Data Communication

Data Communication is the exchange of information from one entity to the other using a Transmission Medium.

Data Communication

- **1883: Samuel Morse & Alfred Veil invent Morse Code Telegraph System**
- **1876: Alexander Graham Bell invented Telephone**
- **1930: Development of ASCII Transmission Code**
- **1950: IBM releases its first computer IBM 710**
- **1960: IBM releases the First Commercial Computer IBM 360**

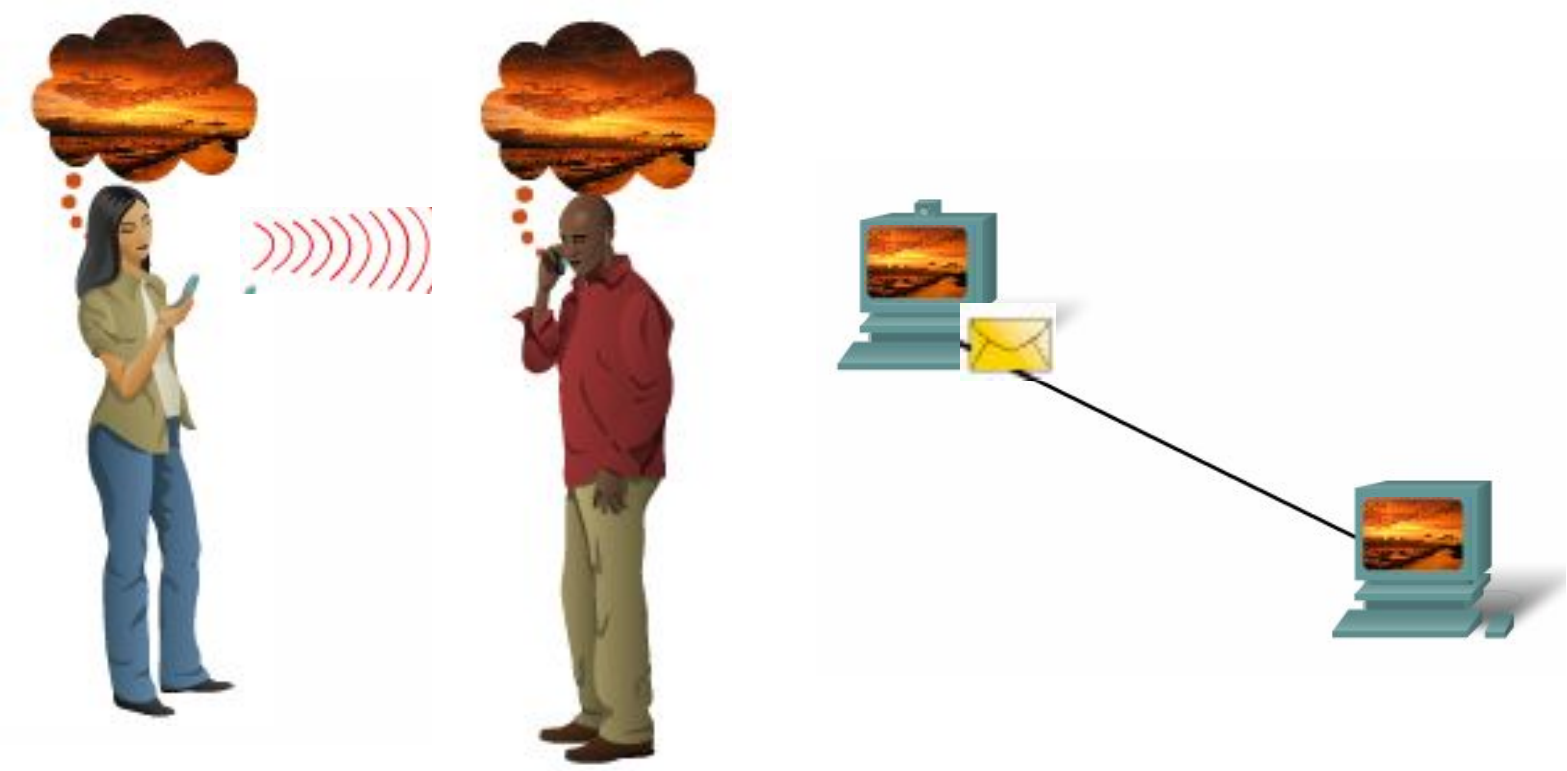
Data Communication Definition (Modified)

Data Communication is the exchange of data (in the form of 0's and 1's) between two devices (computers) via some form of the transmission medium.

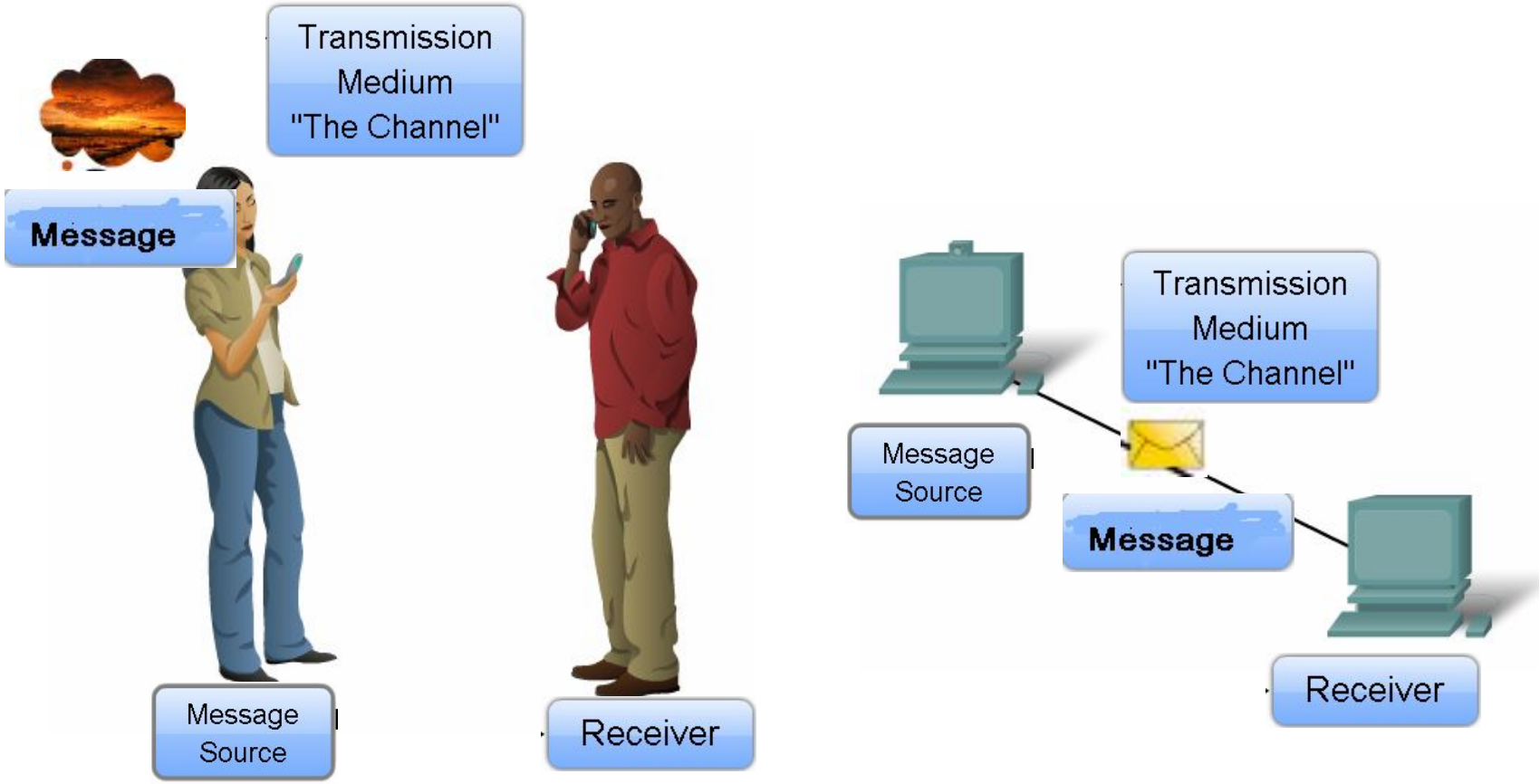
DATA COMMUNICATIONs

The term telecommunication means communication at a distance. The word data refers to information presented in whatever form is agreed upon by the parties creating and using the data. Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable.

Elements of Communication



Elements of Communication

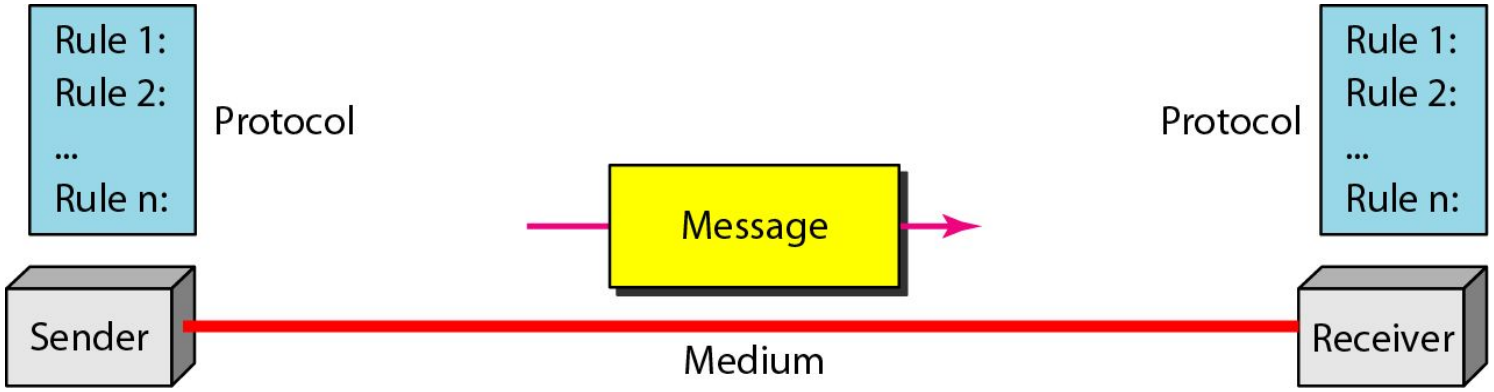


- What are the elements?

Elements of Communication over Networks

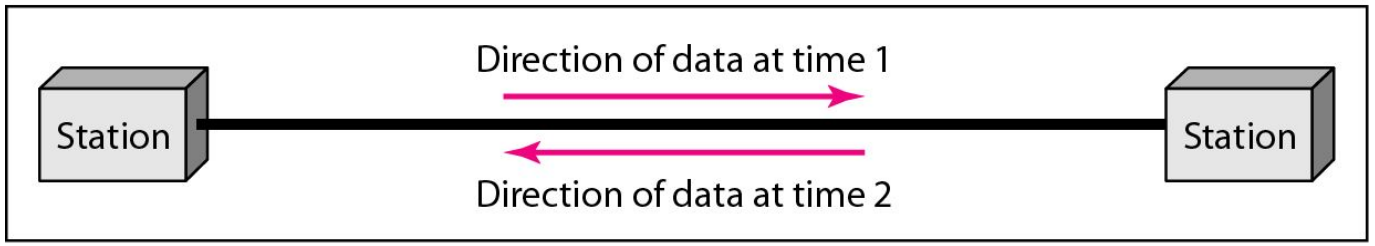
- **Devices (Sender/Receiver)**
  - These are used to communicate with one another
- **Medium**
  - This is how the devices are connected together
- **Messages**
  - Information that travels over the medium
- **Rules/Protocols**
  - Governs how messages flow across network

Five elements/components of data communication

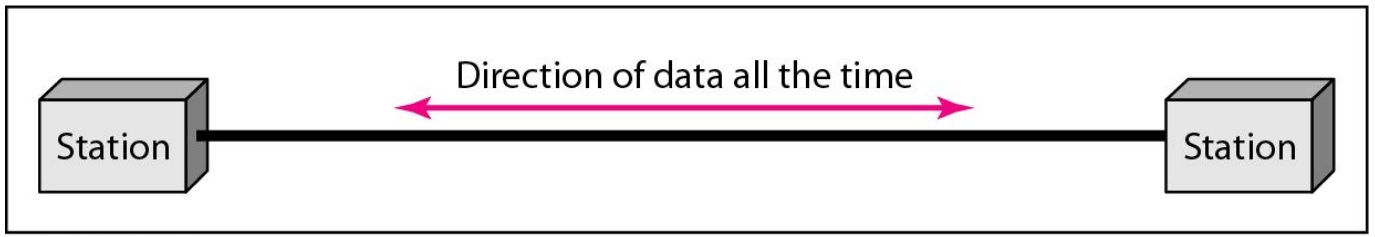


Data flow (simplex, half-duplex, and full-duplex)

a. Simplex



b. Half-duplex



c. Full-duplex

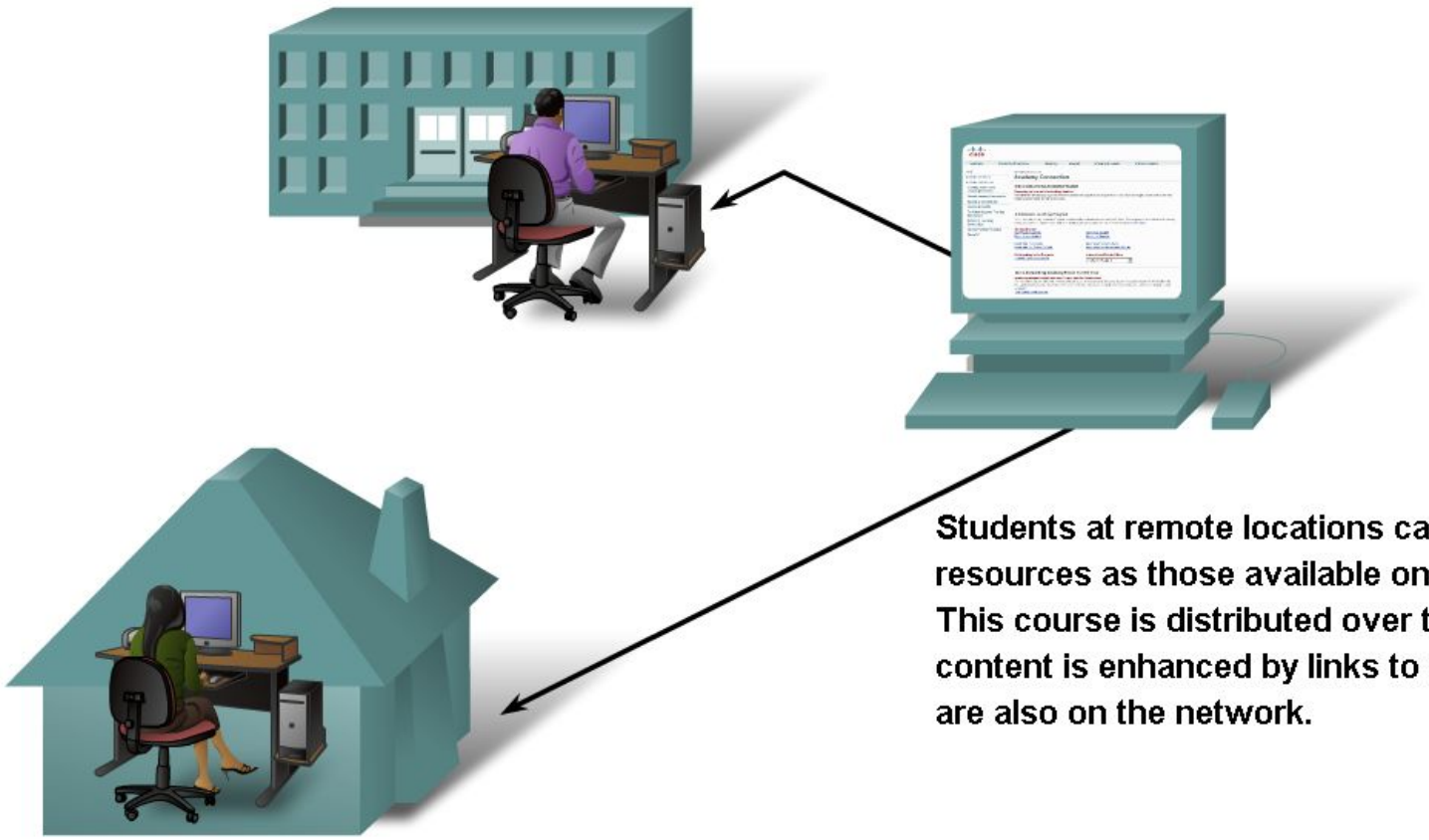
NETWORKS

A network 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.

Topics discussed in this section:

Distributed Processing
Physical Structures
Categories of Networks
Interconnection of Networks: Internetwork

Networks supporting the way we learn.



Students at remote locations can access the same resources as those available on campus.
This course is distributed over the network and the content is enhanced by links to other resources, which are also on the network.

Networks supporting the way we learn.

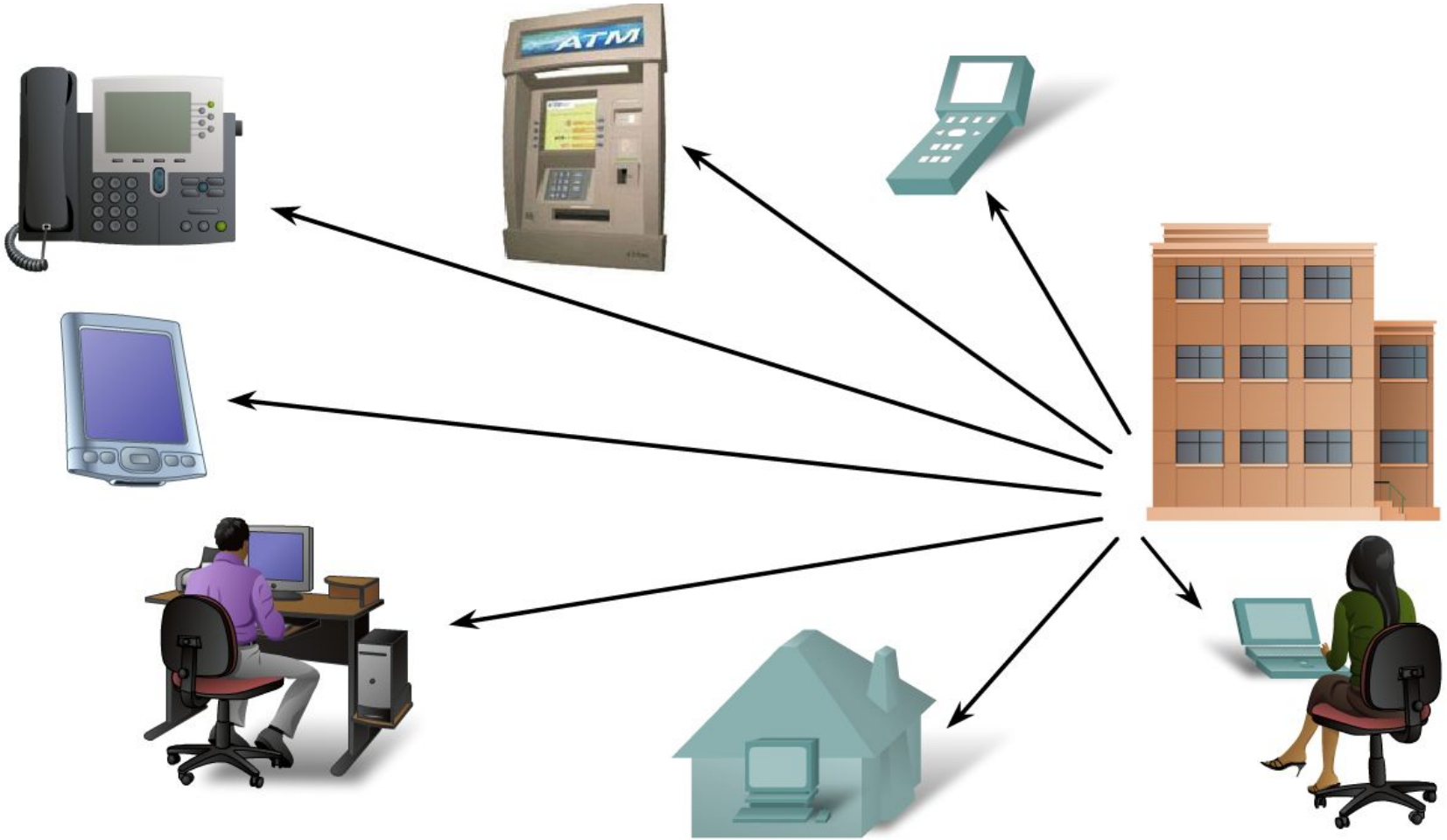
A text message is sent from an instructor telling students that the next class is in the lab.

A student enrolls in classes from home.

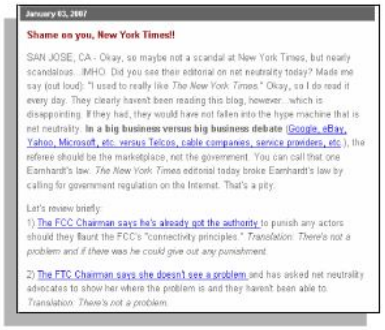
An administrator publishes the course catalog to a web site.

In addition to supporting courseware, data networks support administration, enrollment, and teacher-student communication.

Networks supporting the way we work.



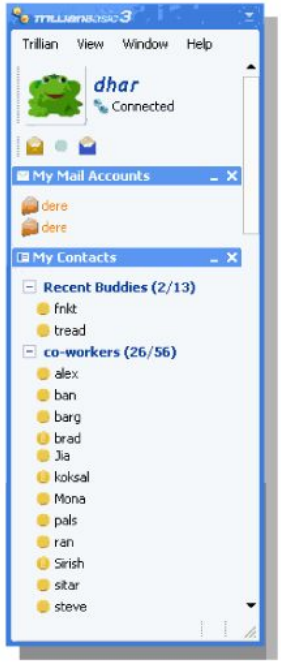
Networks supporting the way we play.



Online Interest Groups

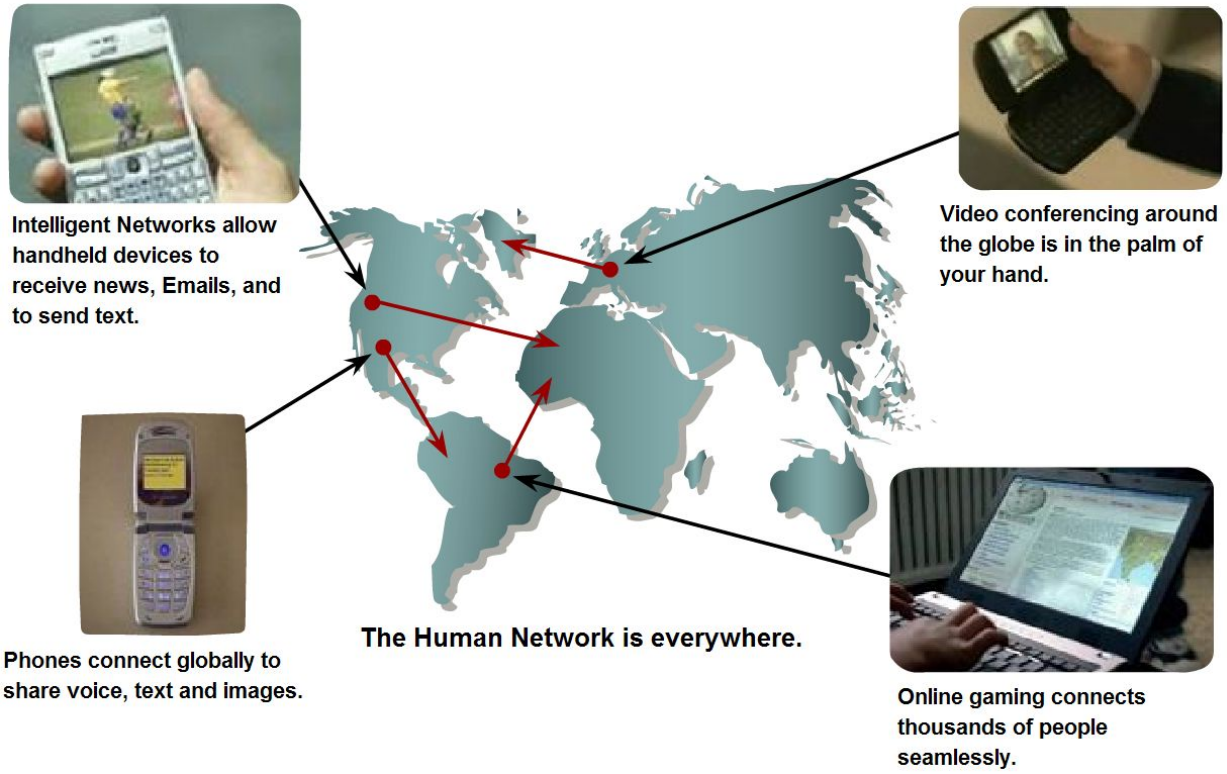
Online Entertainment

The onboard data network provides a range of services to airline personal seatback video systems.



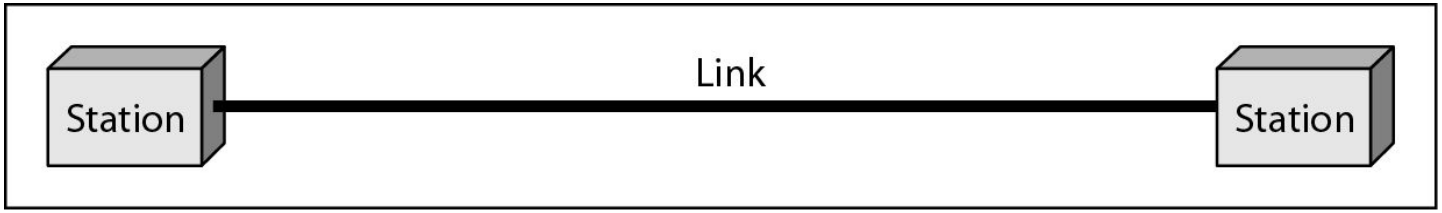
Instant Messaging

Networks- Purpose???

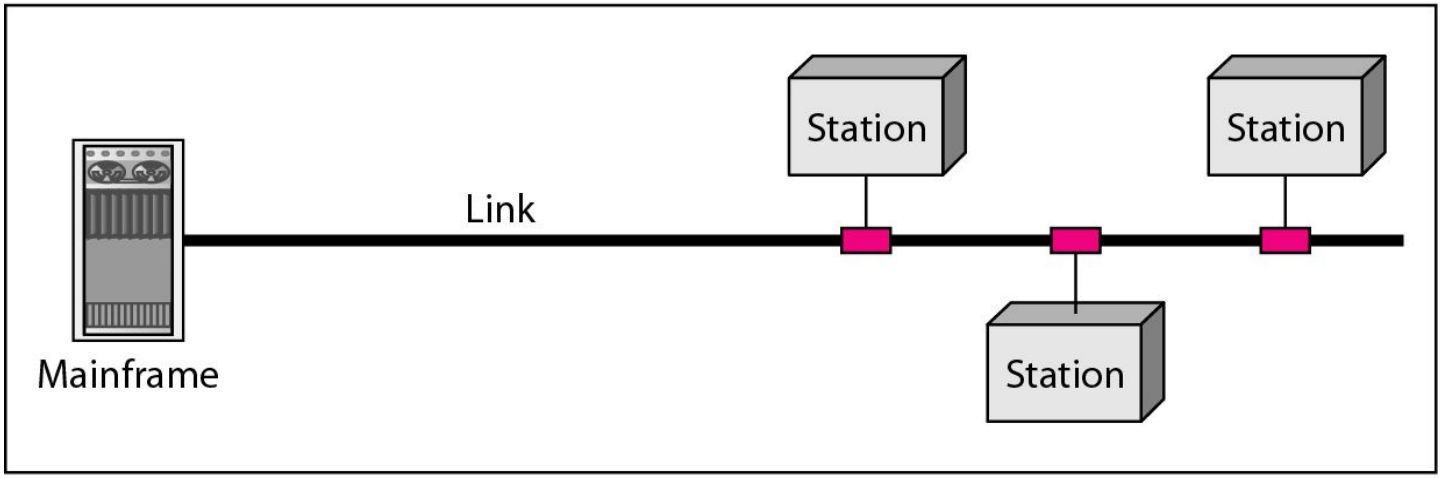


- Communication.

Figure 1.3 *Types of connections: point-to-point and multipoint*



a. Point-to-point



b. Multipoint

Figure 1.4 *Categories of topology*

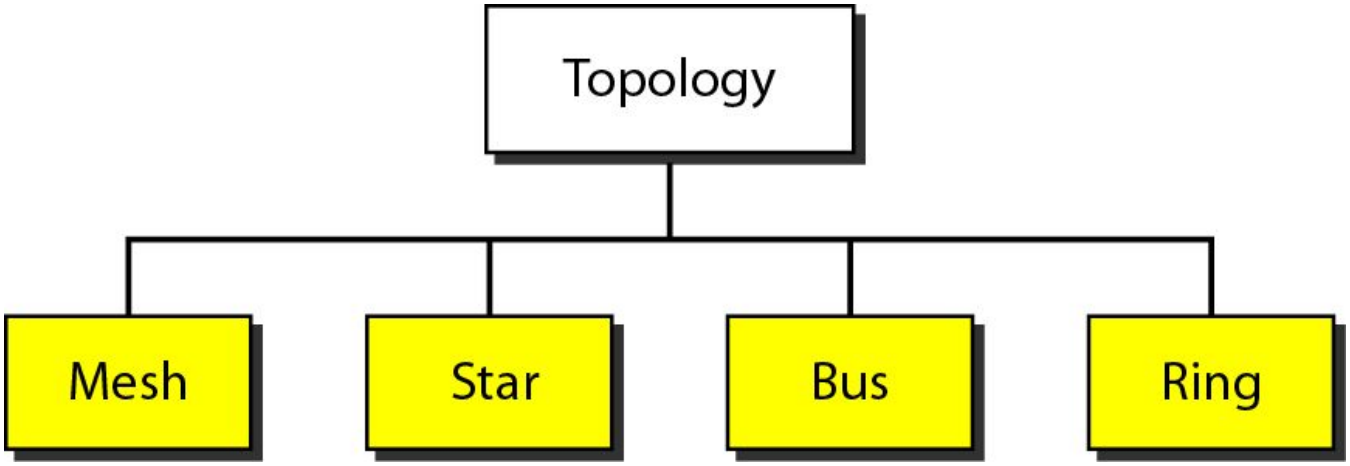


Figure 1.5 *A fully connected mesh topology (five devices)*

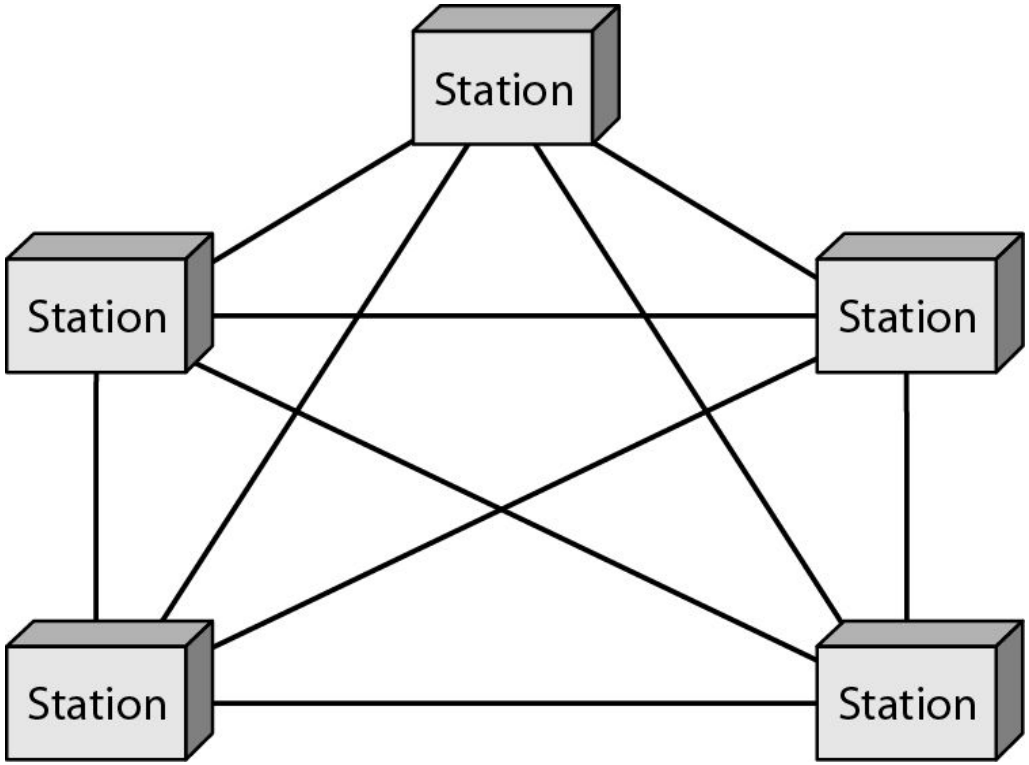


Figure 1.6 *A star topology connecting four stations*

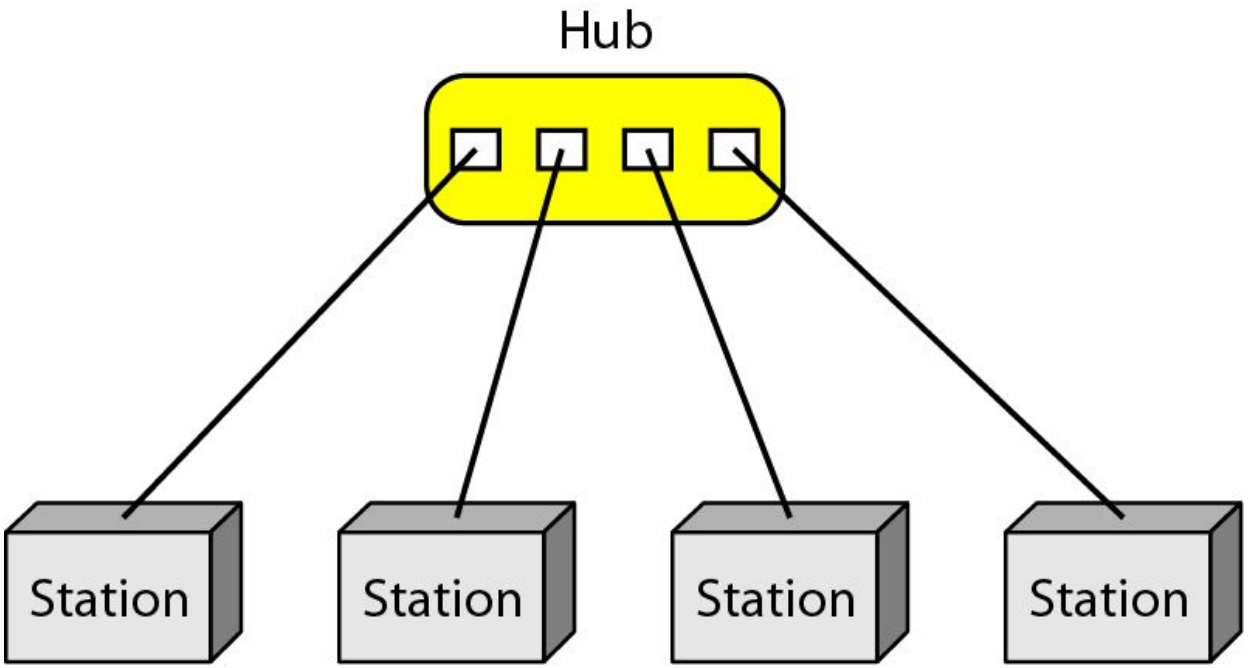


Figure 1.7 *A bus topology connecting three stations*

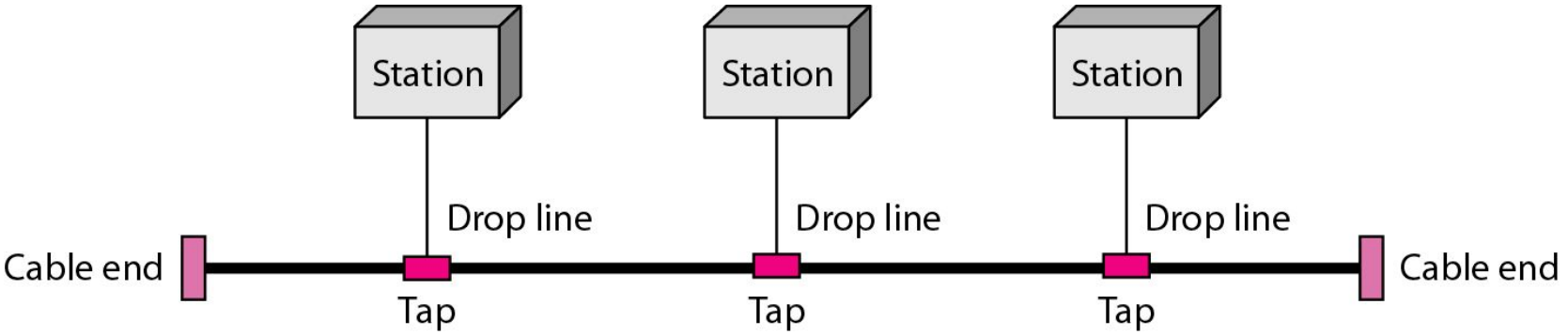


Figure 1.8 *A ring topology connecting six stations*

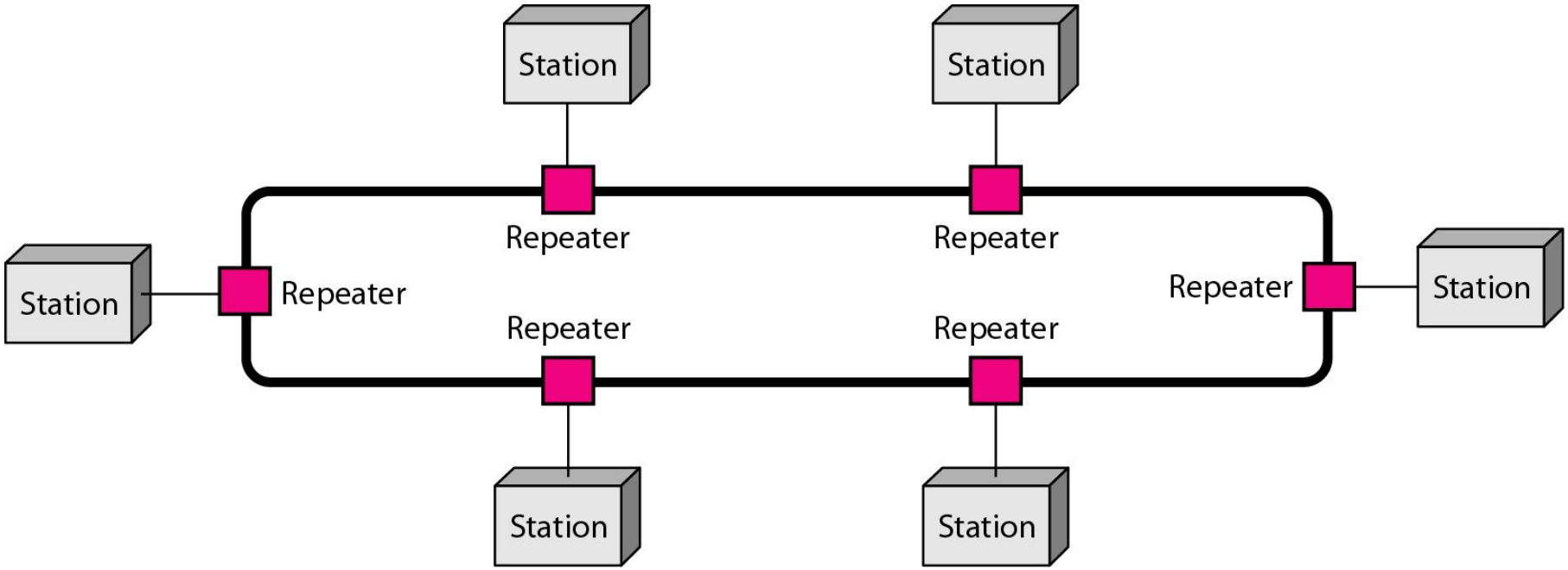
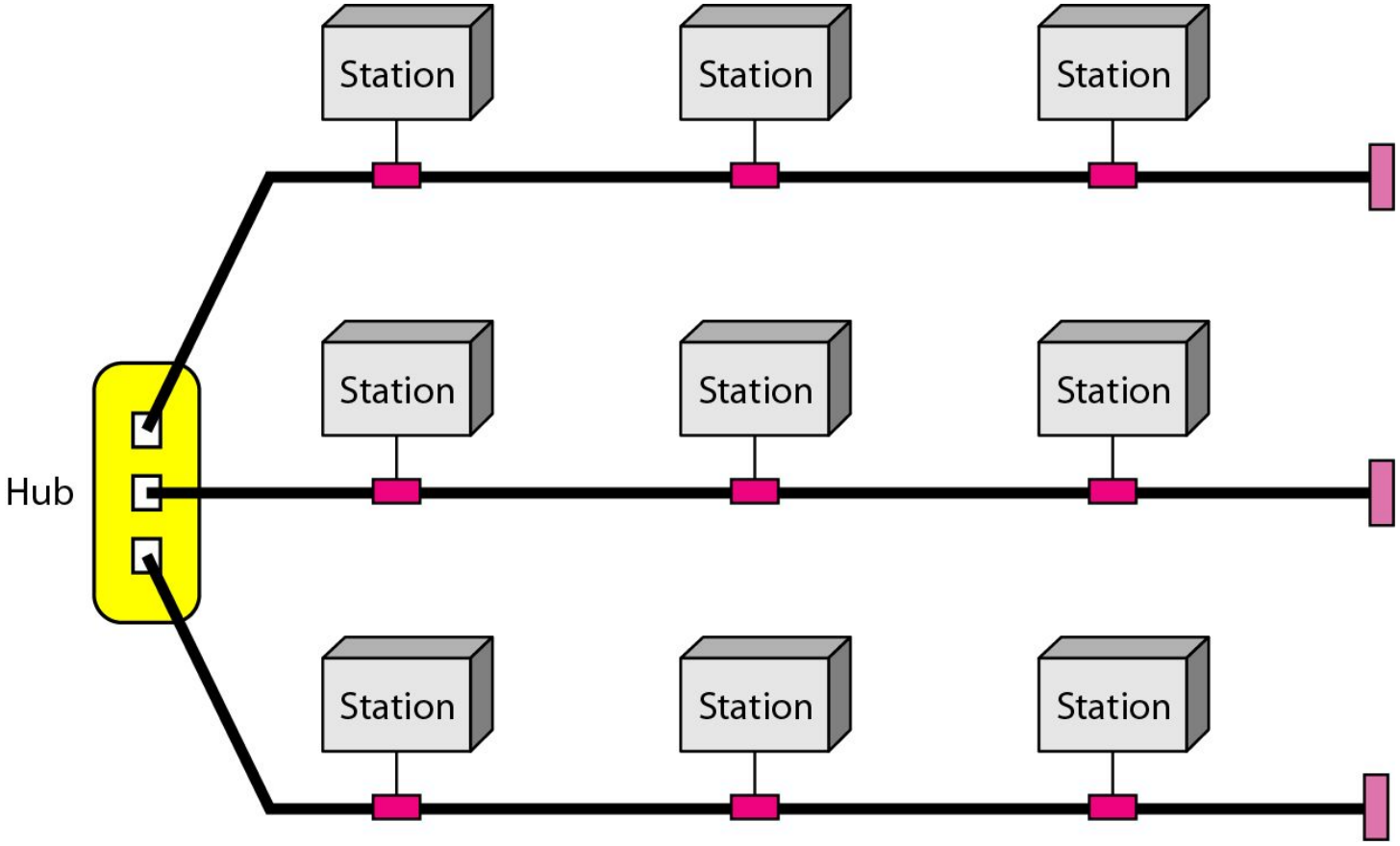
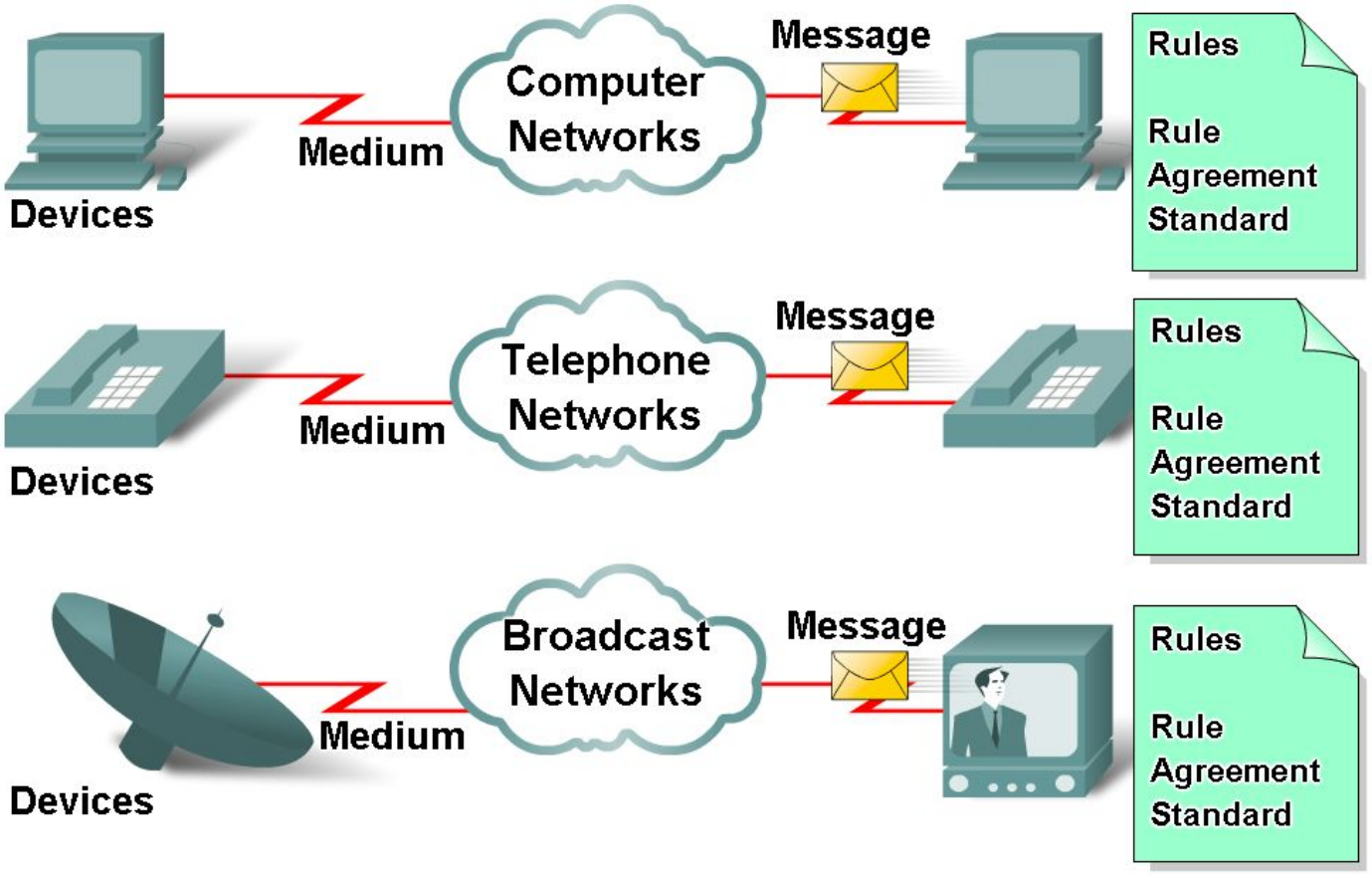


Figure 1.9 *A hybrid topology: a star backbone with three bus networks*

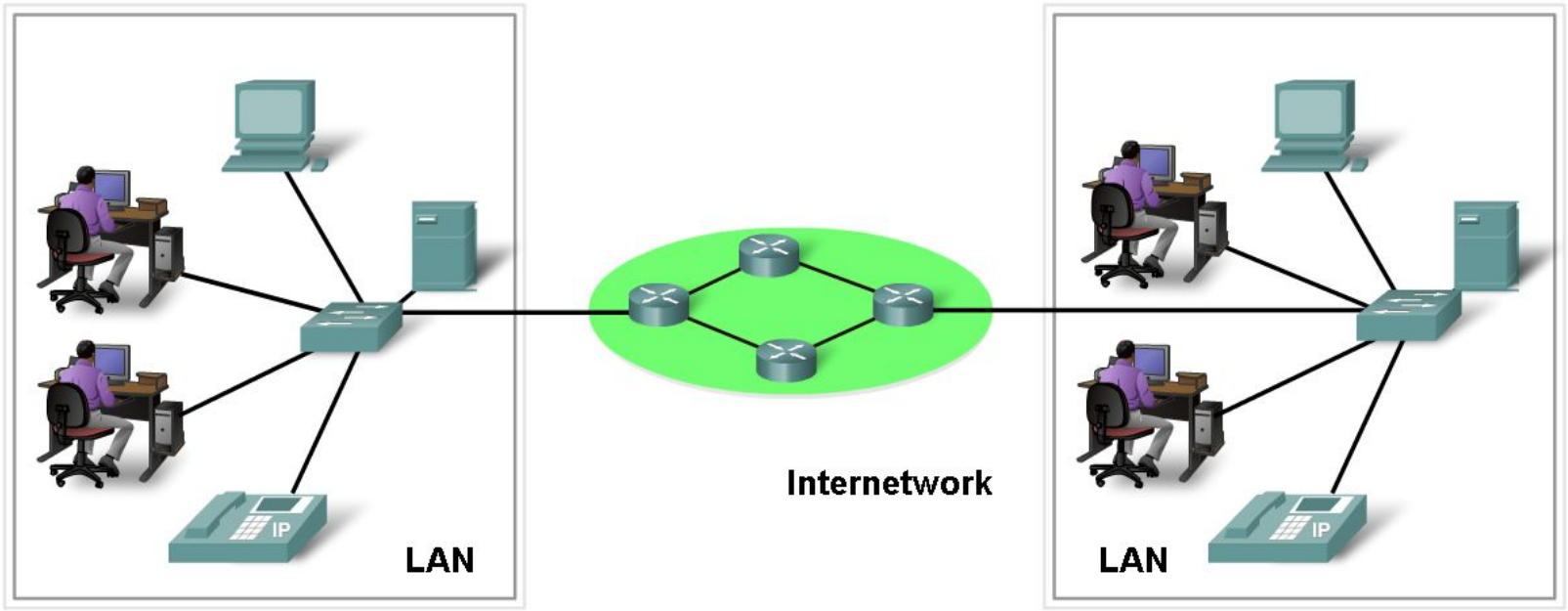


Elements of Communication over Networks

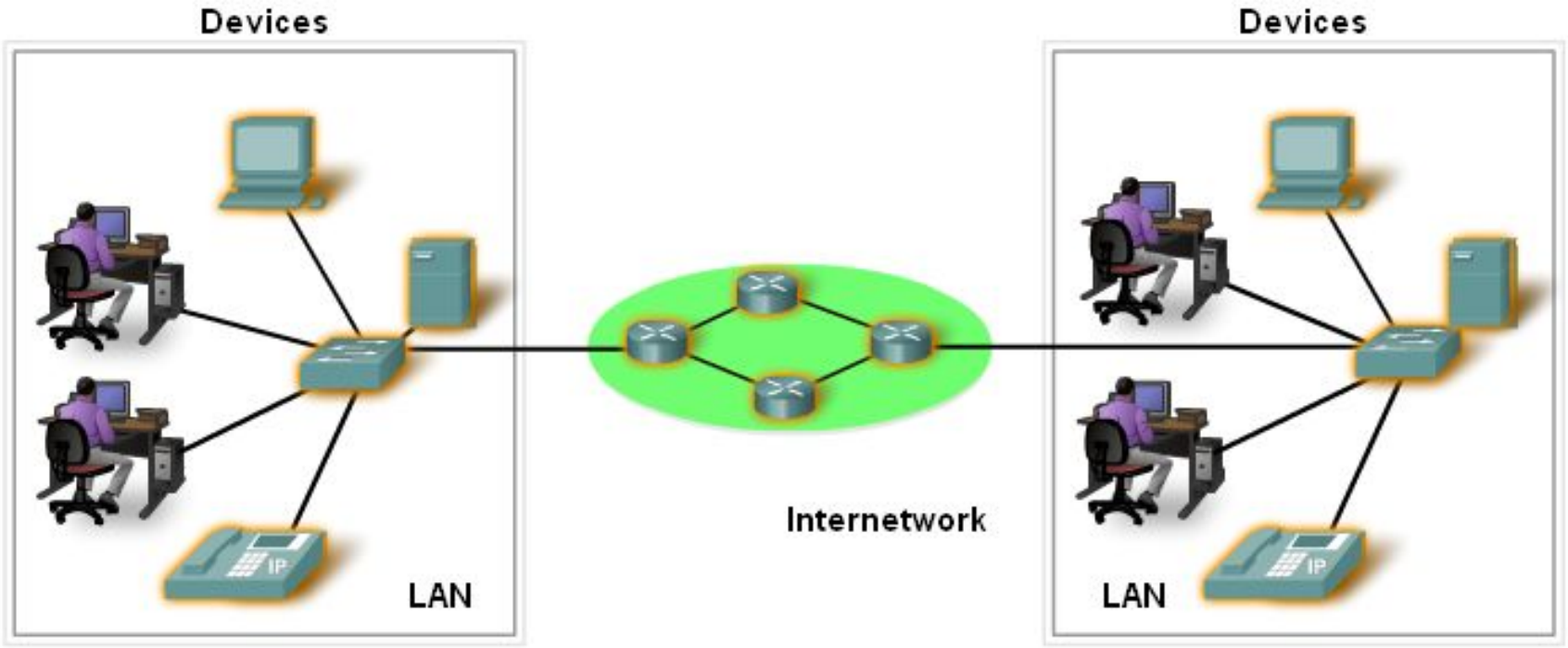


Network Elements/Components

- Network Devices
  - Hardware (Devices and Media)
  - Software (Services and Processes)



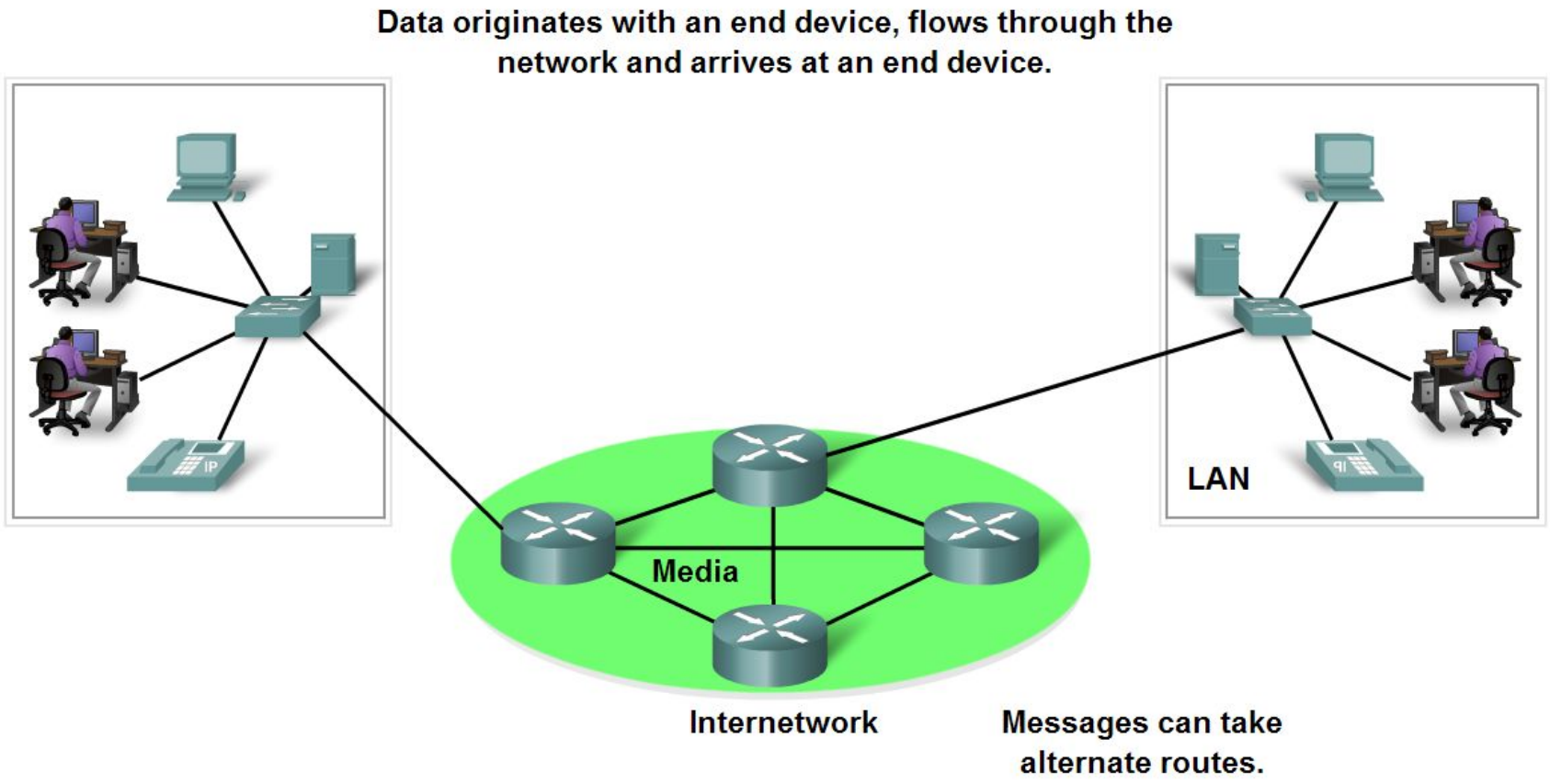
Devices



- Two Types:
  - End Devices
  - Intermediary Devices

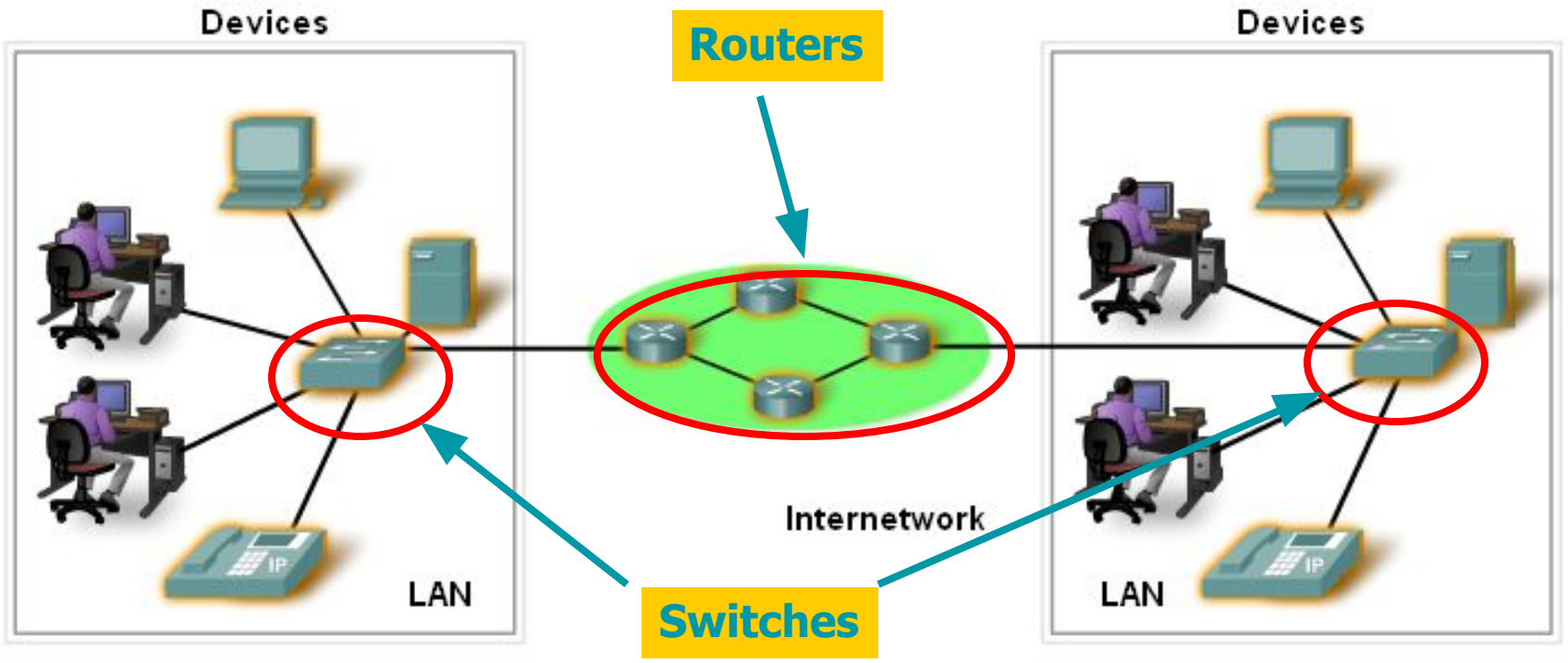
End Devices and their Role

- End devices form interface with human network & communications network



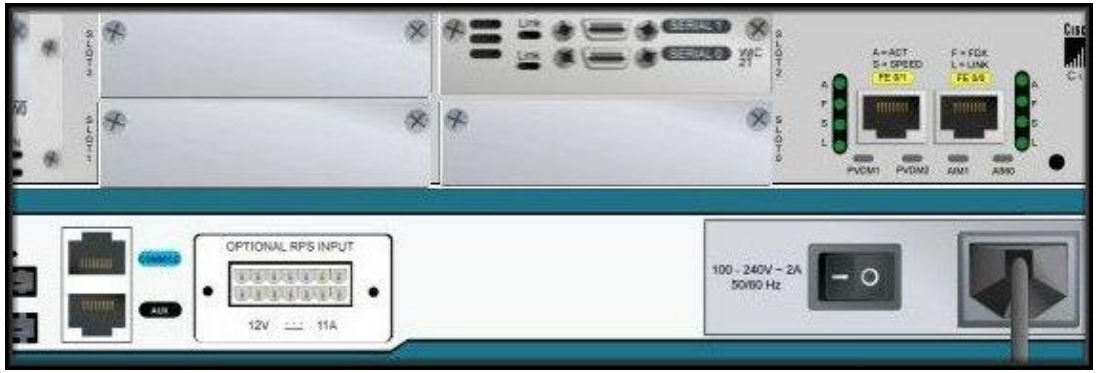
Intermediary devices

- Provides connectivity between end devices.
- Manages data as it flows through the network.
- Examples?



Intermediary devices

Hub



Router

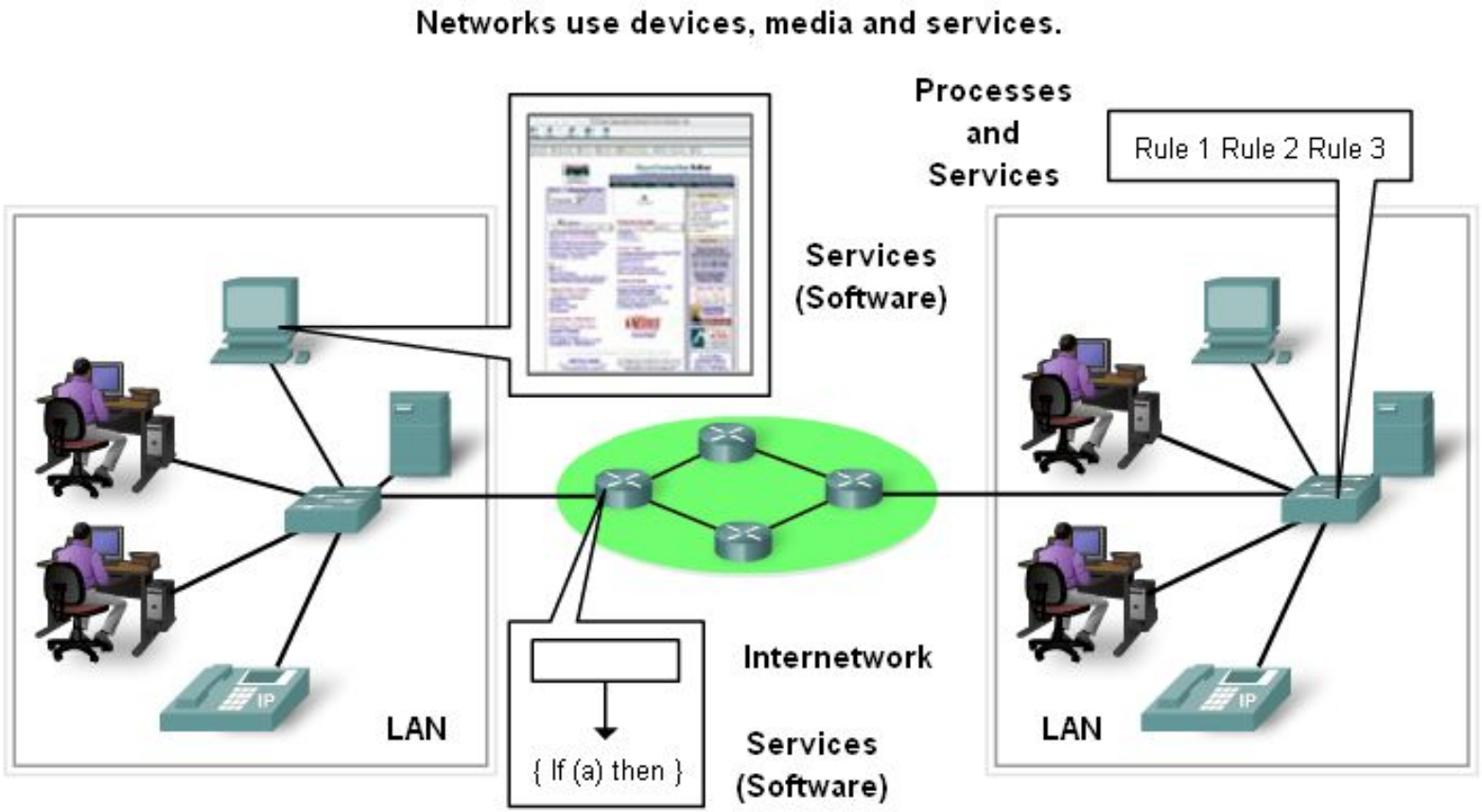
Wireless Router

Switch

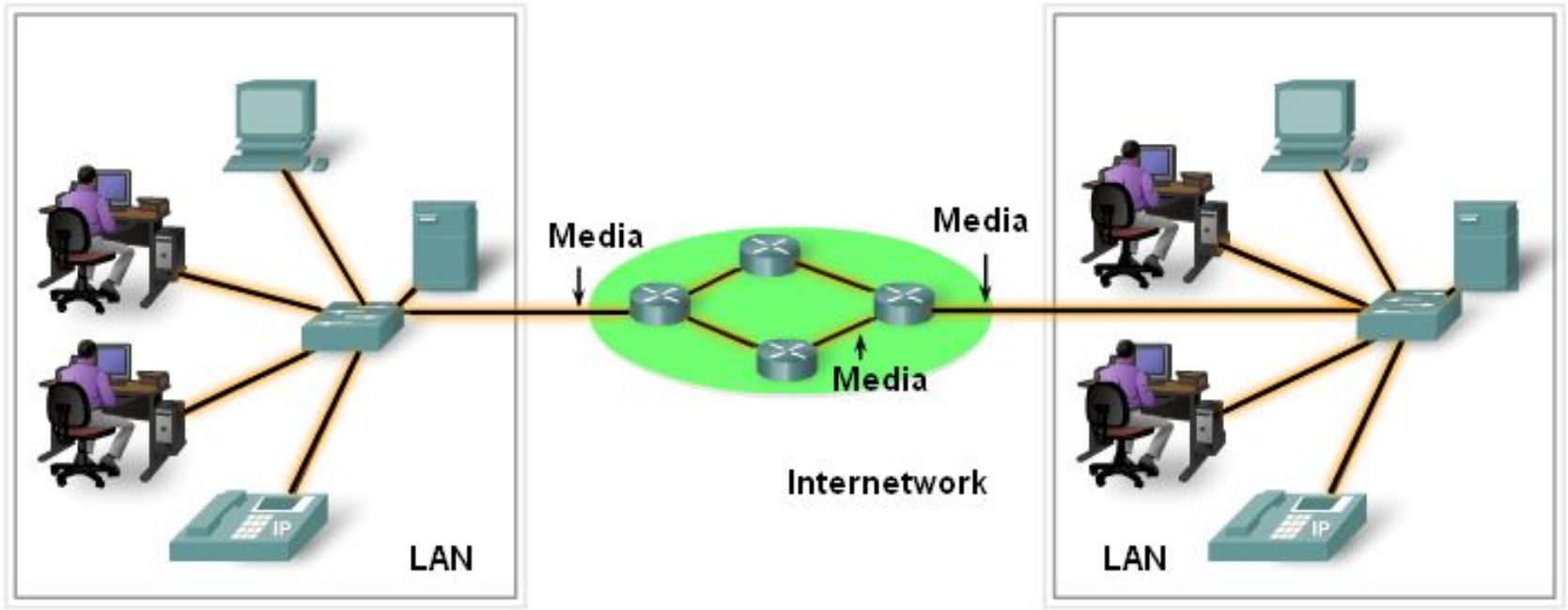
Software

- Services :
  - provides information in response to a request.
  - For example e-mail hosting services and web hosting services.
- Processes :
  - Provide the functionality that directs and moves the messages through the network.
  - Processes are less obvious to us but are critical to the operation of networks.

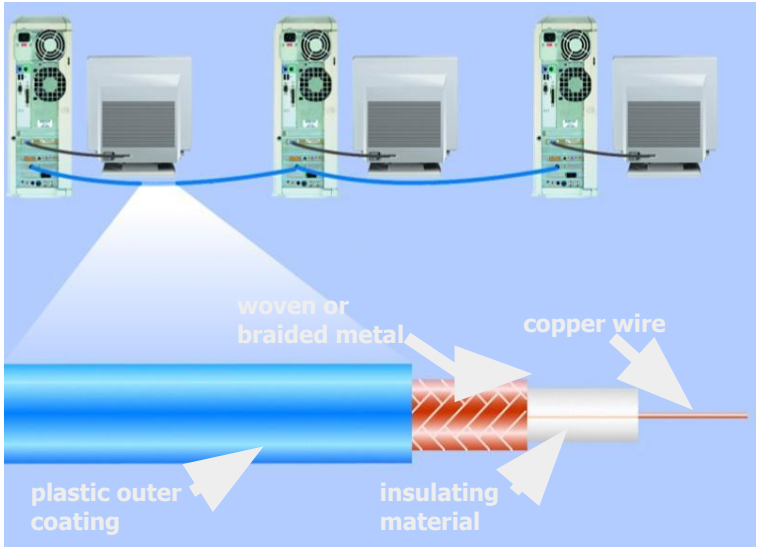
Processes and Services

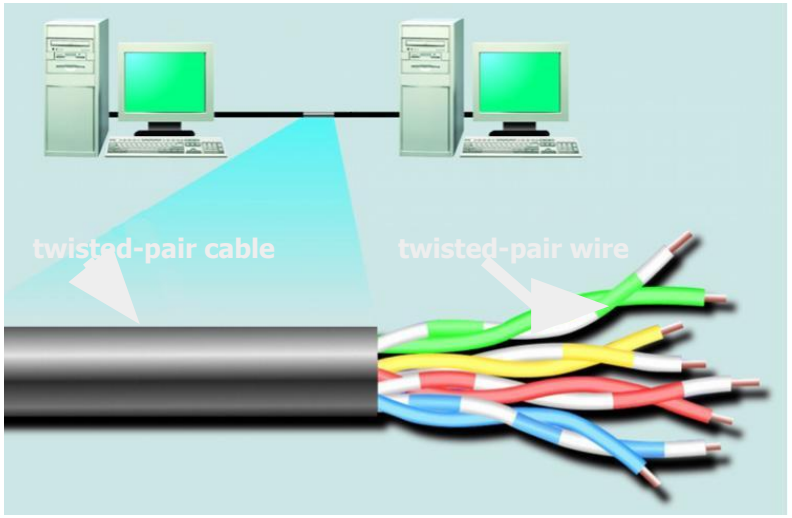


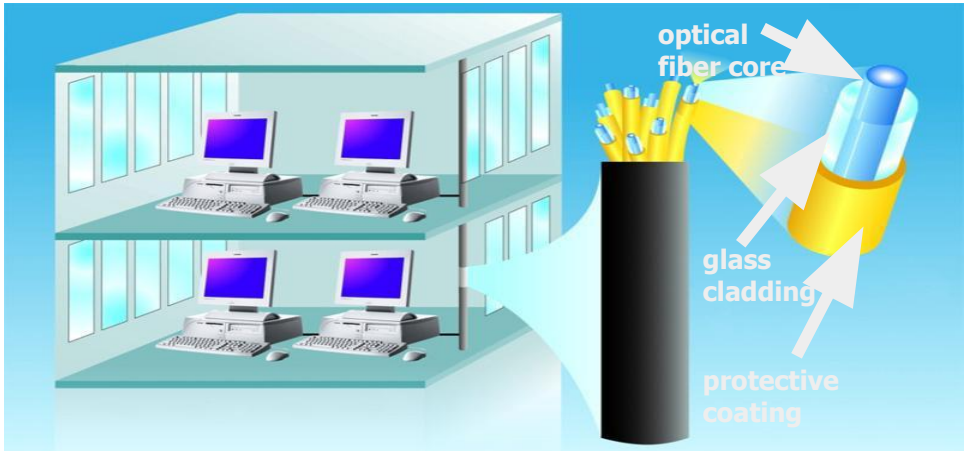
Media



Network Media







Messages- Data Representation

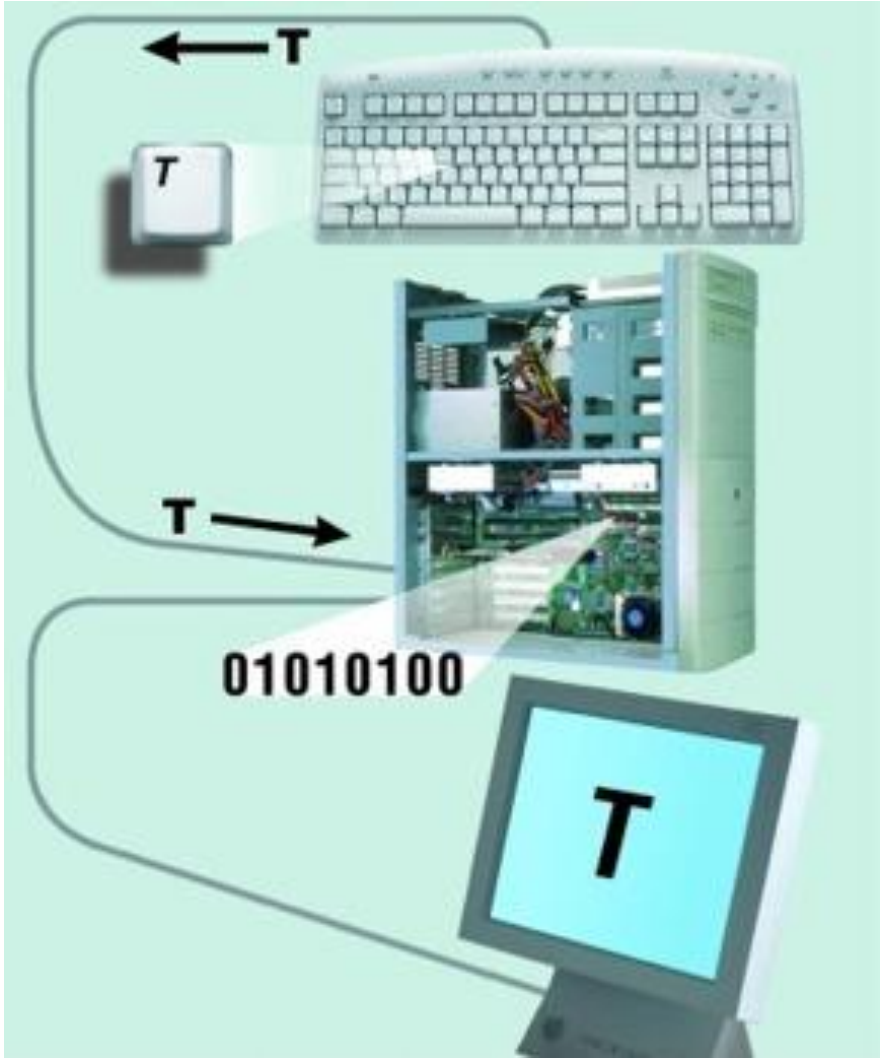
- Information today comes in different forms such as
  - text, numbers, images, audio, and video.

Type of Data	Standards
Alphanumeric	ASCII, Unicode
Image	JPEG, GIF, PCX, TIFF, BMP, etc
Motion picture	MPEG-2, Quick Time, MPEG-4, etc
Sound	Sound Blaster, WAV, AU, MP3, etc..
Outline graphics/fonts	PostScript, TrueType, PDF

Data Representation-Text

- **Text** : Different sets of bit patterns are designed to represent text symbols. Each set is called a code.
  - **ASCII**
    - American Standard Code for Information Interchange: 7-bit code/char, 1 bit for parity.
  - **Unicode** - 16 bit codes to represent a symbol.

Data Representation-Text



Text- Data Representation

ASCII Reference Table

	000	001	010	011	100	101	110	111
0000	NULL	DLE		0	@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EDT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

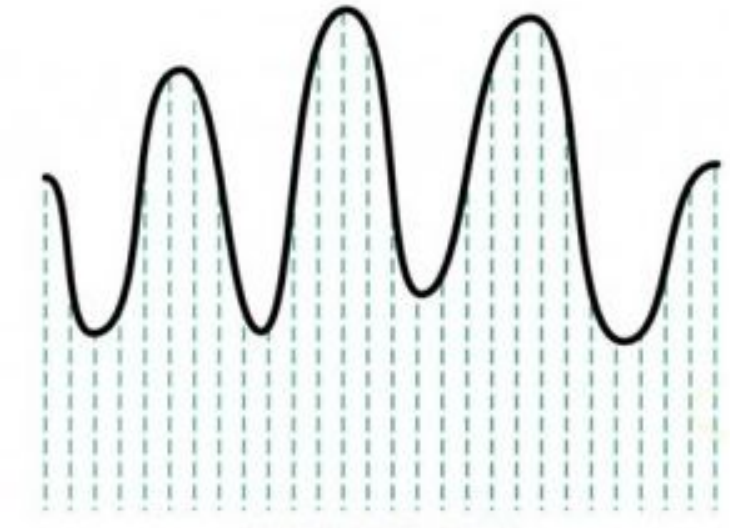
Data Representation

- **Images –**
  - Also represented by bit patterns.
  - Mechanism different. Matrix of Pixels used. Each pixel is assigned to a bit pattern.
  - Color images uses RGB or YCM methods.

RGB Value			Colour
Red	Green	Blue	
0	0	0	black
255	255	255	white
255	255	0	yellow
255	130	255	Pink
146	81	0	brown
157	95	82	purple
140	0	0	maroon

Data Representation

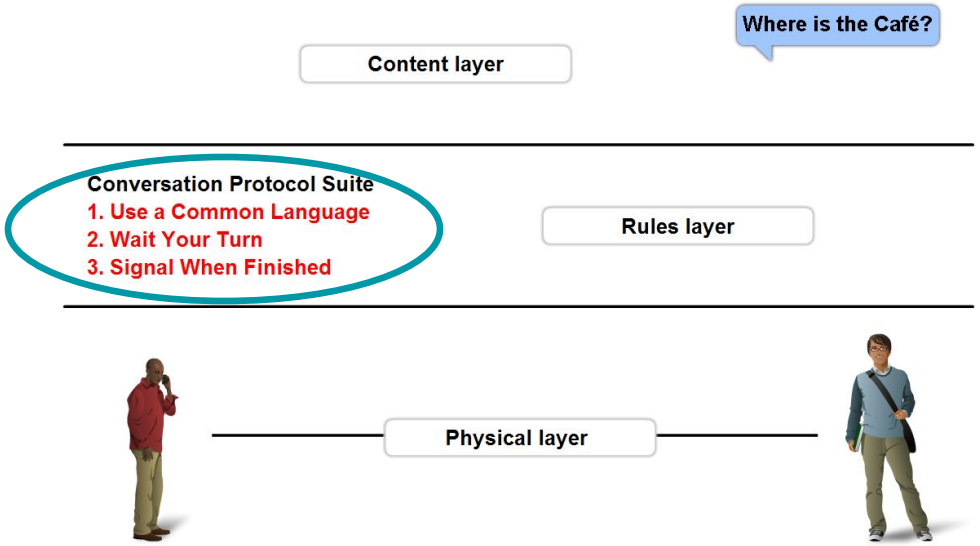
- **Audio**- Continuous, not discrete. Converted to digital or analog signal.



Sampling an audio signal

Rules - Protocols

- A set of predetermined rules that govern communication.
- Defines:
  - What is communicated??
  - How it is communicated??
  - When it is communicated??



Network Types

- PAN
- LAN
- MAN
- WAN

Personal Area Networks (PAN)

- A network that connects computers, peripherals and other devices within a personal operating space.
- Eg. Bluetooth

http://www.conniq.com

Local Area Networks (LAN)

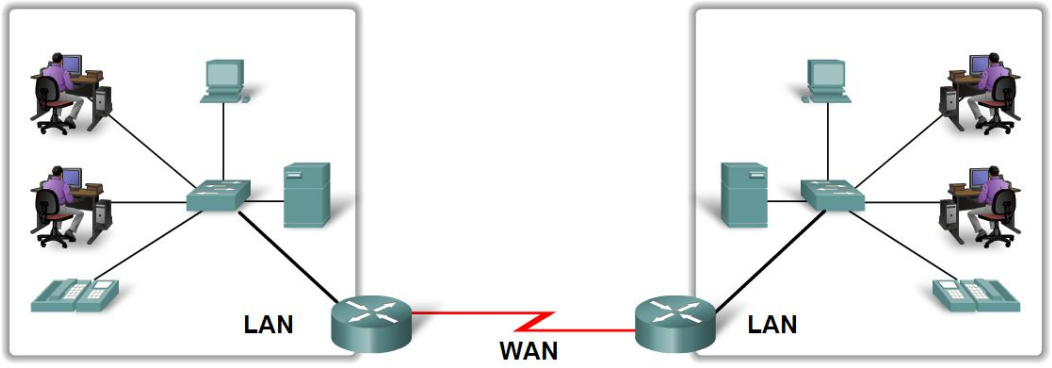
- Connects computers, peripherals and other devices within a building (e.g. office, home) or in a limited area.
- Typical coverage 50 to 300 meters.
- Ex. Ethernet, Wireless LANs

Metropolitan Area Network (MAN)

- Is a city wide network.
- The coverage limitation is not strict, but real implementation may have range of up to 50 km in urban, suburban, or rural area.
- Ex. WiMax

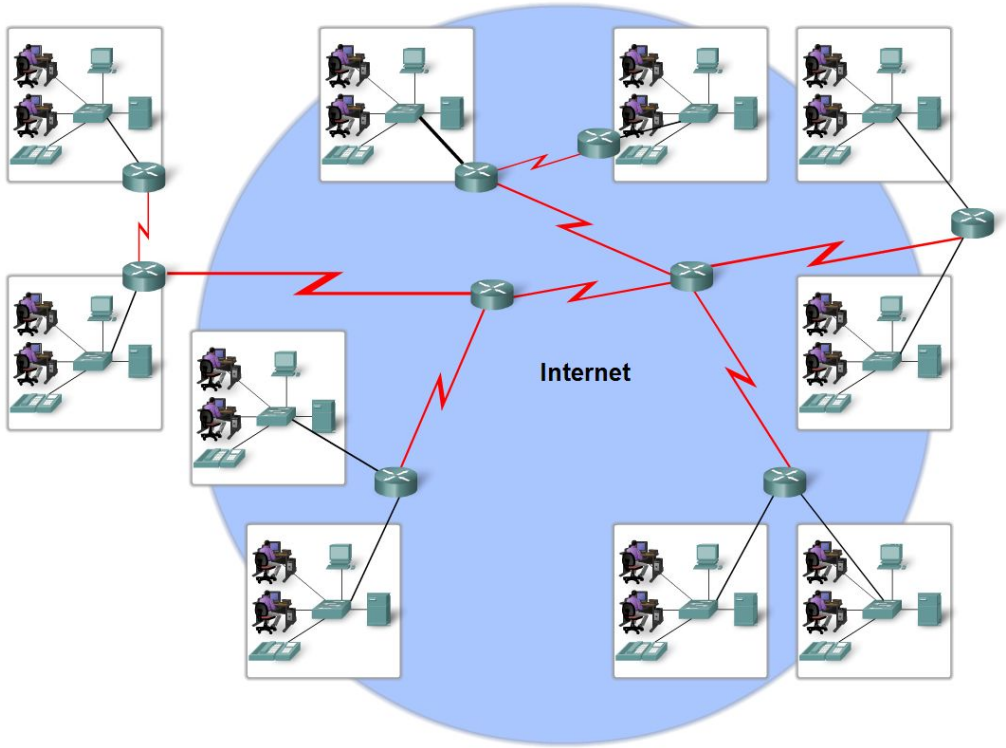
Wide Area Networks (WANs)

- A network that spans larger geographical area.
- LANs separated by geographic distance are connected by a Wide Area Network (WAN)
- PSTN, Cellular Networks (GSM etc)

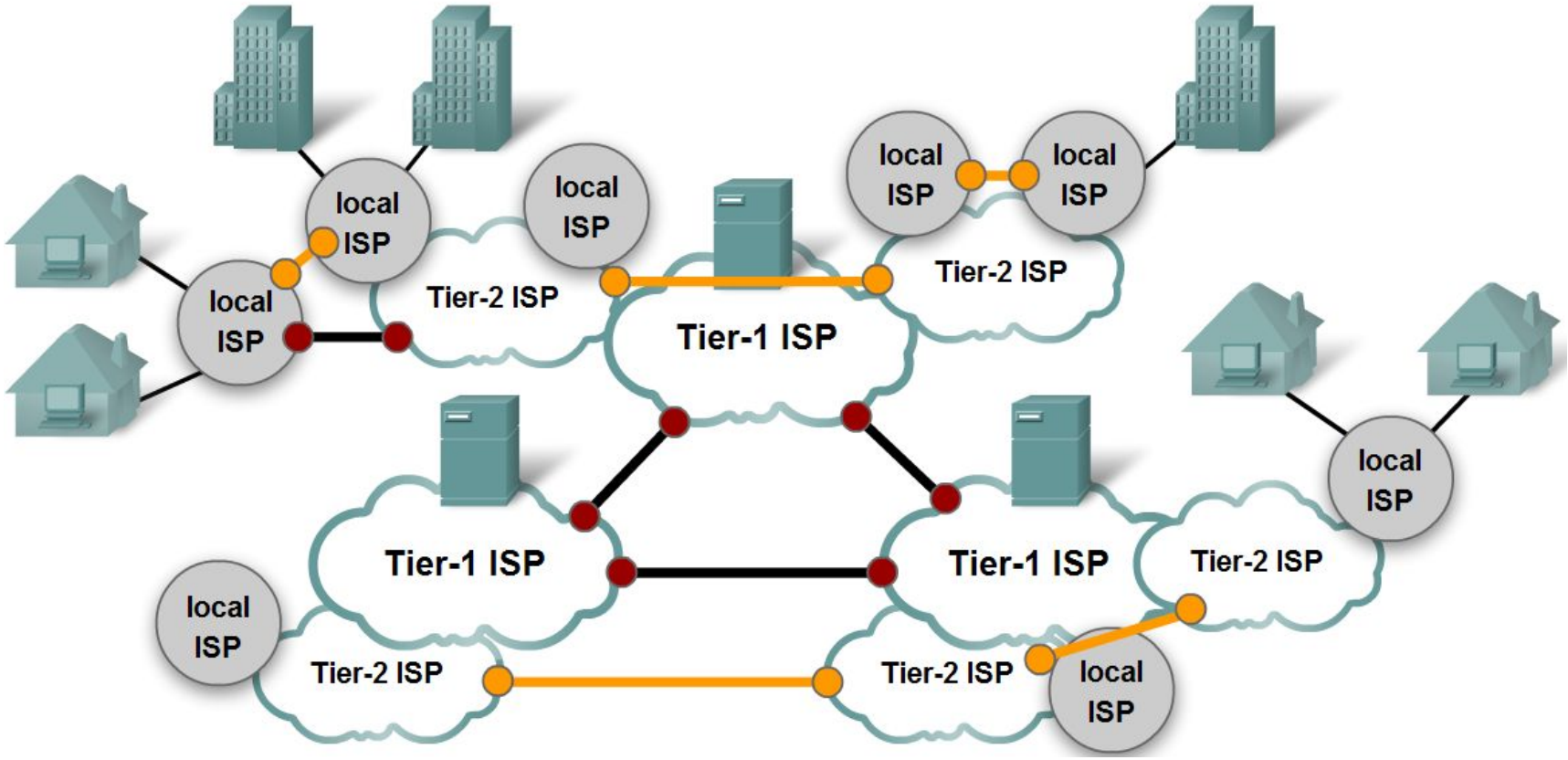


Internet

- The internet is defined as a global mesh of interconnected networks.

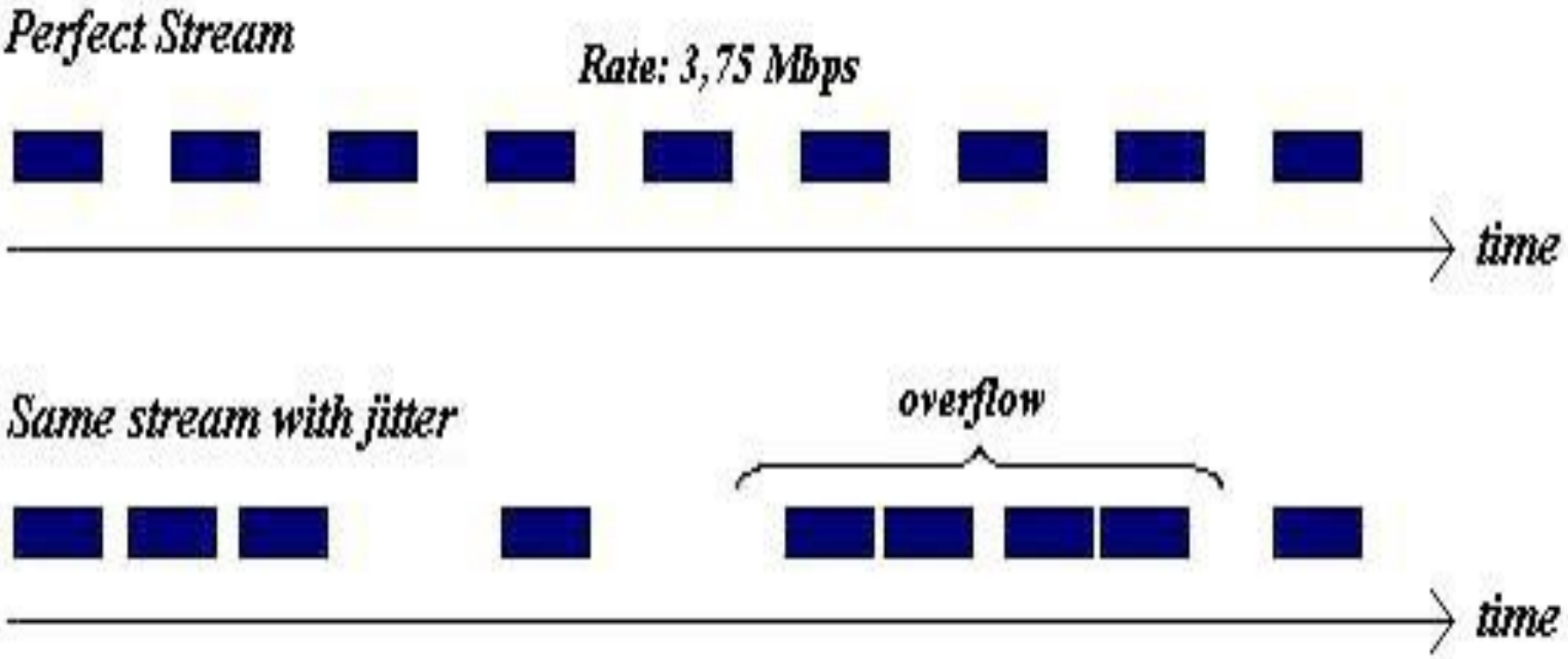


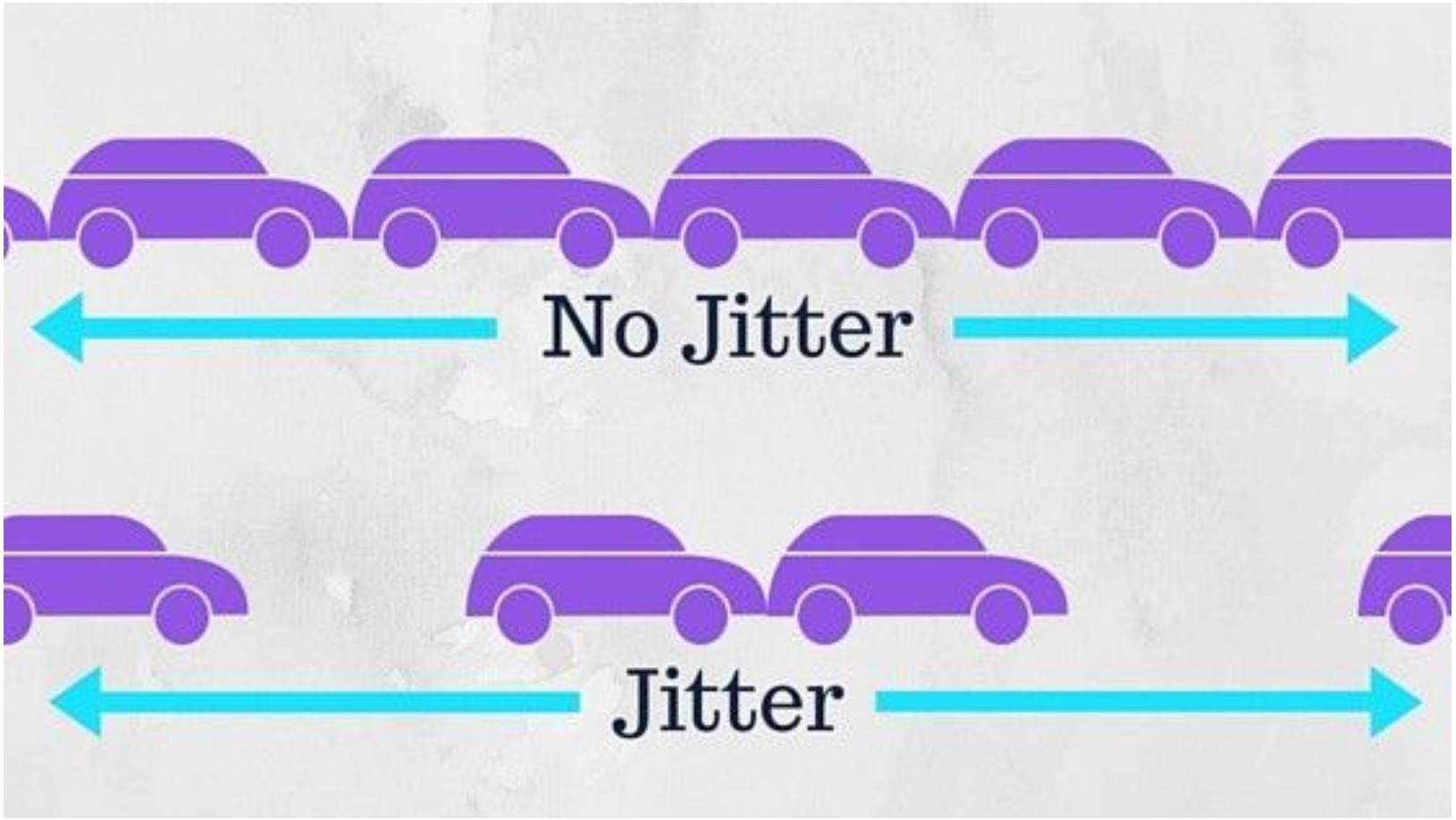
Internet


local ISP
local ISP
local ISP
local ISP
local ISP
local ISP
Tier-2 ISP
Tier-2 ISP
Tier-1 ISP
Tier-1 ISP
Tier-1 ISP
local ISP
local ISP
Tier-2 ISP
Tier-2 ISP
Tier-2 ISP
local ISP

Effectiveness of a system depends upon:

- Delivery
- Accuracy
- Timeliness
- Jitter


Perfect Stream
Rate: 3,75 Mbps
time
Same stream with jitter
overflow
time


No Jitter
Jitter