# NETWORK PROTOCOLS

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# INTRODUCTION TO **NETWORKING** AND **PROTOCOLS**

**LECTURE 1** PART A

*2204 - 2025*

**16 SEPTEMBER**

# Outline

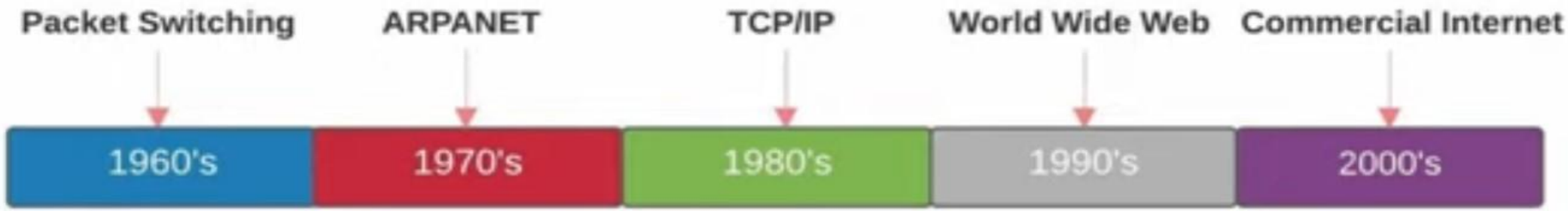
**This lecture will talk about:**

- **Foundations of Networking**
  - Network History
  - Definition of NETWORK
  - Basic networking concepts.
  - Types of Networks.
  - Layered Network Models
  - Addressing
- **Foundations of Network Protocols**
  - Definition of (PROTOCOLS)

# Network History

## The History of Computer Networking

- Packet Switching
- ARPANET
- World Wide Web
- Commercial Internet



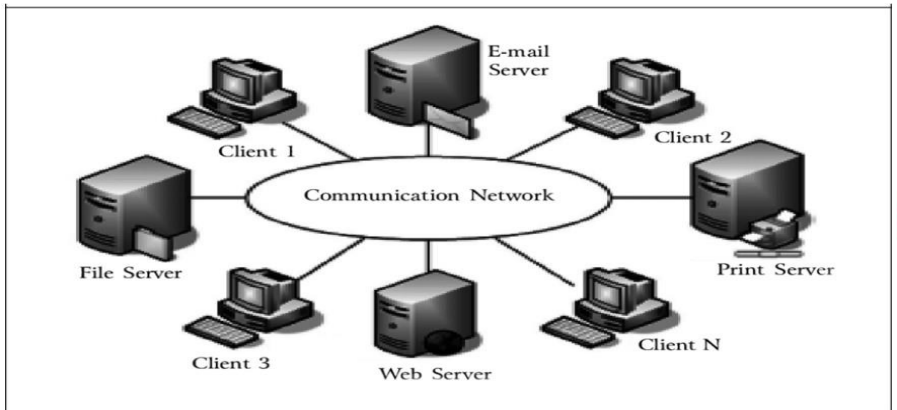
# Definition of NETWORK

## a computer network can be defined as

"Two or more **computers connected** by some means through which they are capable of **sharing information**"

**Ref.:** Donahue, G. A. (2007). Network warrior. " O'Reilly Media, Inc.".

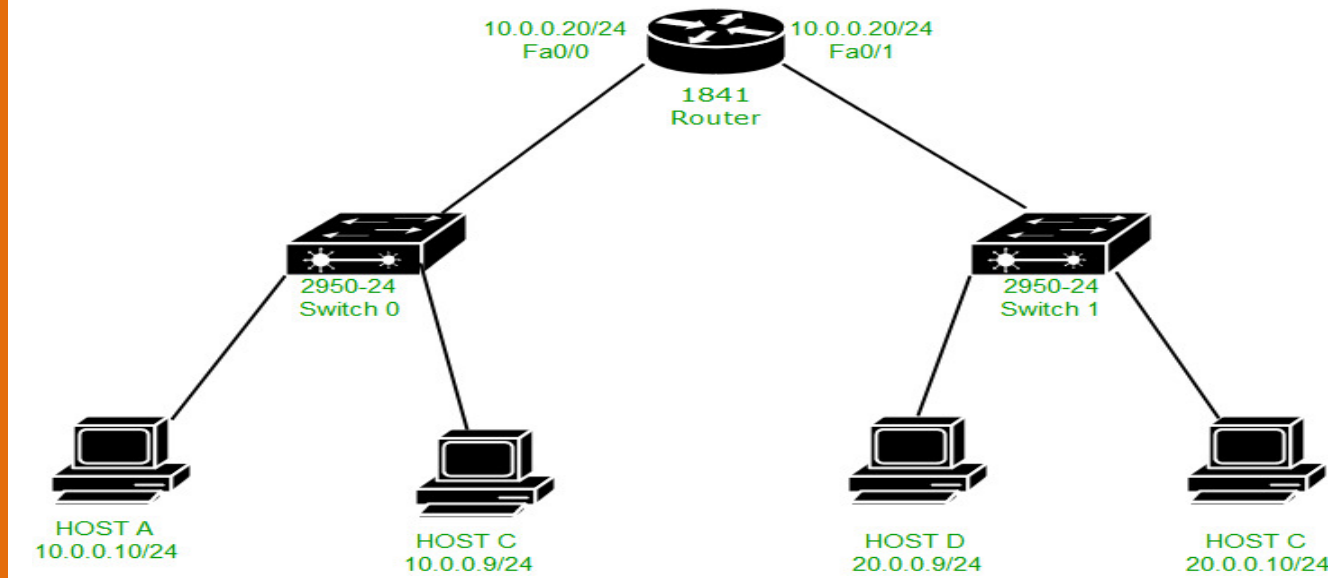
✓ "جهازان أو أكثر من أجهزة الكمبيوتر **متصلان** ببعض الوسائل التي تمكنهما من **مشاركة المعلومات**"

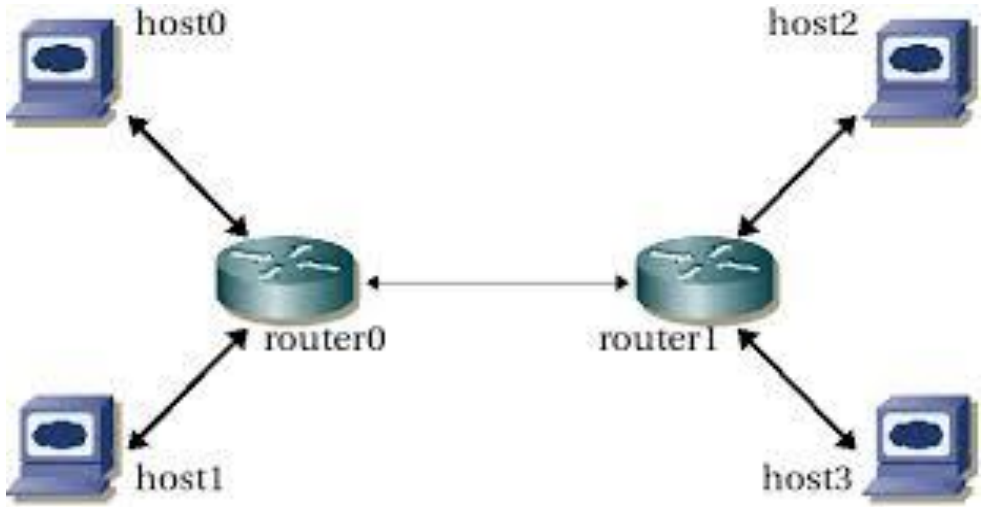



# Basic networking concepts

- Typically, networking refers to the **linking of computers and communication network devices** (also referred to as **hosts**), which **interconnect** through a **network** and are separated by **unique device identifiers**.

**المضيف host:** هو أي جهاز لديه القدرة على السماح بالوصول إلى الشبكة عبر واجهة مستخدم أو برنامج متخصص أو عنوان شبكة أو مجموعة بروتوكولات أو أي وسيلة أخرى.



# Basic networking concepts

- **Host:** can be any **computer or device** that provides resources, services, or data to other devices on a network.

✓ يمكن أن يكون المضيف أي كمبيوتر أو جهاز يوفر الموارد أو الخدمات أو البيانات لأجهزة أخرى على الشبكة.

***Examples of Hosts:***

1) **Computer:** Desktops, laptops, and workstations that users interact with.
2) **Servers**: Powerful machines that manage network resources and services (e.g., web servers, file servers).
3) **Network Devices:** Printers, routers, and switches that can be assigned an IP address and participate in network communication.

# Basic networking concepts

- **Client:** A client is any **device or software** application that accesses a service made available by a server. It initiates requests and utilizes the resources or services provided by the server.

✓ **العميل هو أي جهاز أو تطبيق برمجي يصل إلى خدمة يوفرها الخادم. فهو يبدأ الطلبات ويستخدم الموارد أو الخدمات التي يوفرها الخادم.**

# Basic networking concepts

## *Difference Between Client and Host*

### *1. Scope:*

***Host:*** *A broader term that refers to any device connected to a network, including clients, servers, routers, and other network devices.*

***Client:*** *A specific type of host that initiates requests to access services provided by servers.*

### *2. Functionality:*

**Host:** Can function as a client, server, or both, depending on its role in the network.

**Client:** Primarily focuses on requesting and consuming services from servers.

### *3. Examples:*

**Host:** A laptop, server, printer, or router.

**Client:** A web browser (like Chrome or Firefox) or an email application (like Outlook) that requests data from a web or email server.

# Basic networking concepts

## ❑ Switches:

**Definition:** Network devices that **connect multiple devices within a LAN**.

**Function:** **Directs data packets** to the **correct destination** within the **same network**, reducing traffic and increasing efficiency.

## ❑ Routers:

**Definition:** Devices that **connect <u>different</u> networks and route data between them**.

**Function:** Determines the best path for data packets to travel, enabling communication between different networks (e.g., **connecting a LAN to the internet**).

# Types of Networks

- **Computer networks** are **classified** according to various parameters:

1) Type of **connection**.
2) physical **topology**. الطريقة التي تترابط بها الأجزاء المكونة أو يتم ترتيبها
3) Network **reachability** (reach of the network).

- These classifications are **helpful** in **deciding** the **requirements of a network setup** and **provide insights** توفر رؤى into the **appropriate selection of a network type** for the setup.

# Types of Networks

1) Based on **connection** types,

- Depending on the **way** a host **communicates** with other hosts, computer networks are of two types.

I. Point-to-point:

II. Point-to-multipoint:

# Types of Networks

1) Based on **connection** types,

- Depending on the **way** a host **communicates** with other hosts, computer networks are of two types.

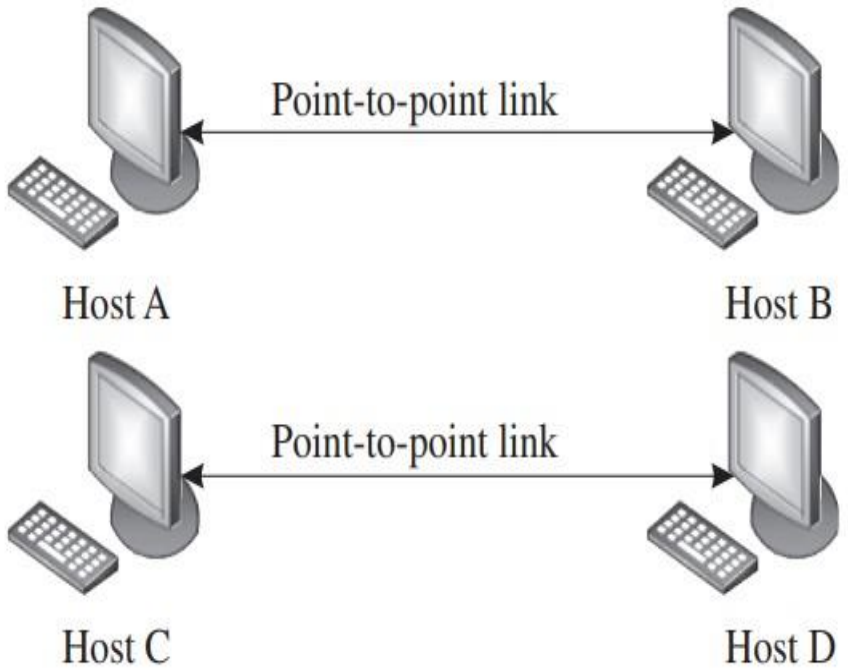
I. Point-to-point:

II. Point-to-multipoint:

# Types of Networks

## I. Point-to-point:

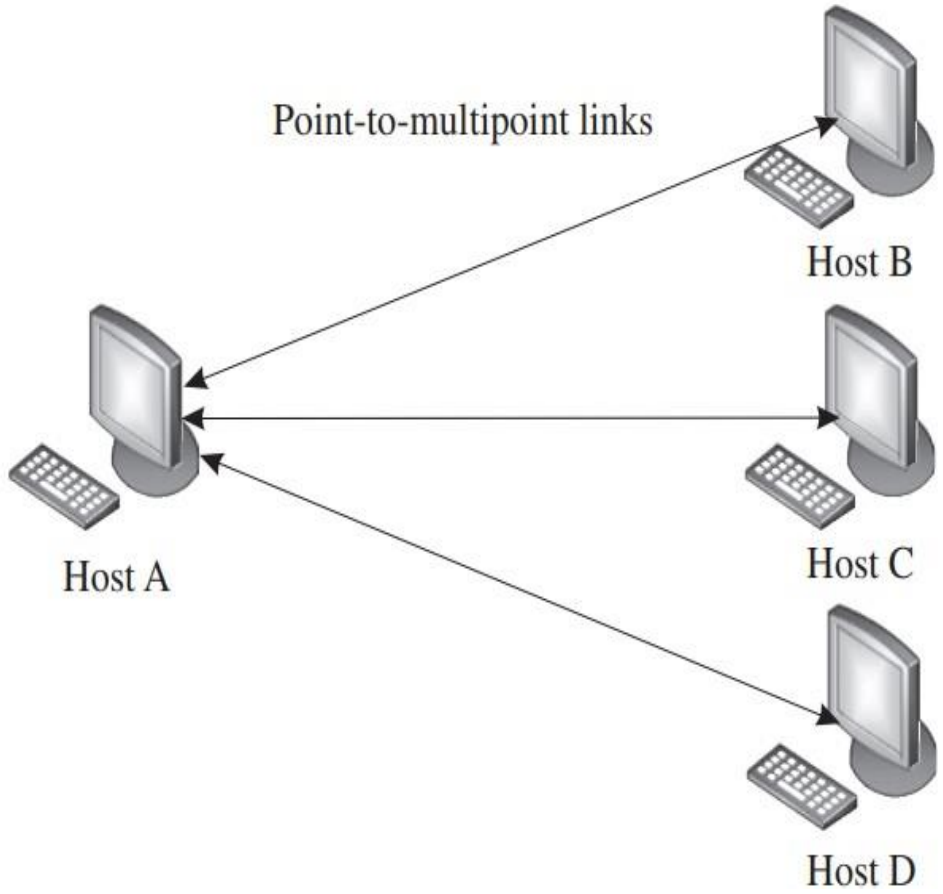
- Point-to-point connections are used to **establish direct connections** between two hosts.
- remote control for an air conditioner or television is a point-to-point connection.
- Regarding **computer networks**, point-to-point connections find usage for **specific purposes**.



# Types of Networks

## II. Point-to-multipoint:

- In a point-to-multipoint connection, **more than two hosts share the same link**.
- Point-to-multipoint connections find popular use in **wireless networks**.



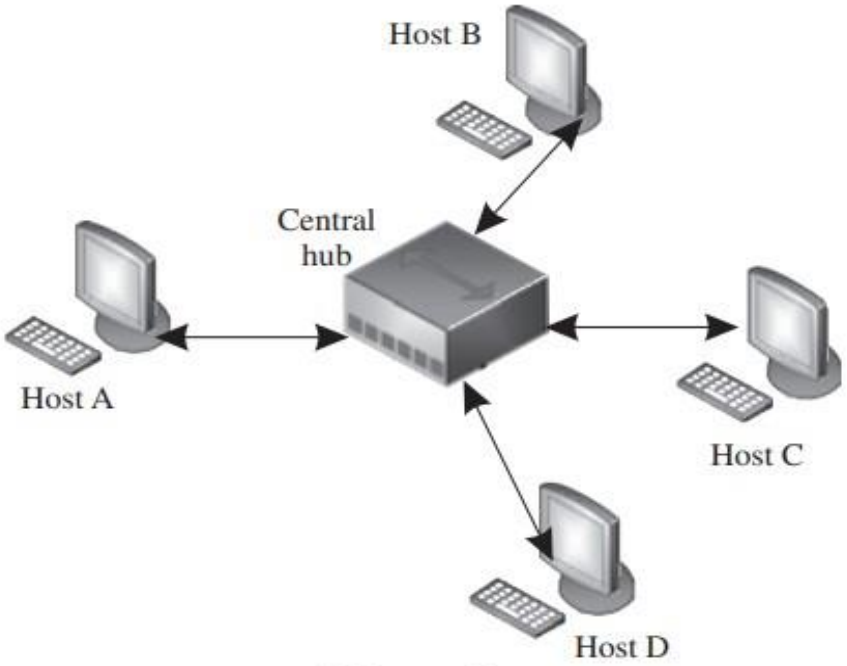
# Types of Networks

2) Based on physical topology

I. **Star:**

In a star topology, every host has a **point-to-point** link to a central controller or hub.

- The **hub** acts as the network traffic exchange.
- This topology is cheaper and easier to set up.
- Main disadvantage of this topology is the danger of a single point of failure. If the hub fails, the whole network fails.



(a) Star topology

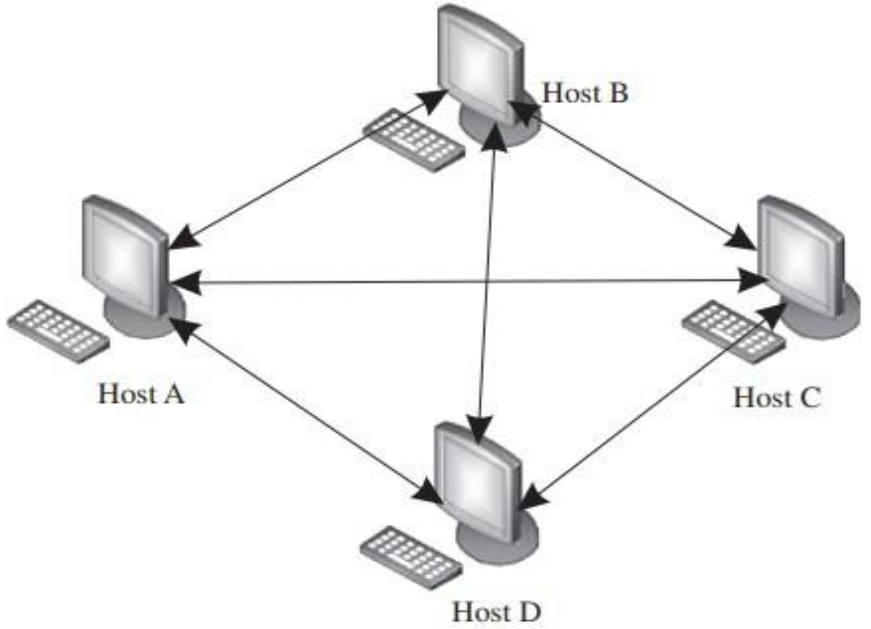
# Types of Networks

2) Based on physical topology

## II. Mesh:

In a mesh topology, every host is connected to every other host using a dedicated link رابط مخصص (in a **point-to-point** manner).

- There are a total of $n(n-1)/2$ dedicated full duplex links between the hosts.
- This massive ضخم - هائل number of links makes the mesh topology expensive.



(b) Mesh topology

# Types of Networks

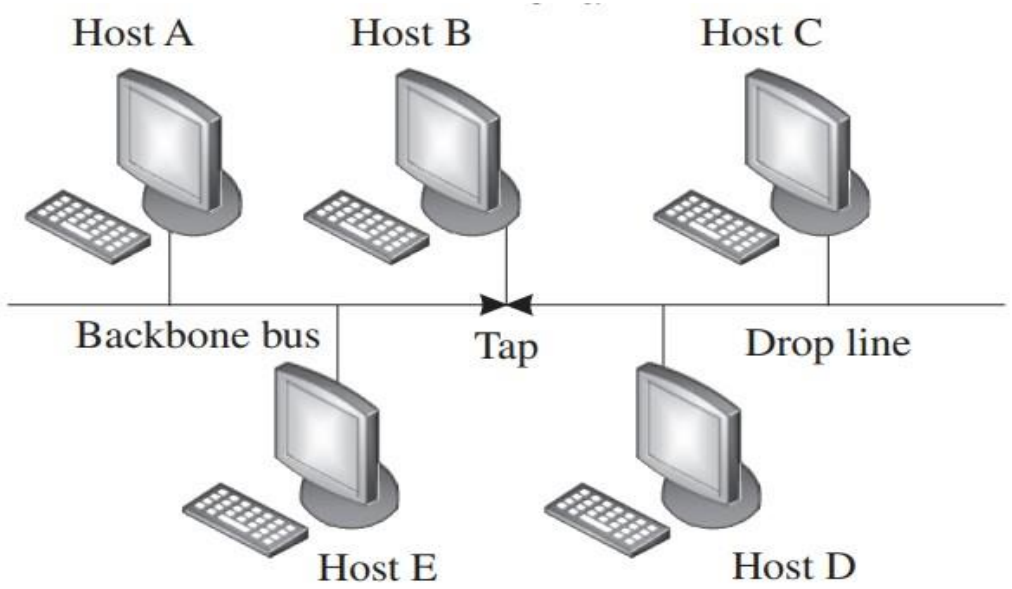
## 2) Based on physical topology

### III. Bus:

A bus topology follows the point-to-multipoint connection.

- **Backbone cable** or **bus serves** as the **primary** traffic **pathway** between the hosts.
- Restriction تحديد - تقييد on the length of the bus and the number of hosts that can be simultaneously connected.
- Advantage: ease of installation and cheap.
- Disadvantage: difficulty in fault localization within the network.

صعوبة تحديد موقع الخطأ داخل الشبكة.




(c) Bus topology

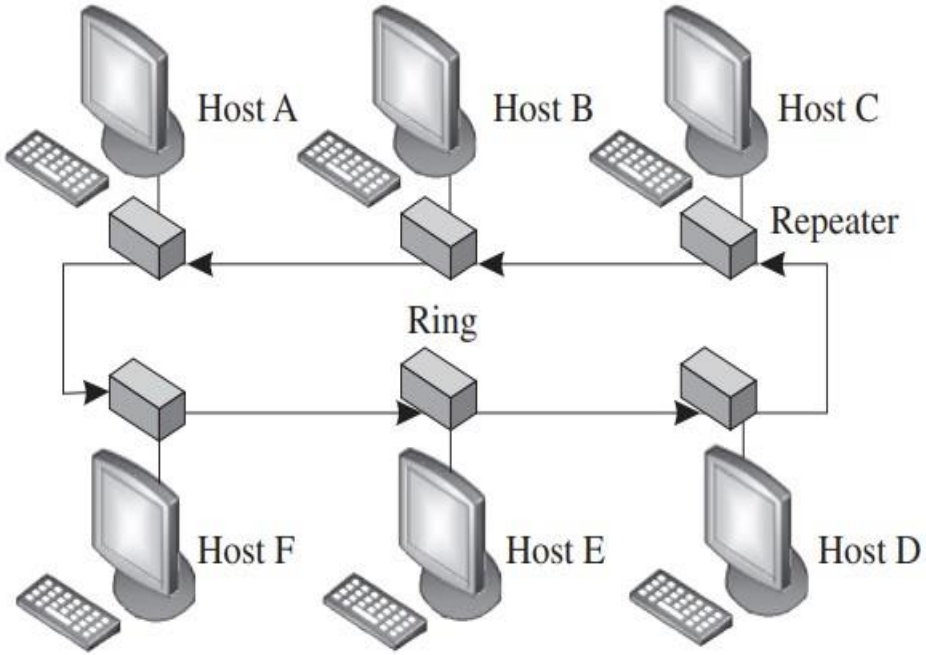
# Types of Networks

2) Based on physical topology

**IV. Ring**:

works on the principle of a connection.

- **Repeaters** will be used on either side of the hosts.
- The **repetition** of this system forms a **ring**.
- repeater **captures**, regenerate and **passes** to the next one.



# Types of Networks

## In Summary: Network topologies

**Table 1.1** Network topology comparison

| Topology | Feature | Advantage | Disadvantage |
|---|---|---|---|
| Star | Point-to-point | Cheap; ease of installation; ease of fault identification | Single point of failure; traffic visible to network entities |
| Mesh | Point-to-point | Resilient against single point of failures; scalable; traffic privacy and security ensured | Costly; complex connections |
| Bus | Point-to-multipoint | Ease of installation; cheap | Length of backbone cable limited; number of hosts limited; hard to localize faults |
| Ring | Point-to-point | Ease of installation; cheap; ease of fault identification | Prone to single point of failure |

# Types of Networks

3) Based on Network reachability.

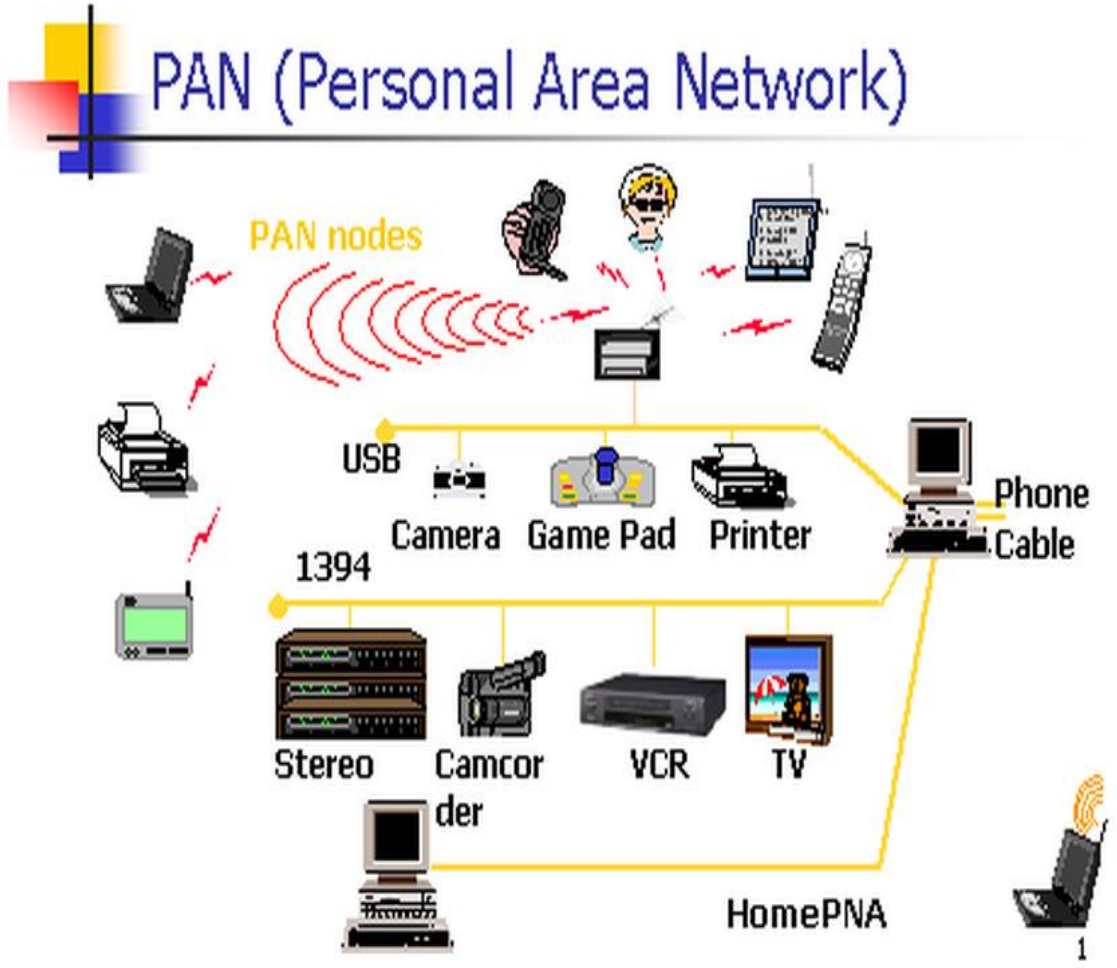
- Computer networks are divided into **four** broad categories based on network reachability:

I. personal area networks (PAN).
II. local area networks (LAN).
III. metropolitan area networks (MAN).
IV. wide area networks (WAN).

# Types of Networks

3) Based on Network reachability.

I. personal area networks (PAN).




- Mostly restricted to **individual usage**.
  يقتصر في الغالب على الاستخدام الفردي.
- A good **example** of PANs may be connected wireless headphones, wireless speakers, laptops, smartphones, wireless keyboards, wireless mouse, and printers within a house.
- **reachability** of PANs lies in the range of a **few centimeters to a few meters**.

# Types of Networks

3) Based on Network reachability.

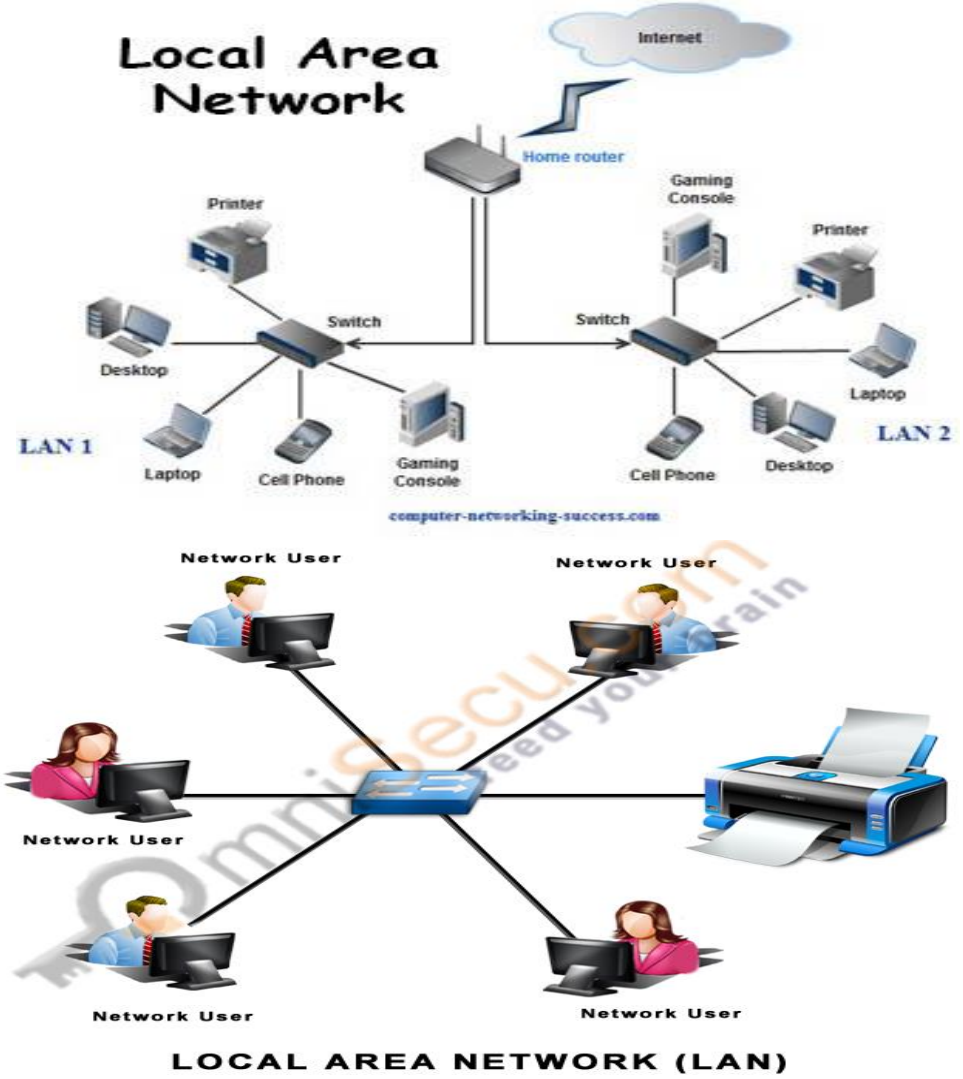
II. local area networks (LAN).

- A LAN is a **collection of hosts linked to a single network** through wired or wireless connections.

الشبكة المحلية هي مجموعة من المضيفين المرتبطين بشبكة واحدة من خلال اتصالات سلكية أو لاسلكية.

- LANs are restricted to **buildings**, **organizations**, or **campuses**.

تقتصر الشبكات المحلية على المباني أو المؤسسات أو الحرم الجامعي.



# Types of Networks

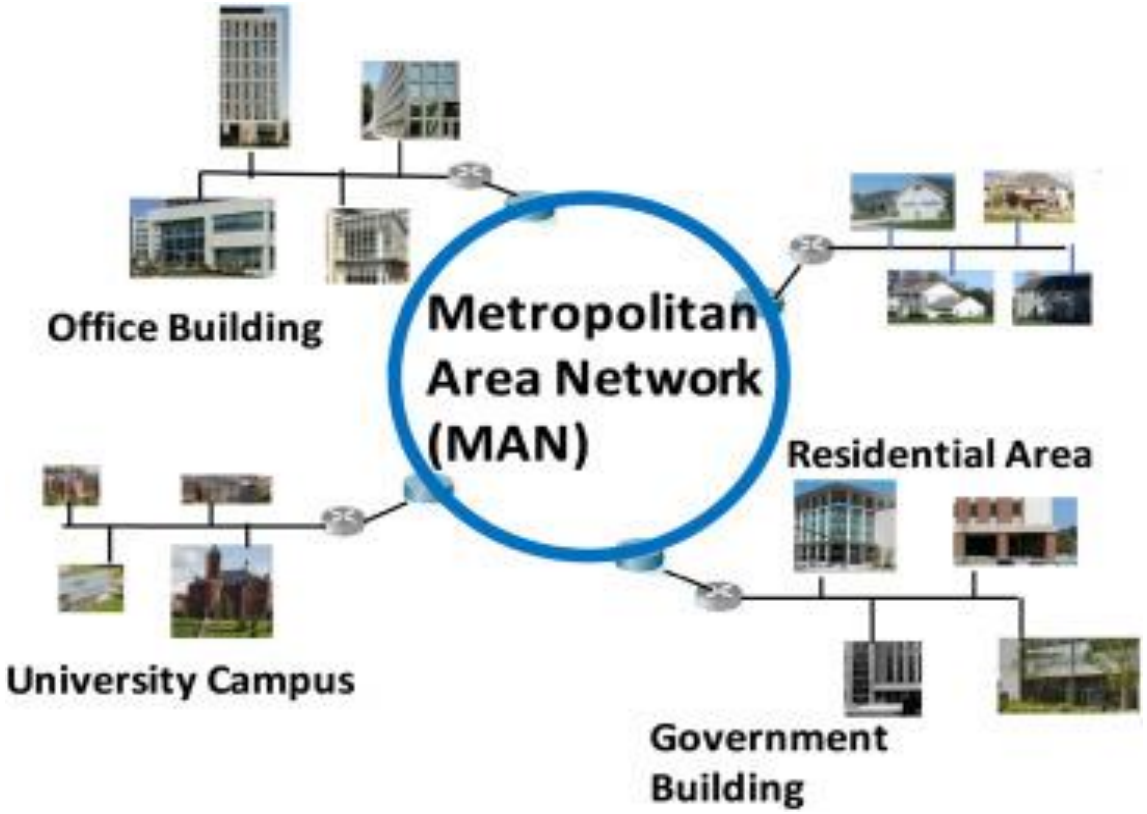
3) Based on Network reachability.

III. Metropolitan المدن الكبرى area networks (MAN).

- The reachability of a MAN lies **between** that of a **LAN and a WAN**.
- Typically, MANs connect **various organizations** or **buildings** within a given geographic location or **city**.

عادةً، تربط شبكات MAN بين العديد من المؤسسات أو المباني داخل موقع جغرافي أو مدينة معينة.

- An excellent **example** of a MAN is an **Internet service provider (ISP).**

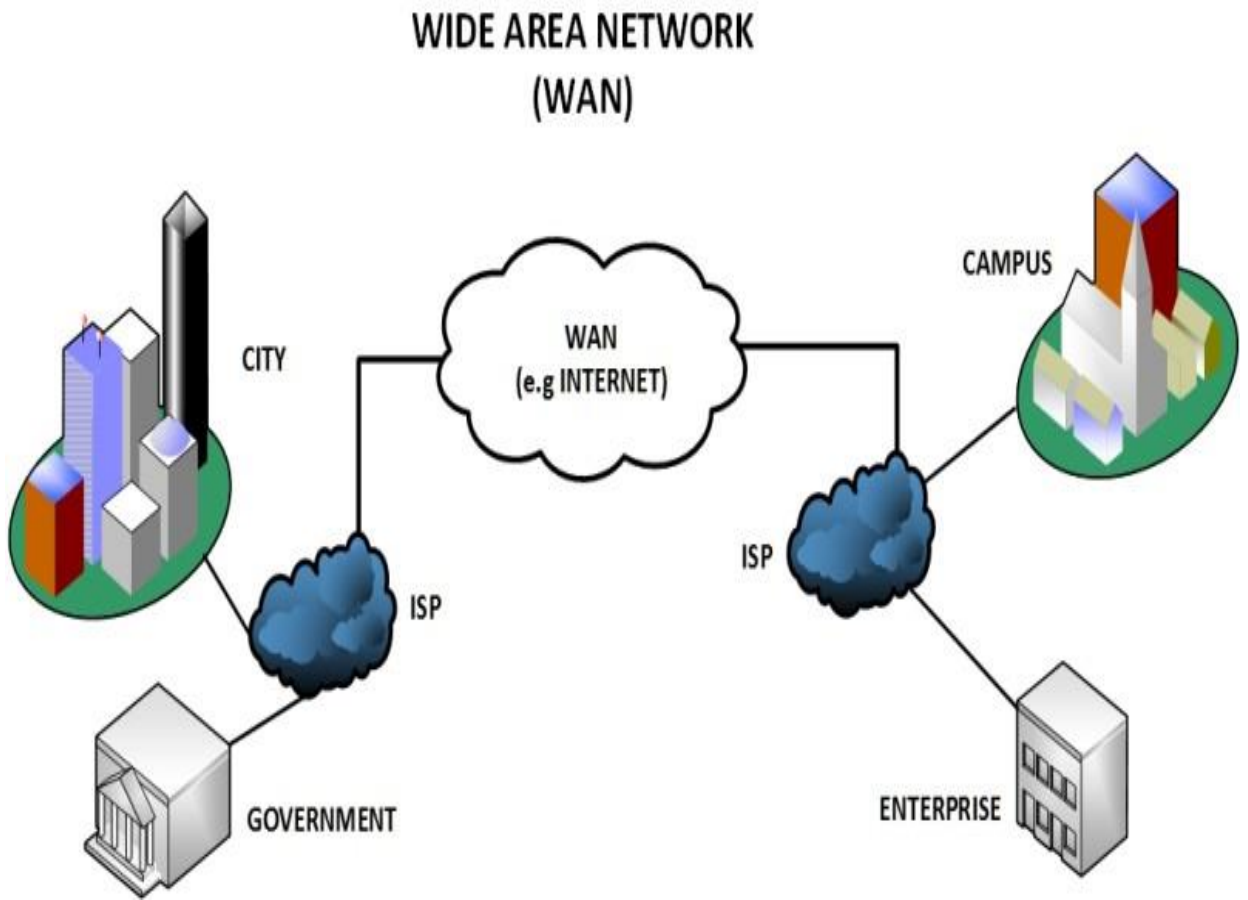


# Types of Networks

3) Based on Network reachability.

## IV. wide area networks (WAN).

- WANs typically connect **diverse geographic locations**.
  عادةً ما تربط شبكات WANبين مواقع جغرافية متنوعة.
- restricted within the boundaries of a **state or country**.
  تقتصر على حدود دولة أو بلد.
- Due to the **long transmission ranges**, WANs tend to have **more errors and noise** during transmission and are **very costly to maintain**.



# Layered Network Models

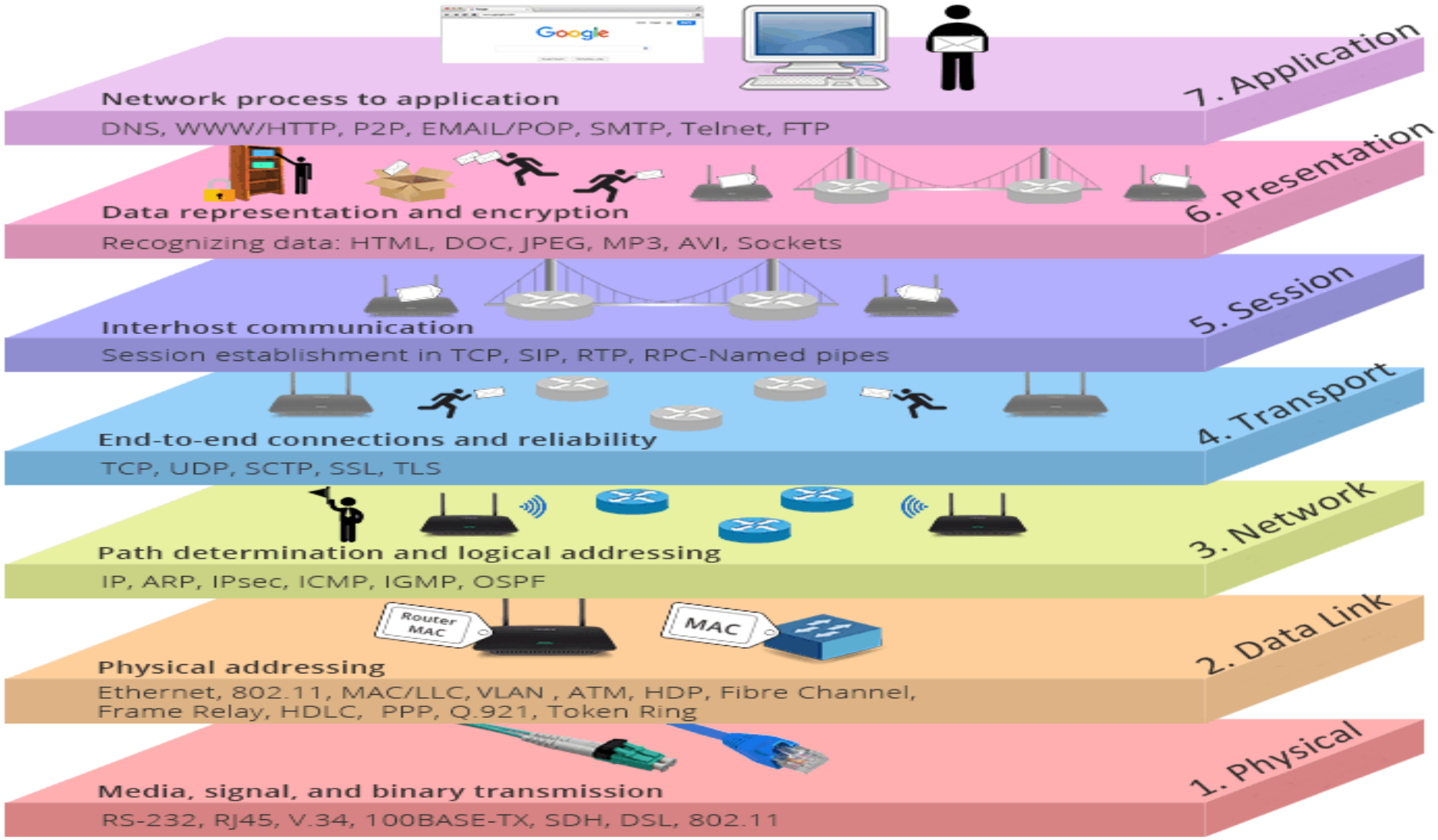
- The intercommunication between hosts in any computer network, be it a large-scale or a small-scale one is **built upon the premise** of various task-specific **layers**.

✓ يعتمد الاتصال المتبادل بين المضيفين في أي شبكة كمبيوتر، سواء كانت واسعة النطاق أو صغيرة النطاق، على فرضية وجود طبقات مختلفة خاصة بالمهام.

- Most **commonly** accepted and used **traditional** layered network models.
  - open systems interconnection (**OSI**) 7-layer model developed by the International Organization of Standardization (ISO).
  - Internet protocol suite (**TCP/IP**) 4-layer model.

# Layered Network Models

- open systems interconnection (**OSI**)



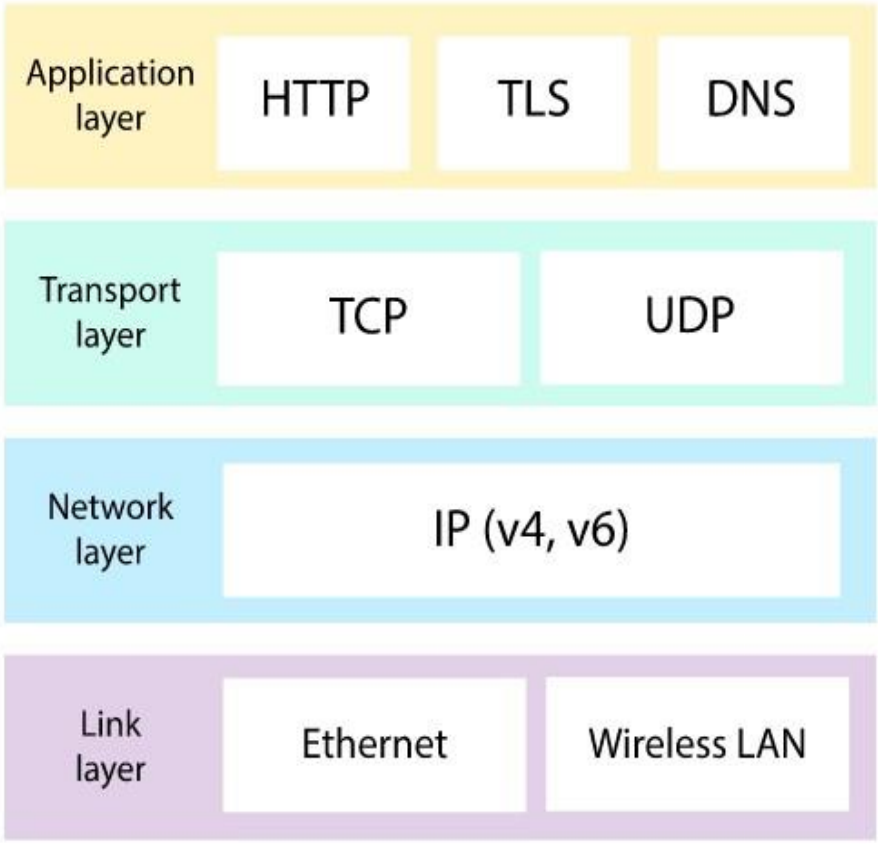
# Layered Network Models

- **(ISO-OSI) reference model:**

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

# Layered Network Models

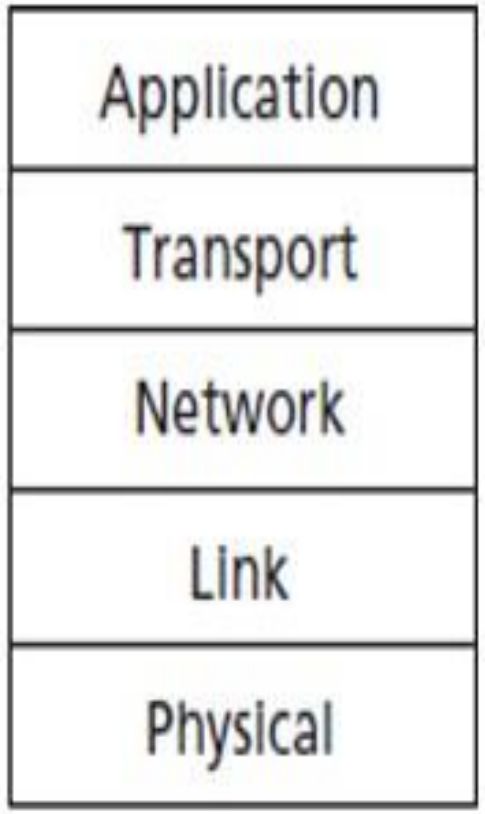
- Internet protocol suite, Transmission Control Protocol (**TCP**) and Internet Protocol (**IP**), (**TCP/IP**).

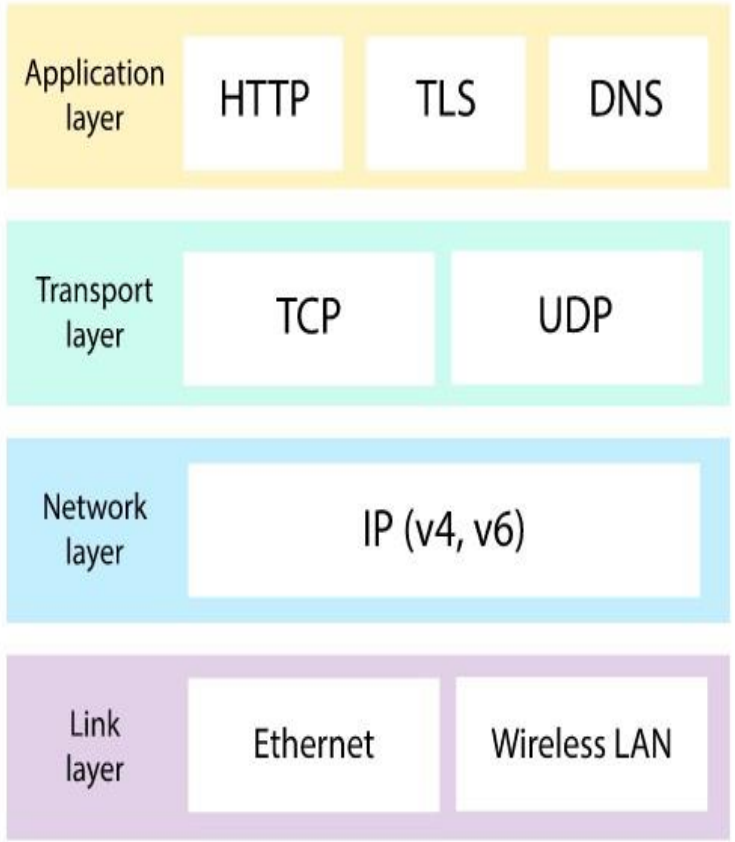


# Layered Network Models

- **Internet protocol suite (TCP/IP)**

1) **Application layer**
2) **Transport layer**
3) **Internet layer**
4) **Link layer.**
   - Data link layer
   - Physical layer



# Layered Network Models

- **Internet protocol suite (TCP/IP)**

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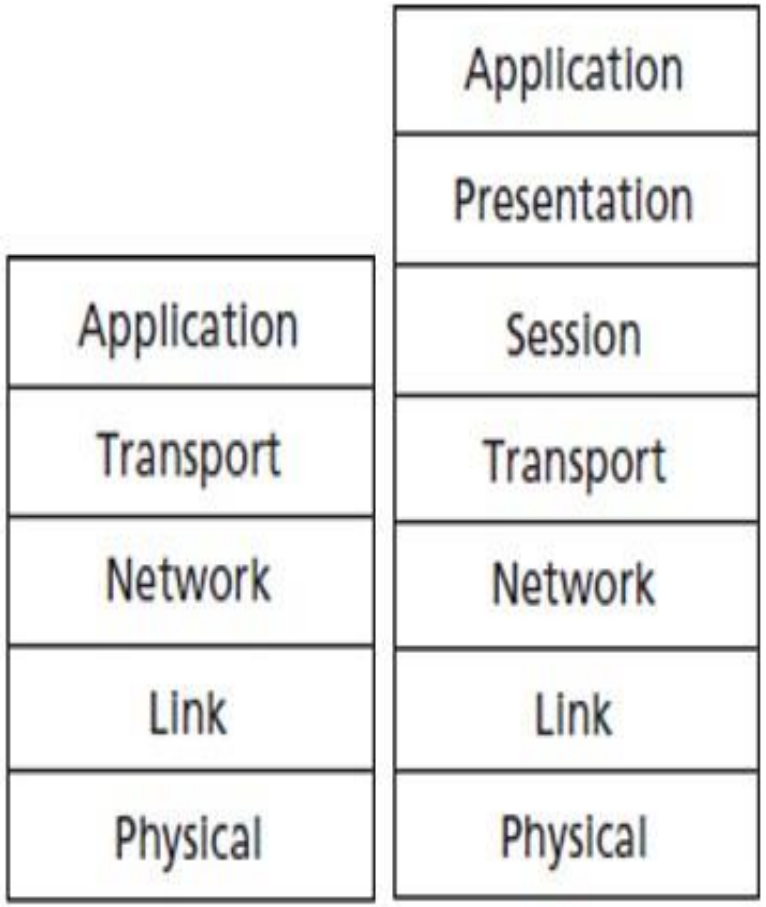


- **(ISO-OSI) reference model:**

1) **Application Layer**
2) **Presentation Layer**
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6) **Data Link Layer**
7) **Physical Layer**

# Basics of Networking / Addressing

- Addressing in networked devices plays a critical role in ensuring the delivery of packets to the designated/intended receivers.
- Addressing mechanisms can be divided into two parts:

I. one focusing on **data link layer** address.

II. other focuses on **network layer** addressing.

# Foundations of PROTOCOLS

## ❑ Definition of (PROTOCOLS)

- A protocol is a formal set of rules that govern the communication between devices on a network.

✓ البروتوكول هو مجموعة رسمية من القواعد التي تحكم الاتصال بين الأجهزة على الشبكة.

- A protocol defines the format and the order of messages exchanged between two or more communicating entities, as well as the actions taken on the transmission and/or receipt of a message or other event.

✓ يحدد البروتوكول تنسيق وترتيب الرسائل المتبادلة بين كيانين أو أكثر من الكيانات المتواصلة، بالإضافة إلى الإجراءات المتخذة عند إرسال و/أو استلام رسالة أو حدث آخر.

# Basics of Networking / on summary

- Network link importance
- Network Types: Connection types, Physical topology, Network reachability
- Layered Network Models: OSI Model, Internet protocol suite
- Addressing Strategies: Data link layer & Network layer

END OF LECTURE (1) PART A

Keep connected with the classroom

lmzcbsf

THANK YOU FOR YOUR ATTENTION