HDLC (High-level Data Link Control)

High-level data link control (HDLC) is a bit-oriented synchronous data link layer protocol used to ensure the error-free transmission of data to respective destinations and control the speed at which data is transmitted.

HDLCs provide both **connection-oriented and connectionless services.**

High-level data link control is a set of protocols that defines rules for transmitting data between network points. Data in HDLC is organized into units called **frames** and is sent across networks to specified destinations.

HDLC is commonly used in Data Link Layer (layer 2) of the open systems interconnection (OSI) model.

HDLC frames are transmitted over synchronous links or asynchronous links, which do not mark the start and end of frames. This is done using a frame delimiter or flag, which contains unique sequence of bits that are not visible inside a frame.
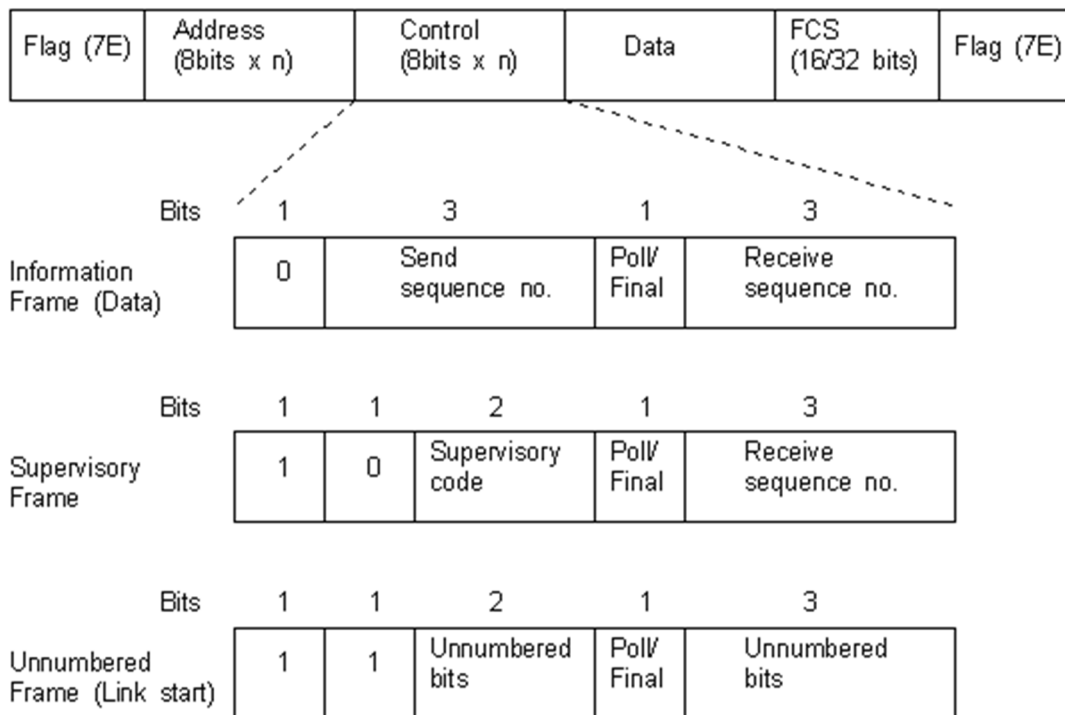
There are three types of HDLC frames:

- Information frames/User data (I-frames)
- Supervisory frames/Control data (S-frames)
- Unnumbered frames (U-frames)

The common fields within an HDLC frame are:

- Flag
- Address
- Control information
- Frame check sequence

The HDLC protocol is used by a variety of standards implemented in the protocol stacks of X.25, and many other protocol stacks

The following diagram details the HDLC frame format:

Flag (7E)	Address (8bits x n)	Control (8bits x n)	Data	FCS (16/32 bits)	Flag (7E)

Information Frame (Data)

Bits	1	3	1	3
	0	Send sequence no.	Poll/Final	Receive sequence no.

Supervisory Frame

Bits	1	1	2	1	3
	1	0	Supervisory code	Poll/Final	Receive sequence no.

Unnumbered Frame (Link start)

Bits	1	1	2	1	3
	1	1	Unnumbered bits	Poll/Final	Unnumbered bits

The HDLC frame begins and ends the error checking procedure with **01111110** in binary.

There are three types of HDLC frame types defined by the control field:

- **Information Frames** are used for the data transfer between stations. The send sequence, or next send N(S), and the receive sequence, or next receive N(R), hold the frame sequence numbers. The **Poll/Final** bit is called Poll when used by the primary station to obtain a response from a secondary station, and Final when used by the secondary station to indicate a response or the end of transmission.
- **Supervisory Frames** are used to acknowledge frames, request for retransmissions or to ask for suspension of transmission. The Supervisory code denotes the type of supervisory frame being sent.
- **Unnumbered Frames** are used for link initialization or link disconnection. The Unnumbered bits indicate the type of Unnumbered frame being used.

HDLC (High-level Data Link Control) is a group of protocols or rules for transmitting data between network points (sometimes called **Nodes**). In HDLC, data is organized into a unit (called a **Frame**) and sent across a network to a destination that verifies its successful arrival.

Variations of HDLC are also used for the public networks that use the X.25 communications protocol.
The following table summarizes the HDLC variations and who uses them.

HDLC SUBSET	USES
NRM (Normal Response Mode)	Multipoint networks that typically use SDLC
LAP (Link Access Procedure)	Early X.25 implementations
LAPB (Link Access Procedure, Balanced)	Current X.25 implementations
LAPD (Link Access Procedure for the Integrated Services Digital Network D channel)	ISDN D channel and frame relay
LAPM (Link Access Procedure for Modems)	Error-correcting modems (specified as part of V.42)