Network Working Group
Request for Comments: 1618
Category: Standards Track

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May 1994

PPP over ISDN

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 PPP over Integrated Services Digital Network (ISDN) switched circuits.

This document is the product of the Point-to-Point Protocol Working Group of the Internet Engineering Task Force (IETF). Comments should be submitted to the ietf-ppp@merit.edu mailing list.

Applicability

This specification is intended for those implementations which desire to use the PPP encapsulation over ISDN point-to-point links. PPP is not designed for multi-point or multi-access environments.

"It is clear that there is never likely to be a single, monolithic, worldwide ISDN." [3] The goal of this document is to describe a few common implementations, chosen from the current wide variety of alternatives, in an effort to promote interoperability.

Table of Contents

1. Introduction

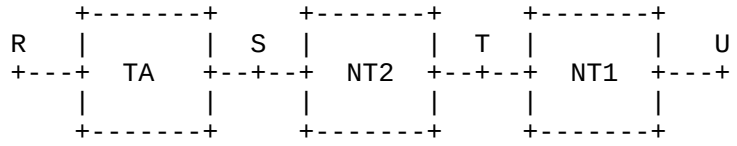
PPP was designed as a standard method of communicating over point-to-point links. Initial deployment has been over short local lines, leased lines, and plain-old-telephone-service (POTS) using modems. As new packet services and higher speed lines are introduced, PPP is easily deployed in these environments as well.

This specification is primarily concerned with the use of the PPP encapsulation over ISDN links. Since the ISDN B-channel is by definition a point-to-point circuit, PPP is well suited to use over these links.

The ISDN Primary Rate Interface (PRI) may support many concurrent B-channel links. The PPP LCP and NCP mechanisms are particularly useful in this situation in reducing or eliminating hand configuration, and facilitating ease of communication between diverse implementations.

The ISDN D-channel can also be used for sending PPP packets when suitably framed, but is limited in bandwidth and often restricts communication links to a local switch.

The terminology of ISDN can be confusing. Here is a simple graphical representation of the points used in subsequent descriptions:



These elements are frequently combined into a single device.

2. Physical Layer Requirements

PPP treats ISDN channels as bit or octet oriented synchronous links. These links MUST be full-duplex, but MAY be either dedicated or circuit-switched.

Interface Format

PPP presents an octet interface to the physical layer. There is no provision for sub-octets to be supplied or accepted. The octet stream is applied primarily at the R or T reference points.

Transmission Rate

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

Control Signals

PPP does not require the use of control signals. When available, using such signals can allow greater functionality and performance. Implications are discussed in [2].

Control signals MAY be required by some of the framing techniques described, and is outside the scope of this specification.

Encoding

The definition of various encodings and scrambling 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, lack of standards for transmission will hinder interoperability as surely as lack of data link standards. The D-channel LAPD interface requires NRZ encoding at the T reference point. Therefore, as a default, it is recommended that NRZ be used over the B-channel interface at the T reference point. This will allow frames to be easily exchanged between the B and D channels.

When configuration of the encoding is allowed, NRZI is recommended as an alternative in order to ensure a minimum ones density where required over the clear B-channel, with caveats regarding FCS [2].

Historically, some implementations have used Inverted NRZ (merely switching the sense of mark and space), in order to ensure a minimum ones density with bit-synchronous HDLC. The use of Inverted NRZ is deprecated.

Automatic Detection

Implementations which desire to interoperate with multiple encodings MAY choose to detect those encodings automatically. Automatic encoding detection is particularly important for Primary Rate Interfaces, to avoid extensive pre-configuration. Only simple encodings are currently distinguished.

The only reliable method of detection available is to switch modes between the supported encodings. Transmission of the LCP

Configure-Request SHOULD be tried twice for each mode before switching in rotation. This ensures that sufficient time is available for a response to arrive from the peer.

Max-Configure MUST be set such that the cumulative attempts result in no more than 59 seconds of time before disconnect. It is preferable that the usual limit of 30 seconds be observed.

Prior Configuration

By prior configuration, PPP MAY also be used with other encodings. Because of difficulty distinguishing them, it is not recommended that these encodings be automatically detected.

Terminal adapters conforming to V.120 [4] can be used as a simple interface to workstations. Asynchronous HDLC framing [2] is accepted at the R reference point. The terminal adapter provides async-sync conversion. Multiple B-channels can be used in parallel. Unfortunately, V.120 has a framing mode of its own for rate adaptation, which is difficult to distinguish from Frame Relay, and which can confuse in-band frame detection. V.120 is not interoperable with bit-synchronous links, since V.120 does not provide octet-stuffing to bit-stuffing conversion. Therefore, V.120 is deprecated in favor of more modern standards, such as "PPP in Frame Relay".

The "Bandwidth On Demand Interoperability Group" has defined a proposal called BONDING. Multiple B-channels can be used in parallel. BONDING has an initialization period of its own, which might conflict with the simple detection technique described above, and requires extensive individual configuration in some current implementations when multiple B-channels are involved. It is recommended that the PPP Multi-Link Procedure be used instead of BONDING.

3. Framing

For B-channels, in the absence of prior configuration, the implementation MUST first use bit-synchronous HDLC [2], as opposed to other framings, for initial link establishment. This assumes that circuit-switched communications are generally [host | router] to [host | router].

By prior configuration, octet-synchronous HDLC [2] is recommended where the network termination equipment interfaces directly to the T

reference point, and octet boundaries are available at the time of framing. Such equipment is likely to be highly integrated, and the elimination of bit-synchronous hardware can reduce the part count, resulting in lower cost interfaces and simpler configuration. Octet-synchronous HDLC MUST be used with NRZ bit encoding.

For D-channels, by default no data service is expected. By prior configuration, "PPP in X.25" or "PPP in Frame Relay" framing MAY be used.

Despite the fact that HDLC, LAPB, LAPD, and LAPF are nominally distinguishable, multiple methods of framing SHOULD NOT be used concurrently on the same ISDN channel. There is no requirement that PPP recognize alternative framing techniques, or switch between framing techniques without specific configuration.

4. Out-of-Band signaling

Experience has shown that the LLC Information Element is not reliably transmitted end to end. The deployment of compatible switches is too limited, and the subscription policies of the providers are too diverse. Therefore, transmission of the LLC-IE SHOULD NOT be relied upon for framing or encoding determination.

No LLC-IE values which pertain to PPP have been assigned. Any other values which are received are not valid for PPP links, and can be ignored for PPP service.

As an alternative administrative measure, multiple directory numbers can point to the same physical access facility, by binding particular services to each directory number. The called party identifier has proven to be reliably provided by the local switch.

When a called party identifier is used, or when a future LLC-IE value is assigned to PPP and the PPP value is received, if the LCP has not had the administrative Open event, the call MUST be rejected. Receivers MUST NOT accept an incoming call, only to close the circuit or ignore packets from the circuit.

5. Configuration Details

The LCP recommended sync configuration options apply to ISDN links.

The standard LCP sync configuration defaults apply to ISDN links.

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.

Instead of a constant value for the Restart timer, the exponential backoff method is recommended. The Restart Timer SHOULD be 250 milliseconds for the initial value, and 3 seconds for the final value.

Implementations that include persistent dialing features, such as "demand dialing" or "redialing", SHOULD use mechanisms to limit their persistence. Examples of such mechanisms include exponential backoff, and discarding packet queues after failure to complete link establishment. In some implementations, discarding the transmit queue can temporarily remove the stimulus to retry the connection.

Security Considerations

Security issues are not discussed in this memo.

References

[1] Simpson, W., Editor, "The Point-to-Point Protocol (PPP)", RFC 1548, Daydreamer, December 1993.

[2] Simpson, W., Editor, "PPP in HDLC Framing", RFC 1549, Daydreamer, December 1993.

[3] Stallings, W, "ISDN and Broadband ISDN - 2nd ed", Macmillan, 1992.

[4] CCITT Recommendations I.465 and V.120, "Data Terminal Equipment Communications over the Telephone Network with Provision for Statistical Multiplexing", CCITT Blue Book, Volume VIII, Fascicle VIII.1, 1988.

Acknowledgments

This design was inspired by previous drafts of C. Frost, B. Gorsline, D. Leifer, K. Muramaki, S. Sheldon, K. Sklower, and T. Sugawara.

Thanks to Oliver Korfmacher (NetCS) for European considerations, Dory Leifer (University of Michigan) for technical details and called party signalling, and Vernon Schryver (Silicon Graphics) regarding handling of link misconfiguration and timeouts.

Special thanks to Morning Star Technologies for providing computing resources and network access support for writing this specification.

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