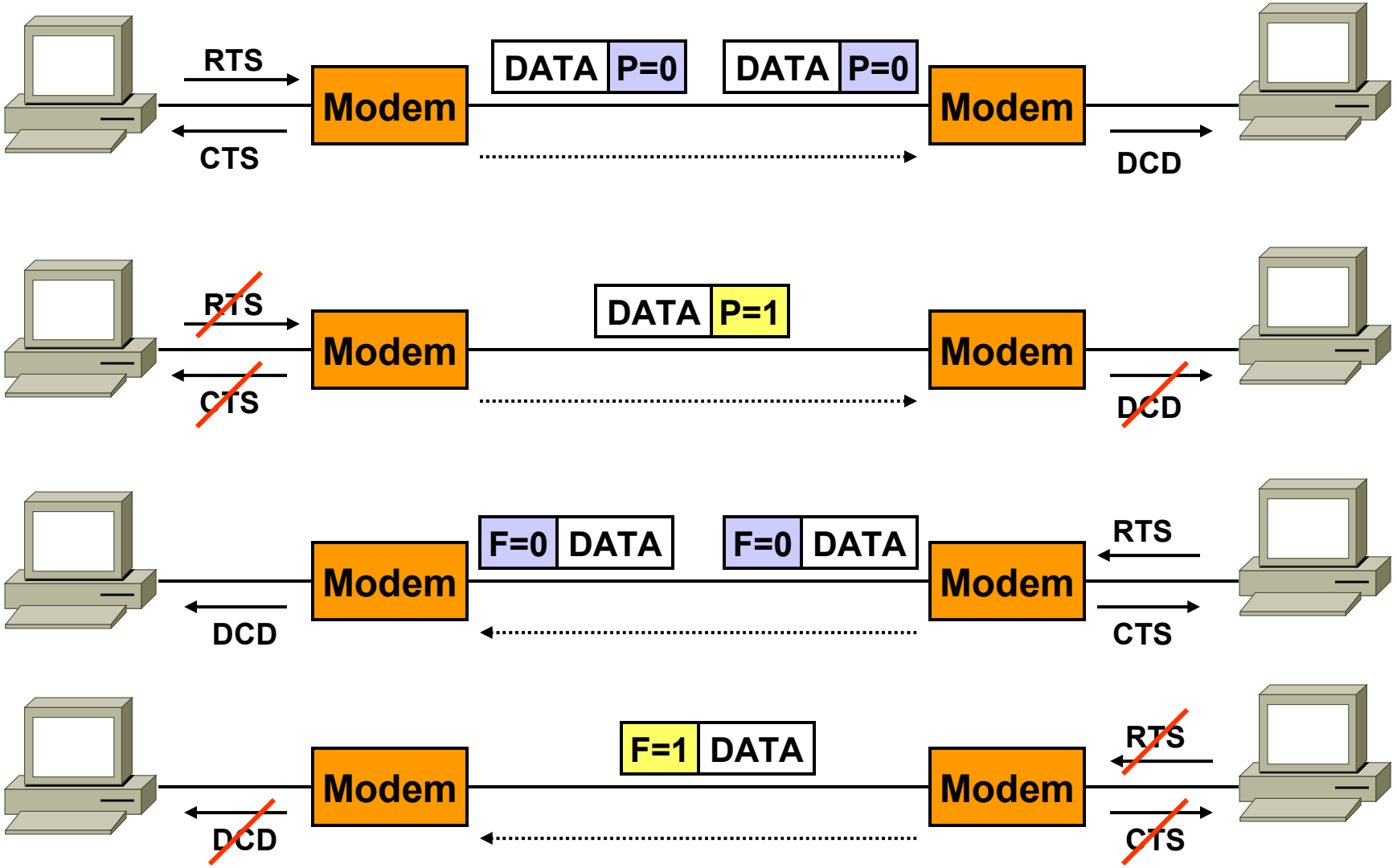
HDLC

King of the Link

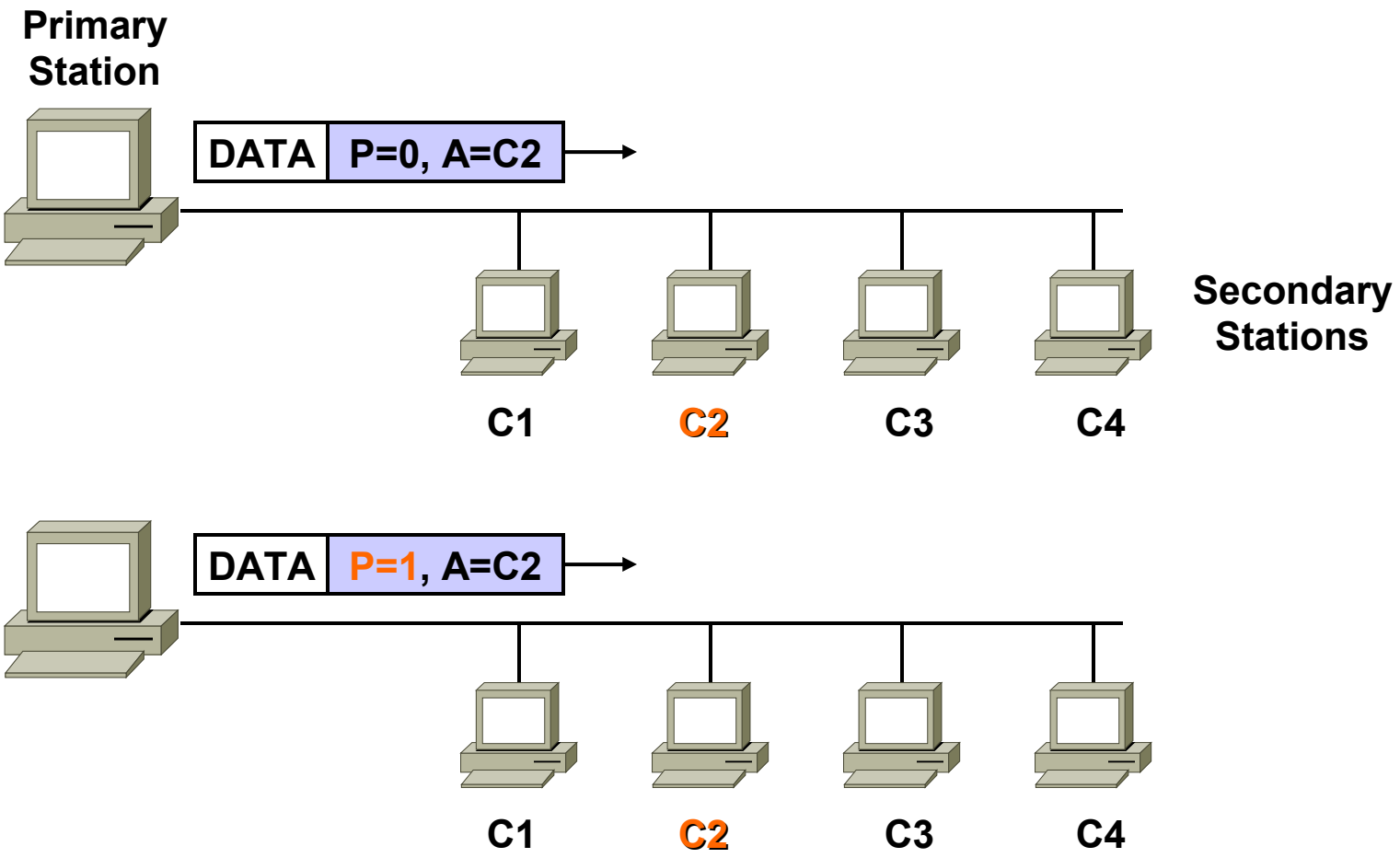
What is HDLC ?

- High-Level Data Link Control
- Early link layer protocol
- Based on SDLC (Synchronous-DLC, IBM)
  - Access control on half-duplex modem-lines
  - Connectionoriented or connectionless
  - Framing
  - Frame Protection
- Mother of many LAN and WAN protocols

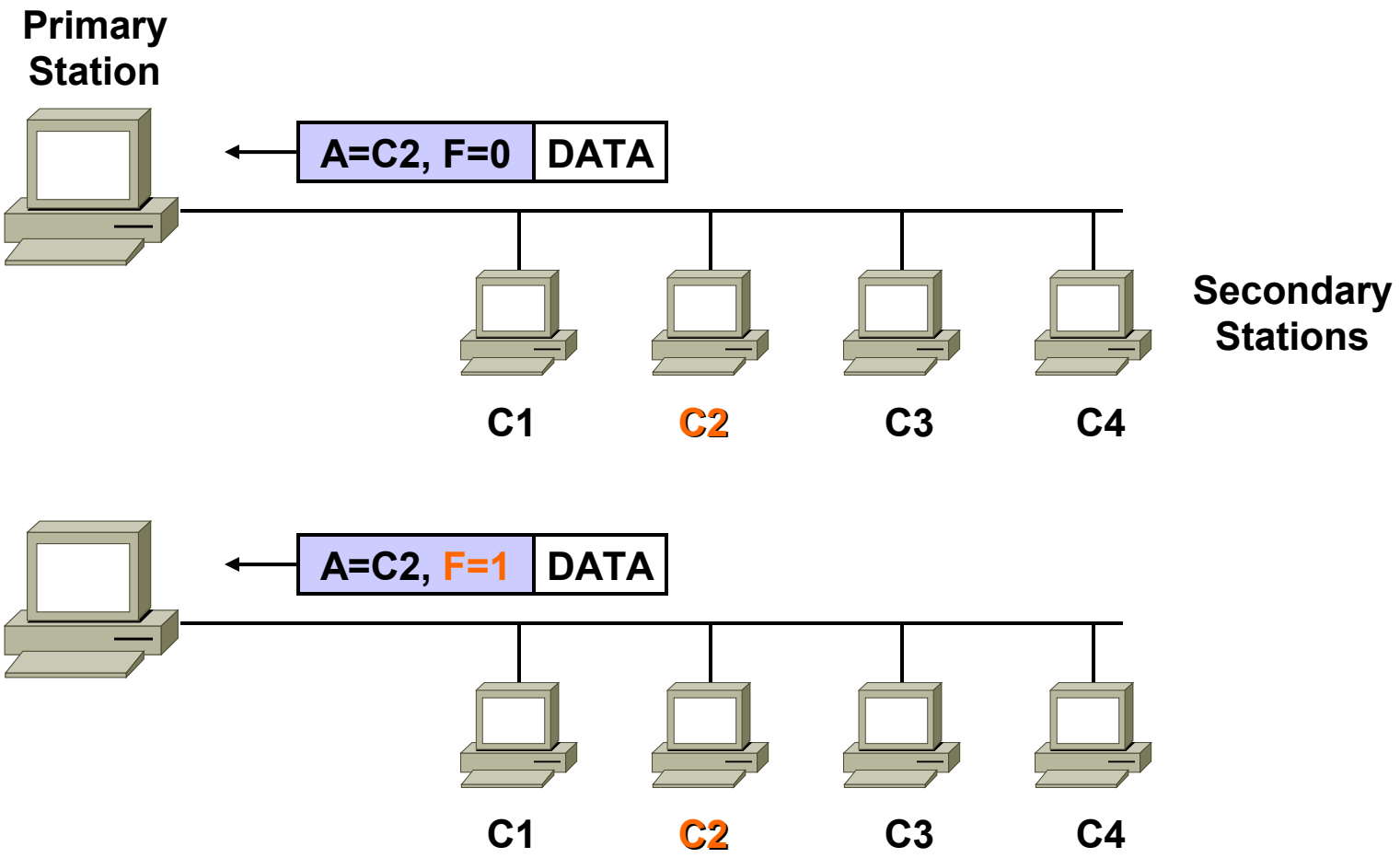
Half-Duplex Management



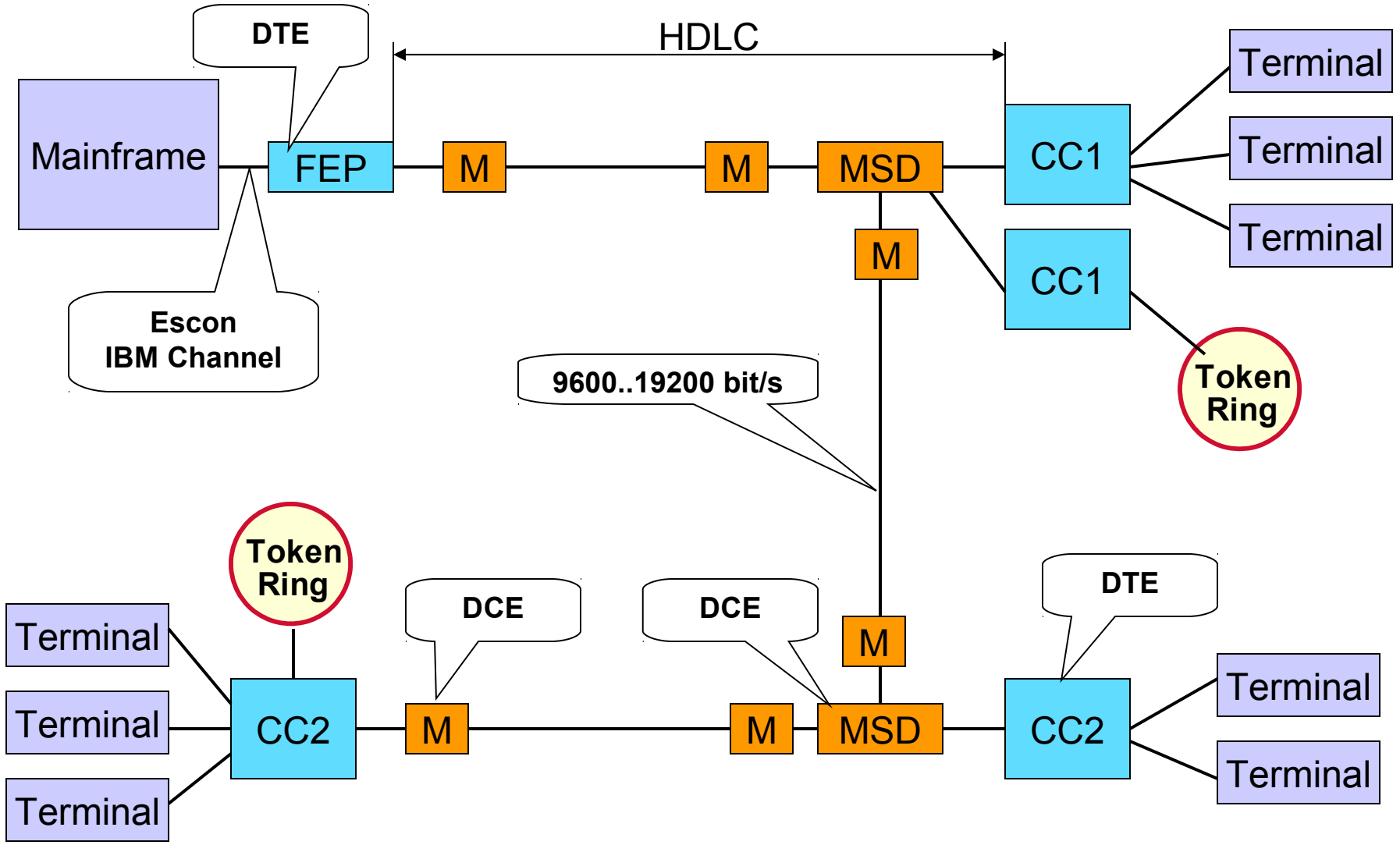
Same on Multipoint Lines (1)



Same on Multipoint Lines (2)



Early HDLC Example



HDLC Basics (1)

- Synchronous Transmission
- Bit-oriented (Bit-Stuffing)
- Developed by ISO
  - ISO 3309 and ISO 4335
- Supports
  - Half- and full-duplex lines
  - Switched and non-switched channels
  - Point-to-point and multipoint lines

HDLC Basics (2)

- Why do we use it today?
  - Framing
  - Frame protection
  - Error recovery
- Building Blocks
  - SDLC is now a subset of HDLC

HDLC Basics (3)

- Three types of stations
  - Primary Station
  - Secondary Station
  - Combined Station
- Three modes
  - Normal Response Mode (NRM)
  - Asynchronous Response Mode (ARM)
  - Asynchronous Balanced Mode (ABM)

HDLC Modes (1)

- NRM
  - Secondary sends only when permitted by primary
  - No communication between secondaries
  - Typically used in multipoint lines
- ARM
  - Only a single secondary in ARM
  - This ARM-secondary may transmit whenever it wants (hereby avoiding collisions)

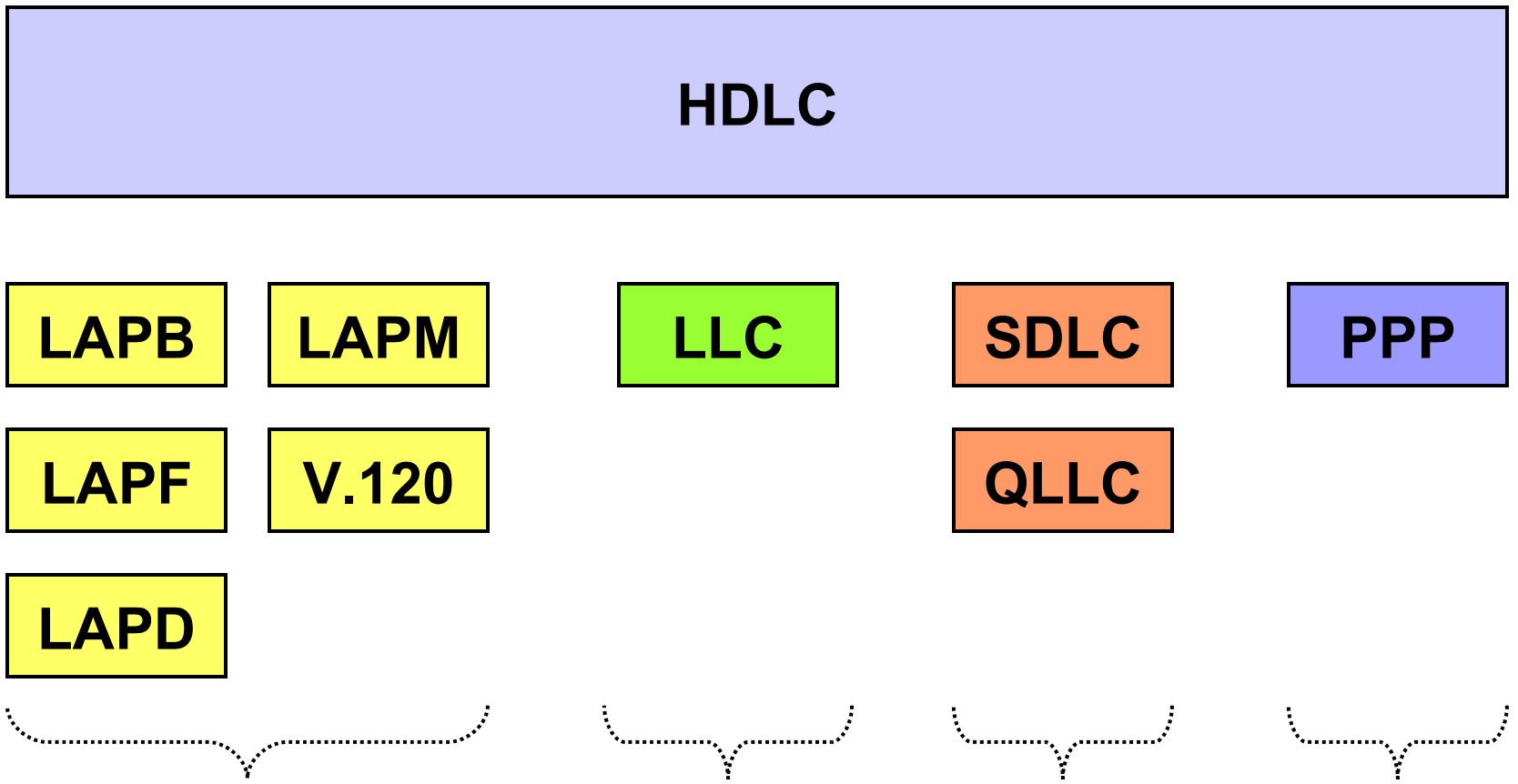
HDLC Modes (2)

- ABM
  - Most important mode today !!!
  - Requires combined stations
  - Best mode for point-to-point lines

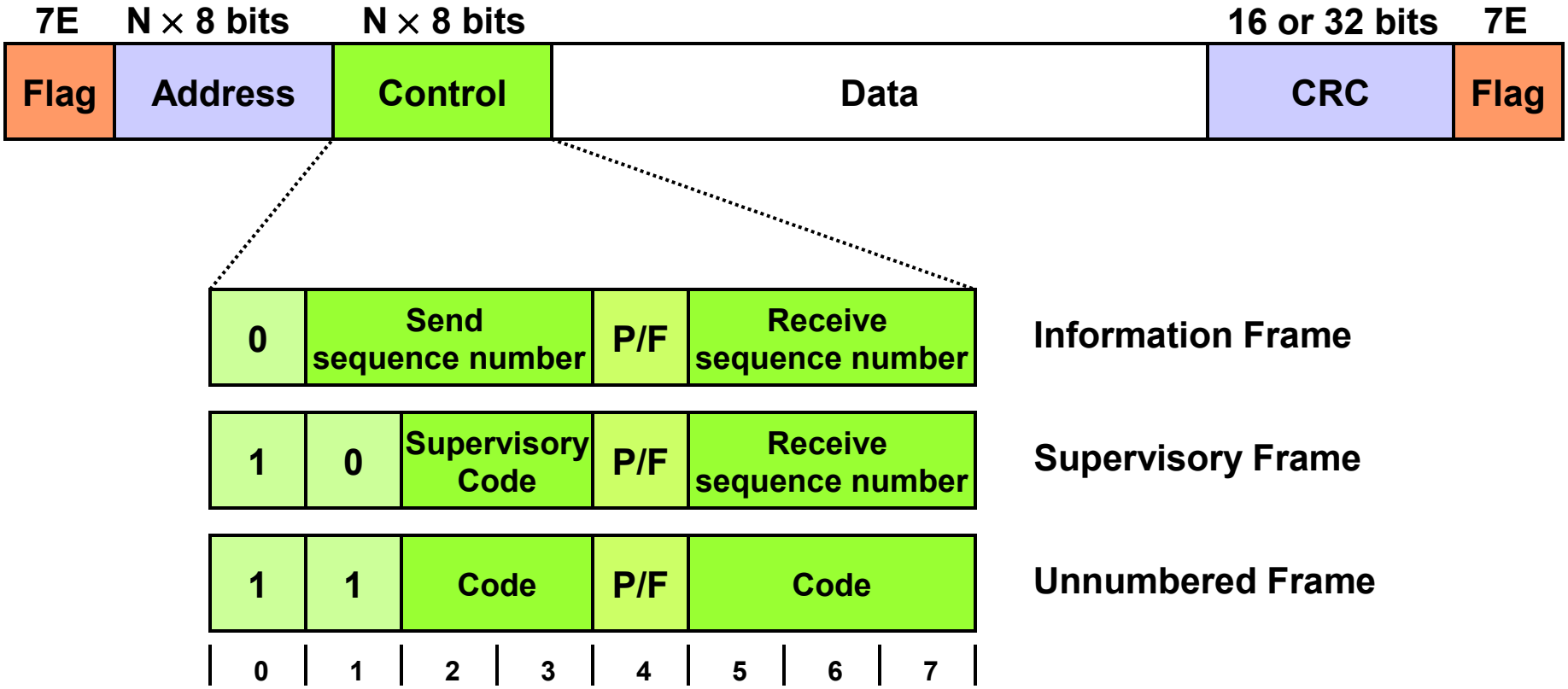
Non-operational Modes

- Normal Disconnected Mode (NDM)
  - For unbalanced modes only
  - Secondary not able to receive
- Asynchronous Disconn. Mode (ADM)
  - For balanced mode only
  - Combined station not able to receive
- Initialization Mode (IM)
  - Parameter exchange or SW download

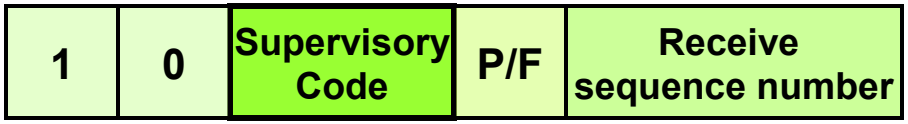
HDLC Family


HDLC
LAPB
LAPM
LLC
SDLC
PPP
LAPF
V.120
QLLC
LAPD
ITU-T
IEEE
IBM
IETF

HDLC Frame Format



Supervisory Frames



0	0
0	1
1	0
1	1

RR (Receiver Ready)

REJ (Reject)

RNR (Receiver Not Ready)

SREJ (Selective Reject)

Unnumbered Frames

1	1	Code	P/F	Code

					Command	Response
0	0		0	0	0	UI	UI
0	0		0	0	1	SNRM	
0	0		0	1	0	DISC	RD
0	0		1	0	0	UP	
0	0		1	1	0		UA
0	1		0	0	0	NR0	NR0
0	1		0	0	1	NR1	NR1
0	1		0	1	0	NR2	NR2
0	1		0	1	1	NR3	NR3
1	0		0	0	0	SIM	RIM
1	0		0	0	1		FRMR
1	1		0	0	0	SARM	DM
1	1		0	0	1	RSET	
1	1		0	1	0	SARME	
1	1		0	1	1	SNRME	
1	1		1	0	0	SABM	
1	1		1	0	1	XID	XID
1	1		1	1	0	SABME	

XID Frames

- Used for user data exchange
  - For upper layer protocols prior to connection establishment
- Used for address resolution
  - Used on switched lines only
- Used for parameter negotiation
  - Max send and receive frame sizes
  - Window sizes
  - Extensions, etc...

ARQ (1)

- Default: GoBack N without dedicated NACK frame (!)
  - Receive-Sequence Number indicates next frame expected
- "Checkpointing"
  - Sender triggers (N)ACK information with P/F bit

ARQ (2)

- Optional: Reject (REJ)
  - Dedicated NACK frame
  - Can be sent at any time (no checkpointing)
- Optional: Selective Reject (SREJ)
  - Requests retransmission of single frame
- Flow control with RR and RNR

HDLC Classes

Unbalanced Normal (UN)	Unbalanced Asynchronous (UA)	Balanced Asynchronous (BA)
I, RR, RNR, SNRM, UA, DISC, DM, FRMR	I, RR, RNR, SARM, UA, DISC, DM, FRMR	I, RR, RNR, SABM, UA, DISC, DM, FRMR

Extensions:

1	Switched Circuits (XID, RD)
2	Reject (REJ)
3	Selective Reject (SREJ)
4	Unnumbered Information (UI)
5	Initialization (SIM, RIM)
6	Group Polling (UP)
7	Extended Addressing (16 bit)

8	Delete Response I Frames
9	Delete Command I Frames
10	7 bit sequence numbering
11	RESET
12	Data Link TEST
13	Request Disconnect (RD)
14	32 Bit CRC

Summary

- Access control with P/F bit
- Three modes: NRM, ARM, ABM
- Error recovery uses Checkpointing
- Mother of many LAN and WAN protocols
- Extensible through building blocks

Quiz

- What is Cisco-HDLC ?
- Does Ethernet (802.3) utilize connection-oriented HDLC ?
- What is Q.921 used for ?
- Which HDLC variant can be used on erroneous links ?