PPP in X.25
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Abstract

   The Point-to-Point Protocol (PPP) [RFC-1661] provides a standard
   method for transporting multi-protocol datagrams over point-to-point
   links. This document describes the use of X.25 for framing PPP
   encapsulated packets.

Applicability

   This specification is intended for those implementations that desire
   to use facilities which are defined for PPP, such as the Link Control
   Protocol, Network-layer Control Protocols, authentication, and com-
   pression. These capabilities require a point-to-point relationship
   between peers, and are not designed for multi-point or multi-access
   environments.

   Use of X.25 as a secondary framing mechanism (for example, with asyn-
   chronous HDLC-like frames tunnelled through X.3) is outside the scope
   of this specification.

1. Introduction

CCITT recommendation X.25 [X.25] describes a network layer protocol
providing error-free, sequenced, flow controlled, virtual circuits.
X.25 includes a data link layer, X.25 LAPB, which uses ISO 3309, 4335
and 6256.

At one time, it had been hoped that "PPP in HDLC-like Framing"
[RFC-1662] would co-exist with other X.25 transmissions on the same
links. Equipment could gradually be converted to PPP. Subsequently,
it has been learned that some switches actually remove the X.25
header, transport packets to another switch using a different proto-
col such as Frame Relay, and reconstruct the X.25 header at the final
hop. Co-existance and gradual migration are precluded.

When X.25 is configured as a point-to-point circuit, PPP can use X.25
as a framing mechanism, ignoring its other features. This is equiva-
lent to the technique used to carry SNAP headers over X.25
[RFC-1356].

1.1. Terminology

In this document, the key words "MAY", "MUST, "MUST NOT", "optional",
"recommended", "SHOULD", and "SHOULD NOT", are to be interpreted as
described in [RFC-2119].

To remain consistent with standard Internet practice, and avoid con-
fusion for people used to reading RFCs, all binary numbers in the
following descriptions are in Most Significant Bit to Least Signifi-
cant Bit order, from Most Significant Byte to Least Significant Byte,
reading from left to right, unless otherwise indicated. Note that
this is contrary to ISO and ITU practice, which orders bits as trans-
mitted (network bit order). Keep this in mind when comparing this
document with the other documents.

2. Physical Layer Requirements

PPP is capable of operating across most X.25 interfaces. The only
absolute requirement imposed by PPP is the provision of a bi-
directional full-duplex circuit, either dedicated (permanent) or cir-
cuit-switched, that can operate in a bit-synchronous mode, transpar-
ent to PPP Data Link Layer frames.

Interface Format

   PPP presents an octet interface to the physical layer. There is
   no provision for sub-octets to be supplied or accepted.

Transmission Rate

   PPP does not impose any restrictions regarding transmission rate,
   other than that of the particular X.25 interface.

Control Signals

   Implementation of X.25 requires the provision of control signals,
   that indicate when the link has become connected or disconnected.
   These in turn provide the Up and Down events to the PPP LCP state
   machine.

   Because PPP does not normally require the use of control signals,
   the failure of such signals MUST NOT affect correct operation of
   PPP. Implications are discussed in [RFC-1662].

2.1. Transmission Considerations

   The definition of various encodings is the responsibility of the
   DTE/DCE equipment in use, and is outside the scope of this specifica-
   tion.

   While PPP will operate without regard to the underlying representa-
   tion of the bit stream, bit-synchronous X.25 requires NRZ encoding.

3. The Data Link Layer

   This specification uses the principles, terminology, and frame struc-
   ture described in [RFC-1356].

   The purpose of this specification is not to document what is already
   standardized in [RFC-1356]. Instead, this document attempts to give
   a concise summary and point out specific options and features used by
   PPP.

3.1. **Frame Header**

Since both "PPP in HDLC-like Framing" [RFC-1662] and X.25 use ISO
3309 as a basis for framing, the X.25 header is easily substituted
for the smaller HDLC header. These fields are transmitted from left
to right.

```
+-+-+-+-+-+-+-+-+
|  Flag (0x7e)  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+?+?+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Address    |    Control    |0|0| SVC# (hi) |   SVC# (lo)   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|p(r) |M|p(s) |0|         PPP Protocol          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

The PPP Protocol field and the following Information and Padding
fields are described in the Point-to-Point Protocol Encapsulation
[RFC-1661].

3.2. **Modification of the Basic Frame**

The Link Control Protocol can negotiate modifications to the basic
frame structure. This is not compatible with X.25.

Address-and-Control-Field-Compression

   Since the X.25 Address and Control field values are not constant,
   and are modified as the frame is transported by the network
   switching fabric, Address-and-Control-Field-Compression cannot
   affect the frame format.

FCS-Alternatives

   Since X.25 requires a 16-bit FCS, which is modified as the frame
   is transported by the network switching fabric, FCS-Alternatives
   cannot affect the frame format.

In general, framing-related LCP Configuration Options are not recog-
nizable, and are not acceptable for negotiation. The implementation
MUST NOT send ineffectual options in a Configure-Request, and SHOULD
respond to such requested options with a Configure-Reject. See [RFC-
ffff] for details.

3.3. Modification of the Basic Packet

The Link Control Protocol can negotiate modifications to the basic
packet structure.   These are transparent to X.25.

Protocol-Field-Compression

The X.25 framing does not align the PPP Information field on a
32-bit boundary.   Alignment to a 16-bit boundary occurs when the
Protocol field is compressed to a single octet.   When this
improves throughput, Protocol-Field-Compression SHOULD be negoti-
ated.

[4](#). **Call Setup**

   When the link is configured as a Permanent Virtual Circuit (PVC),
   support for Switched Virtual Circuit (SVC) call setup and clearing is
   not required. Calls are Established and Terminated using PPP LCP
   packets.

   When the link is configured as a Switched Virtual Circuit (SVC), the
   first octet in the Call User Data (CUD) Field (the first data octet
   in the Call Request packet) is used for protocol demultiplexing, in
   accordance with the Subsequent Protocol Identifier (SPI) in ISO/IEC
   TR 9577 [TR 9577]. This field contains a one octet Network Layer
   Protocol Identifier (NLPID), which identifies the encapsulation in
   use over the X.25 virtual circuit. The CUD field MAY contain more
   than one octet of information.

   The PPP encapsulation MUST be indicated by the PPP NLPID value (CF
   hex). Any subsequent octet in this CUD is extraneous and MUST be
   ignored.

   Multipoint networks (or multicast groups) MUST refuse calls which
   indicate the PPP NLPID in the CUD.

   The accidental connection of a link to feed a multipoint network (or
   multicast group) SHOULD result in a misconfiguration indication.
   This can be detected by multiple responses to the LCP Configure-
   Request with the same Identifier, coming from different framing
   addresses. Some implementations might be physically unable to either
   log or report such information.

   Conformance with this specification requires that the PPP NLPID (CF)
   be supported. In addition, conformance with [RFC-1356] requires that
   the IP NLPID (CC) be supported, and does not require that other NLPID
   values be supported, such as Zero (00), SNAP (80), CLNP (81) or ES-IS
   (82).

   When IP address negotiation and/or VJ header compression are desired,
   the PPP call setup SHOULD be attempted first. If the PPP call setup
   fails, the normal IP call setup MUST be used.

   The PPP NLPID value SHOULD NOT be used to demultiplex circuits that
   use the Zero NLPID in call setup, as described in [RFC-1356]. When
   such a circuit exists concurrently with PPP encapsulated circuits,
   only network layer traffic which has not been negotiated by the asso-
   ciated NCP is sent over the Zero NLPID circuit.

Rationale:

    Using call setup to determine if PPP is supported should be inex-
    pensive, when users aren't charged for failed calls.

    Using the Zero NLPID call together with PPP could be expensive,
    when users are charged per packet or for connect time, due to the
    probing of PPP configuration packets at each call.

    PPP configuration provides a direct indication of the availability
    of service, and on that basis is preferred over the Zero NLPID
    technique, which can result in "black-holes".

5. Configuration Details

The following Configuration Options are recommended:

    Magic Number
    Protocol Field Compression

The standard LCP configuration defaults apply to X.25 links, except
Maximum-Receive-Unit (MRU).

To ensure interoperability with existing X.25 implementations, the
initial MRU is 1600 octets [RFC-1356]. This only affects the minimum
required buffer space available for receiving packets, not the size
of packets sent.

The typical network feeding the link is likely to have a MRU of
either 1500, or 2048 or greater. To avoid fragmentation, the Maxi-
mum-Transmission-Unit (MTU) at the network layer SHOULD NOT exceed
1500, unless a peer MRU of 2048 or greater is specifically negoti-
ated.

The X.25 packet size is not directly related to the MRU. Instead,
Protocol Data Units (PDUs) are sent as X.25 "complete packet
sequences". That is, PDUs begin on X.25 data packet boundaries and
the M bit ("more data") is used to fragment PDUs that are larger than
one X.25 data packet in length.

Security Considerations

   Implementations MUST NOT consider PPP authentication on call setup
   for one circuit between two systems to apply to concurrent call setup
   for other circuits between those same two systems. This results in
   possible security lapses due to over-reliance on the integrity and
   security of switching systems and administrations. An insertion
   attack might be undetected. An attacker which is able to spoof the
   same calling identity might be able to avoid link authentication.

Acknowledgements

   This design was inspired by the paper "Parameter Negotiation for the
   Multiprotocol Interconnect", Keith Sklower and Clifford Frost, Uni-
   versity of California, Berkeley, 1992, unpublished.

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