Post 3

Thursday, January 24, 2019 11:23 PM

POINT-TO-POINT CONNECTIONS P1

Serial/Parallel Ports: Common WAN connection: Point-to-point: LANs to SP WANs/LAN segments w/in enterprise

LAN-to-WAN/Point-to-point	**AKA: Serial connection/leased-line** • Lines leased from carrier (phone): Dedicated • Companies pay for connection bet 2 remote sites • Price based on BW/distance bet sites

Serial comm: Data transmission: Bits transmitted sequentially over single chan

- Pipe big enough to fit 1 ball at time: Multiple balls go into pipe: 1 at time: 1 exit point
- Serial port: Bidirectional
- Less expensive: Fewer wires/cheaper cables/less pins
- WAN: Data encapsulated by comms protocol used by sending rtr
    - Encapsulated frame sent on phys medium to WAN
    - Receiving rtr uses same protocol to de-encapsulate frame

Parallel comm: Bits transmitted simultaneously over multiple wires

- Theoretically: Xfers 8x faster than serial
- Sends byte (8 bits) in time serial sends single bit

Issues: Crosstalk as wire length increases/Clock skew

Clock skew: Data across various wires doesn't arrive at same time: Sync issues

- Most parallel: Only 1-direction: Outbound-only

3 serial comm standards/LAN-to-WAN connections:

RS-232	Most serial ports conform RS-232C|RS-422|RS-423 standards • 9-pin/25-pin connectors used • General-purpose int: Almost any device type • Replaced by faster standards (USB)
V.35	**Modem-to-multiplexer** comm: ITU standard: High-speed sync data exchange • Combined BW of 7 phone circuits • Serial designed to support higher rates/connectivity bet DTEs/DCEs over digital lines
HSSI	**High-Speed Serial Int:** Up to 52 Mb/s • Rtrs on LANs w/WANs over high-speed lines (T3) • Token Ring/Ethernet • DTE/DCE int dev by Cisco/T3

Point-to-Point Comm Links: Dedicated connection

- Single/pre-established WAN comm path: Connects 2 geo distant sites
- NOT limited to connections that cross land
- More $ than shared services
- Dedicated capacity removes latency/jitter bet endpoints

TDM: Time-Division Multiplexing

Multiplexing: Scheme allows multiple logical sigs to share single phys chan

2 Types of Multiplexing

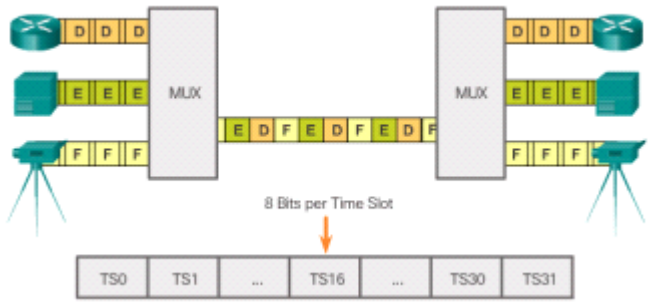
1. TDM: Time-Division Multiplexing
2. STDM: Statistical Time-Division Multiplexing

TDM: Time-Division Multiplexing

Bell Labs: To max amt of voice traffic over carried medium: Before? Phone calls required own physical link

- Expensive/unscalable

TDM: Divides BW of single link into separate time slots

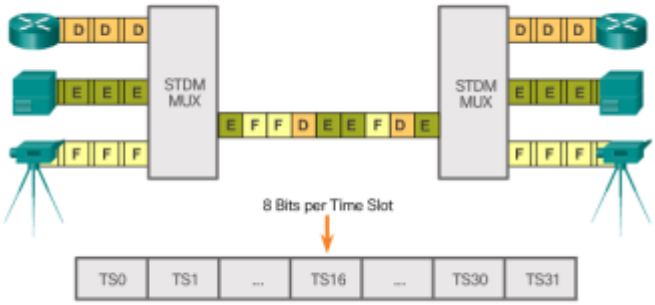


- Transmits over 2/more chans (data stream) over same link by allocating diff time slots for trans of each chan
- Chans take turns using link
- Phys layer concept: No regard for nature of info multiplexed to output chan
- Independent of L2 protocol used by input chans

MUX: Multiplexer: Accepts 3 separate sigs: MUX breaks each sig into segments: MUX puts each seg into single chan

Interleaving: Keeps track of #/sequence of bits from each specific trans so they can quickly be reassembled

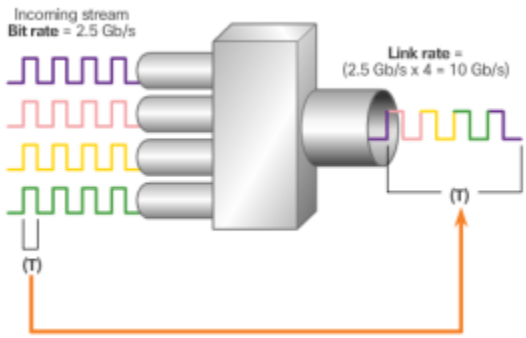
STDM: Statistical Time-Division Multiplexing



STDM: Dev to overcome inefficiency w/TDM: Var time slot length:

- Allows chans to COMPETE for any free slot space
- Buffer mem: Temp stores data during periods of peak traffic
- Doesn't waste line time w/inactive chans
- Requires each trans to carry ID info/chan identifier

TDM Examples



SONET/SDH: Synchronous Optical Networking/Synchronous Digital Hierarchy

- Standard for optical transport of TDM data
- SONET: N/America/SDH: Elsewhere
- 2 closely-related standards: Specify int params/rates/framing fmts/multiplexing methods
  - Mgmt for sync TDM over fiber
  - Example of STDM

SONET/SDH: Takes in bit streams: Multiplexes them: Optically modulates sigs

- Sends sigs out using a light emitting device over fiber w/bit rate equal to x n (incoming bit rate)
- Traffic arriving at SONET multiplexer from 4 places at X Gb/s goes out

Demarcation Point

Prior to deregulation in N/America/countries: Phone companies: Owned local look
Local loop: Line from premises of phone sub to phone CO
- Deregulation forced phone companies to unbundle local loop infrastructure

Delineation is demarcation/demarc point: Marks where your network ints are owned by another org
- Int bet CPE: Customer Premises Equip/Network SP equip

CSU/DSU: Provides clocking sig to cust equip int from DSU/terms chan transport media of carrier onto CSU

DTE-DCE:

CPE	Generally rtr: DTE: Could also be term/computer/printer/fax machine: Connects directly to SP network
DCE	**Commonly modem or CSU/DSU:** Device used to convert usr data from DTE into form acceptable to WAN SP trans link • Sig received at remote DCE: Decodes sig back into seq of bits • Remote DCE then sigs this seq to remote DTE

Serial Cables:

Originally, DCEs/DTEs based on 2 types of equip:
1. Term equip: Generated/received data
2. Comm equip: Only relayed data

DTE/DCE int for a particular standard defines following specs:

Mech/phys	# of pins/connector type
Electrical	Defines voltage lvls for 0/1
Functional	Specifies functions performed by assigning meanings to each of sig lines in int
Procedural	Specifies the seq of events for transmitting data
Original RS-232	Standard only defined connection of DTEs w/DCEs, which were modems.

DTE to DCE cable: Shielded serial transition
- Rtr end of shielded serial transition may be DB-60 connector
- WAN provider/CSU/DSU dictates cable type
- Cisco devices support: EIA/TIA-232, EIA/TIA-449, V.35, X.21, and EIA/TIA-530 serial standards

WAN Encapsulation Protocols:
- Data encapsulated into frames before crossing WAN link
- Appropriate L2 encapsulation type must be config

Types of WAN protocol:

HDLC	**Default encapsulation type:** • Point-to-point/dedicated links/circuit-switched connections ○ When link uses 2 Cisco devices • HDLC: Basis for sync PPP: Many servers connect WAN most commonly Internet
PPP	Rtr-to-rtr/host-to-network connections over sync/async circuits • Works w/7 network layer protocols (IPv4/IPv6) • HDLC encapsulation protocol: Built-in sec mechs such as PAP/CHAP
SLIP: Serial Line Internet Protocol	Standard protocol for point-to-point serial connections using TCP/IP • SLIP largely displaced by PPP
X.25/LAPB	**Link Access Procedure Balanced:** **ITU-T standard**: How connections bet DTE/DCE maintained for remote access/comms • Public data networks • X.25 specifies LAPB: DLL protocol • X.25 predecessor to Frame Relay
Frame Relay	Industry standard: Switched, DLL protocol: Handles multiple virtual circuits • Next gen protocol after X.25 • Eliminates time-consuming processes (error correction/flow control) employed in X.25
ATM	International standard for cell relay: • Devices send multiple service types (voice/data) in fixed-length (53-byte) cells

	• Fixed-length cells allow processing to occur in HW: Reducing transit delays • ATM takes advantage of high-speed trans media: E3/SONET/T3

HDLC Encapsulation: Bit-oriented synchronous DLL protocol: Developed by ISO: International Org for Standardization

- ISO 13239: Current standard
- Dev from SDLC: Synchronous Data Link Control standard proposed in 70's
- Both connection/connectionless service

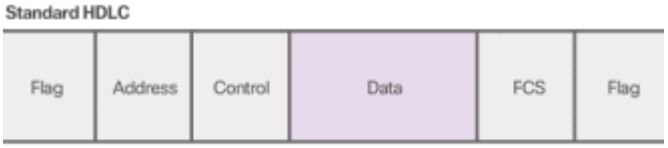
Synchronous serial transmission: Error-free comm bet 2 points:

- Defines L2 framing structure: Flow/error control through acknowledgements
- Each frame: Same fmt: Whether data or control
- When frames transmitted over sync/async links: Links have no mech to mark beginning/end of them

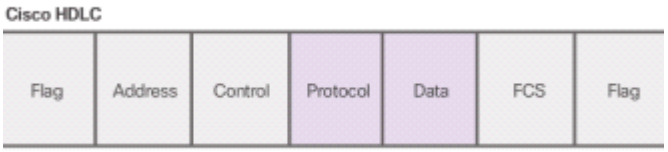
HDLC uses frame delimiter (flag): Marks beginning/end of each frame:

cHDLC: Cisco dev extension to HLDC protocol to solve inability to provide multiprotocol support

- cHDLC frames contain field for ID network protocol being encapsulated



Supports only single-protocol environments.



Uses a protocol data field to support multiprotocol environments.

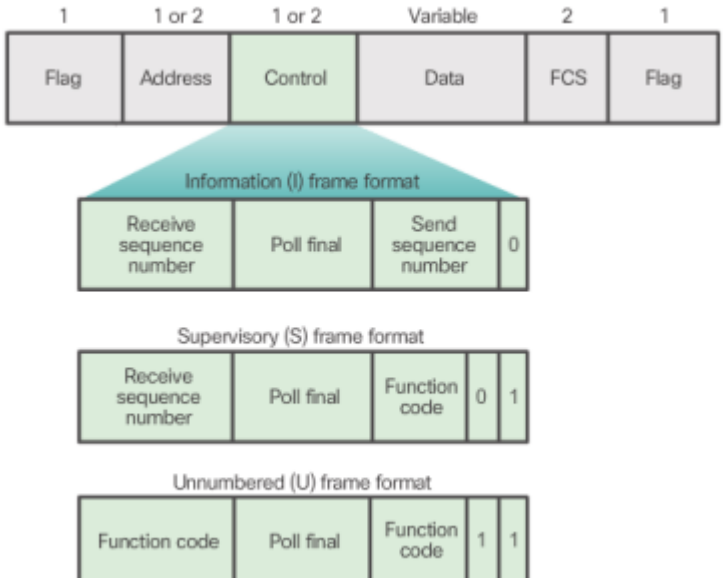
HDLC Frame Types

3 frame types: Each diff control field fmt:

Flag	**Initiates/terminates error checking:** • **Frame**: Always starts/ends w/8-bit flag field • **Bit pattern:** 01111110 • B/C pattern occurs in actual data: HDLC always inserts 0 bit after every 5 consecutive 1's in data field • **Flag seq:** Can only occur at frame ends • **Receiving sys:** Strips out inserted bits • Transmitted consecutively: End flag of 1st frame used as start flag of next frame
Address	Contains HDLC addr of 2ndary station: Can contain specific/group/broadcast addr **Primary addr:** Comm source/dest: • Eliminates need to include addr of primary
Control	Field uses 3 diff fmts (depends on HLDC frame used): • **Info Frame [I]: I-frames:** ▪ Carry upper layer info/some control info ▪ Sends/receives seq #'s | P/F: Poll final bit: Performs flow/error control ▪ **Send seq #:** The # of frame to be sent next ▪ **Receive seq #:** The # of frame to be received next ▪ Both sender/receiver maintain seq #'s □ **Primary station:** Uses P/F bit to tell 2ndary whether it needs immed response □ **2dary station:** Uses P/F bit to tell primary whether current frame is last in current response • **Supervisory Frame [S]: S-frames:** ▪ Provide control info ▪ Can req/suspend transmission/report on status/ack receipt of I-frames ▪ Don't have an info field • **Unnumbered Frame (U):** U-frames:

	○ Support control purposes/not seq ○ Depend on function of U-frame: Control field is 1 or 2 bytes ○ Some have an info field
Protocol	**Only used in cHDLC:** Field specifies protocol type encapsulated w/in frame (0x0800 for IP)
Data	Field contains PIU: Path Info Unit || or || XID: Exchange ID Info
FCS	**Frame Check Sequence (FCS)** • Precedes ending flag delimiter: Usually a CRC: Cyclic Redundancy Check calc remainder • CRC calc redone in receiver: If results differ from value in original frame: Error assumed

Config HDLC Encapsulation:



- cHDLC default encapsulation method used by Cisco on sync serial lines
- Use as point-to-point protocol on leased lines bet 2 Cisco devices
- If non-Cisco: Use sync PPP

If default encapsulation method changed: Enter int config of serial int
encapsulation hdlc *[priv exec]* Specify/re-enable encapsulation protocol on int
Troubleshooting Serial Int
show interfaces serial Displays info specific to serial ints

- HDLC config: Encapsulation HDLC should be in output

Returns 1 of 6 possible states: 5 are problems

Status Line	Possible Condition	Problem/Solution
Serial up: Line up	Good	No action
Serial down: Line down	Rtr not sensing CD: Carrier Detect sig: • CD not active WAN SP problem Cabling faulty/incorrect HW failure: CSU/DSU	1. Check LED's on CSU/DSU to see CD active ▪ Breakout box line to check CD sig 2. Verify cable/int used 3. Breakout box/check control leads 4. Contact SP 5. Swap faulty parts 6. If rtr HW: Change serial line to other port: ▪ If comes up previous int problem
Serial up: Line down	Local Rtr misconfig Keepalives not sent by remote rtr Leased-line/SP problem **Timing problem on cable** **SCTE: Serial Clock Transmit External:**	1. Put modem/CSU/DSU in local loopback mode ▪ **sh int serial**Determine if line comes up ▪ If yes: WAN/SP problem 2. Appears on remote end:

	• Not set on CSU/DSU • Made for clock phase shift on long cables When DCE devices uses SCTE: • Not internal clock sampled from DTE • Better to sample data w/out error • Even if phase shift in cable	▪ Repeat step 1 3. Verify cabling: **show controllers** *[exec]* **4. debug serial int** *[exec]* 5. If line doesn't come up in loopback: ▪ If shows keepalive counter not incrementing: ▪ Rtr HW problem: Swap rtr int HW 6. Line comes up/keepalive counter increments: ▪ Problem not in local rtr 7. Faulty HW: Change serial line to unused port ▪ Connection comes up? Int issue
Serial up, line up (looped)	Loop in circuit: • Seq # in keepalive packet • Changes to random # when loop detected	**1. sh run** for loopback int config entries **2. no loopback** [int config] 3. Examine CSU/DSU: Manual loopback mode? ▪ Disable mode: Reset CSU/DSU 4. Contact SP
Serial up, line down (disabled)	High error rate: WAN SP issue CSU/DSU HW problem Rtr HW (int) bad	1. Troubleshoot: Serial analyzer/breakout box ▪ Look for toggling CTS/DSR sigs 2. Loop CSU/DSU (DTE loop) ▪ If continues: Most likely HW 3. Swap bad HW
Serial admin down, line down	Rtr config includes shutdown Duplicate IP exists	1. Check config for **shutdown** • **no shut** 1. Verify no identical IPs: **sh run/sh int**

show controllers Indicates state of int chans/whether cable attached to int
show controllers cbus
PPP: When need to connect to non-Cisco rtr: PPP encapsulation

- Designed for compatibility
- Encapsulates data frames for trans over L2 phys links
- Establishes direct connection using serial/phone/trunk/cellular/radio/fiber links

3 main components:

HDLC-like	Framing for transporting multiprotocol packets over point-to-point
LCP	**Extensible Link Control Protocol:** • Establishing/config/testing data-ling connection
NCP's	**Network Control Protocols:** • Establishing/config diff network layer protocols • PPP allows simultaneous use of multiple network layer protocols • Common NCPs: IPv4/IPv6/AppleTalk/Novell IPX/Cisco/SNA/Compression

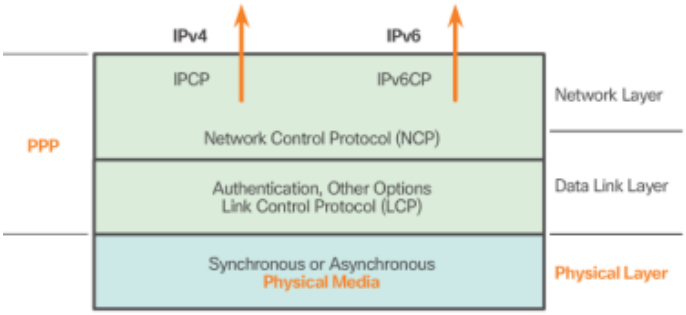
Advantages: Originally: Encapsulation protocol for transporting IPv4 traffic over point-to-point links

- Method for transporting multiprotocol packets over point-to-point
- Not proprietary

Features not available in HDLC:

- Link quality mgmt: Monitors quality of link
- If too many errors: PPP takes link down
- Supports PAP/CHAP auth

Layered Architecture



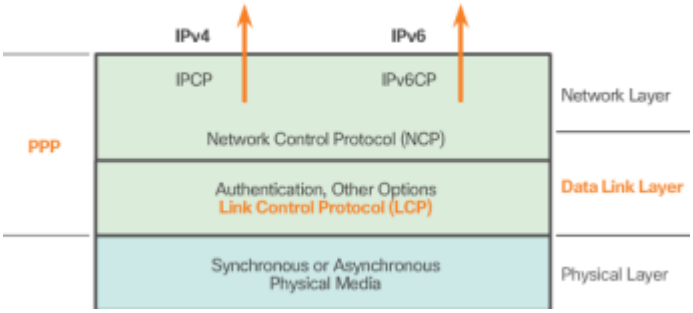
Layered architecture: A logical model/design/blueprint that aids in comm bet interconnecting layers
At physical layer: Can config PPP on a range of ints including:

- Async serial
- Sync serial
- HSSI
- ISDN

Ops across any DTE/DCE int (RS-232-C/422/423/V.35)

- **Absolute req:** Full-duplex circuit (dedicated/switched)
- Can op in an async/sync bit-serial mode, transparent to PPP link layer frames
- No restrictions on trans rate
- Most work done by PPP at DLL/Network layers by LCP/NCP's

LCP: Sets up PPP connection/params
NCPs: Handle higher layer protocol configs/LCP terms PPP
LCP: Link Control Protocol



Functions w/in DLL:

- Establishing/config/testing/data-link connection
- LCP establishes point-to-point link
  - Also negotiates/sets up control options on WAN link: Handled by the NCP's

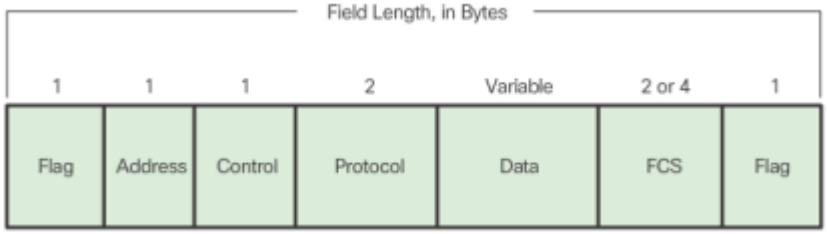
Provides auto config of ints at each end including:

- Varying limits on packet size
- Detecting common misconfig errors
- Term link
- Determining when link is func properly/failing
- After link establish: PPP uses LCP to auto agree on encapsulation fmts such as auth/compression/error detection

NCP: Network Control Protocol

- PPP permits multiple network layer protocols to op on same comm link
- For every network layer protocol used: PPP uses separate NCP
- Includes func fields containing standardized codes to indicate network layer protocol PPP encapsulates
- Each NCP manages specific needs req by its network layer protocols
- Various NCP components encapsulate/negotiate options for multiple network layer protocols

PPP Frame Structure



Consists of 6 fields:

Flag	**Single byte:** Indicates beginning/end of frame • Bin seq 01111110 • Successive PPP frames: Only single Flag char used
Address	**Single byte:** Bin seq 11111111 [standard broadcast addr] • PPP doesn't assign individual station addr
Control	**Single byte:** Bin seq 00000011 • Calls for trans of usr data in unseq frame • Provides connectionless link service: Requires establishment of data links/link stations • PPP link: Dest node doesn't need to be addressed ○ For PPP: Address field set to 0xFF broadcast ○ If both PPP peers agree to perform address/control field compression during LCP negotiation ○ Address field not included
Protocol	**2 bytes ID protocol encapsulated in info field of frame** • ID's protocol of PPP payload • If both PPP peers agree to perform protocol field compression during LCP negotiation: ○ Protocol field is 1 byte for ID in range 0x00-00 to 0x00-FF ○ Most up-to-date values of field specified in most recent Assigned Numbers RFC
Data	**0/more bytes contain datagram for protocol specified in protocol field** • End of info field found by locating closing flag seq/allowing 2 bytes for FCS field • Default max length of info field: 1,500 bytes • Consenting PPP implementations can use other values for max info
FCS	**Frame Check Sequence:** Normally 16 bits (2 bytes) • Consenting PPP implementations can use 32-bit (4-byte) FCS for improved error detection • If receiver's calc of FCS doesn't match FCS in frame: Frame is silently discarded • LCPs can negotiate mods to PPP frames: ○ Mod frames: Always distinguishable from standard ones