Flow control and MAC

ICNE532C - Computer Networks

S.Venkatesan

Indian Institute of Information Technology, Allahabad

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Acknowledgment

- Cumulative Acknowledgment or Group Acknowledgment
- Individual Acknowledgment or Selective acknowledgments

Mechanism for Flow Control

- Stop and Wait Protocol
- Sliding Window Protocol
  - Automatic Repeat Request
    - Go Back 'n'
    - Selective Repeat

Sliding Window

- Sender Sliding Window
- Receiver Sliding Window
- Control Variable at sender
  - Sequence number of first frame
  - Sequence number of last frame
  - Sequence number of recently sent frame
- Control variable - a frame that to be accepted.

Go Back 'n' ARQ

- Send frames continuously and the timer of any expires than resend the frame from that portion to all the remaining.
- Receiver is not required to give ACK for all frames. Cumulative ACK will be sent.

Go Back 'n' ARQ

Go-Back-N ARQ, normal operation

- The sender keeps track of the outstanding frames and updates the variables and windows as the ACKs arrive.

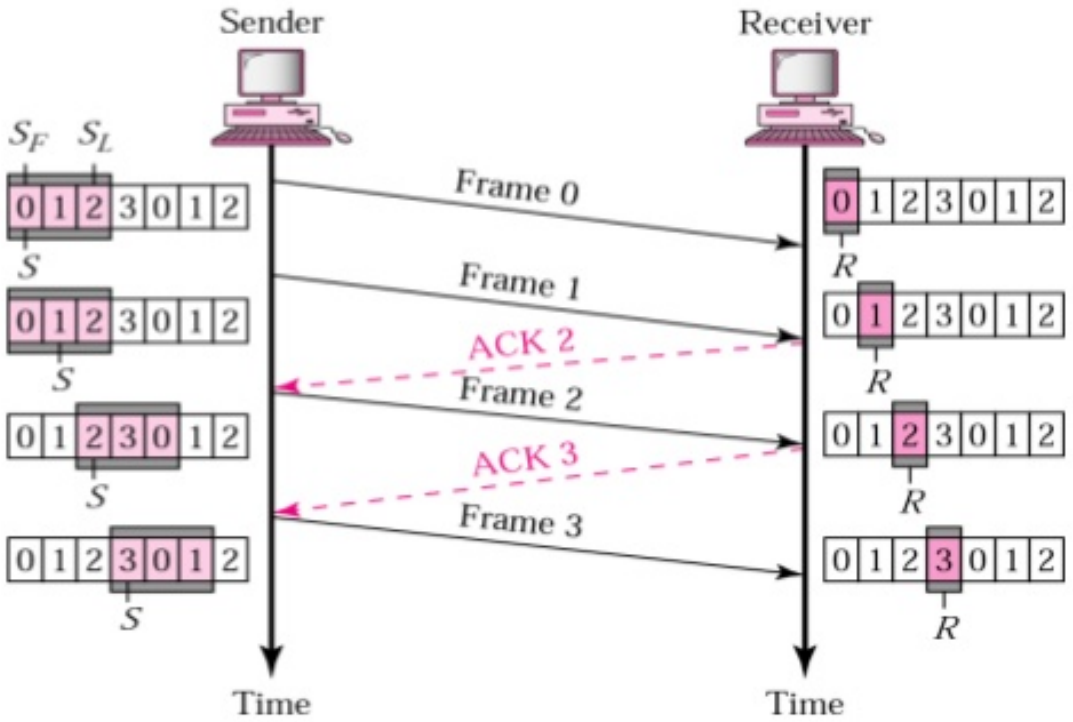
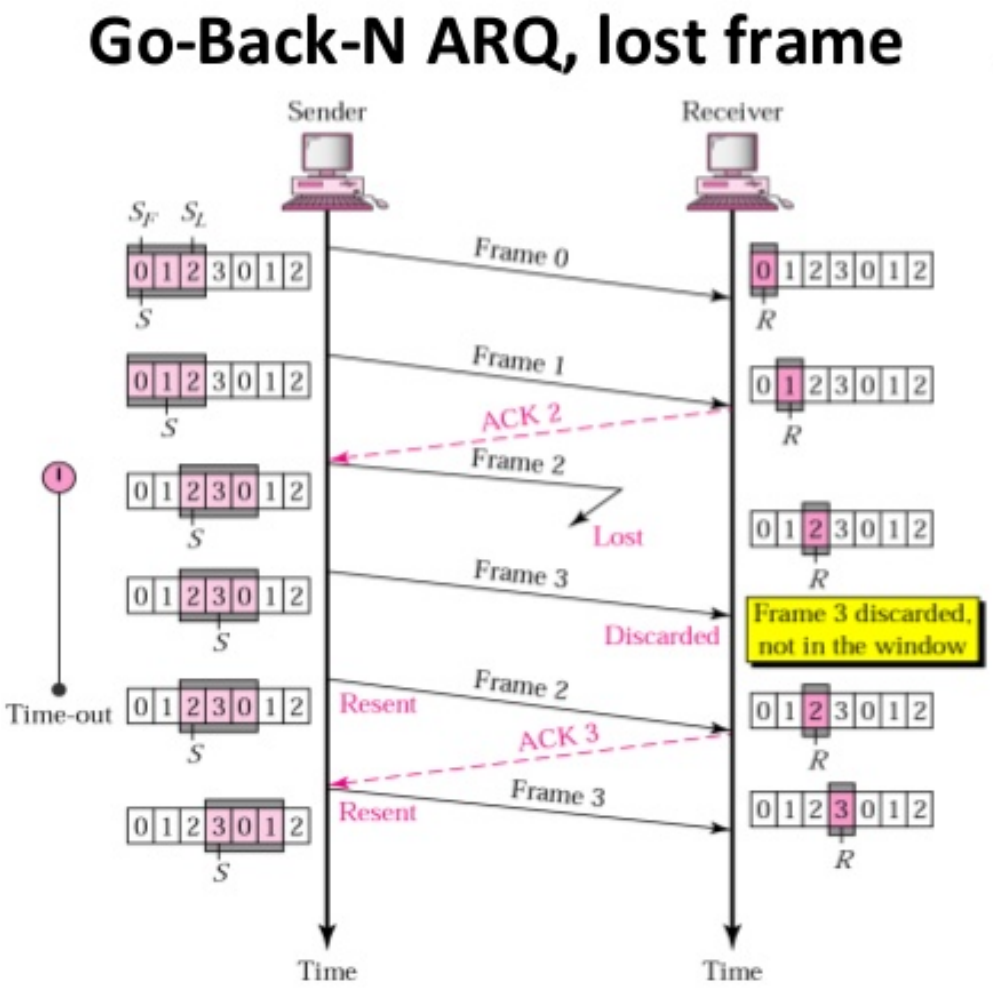


Figure:

Go Back 'n' ARQ



- Frame 2 is lost
- When the receiver receives frame 3, it discards frame 3 as it is expecting frame 2 (according to window).
- After the timer for frame 2 expires at the sender site, the sender sends frame 2 and 3. (go back to 2)

Figure:

Go Back 'n' ARQ

Go-Back-N ARQ, damaged/lost/delayed ACK

- If an ACK is damaged/lost, we can have two situations:
- If the next ACK arrives before the expiration of any timer, there is no need for retransmission of frames because ACKs are cumulative in this protocol.
- If ACK1, ACK2, and ACk3 are lost, ACK4 covers them if it arrives before the timer expires.
- If ACK4 arrives after time-out, the last frame and all the frames after that are resent.
- Receiver never resends an ACK.
- A delayed ACK also triggers the resending of frames

Figure:

Go Back 'n' ARQ

Go-Back-N ARQ, sender window size

- Size of the sender window must be less than 2^m. Size of the receiver is always 1. If m = 2, window size = $2^m - 1 = 3$.
- Fig compares a window size of 3 and 4.

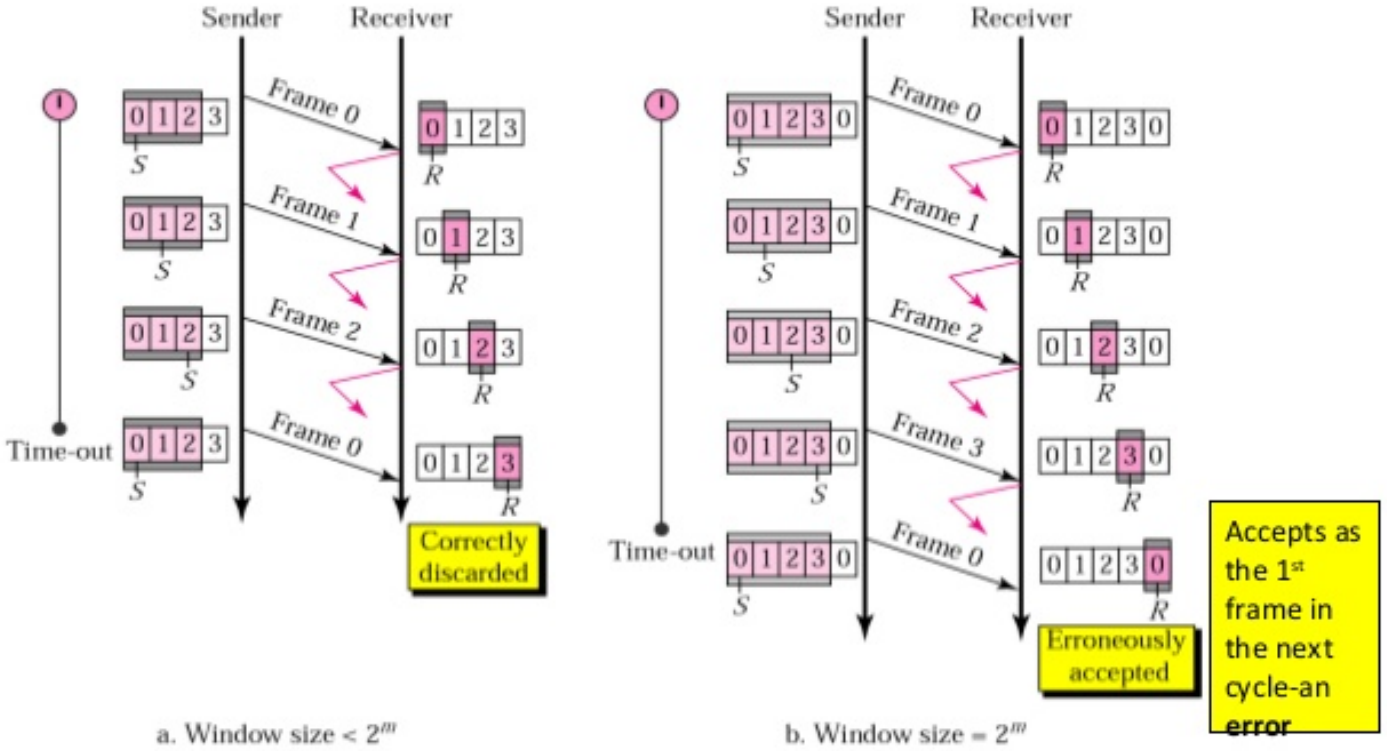


Figure:

Selective Repeat ARQ

Selective Repeat ARQ, sender and receiver windows

- Go-Back-N ARQ simplifies the process at the receiver site. Receiver only keeps track of only one variable, and there is no need to buffer out-of-order frames, they are simply discarded.
- However, Go-Back-N ARQ protocol is inefficient for noisy link. It bandwidth inefficient and slows down the transmission.
- In Selective Repeat ARQ, only the damaged frame is resent. More bandwidth efficient but more complex processing at receiver.
- It defines a negative ACK (NAK) to report the sequence number of a damaged frame before the timer expires.

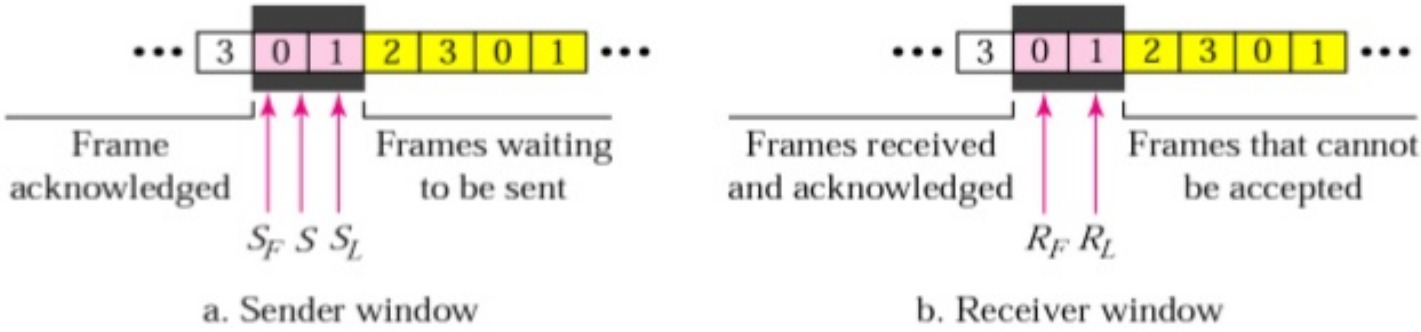
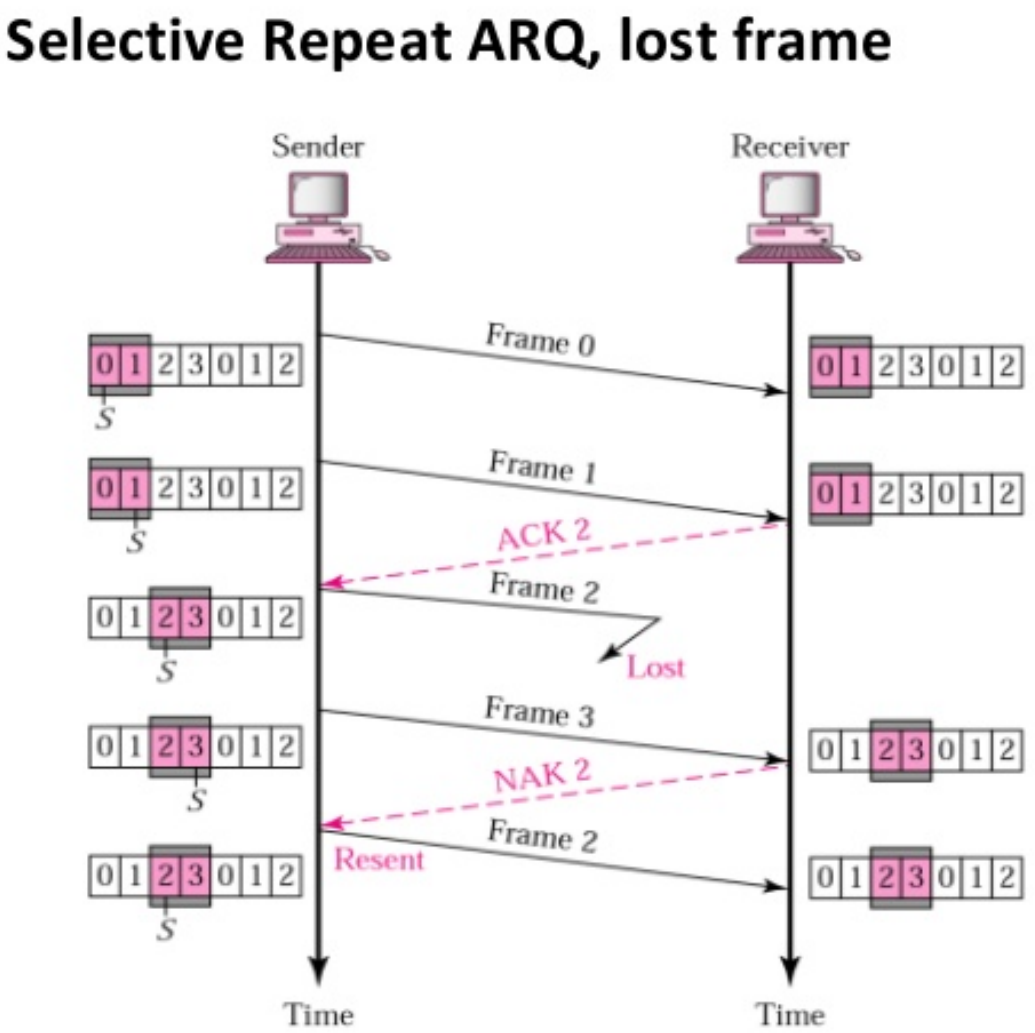


Figure:

Selective Repeat ARQ



- Frames 0 and 1 are accepted when received because they are in the range specified by the receiver window. Same for frame 3.
- Receiver sends a NAK2 to show that frame 2 has not been received and then sender resends only frame 2 and it is accepted as it is in the range of the window.

Figure:

Media Access Control

- When nodes or stations are connected and use a common link, called a multipoint or broadcast link, we need a multiple-access protocol to coordinate access to the link.
- Protocols have been devised to handle access to a shared link will belong to a sublayer in the data link-layer called **media access control**.
- Multiple Access Protocols - Random-Access Protocols, Controlled Access Protocols and Channelization Protocols

Random Access

- ALOHA
- CSMA
- CSMA/CD
- CSMA/CA

ALOHA

- pure ALOHA - Wait for a random period and wait for the next round of attempts
- slotted ALOHA - Send only at the beginning of the slot.

CSMA

- 1-persistent CSMA
- Non-persistent CSMA
- P-persistent CSMA

CSMA/CA

- Interframe Space
- Contention Window
- Acknowldegment

References

[1] Behrouz A. Forouzan *Data Communications and Networking*. McGraw-Hill fifth edition.

[2] *http://www.slideshare.net/hemangkothari/flowcontrol-error-control-at-data-link-layer*.