

CPS 422
Computer Networks

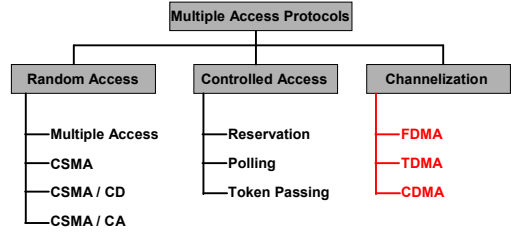
DATA LINK LAYER

MEDIUM ACCESS CONTROL

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Categories of Multiple Access Protocols



Reservation Protocols

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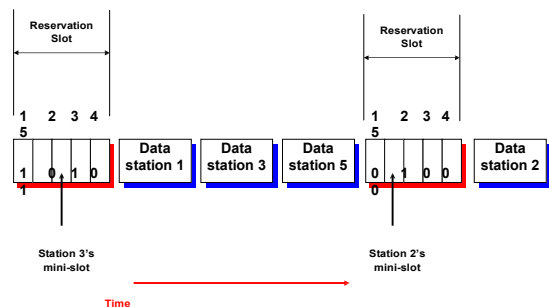
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Reservation Protocol

- ‰ Stations need to make reservation before sending data
- ‰ Time is divided into intervals or slots
- ‰ Reservation always precedes data transmission
- ‰ For N stations, there are N Reservation mini-slots
- ‰ Each mini-slot belongs to a station
- ‰ When a station has to send data it makes a reservation in its own mini-slot
- ‰ After the reservation mini slots have finished, stations that have made reservations can send data sequentially

Reservation Access Method

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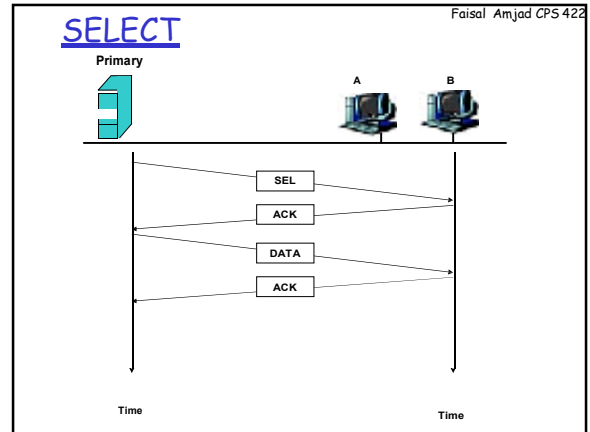
POLLING

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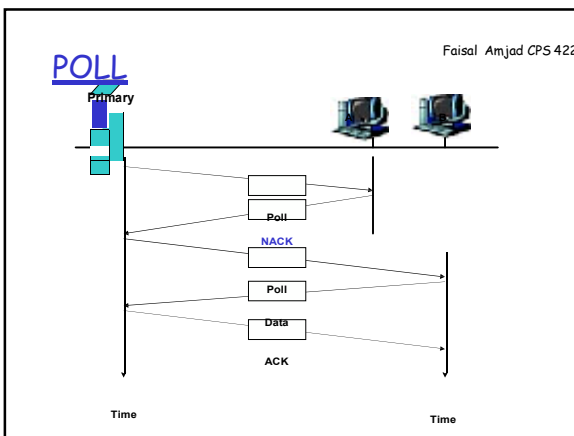
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Polling

- % Polling works where link is in **un-balanced** mode i.e. with stations designated as primary and secondary
- % All data exchanges are made through the primary station even if destination is a secondary
- % Primary is always the initiator of a session as it controls the link
- % Two modes **Select** and **Poll**



• Select mode is used when Primary has data to send



• Poll mode is used when Primary Solicits data from secondary stations

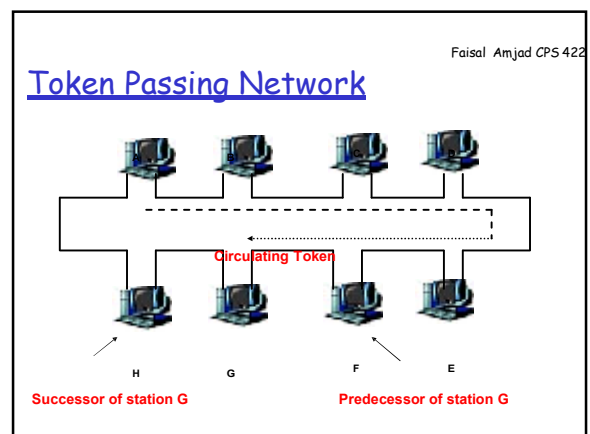
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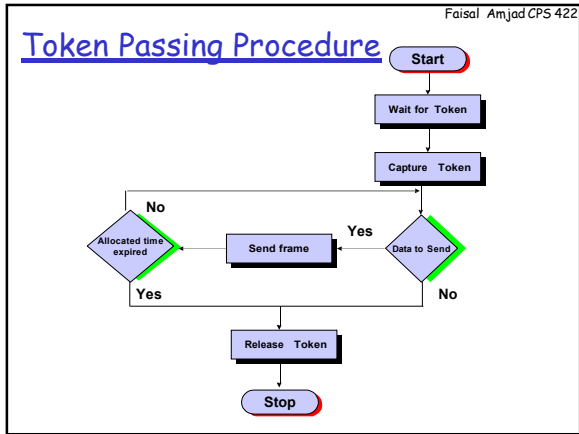
TOKEN PASSING

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TOKEN PASSING

- % Token is a special Frame which gives the holder station the **"Right to Transmit"**
- % All stations are organized in a **ring**
- % Frames are passed from the Predecessor to the successor after a specified time interval
- % When there is no data to be sent the token **circulates** around the ring
- % Whenever a station has data to send, it waits for a token to arrive
- % Station then **captures** the token and keeps transmitting data until allocated time for keeping the token expires
- % After the specified time the token **must** be passed on to the successor





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DATA LINK LAYER

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HDLC

High Level Data Link Control

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HDLC

- % One of the most important Data Link Control protocol.
- % Widely used, basis for many other protocols which use similar formats and mechanisms.
- % Supports half and full duplex communication over point-to-point and multipoint links.
- % Implements the ARQ mechanisms studied.

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HDLC Defines :

- % Three types of stations,
- % Two link configurations and
- % Three data transfer modes

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Station Types

- % Primary station
 - o Responsible to control the operation of link
 - o Frames issued by primary are called **commands**
- % Secondary station
 - o Operates under control of primary
 - o Frames issued by secondary are called **responses**
- % Combined station
 - o A combination of above
 - o Issues commands and responses

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Link Configurations

- % Unbalanced
 - o Consists of one primary and one or many secondary stations
- % Balanced
 - o Consists of two combined stations

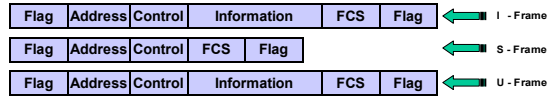
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Data Transfer Modes

- %% **Normal Response Mode (NRM)**
 - o Used with unbalanced configuration
 - o Primary may initiate data transfer
 - o Secondary can transmit data only as a response
 - o Used on point-to-point and multi-point links
- %% **Asynchronous Response Mode (ARM)**
 - o Used with unbalanced configuration
 - o Secondary station may initiate data transfer without explicit permission from the primary. Primary still responsible for overall control
 - o Rarely used
- %% **Asynchronous Balanced Mode (ABM)**
 - o Used with balanced configuration
 - o Any combined station may initiate data transfer without permission from the other
 - o Most widely used because more efficient on full duplex point-to-point link

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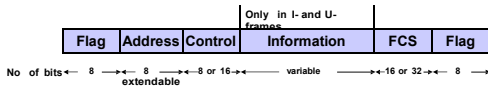
HDLC Frame Types



- %% **Information Frames (I-Frame)**
 - o Used to transmit user data and control info
- %% **Supervisory Frames (S-Frame)**
 - o Used to transmit only control info
- %% **Un-numbered Frames (U-Frame)**
 - o Reserved for system maintenance (link management)

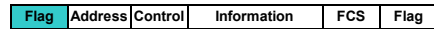
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HDLC Frame Format



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HDLC Frame Format



- %% **Flag Field**
 - o Delimits the frame at both ends with the pattern 01111110.
 - o Acts as a synchronization pattern for the receiver.
 - o A single flag may act as closing flag for one frame and opening flag for another.
 - o It is possible that the pattern 01111110 appears within the frame, thus destroying frame level sync.
 - o To avoid this (and to ensure data transparency) a technique called **bit-stuffing** is used

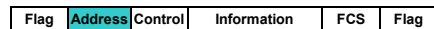
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Bit Stuffing (for data transparency)

- %% Between the transmission of starting and end flags, transmitter will always insert an extra 0 bit after each occurrence of five 1s in the frame.
- %% After detecting a starting flag, if the receiver sees five 1s in the pattern, the sixth bit (seventh starting from 0) is examined.
- %% If seventh bit is a 1, and eighth bit is a 0, it is accepted as a flag.
- %% If bit number 7 - 14 are 1s, and 15th bit is 0, the sender is indicating an abort condition
- %% If 15th bit is also a 1, idle channel is indicated.

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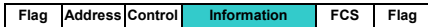
HDLC Frame Format



- %% **Address Field**
 - o Identifies the secondary station that has transmitted or is to receive the frame.
 - o Consists of 1-byte, can be more on prior agreement.
 - o Actual address is multiple of **seven** bits.
 - o Least significant bit is used to determine whether it is or is not the last octet of the address field.
 - o All 1s in an address used to allow the primary to **broadcast**.

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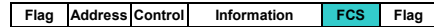
HDLC Frame Format



Information Field

- Contains user data from the network layer or system management info
- Length varies for networks but always pre-decided.

HDLC Frame Format



FCS Field

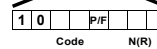
- Frame check sequence is HDLC's error detection field.
- Can contain a 2 - byte or 4 - byte ITU-T CRC.

HDLC Frame Format (I - Frame)



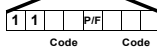
- First bit "0" indicates an I-frame
- 3-bit N(S) represents 'Sent' sequence number
- 3-bit N(R) represents 'Received' seq numbers. Corresponds to value of ACK when piggybacking is used.
- P/F bit means poll or final. Has meanings **only when set** (i.e. 1). Means Poll when used by primary while sending frame to secondary. Means Final, when used by secondary while sending frame to primary.

HDLC Frame Format (S - Frame)



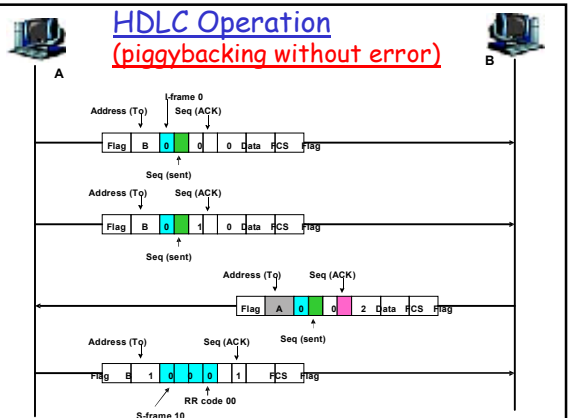
- bits "1 and 0" indicate an S-frame
- Code 00 - Receive Ready (RR): acknowledges safe receipt of a group of frames
- Code 01 - Reject (REJ): represents NAK for Go-Back-N to improve efficiency.
- Code 10 - Receiver Not Ready (RNR) same as RR but also tells the sender that it cannot receive more frames.
- Code 11 - Selective Reject (SREJ): represents NAK for Selective Reject.
- 3-bit N/R. Corresponds to value of ACK or NAK seq number.
- P/F bit same as in I-frame.

HDLC Frame Format (U - Frame)



- U-frames used for session mgmt, mode setting, connection and disconnection of link etc.
- bits "1 and 1" indicate an S-frame
- 5 - bit code represents 32 different types of U-frames (table 11.1)
- P/F bit same as in I-frame.

HDLC Operation (piggybacking without error)



<http://www.uandiStar.org>

Reading Assignment

% HDLC operation examples in William Stallings and Forouzan books.

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