Point-to-Point Protocol (PPP):

- Connects LAN to WAN through a serial connection or leased line

- Parallel and serial connections:

- Parallel connection sends data over multiple paths simultaneously

- Serial link uses just two wires, one for each direction of communication

- Fewer wires, cheaper cables, and fewer connector pins

- Clock skew -- messages traveling along different channels in a parallel connection reach the destination at different times, which slows it down.

- Interference -- signals along multiple wires can crosstalk with each other

- Serial communiation standards:

- RS-232 -- 9-pin and 25-pin connectors, includes RJ-45

- V.35 -- high speed serial link used by most routers and DSUs, supports T1 lines

- HSSI -- high speed link that supports up to 52 MB/s and T3 lines

- Time division multiplexing (TDM) -- data from multiple sources is placed onto a single line by taking a segment from each source in a cycle (taking turns)

- Statistical TDM (STDM) -- uses variable length time slots and does not multiplex lines that are inactive, also requires a channel ID for each source

- Universal Asynchronous Receiver/Transmitter (UART) -- chip on computer that converts outgoing stream of parallel bits into serial stream, which is then sent to the DCE device (usually your modem)

- HDLC -- default encapsulation used for serial connections on Cisco devices

- basically synchronous PPP, used to connect to other Cisco routers

- PPP is used for point-to-point serial connections to non-Cisco routers

Components of PPP:

- HDLC -- for sending messages over point-to-point serial links

- Network Control Protocols (NCPs) -- configure different network layer protocols (IP, etc)

- Link Control Protocol (LCP) -- sets up the PPP connection and its parameters

Establishing a PPP Session:

1) Link establishment -- open the connection and negotiate configuration settings

2) Link quality determination -- optional step that negotiates link quality if necessary

3) Network layer configuration -- NCP configures layer 3 protocols after LCP is done

PPP Configuration Options:

- Authentication -- PAP or CHAP

- Compression -- Stacker or Predictor

- Error detection -- detect errors using Quality and Magic Number fields

- Multilink -- spread traffic across multiple physical WAN links

- Callback -- used to increase security

Password Authentication Protocol (PAP):

- Two-way handshake used for PPP authentication

- Username and password are sent unencrypted in one LCP data package

- Authentication server responds with an Accept or Reject message

- Overall not very secure

Challenge Handshake Authentication Protocol (CHAP):

- Server starts 3-way handshake by sending challenge message to local router

- Local router sends encrypted version of username and password (usually MD5)

- Server compares hash to its database and then accepts or rejects the connection

- Also periodically checks to see if authentication credentials are still valid

IOS Commands:

- encapsulation ppp -- sets PPP as the encapsulation type for the interface

- compress [predictor | stac] -- sets compression type

- ppp quality [1-100] -- sets quality level (which is packets sent vs. packets received)

- ppp multilink -- enables load balancing for PPP

- debug ppp [packet | encap | auth | comp | negot | error | cbcp] -- debugs PPP

- ppp authentication [pap | chap | pap chap | chap pap] -- sets up authentication for PPP

- username [USER] password [PASS] -- sets authentication credentials in global config