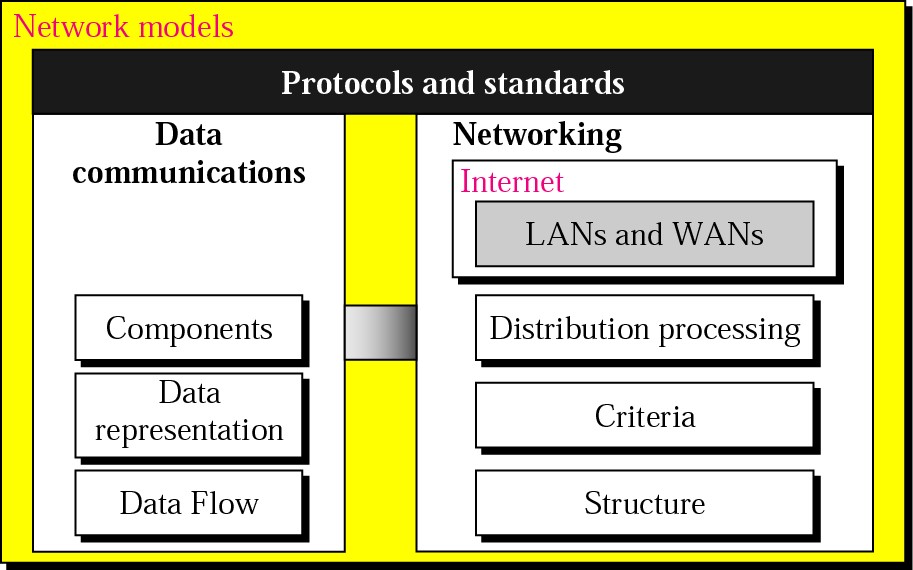
|  |
| --- |
| PART I  **Overview of**  **Data Communications and**  **Networking**  **Dr.Gihan Naguib** Behrouz A. Forouzan” Data communications and Networking **1** |

**2**



**Overview**

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**5**

**1**

**.**

**1**

**Data Communication**

**Communication**

:

sharing information. Sharing can be local (face to face) or

remote (over distance)

**Tele communication**

:

telephone, television, telegraphy) means communication at a

(

distance remote communication. (tele: far)

**Data communication**

:

exchange of data between two devices via transmission medium

wire cable)

(

**Communicating devices**

made up of : H.W( physical equipments )and S.W

**6**

**1**

**.**

**1**

**Data Communication**

**Effectiveness of data communication depends on :**

•

**Delivery**

**:**

System must deliver data to

**correct destination**

. Data must be

received by only intended device or user.

•

**Accuracy**

**:**

The system must deliver data accurately

•

**Timeliness**

**:**

the system must deliver data in a timely manner. Data

delivered later are useless.

•

**Jitter:**

Variation in the packet arrival time. It is the uneven delay in the

delivery of audio or video packets.

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**7**

**1**

**.**

**1**

**Data Communication**

•

Components

•

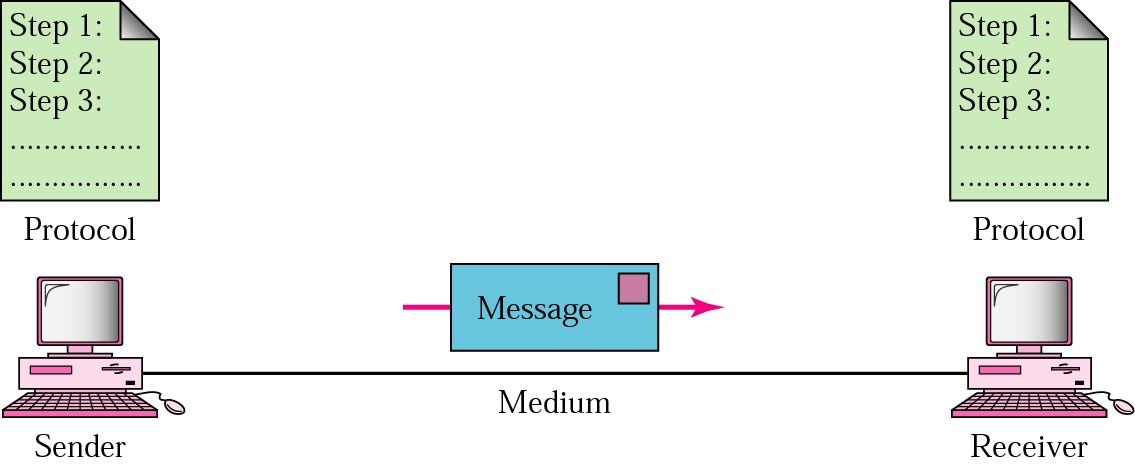
Data Representation

•

Direction of Data Flow

**8**

**Five components of data communication**



**Protocol**

**:**

**is a set of rules that governs data communications. It represents**

**an**

**agreement**

**between the communicating devices. Without a protocol two**

**devices may be connected but not communicating.**

**Components**

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**9**

**Data representation**

**Text, numbers, images, audio, and video**

**Text:**

•

**ASCII**

**:**

7

-

bit

patteren

(

128

different symbols

**)**

•

**Extended ASCII**

**:**

8

-

bit pattern (with an extra

0

at left from

00000000

to

0111111

•

**Unicode**

:

32

bits pattern (

65

,

536

,

216

symbols

)

**,**

which is definitely

enough to represent any symbol in the world.

**Numbers**

**:**

represented by bit pattern (binary number)

**Images :**

represented by matrix of pixels (picture element),

small dot. The size of pixel represent the resolution.

**Audio**

:

represent sound by continuous (analog) signal

**Video**

:

can be analog or digital signal

|  |  |
| --- | --- |
| **1** | **Direction of data flow** |
| **Simplex, half duplex and full duplex**    **. Simplex**:    **Co communication is unidirectional. (one-way-street). Only one of the two devices on a link can transmit; the other can only receive**    **E x: As Keyboard (only input) and monitors (only output )**  **Dr.Gihan Naguib** Behrouz A. Forouzan” Data communications and Networking **10** |

|  |  |
| --- | --- |
| **2** | **Direction of data flow** |
| **. Half duplex**:  Each station can both transmit and receive , **but not at the same time.** When one device is sending the other can receive and vice versa. onelane road with two direction).    **Dr.Gihan Naguib** Behrouz A. Forouzan” Data communications and Networking **11** |
| **3** | **Direction of data flow** |
| **. Full-Duplex:**  Both stations can transmit and receive simultaneously. ( telephone network) Like two way street with traffic flowing in both directions at the same time.      **Signals going in either direction share the capacity of the link in two ways:**   * Either the link must contain two physically separate transmission paths one for sending and other for receiving.      * Capacity of the channel is divided between signals traveling in both direction   **Dr.Gihan Naguib** Behrouz A. Forouzan” Data communications and Networking **12** |

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**1**

**.**

**2**

**Networks**

**is**

**a set of devices (often referred to as**

**nodes**

**connected by communication links.**

**)**

**A node**

**can be a computer, printer, or any**

**other device capable of sending and/or**

**receiving data generated by other nodes on**

**the network.**

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**1**

**.**

**2**

**Networks**



Network Criteria



**Performance,**



**Reliability and**



**security**



Physical Structures



**Type of connection**



**physical topology**



Categories of Networks



**(**

**LAN, MAN and WAN)**

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**Network criteria**

**1**

**. Performance:**

The performance depends on

:

1.

Number of user

2.

Type of transmission media,

3.

Capabilities of connected H.W and the efficiency of software.

**2**

**. Reliability**

Measured by frequency of failure, the time it takes to recover from

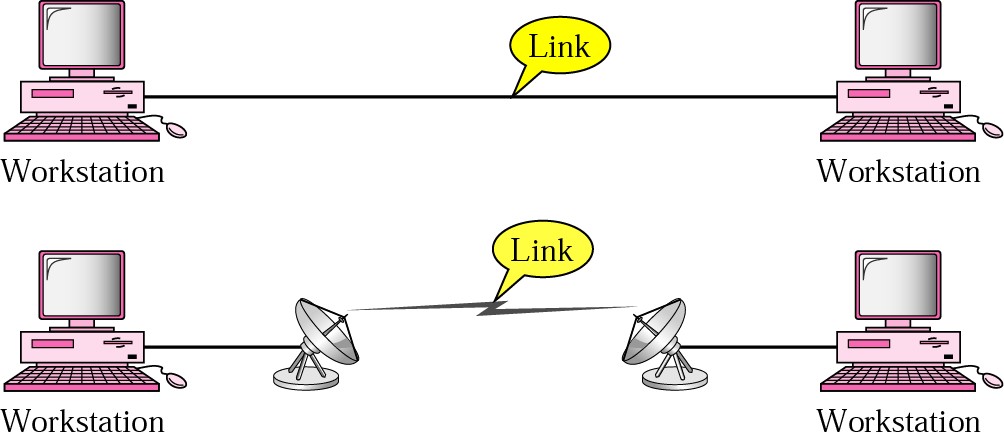
failure, and network’s robustness in a catastrophe.

**3**

**. Security:**

Protecting data from unauthorized access.

**16**



1

.

**Point**

**–**

**to**

**-**

**point**

Dedicated link between two devices. Most of them uses an actual length of wire

or cable to connect the two ends but other options ,such as microwave satellite are

possible.

change T.V channel by infrared remote control is

**point**

**-**

**to**

**-**

**point connection**

**Physical Structures:**

**Type**

**of connection**

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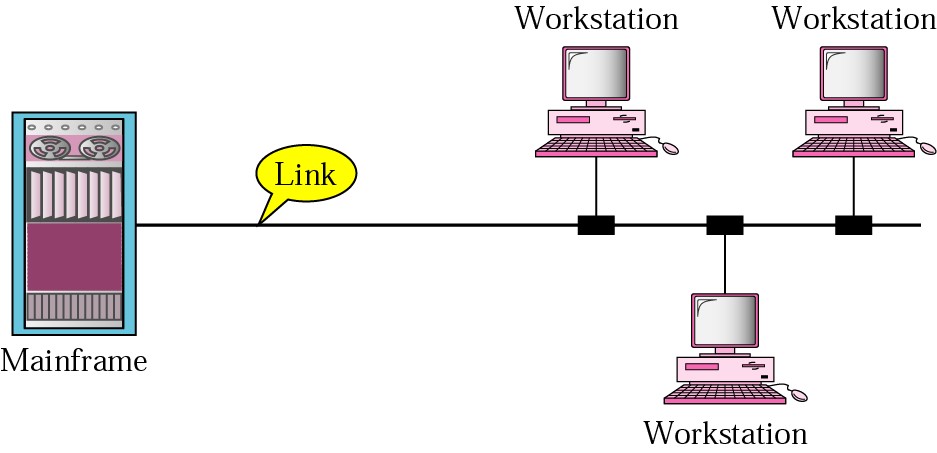
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**Physical Structures:**

**Type of connection**



**2**

**. Multipoint (multidrop) connection:**

more than two devices share a single line. The capacity is shared either

spatially or temporally.

**Spatially**

:

Several devices can use link simultaneously

**Temporally**

:

Users take turns , it is a timeshared

|  |  |
| --- | --- |
|  | **Physical Structures :physical topology** |
| * The way in which a network is laid out physically. . * It is the geometric representation of the relationship of all the links and linking devices (nods) to one another.     **Dr.Gihan Naguib** Behrouz A. Forouzan” Data communications and Networking **18** |

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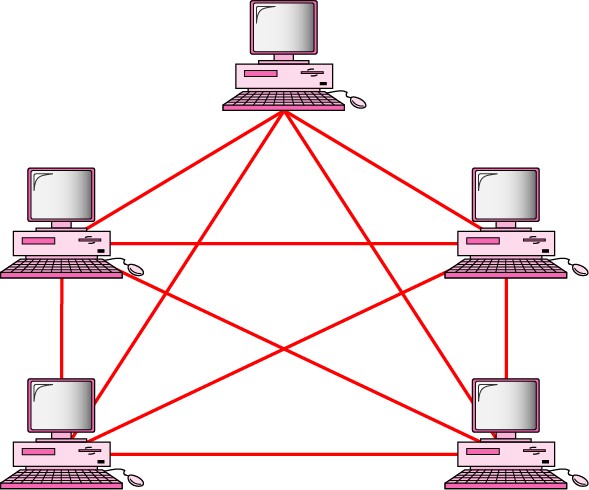
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**Fully connected mesh topology (for five devices)**





**Every device has a dedicated point**

**-**

**to**

**-**

**point link to every other devices**



**Fully connected mesh network has**

**n(n**

**-**

**1**

**/**

**)**

**2**

**physical connection to**

**link n devices.**



**Every device on the network must have**

**n**

**-**

**1**

**input/output (I/O) ports**

**20**

**Mesh topology**

**Advantages:**



**Privacy or security**

(

every message travels along a dedicated

line, only the intended recipient sees it. Physical boundaries prevents

other user from gaining access the message



**eliminating the traffic problems**

The use of dedicated links

guarantees that each connection can carry its own data load; that can

occur when links must be shared by multiple devices.



**A mesh is robust**

. If one link becomes unusable, it does not

incapacitate the entire system.



**Fault identification and fault isolation**

easy. This enables

the network manager to discover the precise location of fault and aids

in finding its cause and solution.

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**Mesh topology**

**Disadvantages**

**Related to the amount of cabling devices and the amount of I/O ports**

**required**

:



Every device must be connected to every other device,

**installation**

**and reconnection are difficult**



The sheer bulk of the wiring can be greater than the available space can

accommodate.



The H.W required to connect each link (I/O ports and cable) expensive.

**So a mesh topology is usually implemented in a limited fashion( as a**

**backbone**

**connecting the main computers of a hybrid network that can**

**include several other topology**

|  |  |
| --- | --- |
|  | **Star topology** |
| **Each device has a dedicated point-to-point link only to a central controller (hub)**  **Unlike a mesh , a star topology does not allow direct traffic between devices, if one device want to send data to another , it send it to the hub, which send it to other device**  Behrouz    A.  Forouzan  ” Data communications and Networking    **Dr.Gihan Naguib**    **22** |

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**Star topology**

**Advantages**

**1.**

**Easy to install and reconfigure and less expensive**

•

**each device need only one link and I/O port to connect it**

**to any other devices.)**

**2.**

**Robustness:**

•

**if one link fails, only that link affected and other links**

**remain active.**

**3.**

**identification and fault isolation**

**24**

**Star topology**

**Disadvantages**



**The dependency of the whole topology on one single point,**

**the hub.**

**If**

**the hub goes down, the whole system is**

**dead.**

|  |  |
| --- | --- |
| **to** | **Tree topology : Is a variation of star** |
| **Not every device plugs directly into the central hub. The majority of devices connect secondary hub that in turn is connected to the central hub**  **The advantages and disadvantages of tree topology are generally the same as those of star .The addition of secondary hubs bring more advantage:**  **Allow more devices to be attached to a single central hub, therefore increase the distance a signal can travel between devices.**  **Example of tree : Cable TV technology where the main cable from the main office is divided into main branches and each branch divided into smaller branches and so on.**  **Dr.Gihan Naguib** Behrouz A. Forouzan” Data communications and Networking **25** |
|  | **Bus topology** |
| •**Multipoint connection. Acts as a backbone to link all the devices in a network.**    **There is a limit on the number of taps a bus can support and on the distance between those taps**  **As a signal travels along the backbone, some of its energy is transformed into heat, therefore, it becomes weaker and weaker as it has travel farther and farther**  **Dr.Gihan Naguib** Behrouz A. Forouzan” Data communications and Networking **26** |

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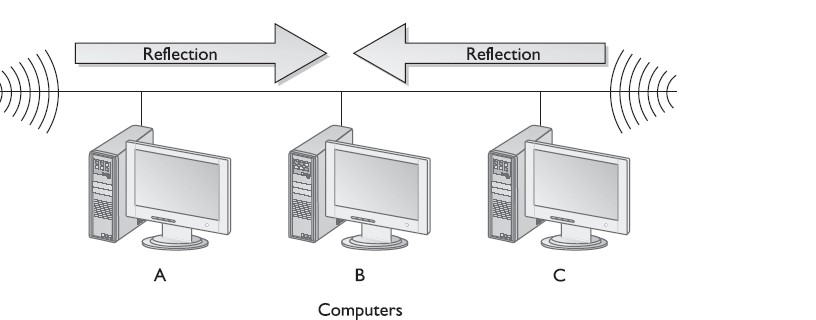
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**28**

**Bus topology**

**Advantages**

**Easy of insulation, use less cabling than mesh or star**

**Disadvantages**

**Include difficult of reconnection and fault isolation**

**1.**

**Fault**

**A fault in bus cable (break**

)

stops all transmissions

even between devices on the same side of the problem. The

damaged area reflects signals back the direction of origin, creating

noise in both directions

**2**

**.**

**Reconnection**

**It can difficult to add new devices (adding more require**

**modification or replacement of the backbone).**

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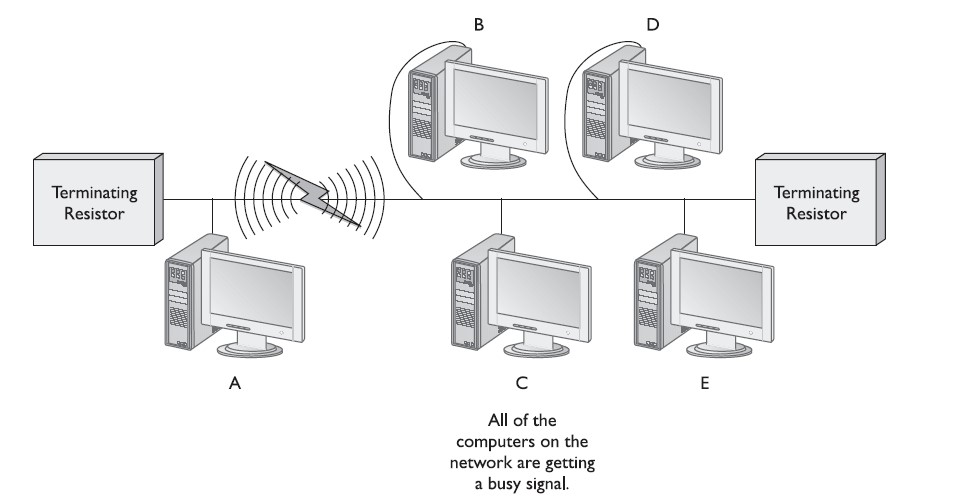
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|  |  |
| --- | --- |
|  | **Ring topology** |
| **Each device has a dedicated point-to-point connection only with the two devices on either side of it**  **A signal is passed along the ring in one direction from device until it reaches its destination.**  **Each device in the ring incorporate as repeater**   * **Repeater :regenerates the signal** * **it receives a weakened signal, creates a copy, bit for bit, at the original strength**   Behrouz    A.  Forouzan  ” Data communications and Networking    **Dr.Gihan Naguib**    **30**      **Repeater**    **Repeater**      **Repeater**    **Repeater**    **Repeater** |

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**Ring topology**

**Advantages:**



**Easy to install and reconfigure**

**.**

Each device is linked only to its immediate neighbors. To add or delete a

device requires hanging only

2

connections



**Fault isolation is simplified**

:

A signal is circulating at all times (token) if one device does not receive a

signal within specified period, it can issue an alarm. The alarm alerts the

network operator to the problem and its location

**Disadvantages**



**Unidirectional traffic.**

**A break in the ring**

**(**

**such as disabled station) can**

**disable**

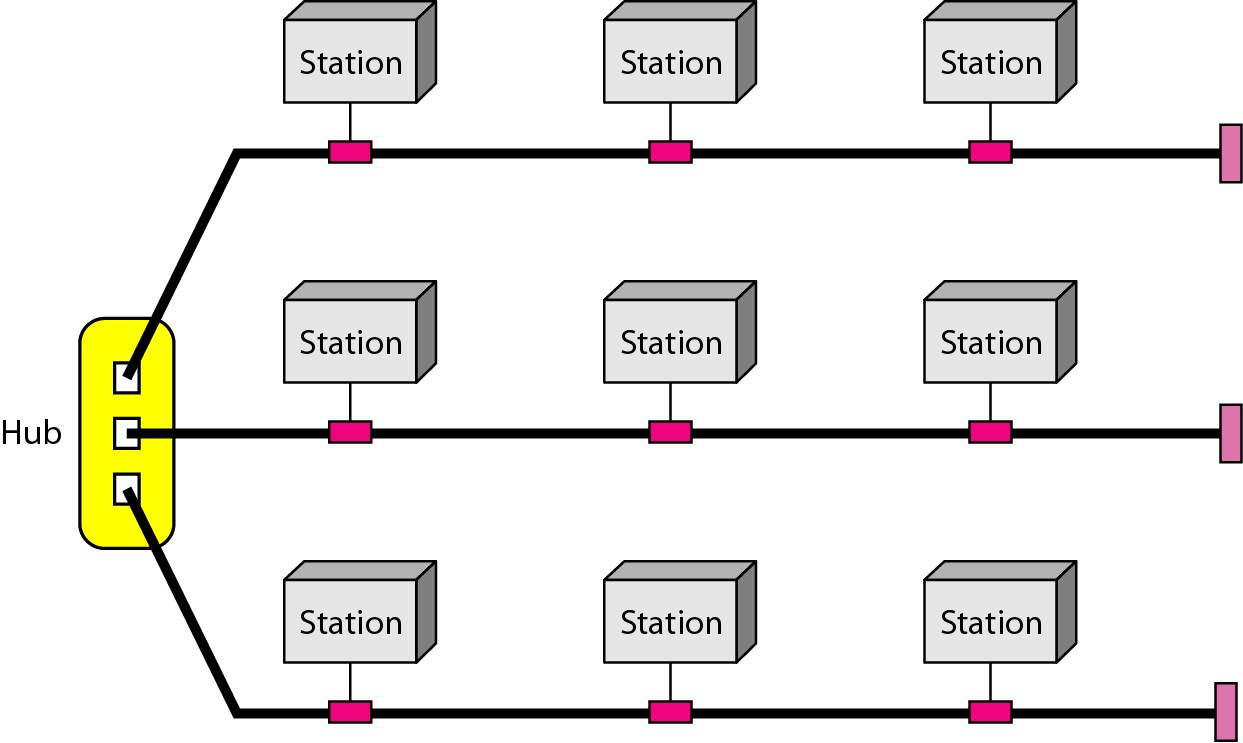
**the entire network**

**. This can be solved by use**

**dual ring**

**32**

**A hybrid topology: a star backbone with three bus networks**



|  |  |
| --- | --- |
|  | **Networks categories** |
| **Network category is determined by its size, ownership, the distance it cover and its physical architecture.**  **Dr.Gihan Naguib** Behrouz A. Forouzan” Data communications and Networking **33** |
|  | **Single building LAN** |
| Used in business environments, links a workgroup of task-related computer.      **Dr.Gihan Naguib** Behrouz A. Forouzan” Data communications and Networking **34** |

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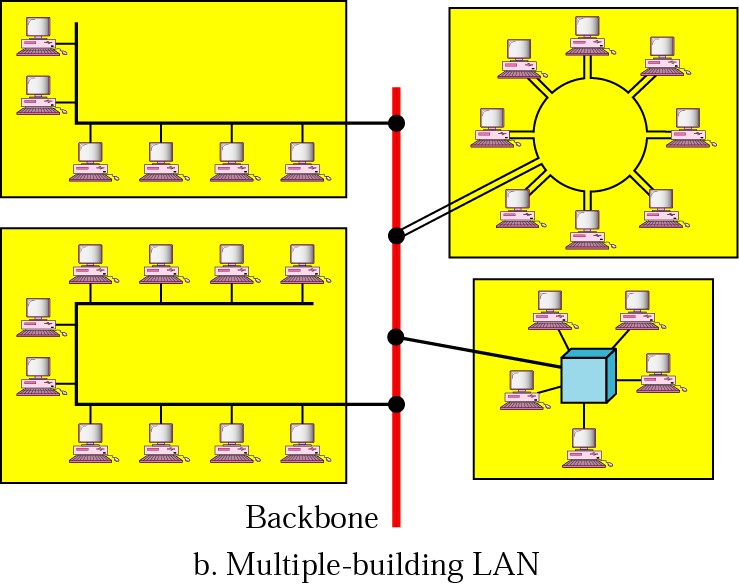
**Multiple**

**-**

**building**

**-**

**LAN**



**36**

**LAN**



**Privately owned and links the devices in a single office, building or**

**campus**



**LANs designed to allow resources to be shared between PCs or**

**workstations. The resources may be H.W (e.g. printer) or S.W(**

**applications program) or data.**



**In LANs one of the computers has a large capacity drive and becomes a**

**server to other clients.**



**S/W stored on server and used as needed by the whole group.**



**LAN size determined by licensing restrictions( No of users per copy of**

**S/W)**



**LAN use only one type of transmission medium.**



**The most common LAN topologies are bus, ring and star.**



**Traditionally LAN have data rates in the**

**4**

**to**

**16**

**Mbps. Today Speed can**

**reach to**

**100**

**Mbps or**

**1000**

**MBps(**

**1**

**G).**

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**37**

**MAN (metropolitan)**



**Owned by private company or it may be a service provided by**

**public company ( such as local tel.**

**-**

**company)**



**Extended over an entire city.**



**May be single network such as a cable television network, or it**

**may be connected number of LANs into a large network so**

**that resources may be shared LAN**

**-**

**TO**

**-**

**LAN.**

**Examples:**

•

**Company can use MAN to connect the LANs in all its**

**offices throughout the city.**

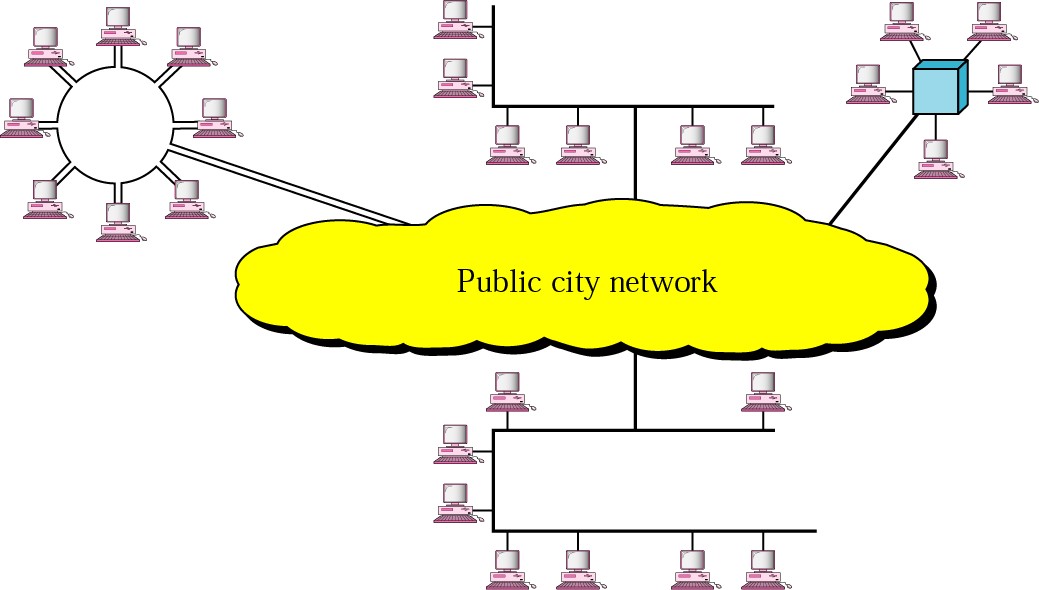
•

**A part of the telephone line network that can provide**

**DSL line to the customer**

**38**

MAN



|  |  |
| --- | --- |
|  | **WAN** |
| **Provides long distance transmission of data, voice , image and video information over large areas ( country or whole world)**  **In contrast to LAN, WAN may utilize public or private communication equipments or combination**  Behrouz    A.  Forouzan  ” Data communications and Networking    **Dr.Gihan Naguib**    **39** |
| **Interconnections of networks :internetwork** | |
| An internet (small i) is two or more networks that can communicate with each other.  Behrouz    A.  Forouzan  ” Data communications and Networking    **Dr.Gihan Naguib**    **40** | |

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**41**

**The Internet**



I

nternet is a collaboration of more than

100

of

1000

interconnected network.

Brief

History ( self

-

reading)



In mid of

1960

.:

The

A

dvanced

R

esearch

P

rojects

A

gency (ARPA) in the

department of defense was interested in finding a way to

connect computers so that the researchers they funded could

share their findings, to reduce costs and eliminating

duplication of effort.

**42**

**Brief history**



1

n

1967

ARPA presented its ideas for ARPANET, small network of connected

computers (mainframe).



1

n

1969

,

ARPANET was reality. Four nodes at the UNV. Of California,(at los

angles and Santa Barba), univ. of utah and SRI (Stand ford Research

Institute connected via IMPs computers to form a network.

Software called Network Control Protocol (

NCP

)

provided

communication between the hosts.

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**Brief history**

1

n

1972

,



Protocol to achieve end

-

to

-

end delivery of packets,

T

ransmission

C

ontrol

P

rotocol (

TCP).



Authorities made decision to split

TCP

into two protocols:



IP

:

Internetworking protocol to handle datagram routing and



TCP:

responsible for higher

-

level

-

functions such as error

detection, segmentation and reassembly.

**Internet today**

Made up of many wide and local area networks joined by connecting

devices and switching stations. Today most end users use the

**services**

**of internet service providers (ISPs**

**)**

**.**

**44**

**Protocols and Standards**

Protocols

Standards

Standards Organization

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**Protocols**

Set of rules that governs data communications.

Protocol defines :

•

What is communicated?

•

How it communicated?

•

When it is communicated?

•

Key elements of a protocol:

**Syntax, semantics and timing**

•

**Syntax:**

•

Structure or format of the data, meaning the order in which they

are presented.

Example:

A simple protocol might expect the

first

byte of data to be the

address of the sender,

the second

byte to be the address of the

receiver and

the reset

of the stream to be the message itself.

**46**

**Protocols**

**Semantics:**

•

Refers to the meaning of each section of bits.

•

Example:

does an address identify the route to be taken or the final

destination of the message.

•

**Timing:**

•

**When data to should be sent?**

•

**How fast they can be sent?**

Example:

If a sender produces data at

100

Mpbs but the receiver can

process data at only

1

Mpbs, transmission will overload the

receiver and data will be largely lost.

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**Standers**

Provide guidelines to manufactures, vendors, government agencies

and other service provides to ensure the kind of interconnectivity

necessary in today's marketplace and international

communication.

Two categories:

**1.**

**De fact:**

Have been adopted as standers through widespread

use .Established by manufacturers that define the

functionality of a new product or technology

**2.**

**De jure**

:

officially recognized body.

**48**

**Standers Organization**

1.

International Organization for Standardization

(

ISO

)

•

Multinational body

•

OSI

2

. International Telecommunication Union Telecommunication

standard sector

(

ITU

-

T)



devoted to the research of standards for telecommunication

in general and for phone and data system in particular



**Data transmission over telephone line Modems**

**standards :**

**V**

**-**

**series( V**

**32**

**, V**

**34**

**,V**

**90**

**)**



X

-

series

:

data transmission over public digital network (e

-

mail)

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**Standers Organization**

3

. American National Standards Institute (ANSI)



completely private, nonprofit corporation

4

. Institute of Electrical and Electronics Engineers

(

IEEE

)



International in scoop



In the fields of electrical engineering, electronics and all related

branches of engineering



International standards for computing and communications

LAN (project

802

):

IEEE Ethernet

802

.

3

5

. Electronic Industries Association (EIA)



Field of Information Technology (

SONET)