HDLC Protocol Overview

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HDLC – A Brief Overview

What is HDLC?

- High Level Data Link Control is a protocol, which operates at the data link layer. The HDLC protocol embeds information in a data frame that allows devices to control data flow and correct errors

- HDLC is an ISO Standard developed from the Synchronous Data Link Control (SDLC) standard proposed by IBM

- Operates at the data link layer

- Used on both point-to-point and multipoint (multi-drop) data links

- Role of HDLC is to ensure that the data has been received without any loss or errors and in the correct order

- Provides connection-oriented and connection-less service
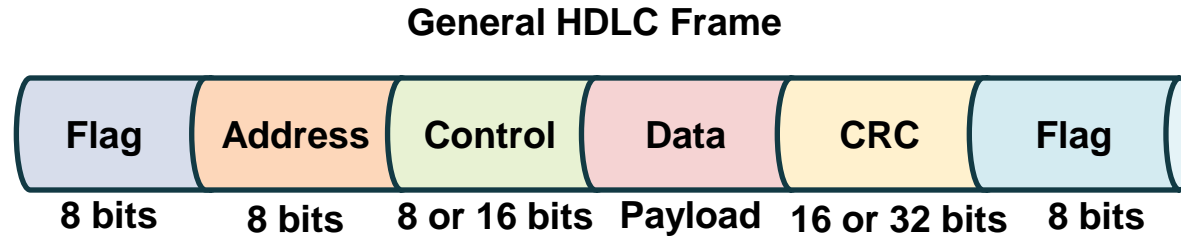
- ISO Standards: 3009, 4305

HDLC Basics

- Stations:

  ➢ Primary: sends data, controls the link with commands

  ➢ Secondary: receives data, responds to control messages

  ➢ Combined: can issue both commands and responses

- Link configuration:

  ➢ Unbalanced: one primary station, one or more secondary stations

  ➢ Balanced: two combined stations

Operation Modes

- HDLC has three operation modes –

  ➢ Normal Response Mode (NRM)

    ▪ Used with unbalanced configuration

    ▪ Primary initiates data transfer; secondary can only reply

  ➢ Asynchronous Response Mode (ARM)

    ▪ Secondary station initiates a transmission without receiving permission from the primary station

    ▪ Primary terminal still retains responsibility for line initialization, error recovery, and logical disconnect

    ▪ Allows the secondary station to send frames asynchronously with respect to the primary station

  ➢ Asynchronous Balanced Mode (ABM)

    ▪ Used with Balanced configuration

    ▪ Either station may initiate the transmission at any time

HDLC Frame Structure

General HDLC Frame

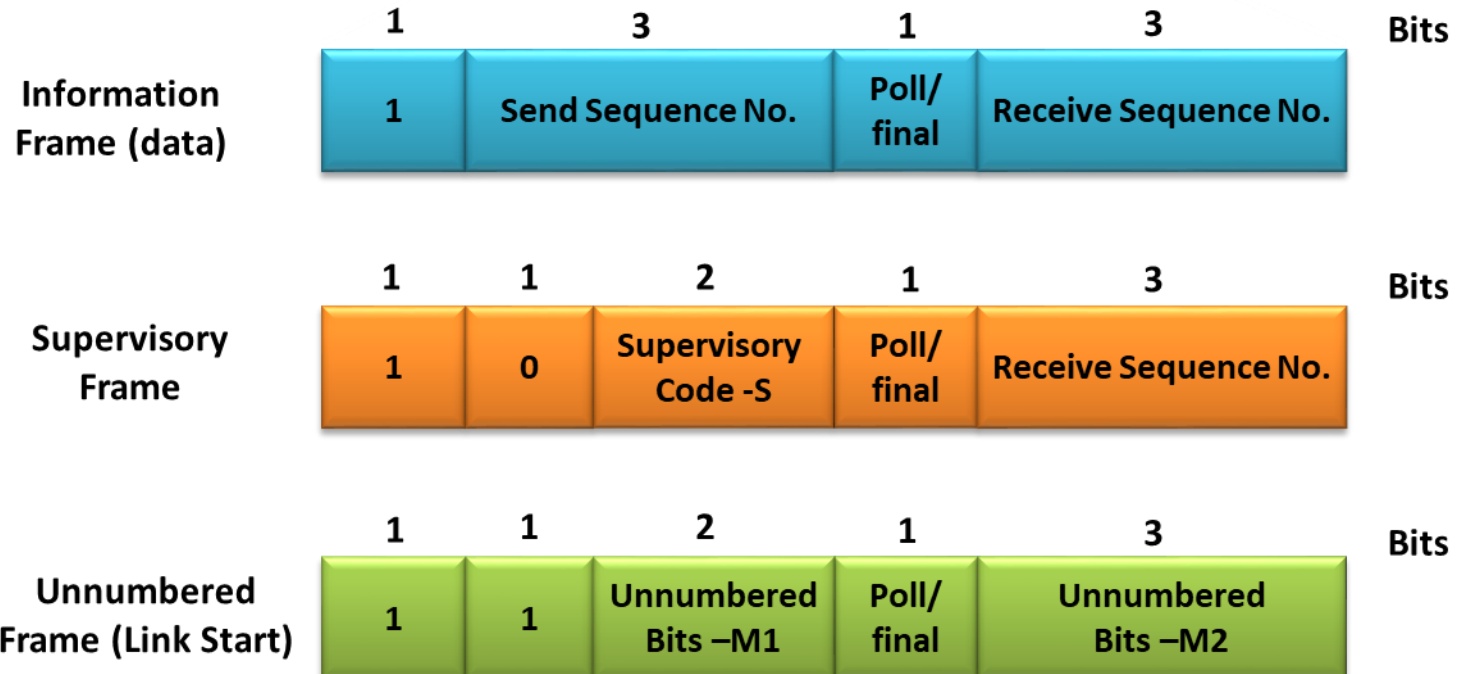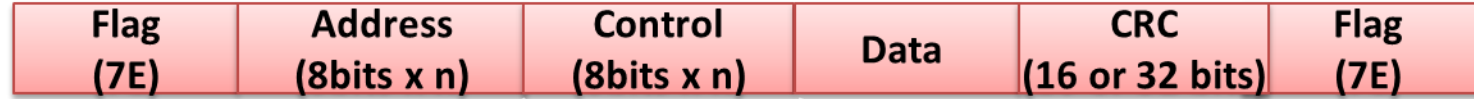| Flag	Address	Control	Data	CRC	Flag
8 bits	8 bits	8 or 16 bits	Payload	16 or 32 bits	8 bits

- Flag – Identifies the beginning and end of a frame – 01111110 (7E Hex)

- Address – Address of the station: Single byte

- Control – Defines the frame type and is protocol dependent

- Data – Data field may vary in length depending upon the protocol using the frame. Layer 3 frames are carried in the data field

- FCS – Frame Check Sequence is used to verify the data integrity

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Frame Types

Three classes of frames are used -

- Information frames (I-Frames) – Carry the actual data. Transport user data from the network layer. In addition, they can also include flow and error control information piggybacked on data

- Supervisory frames (S-Frames) – Used for error and flow control. They contain, send and receive sequence numbers

- Unnumbered frames (U-Frames) – Used for various miscellaneous purposes, including link management

Control Fields

Flag (7E)	Address (8bits x n)	Control (8bits x n)	Data	CRC (16 or 32 bits)	Flag (7E)

Information Frame (data)

1	3	1	3	Bits
1	Send Sequence No.	Poll/final	Receive Sequence No.	

Supervisory Frame

1	1	2	1	3	Bits
1	0	Supervisory Code -S	Poll/final	Receive Sequence No.	

Unnumbered Frame (Link Start)

1	1	2	1	3	Bits
1	1	Unnumbered Bits –M1	Poll/final	Unnumbered Bits –M2	

Information Frames (I-Frames)

1	3	1	3
1	Send Sequence No.	Poll/ final	Receive Sequence No.

- N(S): Sending Sequence Number

- N(R): Receiving sequence number

- P/F: Poll or Final bit

Supervisory Frames (S-Frames)

1	1	2	1	3
1	0	Supervisory Code – S	Poll/ final	Receive Sequence No.

- S =00 RR - Receiver Ready to accept more I-frames (data)

- S =10 RNR - Receiver Not Ready to accept more I-frames

- S =01 REJ - Go-Back-N retransmission request for an I-frame

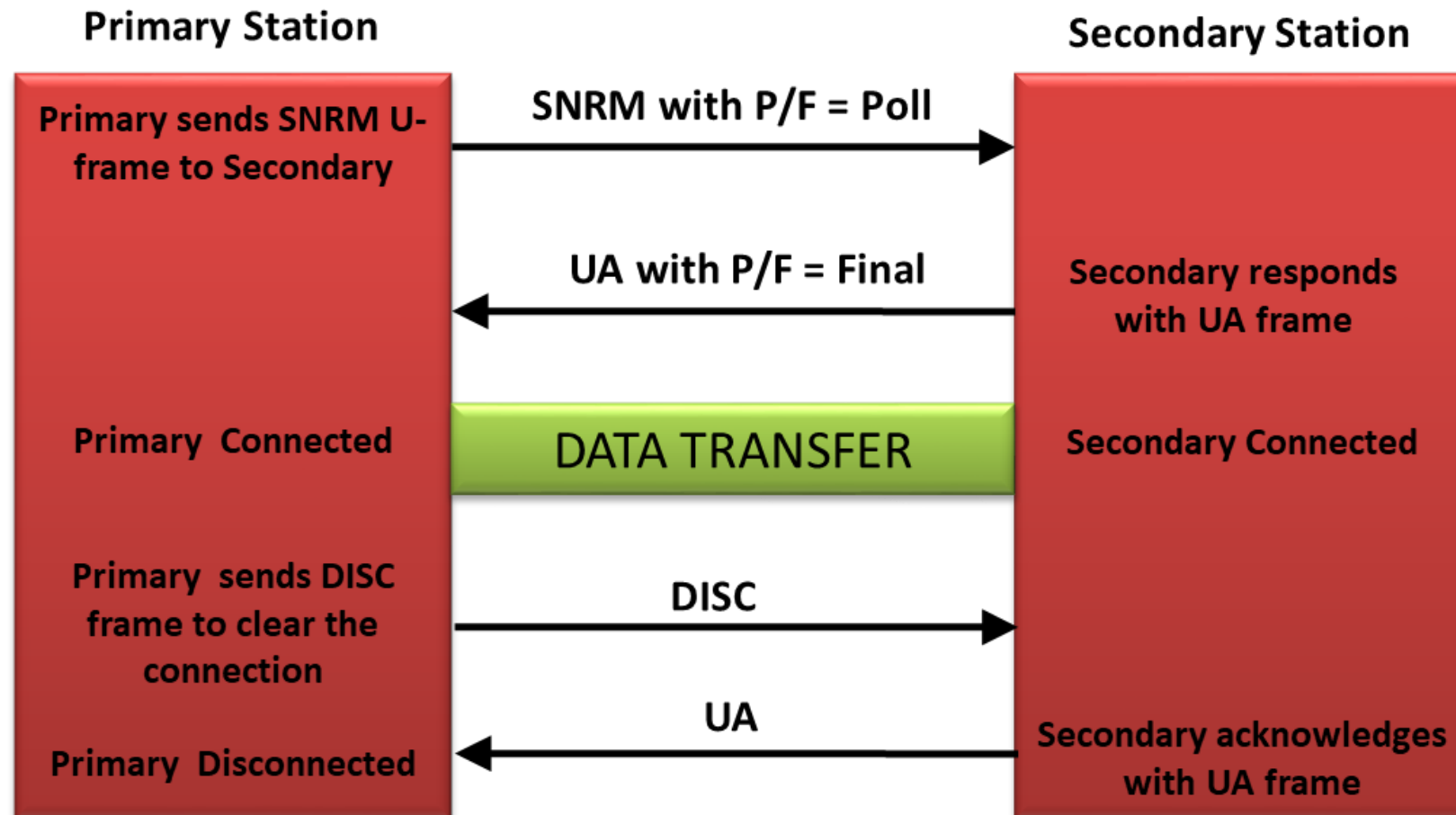- S =11 SREJ - Selective retransmission request for an I-frame

Unnumbered Frames (U-Frames)

1	1	2	1	3
1	1	M1	Poll/final	M2

- SNRM: set normal response mode (M1 = 00, M2 = 001)

- SABM: set asynchronous balanced mode (M1 = 11, M2 = 100)

- SABME: set asynchronous balanced mode, extended (M1 = 11, M2 = 110)

- DISC: disconnect (M1=00, M2=010)

- UA: un-numbered acknowledgement (M1 = 00, M2 = 110)

- RSET: resets send and receive sequence numbers (M1 = 11, M2=001)

- FRMR: frame reject (M1 = 10, M2=001)

Protocol Operation

- Basic functions involves –
  - ➢ Link management
  - ➢ Data transfer (includes error and flow control)

Primary Station   **Secondary Station**

Primary sends SNRM U-frame to Secondary	SNRM with P/F = Poll →	
	UA with P/F = Final ←	Secondary responds with UA frame
Primary Connected	**DATA TRANSFER**	Secondary Connected
Primary sends DISC frame to clear the connection	DISC →	
Primary Disconnected	UA ←	Secondary acknowledges with UA frame

# Link Management and Data Transfer

- Establishes a logical connection between the two communication parties prior to any transmission

- Primary station sends the SNRM (Set Normal Response Mode) , SABM (Set Asynchronous Balanced Mode), SABME (Set Asynchronous Balanced Mode, Extended) with the poll bit set to 1 and the address of the appropriate secondary in the address field

- Primary sets the mode, and the length of sequence numbers

- The secondary responds with a UA frame with the final bit set and its own address in the address field

- If data is waiting, it transmits the data, typically as a sequence of information frames

- Primary clears the link is cleared by sending a DISC (Disconnect) frame and the secondary responding with a UA

Link Management and Data Transfer (Contd.)
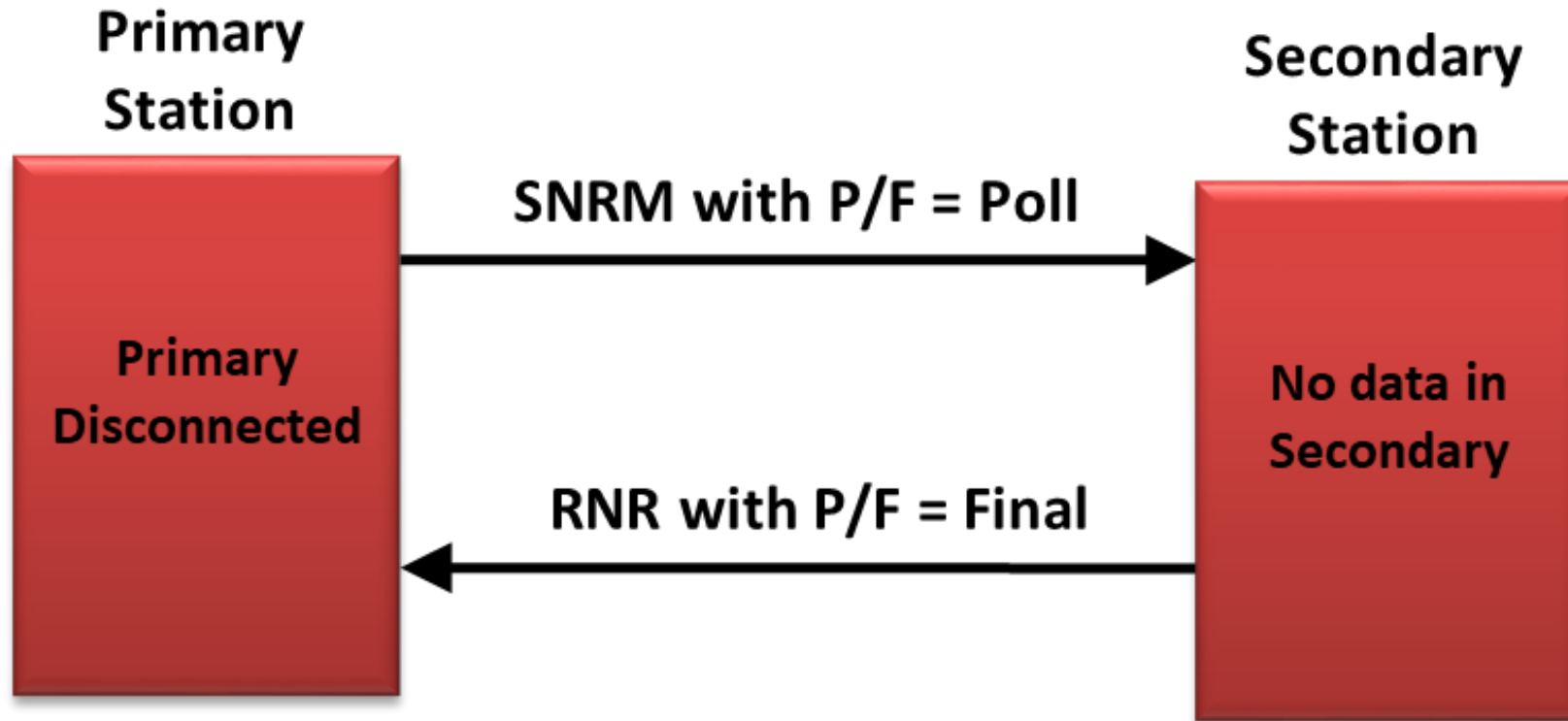
- If the secondary has no data to transmit, it returns an RNR frame with the F bit set
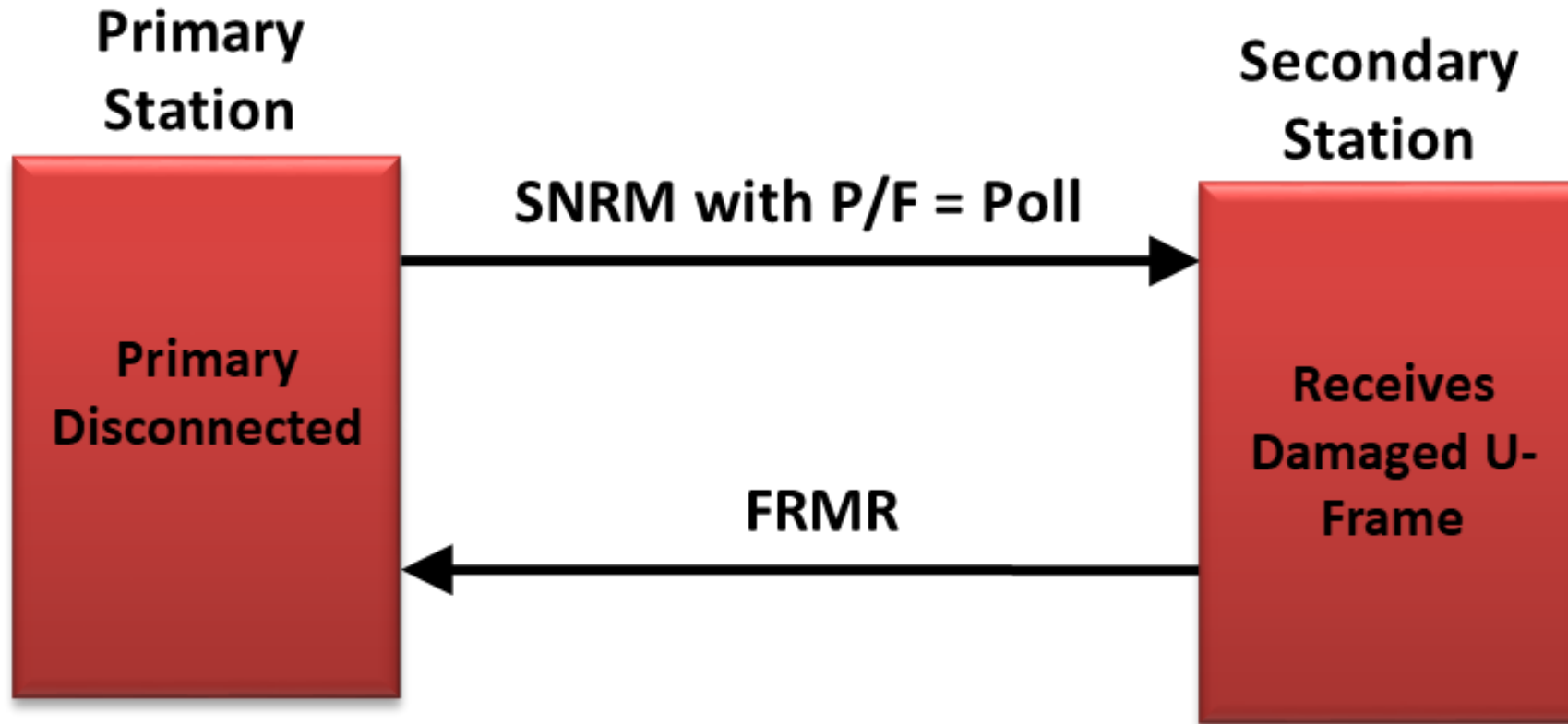
- If a damaged U-frame is received, FRMR is sent as a reply

GL Test Tools for HDLC

- For T1

  - HDLC Playback

  - HDLC Tx/Rx Utility

  - HDLC Tx/Rx Client Server Applications

  - HDLC Impairment

  - HDLC Analyzer

- For T3

  - HDLC Playback

  - HDLC Tx/Rx Utility

  - HDLC Tx/Rx Client Server Applications

  - HDLC Analyzer

- For Datacom

  - HDLC Playback

  - HDLC Impairment

  - HDLC Tx/Rx Client Server Applications

  - HDLC Analyzer

Thank you