Veri İletişimi ve Bilgisayar Ağları
BLM3051

Dr. Öğr. Üyesi Furkan ÇAKMAK

Ders Bilgilendirme Formu – Haftalık Konular

Week #	Date	Subjects
1	20.02.2025	Veri İletişimine Giriş, Mimari Modeller
2	27.02.2025	OSI Referans Modeli, Katmanları, Fonksiyonları
3	06.03.2025	Fiziksel Katman, Sinyalleşme
4	13.03.2025	Paralel ve Seri İletişim, Haberleşme Ortamları ve Teknik Özellikleri, Multiplexing (TDM, FDM)
5	20.03.2025	Hata Tespiti ve Düzeltme Yöntemleri
6	27.03.2025	Veri Bağı Kontrol Teknikleri ve Akış Kontrolü
7	03.04.2025	Senkron ve Asenkron Veri Bağı Protokolleri (BSC, HDLC)
8	10.04.2025	Ara Sınav
9	17.04.2025	LAN Teknolojileri, IEEE 802.3, IEEE 802.4, 802.5, 802.11
10	24.04.2025	Geniş Alan Ağlarında Kullanılan Teknolojiler (X.25, ISDN, FR, ATM, xDSL.)
11	01.05.2025	Emek ve Dayanışma Günü
12	08.05.2025	Ağ Katmanı, Anahtarlama, Bağlantılı ve Bağlantısız Servisler, Statik ve Dinamik Routing
13	15.05.2025	Ağ Katmanında Sıkışıklık, Sebepleri ve Çözümleri, IP (Internetworking Protocol)
14	22.05.2025	ICMP, BOOTP, DHCP, Taşıma Katmanı - UDP (User Datagram Protocol), TCP (Transmisson Control Protocol)
15	29.05.2025	Öğrenci Proje Sunumları

Data Link Control

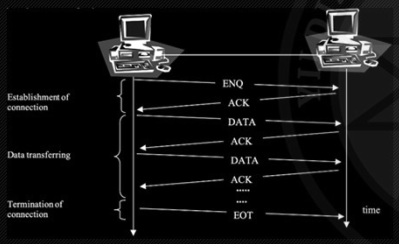
- Basic tasks of the data link layer:
  - Framming and determining of start and end points to ensure synchronization
  - Flow control
  - Error control / Retransmission
  - Addressing
  - Line dicipline / Link management

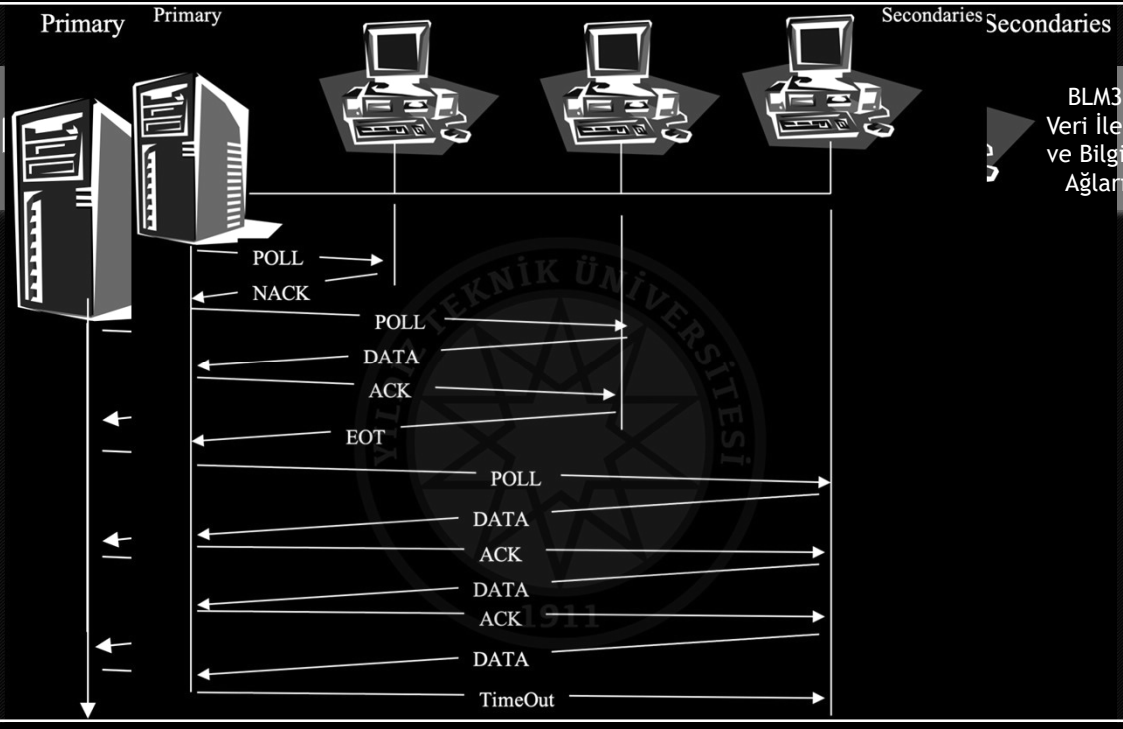
Line Dicipline / Link Management

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

Enq/Ack (Enquiry/Acknowledgement)

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





BLM3051
Veri İletişimi
ve Bilgisayar
Ağları - 6

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?

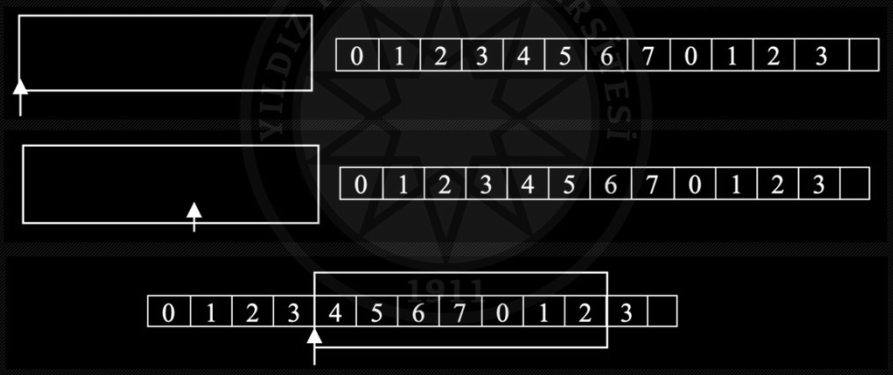
- Answer
  - $a = \frac{t_{prop}}{t_{frame}} \Longrightarrow U = \frac{1}{1+2a}$
  - $t_{prop} = \frac{distance}{velocity} = \frac{d}{v}$ and $t_{frame} = \frac{frameSize}{dataRate} = \frac{L}{R}$
  - $\frac{10^6}{\frac{155,52x10^6}{424}} \approx 3030$
  - $\frac{1}{1+2x3030} \approx 1,65x10^{-4}$

Sliding Window

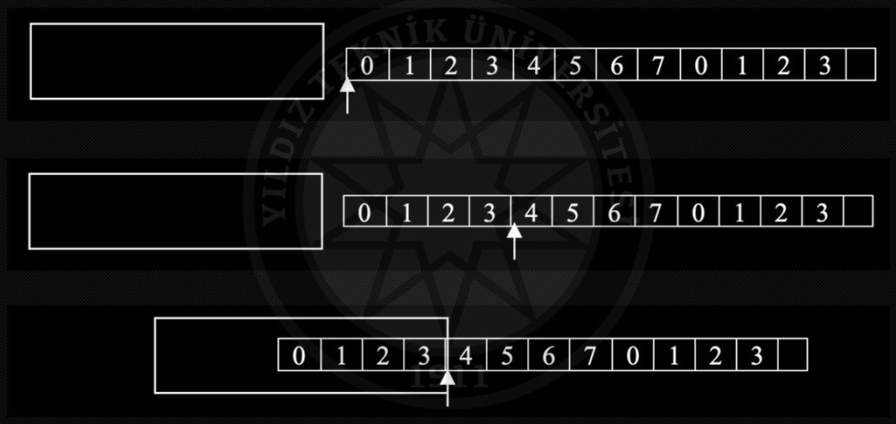
- U rate is low in Stop & Wait
- The sender sends a certain amount of data to the receiver without ACK data.
- Frames are transmitted in convoys.
- The receiver can send ACK data for several frames.
- Frame number is necessary
  - n-bit ⇒ 2^n frame
- Piggy backing

Sliding Window – Sender Side

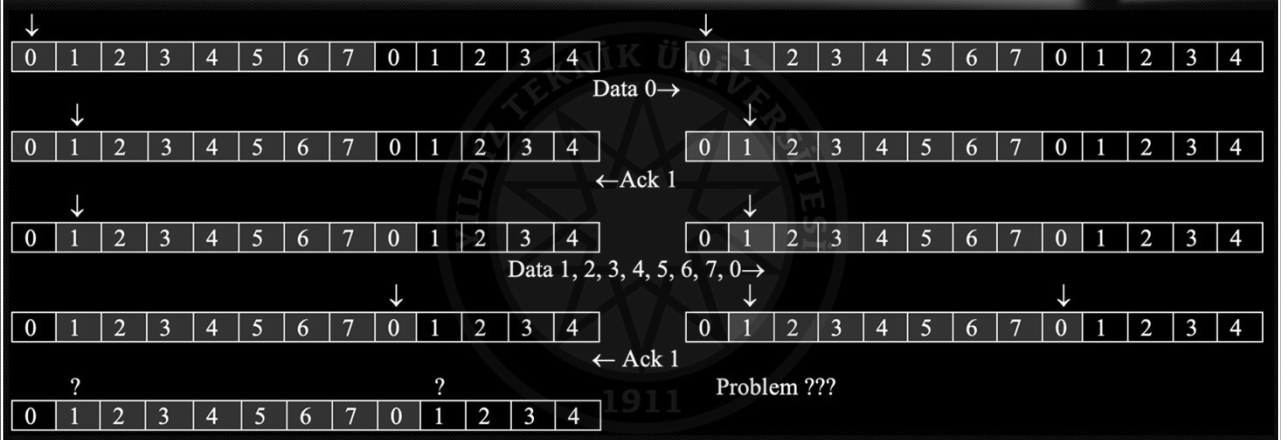
- Window size: 2^n-1
  - Example: If frame sequence number bit length is n=3, windows size is 2^n-1 = 7



Sliding Window – Receiver Side



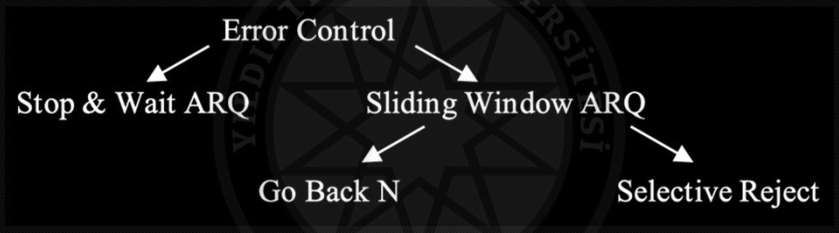
Sliding Window – Window Size 2^n-1



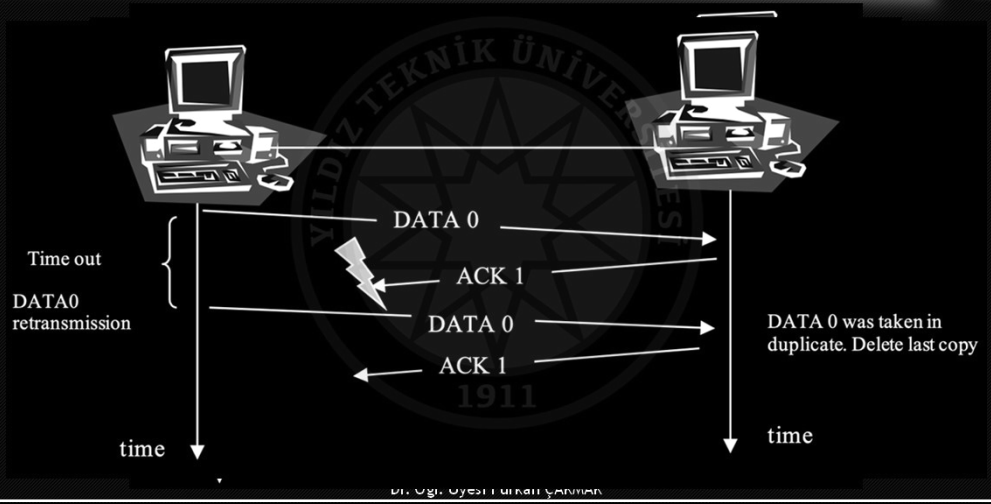
Sliding Window - Line Utilization (U) Rate

- 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)



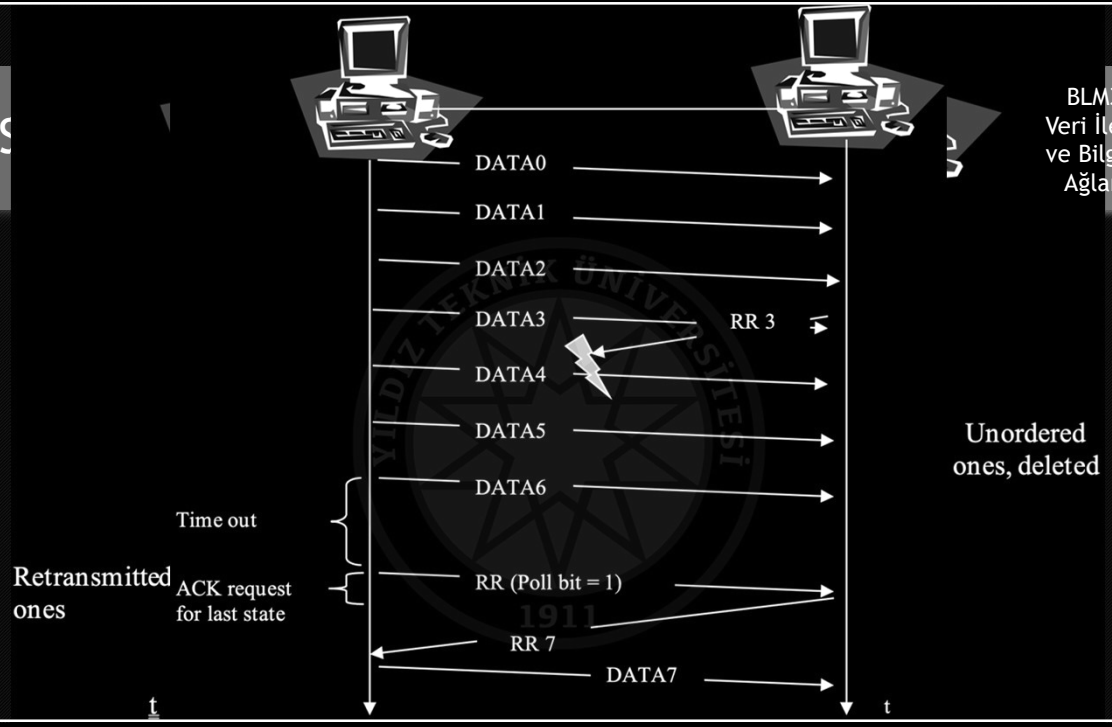
Stop & Wait ARQ



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 send**er also **has a timer** in the sliding window approach.
    - Lost data frame
    - Lost acknowledge frame

BLM3051
Veri İletişimi
ve Bilgisayar
Ağları - 6

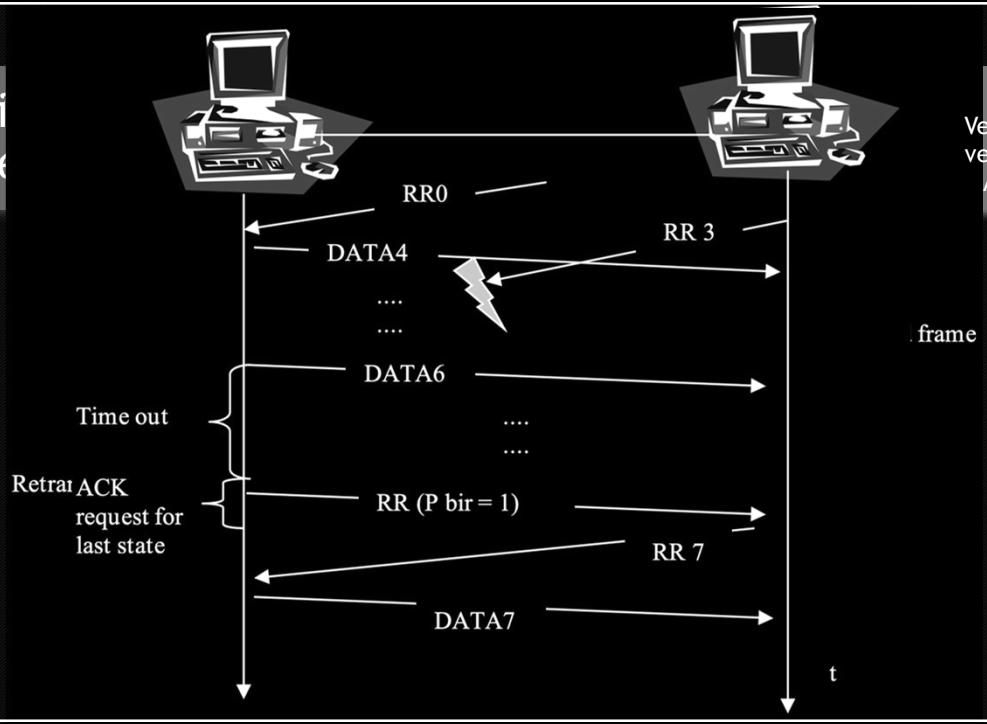


Sliding Window - Selective Reject / Selective Repeat ARQ

- 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

Slidi
Repe

BLM3051 Veri İletişimi ve Bilgisayar Ağları - 6



Thank you for listening…

BLM3051
Veri İletişimi
ve Bilgisayar
Ağları - 6

Dr. Öğr. Üyesi Furkan ÇAKMAK