Data Communication and Computer Network
BLM3051

Dr. Öğr. Üyesi Furkan ÇAKMAK

Lecture Information

- Course Hours: **Tuesday 09:00 – 11:50**

- All courses will be face 2 face.

- For announcements: https://avesis.yildiz.edu.tr/fcakmak/dokumanlar
  - OBS Course/Bulk Messaging System
  - Google Classroom Class Code: b5ggwqk
  - You can ask your questions via Google Classroom
  - Zoom Personal Room:
  - https://us04web.zoom.us/j/3752287039?pwd=TTFKNittZWJTUEhHREovckl0VTVYUT09
  - Meeting ID: 375 228 7039
  - Passcode: 5AXMNd

- For your questions and consultations about the course, make an appointment **AT LEAST 1 (ONE) DAY BEFORE** via the link below.
  - https://fcakmak.simplybook.it/v2/
  - No appointment will be made by e-mail.
  - Please be at the above mentioned Zoom room at the appointment time.

Lecture Information Form - Weekly Subjects

Hafta	Tarih	Konular
1	20.02.2024	Introduction to Data Communication Standards Used on Data Communication, Architectural models
2	27.02.2024	OSI Reference Model , Layers and Their Functions, Signaling and Signal Encoding
3	05.03.2024	Parallel and Serial Transmission, Communication Media and Their Technical Specs., Multiplexing (TDM, FDM)
4	12.03.2024	Error Detection and Error Correction Techniques, Data Link Control Techniques, Flow Control
5	19.03.2024	Asynchronous and Synchronous Data Link Protocols (BSC, HDLC)
6	26.03.2024	LAN Technologies Continued, IEEE 802.4, 802.5, 802.11
7	02.04.2024	Connectionless and Connection Oriented Services, Switching
8	09.04.2024	Tatil – Ramazan Bayramı Arifesi
9	16.04.2024	1. Ara Sınav
10	23.04.2024	Tatil – 23 Nisan Ulusal Egemenlik ve Çocuk Bayramı
11	30.04.2024	Static and Dynamic Routing, Congestion in the Network Layer, Its Causes and Solutions
12	07.05.2024	IP (Internetworking Protocol), ICMP, BOOTP, DHCP
13	14.05.2024	2. Ara Sınav
14	21.05.2024	UDP (User Datagram Protocol), TCP (Transmisson Control Protocol)

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Lecture Information Form– Coursebook

	Coursebooks
1	Introduction to Data Communications & Networking, Behrouz Foruzan
2	Computer Networks 2e, Andrew S. Tanenbaum
3	Data Networks:Concepts, Theory and Practice, Uyless D.Black
4	Routing & Switching: Time of convergence, Puzmanova

Lecture Information Form– Evaluation

| Evaluation System	Method	#	Impact (%)
	Midterms	2	40
	Quizs	-	-
	Homeworks	-	-
	Projects	1	20
	Semester Project	-	-
	Laboratory	-	-
	Other	-	-
	Final Exam	1	40

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What is Communication?

- Sharing information/data
- Telecommunication (Tele -> far *Greek)
- Communication Aim: Trafic data
- Telephone, Television, vb.
  - Ses, video, resim
- Computer
  - Medium/Media -> 0/1
- Protocol Stack: Software and Hardware

What is Communication? – Con't

- Humanity History: 200k
- Sumerians: B.C 4000
- *«Verba volant, scripta manent»*
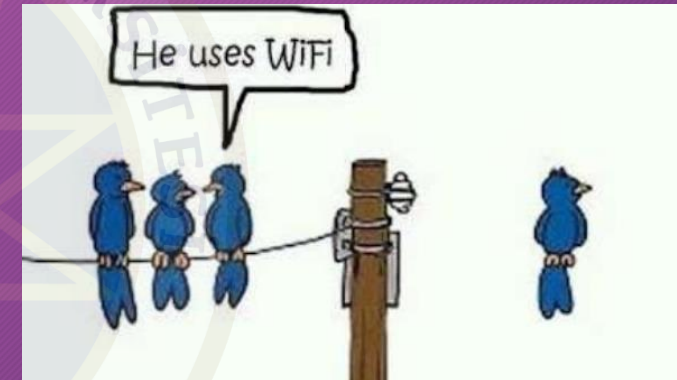- Copper Cable
  - Telegraph: 1837-1838
  - Telephone: 1876

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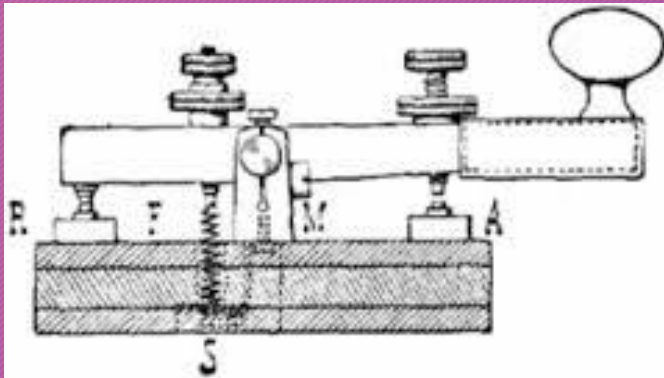
Essentials of Data Communication

- Message
- Sender
- Receiver
- Medium
- Protocol

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Data Communication

Protocol

Message

Medium

Sender

Receiver
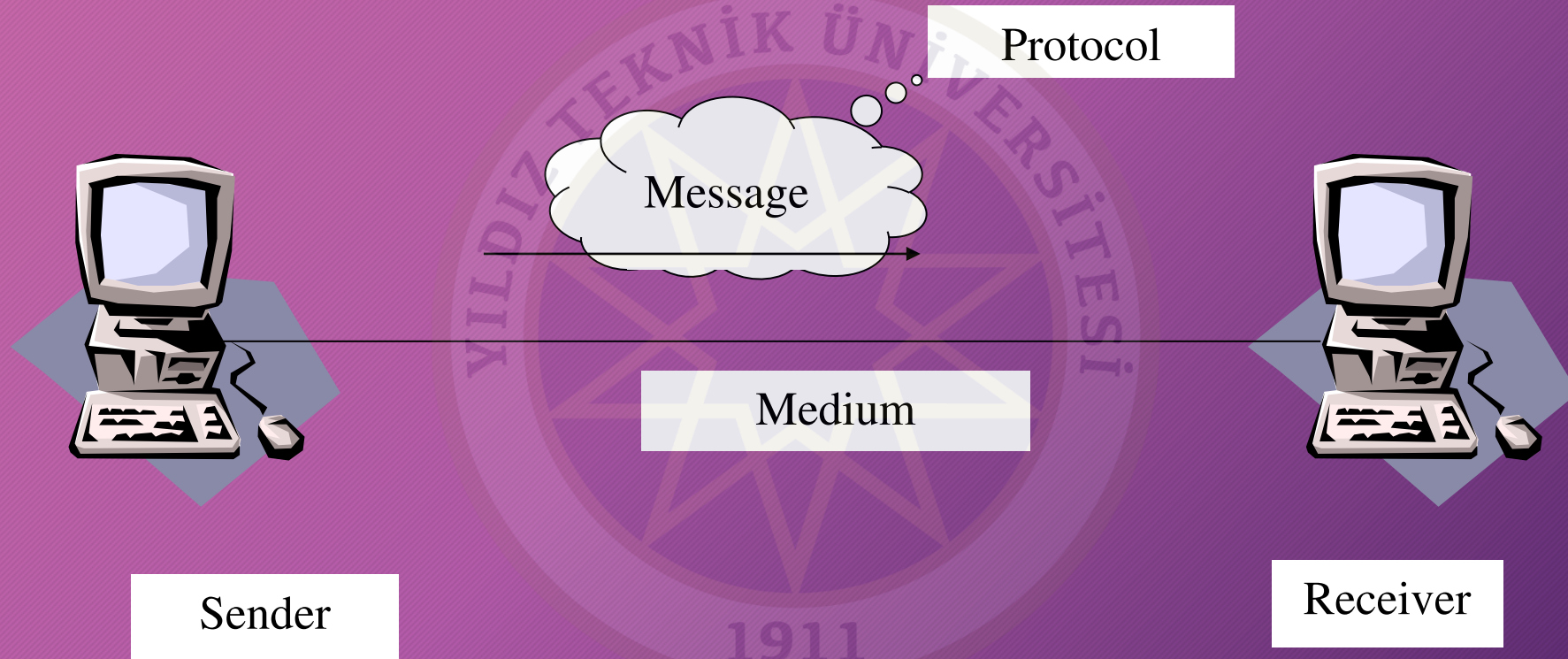
Data Comm. Features

- Delivery
- Accuracy
- Timeliness

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Pros of Computer Network

- Resource Sharing
- Info/Data Sharing
- Load Sharing / Balancing
- Reliability
- Econmony
- Efficient communication between in different places

Printing

Printing

Receiving Scanned File

INBOUND TRAFFIC

LOAD BALANCING

SERVERS

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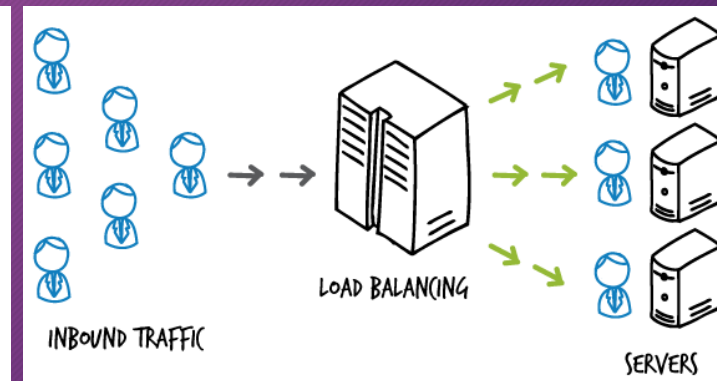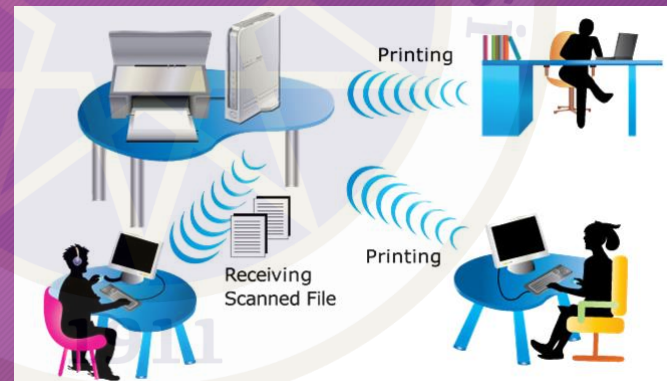
Evaluation Criteria for Computer Networks

- Performance
  - Transmit time
  - Response time

- QoS
  - Circuit-switched (Synchronous)$\rightarrow$ Bit rate, Min Error Rate, Transmission Rate
  - Packet-switched (Asynchronous) $\rightarrow$ Maximum Packet Size, Mean Packet Transfer Rate, Mean Packet Error Rate, Jitter, Mean Packet Transmit Delay

- Reliability/Availability
  - MTBF – Mean Time Between Failure
  - Restoring Time
  - 5-9 $\rightarrow$ 99,999%

- Security

- Scaleable

- Adaptable
  - Software, Hardware
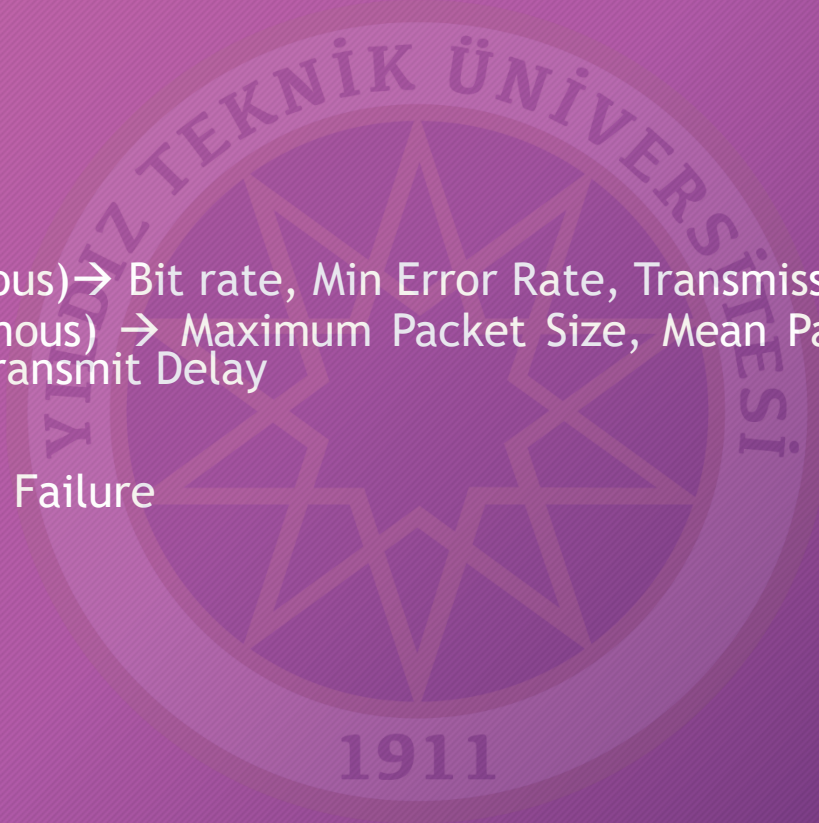
Network Standards

- De Jure
  - ISO (International Organization for Standardization)
  - ITU (The **International** Telegraph and **Telephone** Consultative Committee)
  - IEEE (The Institute of Electrical and Electronics Engineers)
  - ETSI (The European Telecommunications Standards Institute)
  - EIA (Energy Information Administration)
  - TIA (Telecommunications Industry Association)
  - ANSI (American National Standards Institute)
  - TSE (Türk Standartları Enstitüsü)
  - IETF (Internet Engineering Task Force)

- De Facto
  - QWERTY keyboards
  - VHS video format
  - PDF document type
  - Buttons on men's shirts are on the right, buttons on women's shirts are on the left.

Computer Network (CN)

- ARPANET (1970s)

- Classification of CN
  - Technique of Tranmission
    - Broadcast
    - Peer to peer – P2P
  - Network Dimension
    - PAN-Personal Area Network (< 10m)
    - LAN-Local Area Network (< 100m-200m)
    - CAN-Campus Area Network (< 1-5km)
    - MAN-Metropolitan Area Network (< 10-50km)
    - RAN-Regional Area Network (< 100-200km)
    - WAN- Wide Area Network (< 1000km)
  - Bit Rate

10Gbps	Çok yüksek hızlı LAN					
1Gbps	Yüksek hızlı LAN		MAN		Yüksek hızlı WAN	
100Mbps	Hızlı LAN					
10Mbps	Düşük hızlı LAN					
1Mbps					WAN	
100kbps						
10kbps						
	10m	100m	1Km	10Km	100Km	1Mm

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Topology

- Bus
- Star
- Tree
- Ring
- Mesh
- Hybrid
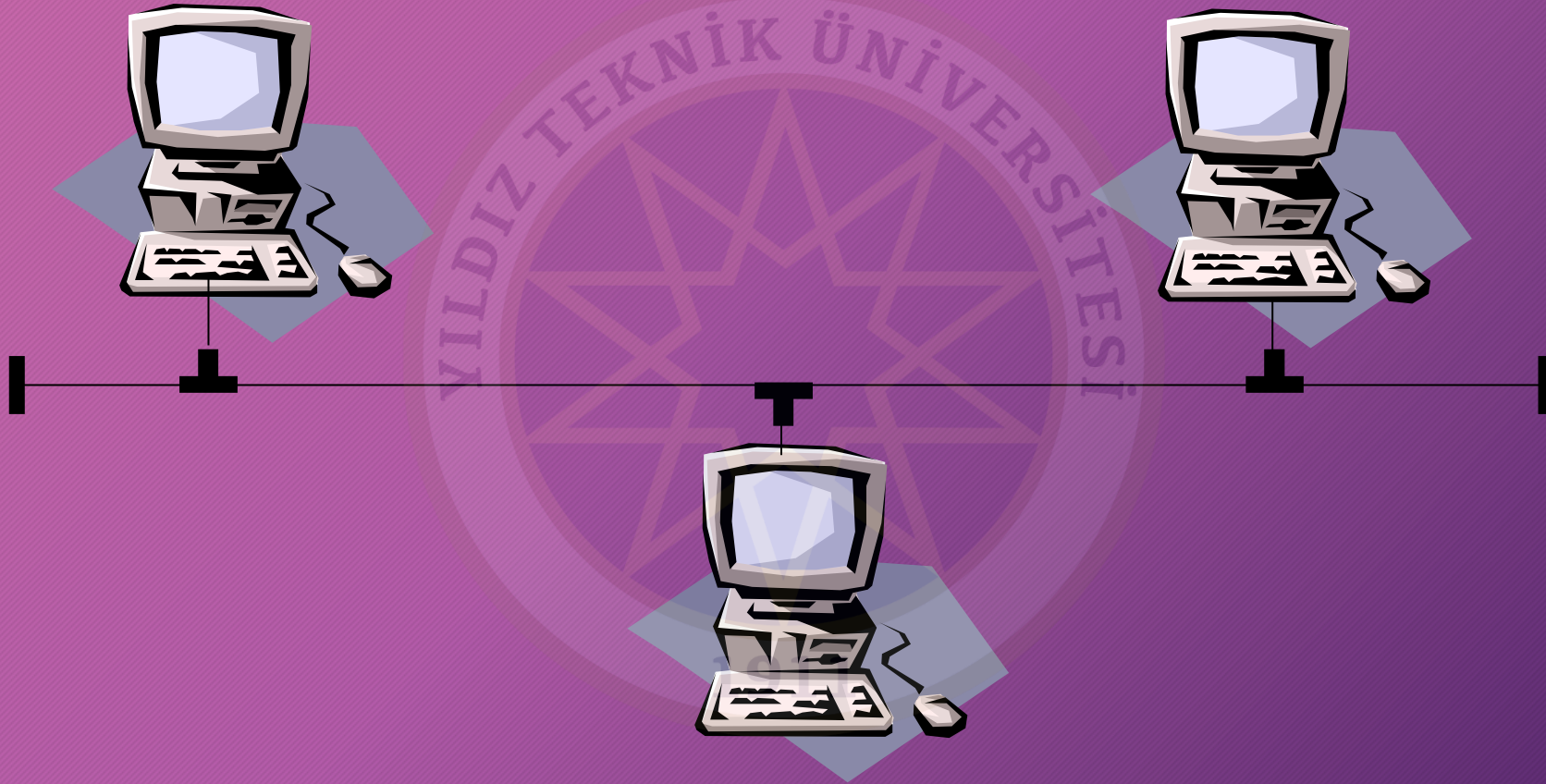
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Bus Topology

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Star Topology

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Tree Topology

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Ring Topology

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Mesh Topology

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Hybrid Topology

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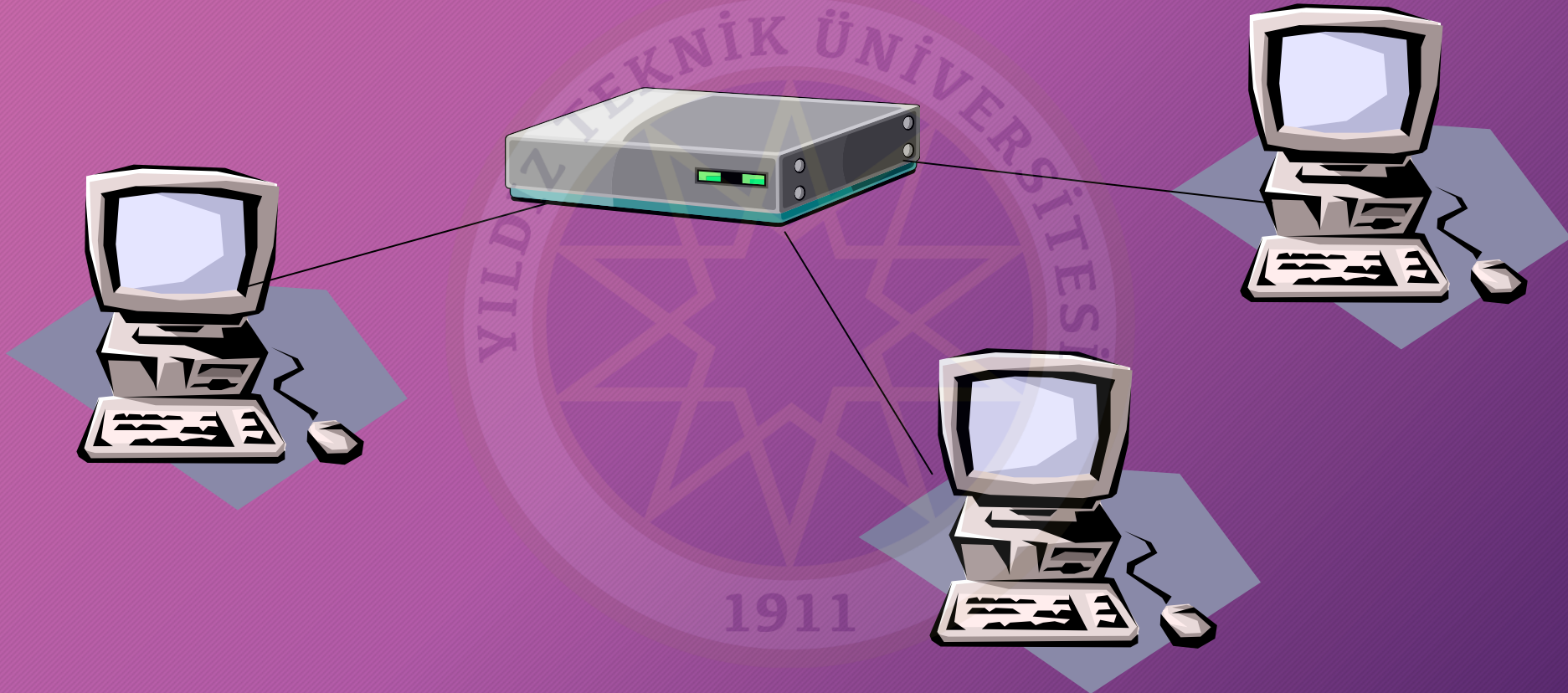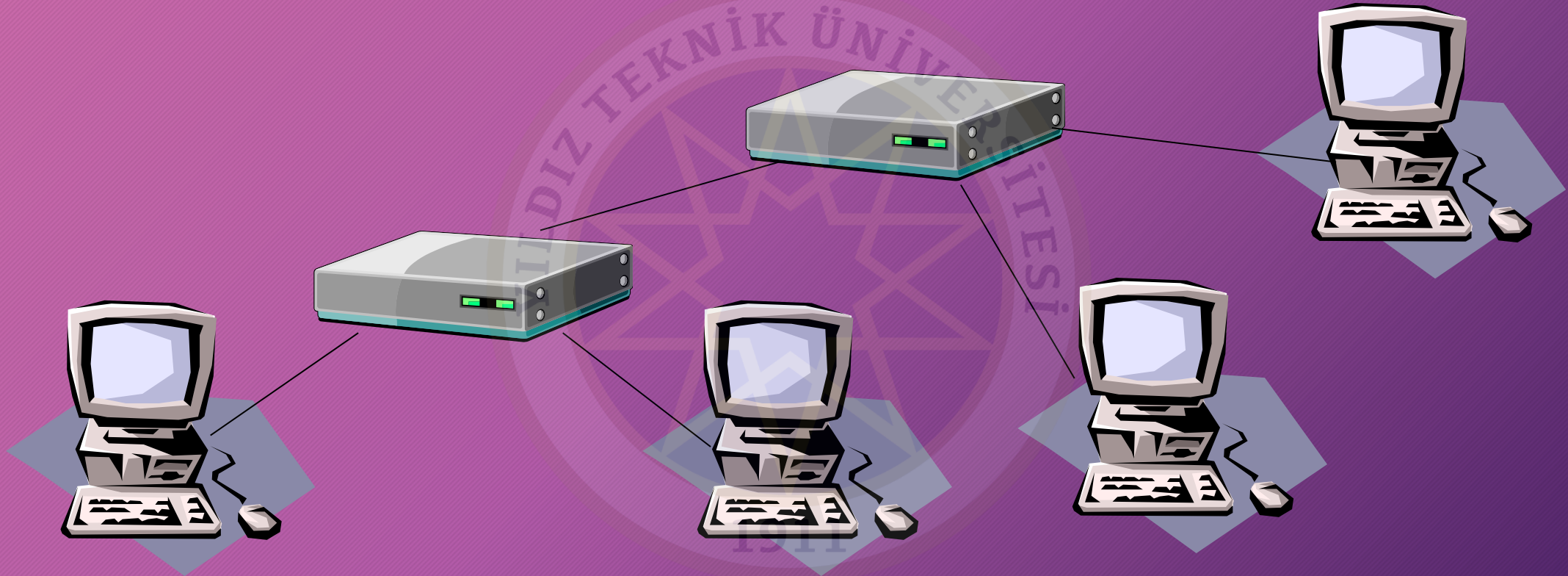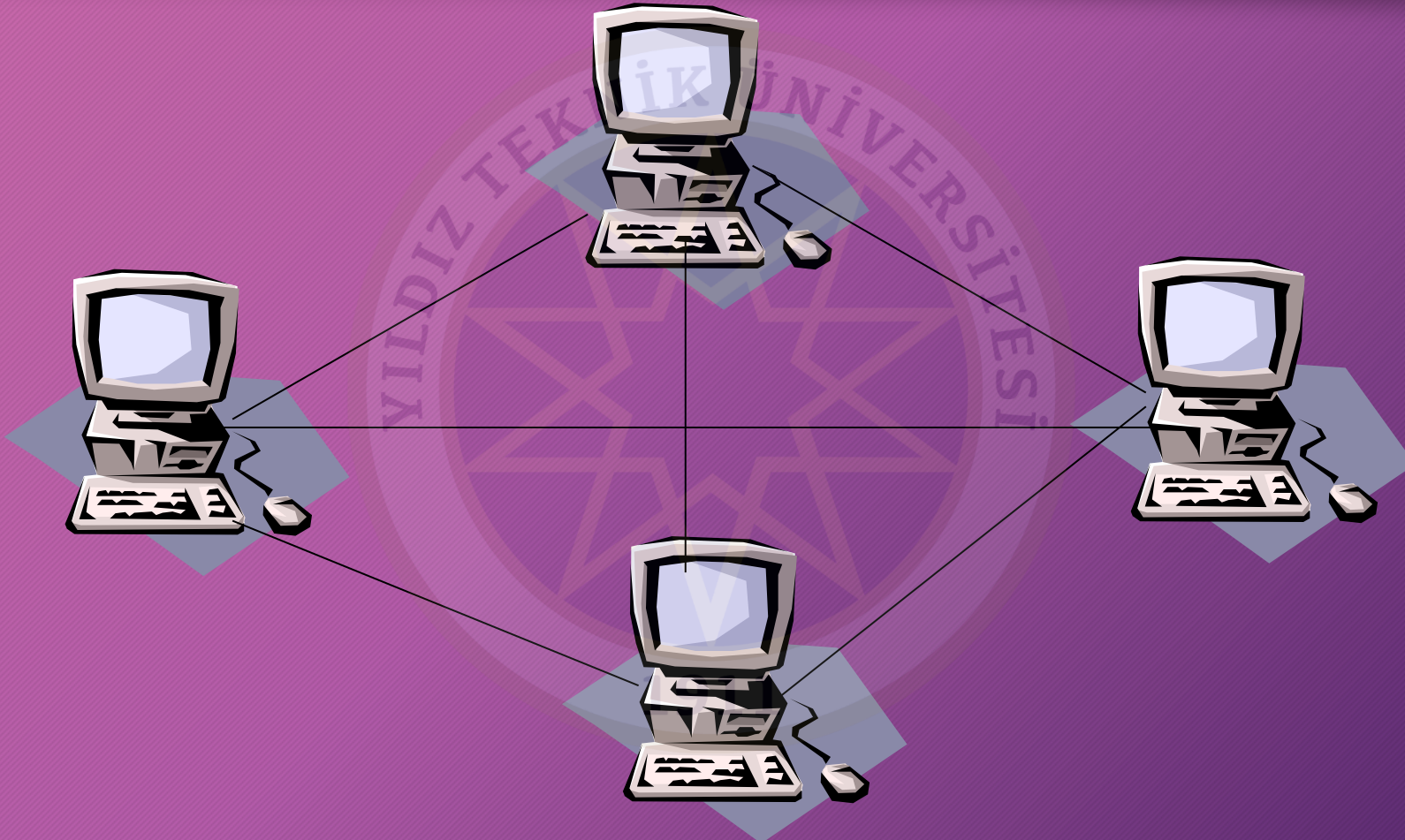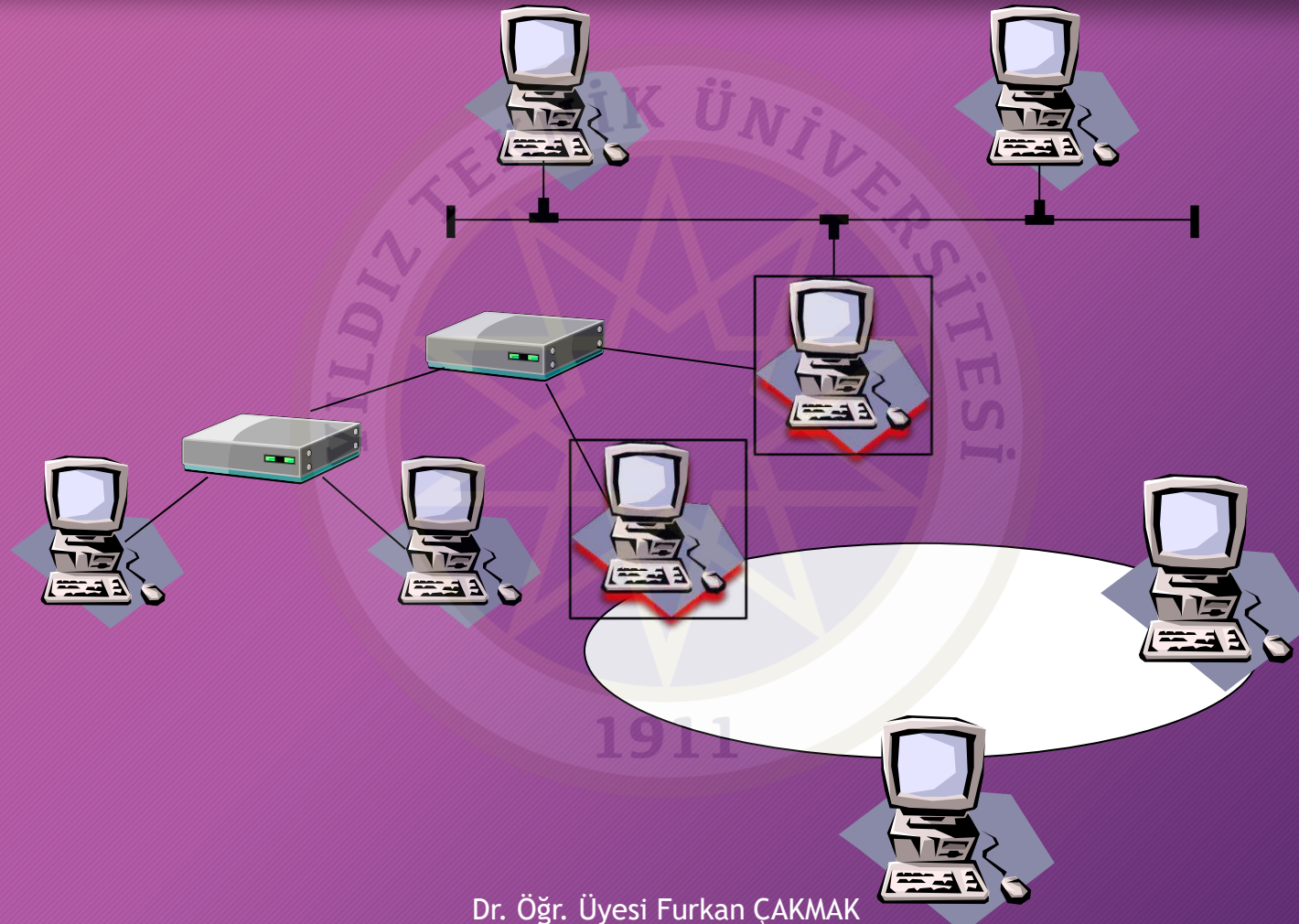
Transmission Model

- Simplex
  - Mouse
  - Bar Code Reader

- Half-Duplex
  - Radio

- Duplex
  - LAN

Addressing Model

- Broadcast
  - TV
- Multicast
  - Stream Video
- Anycast
  - DNS
- Unicast
  - Letter
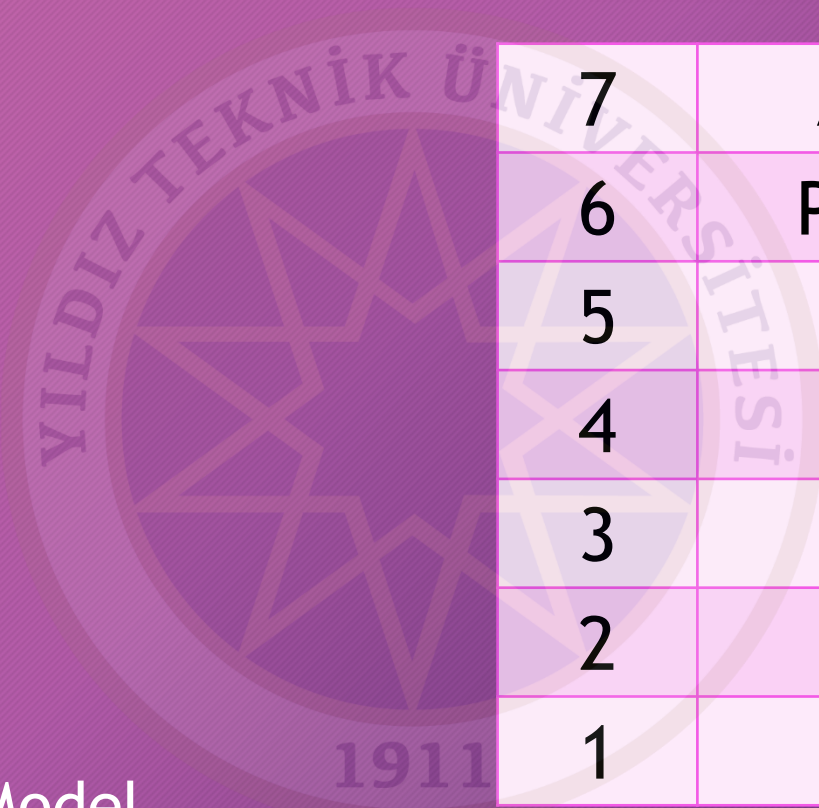
Data Flow Density, Bit Rate, Throughput

- Symmetric
- Asymmetric

- bps (bit-ps), Bps (Byte-ps)
  - Kilo (k), Mega (M), Giga (G), Tera (T), Peta (P), Exa (E), Zetta (Z) ve Yotta (Y)

- Throughput
- Response time
- Jitter

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OSI Reference Model

- ISO – 1984
- De Jure
- Features
  - Open
  - Flexible
  - Robust
  - Interoperable
  - Easy to explain
  - Easy to understand
- 7-layers
- Never applied / Ideal Model

7	Application Layer
6	Presentation Layer
5	Session Layer
4	Transport Layer
3	Network Layer
2	Data Link Layer
1	Physical Layer

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OSI Reference Model – Con't

A

B

User Support Layers

Application Layer	Peer to peer	Application Layer
7–6 Interface		7–6 Interface
Presentation Layer	Peer to peer	Presentation Layer
6–5 Interface		6–5 Interface
Session Layer	Peer to peer	Session Layer
5–4 Interface		5–4 Interface

Service Layer

| Transport Layer | Peer to peer | Transport Layer |
| 4–3 Interface | | 4–3 Interface |

Network Support Layers

Network Layer	Network Layer	Network Layer	Network Layer
3–2 Interface			3–2 Interface
Data Link Layer	Data Link Layer	Data Link Layer	Data Link Layer
2–1 Interface			2–1 Interface
Physical Layer	Physical Layer	Physical Layer	Physical Layer

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OSI Reference Model – Con't

- Each layers add a **header** package.

- Only second layer (Data link) add a **trailer** end of the package.
  - Error control

- Encapsulation

Katman 7	Data7
Katman 6	H6 Data7
Katman 5	H5 Data6
Katman 4	H4 Data5
Katman 3	H3 Data4
Katman 2	H2 Data3 T2
Katman 1	...............010001110100..............

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OSI – Physical Layer

- Responsible for **trasmitting bit arrays** between peers.

- General functions of the Physical Layer;
  - Electromechanic
  - **Direction** of the package
  - Determining **magnitudes** of signals
    - Amplitude, Wavelength, Frequency
  - **Initiation** and **termination** of the physical connection.

7	Application Layer
6	Presentation Layer
5	Session Layer
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2	Data Link Layer
1	Physical Layer

OSI – Data Link Layer

- Extract/divide **frames** from the messages.
- Send frames to receiver side **in an order.**
- Using acknowledgment (ACK) info;
  - In case of an **error,**
  - In case of **not receive** the package,
  - **Re-transmission**
- Add **header** and **trailer** data to frames.
  - To determine the **starting and ending points** of the frame.
- Header includes;
  - Sender address,
  - Receiver address,
  - Order info
- Trailer includes;
  - A code (to check errors)

7	Application Layer
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OSI – Data Link Layer – Con't

- General functions of the Data Link Layer;
  - Node to node **error free** delivery
  - Addressing (in header part)
    - MAC Address
  - Access Control
  - Flow Control
  - Error Handling
  - Synchronization

- In Local Area Network (LAN)
  - DLL divides into 2 different layers;
    - LLC (Logical Link Control)
    - MAC (Media Access Control)

- Communication at the data link layer is in the **same network**.

7	Application Layer
6	Presentation Layer
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OSI – Network Layer

- Network layer is responsible for;
  - **Efficiently** and **accurately** forwarding the packet
  - From source to destination **over different network links**.
- Communication at the network layer is in the **different network**
  - **Router (3rd level devices)**
- **Switching**
  - Connection oriented
    - like telephone infrastructure system
- **Routing**
  - **Determining the path between sender and receiver**
  - **Connectionless**
    - **Delivering packages**
  - **In DLL, data transfer occurs between nodes**

7	Application Layer
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OSI – Network Layer – Con't

7	Application Layer
6	Presentation Layer
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1	Physical Layer

- Address must be different from DLL's addresses.
  - Logical Address
- **Data transfer occurs between the source and the destination.**
- General functions of the Network Layer;
  - **Source to Destination packet delivery**
  - **Logical addressing**
  - **Routing**
  - **Address transformation**
    - Between logical and physical addresses
  - **Multiplexing**
    - Multiple physical connections on a single newtwork connection at the same time

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OSI – Transport Layer

- Responsible for the **transmission of data**
  - from source to destination
- Network layer responsible for delivering data
- Transport layer responsible for delivering packages
  - data = package[]
- Data transmission is between applications, not computers.
- An additional addressing mechanism is required
  - to **distinguish the applications from each other**.
  - **Service Access Point – SAP**
    - Ports, Sockets
- Transport layer **divides the incoming information into pieces (_segment_)** in sizes **supported by the infrastructure**.
  - Segmentation
    - Sequence number
    - Re-assembly

7	Application Layer
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OSI – Transport Layer – Con't

- There are **two types** of services.
  - **Connectionless**
    - Like post services
  - **Connection oriented**
    - Like phone services
      - Establish connection
      - Data transmission
      - Terminate connection
  - **More control over the data to be transferred**

- General functions of the Transport Layer;
  - Data transmission between source and destionation nodes
  - To **provide data flow** between applications with **the help of service points**
  - **Segmentation & Re-assembling**
  - Ensuring connection control
    - Connectionless | Connection oriented

7	Application Layer
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OSI – Session Layer

- This layer is responsible for **ensuring continuity**.
  - Synchronization
- Choosing connection type
  - Half-duplex
  - Duplex
- Session data transfering
  - Password
  - Logon verification
- **Sessions** can **be split into sub-sessions** to ensure the **reliability of the connection**
- Sub-sessions are provided with **checkpoint** information.

7	Application Layer
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OSI – Session Layer – Con't

- General functions of the Session Layer;
  - **Managing the session**
  - **Communication control**
    - if it is half-duplex
  - **Ensuring synchronization**
  - **Gracefull close**

7	Application Layer
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OSI – Presentation Layer

- General functions of the Presentation Layer;
  - **Provides interoperability** by **eliminating possible differences** in **information representation** between devices during data communication
    - Abstract data syntax
  - **Encryption & Decryption**
  - **Compression & Decompression**

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OSI – Application Layer

- User Interfaces
  - Electronical mail (e-mail)
  - File transfering
  - Remote desktop control
  - Internet explorer
  - vb.

7	Application Layer
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Other Network Models

OSI Modeli	TCP/IP Modeli		DNA	
Uygulama Katmanı	Uygulama Katmanı		Ağ Uygulama	
Sunu Katmanı			Son Kullanıcı	
Oturum Katmanı				Oturum
Taşıma Katmanı	Taşıma Katmanı		Ağ Servisleri	
Ağ Katmanı	Internet Katmanı		Taşıma Katmanı	
Veri Bağı Katmanı	Ağ Erişim Katmanı		Veri Bağı Katmanı	
Fiziksel Katman			Fiziksel Katmanı	

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Thank you for your listening.

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