PPP in Frame Relay
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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 Frame Relay 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 compression. These capabilities require a point-to-point relationship between peers, and are not designed for multi-point or multi-access environments.

1. Introduction

Frame Relay [Q.922] 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.

At one time, it had been hoped that "PPP in HDLC-like Framing" [RFC-1662] would co-exist with other Frame Relay transmissions on the same links. Unfortunately, the Q.922 method for expanding the address from 1 to 2 to 4 octets is not reliably distinguishable from the ISO 3309 HDLC method, due to the structure of its Data Link Connection Identifier (DLCI) subfields. Co-existance is precluded.

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 [RFC-1490].

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 confusion for people used to reading RFCs, all binary numbers in the following descriptions are in Most Significant Bit to Least Significant 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 transmitted (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 Frame Relay interfaces. The only absolute requirement imposed by PPP is the provision of a bi-directional full-duplex circuit, either dedicated (permanent) or frame-switched, that can operate in either a bit-synchronous, or octet-synchronous mode, transparent 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 Frame Relay interface.

Control Signals

Implementation of Frame Relay 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 specification.

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

In addition, this specification permits octet-synchronous Frame Relay, with the same stuffing conventions as HDLC [RFC-1662].

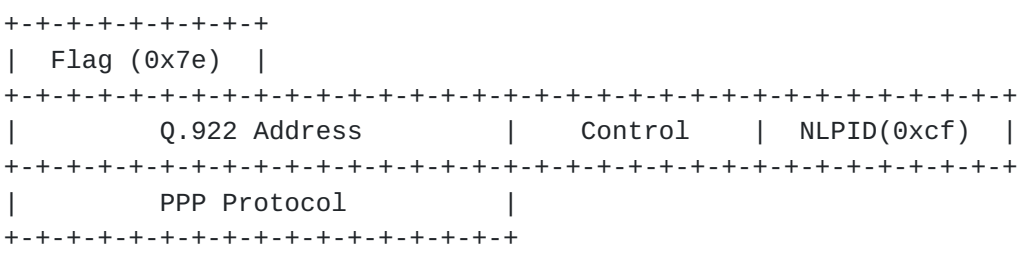
3. The Data Link Layer

This specification uses the principles, terminology, and frame structure described in [RFC-1490].

The purpose of this specification is not to document what is already standardized in [RFC-1490]. Instead, this document attempts to give a concise summary and point out specific options and features used by PPP.

3.1. Frame Header

As described in [RFC-1490], Q.922 header address and control fields are followed by a Network Layer Protocol Identifier (NLPID) to identify the encapsulated packet. This specification describes the PPP Protocol encapsulation. These fields are transmitted from left to right.



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 Frame Relay.

Address-and-Control-Field-Compression

> Since Frame Relay Address and Control field values are not constant, are variable size, 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 Frame Relay 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 recognizable, 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 Frame Relay.

Protocol-Field-Compression

The default Frame Relay header does not align the PPP Information field on a 32-bit boundary. Alignment to a 32-bit boundary occurs when the NLPID is removed and the PPP 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 [RFC-1490].

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 that have no PPP Protocol assignment, or have not yet been implemented under the PPP encapsulation, or have not been successfully negotiated by a PPP NCP, another method of encapsulation defined under [RFC-1490] 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 Control field is examined:

- If the octet is zero, it MUST be assumed that the packet is formatted according to [RFC-1490].

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

- If the octet is not the PPP NLPID value, 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 [RFC-1490].

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 [RFC-1490], 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 that 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 [RFC-1490].

Implementation Notes

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

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.

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 [RFC-1490]. 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 that is capable of less than 1600 octet frames. However, PPP implementations MUST be configurable to limit the size of LCP packets that are sent to 259 octets (leaving room for the NLPID and PPP Protocol fields), until LCP negotiation is complete.

XID negotiation is not required to be supported for links that 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

This specification introduces no known security vulnerabilities.

Acknowledgements

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

Use of octet-synchronous interfaces, such as SONET/SDH, was first proposed by John Bartell (BellSouth).

References

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

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

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

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

[RFC-2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP-14, Harvard University, March 1997.

[RFC-ffff] Simpson, W., "PPP with Framing Conversion", work in progress.

Contacts

Comments about this document should be discussed on the ietf-ppp@merit.edu mailing list.

This document was reviewed by the Point-to-Point Protocol Working Group of the Internet Engineering Task Force (IETF). The working group can be contacted via the current chair:

Karl Fox
Ascend Communications
655 Metro Place South, Suite 370
Dublin, Ohio 43017

karl@Ascend.com

Questions about this document 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)

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