol implementations over Local Area Networks (LANs), Switched Multimegabit Data Service (SMDS), AAL type 5 and FR as described in IEEE 802.6i [1], RFC 1042 [15], RFC 1188 [16], RFC 1209 [17], RFC 1294 [18], RFC 1356 [19] and RFC 1483 [20].

4.1 Multiprotocol over CLNAP



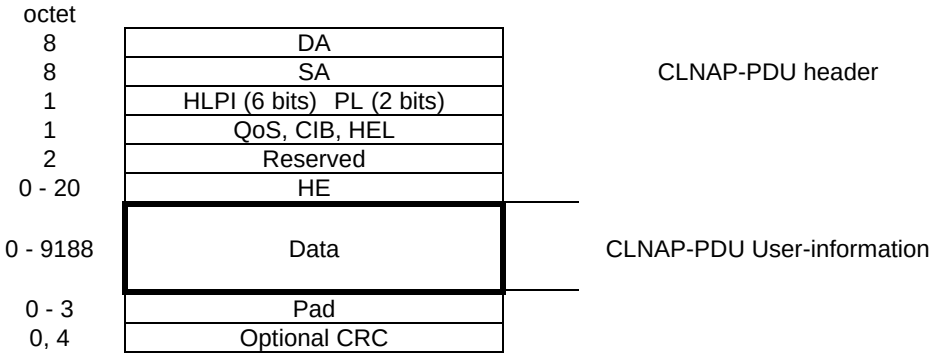
Generic protocol stack

Example 1: ISO standardized network layer protocol

Example 2: Encapsulated protocol

CLNP:	Connectionless Network Protocol	PHY:	Physical layer
CPCS:	Common Part Convergence Sublayer	SAR:	Segmentation And Reassembly
MAC:	Medium Access Control		

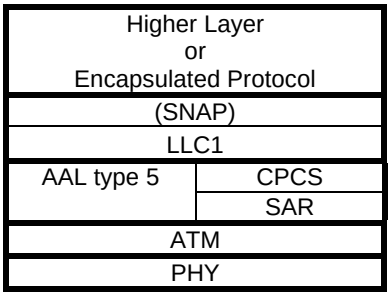
NOTE: AAL type 3/4 SSCS is empty.



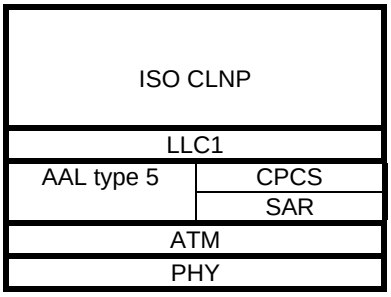
CIB:	CRC Indication Bit	HLPI:	Higher Layer Protocol Identifier
DA:	Destination Address	PL:	Pad Length
HE:	Header Extension	QoS:	Quality of Service
HEL:	Header Extension Length	SA:	Source Address

The "Higher Layer Protocol Id" (HLPI) field in the CLNAP-PDU header is set to the assigned value for LLC (decimal 1) (ITU-T Recommendation I.364 [12], ISO/IEC 8802-6 [6]).

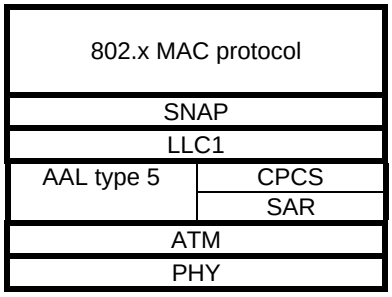
4.2 Multiprotocol interconnect over AAL type 5 with empty SSCS



Generic protocol stack

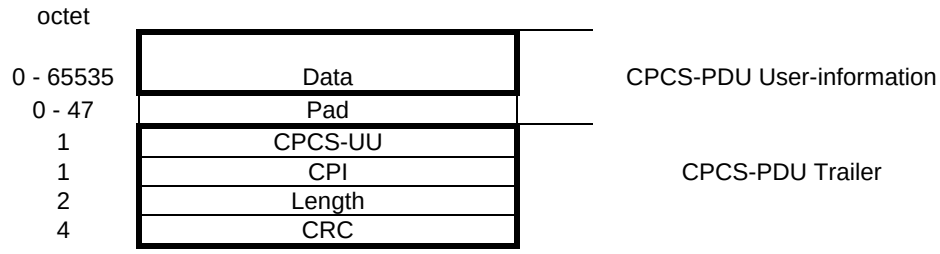


Example 1: ISO standardized network layer protocol



Example 2: Encapsulated protocol

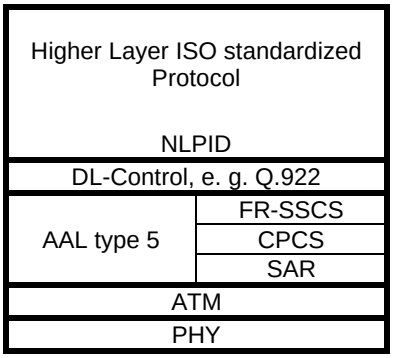
All encapsulated (bridged) and higher layer (routed) PDUs need to be encapsulated in the AAL type 5 Common Part payload field. The format of the AAL type 5 Common Part PDU is as follows:



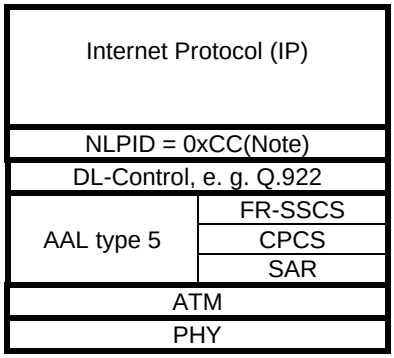
4.3 Multiprotocol interconnect over FR-SSCS

An encapsulation scheme for FR as well as ISDN and X.25 is defined in RFC 1294 [18] and RFC 1356 [19] using a one octet Network Layer Protocol Identifier (NLPID). As a FR end system shall not see any difference between an ATM based or native FR virtual circuit, the same encapsulation scheme shall be used.

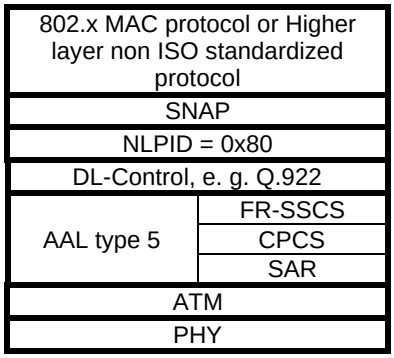
4.3.1 NLPID encapsulation scheme



Case 1: ISO standardized network layer protocol



Case 2: IP

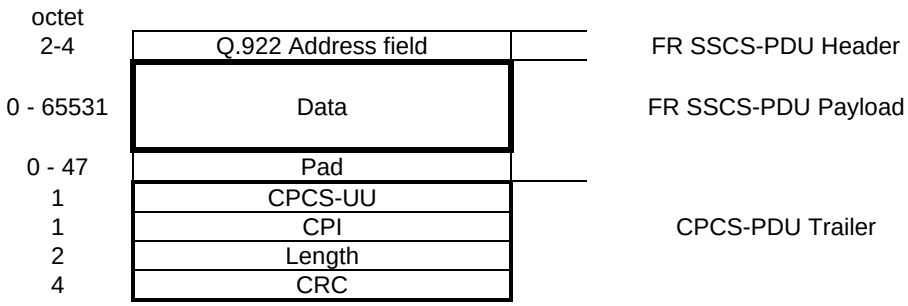


Case 3: Encapsulated protocol or non ISO standardized Higher layer protocol

The IP can be encapsulated in different ways (Direct unique NLPID or SNAP variant). The SNAP variant shall only be used if no unique NLPID value is assigned to a given protocol.

4.3.2 Resulting FR-SSCS PDU

All encapsulated (bridged) and higher layer (routed) PDUs need to be encapsulated between the FR-SSCS header and the AAL type 5 Common Part trailer. The format of the FR-SSCS PDU is as follows:



Q.922: ITU-T Recommendation Q.922 [14].

When ITU-T Recommendation Q.922 [14] is used as the DL-Control protocol, one padding octet may be used after the DL-Control octet to align the NLPID to a two-octet boundary with reference to the beginning of the encapsulating PDU. If present, the padding octet shall be set to "0".

5 Encapsulation format for higher layer (routed) PDUs

Figure 1 shows the encapsulation scheme for routed PDUs over the two distinct cases of ATM based subnetworks.

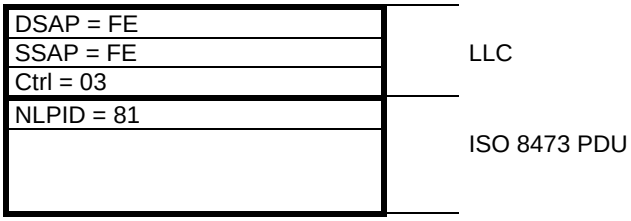
5.1 General case

In LLC/SNAP encapsulation the carried protocol is always identified by prefixing the Encapsulated/Higher Layer PDU by an LLC header possibly followed by an SNAP header. The LLC header consists of three fields (see ISO/IEC 8802-2 [7]):

DSAP: Destination Service Access Point SSAP: Source Service Access Point

For ISO network layer protocols the LLC header value is 0xFE-FE-03 (see ISO/IEC 11802-1 [8]

The following figure gives an example of the resulting user information in the ATM based subnetwork PDU.



The carried ISO protocol is identified by a one octet NLPID field that is part of protocol data. Values for this field are defined in ISO/IEC 9577 [10]. A list of NLPIDs is given below:

0x00 Null Network Layer or Inactive Set (not used)
0x80 SNAP (not used in LLC context)
0x81 ISO CLNP
0x82 ISO ES-IS
0x83 ISO IS-IS
0xCC IP (not used in LLC context)

For non-ISO protocols (e.g. XEROX Network System Internet Datagram Protocol (IDP)) the LLC header value 0xAA-AA-03 indicates that an SNAP header follows. A SNAP header is of the form (see ISO/IEC 8802-1 [9]):

octet	
3	OUI
2	PID

The three-octet Organizationally Unique Identifier (OUI) identifies an organization which administers the meaning of the following two-octet Protocol Identifier (PID). Together they identify a distinct protocol (ISO/IEC 8802-1 [9]).

NOTE: OUI 0x00-00-00 specifies that the following PID is an EtherType.

The following figure gives an example of the resulting user information in the ATM based subnetwork PDU.

DSAP = AA	LLC
SSAP = AA	
Ctrl = 03	
OUI = 00 00 00	SNAP
Ethertype = 06 00	
	XEROX NS IDP PDU

5.2 FR AAL type 5 SSCS case

The carried protocol is always identified by an NLPID octet. Thus ISO standardized protocols are self-identified and non ISO protocols are identified through a NLPID/SNAP scheme with the exception of IP which is identified by a specially allocated NLPID value of 0xCC (See figure 1).

6 Encapsulation format for encapsulated (bridged) PDUs

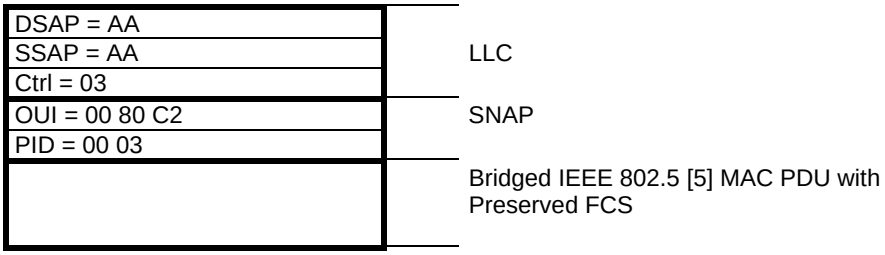
The second type of ATM based subnetwork traffic is bridged PDUs (IEEE 802.6i [1]. They are encapsulated using the LLC header value of 0xAA-AA-03 in LLC/SNAP encapsulation scheme or the NLPID value of 0x80 in the NLPID/SNAP encapsulation scheme.

Figure 1 shows both encapsulation schemes for bridged MAC PDUs over the two distinct cases of ATM based subnetworks.

The SNAP header identifies the format of the bridged PDU. The OUI value used for this encapsulation is IEEE 802.1 [2] organization code 0x00-80-C2. The following two octets (PID) specify the form of the MAC header. Additionally, the PID indicates whether the original Frame Check Sequence (FCS) is preserved within the bridged PDU.

Padding shall be introduced before the header of the encapsulated MAC frame to simplify implementations. When possible, both the 48 bit MAC destination address and the beginning of the frame information field shall be aligned to a multiple of four octets with reference to the start of the encapsulating PDU. When both fields can not be aligned to a four octet boundary, as is the case with IEEE 802.3 [3]/Ethernet frames, the beginning of the information field shall be aligned. If present, the padding octets shall be set to '0'.

The following figure gives an example of the resulting user information in the ATM based subnetwork PDU.



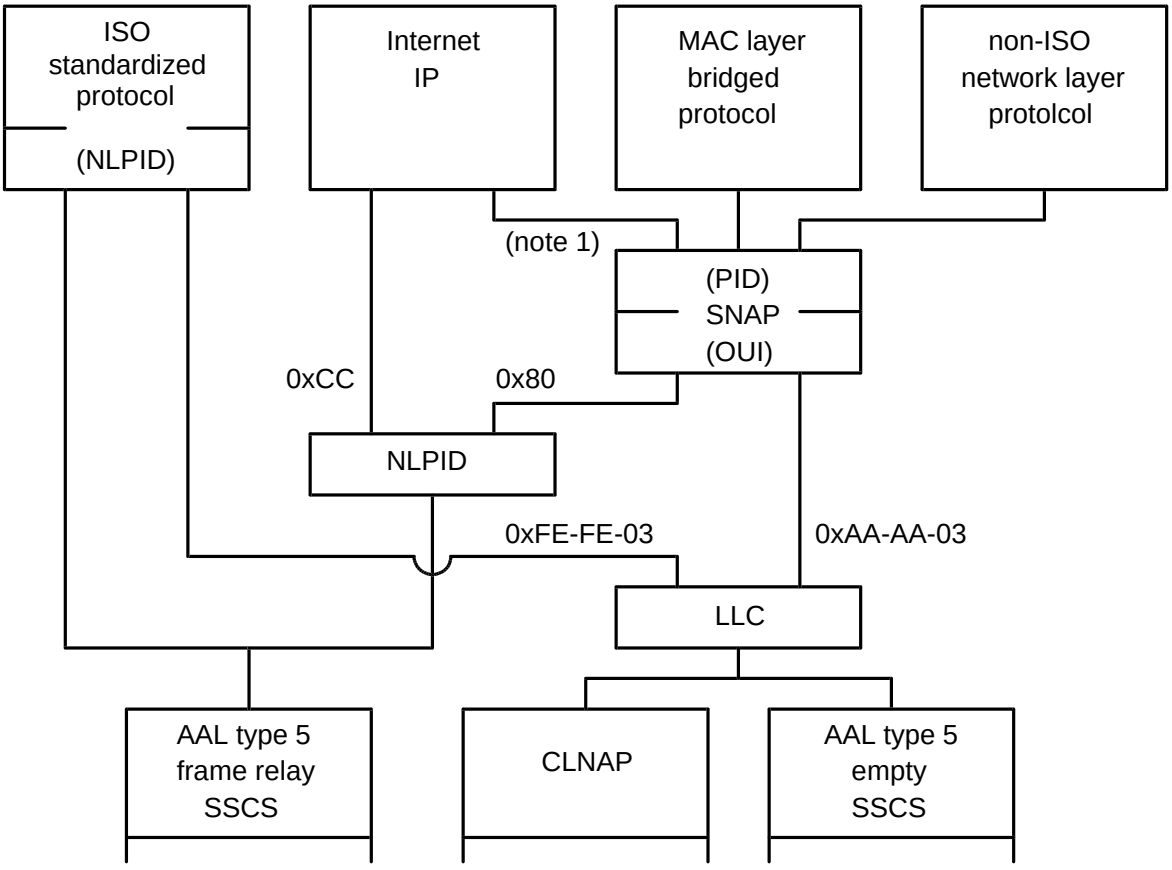
Padding is not shown in this figure.

IEEE 802.1 [2] has reserved the following values:

PID Values for OUI 0x00-80-C2

with preserved FCS	without preserved FCS	Media Access Protocol
0x00-01	0x00-07	IEEE 802.3 [3]/Ethernet
0x00-02	0x00-08	IEEE 802.4 [4]
0x00-03	0x00-09	IEEE 802.5 [5]
0x00-04	0x00-0A	FDDI
0x00-05	0x00-0B	IEEE 802.6i [1]

In addition, the PID value 0x00-0E, when used with OUI 0x00-80-C2, identifies Bridge Protocol Data Units (BPDUs) exchanged between Remote Bridges.



NOTE 1: This path is not used in case of an AAL type 5 FR-SSCS according to the preference rule given in subclause 4.3.1

Figure 1: Multiprotocol encapsulation over ATM based subnetworks

History

Document history	
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