Noah Barrall
Dr. Bibighaus
Data Communications and Networking

Point-to-Point Protocol

1. Who published this protocol and what authority did they use?

Point-to-Point Protocol (PPP) was first published in 1990 under the title RFC 1171, by Drew D. Perkins. This publication lays out the basic structure and initial protocols of PPP, however this version is lesser known. The more widely referenced version was published four years later. William Simpson, the author of RFC 1661, published his version of PPP in 1994 under the same authority as Perkins, the Internet Engineering Task Force (IETF). This organization sets digital standards for the internet protocol suite that makes up the internet.

2. What is the goal of this protocol and what layer does it operate at?

According to Simpson, the main goal of this protocol is to provide a standard method for transporting multi-protocol datagrams over point-to-point links. This design is primarily meant for simple links which transport packets between two peers, and intended as a solution for easy connection for a wide variety of hosts, bridges, and routers. PPP consists of three main components, the first being Encapsulation. The main idea is that encapsulation is a process in which lower layer protocols receive data from higher layer protocols and then place the data portion of its frame. It also allows for PPP to package and transmit data over various physical connections allowing for support of various network layer protocols. The second component of PPP is Link Control Protocol. The main goal of Link Control Protocol is to establish, configure, and test the data-link connection. The third component of PPP is the Network Control Protocols, which establish and configure different network-layer protocols. Each family of network control protocols can negotiate and manage the specific needs required by their respective network-layer protocols.

Point-to-Point Protocol operates at Layer 2, the Data Link Layer. This layer is responsible for establishing and maintaining a direct connection between two nodes, or links, on a network.

3. What assumptions are made about the environment in which this protocol operates?

The environment that this protocol operates in has a few things that are assumed for this protocol to work. PPP assumes an already dedicated point-to-point link between two devices on the network such as a serial link or dial-up connection. PPP also assumes a means of reliable transmission. It does include error detection using CRC to ensure data integrity but the protocol itself is assumed to be used with a reliable connection. Building off of this assumption, the protocol also assumes there to be a stable link that supports two way communication allowing both devices to send and receive data at the same time. One big thing that PPP does is that it expects the network to carry all types of traffic, so the protocol itself is designed to support different network layer protocols, such as IP, IPX, and AppleTalk. This greatly broadens the use for PPP and allows for its use in diverse network environments. One of the components that is very essential is that PPP assumes that the devices can support and correctly implement configuration protocols like Link Control Protocol and Network Control Protocol while setting up and managing the connection. A final thing that is big for PPP to assume is already correct, is that Layer 1, the Physical Layer, already is functioning and exists for establishing the connection that it needs to make.

4. Describe one problem that this protocol must solve and how the designers chose to solve it?

One problem that Point-to-Point Protocol must solve is the idea of framing. Framing is crucial because it ensures that the data sent over the link is correctly interpreted by the receiving end. If framing is correctly managed by PPP, this enables the proper transmission of data packets. The designers chose to solve this in a 3 step solution. The first has to deal with how the frame itself is structured. Each frame begins and ends with a flag byte or delimiter, for example 0x4J. If any of the data that is being sent within the frame contains the same byte information as what is in the flag, it could cause confusion and data may get confused with control signals. What designers did to solve this was called byte stuffing, which inserts an extra byte or “escape character” before the byte that would be the same as the flag byte. This signifies that this byte is a piece of data and not a control signal. Upon receiving the data, the receiver would know that this byte is part of the data and be able to process the frame correctly. The final step is error detection. Each frame that is sent includes a Frame Check Sequence at the end of it. The Frame Check Sequence allows the receiver to detect if any errors may have occurred during transmission. This idea helps prevent errors with frames and also helps improve the reliability of error detection.

5. Evaluate the designers solution to question 4 above.

When evaluating how the designers solved the issue of framing, one major thing comes to mind that can both be good and bad. This is the idea of the flag byte. The idea of there being a byte at the beginning and end that helps distinguish the start and end of each frame, ensuring data can be transmitted in an organized manner. On the contrary, the idea of byte stuffing which plays off of the flag byte can cause two different issues. A very minimal issue is that adding escape characters to the data can cause slight overhead, and while this is most likely going to be very minimal, it still is there. The other issue is that there is a reliance on the escape character. If the escape character which distinguishes data from control signals is misconfigured, corrupted, or simply just not correct, the entire frame may cause issues. A positive to this protocol, is that it also offers error detection, which is very much needed due to there being such a simple solution to the framing problem. The error detection with Frame Check Sequence ensures that incorrect frames can be retransmitted. Another positive thing about framing is that it is flexible and can be used across different physical links including serial links such as dial-up connections and leased lines, as well as DSL, and fiber optic cables.