Data Link Layer in Internet
- We know that Internet consists of individual systems that are connected to each other.
- Basically, it is wide are network that is built up from point-to-point leased lines.
- In these point-to-point lines, two major data link protocols are used:
  - Serial Line Internet Protocol (SLIP)
  - Point-to-Point Protocol (PPP)

Serial Line Internet Protocol (SLIP)
- It is a means of sending Internet Protocol datagrams over a serial link.
- It can be used by two systems to communicate via a direct cable connection or modem link.
- The initial purpose of this protocol was to connect Sun workstation to the Internet over a dial-up line using modem.

Problems with SLIP
- It does not perform any error detection and correction.
- It supports only IP (Internet Protocol). So, it cannot be used for other networks that do not use IP (for e.g.: Novell LANs).
- It does not support the allocation of dynamic IP address.
- Both the communicating systems should be assigned a specific IP address before hand.
- It does not provide any authentication.
- It is not an approved Internet standard.

Data Format of SLIP
- The data format of SLIP is:
  - Data
  - End Flag
- A special END character (equivalent to decimal 192) marks the end of data.

Point-to-Point Protocol (PPP)
- PPP was devised by IETF (Internet Engineering Task Force) to create a data link protocol for point-to-point lines that can solve all the problems of SLIP.
- It is the most commonly used data link protocol.
- It is used to connect the home PC to the ISP server.
Benefits of PPP

- PPP defines the format of the frame to be exchanged between the devices.
- It defines Link Control Protocol (LCP) for:
  - Establishing the link between two devices.
  - Maintaining this established link.
  - Configuring this link.
  - Terminating this link after the transfer.

- It provides error detection.
- Unlike SLIP, that supports only IP, it supports multiple protocols.
- It supports dynamic allocation of IP address.
- It provides authentication.
- It provides NCP (Network Control Protocol), that supports variety of network layer protocol.

PPP Frame Format

- Frame format of PPP is similar to HDLC frame:
  - **Flag Field**: It marks the beginning and end of the PPP frame. Flag byte is 01111110.
  - **Address Field**: This field is of 1 byte and is always 11111111. This address is the broadcast address i.e. all stations accept this frame.
  - **Control Field**: It is also of 1 byte. It uses the format of U-Frame in HDLC. The value is always 00000011 to show that the frame does not contain any sequence number and there is no flow control or error control.
  - **Protocol Field**: This field specifies the kind of protocol of the data in the information field.
  - **Information Field**: Its length is variable. It carries user data or other information.
  - **FCS Field**: It stands for Frame Check Sequence. It contains checksum. It is either 2 bytes or 4 bytes.

Transition Phases in PPP

- The PPP connection goes through different states:
Transition Phases in PPP

- **Down:**
  - In down phase, the link is not used.

- **Establish:**
  - Connection goes into this phase when one of the nodes start communication.

- **Authenticate:**
  - This phase is optional. The two nodes may decide during establishment phase, to use this phase.

- **Up:**
  - In this phase, data transfer takes place. The connection remains in this phase until one of the node wants to end the connection.

- **Terminate:**
  - In this phase, connection is terminated.

PPP Stack

PPP uses several other protocols to establish link, authenticate users and to carry the network layer data:

- The various protocols used are:
  - Link Control Protocol
  - Authenticate Protocol
  - Network Control Protocol

Link Control Protocol

- It is responsible for establishing, maintaining, configuring and terminating the link.
- It provides negotiation mechanism to set options between two nodes.
- All LCP packets are carried in the information field of the PPP frame.

Authentication Protocol

- Authentication protocol helps to validate the identity of a user who needs to access the resources.
- There are two authentication protocols:
  - Password Authentication Protocols (PAP)
  - Challenge Handshake Authentication Protocol (CHAP)

Password Authentication Protocol (PAP)

- This protocol provides two step authentication procedure:
  - **Step 1:** Username and password is provided by the user who wants to access the system.
  - **Step 2:** The system checks the validity of username and password, and either accepts or rejects the connection.
Challenge Handshake Authentication Protocol (CHAP)

- It provides more security than PAP.
- In this method, password is kept secret.
- It is a three way authentication protocol:
  - **Step 1:** System sends a challenge packet to the user. It contains a value, usually a few bytes.
  - **Step 2:** Using a predefined function, a user combines this challenge value with the user password and sends the resultant packet back to the system.
  - **Step 3:** System then applies the same function to the password of the user & challenge value, and creates a result. If the result is same as the result sent in the response packet, access is granted, otherwise, it is denied.

Network Control Protocol (NCP)

- After establishing the link & authenticating the user, PPP connects to the network layer.
- This connection is established by NCP.
- Therefore, NCP is a set of control protocols that allow the encapsulation of the data coming from the network layer.
- After the network layer configuration is done by one of the NCP, the user can exchange data from the network layer.

Differences Between SLIP & PPP

<table>
<thead>
<tr>
<th>S. No.</th>
<th>SLIP</th>
<th>PPP</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>SLIP stands for Serial Line Internet Protocol.</td>
<td>PPP stands for Point-to-Point Protocol.</td>
</tr>
<tr>
<td>2.</td>
<td>SLIP does not perform error detection &amp; correction.</td>
<td>PPP performs error detection &amp; correction.</td>
</tr>
<tr>
<td>3.</td>
<td>SLIP supports only IP.</td>
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<tr>
<td>4.</td>
<td>IP address is assigned statically.</td>
<td>IP address is assigned dynamically.</td>
</tr>
<tr>
<td>5.</td>
<td>SLIP does not provide any authentication.</td>
<td>PPP provides authentication.</td>
</tr>
<tr>
<td>6.</td>
<td>SLIP is not approved Internet standard.</td>
<td>PPP is approved Internet standard.</td>
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</tbody>
</table>

Thank You
Have a Nice Day