(*) Introduction

^ The largest computer network, the INTERNET, has billions of users in the world who use WIRED and WIRELESS transmission media to connect small and large computers.

DATA refers to INFORMATION presented in whatever FORM is agreed upon by the parties CREATING and USING it.

DATA COMMUNICATIONS is the exchange of DATA between two devices via a combination of HARDWARE (physical equipment) and SOFTWARE (programs).

The EFFECTIVENESS of a data communications system depends upon :—

1. DELIVERY —

   Delivery must be ensured ONLY to the CORRECT destination.

2. ACCURACY —

   Data ALTERED during transmission must be CORRECTED.
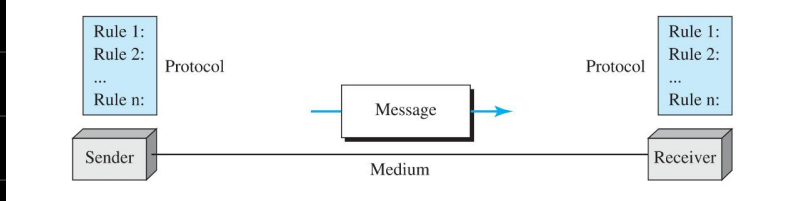
3. TIMELINESS —

   Data must be delivered AS they are produced, in the same ORDER that they are produced, and without significant DELAY.

4. JITTER —

   The variation in the ARRIVAL RATE of data must be minimized.

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Figure 1.1   *Five components of a data communications system*

A protocol is a set of RULES.

Message is the DATA to be sent.

Medium can be CABLES, RADIO WAVES, etc.

Without a PROTOCOL, two devices may be CONNECTED but not able to COMMUNICATE, just as a person speaking French cannot be understood by a person who only speaks Japanese.

Data/Information can come in different FORMS, such as text, numbers, images, audio and video.

Figure 1.2 *Data flow (simplex, half-duplex, and full-duplex)*
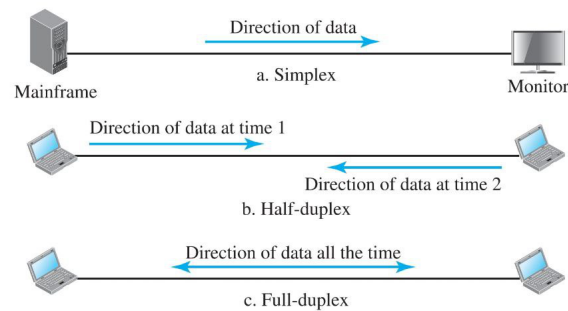
1. SIMPLEX —

   The communication is UNIDIRECTIONAL. Only one of the two devices on a link can TRANSMIT; the other can only RECEIVE. For eg., keyboards and traditional monitors.

2. HALF-DUPLEX —

   Each station can both TRANSMIT and RECEIVE, but NOT at the same time. For eg., walkie-talkies.

3. FULL-DUPLEX —

   Both stations can TRANSMIT and RECEIVE SIMULTANEOUSLY. For eg., telephone network.

A NETWORK is the interconnection of a set of DEVICES capable of COMMUNICATION, where a device can be a HOST (for eg., desktop) or a CONNECTING DEVICE (for eg., router).

Network criteria :-

1. PERFORMANCE —

   For eg., TRANSIT TIME (amount of time required for a MESSAGE to travel from one DEVICE to another), RESPONSE TIME (elapsed time between an INQUIRY and a RESPONSE), etc.

   These depend upon a number of FACTORS, for eg., the number of USERS, the TYPE of TRANSMISSION MEDIUM, etc.

2. RELIABILITY —

   For eg., the frequency of FAILURE, RECOVERY time, etc.

3. SECURITY —

   For eg., protection from UNAUTHORIZED access, protection from DAMAGE, policies for

   recovery from BREACHES, etc.

^ In a network, devices are connected through LINKS. A link (also known as a CHANNEL)
is a COMMUNICATION pathway that TRANSFERS data from one DEVICE to another. For
communication to occur, two devices must be connected in some way to the SAME LINK at
the SAME TIME.

Figure 1.3 *Types of connections: point-to-point and multipoint*
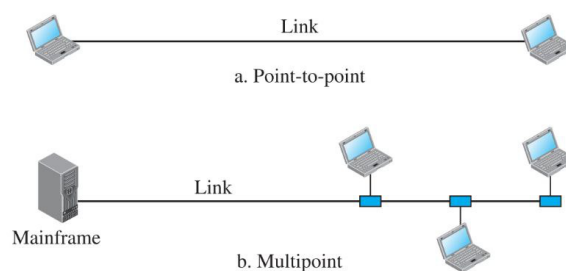
1. POINT—TO—POINT CONNECTION —

   It provides a DEDICATED link between TWO devices, and the ENTIRE capacity of the

   link is reserved for TRANSMISSION between those two devices ONLY.

2. MULTIPOINT/MULTIDROP CONNECTION —

   MORE than two devices share a single link, and the capacity of the link is shared,

   either SPATIALLY (i.e. if several devices can use the link SIMULTANEOUSLY) or

   TEMPORALLY (i.e. if the devices must take TURNS to use the link).

^ PHYSICAL TOPOLOGY refers to the way in which a network is laid out PHYSICALLY, i.e.
it is the GEOMETRIC representation of the relationship of all the LINKS and the
LINKING DEVICES (NODES) to one another.

1. MESH TOPOLOGY –

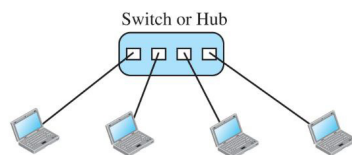**Figure 1.4** *A fully connected mesh topology (five devices)*
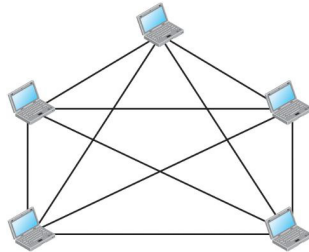
Every device has a dedicated POINT–TO–POINT link to every other device.

Total number of physical links = $^nC_2$ = n (n – 1) / 2, where n is the number of devices.

Every device must have n – 1 input/output (I/O) ports.

2. STAR TOPOLOGY –

**Figure 1.5** *A star topology connecting four stations*

Switch or Hub

Each device has a dedicated POINT–TO–POINT link only to a CENTRAL controller, usually a HUB, and is NOT directly linked to any other device.

The controller acts as an EXCHANGE, i.e. if one device wants to send data to another, it sends the data to the CONTROLLER, which then relays the data to the target device.

1. MESH TOPOLOGY –

3. BUS TOPOLOGY —

Figure 1.6   *A bus topology connecting three stations*
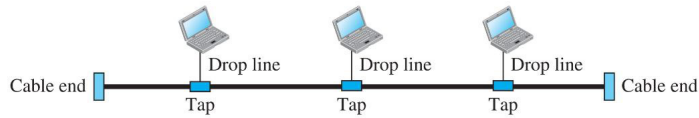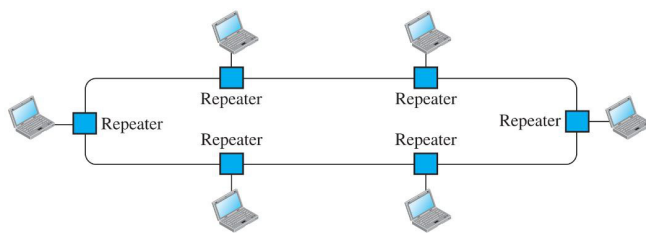
Each device is connected to a MULTIPOINT link, which acts as a BACKBONE to link all the devices in the network.

A DROP LINE is a connection running between the DEVICE and the MAIN CABLE.

A TAP is a connector.

4. RING TOPOLOGY —

Figure 1.7   *A ring topology connecting six stations*

Each device has a dedicated POINT—TO—POINT connection with only the TWO devices on either side of it. Data are passed along the ring in ONE direction, from device to device, until they reach the DESTINATION.

A REPEATER regenerates the BITS and passes them along.

^   Network Types :—

1. LOCAL AREA NETWORK —