UNIT- 2

DATA LINK Layer

Framing:

⇒ physical layer means moving bit in the form of signal from source to destination.

⇒ Data Link Layer packs bits into frames to distinguish from one other.

⇒ Frames separates msg from one source to distination by adding the sender address and the destination addrs.

⇒ when a msg is divided into small frames the single bit error occurs affects only the small frames.

fixed size framing:

⇒ No need for defining the boundaries of the frames. the size itself can be used as delimeter. eg: ATM wide area n/w

Variable - size framing:

⇒ need to define end of the frame and beginning of the next frames.

2 approaches:

⇒ Suitable only for text data transmission.
⇒ To separate one frame from other 8 bit flag is added at beg and end of frames

① Character Oriented protocol:

ASCII as 8-bit characters.

Byte stuffing and Bit stuffing.

header contains source & destinal. addrs. Trailer unit [correction bit error detection

② Bit-Oriented protocols:

Bit stuffing.

Error Control: Flow control:

⇒ Amt of data that can be transferred before receiving an acknowledgement (list of procedures)

⇒ Tells the sender how much data can be sent before receiving the ack.

⇒ The receiving device must inform the sending device to limit the data transformation as it reaches the limit of data transfer. or stop temporarily.

⇒ contains space for storing the data called buffer.

Error Control:

⇒ Error contrl is both Error detection and correction

⇒ It allows the recives to inform the sender of any frames lost or damaged in transmission and coordinates the re-transmission of those frames by the sender.

Protocols:

- noiseless channels
  - ① Simplest
  - ② Stop and wait
- noisy channels
  - ① Stop and wait ARQ.
  - ② Go-back-N ARQ
  - ③ Selective Repeat ARQ.

ARQ - Auto matic Repeat Request.

Noiseless

⇒ doesnot use flow contrl protocols.

Simplest:

⇒ direction of data is only in one direction.

⇒ doenot contain any flow/error contrl

⇒ Receiver can immediately handle any frame it receives with processing time.

⇒ DLL removes the header from frames and hands the data packet to NL.

Stop and wait protocol :

Sender side.

Rule 1: Sender sends one data packet at time

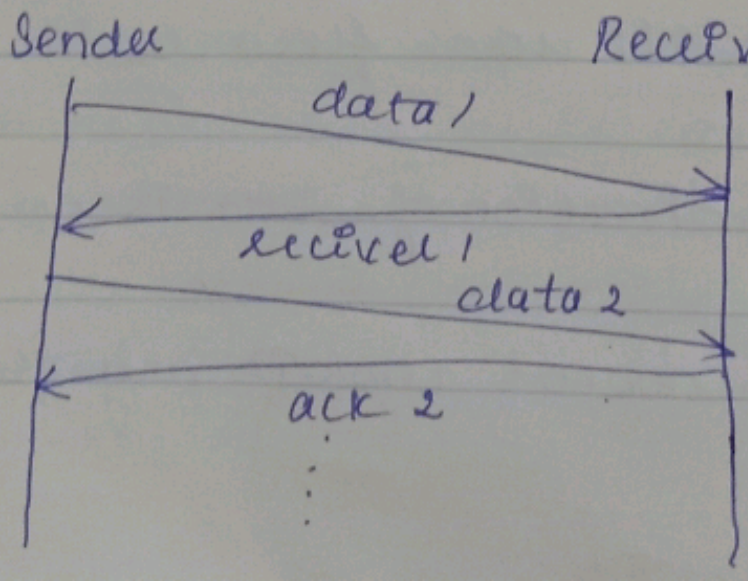
Rule 2: Sender sends next packet only when it receives the ack of the prev packet

Rule 3:

Receiver side:

Rule 1: Receive and then consume the data packet

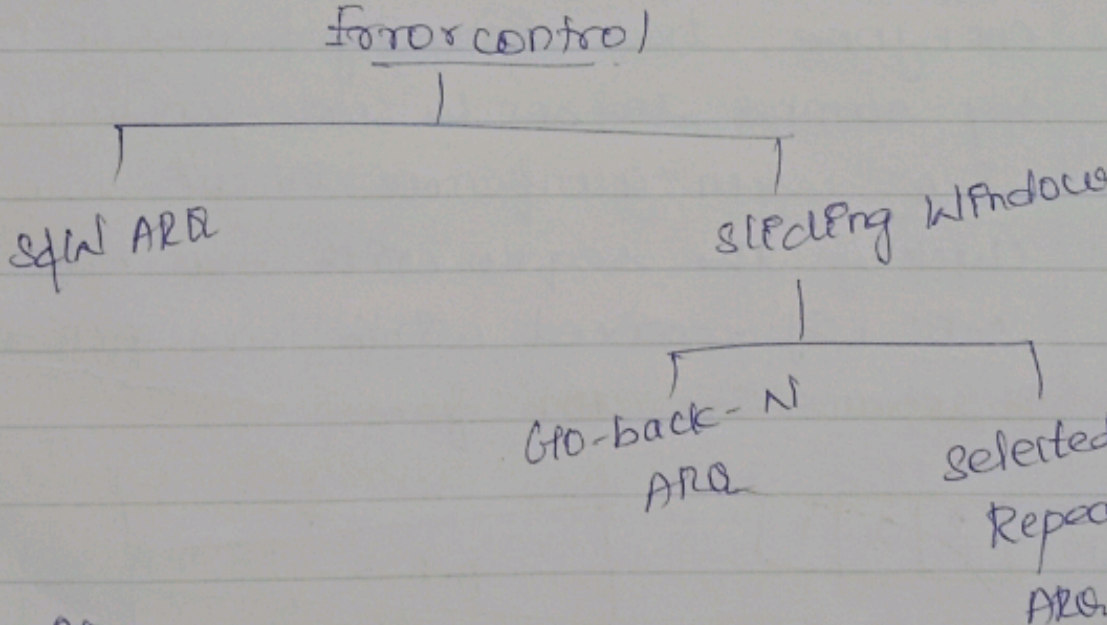
Rule 2: When the data packet is consumed, receiver sends the ack to sender.



Problems in S/W:

1. due to lost data
2. due to lost of ack.
3. due to delayed data or ack.

Noisy channel: Working of Stop & Wait ARQ and S & W is same only diff is that it includes some additional components, like, Time out timer, Sequence no of datapac seq no for feedback.



S/W ARQ:

Contains a timeout counter when data is sent it waits for ack. If the ack

was not transmitted in time then the sender thinks that frame/ack is lost and retransmit the frame again

Go-back-N ARQ :

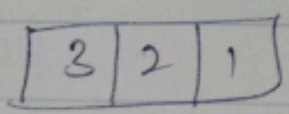
S-1 : The sender has buffer called sending window

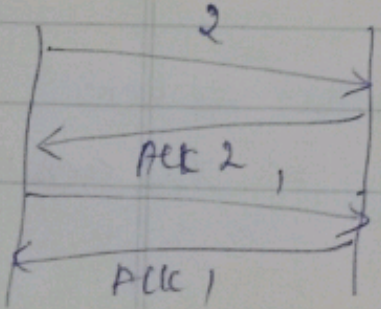
S-2: The sender sends multiple frames based upon sending-window size, without receiving the Ack of prev one.

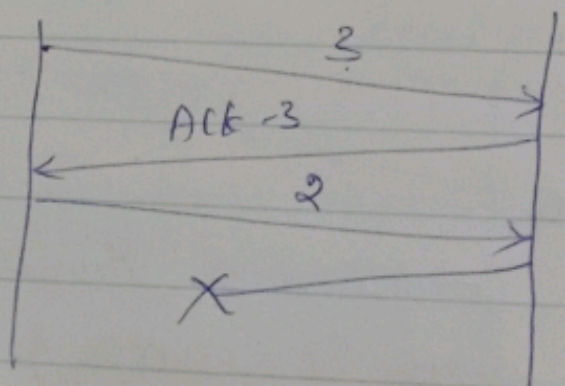
S-3: The recurer receives the frame one by one, track incoming frames with seq number and sends corresponding Ack.

S-4: When all frames in window sent, check up the seq no with +ve Ack

S-5: If received with -ve Ack then it retransmits the frame.







Selective Repeat ARQ:

S-1 : contain separate sending and receiving window

S-2: Sender sends multiple data based on sending window

S-3: the receiver receives multiple frames within receiving window

S-4 & Marks seq no and buffers the frames in memory.

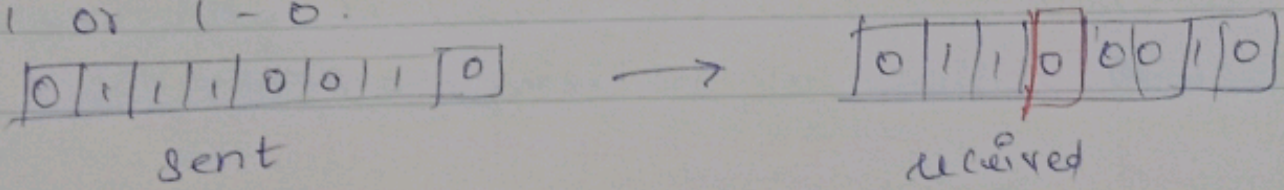
S-5: sends Ack for all successful frames and send NAK for only frames which are missing / damaged.

Error detection and Correction:

Data can be corrupted during transmission. Some applications required that errors tobe detected and corrected.

Types of Error:

① Single bit Error: one bit is changed from 0 - 1 or 1 - 0.



sent received

② Burst Error: 2 or more bits changed from 0 to 1 / 1 to 0. (consequently)

③ Redundancy: To detect or correct errors we need to send extra (redundant) bits with data

Varieties 10Base - X

IEEE - 802.3 - Ethernet

defined by IEEE.

Ethernet LAN - 802.3.

⇒ It is more popular

- easy to understand
- easy to implement
- easy to maintain.

⇒ low cost

⇒ operates at physical + data Link

⇒ CSMA/CD as Medium access

- 1 persistant.

① classic ethernet: data rate - 3 - 10 mbps.

② switched: uses switch to connect two diff stns in a LAN - 10/100 mbps.

802.3 - 10base5: (BUS) thick wire coaxial cable

3a - 10Base2: thin wire coaxial, uses BNC connectors (bus).

3i - 10BaseF: optical (star)

3i - 10Base T (star) unshielded twisted pair

* when one station wants to send data to other stn, it senses the medium, if empty it transfers the data, when medium is not empty. it waits and sends the data.

* when two stations wants to send a data, there is a chance of collision to avoid. The particular frame intimate the stn abt collision and repeats.

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IEEE - 802.5 used in LAN.

token passing

tokenring: As token circulates on ring, any stnt which wants to transmit frame may reserve token by entering its priority code in access control of token frame.

IEEE 802.11 provide time bounded delivery service. ⇒ It gives continuity of service to/then extended areas via distribution sys/ such as ethernet.

MA protocols: If there is a dedicated link b/w sender and R then data link control layer is sufficient, however if there is no dedicated link present then multiple stations can access channel simultly results in collision.

Random Access: Any stnt can send data anytime depending on state (idle/busy)
⇒ if more than 1 station tries to send, there is access conflict (collision) hence frames will destroyed or modified channelization is a multiple access method in which the available

Unit - 2

Block coding: Msg is divided into blocks,

⇒ Each blocks is k bits and called as datawords.

⇒ Redundant bits are added to each block to make the length $n = k + r$.

⇒ The resulting n-bit blocks called codewords

Error detection: following steps are used for detecting errors in block coding.

① The receiver has a list of valid codewords

② The original codeword has changed to an invalid one

③ The sender creates codeword out of dataword by using a generator that applies rules and procedures of encoding.

⇒ Each codeword sent to the receiver may change during transmission

⇒ If the received codeword is the same as one of valid codewords, the word is accepted; the corresponding dataword is extracted for use

⇒ If the received codeword is not valid, it is discarded

⇒ If the codeword is corrupted during

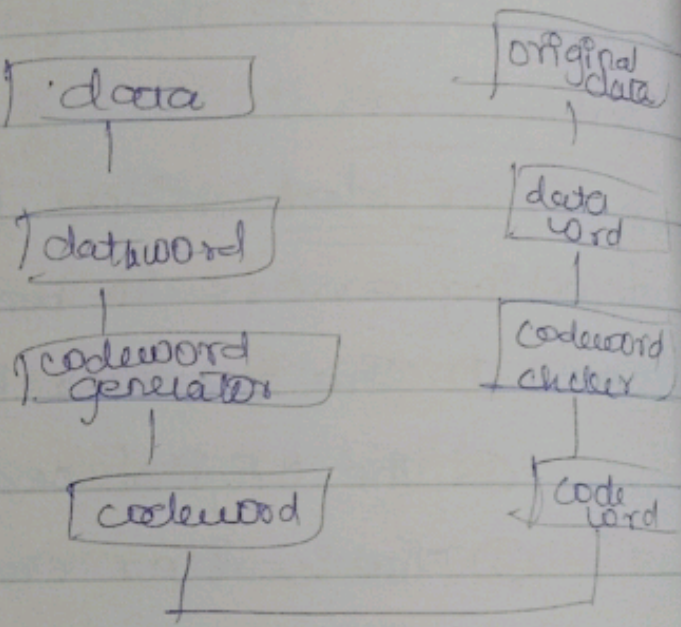
transmission but the received coord still matches a valid codeword, the error remains undetected.

⇒ Block coding can detect only single errors, two or more errors may remain undetected.

Error Correction:

⇒ The receiver needs to find the original codeword sent

⇒ More no of redundant bits are required for error correction than for error detection



Media Access Control: (MAC)

⇒ One feature of LAN is that its backbone is a shared channel or transmission link, which provides all user to access to the transmission facilities.

⇒ it may be possible that two or more stations transmitting simultaneously, causing their signals to interfere and becomes garbled.

Random Access: Access to the medium from many entry points called contention. It is controlled with a contention protocol.

⇒ In RA, each station has the right to the medium without being controlled by other stations.

⇒ If more than one station tries to send, there is an access conflict, i.e, frame may be either destroyed or modified.

① ALOHA:

⇒ applicable to any shared medium.

⇒ In a system when multiple users try to send msg to other stations through a common broadcast channel RA or contention is used.

⇒ In ALOHA, when a station sends data, another station may attempt to do so at the same time. The data from the two station collide and become garbled. If two signals collide, each station would simply wait a random time and try again.

② Pure ALOHA: Here each station sends a frame whenever it has a frame to send. Since there is only one channel to share, there is the possibility of

collision, b/w frames from different stations.

⇒ Pure ALOHA relies on ack from the receiver. When sender sends a frame, it expects the ACK from the receiver.

② Slotted ALOHA:

⇒ The channel time is div into time slots, and the stations are allowed to transmit at specific instance of time.

⇒ all users are then synchronized to these time slots, so that whenever a user generate a packet it must synchronize exactly with the next possible channel slot.

② ⇒ Carrier Sense Multiple Access (CSMA)

⇒ CSMA requires that each station first listen to the medium before sending.

⇒ CSMA can reduce the possibility of collision, but it cannot eliminate it.

⇒ A station may sense the medium and find it idle, only because the first bit send by another station has not yet received

Protocols

① Non persistant CSMA: When a station having a packet to transmit and finds that channel is busy, it tracks off for a fixed interval of time.

⇒ It then checks the channel again and if channel is free then it transmits.

② 1-persistant CSMA: Any station wishing to transmits, monitor the channel continuously until the channel is idle and then transmits immediately with probability one, hance named 1-persistant

⇒ The performance of 1-persistant CSMA depends on channel delay time.

③ p-persistant CSMA:

⇒ To reduce the probability of collision in 1-persistent, not all the waiting stations are allowed to transmit, after the channel is idle.

⇒ when a station becomes ready to send and it senses the channel to be idle, it either transmits with a probability p or it defer transmission by one time slot with a probability $q = 1-p$. If the defered slot is also idle, the station either transmits with probability p or defers again with probab. q

⇒ ③ Carrier Sense Multiple Access with Collision Detection (CSMA/CD)

⇒ A station with a msg to send must monitor the channel to see if any other station is sending.

⇒ If another stnt is sending, the 2nd station must wait or defer, until the sending station has finished.

⇒ If no station sends at the time that it is first started, the station may send its msg. The term, "carrier sense" indicates "listening before transmitting".

⇒ ④ Carrier sense MA with collision Avoidance (CSMA/CA):

⇒ Wireless n/w cannot use CSMA/CA, on the MAC sublayer, since this requires the ability to receive and transmit at the same time hence the use of CSMA/CA.

Collision is avoided by 3 methods:

① Inter-frame space:

⇒ When an idle channel is found,

the station must not send immediately. It waits for a period of time called (IFS)

② contention window.

⇒ amount of time divided in slots. A station that is ready chooses a random amt of the

③ Ack: The +ve acks and time out can help guarantee that receiver has received in time

Controlled Access: stations consult one other to find which station has the right to send.

① Reservation: Before sending station has to made reservation.

⇒ No. of reservation is equal to no of stns.

② Polling: works with topology.

⇒ one device is designed as primary and others are secondary stations.

⇒ link control is done by primary stns

⇒ all data exchange takes place through primary stations.

⇒ If primary device wants to receive data it asks the secondaries if they have any data to send called as poling.

② Token passing: A station is allowed to send data when it receives a token.

⇒ Ring-topology is used for connecting devices

⇒ each station has predecessor and a successor

⇒ the station captures the token if they need to send data.

⇒ Channelization: is the multiple access method.

Methods:

① Frequency division Multiple Access (FDMA)

⇒ the amount of available bandwidth is divided into N numbers of smaller frequency bands called sub bands.

⇒ Each station transmits its information continuously on an assigned sub band.

② Time division Multiple Access (TDMA)

⇒ each stations transmits digitally modulated carriers during a preassigned time slots, making use of the entire transmission channel during its transmission.

⇒ the stations are synchronized only

one carrier is present on the channel at given time.

⇒ Thus avoids collision of stations

③ Code division Multiple Access (CDMA):

⇒ each station transmitter may transmit whenever it requires and can use entire bandwidth i.e, There is no restrictions on time & bandwidth.

⇒ also called as spread spectrum MA, because transmission can spread throughout the bandwidth.

MAC

- RandomAccess
  - ALOHA
  - CSMA
  - CSMA/CD
  - CSMA/CA
- controlled access
  - reservation
  - polling
  - Token passing
- channelization
  - FDMA
  - TDMA
  - CDMA