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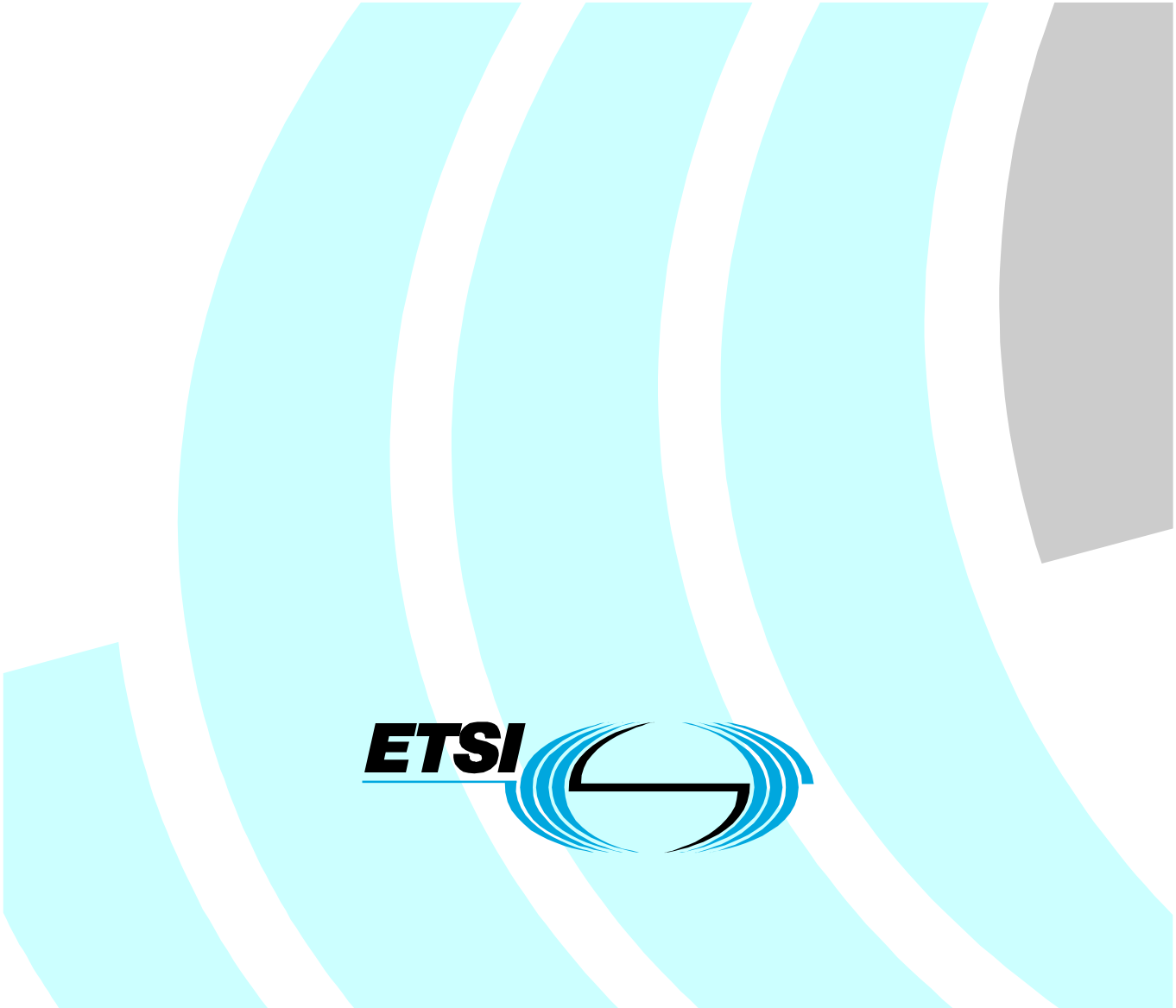
Technical Report

Services and Protocols for Advanced Network (SPAN);
Integrated Services Digital Network (ISDN);
Potential solutions to support the transmission of PPP



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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Services and Protocols for Advanced Networks (SPAN).

1 Scope

The present document gives guidance on potential solutions to support the tranmission of Point-to-Point Protocol (PPP) packets over the D channel of an ISDN access without the need of an X.25 virtual circuit as used and defined in the Always On/Dynamic ISDN (AO/DI) [1] networking service.

2 References

For the purposes of this Technical Report, the following references apply:

[1] IETF, PPP extensions, draft-ietf-pppext-aodi-02: "Always On/Dynamic ISDN (AO/DI)" (http://www.ietf.org/proceedings/00jul/I-D/pppext-aodi-02.txt)

[2] IETF, RFC1548: "The Point-to-Point Protocol (PPP)".

[3] IETF, RFC1990: "The PPP Multilink Protocol (MP)".

[4] ITU-T Recommendation Q.921: "ISDN User-Network interface - Data link layer specification".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following term and definition applies:

Always On/Dynamic ISDN (AO/DI): networking service that provides an always-available connection to TCP/IP based services

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AO/DI	Always On/Dynamic ISDN
IETF	Internet Engineering Task Force
IP	Internet Protocol
ISDN	Integrated Services Digital Network
LAPD	Link Access Protocol on channel D
LCP	Link Control Protocol
MP	Multilink Protocol
MPoLAPD	Multilink Protocol over LAPD
MRRU	Maximum Receive Reconstructed Unit
MRU	Maximum Receive Unit
MTU	Maximum Transfer Unit
NCP	Network Control Protocol
PPP	Point-to-Point Protocol
PPPoLAPD	Point-to-Point Protocol over LAPD
RFC	Request For Comment
SAPI	Service Access Point Identifier
TCP/IP	Transmission Control Protocol/IP
TCP/UDP	Transmission Control Protocol/UDP
TEI	Terminal End-point Identifier
UDP	User Data Protocol

4 Description

AO/DI [1] is a networking service that provides an always-available connection to TCP/IP based services. This service is provided to ISDN subscribers; an ISDN D channel permanent logical link is established between the subscriber and a packet handler, a X.25 virtual circuit is then established between the subscriber and his Internet service provider. This virtual circuit is used to establish an Internet connection, when bandwidth is required for the transmission of Internet data (downstream and/or upstream), one or two B channels are established.

The present document gives guidance on potential solutions to support the transmission of Point-to-point Protocol (PPP) packets over the D channel of an ISDN access without the need of an X.25 virtual circuit as used and defined in the Always On/Dynamic ISDN (AO/DI) networking service.

5 LAPD restrictions

Whereas fragmentation exists at X.25 level, using bit M (More), there is no such mechanism within LAPD. As specified by ITU-T Recommendation Q.921 [4], the maximum number of octets in the information field is 260, thus the internet packets shall fit into these 260 octets.

The LAPD address and control fields pair shall be defined for the implementation. The address field is composed of the SAPI and TEI values. The SAPI standardized values do not suit for the implementation of PPP over LAPD (values 0, 12, 16 or 63). A new codepoint is preferred for the identification of internet traffic on an ISDN access. For the allocation of the TEI value, two methods are available: TEI value assigned non-automatically or automatically. Having a non-automatically assigned value ([0; 63]) will limit the responsibility of the local exchange which will have in charge a routing function. But as a procedure for the allocation of a TEI value already exists in all local exchange, it could be re-used for the allocation of a TEI value ([64; 128]). To be respectful with TEI assignment for permanent logical links using SAPI 16, a similar solution shall be implemented for a the allocation of TEI values for the transportation of internet packets over the D channel, i.e. a non-automatically assigned value method.

The control field shall be encoded as "unnumbered information" as the management entity does not request acknowledgement of the transferred information.

The LAPD header shall be encoded as shown in table 1.

Table 1: LAPD frame global structure to transfer internet packets

8	7	6	5	4	3	2	1		
Flag (0x7E)								octet	1
SAPI						C	0		2
TEI							1		3
0	0	0	P	0	0	1	1		4
Information (260 octets)									5 …
FCS (first octet)									N-2
FCS (second octet)									N-1
Flag (0x7E)									N

6 PPP over LAPD (PPPoLAPD)

The length of a PPP frame is fixed by parameter Maximum Receive Unit (MRU) which is negotiated at the beginning of any PPP session, during the first negotiation phase using the Link Control Protocol (LCP). There are three basic phases of negotiation: Link Control Protocol (LCP) negotiation, Authentication & Link Quality Management and Network Control Protocol (NCP) negotiation. The MRU is used for both subsequent NCP negotiation messages and user data messages. The MRU value shall be negotiated to transfer the largest negotiation message or any user IP datagram. If the negotiated MRU is too small, it may need to be altered to allow authentication procedure.

The value of the MRU is a two octets length parameter. This value is the maximum size of a PPP information field that the implementation can receive; it does not include the LAPD address, control or check fields or the PPP protocol field. As the LAPD frame structure limits to 260 octets the size of the information field, the MRU shall be fixed to 258 octets (2 octets are reserved for the PPP protocol field).

Table 2 shows the LAPD information field.

Table 2: LAPD information field of a LAPD frame

8 7 6 5 4 3 2 1	
PPP	octet 1
protocol	2
PPP information & padding (258 octets)	…
	260

PPP does not include any fragmentation mechanism (PPP Multilink Protocol does), thus having a 258 octets length PPP information and padding fields limits the size of an IP datagram up to 258 octets. It is at the IP level that a fragmentation mechanism is implemented. Each TCP packet or UDP datagram would be fragmented into small parts that are encapsulated into IP datagrams. Figure 1 shows the PPP, IP, TCP or UPD layers.

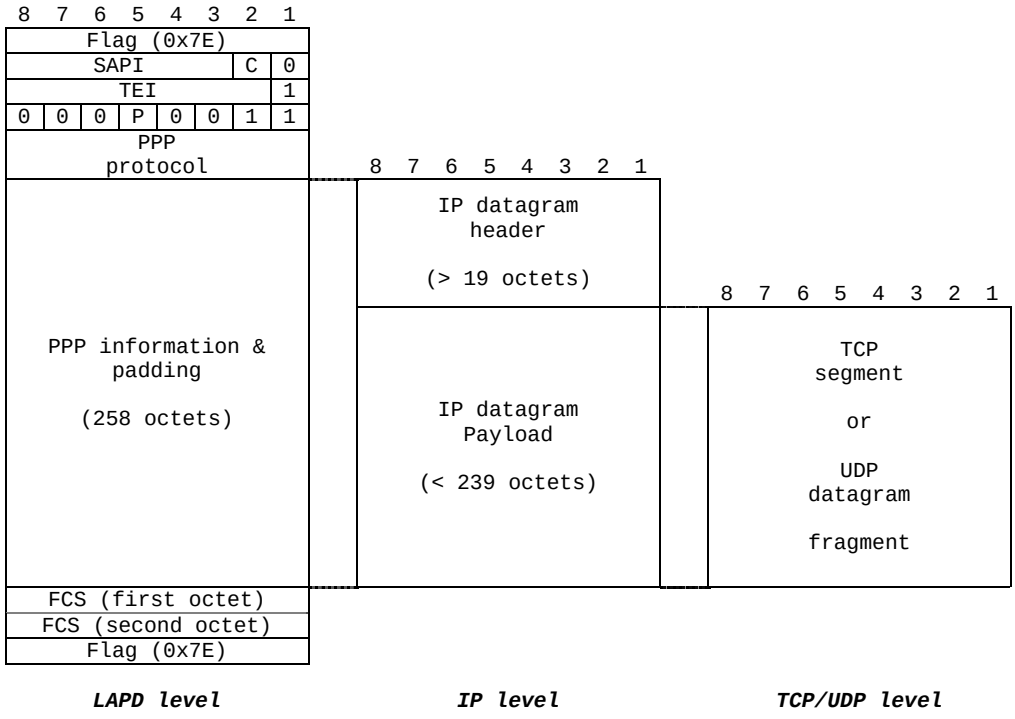

Figure 1: LAPD, IP, TCP/UDP layers

7 MP over LAPD (MPoLAPD)

A second solution to implement internet protocols over LAPD of an ISDN access is to use the PPP Multilink Protocol (MP) [1]. MP specifies a means to negotiate MP mode, detect the establishment of new links (termed bundling), detect fragment loss, and fragment and reassemble messages. MP does not specify when (or even if) additional links should be established, or when to drop links, or how to acquire necessary telephone numbers.

MP may be used on a single link to increase the effective MRU for the network layer protocols when the negotiated MRU is too small for the intended application or can't be changed due to hardware or serial driver specifications.

The Multilink Maximum Receive Reconstructed Unit (MRRU) is the number of octets an implementation can concatenate together for a giver-reconstructed frame. MRRU is analogous to the MRU at the link level. In a non-multilink PPP system, the MRU is the maximum PPP information field size at the link level and is used as the Maximum Transfer Unit (MTU) advertised to network layer interfaces, such as IP, on the peer's side. In a multilink PPP system, the MRRU sent by the peer is used as the MTU for the network level interfaces and the MRU is used as the maximum message size within MP fragmentation. If the MRRU given by the peer is less than or equal to its MRU+4 (or +6, depending on MP length header) then it is not necessary to support fragmentation. The MRRU is negotiated and a desired value is the default 1 500 octets. The MRU is used as the maximum message size within MP fragmentation and shall be fixed to 256 octets length (4 octets are used for MP header).

There are two types of fragment format, the long sequence number fragment format and the short sequence number format. First one has a fragment header set to 6 octets and second is set to 4 octets. The choice between on these two types of fragment format is done during the negotiation phase through boolean parameter Short Sequence Number Header Format. As LAPD information field is limited to 260 octets it is desirable to have a short sequence number format. Table 3 shows the MP fragment format.

Table 3: MP fragment format

8	7	6	5	4	3	2	1	octet
MP protocol ID (0x00)								1
(0x3D)								2
B	E	0	0	seq				3
number								4
information (256 octets)								5 … 260

This implementation has no impact on the size of the IP datagram as the reconstructed datagram can be up to 1 500 octets. IP datagram fragments shall be encapsulated in LAPD frames as shown in table 4.

Table 4: MP fragment format

8	7	6	5	4	3	2	1
Flag (0x7E)							
SAPI						C	0
TEI							1
0	0	0	P	0	0	1	1
MP protocol ID (0x00) MP protocol ID (0xED)							
B	E	0	0	Sequence			
number							
Data (256 octets) (IP datagrams fragment)							
FCS (first octet)							
FCS (second octet)							
Flag (0x7E)							

8 Conclusion

Two solutions are available to transfer internet protocols over the LAPD of an ISDN access:

- Point-to-point Protocol over LAPD (PPPoLAPD);
- PPP Multilink protocol over LAPD (MPoLAPD).

The main difference between these two solutions resides at the IP level. PPPoLAPD limits the size of an IP datagram to 258 octets whereas MPoLAPD does not. The risk of using PPPoLAPD is during the negotiation phase, it may be possible that the size of PPP packet (fixed by parameter MRU) is too small to transfer some parameters. MPoLAPD does not restrict the size of an IP datagram and the PPP Multilink Protocol can be associated with IP traffic in B channels.

This study is based on existing IETF standards, no parameter or protocol has been introduced. Using existing standards will help manufacturers to implement PPPoLAPD or MPoLAPD easily.

At the LAPD level it is recommended to define a new SAPI codepoint dedicated to internet traffic. The TEI value should be assigned non-automatically (as already done for the permanent logical link services).

History

Document history		
V1.1.1	November 2001	Publication