DATA LINK PROTOCOLS

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Data Link Protocols

- Data Link Protocols are sets of rule and regulations used to implement data link layer.
- They contain rules for:
  - Line Discipline
  - Flow Control
  - Error Control

Types of Data Link Protocols

- Data Link Protocols are divided into two categories:
  - Asynchronous Protocols
  - Synchronous Protocols

Asynchronous Protocols

- Asynchronous protocols treat each character in a bit stream independently.
- These protocols are used in modems.
- They use ***start*** and ***stop*** bits, and variable gaps between characters.
- They are slower than synchronous protocols in transmitting data.

Asynchronous Protocols

- The different asynchronous protocols are:
  - XMODEM
  - YMODEM
  - ZMODEM
  - Block Asynchronous Transmission (BLAST)
  - Kermit

XMODEM

- It is a half duplex stop & wait protocol.
- It is used for telephone line communication between PCs.
- The sender sends a frame to receiver & waits for ACK frame.
- The receiver can send one cancel signal (CAN) to abort the transmission.
- The frame format of XMODEM is:

SOH	Header	Data	CRC
1 Byte	2 Bytes	128 Bytes	

XMODEM

- The various fields of frame are:
  - **SOH:** It is start of header. It is 1 byte field.
  - **Header:** It contains the sequence number. It is 2 bytes in length.
  - **Data:** This field holds 128 bytes of data.
  - **CRC:** It is Cyclic Redundancy Check. This field checks the errors in data field.

YMODEM

- This protocol is similar to XMODEM with the following major differences:
  - Two cancel signals (CAN) are used to abort the transmission.
  - The data field is 1024 bytes long.
  - ITU-T CRC-16 is used for error checking.

ZMODEM

- It is a combination of XMODEM and YMODEM.

BLAST

- BLAST is more powerful than XMODEM.
- It is a full duplex protocol.
- It uses sliding window flow control.

Kermit

- It is a terminal program as well as file transfer protocol.
- It is similar in operation to XMODEM, except that sender has to wait for a negative acknowledgement (NAK) before it starts transmission.

Synchronous Protocols

- Synchronous Protocols take the whole bit stream and divide it into characters of equal size.
- These protocols have high speed and are used for LAN, WAN and MAN.
- Synchronous protocols are categorized into two groups:
  - Character-Oriented Protocol
  - Bit-Oriented Protocol

Character-Oriented Protocol

- It interprets frame as a series of characters.
- These are also known as Byte-Oriented Protocols.
- Control information is inserted as separate control frames or as addition to existing data frame.
- The example of character-oriented protocol is Binary Synchronous Communication (BSC) developed by IBM.

Bit-Oriented Protocol

- It interprets frame as a series of bits.
- Control information can be inserted as bits depending on the information to be contained in the frame
- Bit-oriented protocol can pack more information into shorter frames.
- The examples of bit-oriented protocol are:
  - Synchronous Data Link Control (SDLC)
  - High Level Data Link Control (HDLC)

Synchronous Data Link Control (SDLC) Protocol

- SDLC protocol was developed by IBM in 1975.
- After developing SDLC, IBM submitted it to American National Standard Institute (ANSI) and to International Standard Organization (ISO) for acceptance.
- ANSI modified it to ADCCP (Advanced Data Communication Control Procedure.
- ISO modified it to HDLC (High Level Data Link Control).

Synchronous Data Link Control (SDLC) Protocol

- The frame format of SDLC is:

Flag	Address	Control	User Data	ECF	Flag
01111110	8-Bit	8-Bit		16-Bit	01111110

- The flag sequence of 8-bits 01111110 marks the beginning and ending of the frame.
- Address field contains the address of the receiver.
- Control field carries the sequence number, acknowledgement, requests and responses.

Synchronous Data Link Control (SDLC) Protocol

- The frame format of SDLC is:

01111110					01111110
Flag	Address	Control	User Data	ECF	Flag
	8-Bit	8-Bit		16-Bit	

- The user data field carries the data and is of variable length.
- ECF stands for Error Checking Field and is of 16-bits. It is used for error control.

High Level Data Link Control (HDLC) Protocol

- HDLC came into existence after ISO modified the SDLC protocol.
- It is a bit-oriented protocol that supports both half and full duplex communication.
- Systems using HDLC are characterized by:
  - Station Types
  - Configuration.
  - Response Modes

Station Types

- To make HDLC protocol applicable to various network configurations, three types of stations have been defined:
  - Primary Station
  - Secondary Station
  - Combined Station

Primary Station

- It has complete control over the link at any time.
- It has the responsibility of connecting & disconnecting the link.
- The frames sent by primary station are called **commands**.

Secondary Station

- All the secondary stations work under the control of primary station.
- The frames sent by secondary station are called **responses**.

Combined Station

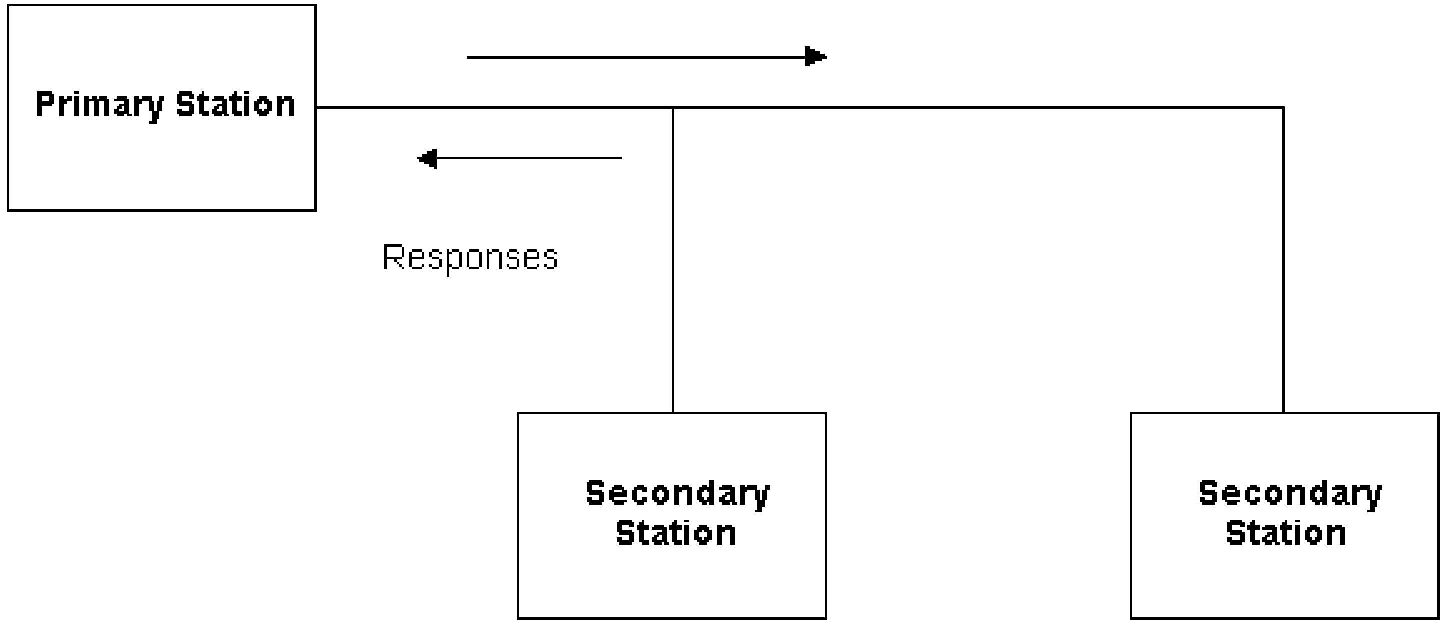
- A combined station can behave either as primary or as secondary station.
- It can send commands as well as responses.

Configuration

- Configuration defines how the various stations are connected to a link.
- There are three possible configurations:
  - Unbalanced Configuration
  - Symmetrical Configuration
  - Balanced Configuration

Unbalanced Configuration

- This type of configuration exists if one station is primary and other is secondary.

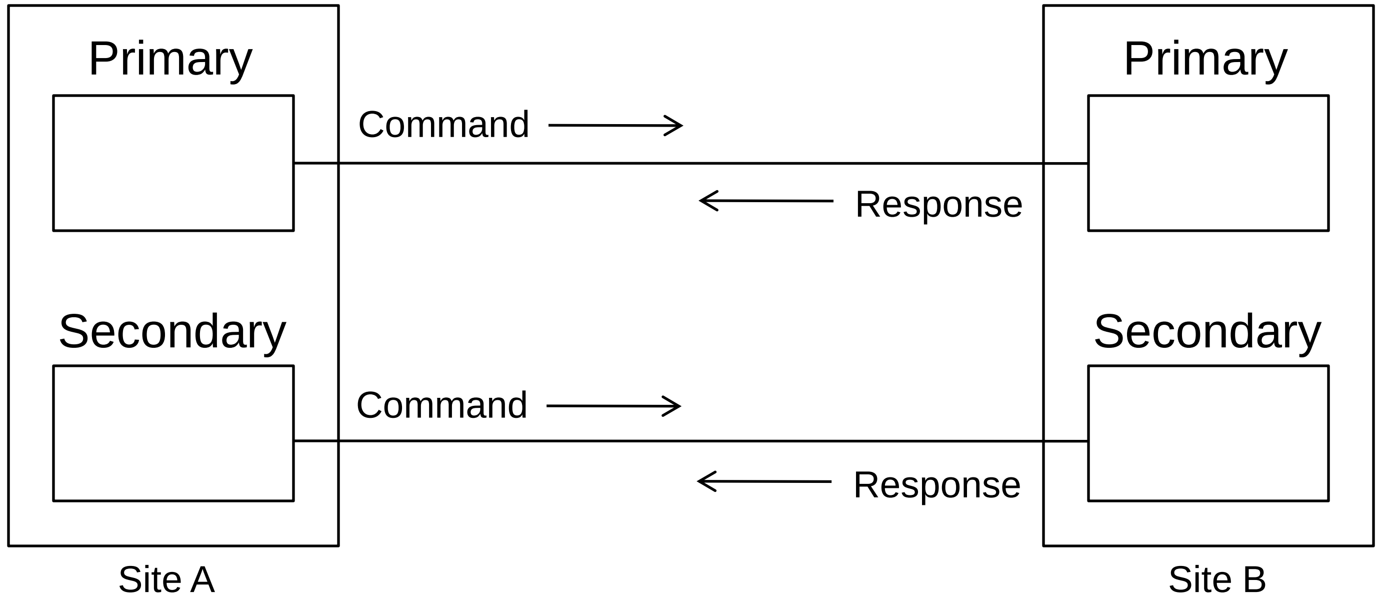


Unbalanced Configuration

- It can further be of two types:
  - **Point-to-Point Unbalanced Configuration**:
    - If there is one primary and one secondary station.
  - **Multipoint Unbalanced Configuration**:
    - If there is one primary and many secondary stations.

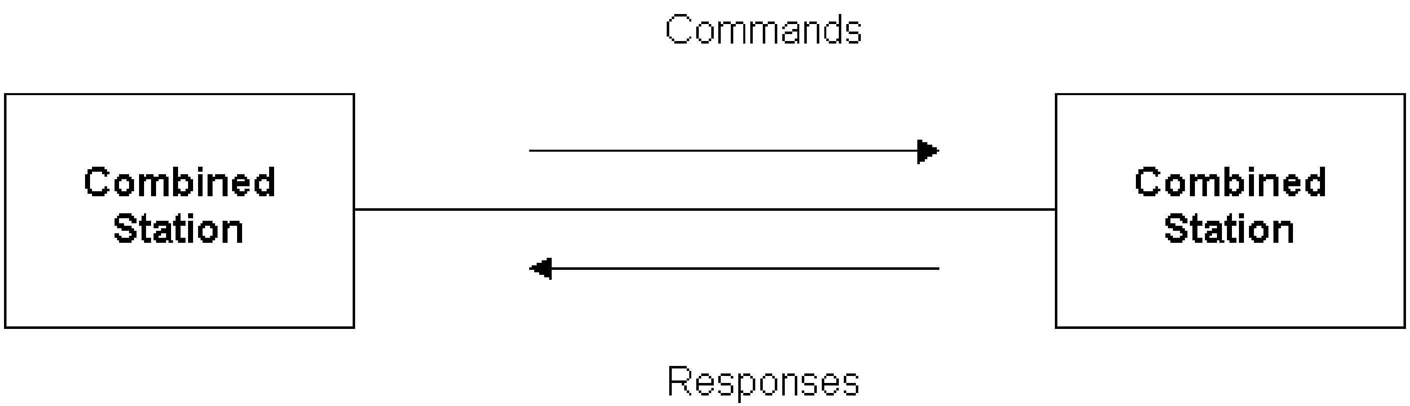
Symmetrical Configuration

- In this configuration, both sites contain two stations: one primary and one secondary.
- Primary station of one site is linked with secondary station of the other and vice versa.



Balanced Configuration

- In this configuration, both sites have combined stations.
- These combined stations are connected with single link.
- This single link can be controlled by either station.



Response Modes

- HDLC supports three modes of communication between stations:
  - Normal Response Mode (NRM)
  - Asynchronous Response Mode (ARM)
  - Asynchronous Balanced Mode (ABM)

Normal Response Mode (NRM)

- In this mode, primary station controls the link.
- Secondary station seeks permission from primary before transmitting the data.

Asynchronous Response Mode (ARM)

- In this mode, if channel is idle, secondary station may initiate the transmission without seeking permission from the primary.
- If any secondary station wants to communicate with other secondary station, the transmission is done via primary station only.

Asynchronous Balanced Mode (ABM)

- This type of mode involves combined stations.
- There is no primary-secondary relationship, all stations are equal.
- Therefore, either of the combined station can initiate the transmission without seeking permission from the other.

Frame Structure in HDLC

- Frame in HDLC can have six fields:

01111110					01111110
Flag	Address	Control	Information	FCS	Flag
8-Bit	8-Bit	8/16-Bit	Variable	16-Bit	8-Bit

- **Flag Field:** It is the 8-bit field that contains 01111110. It marks the beginning and end of a frame.
- **Address Field:** This field contains the address of the receiver. It is 8-bit long.

Frame Structure in HDLC

- Frame in HDLC can have six fields:

01111110					01111110
Flag	Address	Control	Information	FCS	Flag
8-Bit	8-Bit	8/16-Bit	Variable	16-Bit	8-Bit

- **Control Field:** It carries the sequence number, acknowledgements, requests and responses. It can be of 8-bit or 16-bit.
- **Information Field:** It contains user data. Its length is different for different networks.

Frame Structure in HDLC

- Frame in HDLC can have six fields:

01111110					01111110
Flag	Address	Control	Information	FCS	Flag
8-Bit	8-Bit	8/16-Bit	Variable	16-Bit	8-Bit

- **FCS Field:** FCS stands for Frame Check Sequence. It is the error detection field and is 16-bit long. It contains either 16-bit CRC or 32-bit CRC.

Types of Frames in HDLC

- HDLC defines three types of frames:
  - **Information Frame (I-Frame):**
    - I-Frames carry user data, and control information about user's data.
  - **Supervisory Frame (S-Frame):**
    - S-Frames carry flow & error control information.
  - **Unnumbered Frame (U-Frame):**
    - U-Frames are reserved for system management.
    - They are used to exchange session management & control information between the two connected devices.

Thank You

Have a Nice Day