Data Communication BLM3051

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Lecture Information Form - Weekly Subjects

BLM3051 Data Communication

Week 6

Week	Date	Subjects
1	04.10.2021	Introduction to Data Communication Standards Used on Data Communication, Architectural models
2	11.10.2021	OSI Reference Model , Layers and Their Functions
3	18.10.2021	Signaling and Signal Encoding
4	25.10.2021	Parallel and Serial Transmission, Communication Media and Their Technical Specs., Multiplexing (TDM, FDM)
5	01.11.2021	Error Detection and Error Correction Techniques
6	08.11.2021	Data Link Control Techniques, Flow Control
7	15.11.2021	Asynchronous and Synchronous Data Link Protocols (BSC, HDLC)
8	22.11.2021	Ara Sınav
9	29.11.2021	Synchronous and Asynchronous Data Link Protocols
10	06.12.2021	LAN Technologies Continued, IEEE 802.4, 802.5, 802.11
11	13.12.2021	Connectionless and Connection Oriented Services, Switching
12	20.12.2021	Wide Area Networking Technologies (X.25, ISDN, FR, ATM, xDSL.)
13	27.12.2021	Communications Equipment's, TCP/IP Model, Security Issues
14	03.01.2022	Research Presentation 1

Data Link Control

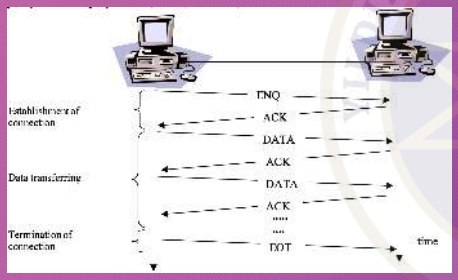
- Basic tasks of the data link layer:
  - Framming and determining of start and end points to ensure synchronization
  - Flow control
  - Error control / Retransmission
  - Addressing
  - Line dicipline / Link management

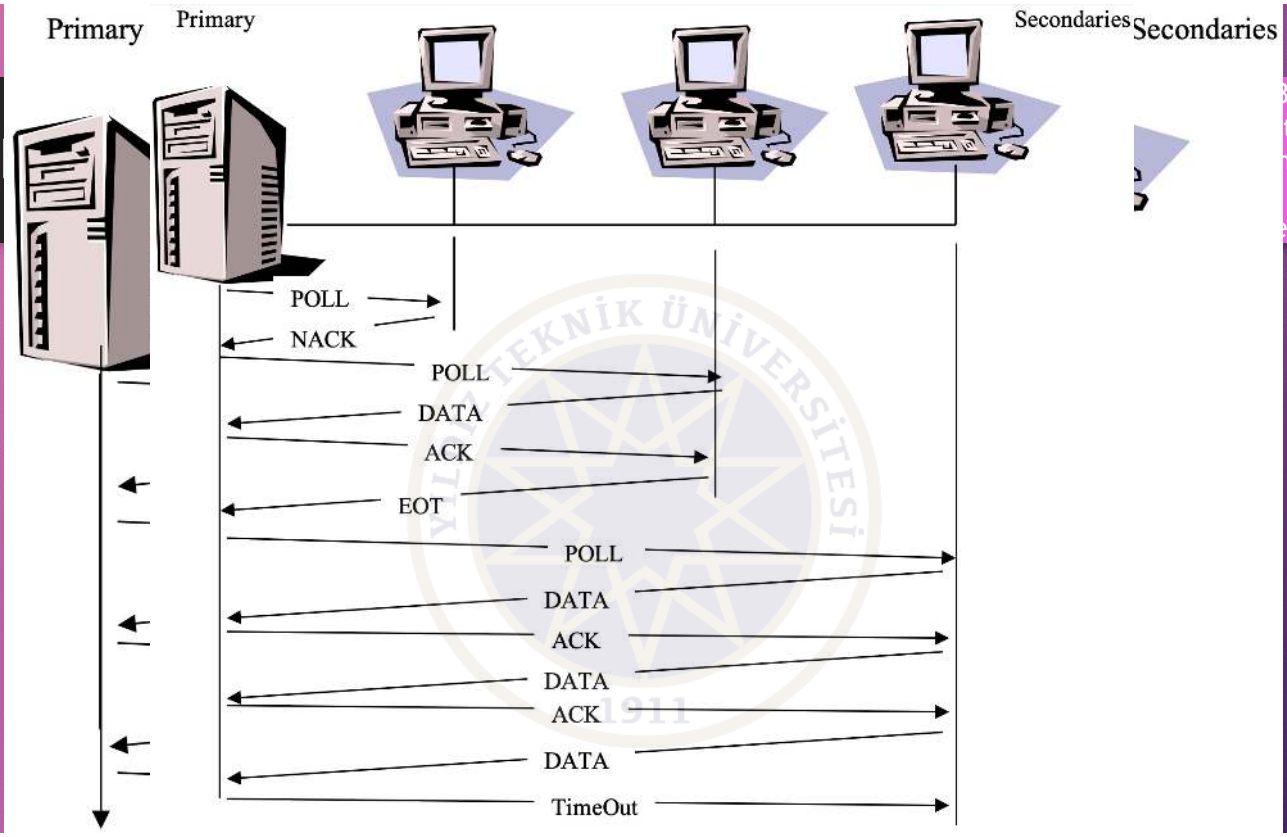
Line Dicipline / Link Management

- Enq/Ack (Enquiry/Acknowledgement)
- Poll/Select Connection Management

Enq/Ack (Enquiry/Acknowledgement)

- Point to point (in WANs)
- Units are expected to have equal properties





Flow Control

- Overwhelm
- Buffer
- There are two basic techniques:
  - Stop & Wait
  - Sliding Window

Stop & Wait

- ACK is required for every transfer.
- Pros:
  - Packages consist of smaller pieces
  - Effective use of buffers
  - Medium is busy for a shorter time
  - Error probability decreases
  - Error control processing times are shortened.
  - Wait time may be shorter for other devices in LANs.

Stop & Wait – Line Utilization (U) Rate

- t_{frame}: Transmission time of a single frame
- t_{prop}: The time it takes from the sender to the receiver
- t_{ack}: The time it takes for all bits of the ACK to exit the receiver
- $T_F = t_{frame} + t_{prop} + t_{ack} + t_{prop}$
- $T_F = t_{frame} + 2t_{prop}$
- $U = \frac{t_{frame}}{t_{frame}+2t_{prop}}$
- $a = \frac{t_{prop}}{t_{frame}} \Longrightarrow U = \frac{1}{1+2a}$
- $t_{prop} = \frac{distance}{velocity} = \frac{d}{v}$ and $t_{frame} = \frac{frameSize}{dataRate} = \frac{L}{R}$

Stop & Wait – Line Utilization (U) Rate – Con't

- Example:
  - Data communication is made between two points at a distance of 1000 km (d = 1000 km = 10^6 m) at a speed of 155.52 Mbps (R=155.52 10^6 bit/sec).
  - The transmission speed of the line is 200.000.000 m/sec (V=2 10^8 m/sec).
  - Frame size is 424 bits (L = 424 bit).
  - What is the Line Utilization (U) in Stop & Wait Flow Control mode?

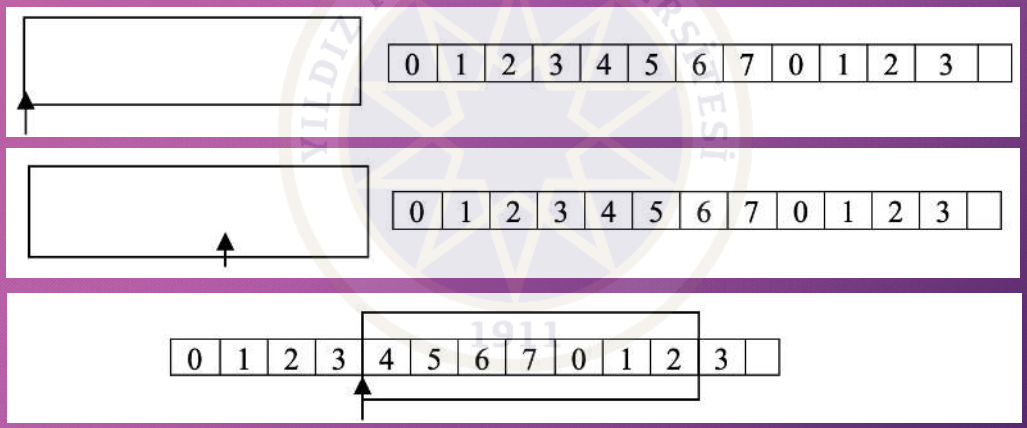
- Answer
  - $a = \frac{t_{prop}}{t_{frame}} \Longrightarrow U = \frac{1}{1+2a}$
  - $t_{prop} = \frac{distance}{velocity} = \frac{d}{v}$ and $t_{frame} = \frac{frameSize}{dataRate} = \frac{L}{R}$
  - $\frac{10^6}{\frac{155,52x10^6}{424}} \approx 3030$
  - $\frac{1}{1+2x3030} \approx 1,65x10^{-4}$

Sliding Window

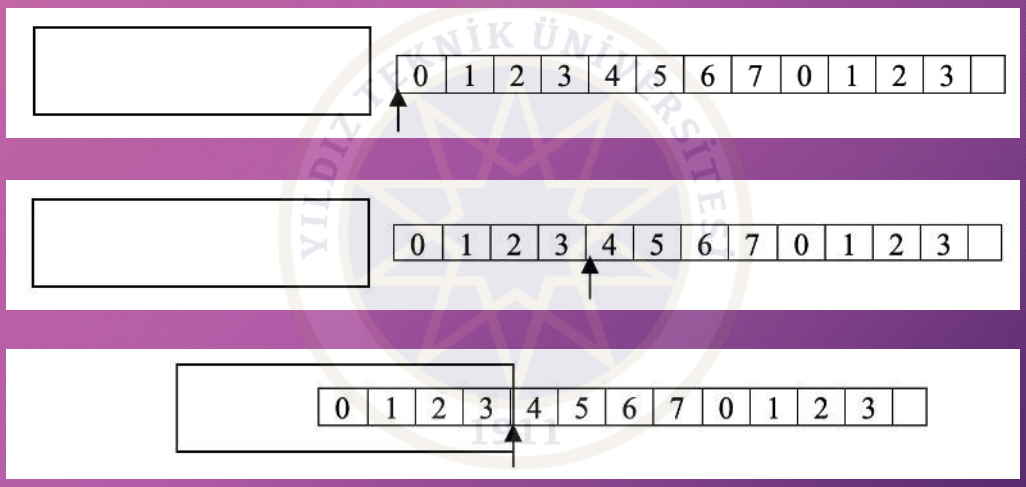
- U rate is low in Stop & Wait
- The sender sends a certain amount of data to the receiver without ACK data.
- Frames are transmitted in convoys.
- The receiver can send ACK data for several frames.
- Frame number is necessary
  - n-bit ⇒ 2^n frame
- Piggy backing

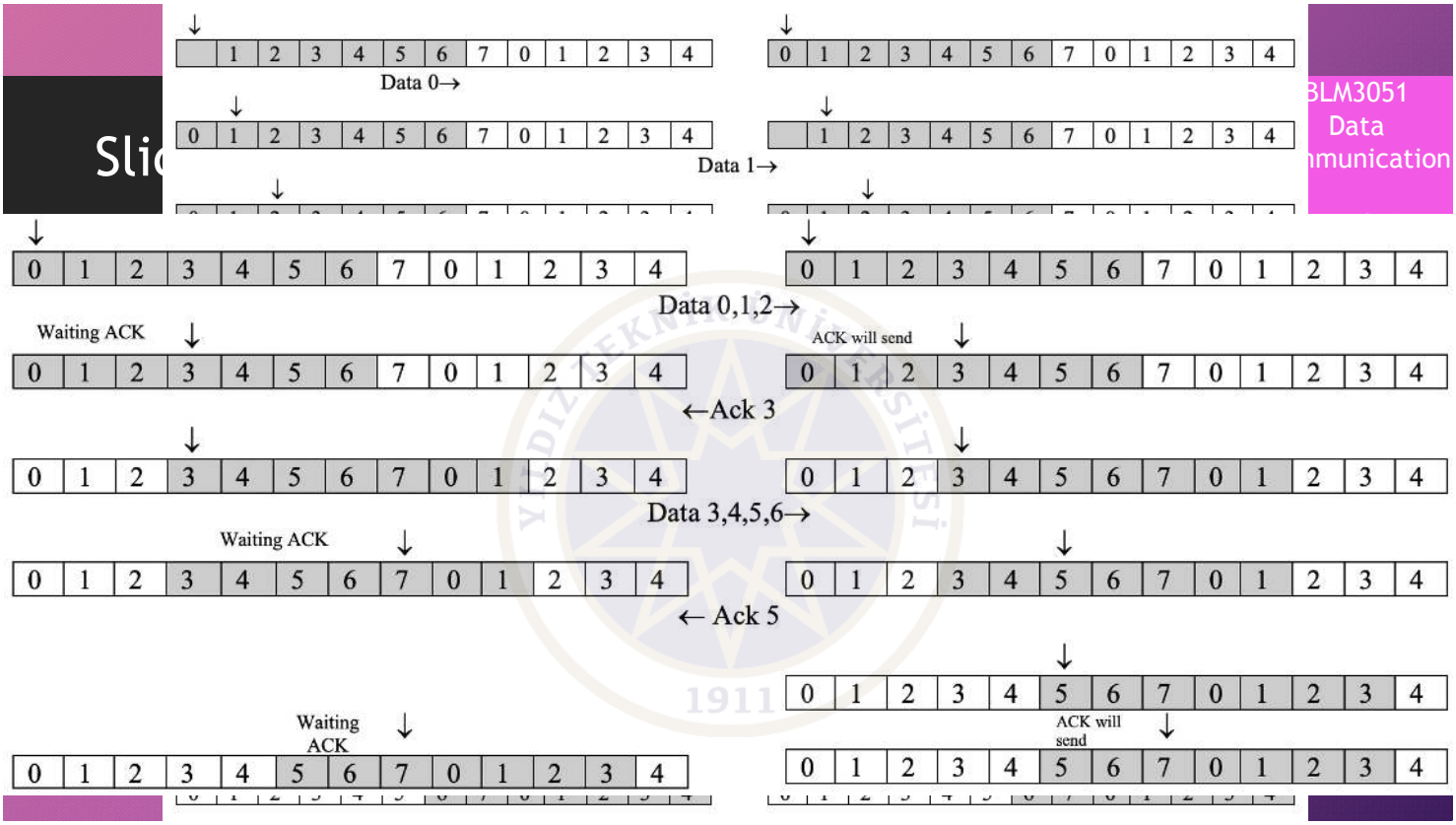
Sliding Window – Sender Side

- Window size: 2^n-1
  - Example: If frame sequence number bit length is n=3, windows size is 2^n-1 = 7

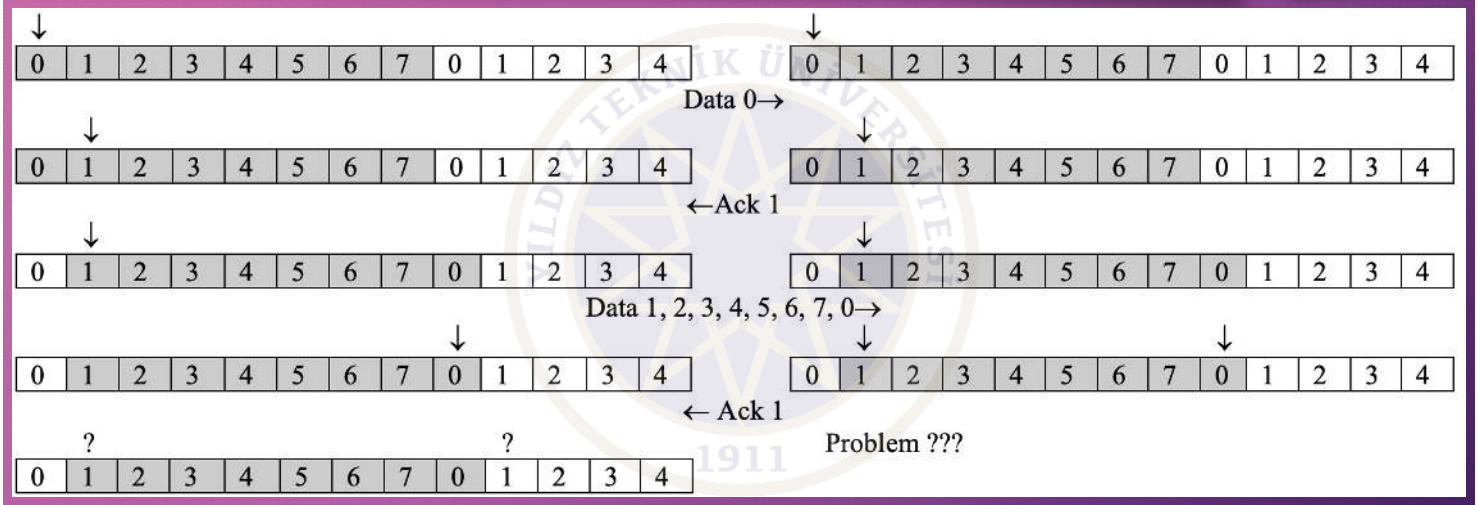


Sliding Window – Receiver Side





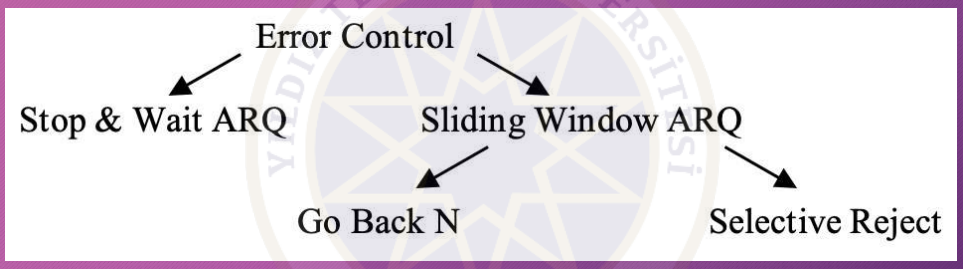
Sliding Window – Window Size 2^n-1



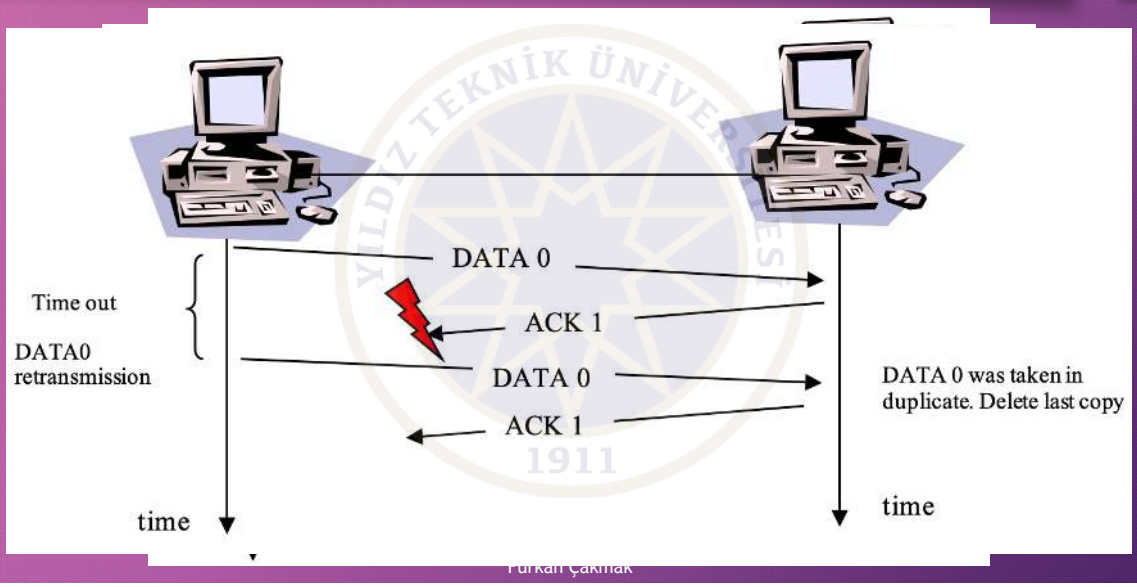
Sliding Window - Line Utilization (U) Rate

- In Stop & Wait $a = \frac{t_{prop}}{t_{frame}}$
- In Sliding Windows $t_{frame} = 1 \implies a = t_{prop}$
- If w (window size) ≥ (2a +1)
  - U = %100
- If w < (2a+1)
  - $U = \frac{w}{2a+1}$
- $U = \begin{cases} 1 & w \geq 2a+1 \\ \frac{w}{2a+1} & w < 2a+1 \end{cases}$

Error Control, Automatic Repeat reQuest (ARQ)

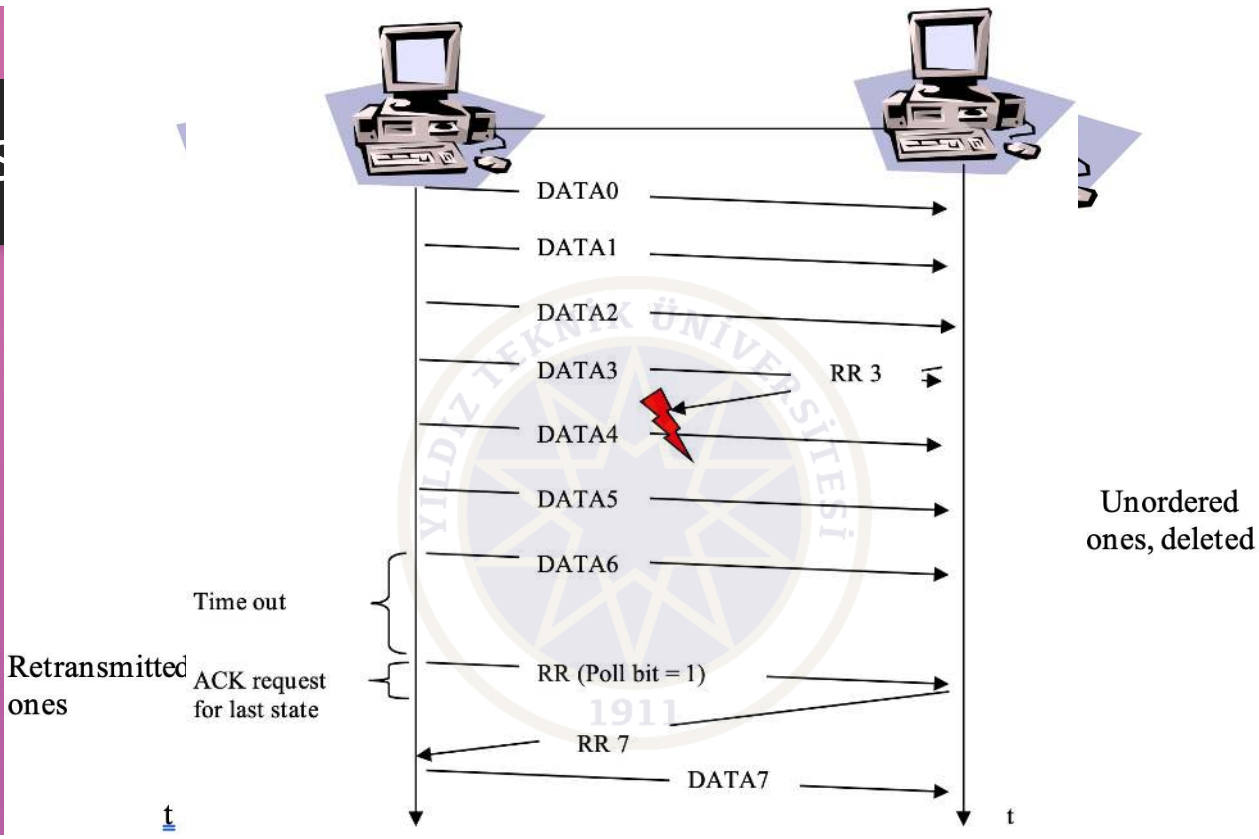


Stop & Wait ARQ



Sliding Window ARQ

- There are some differences caused by the sliding window technique when the frames inside the window are sent without a receipt.
  - The sender continues to store the frames in the buffer until it receives ACK for the frames.
  - In the ACK / NACK information coming from the receiver, there will be a number field showing which numbered frame it is for.
  - Receive Ready
    - RR 3 and RR 6 means: I have received 3, 4, 5 numbered frames, waiting for frame 6.
  - Each faulty frame is immediately reported by the receiver to the sender.
    - REJ - Reject
    - SREJ – Selective Reject
  - The sender also has a timer in the sliding window approach.
    - Lost data frame
    - Lost acknowledge frame



Sliding Window - Selective Reject / Selective Repeat ARQ

- In this technique, the receiver will receive the frames unordered.
  - Search and Sort Algorithms are necessary.
  - Processing complexity increases
    - In Go Back n: $w = (2^n-1)$
    - In Selective Reject: $w \leq (2^n+1)/2$
  - SREJ
  - The receiver accepts frames without error after faulty frame.
  - Frames will come in different order due to faulty frames.
    - Duplicated ones

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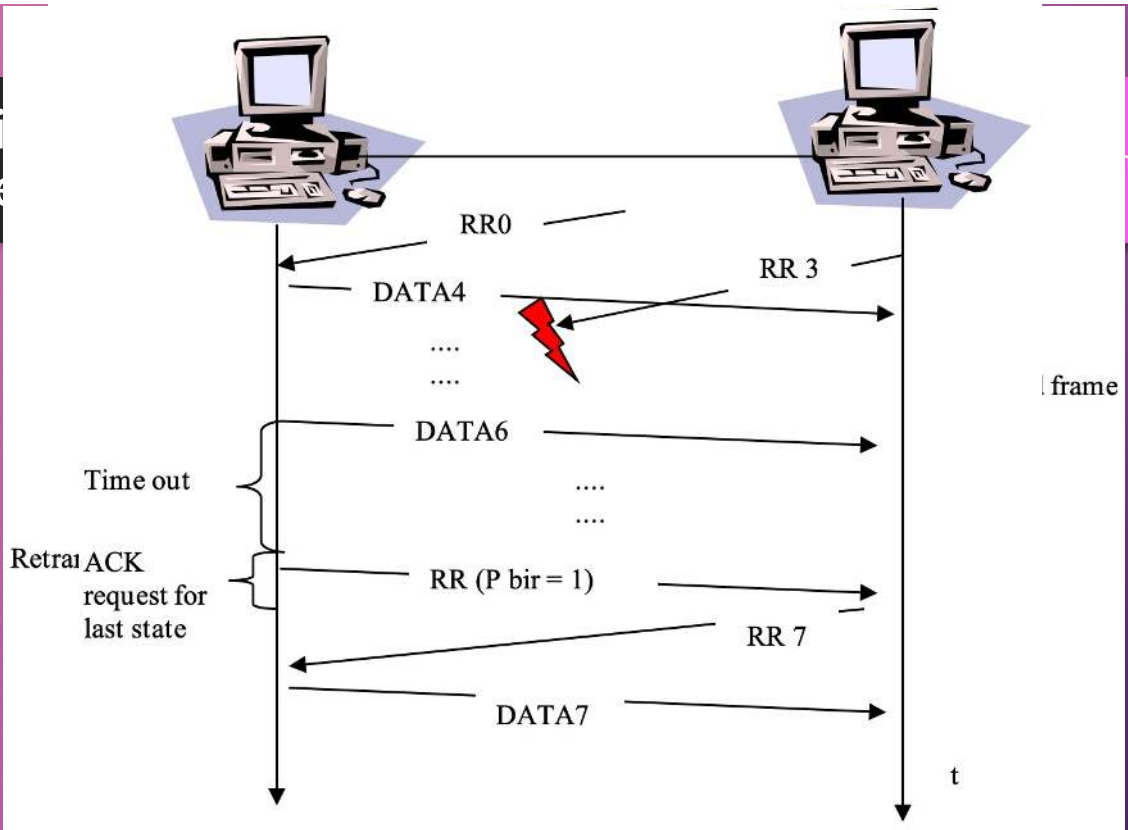

Thank you for your listening.

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