PPP in Frame Relay

Status of this Memo

Abstract

   The Point-to-Point Protocol (PPP) [1] provides a standard method for
   transporting multi-protocol datagrams over point-to-point links.

   This document describes the use of Frame Relay for framing PPP
   encapsulated packets.

Applicability

   This specification is intended for those implementations which desire
   to use facilities which are defined for PPP, such as the Link Control

Protocol, Network-layer Control Protocols, authentication, and
compression. These capabilities require a point-to-point
relationship between peers, and are not designed for multi-point or
multi-access environments.

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1. Introduction

   Frame Relay [2] is a relative newcomer to the serial link community.
   Like X.25, the protocol was designed to provide virtual circuits for
   connections between stations attached to the same Frame Relay
   network. The improvement over X.25 is that Q.922 is restricted to
   delivery of packets, and dispenses with sequencing and flow control,
   simplifying the service immensely.

   PPP uses ISO 3309 HDLC as a basis for its framing [3].

   When Frame Relay is configured as a point-to-point circuit, PPP can
   use Frame Relay as a framing mechanism, ignoring its other features.
   This is equivalent to the technique used to carry SNAP headers over
   Frame Relay [4].

   At one time, it had been hoped that PPP in HDLC-like frames and Frame
   Relay would co-exist on the same links. Unfortunately, the Q.922
   method for expanding the address from 1 to 2 to 4 octets is not
   indistinguishable from the ISO 3309 method, due to the structure of
   its Data Link Connection Identifier (DLCI) subfields. Co-existance
   is precluded.

2. Physical Layer Requirements

   PPP treats Frame Relay framing as a bit-synchronous link. The link
   MUST be full-duplex, but MAY be either dedicated (permanent) or
   switched.

   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 Frame Relay interface.

   Control Signals

      Implementation of Frame Relay requires the provision of control
      signals, which indicate when the link has become connected or
      disconnected. These in turn provide the Up and Down events to the
      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 [2].

   Encoding

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

      While PPP will operate without regard to the underlying
      representation of the bit stream, Frame Relay requires NRZ
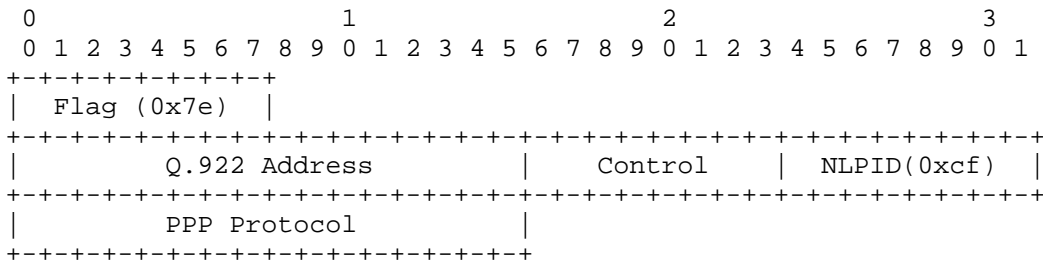   encoding.

3. The Data Link Layer

   This specification uses the principles, terminology, and frame
   structure described in "Multiprotocol Interconnect over Frame Relay"
   [4].

   The purpose of this specification is not to document what is already
   standardized in [4]. Instead, this document attempts to give a
   concise summary and point out specific options and features used by
   PPP.

3.1. Frame Format

   As described in [4], Q.922 header address and control fields are
   combined with the Network Layer Protocol Identifier (NLPID), which
   identifies the encapsulation which follows. The fields are
   transmitted from left to right.

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+
   | Flag (0x7e)   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |         Q.922 Address       |   Control   |  NLPID(0xcf)  |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |         PPP Protocol        |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

   The PPP Protocol field and the following Information and Padding
   fields are described in the Point-to-Point Protocol Encapsulation

   [1].

3.2. Modification of the Basic Frame

   The Link Control Protocol can negotiate modifications to the basic
   frame structure. However, modified frames will always be clearly
   distinguishable from standard frames.

   Address-and-Control-Field-Compression

      Because the 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 MUST NOT be
      negotiated.

   Protocol-Field-Compression

      Note that unlike PPP in HDLC-like framing, the Frame Relay framing
      does not align the Information field on a 32-bit boundary.
      Alignment to a 32-bit boundary occurs when the NLPID is removed
      and the Protocol field is compressed to a single octet. When this
      improves throughput, Protocol-Field-Compression SHOULD be
      negotiated.

4. In-Band Protocol Demultiplexing

   The PPP NLPID (CF hex) and PPP Protocol fields easily distinguish the
   PPP encapsulation from the other NLPID encapsulations described in
   [4].

   The joining of the PPP and NLPID number space has an added advantage,
   in that the LCP Protocol-Reject can be used to indicate NLPIDs that
   are not recognized. This can eliminate "black-holes" that occur when
   traffic is not supported.

   For those network-layer protocols which have no PPP Protocol
   assignment, or which have not yet been implemented under the PPP
   encapsulation, or which have not been successfully negotiated by a
   PPP NCP, another method of encapsulation defined under [4] SHOULD be
   used.

   Currently, there are no conflicts between NLPID and PPP Protocol
   values. If a future implementation is configured to send a NLPID
   value which is the same as a compressed Protocol field, that Protocol
   field MUST NOT be sent compressed.

   On reception, the first octet following the header is examined. If
   the octet is zero, it MUST be assumed that the packet is formatted
   according to [4].

   PPP encapsulated packets always have a non-zero octet following the
   header. If the octet is not the PPP NLPID value (CF hex), and
   Protocol-Field-Compression is enabled, and the associated NCP has
   been negotiated, then it is expected to be a compressed PPP Protocol
   value. Otherwise, it MUST be assumed that the packet is formatted
   according to [4].

   The Protocol field value 0x00cf is not allowed (reserved) to avoid
   ambiguity when Protocol-Field-Compression is enabled. The value MAY
   be treated as a PPP Protocol that indicates that another PPP Protocol
   packet follows.

   Initial LCP packets contain the sequence cf-c0-21 following the
   header. When a LCP Configure-Request packet is received and
   recognized, the PPP link enters Link Establishment phase.

   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.

Once PPP has entered the Link Establishment phase, packets with other
NLPID values MUST NOT be sent, and on receipt such packets MUST be
silently discarded, until the PPP link enters the Network-Layer
Protocol phase.

Once PPP has entered the Network-Layer Protocol phase, and
successfully negotiated a particular NCP for a PPP Protocol, if a
frame arrives using another equivalent data encapsulation defined in
[4], the PPP Link MUST re-enter Link Establishment phase and send a
new LCP Configure-Request. This prevents "black-holes" that occur
when the peer loses state.

An implementation which requires PPP link configuration, and other
PPP negotiated features (such as authentication), MAY enter
Termination phase when configuration fails. Otherwise, when the
Configure-Request sender reaches the Max-Configure limit, it MUST
fall back to send only frames encapsulated according to [4].

5. Out-of-Band signaling

   There is no generally agreed method of out-of-band signalling. Until
   such a method is universally available, an implementation MUST use
   In-Band Protocol Demultiplexing for both Permanent and Switched
   Virtual Circuits.

6. Configuration Details

   The following Configuration Options are recommended:

      Magic Number
      Protocol Field Compression

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

   To ensure interoperability with existing Frame Relay implementations,
   the initial MRU is 1600 octets [4]. 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
   Maximum-Transmission-Unit (MTU) at the network layer SHOULD NOT
   exceed 1500, unless a peer MRU of 2048 or greater is specifically

   negotiated.

   Some Frame Relay switches are only capable of 262 octet frames. It
   is not recommended that anyone deploy or use a switch which is
   capable of less than 1600 octet frames. However, PPP implementations
   MUST be configurable to limit the size of LCP packets which are sent
   to 259 octets (which leaves room for the NLPID and Protocol fields),
   until LCP negotiation is complete.

   XID negotiation is not required to be supported for links which are
   capable of PPP negotiation.

   Inverse ARP is not required to be supported for PPP links. That
   function is provided by PPP NCP negotiation.

Security Considerations

    Security issues are not discussed in this memo.

References

    [1]   Simpson, W., Editor, "The Point-to-Point Protocol (PPP)", STD
           51, RFC 1661, July 1994.

    [2]   CCITT Recommendation Q.922, "ISDN Data Link Layer Specification
           for Frame Mode Bearer Services", International Telegraph and
           Telephone Consultative Committee, 1992.

    [3]   Simpson, W., Editor, "PPP in HDLC-like Framing", STD 51,
           RFC 1662, July 1994.

    [4]   Bradley, T., Brown, C., and A. Malis, "Multiprotocol
           Interconnect over Frame Relay", RFC 1490, July 1993.

    [5]   ISO/IEC TR 9577:1990(E), "Information technology -
           Telecommunications and Information exchange between systems -
           Protocol Identification in the network layer", 1990-10-15.

Acknowledgments

Chair's Address

    The working group can be contacted via the current chair:

        Karl Fox
        Ascend Communications
        3518 Riverside Drive, Suite 101
        Columbus, Ohio 43221

        EMail: karl@ascend.com

Author's Address

    Questions about this memo can also be directed to:

        William Allen Simpson
        Daydreamer
        Computer Systems Consulting Services
        1384 Fontaine
        Madison Heights, Michigan 48071

            wsimpson@UMich.edu
            wsimpson@GreenDragon.com (preferred)