

LECTURE #1

Course Outline

♦ **The course will consist of :**

- 45 lectures
- 10-14 assignments
- 2exams (1 midterm and 1 final)
- GMDB

♦ **Grading Criteria:**

- One Midterm: 35 %
- Final Exam: 45%
- Assignments: 15%
- GMDB: 5%

Textbook

- ♦ **“Data Communications and Networking” 2nd Edition by Behrouz A. Forouzan**
- ♦ **“Data and Computer Communication” 6th Edition by William Stallings**

INTRODUCTION TO DATA COMMUNICATION

DEFINITION OF DATA COMMUNICATION

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

DEFINITION OF DATA COMMUNICATION (Cont'd)

As you can clearly notice, the definition of Data Communication although Simple leaves many questions unanswered:

- Exchange?????
- Information????
- Entities??????
- Transmission????
- Medium????

We will try to answer all these Questions in this Course

History of Data Communication

Data communications history represents a blend of histories, including:

- The history of the telecommunications industry
- The history of data communications, and
- The history of the Internet

❖ Telegraph 1837 Samuel Morse

Modern telecommunication industry began in 1837 with the invention of the telegraph by Samuel Morse

This led to building a telecommunications infrastructure of poles and wires as well as to the development of communication hardware and protocols

❖ Telephone 1876 Alexander Graham Bell

Invention of telephone by Alexander Graham Bell in 1876 and the development of wireless communication technology by Guglielmo Marconi in the 1890s set the stage for today's communication industry

❖ By 1950's

By 1950s, telephone and telegraph companies had developed a network of communication facilities throughout the industrialized world

❖ 1970'S

Although development of databases, languages, operating systems, and hardware was strong from 1950s to 1970s, large-scale data communication systems did not emerge until the 1970s.

This was stimulated by 3 major developments:

- Large-scale integration of circuits reduced cost and size of terminals and communication equipment
- New software systems that facilitated the development of data communication networks
- Competition among providers of transmission facilities reduced the cost of data circuits

TODAY'S EVERGHANGING & BUSY WORLD

- Today's fast world demands better, secure and most of all FAST ways of communication
- Gone are the days when you had to wait a couple of weeks to get a letter from USA
- Why wait ONE week when you can get the information you require in just a split of a second, using what we know by the name of "**DATA COMMUNICATION**".

HOW TO ACHIEVE THIS?

- How to achieve this ACCURACY, SECURITY and SPEED for the transfer of this information?
- What HARDWARE, and the SOFTWARE is needed ?
- And, what should be the MEANS of sending this info?

ARE SOME OF TOPIC WE WILL BE EXPLORING DURING THE COURSE OF OUR STUDY

DATA COMMUNICATION

- When we communicate , we share information
- Information can be LOCAL or REMOTE
- Between Individuals LOCAL communication occurs face to face
- REMOTE communication occurs over a long distance
- When we refer to COMPUTER SYSTEMS, Data is represented in the form of Binary Units (Bits) in the form of Zeros (0's) and One's (1's)
- Also the entities can most of the times be considered to be COMPUTERS

Data Communication Definition (Modified)

Therefore , our earlier definition can easily be modified to:

“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.”

LOCAL and REMOTE Data Communication

❖ **LOCAL**

Data communication is considered to be local if the communicating devices are present in the same building or a similarly restricted geographical area

❖ **REMOTE**

Data Communication is considered remote, if the devices are farther apart.

VAGUE DEFINITIONS

We will clarify

Data Communication System

For Data Communication to occur, the communicating devices must be a part of a communication system made up of some specific kind of hardware and software

This type of a system is known as a

“DATA COMMUNICATION SYSTEM”

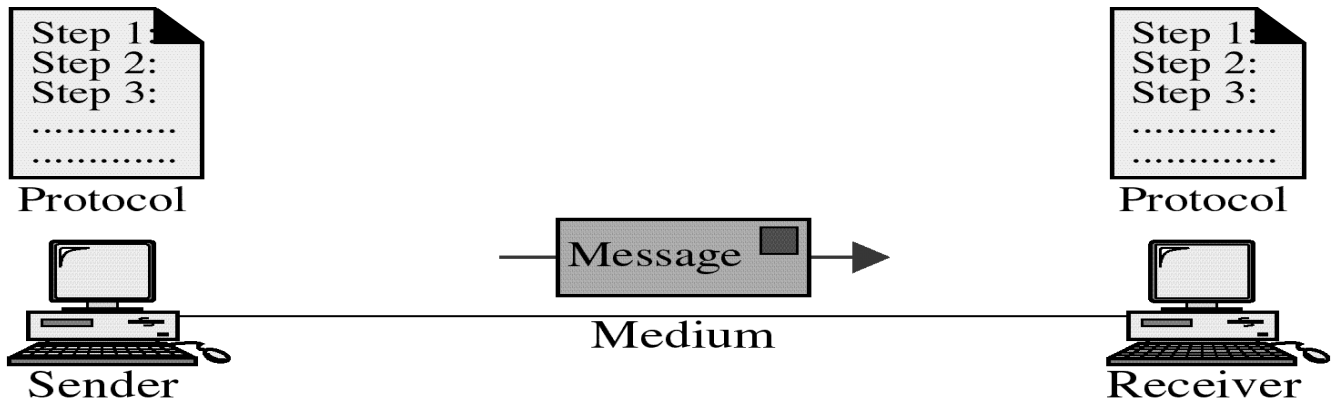
Effectiveness of Data Comm. System

Effectiveness depends upon three fundamental characteristics:

- Delivery
- Accuracy
- Timeliness (Better NEVER than LATE)

✓ Example of the POSTAL MAIL

Components of a Data Comm. Systems



Components of a Data Com Systems

Any system is made up of more than one component. Similarly, a data communication system is made up of 5 components as shown in the fig:

- Message
- Sender
- Receiver
- Medium
- Protocol

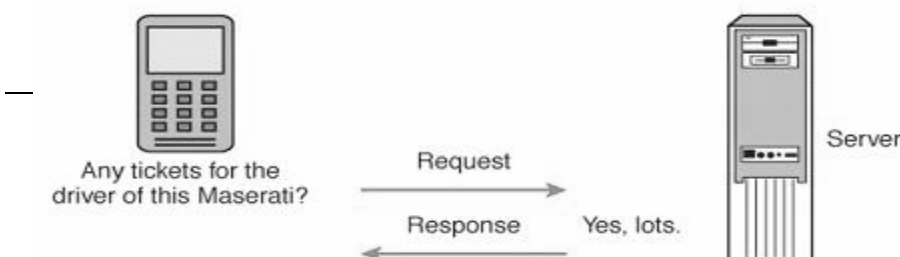
❖ MESSAGE

- Information or Data to be communicated
- Can be text, numbers, video or any combination of these
- In short anything that can be represented using binary bits

Data Communication Messages

- ✓ **Files** (meaningful collections of records)
- ✓ **Data/information requests** (database queries, Web page requests, etc.)
- ✓ **Responses** to requests and commands or error messages
- ✓ **Status messages** (about the network's functional status)
- ✓ **Control messages** transmitted between network devices to control network traffic
- ✓ **Correspondence** among network users

MESSAGE TYPES



❖ **SENDER**

- Device that sends the data message
- Can be a Computer , Workstation, Video camera etc
- As already discussed, the data from the sender might not be in the appropriate format for the transmission medium and will need to be processed

❖ **RECEIVER**

- Device that receives the message
- Can be a computer, workstation, Television etc
- At times, the data received from the transmission medium may not be in a proper form to be supplied to the receiver and it must be processed

❖ **MEDIUM**

- Physical path that a message uses to travel from the Sender to the Receiver
- Can be a Copper Cable (Telephone), Coaxial Cable (Cable TV), Fiber Optic Cable, LASERS or Radio Waves (Wireless Medium)
- We will see that Data needs to be transferred in the form of ELECTROMAGNETIC signals and The Transmission Medium should be capable of carrying these EM Signals
- Transmission Media

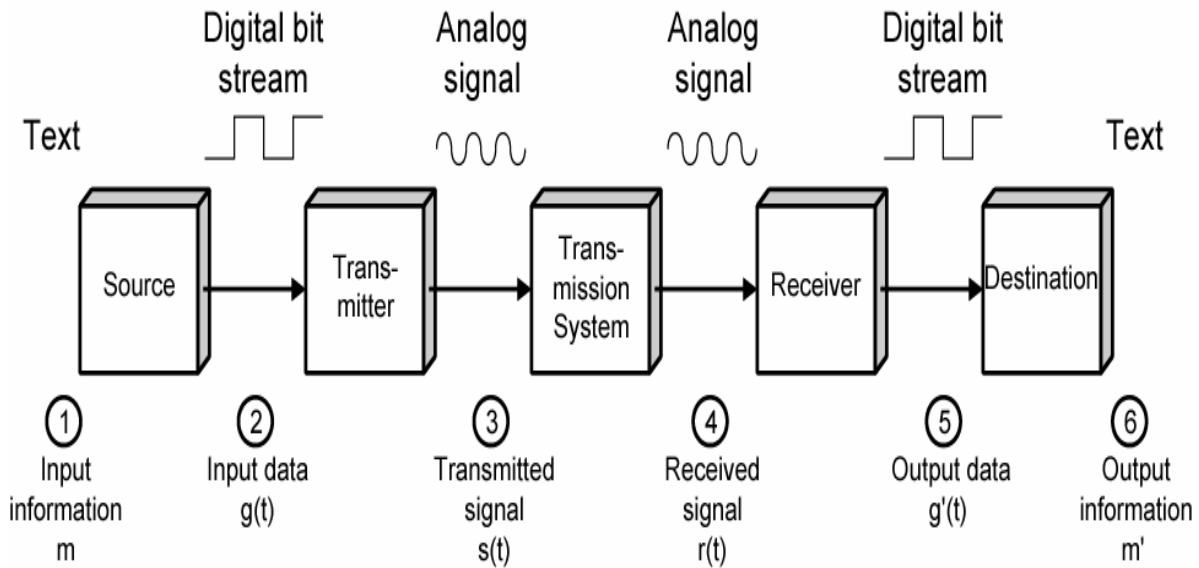
<u>Transmission Media</u>		
<u>Medium</u>	<u>Speed</u>	<u>Cost</u>

<u>Twisted Wire</u>	<u>300bps-10Mbps</u>	<u>Low</u>
<u>Microwave</u>	<u>256Kbps-100Mbps</u>	<u>Low</u>
<u>Coaxial Cable</u>	<u>56Kbps-200Mbps</u>	<u>Low</u>
<u>Fiber Optic Cable</u>	<u>500Kbps-10Gbps</u>	<u>High</u>

❖ **PROTOCOL**

- Set of Rules Governing Communication
 - Represents an Agreement between communication devices
 - Without Protocol, two devices may be connected but they will not be able to communicate
- ✓ **EXAMPLE:** Consider the communication between two individuals. They can only communicate provided they both speak the same language.

A little more complex Comm System



EXAMPLE – ELECTRONIC MAIL



- User of a PC wishes to send a message 'm'
- User activates electronic mail package e.g hotmail
- Enters the message via input device (keyboard)
- Character string is buffered in main memory as a sequence of bits 'g'
- PC is connected to some trans system such as a Telephone Network via an I/O Transmitter like Modem
- Transmitter converts incoming stream 'g' into a signal 's'

❖ RECEIVER SIDE

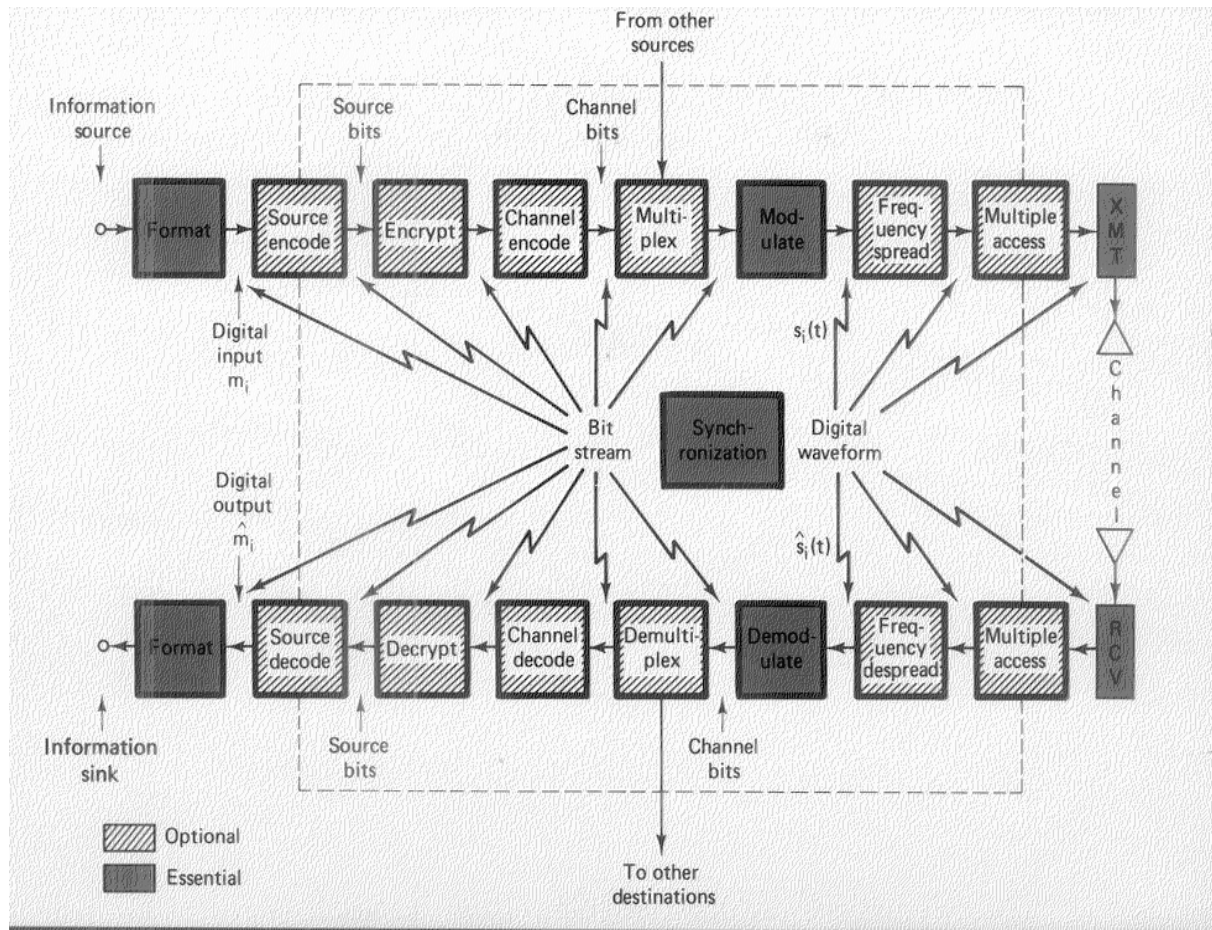
- The transmitted signal 's' is subject to a number of impairments depending upon the medium
- Therefore, received signal 'r' may differ from 's'.
- Receiver attempts to estimate original 's' based on its knowledge of the medium and received signal 'r'

- Receiver produces a bit stream $g'(t)$
- Briefly buffered in the memory
- Data is presented to the user via an output device like printer, screen etc.
- The data viewed by user m' will usually be an exact copy of the data sent ' m '

EXAMPLE-Telephone System

- Input to the Telephone is a message ' m ' in the form of sound waves
- The sound waves are converted by telephone into electric signals of the same frequency
- These signals are transmitted w/o any modification over the telephone line
- Hence $g(t)$ and $s(t)$ are identical
- $S(t)$ will suffer some distortion so that $r(t)$ will not be the same as $s(t)$
- $R(t)$ is converted back to sound waves with no attempt of correction or improvement of signal quality
- Thus m' is not an exact replica of m

An Actual Digital Data Communication System Key Data Communication Terminology



- ❖ **Session:** communication dialog between network users or applications
Different Types of this session for Info Exchange
- ❖ **Network:** interconnected group of computers and communication devices
We will look into it in a little bit
- ❖ **Node:** a network-attached device
Node can be any device in the network

Summary

- ◆ Data Communication
- ◆ Brief History of Communication
- ◆ Data Communication System
- ◆ Key Data Communication Terminology

Reading Sections

- ◆ Section 1.2, “Data Communications and Networking” 2nd Edition by Behrouz A. Forouzan
- ◆ Sections 1.1, 1.2, “Data and Computer Communication” 6th Edition by William Stallings