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Request for Comments: 1973   Daydreamer
Category: Standards Track   June 1996

PPP in Frame Relay

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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

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for the Multiprotocol Interconnect", Keith Sklower and Clifford Frost, University of California, Berkeley, 1992, unpublished.

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