Data Communication and Computer Network

BLM3051

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Lecture Information Form - Weekly Subjects

BLM3051 Data Communication and Computer Network - 7

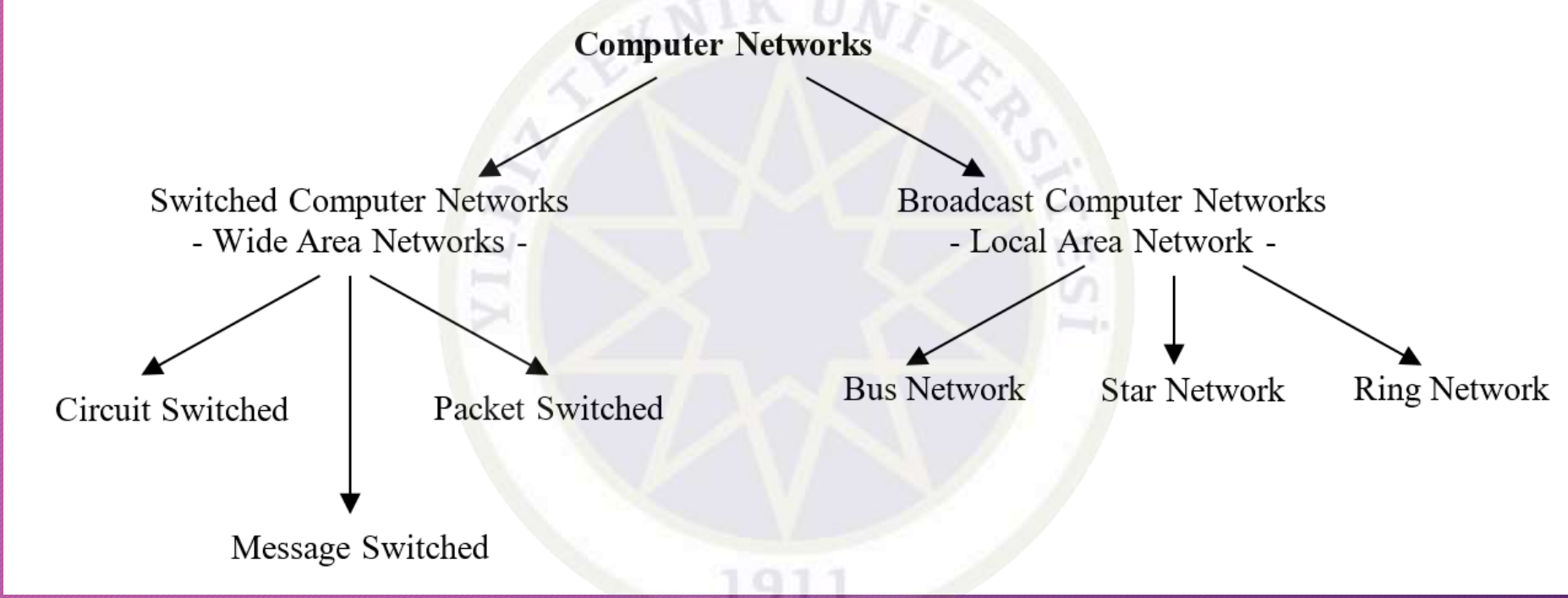
Hafta	Tarih	Konular
1	20.02.2024	Introduction to Data Communication Standards Used on Data Communication, Architectural models
2	27.02.2024	OSI Reference Model , Layers and Their Functions, Signaling and Signal Encoding
3	05.03.2024	Parallel and Serial Transmission, Communication Media and Their Technical 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)

Network Layer

- Delivering packets from the source all the way to the destination
  - Making many hops at intermediate routers
    - This function clearly contrasts with that of the data link Layer.
- Lowest layer that deals with end-to-end transmission
- The network layer must know about the topology of the network (i.e., the set of all routers and links)
  - Choose appropriate paths through it

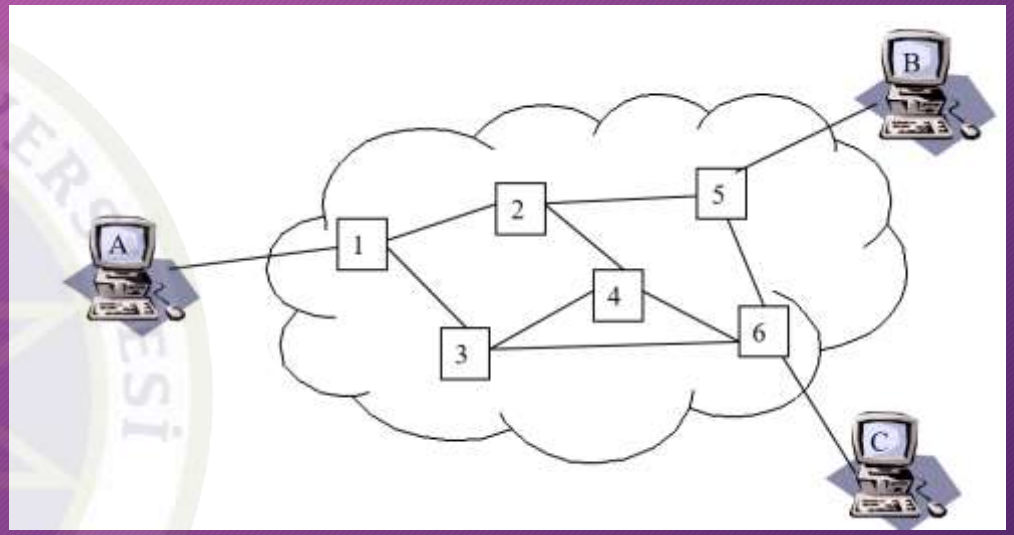
7	Application Layer
6	Presentation Layer
5	Session Layer
4	Transport Layer
3	**Network Layer**
2	**Data Link Layer**
1	**Physical Layer**

Network Layer - Switching



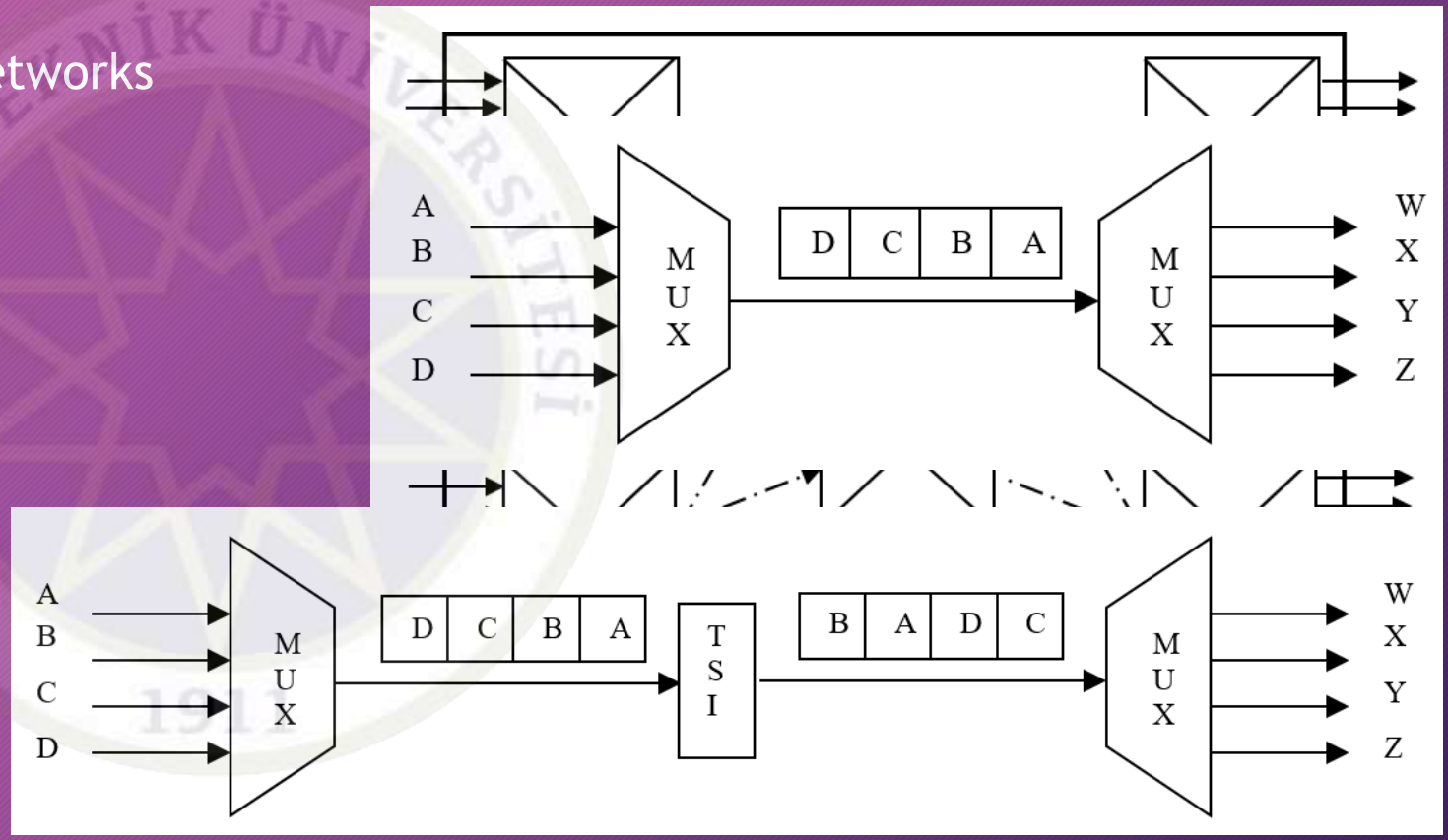
Network Layer - Circuit Switching

- End office (switchboard)
  - Subscriber loop
- It is possible to establish more than one connection using TDM and/or FDM techniques on the connections between intermediate switching elements.
  - Trunk
- Circuit Switched Networks
  - Space Division Circuit Switching
  - Time Division Circuit Switching



Network Layer – Circuit Switching (Con't)

- Space Division Circuit Switching
  - Design for analogue telephone networks
    - Cross-Bar
    - Multistage switch
- Time Division Circuit Switching
  - TDM
  - TSI (Time Slot Interface)
- Hybrid switching
  - TST (Time-Space-Time)
  - TSST (Time-Space-Space-Time)
  - STTS (Space-Time-Time-Space)
- Control Signalin

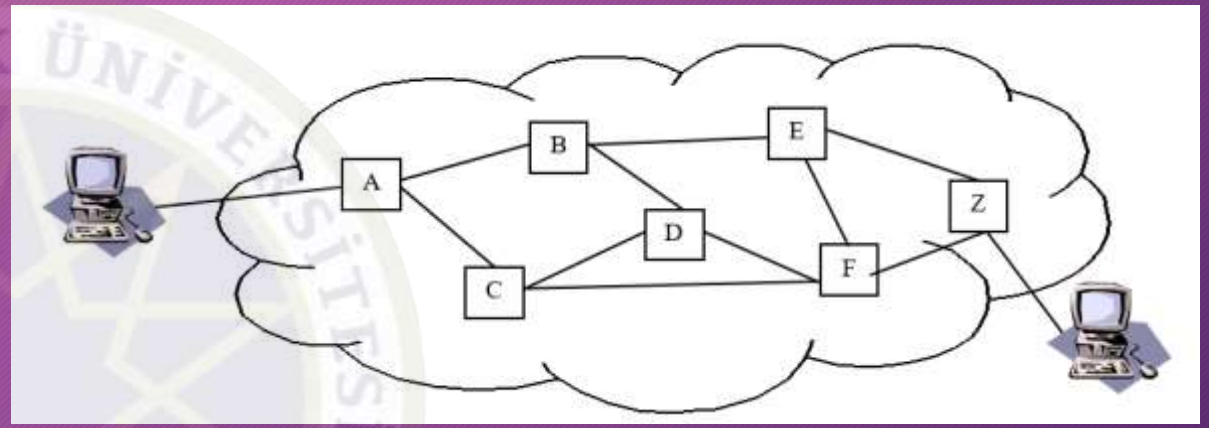


Network Layer – Package Switching

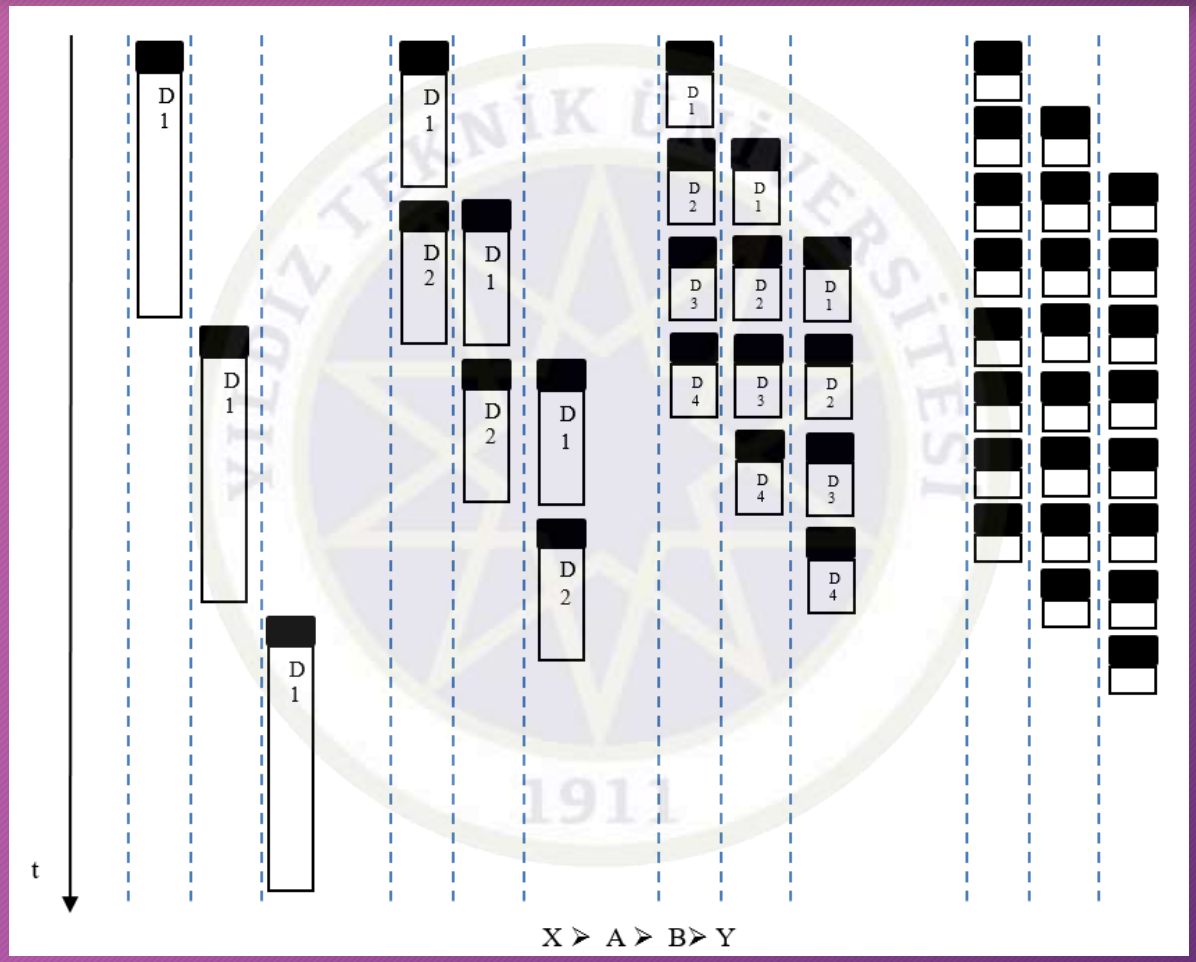
- Circuit Switching is more suitable for telephone infrastructure.
  - A payment is necessary as long as the connection continues
  - Not suitable for bursty traffic
- Package Switching
  - Pricing is based on the amount of information sent rather than the connection time
  - Enabling to provide additional capacity needed for traffic bursts that may occur at different times
  - Adaptive

Network Layer – Package Switching (Con't)

- Datagram
  - Traditional Mail Delivering System
    - Routing Table
  - Suitable for transmission of a small number of packets.
- Virtual Circuit-VC
  - Switched Virtual Circuit-SVC
    - The first packet sent determines the route
      - VCI-Virtual Channel Identifier
  - Permenant Virtual Circuit-PVC
    - CI (Channel Identifier)



Effect of Package Size on Performance



Comparison of Circuit and Packet Switched Networks

- In circuit-switched networks, increased traffic causes some calls to be blocked and new connections not to be accepted.
- On the other hand, in packet-switched networks, even if traffic increases (up to a certain level), packets will be accepted, but delivery times will be longer.
  - In case of congestion, it is possible for nodes on the network to continue functioning by discarding some packets.
  - Packets that are discarded and cannot be delivered to the recipient must be followed by higher-level protocols running at the transport layer.
- In packet-switched networks, node-to-node connections are shared by many packets over time.
  - When necessary, packets are also kept in queues created in the buffer memory area used in intermediate nodes.
- Since simultaneous TDM is used in circuit-switched networks, the connection between the two nodes must be pre-allocated.

Comparison of Circuit and Packet Switched Networks (Con't)

- In packet switching networks, each station is connected to switching elements (PSE) compatible with its own data rate, so they can exchange packets even if they operate at different data rates.
- However, in circuit switched networks, the speed can be equal to the speed of the lowest speed station.
- While a priority mechanism can be established in packet-switched networks because some packets can be sent ahead of others, thanks to the queue structure at intermediate nodes, this is not possible in circuit-switched networks.

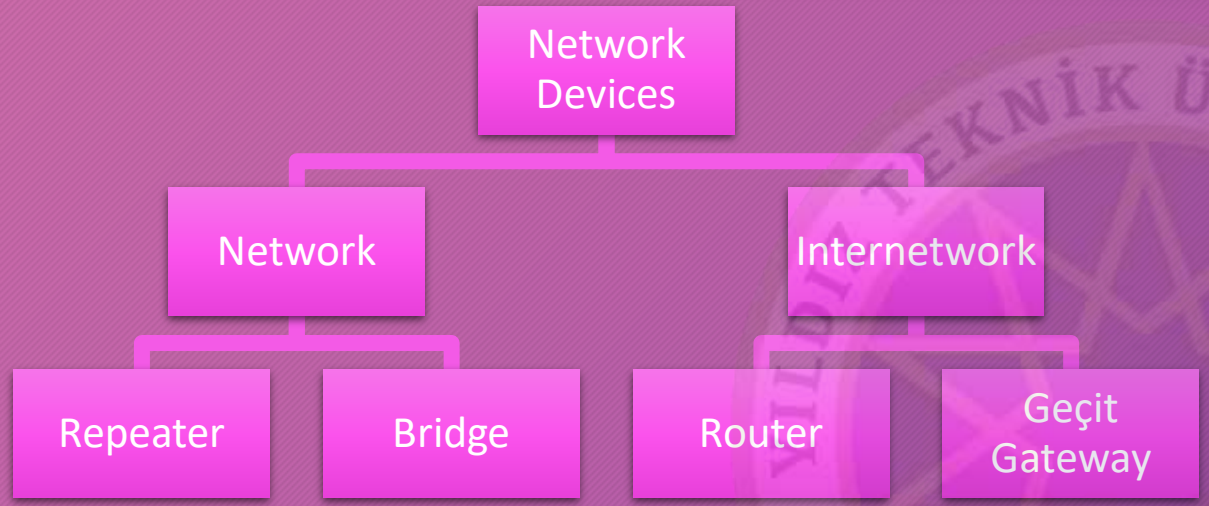
Comparison of General Features of Connection Oriented and Connectionless services

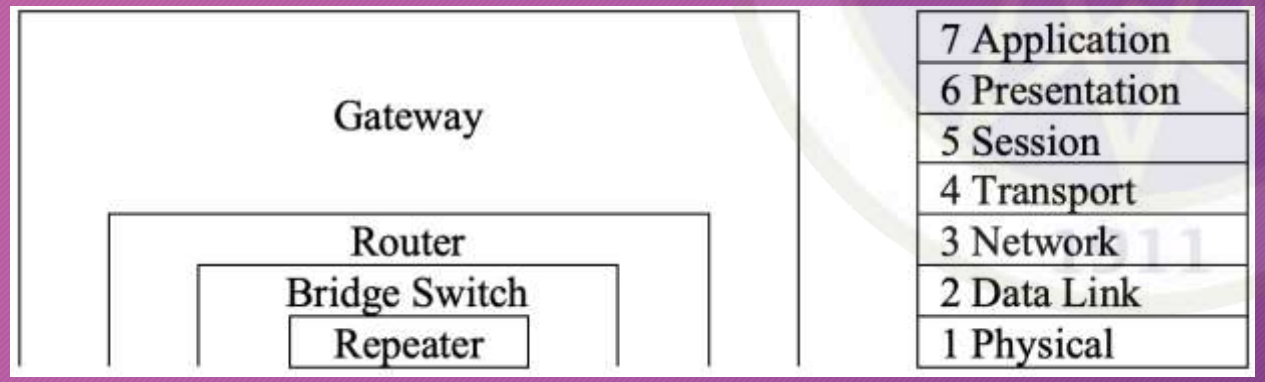
Datagram (Connectionless Services)	+	There is no connection phase.
	+	Provides fast transmission for a small number of packets.
	+	It is extremely simple.
	+	It reacts more quickly to changes/congestion on the line and is flexible.
	–	Receiver and sender addresses must be included on each package.
	–	Determining separate routes for each packet at intermediate nodes causes delay.
	–	There is no guarantee that the package order will be preserved.
Virtual Circuit (Connection Oriented Services)	+	The route is established before packets are sent.
	+	Instead of the receiver and sender addresses being written on each package, the apparent circuit address established beforehand (or during the first packet passage) is included.
	+	Once the virtual circuit is established, no routing is done at intermediate nodes.
	+	Physical lines are shared by multiple virtual circuits.
	+	In cases where two stations will be exchanging data for a long time, it provides superior performance with preservation of packet order (with sequence number), no routing decisions at each node, easy error control and retransmission. Quality of service (QoS) is high.
	–	It cannot adapt to subsequent changes/blockages on the network.
	–	If one of the nodes on the network becomes disabled, all external circuits passing through that node will be affected.

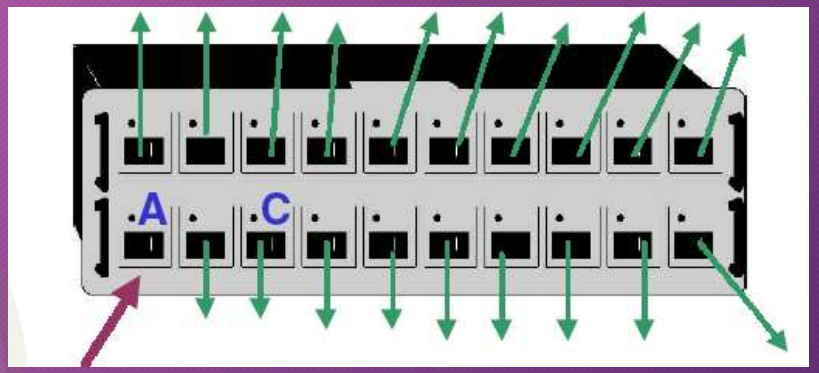
Comparison of Datagram / SVC / PVC

	Datagram	VC	
		SVC	PVC
Connection Establishment	No connection required	The connection is established during the first packet transmission.	The connection is established by the service provider.
Routing	It determines the route across nodes for each packet.	It determines the route once at the nodes during the first packet transit.	It follows the route originally determined by the service provider. No route is determined from any of the nodes.
Transporting of Address Information	Address information is carried in each package.	Address information is carried only in the first package. During the passage of the first packet, the route that will be valid during that transmission time is determined and the route is determined by the VCI value at each node. Following packets reach the destination using VCI information.	The route is determined by the service provider before the transmission begins and is determined by the VCI value. The VCI value does not change as long as the user receives service from the service provider. Accordingly, all packets are delivered to the recipient via the route determined by the VCI value.
Preservation of Packet Order	Packets reaches its recipient at different times via a different route, packet order cannot be preserved.	Each packet arrives at the receiver sequentially, using the VCI determined as the first packet passes when the connection is established.	Since each package is transferred through the VCI determined by the service provider, it reaches its recipient in a preserved order.
Adaptability	Since each packet is sent depending on the route determined by looking at the status of the relevant nodes at that moment, it immediately adapts to changing situations on the network.	Since the route is determined by the passage of the first packet, its ability to adapt to changing situations is limited, as a new route cannot be determined until the connection is terminated and re-established, even if there is a congestion/problem in the nodes on the specified route for subsequent packets.	Since the route is determined by the service provider before the transmission begins, it is not possible for it to adapt to changing situations on the line unless the service provider determines a new route.

Devices


Network Devices
Network
Internetwork
Repeater
Bridge
Router
Geçit Gateway


Gateway
Router
Bridge Switch
Repeater
7 Application
6 Presentation
5 Session
4 Transport
3 Network
2 Data Link
1 Physical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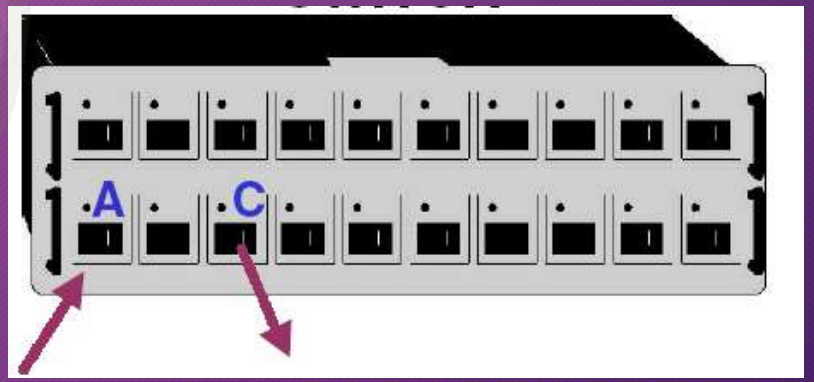
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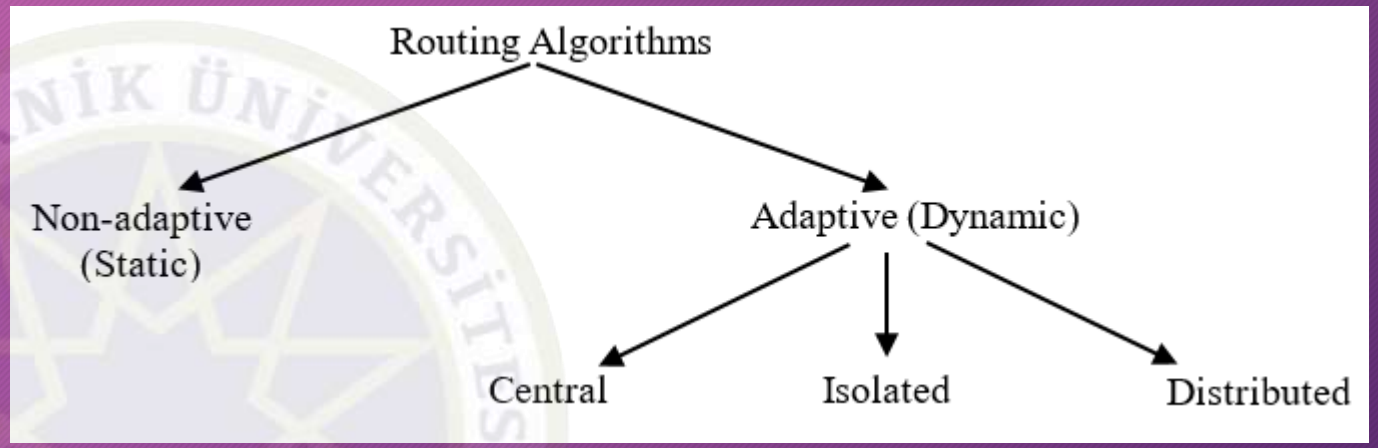
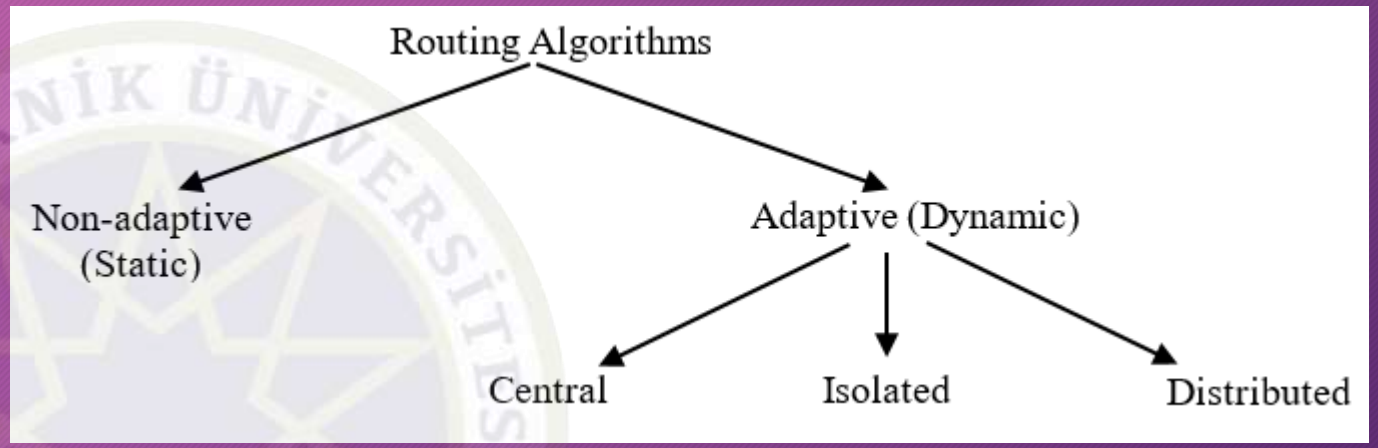
Network Layer – Routing Algorithms Static and Dynamic Routing

- Static Routing Algorithms
  - The route is decided according to the using topology.
- Dynamic Routing Algorithms
  - Monitoring network changing
  - It is possible to react very quickly even to instant changes.
  - Central DRA
    - Collection of data to a central station
    - It is used in networks where topology and traffic density do not change very frequently.



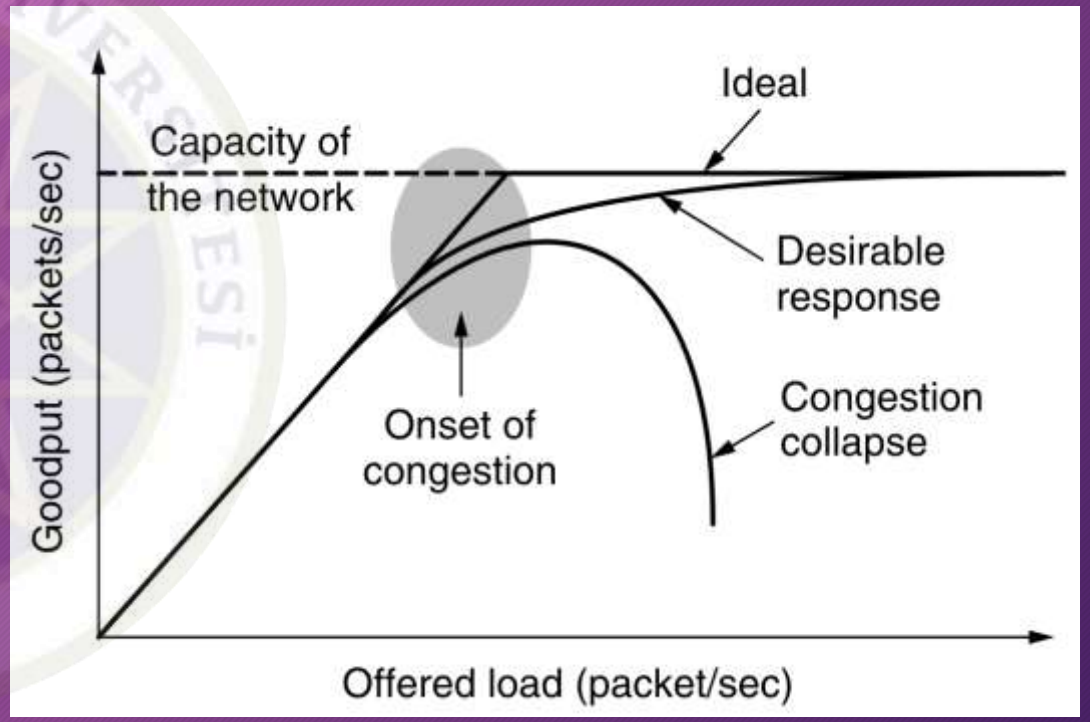
Network Layer – Routing Algorithms Static and Dynamic Routing (Con't)

- Dynamic Routing Algorithms
  - Isolated DRA
    - Not complicated as central DRA
    - Not create additional traffic on the network.
    - **Hot Patato**
    - **Backward Learning**
      - **Distance Vector Routing**
    - **Flooding**
  - Distributed DRA
    - Exchanging available information with neighbors
    - **Link State**



Congestion in the Network Layer, Its Causes and Solutions

- The network and transport layers share the responsibility for handling congestion
  - Congestion occurs within the network
- Routers' buffers
- The low bant traffic
- Congestion control and flow control relationship
- Approaches to Congestion Control
  - The presence of congestion means that the load is greater than the resources can handle.
  - Increase the resources
  - Decrease the load.



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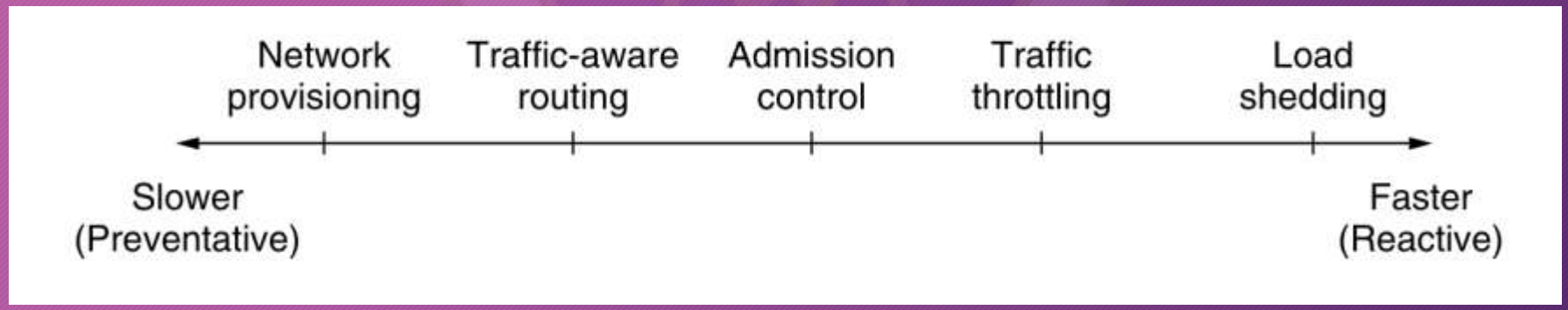
Congestion in the Network Layer, Its Causes and Solutions (Con't)

- Network Provisioning
- Traffic-Aware Routing
- Admission Control
- Traffic Throttling
  - **Choke Packet**
  - Explicit Congestion Notification
  - Hop-by-Hop Backpressure
- Load shedding



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Thank you for your listening.

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