

## Data Link Layer Protocol

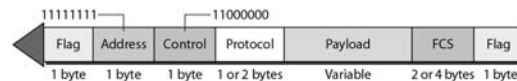
- Asynchronous Transfer Mode
- Ethernet
- Fiber Distributed Data Interface
- Frame Relay
- High-Level Data Link Control
- IEEE 802.2
- IEEE 802.11
- Point-to-Point Protocol
- Ect.

## POINT-TO-POINT PROTOCOL

- Although HDLC is a general protocol that can be used for both point-to-point and multipoint configurations, one of the most common protocols for point-to-point access is the Point-to-Point Protocol (PPP). PPP is a byte-oriented protocol.
  - Framing
  - Transition Phases
  - Multiplexing
  - Multilink PPP

## PPP frame format

- PPP is based on the High-Level Data Link Control (HDLC) protocol
- The difference between PPP frames and HDLC frames is that PPP frames contain protocol and Link Control Protocol (LCP) fields
- LCP
  - Described in RFCs 1548, 1570, 1661, 2153, and 2484
  - Describes PPP organization and methodology, including basic LCP extensions

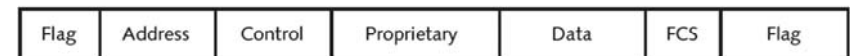


## HDLC & PPP frame format

### HDLC



### Cisco HDLC

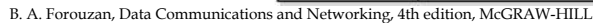


### PPP



Figure 11-2 HDLC and PPP packet structure

Diagram illustrating the structure of a packet (likely HDLC or similar protocol). The packet is divided into fields: Flag, Address, Control, Mgmt. info., FCS, and Flag. A large arrow points left from the first Flag field, indicating the direction of transmission.



```
graph TD
    Dead([Dead]) -- "Carrier detected" --> Establish([Establish])
    Establish -- "Options agreed by both sides" --> Authenticate([Authenticate])
    Authenticate -- "Authentication successful" --> Network([Network])
    Network -- "Network layer configuration" --> Open([Open])
    Open -- "Done" --> Terminate([Terminate])
    Terminate -- "Carrier dropped" --> Dead
    Authenticate -- "Failed" --> Failed([Failed])
    Failed -- "Failed" --> Dead
    Network -.- "If authentication not needed" --> Establish
```

B. A. Forouzan, Data Communications and Networking, 4th edition, McGRAW-HILL

The diagram illustrates the mapping of Network layer and Data link layer components to the HDLC frame structure. It is divided into two main sections: the Network layer and the Data link layer.

**Network layer:** Data from different networking protocols is sent to the Data link layer.

**Data link layer:** This layer contains three main components: NCP, AP, and LCP. NCP includes OSI CP and IPCP. AP includes CHAP and PAP.

**HDLC Frame Structure:** The frame is composed of several fields: Flag, Address, Control, Protocol, Data, FCS, and Flag. The Data link layer components map to these fields as follows:

- NCP:** Maps to the Control field.
- AP:** Maps to the Protocol field.
- LCP:** Maps to the Data field.

LCP: Link Control Protocol  
AP: Authentication Protocol  
NCP: Network Control Protocol

B. A. Forouzan, Data Communications and Networking, 4th edition, McGRAW-HILL.

The diagram illustrates the structure of an LCP packet. The packet itself is a sequence of fields: Flag, Address, Control, 0xC021, Payload (and padding), FCS, and Flag. Above the packet, the LCP packet structure is detailed: Code (1 byte), ID (1 byte), Length (2 bytes), and Information (Variable bytes).

B. A. Forouzan, Data Communications and Networking, 4th edition, McGRAW-HILL

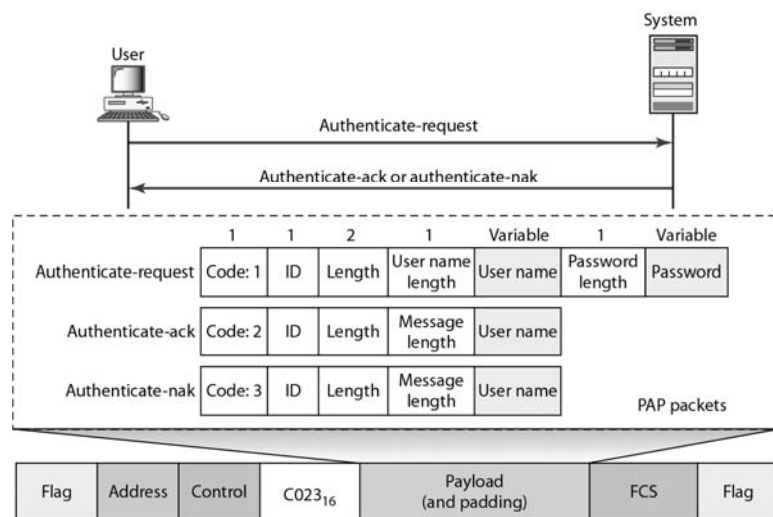
## LCP packets

Code	Packet Type	Description
0x01	Configure-request	Contains the list of proposed options and their values
0x02	Configure-ack	Accepts all options proposed
0x03	Configure-nak	Announces that some options are not acceptable
0x04	Configure-reject	Announces that some options are not recognized
0x05	Terminate-request	Request to shut down the line
0x06	Terminate-ack	Accept the shutdown request
0x07	Code-reject	Announces an unknown code
0x08	Protocol-reject	Announces an unknown protocol
0x09	Echo-request	A type of hello message to check if the other end is alive
0x0A	Echo-reply	The response to the echo-request message
0x0B	Discard-request	A request to discard the packet

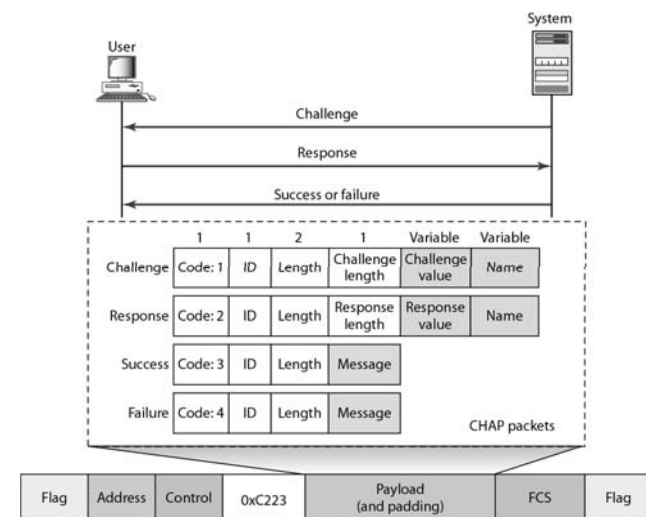
## Common options

Option	Default
Maximum receive unit (payload field size)	1500
Authentication protocol	None
Protocol field compression	Off
Address and control field compression	Off

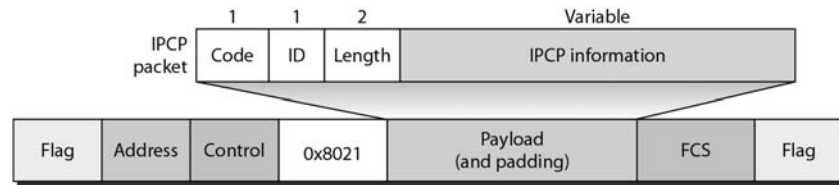
## PAP packets encapsulated in a PPP frame



## CHAP packets encapsulated in a PPP frame



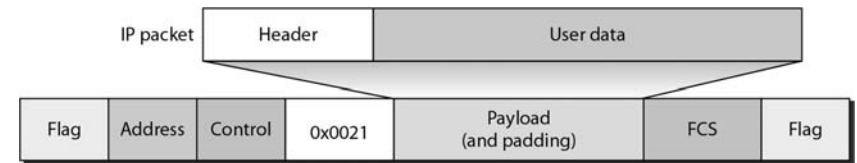
## IPCP packet encapsulated in PPP frame



### • Code value for IPCP packets

Code	IPCP Packet
0x01	Configure-request
0x02	Configure-ack
0x03	Configure-nak
0x04	Configure-reject
0x05	Terminate-request
0x06	Terminate-ack
0x07	Code-reject

## IP datagram encapsulated in a PPP frame



Code	IPCP Packet
01	Configure-request
02	Configure-ack
03	Configure-nak
04	Configure-reject
05	Terminate-request
06	Terminate-ack
07	Code-reject

## Multilink PPP

