



Network



حِمْزَلَرُ الْرَّحْمَةِ اللَّهِ بِسْمِهِ

Lecture 1

Chapter 1:

introduction to computer networks

Network History

- In the 1960s, Paul Baran and Donald Davis independently developed the concept of using packets to transfer information between computers over a network.
- In 1966, Thomas Marilil and Lawrence G. Roberts published an experimental WAN for computer time sharing.
- In 1969, the first four nodes of ARPANET were connected via 50 kbits
- In 1973, Robert Metcalfe wrote a note at Xerox PARC about Ethernet networking system based on the Aloha network
- In 1976, John Murphy established ARCNET, a token-passing network used for sharing storage devices.
- Ethernet's transmission capacity increased from 10 Mbit/s to 100 Mbit/s and now capable of Gigabit transmission speeds.

Computer network definition:

A computer network is a group of interconnected electronic devices that share resources and services through communication links.

The networks vary from wide and transmission media and protocol types.

The network consists of three parts :

1- A resource to share

2- A transport path

3- A set of policies of communication rules (protocols)

** A computer network is not only for the exchange of data but also for the understanding and use of data from other devices in the network.

Benefits of the network computer:

There are many benefits to using the network , such as:

- File Sharing
- Security
- Resource Sharing
- like printers and scanners
- Communication
- Flexible access
- The working groups
- Reduction of the error

Network Applications:

There is a long list of applications. Many of the applications of computer networks such as the following:

- Booking of airline tickets, hotel reservations, train, rental car , etc.

- E-mails (EMM)
- Games
- The commercial applications of various systems, such as an order entry system, central purchasing, etc.
- The radio and television programs
- School Homework, quizzes, tests.

Keys to computer network:

- The nature of the involved nodes:
 - o Homogeneous or Heterogeneous
 - o Topology
 - o Reliability
- The capacity of distribution channels
 - o Techniques for routing
 - o Models
 - o Access

Example of fields of network applications:

- Business applications Field
- Home Applications
 - ** client-server model
 - ** peer-to-peer model ->there is no central database
- Mobile Users
- Connectivity

Chapter 2 : Data Communication

A selection of terms and conditions for the transfer of data and computer networks is an essential problem.

The transfer of data flow associated with the type of applications, and can be done with one of the five modes of operation:

- **Simplex** -> The data relating to the request flows in one direction only -> هنا البيانات مينفعش تتنقل غير في اتجاه واحد بس
- **Half Duplex** -> The data travels in both directions, but alternately. -> هنا This mode can be called a two-way alternate. البيانات بتمشي في الاتجاهين عادي بس مينفعش في نفس الوقت
- **Full Duplex** -> The data flows in both directions at the same time. -> هنا البيانات بتتنقل في الاتجاهين وفي نفس الوقت عادي زي المكالمات حالي

Communication modes :

Unicast جهاز واحد بيكلم جهاز تان ي <->

Multicast -> It is a broadcast, but the performance of the data by the sender is received by only a specific subset of the receiver. -> جهاز بيعت لجزء من الأجهزة الموجودة

Broadcast -> The output of data from the sender is received from all other receivers -> جهاز بيعت لكل الأجهزة

In **semi-duplex** and **duplex** algorithms, the amount of data in each Direction can be equal or different. The flow of data is symmetrical if the amount of data flow is equal and, if it is different called asymmetrically.

** in a browser and a Web server, a low bit-rate come to the server and higher bit rate from the channel server for the subscriber.

Circuit switching

A circuit switching network includes the interrelated elements of a set of exchanges of switching into which the subscriber is connected to .

Circuit-switching network suffers from a delay while a connection is established.

Two examples of networks that operate in this way are PSTN and ISDN.

Packet Switching

Packet-switched has two types:

The first one is **connection-oriented (CO)** and the second is **connectionless (CL)**. The basis of a connection-oriented network comprises an interconnected set of packet-switching exchanges (PSEs).

A device that is connected to the network has an exclusive network-wide number/address correlated with it.

Connection Oriented Network implies, before any data is sent, a beginning connection through the network of the sender address and terminals of destination.

In a packet-switching network, the connection/circuit is configured with only a part of the bandwidth of the connections. The connection is called **virtual circuit (V3)**.

On the other hand, uses a connectionless network, the connection **is not required** and the two communicating terminals/computers can exchange data and communicate if they wish.

طبعاً أنت مفهمني حاجة من الكلام اللي فات تعالى أوضحتك ببساطه

ده زي ما تكون بتعمل مكالمة تليفون عادي. لما بتطلب حد، الشبكة **Circuit Switching**: بتعمل لك خط مخصص طول المكالمة، وده بيضمن إن كل البيانات اللي بتبعتها توصل بنفس الترتيب اللي أنت بعثها بيها. الخطة دي بتفضل مفتوحة ومشغولة طول ما المكالمة شغاله، حتى لو مفيش كلام بيتنقل في اللحظة دي. زي مثلاً مكالمات التليفون الأرضي زمان.

هنا الموضوع مختلف. البيانات اللي بتبعتها بتتقسم لقطع صغيرة (**Packet Switching**)، وكل باكيت بيتمشي في الشبكة بطريقة مستقلة، مش لازم تمشي كلها على نفس الخط أو بنفس الترتيب. بعد كده، لما توصل للطرف الثاني، بتجمع تاني وتتركب في مكانها الصح. دي الطريقة اللي الإنترن트 بيستغل بيها دلوقتي، عشان كده أسرع وأكثر كفاءة، لأن الشبكة بتستغل كل الموارد اللي عندها.

باختصار:

بيعملك خط مخصص طول المكالمة (زي مكالمة التليفون) **Circuit Switching**. بيقسم البيانات ويعطها في أجزاء مستقلة (زي الإنترن트).

Packet Switching (زي الإنترن트) في أجزاء مستقلة

Types of transmission media

The transmission of an electrical signal requires a physical environment.

This environment can be composed of a pair of **conductors or cables**.

Other options are **a ray of light** through fiber or the transfer of **electromagnetic waves** through the free space.

The nature of the transmission is essential because the different types of media have bandwidths dissimilar that are associated with them.

The bandwidth determines the maximum flow rate that can be used.

These are the common types of transmission media:

- Coaxial Cable
- Shielded twisted pair (STP) Cable
- Unshielded twisted pair (UTP)
- Fiber Optic Cable

** Unshielded twisted pair (UTP) is primarily used in a cheap network. ->

RJ-45

** STP is appropriate for the media with an electrical noise.

** Shielded twisted pair used by the Token Ring networks.

Coaxial Cable

Coaxial cable consists of a copper conductor in its center. Plastic provides isolation between the conductor and a metal shielding braid.

The metal shield prevents any outside interference from other devices.

There are two types of coaxial cable.

- Thick coaxial cable -

Thin Coax.

** Thin coaxial cable 10Base2 code refers to a specification for coaxial cable used in Ethernet transport.

The 2 means that the segment length maximum length is 200 meters.

Coaxial cable is used essentially in inexpensive networks, mainly in the networks of **the linear bus**.

Coaxial cable connectors

The connector used with coaxial cable is the (BNC connector). Various types of adapters are available for the BNC connectors, for example, a T-connector, barrel connector, and the terminating resistor.

Optical Fiber Cable

Fiber optic cabling consists of a core of glass in the enclosed environment of multiple layers of defense equipment. It carries light instead of electronic signals to eliminate the difficulty of electrical noise.

Optical fiber is the standard for environments that contain electrical interference.

Fiber optic cable transmits signals at greater distances than a twisted pair and coaxial cables. It can take information at speeds much greater.

An optical receiver is used to make the rollover function at the end of the reception. The transmitter uses a **light-emitting diode (LED)** or **laser diode (LD)** to make the conversion operation, while the receiver uses a light sensitive photodiode or phototransistor.

The fiber has two parts: an **optical core** and an **optics coat** with a low index of refraction. The light propagates along the core of the optical fiber in one of three ways depending on the type and width of the base material used.

The difference between SMF , MMF :

Single-Mode Fiber (SMF):

- **Core size:** Small core diameter (around 8-10 microns).
- **Light transmission:** Transmits only one light mode or ray of light. This allows light to travel in a straight line down the fiber, reducing interference or distortion.
- **Distance:** Capable of transmitting data over long distances (tens to hundreds of kilometers) with minimal loss, making it ideal for long-haul communication and high-bandwidth applications.
- **Use cases:** Long-distance telecommunications, data centers, and high-speed networks.

Multi-Mode Fiber (MMF):

- **Core size:** Larger core diameter (around 50-62.5 microns).
- **Light transmission:** Allows multiple light modes or rays to travel down the fiber, which can lead to modal dispersion (light rays traveling at different speeds), resulting in signal distortion over long distances.
- **Distance:** Best for short-distance applications (up to 2 km), as signal degradation is more significant over longer distances compared to SMF.
- **Use cases:** Local area networks (LANs), data centers, and short-range communication.

The Optical fiber connector

A fiber optic cable connector is an ST connector like a BNC Connector.

Satellites

The data can be transmitted by radio (electromagnetic waves through space and TV A microwave beam climate is transmitted to the satellite from the ground.

This beam is received and relayed to the specified destination(s) using a circuit card known as **a transponder**. A satellite has

several transponders, each covering a band of particular frequencies.

A satellite channel typically has a bandwidth, extremely high (500 MHz), and can provide several hundred high-speed links of data using a technique known as the name of time-division multiplexing (TDM).

Microwave

Microwave Links are widely used to establish communication links when it is **unreasonable or too costly for the configuration of transmission medium physical.**

Ethernet Cables

The Ethernet cable types available are:

- Rolled cable.
- Crossover Cable
- Straight-through cable

Straightforward cable

It is used with Ethernet, Token Ring, ISDN, etc.

The cable used to connect the Router to switch or hub

The host to the switch or hub

Crossover Cable

This type of cable is used to connect:

- Hub / Switch
- Router directly to the host
- Switch to switch
- Hub to hub

- **Host-to-host Rolled Cable** Rolled Ethernet cable is perhaps connecting a host to a router console serial communication port (com).

بص، في تلات أنواع من كابلات الإيثرن特، و كل نوع ليه استخدام:

.1 **Straight-through cable** (الكابل المستقيم) مختلفه الكابل اللي بيتوصل بيه:

الأجهزة المختلفة بيعض، زي مثلاً لما بتوصل الكمبيوتر بتاعك بالراوتر أو السويتش.
ترتيب الأسلاك في الناحيتين بيبقى هو هو، يعني نفس اللون في الناحيتين.

ده بيستخدم لما تيجي توصل جهازين من: (الكابل المقاطع) .2 **Crossover Cable**

نفس النوع ببعض مباشرة، زي مثلاً لما بتوصل كمبيوتر بكمبيوتر تاني من غير ما تتعدي على راوتر أو سويتش. هنا ترتيب الأسلاك بيتغير في الناحيتين، بحيث الإرسال من جهاز بيبقى استقبال في الثاني والعكس.

.3 **Rolled Cable** (الكابل الملف) الكابل ده بيبقى ليه ترتيب مختلف تماماً عن اللي :

فاتوا، وبيستخدم بشكل أساسى في توصيل أجهزة الشبكات المتخصصة، زي لما تيجيتوصل جهاز كمبيوتر بكونسول الراوتر أو السويتش عشان تعمل إعدادات

أو

إصلاحات.

بساطة، الكابل المستقيم للأجهزة المختلفة، المقاطع للأجهزة المتشابهة، والم ملف لأجهزة الشبكات المتخصصة.