



GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY

# Communication Networks

ET 3102

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👤 Classroom > Communication Networks - ET 3102

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# Outline

Overview on ISO/OSI reference model for open systems, packet and distributed systems and Topologies.

Physical and Data Link Layers.

Network (IP) and Transport Layers (TCP/UDP).

Session Layer, Presentation and Application Layer.

Local Area Network and Wide Area Networks.

# Overview on ISO/OSI reference model for open systems, packet and distributed systems and Topologies

# Goal

The goal of telecommunication architectures is to provide people (and machines) with telecommunication services.

# Telecommunication Services - Defined

- the transfer of information.
- In a telecommunication service at least three actors are usually involved:
  - one or more sources;
  - a carrier;
  - one or more receivers

Example:

- ✓ Email
- ✓ FTP
- ✓ Web access
- ✓ Video Conferencing
- ✓ DB access
- ✓ Client/server applications

# Practical 1

1. Type <Cmd> in the search box.
2. Open <Command Prompt>
3. Command: <netstat -a>

# Practical 1

Command Prompt - netstat -a

```
C:\Users\DELL>netsat -a
'netsat' is not recognized as an internal or external command,
operable program or batch file.
```

```
C:\Users\DELL>netsat -a
'netsat' is not recognized as an internal or external command,
operable program or batch file.
```

```
C:\Users\DELL>netstat -a
```

Active Connections

Proto	Local Address	Foreign Address	State
TCP	0.0.0.0:135	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:445	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:2343	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:5040	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:5357	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:6881	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:19575	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:19576	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:19577	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:49664	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:49665	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:49666	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:49667	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:49668	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:49669	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:59110	DESKTOP-NVM4B0B:0	LISTENING
TCP	0.0.0.0:59111	DESKTOP-NVM4B0B:0	LISTENING
TCP	127.0.0.1:5939	DESKTOP-NVM4B0B:0	LISTENING
TCP	127.0.0.1:49705	DESKTOP-NVM4B0B:0	LISTENING
TCP	127.0.0.1:49705	DESKTOP-NVM4B0B:50807	ESTABLISHED
TCP	127.0.0.1:49705	DESKTOP-NVM4B0B:53096	ESTABLISHED
TCP	127.0.0.1:49705	DESKTOP-NVM4B0B:53452	ESTABLISHED
TCP	127.0.0.1:49705	DESKTOP-NVM4B0B:53456	ESTABLISHED
TCP	127.0.0.1:49855	DESKTOP-NVM4B0B:49856	ESTABLISHED
TCP	127.0.0.1:49856	DESKTOP-NVM4B0B:49855	ESTABLISHED
TCP	127.0.0.1:49859	DESKTOP-NVM4B0B:49860	ESTABLISHED
TCP	127.0.0.1:49860	DESKTOP-NVM4B0B:49859	ESTABLISHED
TCP	127.0.0.1:53007	DESKTOP-NVM4B0B:53008	ESTABLISHED
TCP	127.0.0.1:53008	DESKTOP-NVM4B0B:53007	ESTABLISHED
TCP	127.0.0.1:53096	DESKTOP-NVM4B0B:49705	ESTABLISHED
TCP	127.0.0.1:53452	DESKTOP-NVM4B0B:49705	ESTABLISHED



# Telecommunication Services

# Taxonomies According to Different Criteria

- Symmetry
- Configuration
- Initialization
- Communication mode.

# Symmetry

- Unidirectional Services
- Bidirectional Asymmetric Services
- Bidirectional Symmetric Services

Example:

- ✓ TV broadcasting
- ✓ Web browsing
- ✓ Telephone conversation

# Configuration

- Point-to-point services
- Multi-point services
- Broadcast Services

# Initialization

- Call-based services
- Reservation-based services
- Permanent-mode services.

# Communication mode

- Synchronous services
  - Session appears as a continuous stream of traffic,
  - Usually requires fixed and limited delays.
  - e.g, voice.
- Asynchronous services.
  - Session appears as a sequence of messages,
  - Typically bursty.
  - e.g., interactive sessions, file transfers, email.

# Communication Mode

- Connection oriented services,
  - Long sustained session
  - Orderly and timely delivery of packets
  - e.g., Telnet, FTP
- Connectionless services.
  - One time transaction
  - e.g., email

# Communication facilitation

- Interactive services
- Broadcast services.



# Interactive services

- Conversational services
- Messaging services
- Information retrieval services.

# Broadcast services

- Without session control
- With session control.

# Taxonomies of Information Sources

- Constant bit rate (CBR) - e.g., ITU G.711 standard
- Variable bit rate (VBR). - - e.g., ITU G.718 standard

# Practical 2

- Browse following URLs for more information on constant and variable bit rate standards:
  - <https://www.itu.int/rec/T-REC-G.711/en>
  - <https://www.itu.int/rec/T-REC-G.718/en>

# Telecommunication Networks

# Practical 3

The screenshot displays the Windows Defender Firewall with Advanced Security interface. The left pane shows the tree view with 'Inbound Rules' selected. The right pane shows a list of existing rules, including 'AnyDesk', 'CDA Server', 'CDAREcovery', 'ChemDraw', 'EasyPrinterManagerV2', 'EPM2AlertList', 'EPM2Migrator', 'EPM2OrderSupply', 'Firefox', 'Format Factory', 'HP ColorLaserJet M153-M1', 'HP Device Setup (HP Color)', 'HP Network Communicato', 'MathWorks Update Installer', and 'MathWorks Update Installer'. A 'New Inbound Rule Wizard' dialog box is open, showing the 'Name' step. The 'Name' field is empty, and the 'Description (optional)' field is also empty. The 'Steps' list on the left of the wizard includes 'Rule Type', 'Protocol and Ports', 'Action', 'Profile', and 'Name', with 'Name' currently selected. The 'Finish' button is highlighted in blue.

Windows Defender Firewall with Advanced Security

File Action View Help

Windows Defender Firewall with Advanced Security on Local Computer

File Action View Help

Windows Defender Firewall with Advanced Security

File Action View Help

Inbound Rules

Name

- AnyDesk
- AnyDesk
- AnyDesk
- AnyDesk
- AnyDesk
- AnyDesk
- CDA Server
- CDA Server
- CDA Server
- CDAREcovery
- ChemDraw
- ChemDraw
- EasyPrinterManagerV2
- EPM2AlertList
- EPM2Migrator
- EPM2OrderSupply
- Firefox
- Firefox
- Firefox (C:\Program Files (x86)\Mozilla Firefox\firefox.exe)
- Firefox (C:\Program Files (x86)\Mozilla Firefox\firefox.exe)
- Format Factory
- HP ColorLaserJet M153-M1
- HP Device Setup (HP ColorLaserJet M153-M1)
- HP Network Communicato
- MathWorks Update Installer
- MathWorks Update Installer

New Inbound Rule Wizard

Name

Specify the name and description of this rule.

Steps:

- Rule Type
- Protocol and Ports
- Action
- Profile
- Name

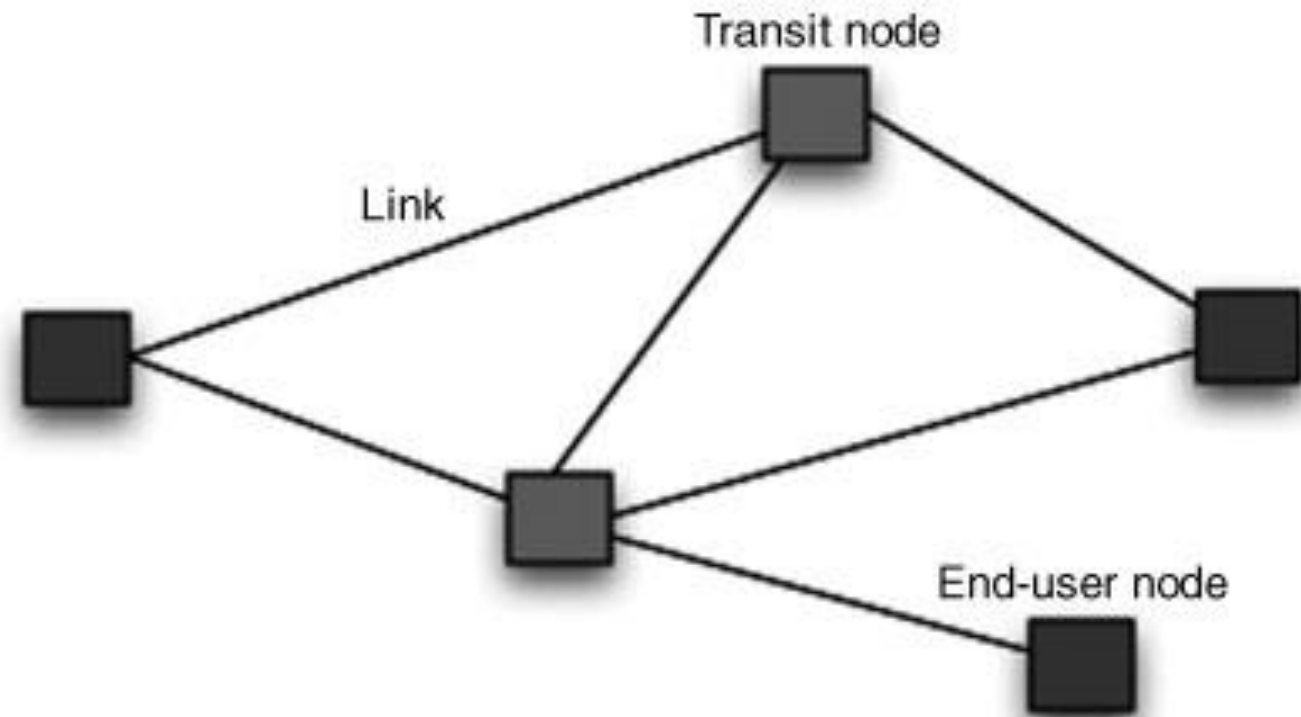
Name:

Description (optional):

< Back Finish Cancel

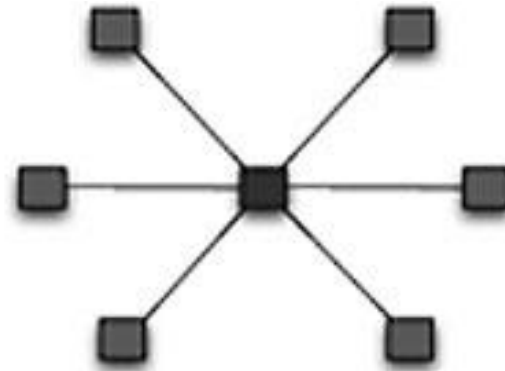
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# Introduction

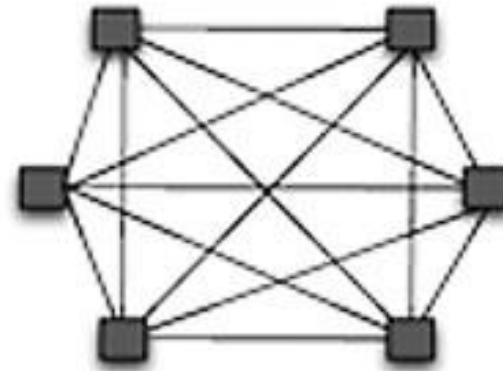


A generic network.

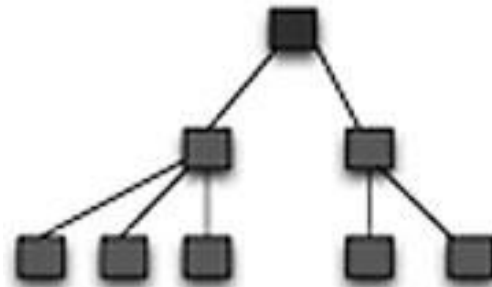
# Network Topologies



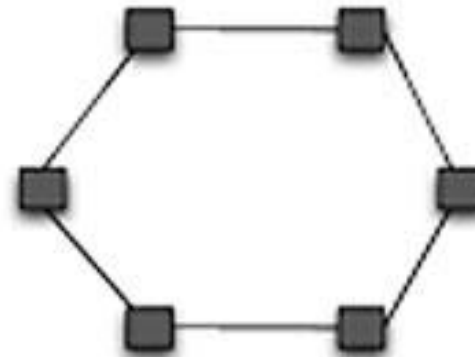
(a) Star



(b) Mesh



(a) Tree



(a) Ring

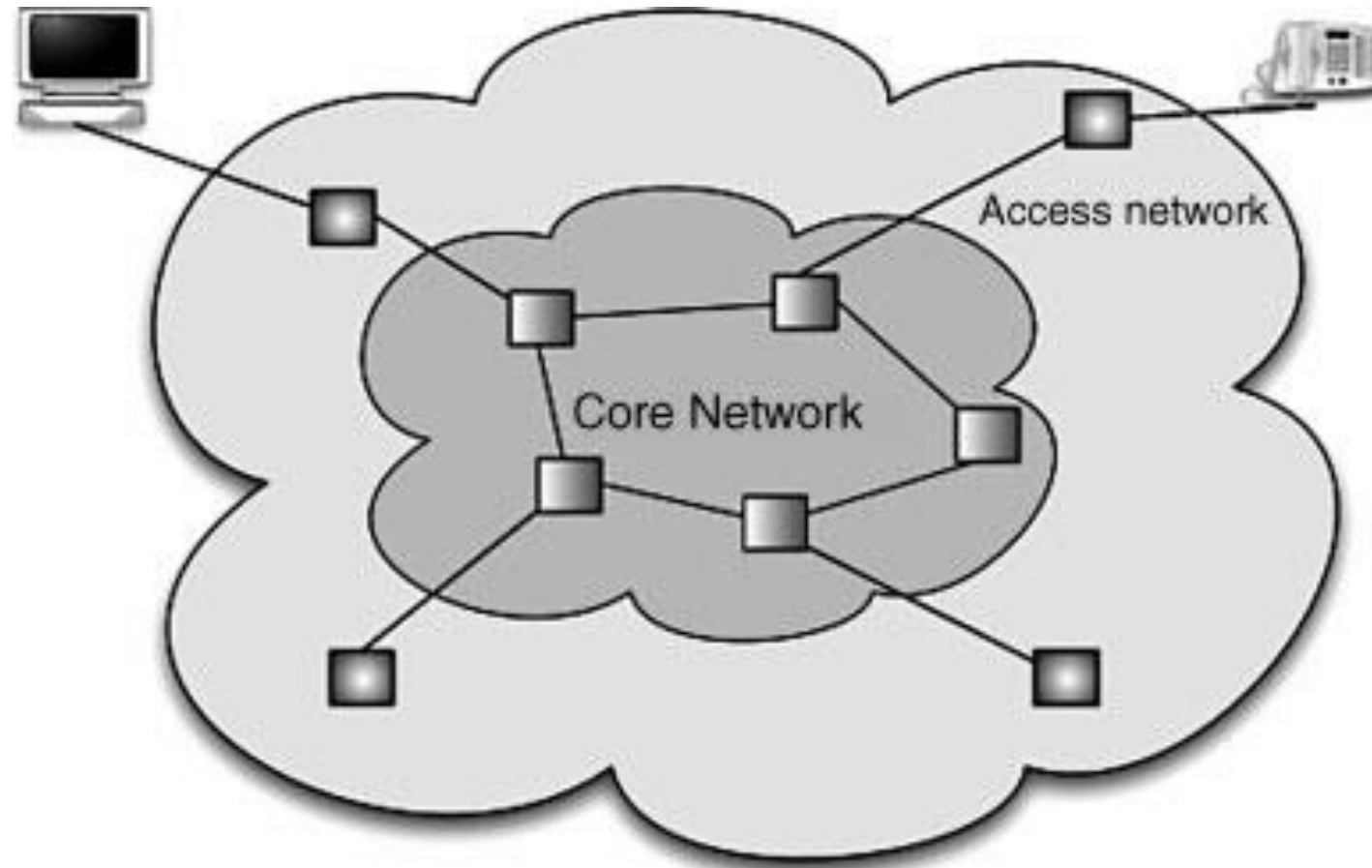


(a) Bus

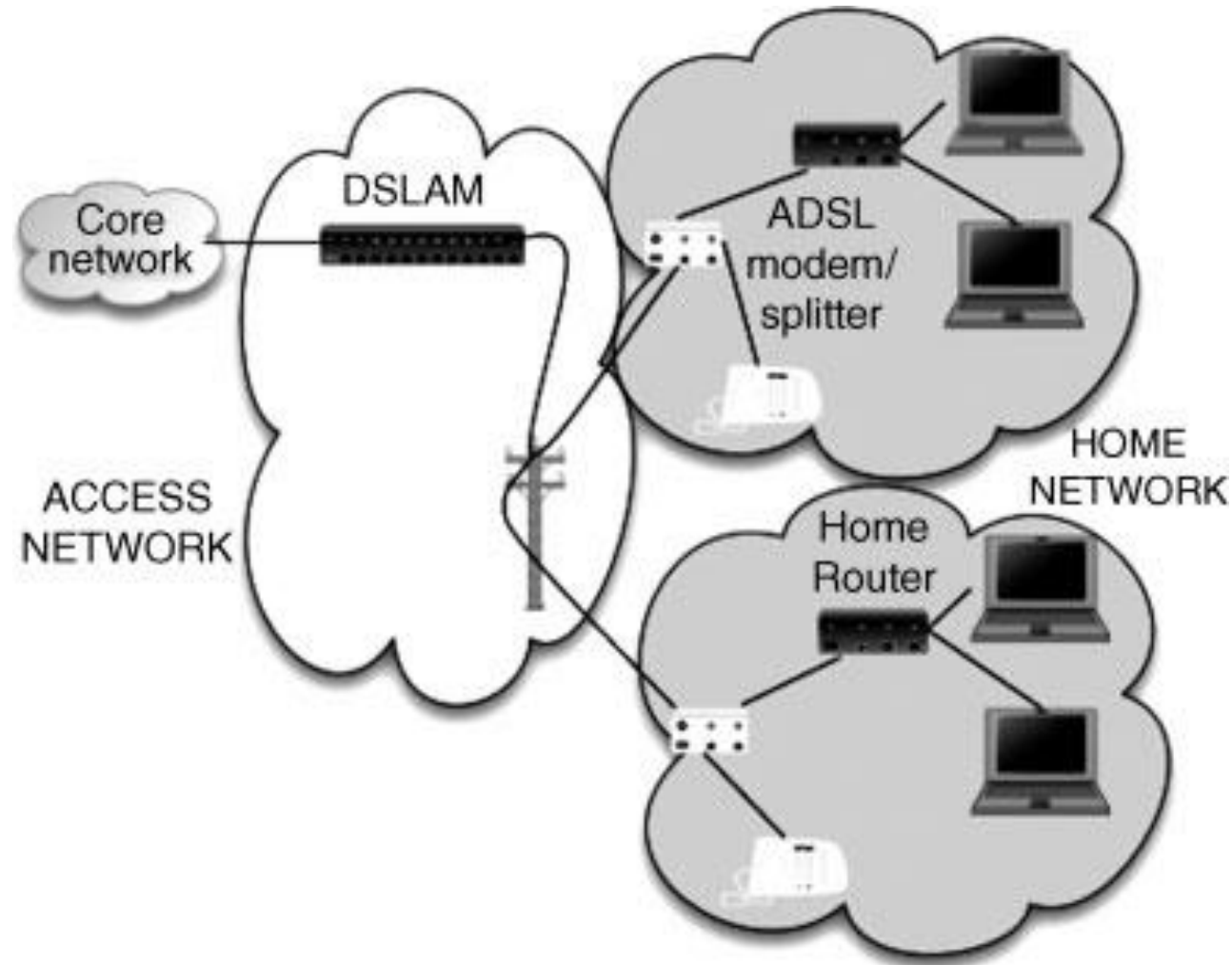
k.



# Access Network and Core Network

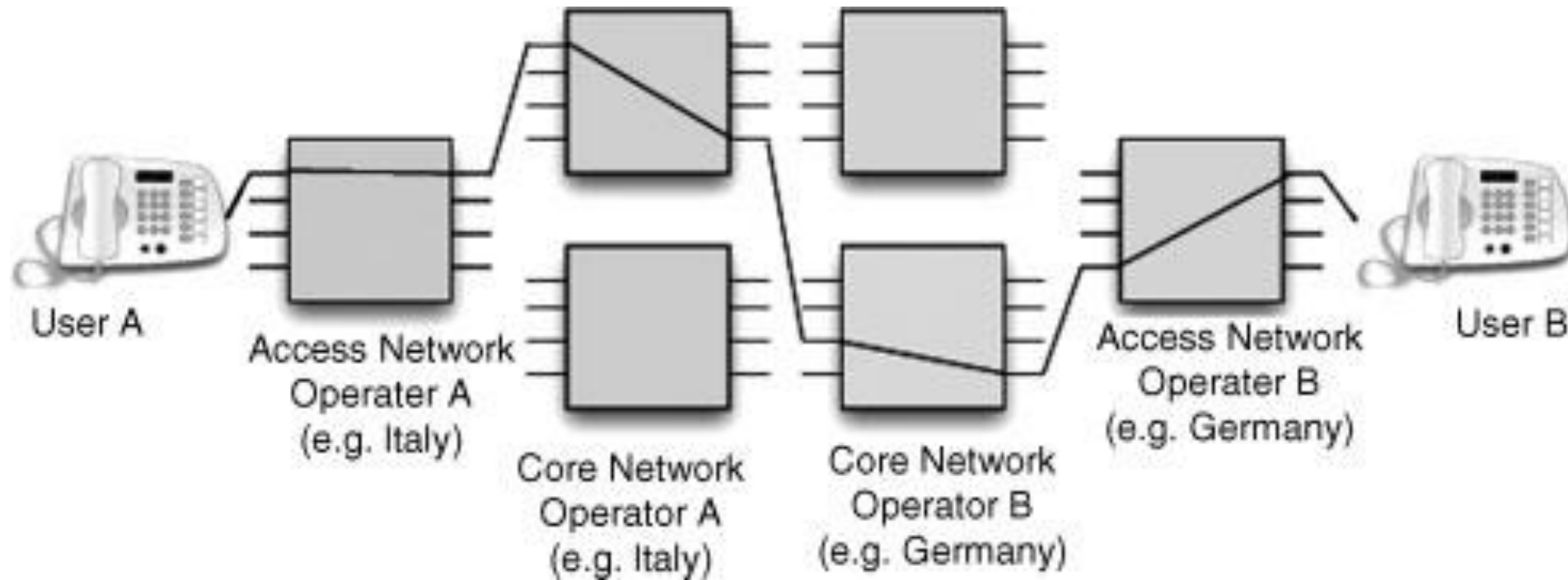


# Access Network and Core Network – ADSL Service



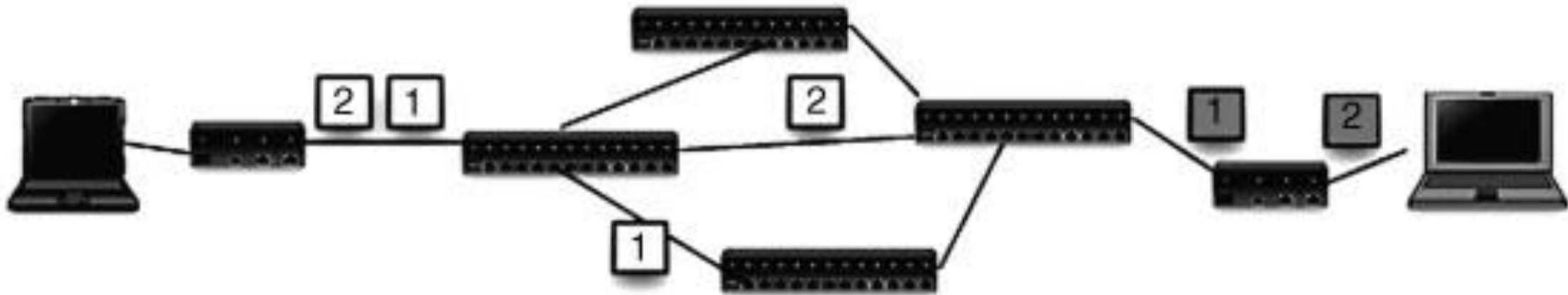
# Switching Modes

# Circuit-Switched Communication Mode



- Dedicated resources, Fixed path, if capacity is used calls are blocked.
- Advantages: Fixed delays, guaranteed continuous delivery
- Disadvantages: Circuits are not used when session is idle, Inefficient, uneconomic for bursty traffic, typically fixed rate: e.g., 64 kbps, if require call set up and setup time is longer than messages, hence not economical.

# Packet-Switched Communication Mode



- Datagram packet switching - connectionless
  - Routed on packet-by-packet basis, different packets follow different routes,
  - packets may arrive out of order at destination
  - e.g., IP protocol
- Virtual circuit packet switching – connection oriented
  - All packets associated with a session follow same path.
  - Route is chosen at the start of the session.
  - packets are labeled with a VC# designating the route.
  - need unique source and destination address.
  - e.g., ATM

## Advantages:

- Efficient for bursty data.
- Bandwidth on demand with variable rates.

## Disadvantages

- Variable delays.
- Difficult to provide QoS assurance.
- Packets can arrive out of order.

# Practical 4

```
Command Prompt
Microsoft Windows [Version 10.0.19045.3803]
(c) Microsoft Corporation. All rights reserved.

C:\Users\DELL>python
Python 3.10.11 (tags/v3.10.11:7d4cc5a, Apr  5 2023, 00:38:17) [MSC v.1929 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>> import socket
>>> tcp_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
>>> udp_socket = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
>>> exit()

C:\Users\DELL>
```

To create a TCP socket using IPv4, you would call: `socket.socket()` function as follows:  
`tcp_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)`

To close a socket:

`tcp_socket.close()`

To create a UDP socket using IPv4, you would use the following code:  
`udp_socket = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)`

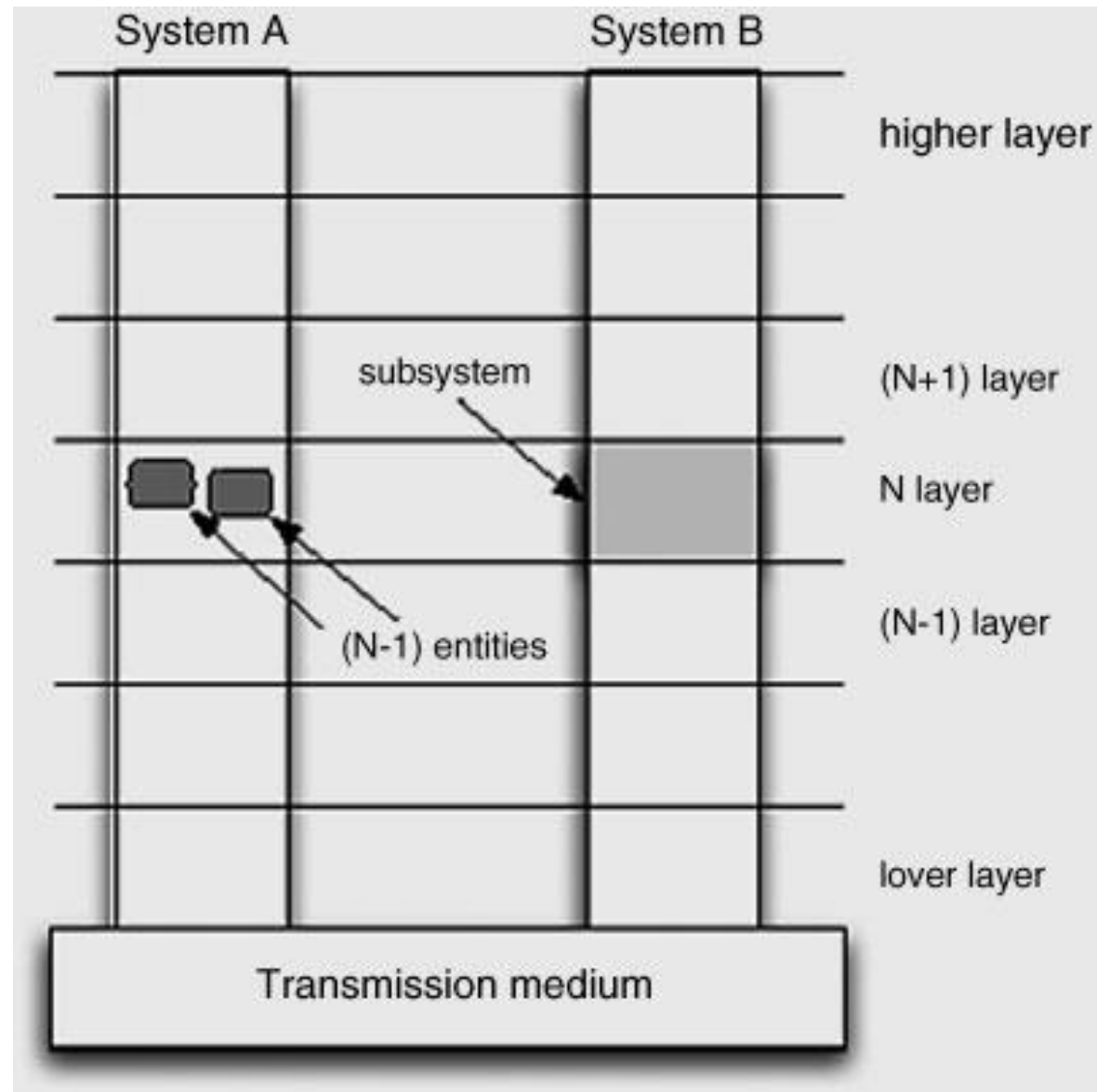
# The ISO/OSI Model

# Protocol

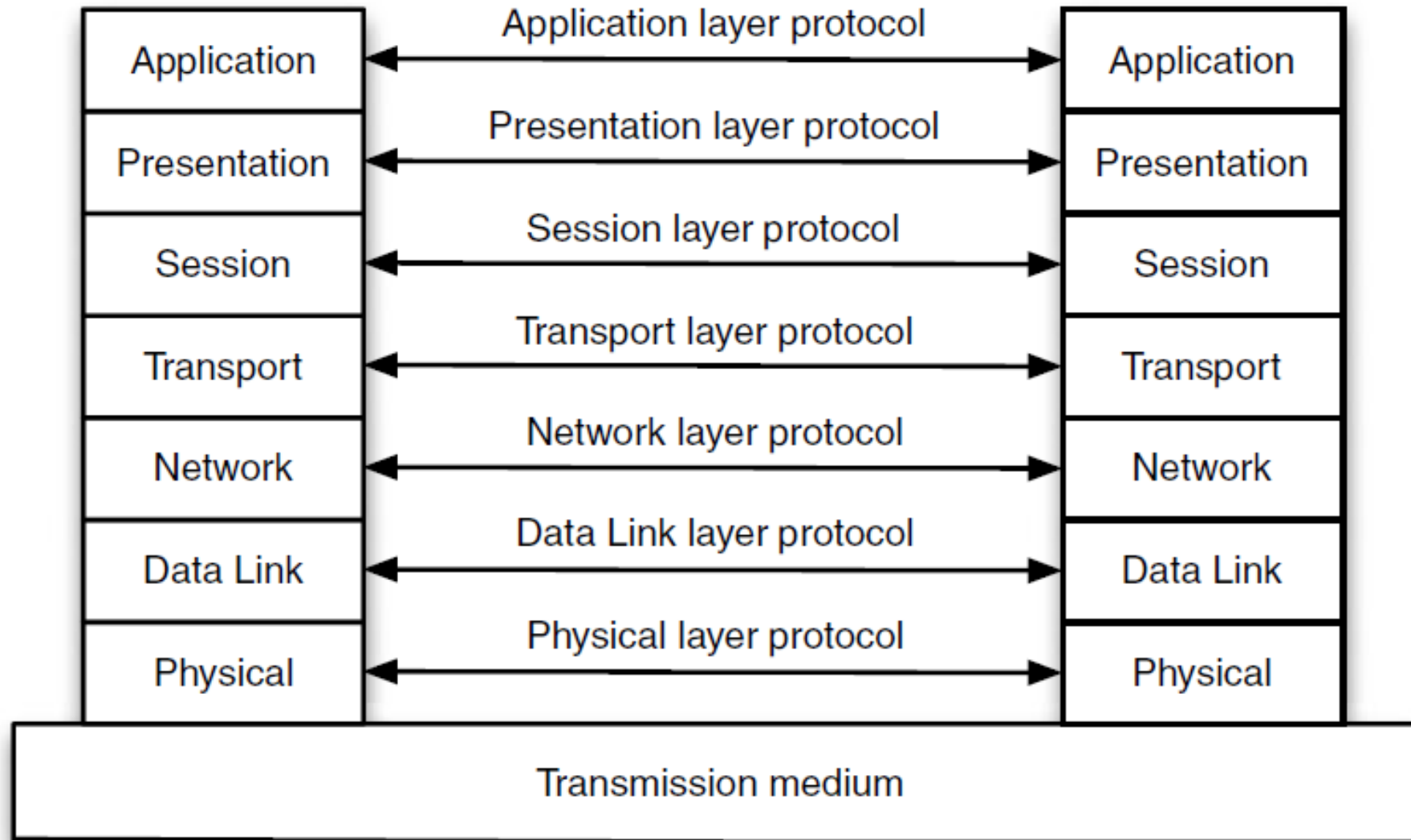
- First we introduce the notion of protocol as a set of rules defining telecommunication systems interact.
- To reduce the unavoidable confusion that could be generated by describing protocols without any guideline, a kind of template has been defined to enable :
  - a consistent definition of different protocols;
  - an easier comparison between them; and
  - a translation of one protocol into another, through a suitable conversion.



# The Layered Model



# The ISO/OSI Model



# Signaling

# Signaling

- The communication between two end-points involves two *planes*:
  - a *user* plane and
  - a *control* plane.

# Signaling

The control flow of information is called signaling.

Control plane protocols are called signaling protocols.

A coordinated set of signaling protocols and entities is called a signaling system.

# References

1. Nevio Benvenuto and Michele Zorzi, (2011). Principles of Communications Networks and Systems, John Wiley.
2. Thomas Robertazzi, (2011). Basics of Computer Networking (Springer Briefs in Electrical and Computer Engineering), Springer



# Exercise One



