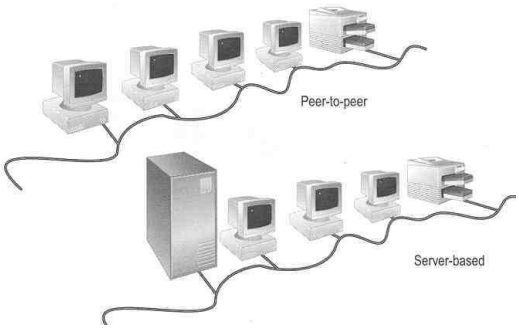
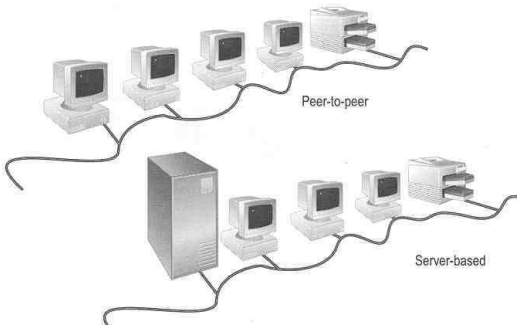
CSC3317: Data Communication & Networks





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1

- Overview
- Types and sources of data. Simple communications network.
- Transmission definitions,
- One way transmission,
- half duplex transmission,
- transmission codes, transmission modes, parallel transmission, serial transmission,
- Synchronisation
  - ✓ bit synchronisation, character synchronisation, character synchronisation, synchronous transmission,
- Asynchronous transmission, efficiency of transmission.
- Introduction to network protocol.
  - Seven Layer ISO-OSI standard protocols and network architecture.
  - Transport protocols, session services protocols, and other protocols.

  Institute of Electrical and Electronics Engineering 802 standards. Error control and Data
- Compression: Forward Error Control; error detection methods.

Local Area Networks: medium access control techniques –
Ethernet, token bus and token ring; fibre distributed data interface, metropolitan area network.
Peer-to-peer,
Client Server. Client-Server Requirements: GUI design standards,
interface independence, platform independence, transaction processing, connectivity, reliability, backup, and recovery mechanisms. Features and benefits of major recovery mechanisms. Network OS: (e.g., Novell NetWare, UNIX/LINUX, OS/2 & Windows NT).
INTERNET: Definition, architecture, services, internet addressing. Internet protocol, IPv4, IPv6.

Brief History of Computer Networks

- 1960's – "How can we transmit bits across a communication medium efficiently and reliably?"
- 1970's – "How can we transmit packets across a communication medium efficiently and reliably?"
- 1980's – "How can we provide communication services across a series of interconnected networks?

3

Brief History of Computer Networks

- 1990's – "How can we provide high-speed, broadband communication services to support high-performance computing and multimedia applications across the globe?"
- 2000's to date - What do you think will dominate in the next 10 years?

4

TODAY'S NETWORKS ARE COMPLEX!

- hosts
- routers
- links of various media
- applications
- protocols
- hardware, software

Tomorrow's will be even more!

5

WHAT ARE THE TRENDS?

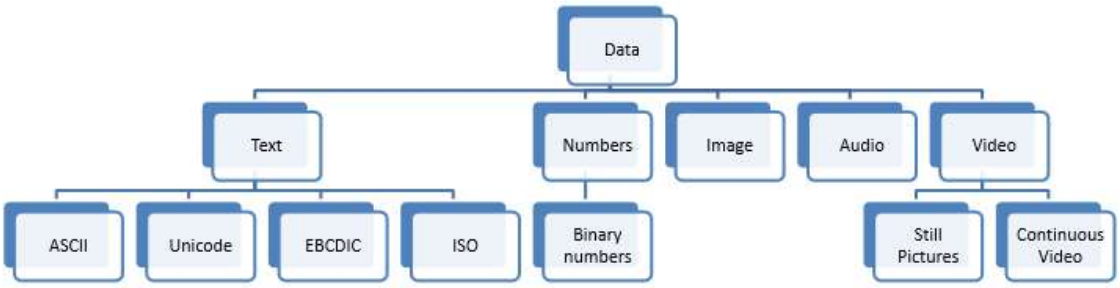
- Three forces are driving the evolution of data communications and networking

1. Growth of communication traffic
   - Voice traffic
     - telephone
   - Data traffic
     - Internet access, video conferencing
   - Challenges (to the network service providers):
     - how to maximize the capacity and minimize the cost?
2. Development of new services
   - Refer to the figure on the next page
3. Advances in technology
   - Faster and cheaper computing and communications
   - Networks are more intelligent: quality of service (QoS)
   - Internet, Web, intranets, extranets, etc.
   - Pervasive computing/ubiquitous computing

6

How data is represented in computer?

- In order to understand data transmission , we need to first understand data types
- Data can be represented using different forms as shown in figure



1. Text

- A binary digit or bit can represent only two symbols as it has only two states “0” and “1”.
- For communication between two computers we need many more symbols for communication. These additional symbols are :
  1. *26 alphabets with capital and small letters.*
  2. *Numbers from 0 to 9.*
  3. *Punctuation marks and other symbols*.
- Therefore instead of using only single binary bits, a group of bits is used as a code to represent a symbol.

- The numbers of bits used per code word will be dependent on the total number of symbols to be represented e.g. if 5-bits used per code word then $2^5 = 32$ combination would be possible.
- If the word length is increased to 8 then the number of combination would be $2^8 = 256$, hence an 8-bit code can represent 256 symbols.

Different Text codes used for representation are as follows :

1. *ASCII*
2. *EBCDIC*
3. *Baudot code*
4. *Extended ASCII*
5. *Unicode*
6. *ISO*

ASCII – (American standard code for information interchange) (7 bit Code)

- It is defined by American national standards institute (ANSI).
- It is a 7 bit code with 2^7 i.e. 128 possible combinations and all of them have defined meanings.
- The ASCII code set consists of 94 printable characters, SPACE and DEL etc. characters, and 32 control symbols.

Figure: ASCII Table

Bit Numbers 7 6 5 / 4321		000	001	010	011	100	101	110	111
		0	1	2	3	4	5	6	7
0000	0	NUL	DLE	SPACE	0	@	P		p
0001	1	SOH	DC1	!	1	A	Q	a	q
0010	2	STX	DC2	"	2	B	R	b	r
0011	3	ETX	DC3	#	3	C	S	c	s
0100	4	EOT	DC4	$	4	D	T	d	t
0101	5	ENO	NAK	%	5	E	U	e	u
0110	6	ACK	SYN	&	6	F	V	f	v
0111	7	BEL	ETB	'	7	G	W	g	w
1000	8	BS	CAN	(	8	H	X	h	x
1001	9	HT	EM	)	9	I	Y	i	y
1010	A	LF	SUB	*	:	J	Z	j	z
1011	B	VT	ESC	+	;	K	[	k	{
1100	C	FF	FS	,	<	L	\	l	|
1101	D	CR	GS	-	=	M	]	m	}
1110	E	SO	RS		>	N	^	n	~
1111	F	SI	US	/	?	O	__	o	DEL

EBCDIC – Extended binary coded decimal interchange code (8bit Code) :

- This is an 8-bit code. So the total no of combinations are $2^8 = 256$. However, all the possible combination are not used.
- There is no parity bit used to check error in the basic code set.
- The EBCDIC code set is shown in table.

- **Extended ACSII (8 bit code):**
- In order to make the size of each code word 1 byte (8 bits) the ASCII patterns are augmented by an extra 0 at the left (MSB position).
- **Unicode (16 Bit Code) :**
- It is a 16 bit code which can represent upto 2^{16} (65,536) symbols.
- It allows the representation of English language in the coded form directly.
- **ISO (32 bit Code) :**
- ISO is the long form of international organization of Standardization. It has designed code of 32 bits.

2 Numbers

- The numbers are represented using bit patterns.
  - The most popular code ASCII is used to represent numbers.
  - The code EBCDIC is also used for this purpose.
- This will simplify the mathematical operations on numbers to a great extent.

3 Images

- Image is another form of data. They also are represented by bit patterns but with a different mechanism.
- *The basic principle is as follow. An image is divided into a matrix of pixels (pixel means picture element).*

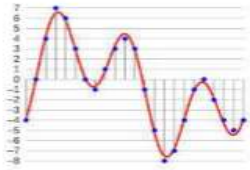
- *Each pixel is in the form of a small dot.* We can use a large number of pixels for better resolution.
- Higher resolution ensures better quality of picture.
- *After dividing the image into pixels, each pixel is represented by a unique bit pattern.*
- For black and white image one 1 bit per pattern is sufficient to represent a pixel.
  - *1 will represent white and 0 will represent black.*
- If the gray shades are to be included then we can use 2 bit pattern to represent each pixel.
  - *00 is black,*
  - *01 is dark gray,*
  - *0 is light gray and*
  - *11 represent white.*

- If a colored image is to be represented, then each colored pixel is decomposed into three primary colors namely Red, Green, Blue (RGB) as shown in figure.
- Example of some images format are JPEG,JIFF, JPEG 2000, TIFF, RIF, GIF, PNG.

4. Audio

- Audio can be understood same as sound. It is continuous with respect to time and not discrete like the text or numbers.
- Microphone is used to convert sound into an equivalent electrical signal. The audio should be converted into a digital single before transmitting it over the medium.
- Example of audio data format include WAV, WMA, Mp3, MIDI, 3gp,raw.

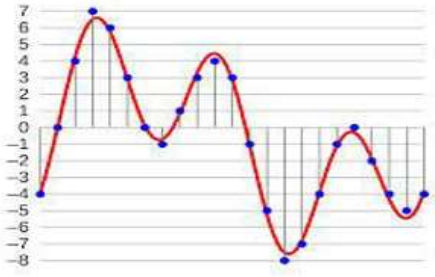
Microphone



Sound Waves

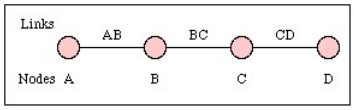
5. Video

- The video can be either a combination of images or it can be a continuous entity (by a TV camera).
- We have to change video signal into a digital signal for transmitting it via data communication system.
- Example : .avi, .mov, .wmv, .mp4, .m4p, .mpeg, .mpg, .3gp.



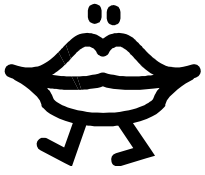
EARLY COMMUNICATIONS SYSTEMS

- I.e. telephone
- point-to-point links
- directly connect together the users wishing to communicate
- use dedicated communication circuit
- if distance between users increases beyond the length of the cable, the connection is formed by a number of sections connected end-to-end in series.



19

HUMAN COMMUNICATIONS



- A transmitter: mouth
- A receiver: ear
- The media: air
  - Question: Can you talk at outer space?
- The protocol: a common human language
  - Question: why do we learn English?

20

WHAT IS A DATA

Data is defined as the entities that convey meaning or information. The data is represented in electric or electromagnetic Signals.

• Data can be two types :

1. Analog data 2. Digital data

Analog Data : • Analog data is the type of data that varies continuously (smoothly) with respect to time. Voice and Video are the best examples of analog data. The other examples are temperature, pressure etc.

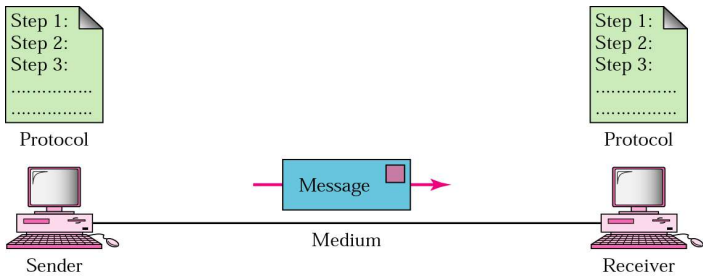
Digital Data : • Digital data is the type of data that can take on

What is data communication?

- The aim of data communication and networking is to facilitate the exchange of data such as audio, text, video between any points in the world
- The word **Data** refers to the information which is presented in a form that is agreed by the users and creators of data.
- **Data communication** is the exchange of data between two devices via some form of transmission medium, e.g. Computer to Computer, Computer to printer, sending email, browsing internet sites such as Facebook, Instagram, twitter & LinkedIn etc.

7

FIVE COMPONENTS OF DATA COMMUNICATION



1. Message
2. Sender
3. Receiver
4. Medium
5. Protocol

23

1. Message •

- Message is nothing but information or data which is to be sent from one point to the other
- A message can be in the form of sound, text, number, picture, video or combination of them.

2. Sender •

- Sender is the device which sends the message.

3. Medium •

- It is the physical path over which the message travels from the sender to the receiver, it can be wired or wireless.

4. Receiver

- It is the device which receives the message.

5. Protocol •

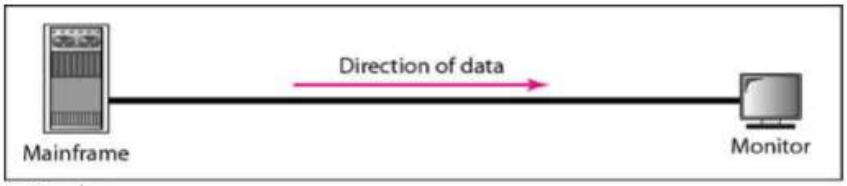
- Protocol is defined as the set of rules which govern data communication. •
- The connection of two devices takes place via the communication medium, but the actual communication between them will take place with the help of protocol.

FUNDAMENTALS CHARACTERISTICS OF DATA COMMUNICATION?

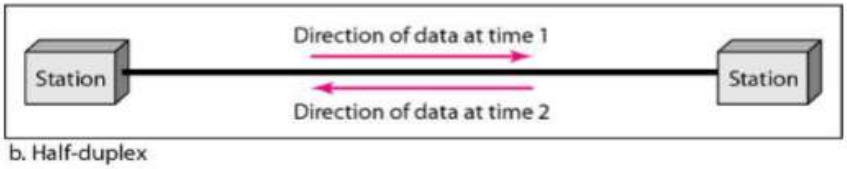
The fundamental characteristics of a Data communication system are:

1. **Delivery**
   - ❖ The data should be delivered to the correct destination. It should reach only to the intended user and not to any other.
2. **Accuracy**
   - ❖ There is a possibility of data alternation or corruption when it is travelling over a communication medium. This will affect the accuracy of the received data.
   - ❖ The data communication system should be such that it should deliver data accurately.
3. **Timelines**
   - ❖ For the audio and video data, the system should deliver the data in a timely manner i.e. deliver as it is produced without any time delay.
   - ❖ Such a data delivery is called as real-time transmission of data.

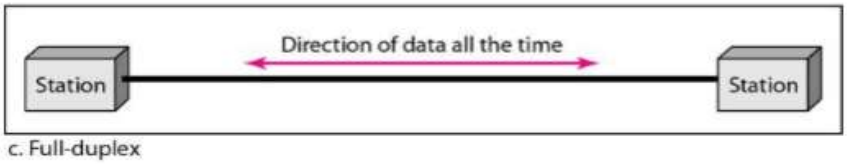
DATA FLOW (SIMPLEX, HALF-DUPLEX, AND FULL-DUPLEX)



a. Simplex



b. Half-duplex

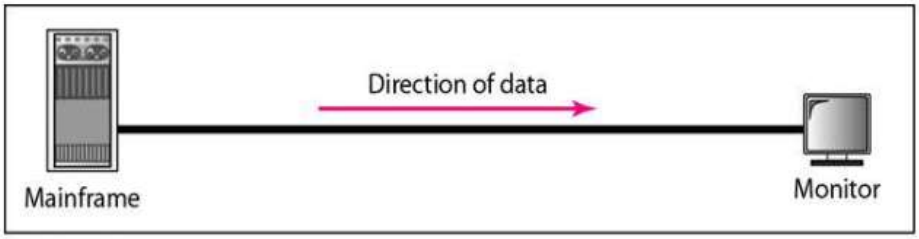


c. Full-duplex

Simplex:

In simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit; the other can only receive.

Examples:- Keyboards and traditional monitors are examples of simplex devices. The keyboard can only introduce input; the monitor can only accept output. The simplex mode can use the entire capacity of the channel to send data in one direction.

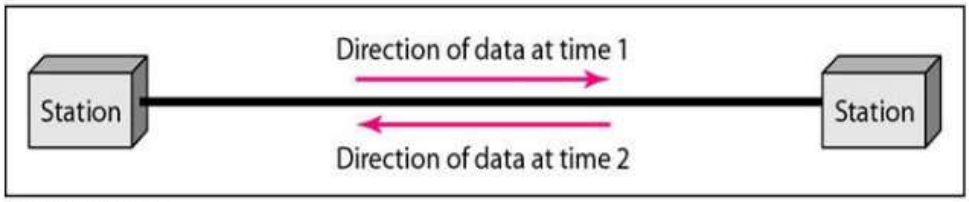


a. Simplex

Half-Duplex:

In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa.

Examples:-When cars are traveling in one direction, cars going the other way must wait. In a half-duplex transmission, the entire capacity of a channel is taken over by whichever of the two devices is transmitting at the time. Walkie-talkies is half-duplex systems.

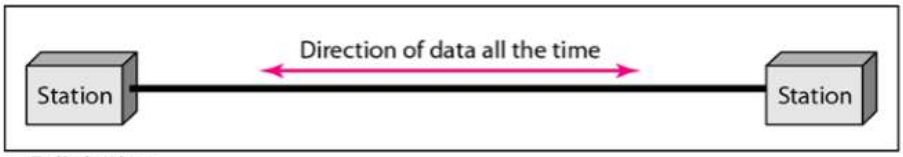


b. Half-duplex

Full-Duplex:

In full-duplex both stations can transmit and receive simultaneously. The full-duplex mode is like a two-way street with traffic flowing in both directions at the same time. In full-duplex mode, signals going in one direction share the capacity of the link: with signals going in the other direction.

Example:- full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time. The full-duplex mode is used when communication in both directions is required all the time. The capacity of the channel, however, must be divided between the two directions.



c. Full-duplex