Computer Networks

BCST -502 BCSP- 502

B.Tech (CSE) 5th Semester

Course Instructor: Dr Bishwajeet Pandey

New 2020 Syllabus

Unit –I

Computer Network: Definitions, goals, components, Architecture, Classifications & Types.Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, ConnectionOriented & Connectionless Services, Service primitives, Design issues & its functionality. ISOOSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations

Unit-II

Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary &Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP/GARP

Unit-III

MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and Slotted- ALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), CollisionFree Protocols: Basic Bit Map, BRAP, Binary Count Down, MLMA Limited Contention Protocols: Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.

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Unit-IV

Network Layer: Need, Services Provided, Design issues, Routing algorithms: Least CostRouting algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing,Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding,Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6

Unit-V

Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, CarryingUnicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of DataTransfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP TimerManagement. Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).

About Course Instructor

- PhD from Gran Sasso Science Institute, Italy
- PhD Supervisor Prof Paolo Prinetto from Politecnico Di Torino, World Rank 13 in Electrical Engineering
- MTech from Indian Institute of Information Technology, Gwalior
- Scopus Profile: https://www.scopus.com/authid/detail.uri?authorId=57203239026
- Google Scholar: https://scholar.google.com/citations?user=UZ_8yAMAAAAJ&hl=hi
- Contact: gyancity@gyancity.com, +91-7428640820 (For help in this Subject @ BIAS and Guidance for future MS from Europe and USA after BIAS)

About Course Outline

- UNIT 1: Lecture No 1-4
- UNIT 2: Lecture No 5-8
- UNIT 3: Lecture No 9-13
- UNIT 4: Lecture No 14-10
- UNIT 5: Lecture No 20-25
- Lecture No 26-35 to Discuss Question Paper of Previous 5 Years
- Out of 35 Lectures: 10 will delivered by Professor From Foreign University

Data Link Layer

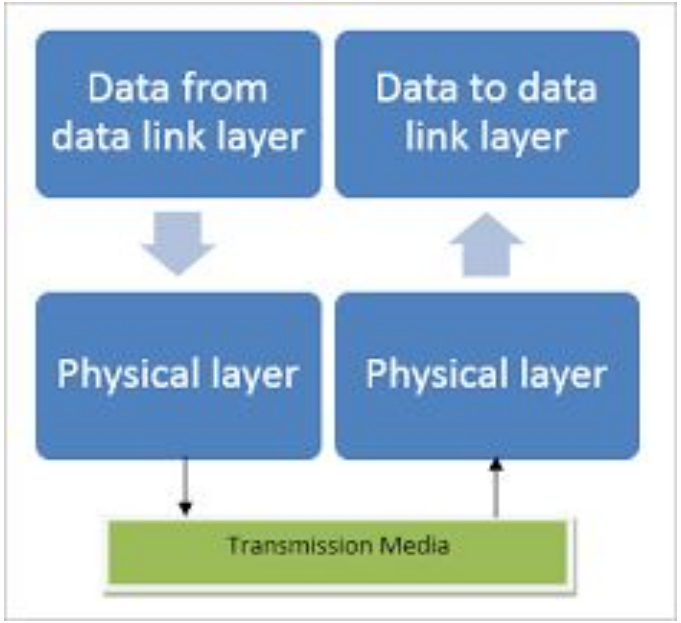
OUTLINE OF LECTURE 5

- Need of Data Link Layer
- Services Provided by Data Link Layer
- Framing in Data Link Layer
- Flow Control in Data Link Layer
- Error control in Data Link Layer

Need of Data Link Layer

- The **data link layer**, or **layer 2**, is the second layer of the seven-layer OSI model of computer networking.

- This layer is the protocol layer that transfers data between nodes on a network segment across the physical layer.



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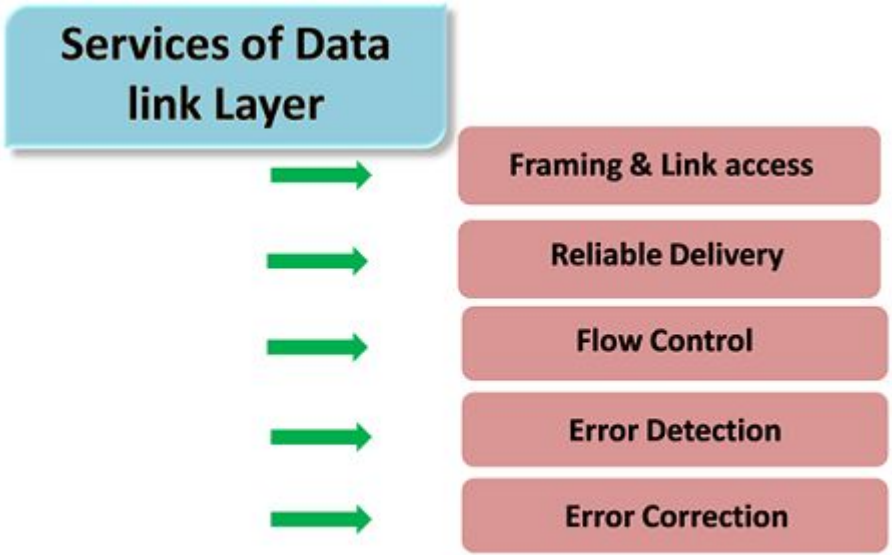
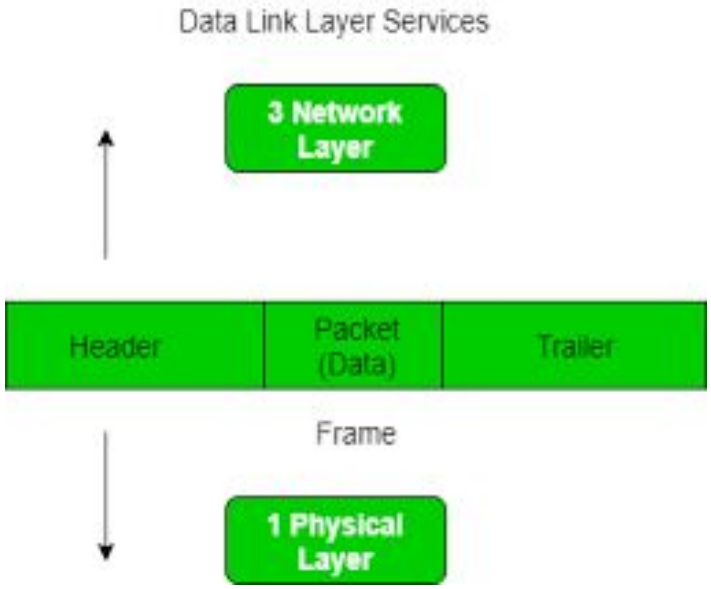
Services Provided by Data Link Layer



Framing in Data Link Layer

- **Framing** is a **Data** Link layer function whereby the packets from the Network Layer are encapsulated into **frames**.
- The **data frames** can be of fixed length or variable length.
- In variable - length **framing**, the size of each **frame** to be transmitted may be different.



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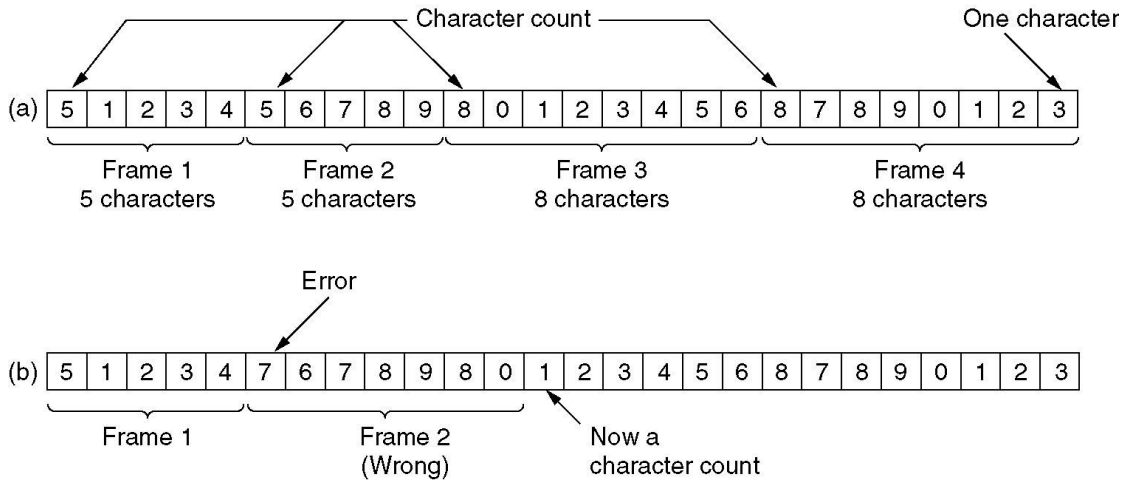
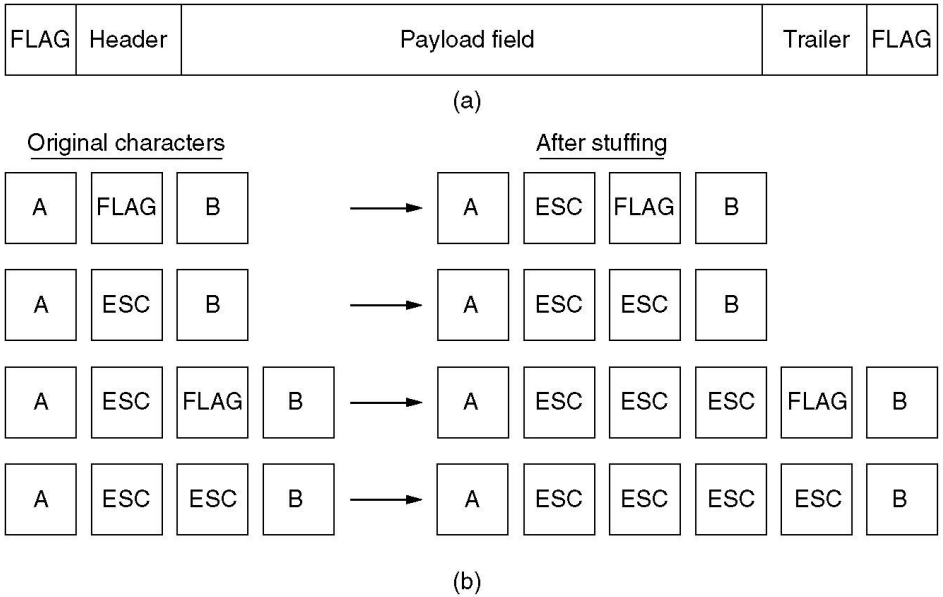
Framing in Data Link Layer

A character stream. (a) Without errors. (b) With one error.



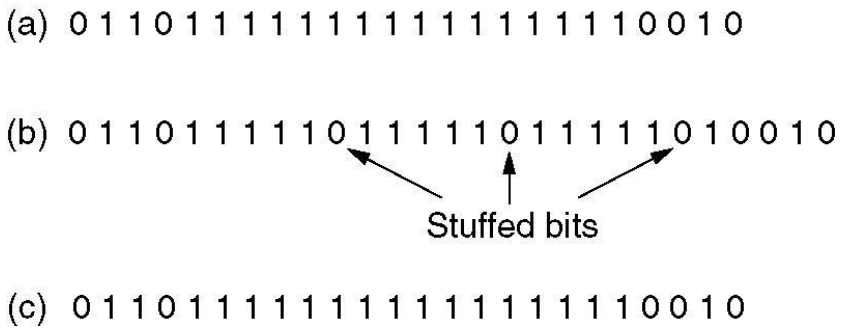
Framing in Data Link Layer

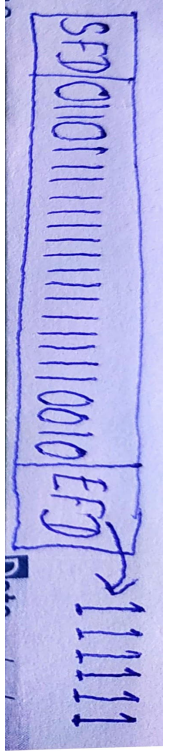


(a) A frame delimited by flag bytes.

(b) Four examples of byte sequences before and after stuffing.

Framing in Data Link Layer





Bit stuffing

(a) The original data.

(b) The data as they appear on the line; we add 0 after every repetition of 5 times 1, because 111111 is taken end of frame delimiter.

(c) The data as they are stored in receiver's memory after destuffing.

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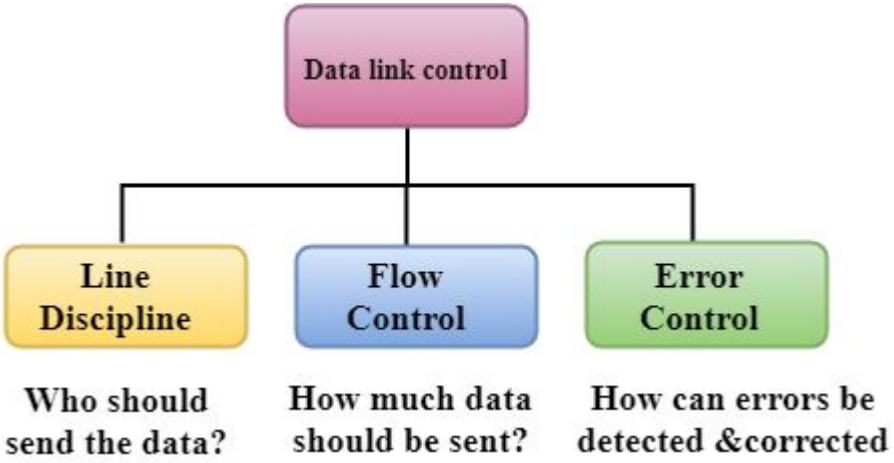
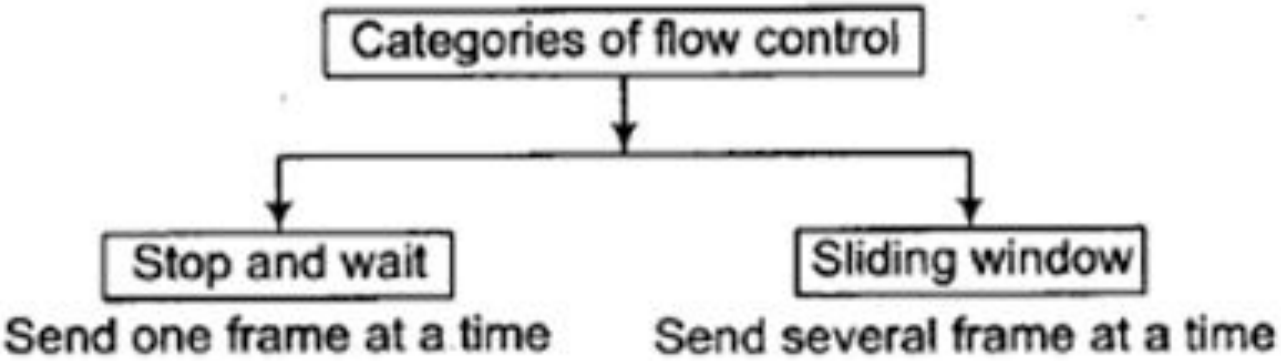
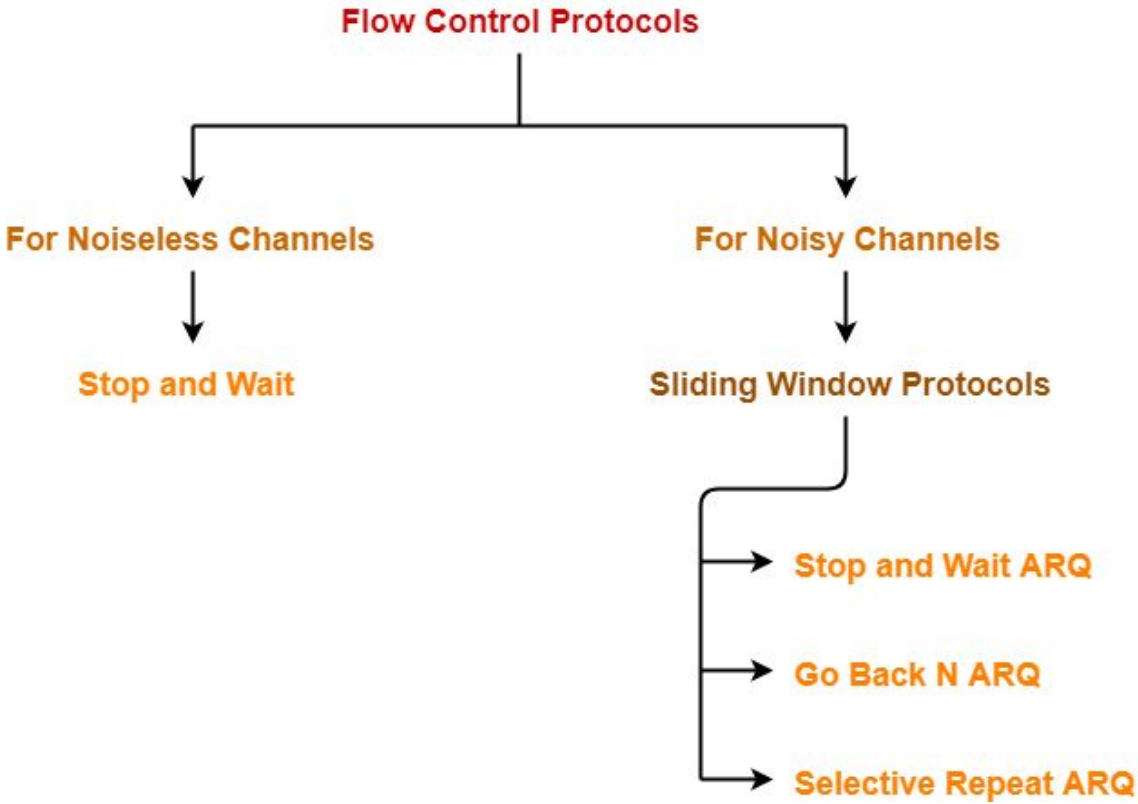
Flow & Error control in Data Link Layer



Flow control in Data Link Layer





Error Control in Data Link Layer

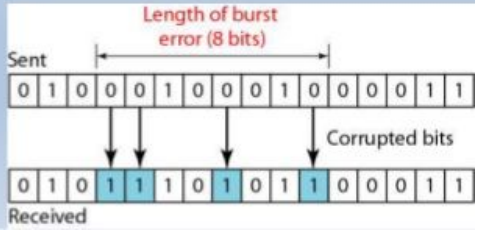
Type of errors

Single-Bit Error

- Only one bit of a given data unit is changed
- The least likely type of error in serial transmission
- Single-bit error can happen in parallel transmission

Burst Error

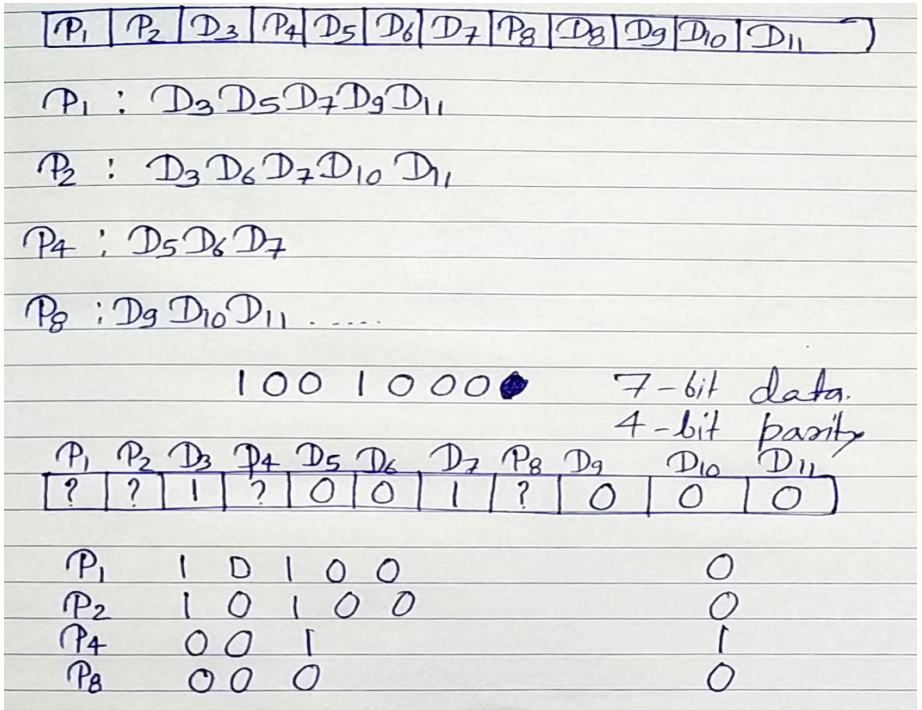
- Two or more bits in the data unit have changed
- Burst error does not necessarily mean that the errors occur in consecutive bits
- Most likely to happen in a serial transmission
- Number of bits affected depends on the data rate and duration of noise



Error-Correcting Codes: Hamming Code

Char.	ASCII	Check bits
H	1001000	00110010000
a	1100001	10111001001
m	1101101	11101010101
m	1101101	11101010101
i	1101001	01101011001
n	1101110	01101010110
g	1100111	01111001111
	0100000	10011000000
c	1100011	11111000011
o	1101111	10101011111
d	1100100	11111001100
e	1100101	00111000101

Order of bit transmission



- Here parity bit is XOR of data bits or check even parity for 1.

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Error Detection by Adding Parity Bit

The two types of parity checking are:

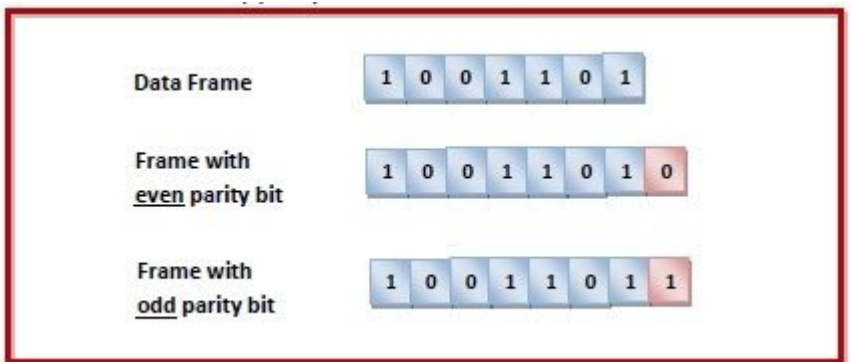
- **Even Parity** − Here the total number of 1s in the message is made even.
- **Odd Parity** − Here the total number of 1s in the message is made odd.

Sender's End − While creating a frame, the sender counts the number of 1s in it and adds the parity bit in following way

- **In case of even parity** − If number of 1s is even, parity bit value is 0. If number of 1s is odd, parity bit value is 1.
- **In case of odd parity** − If number of 1s is odd, parity bit value is 0. If number of 1s is even, parity bit value is 1.

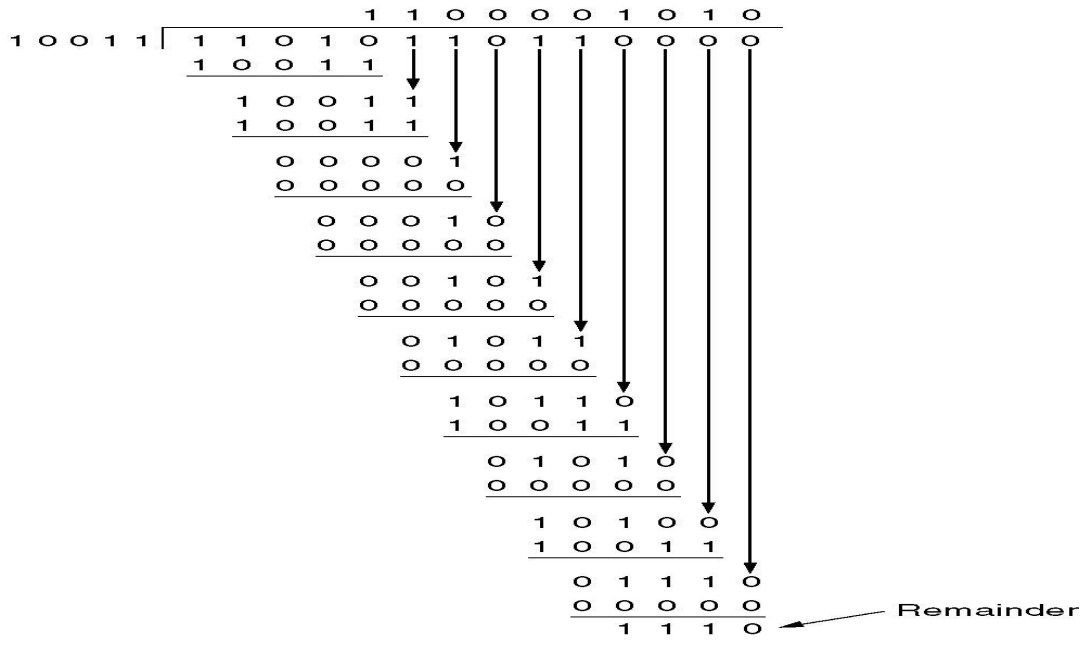
Receiver's End − On receiving a frame, the receiver counts the number of 1s in it.

- **In case of even parity check**, if the count of 1s is even, the frame is accepted, otherwise it is rejected.
- **In case of odd parity check**, if the count of 1s is odd, the frame is accepted, otherwise it is rejected.



Error-Detecting Codes

Frame : 1 1 0 1 0 1 1 0 1 1
Generator: 1 0 0 1 1
Message after 4 zero bits are appended: 1 1 0 1 0 1 1 0 1 1 0 0 0 0



Transmitted frame: 1 1 0 1 0 1 1 0 1 1 1 1 0

- If generator has N bits then N-1 zero bits will append after message.

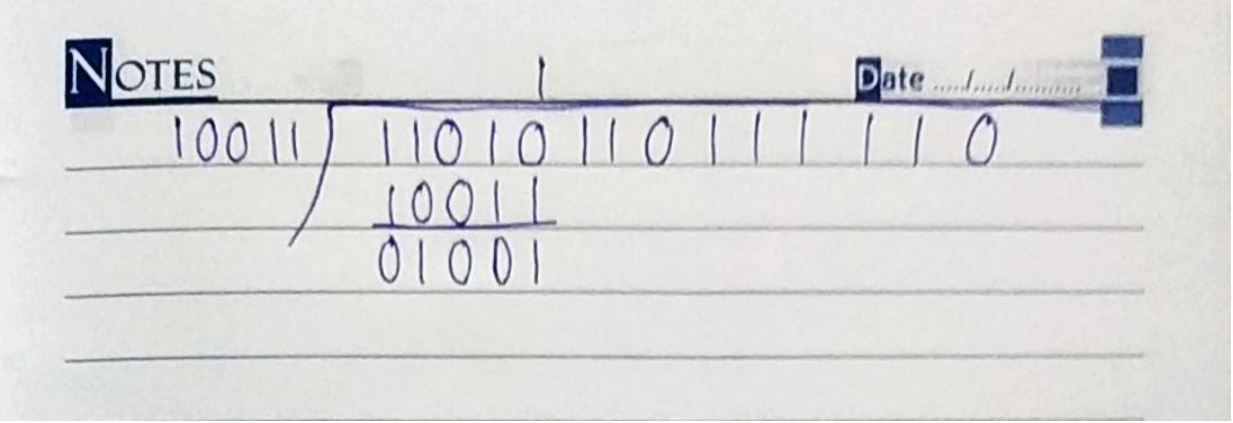
Generator given is - 10011

Generator may also given in form of polynomial as:

$1.x^4 + 0.x^3 + 0.x^2 + 1.x^1 + 1.x^0$

Error-Detecting Codes

- Generator is shared with both receiver and transmitter.
- We again repeat previous process between generator and transmitted data, if we found 0000 in remainder then we conclude that received data has no any error.
- STEP 1:



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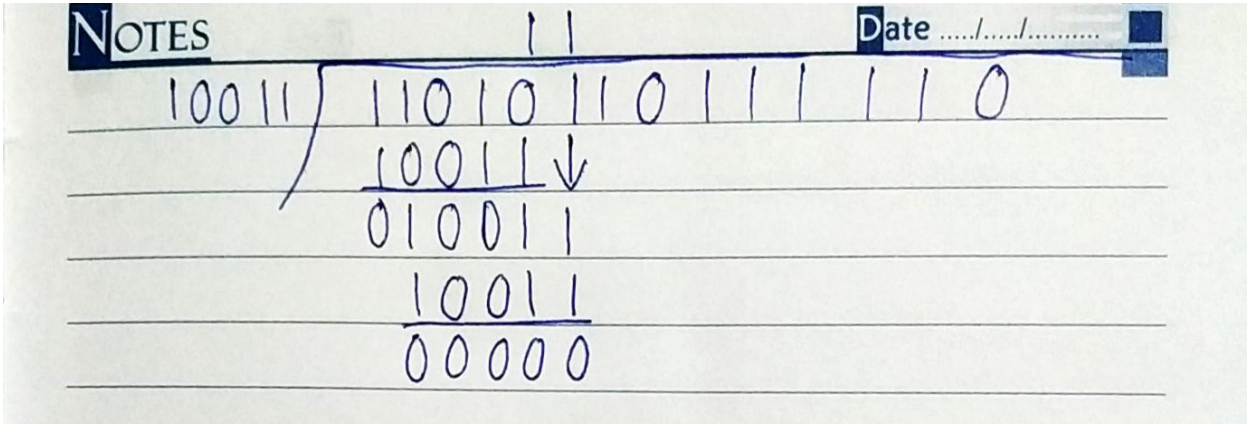
- STEP 2:



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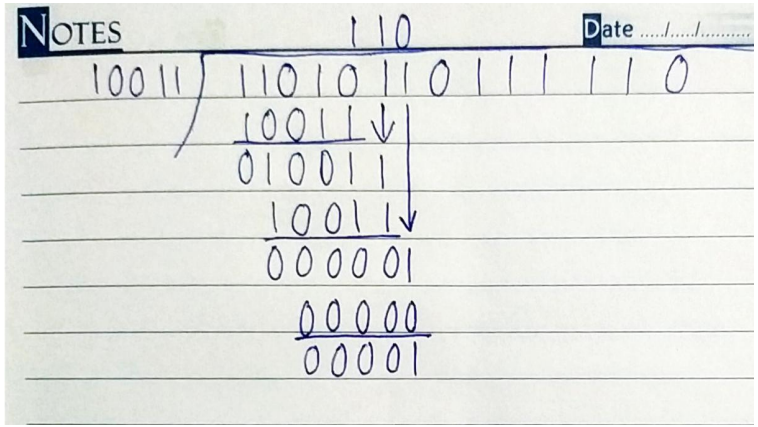

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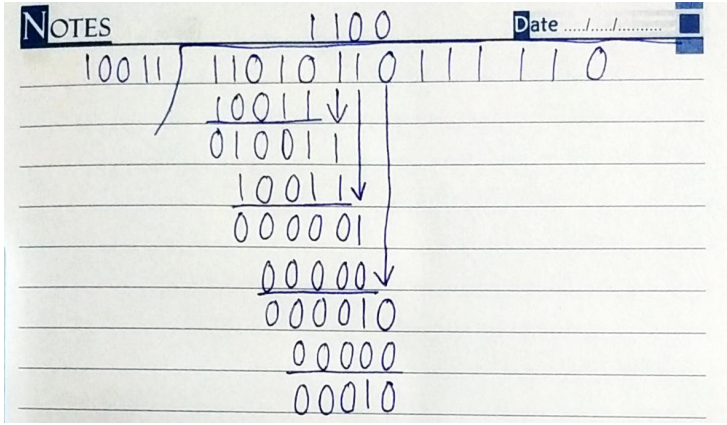
- STEP 4:



Error-Detecting Codes

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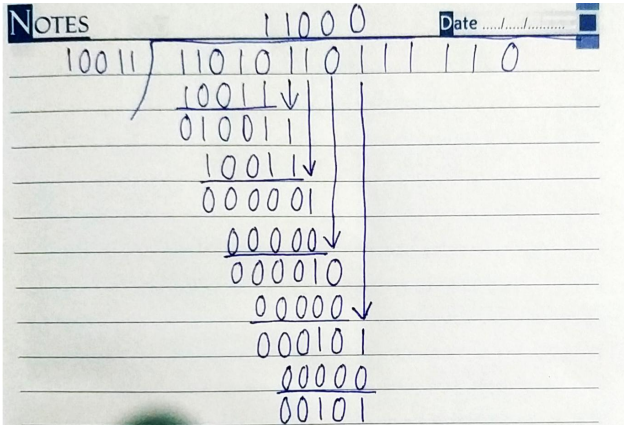

Error-Detecting Codes

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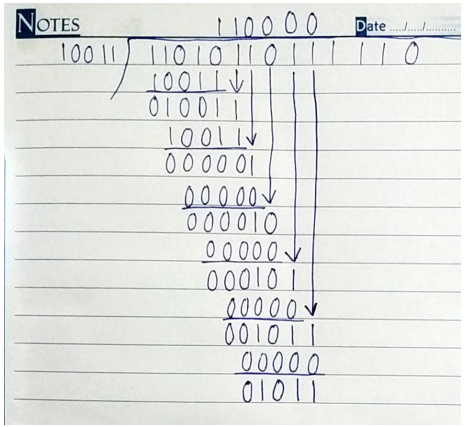
- STEP 6:



Error-Detecting Codes

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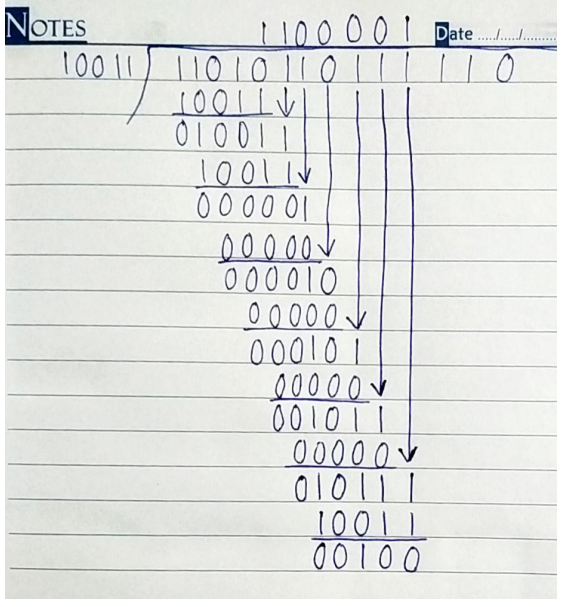
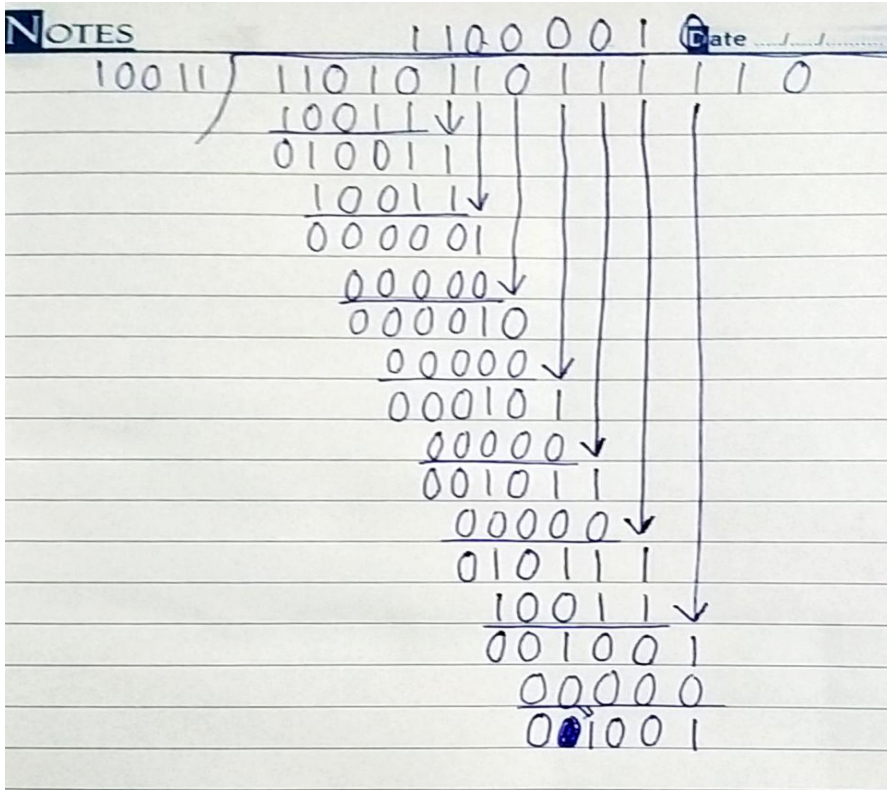
- STEP 7:



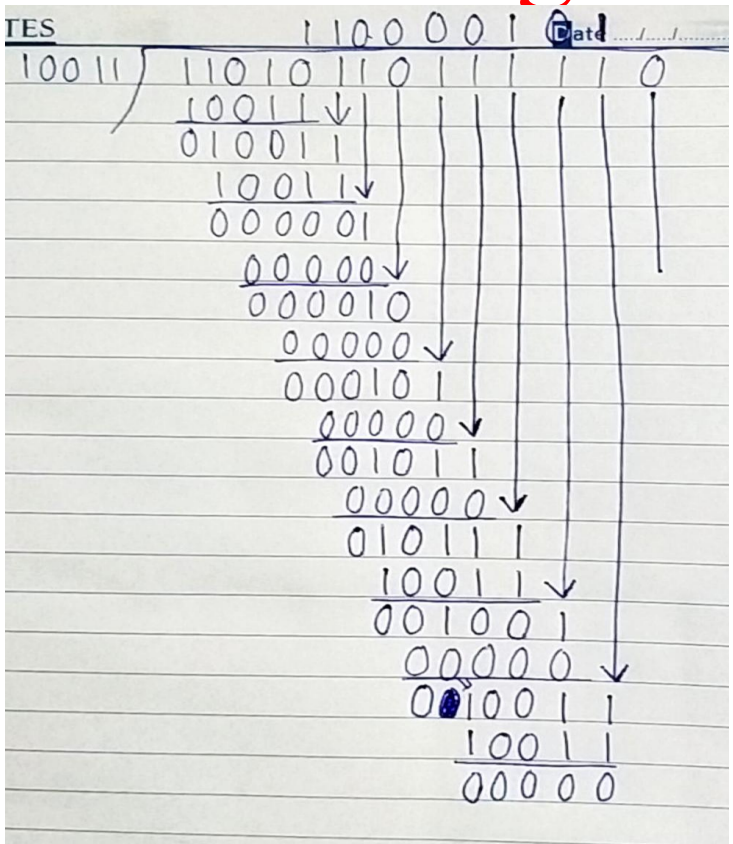
Error-Detecting Codes

- STEP 8:



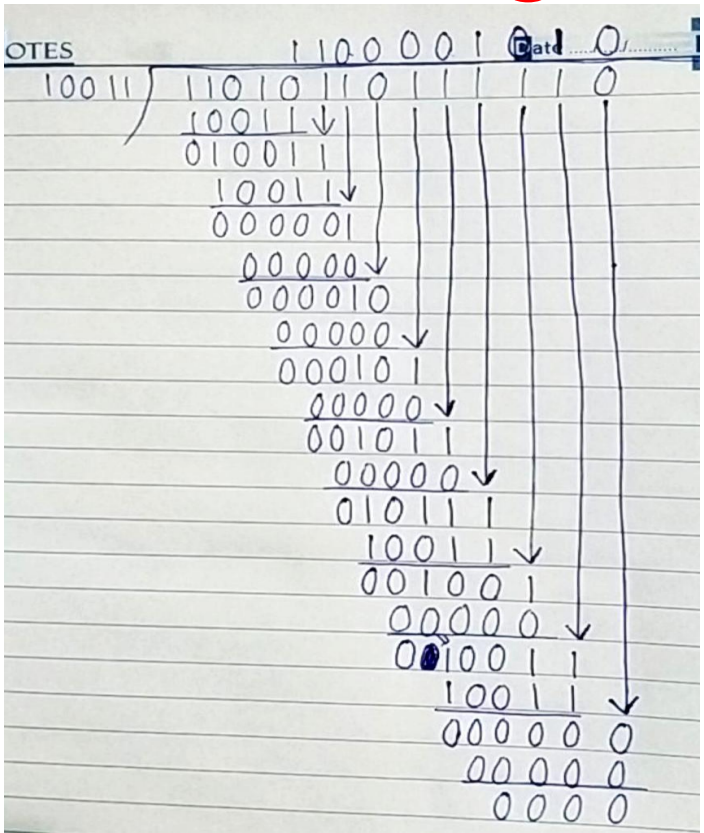
Error-Detecting Codes

- STEP 9:

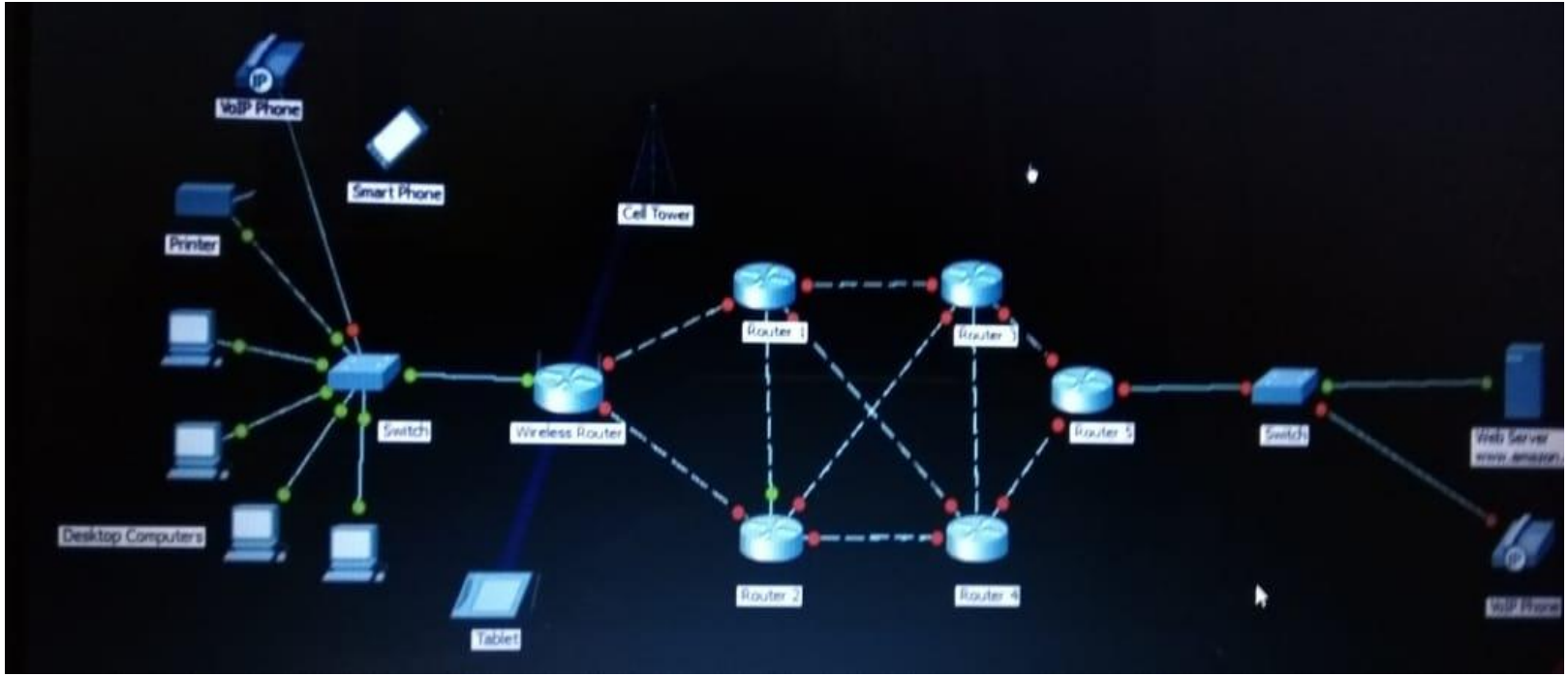


Error-Detecting Codes

- STEP 10:



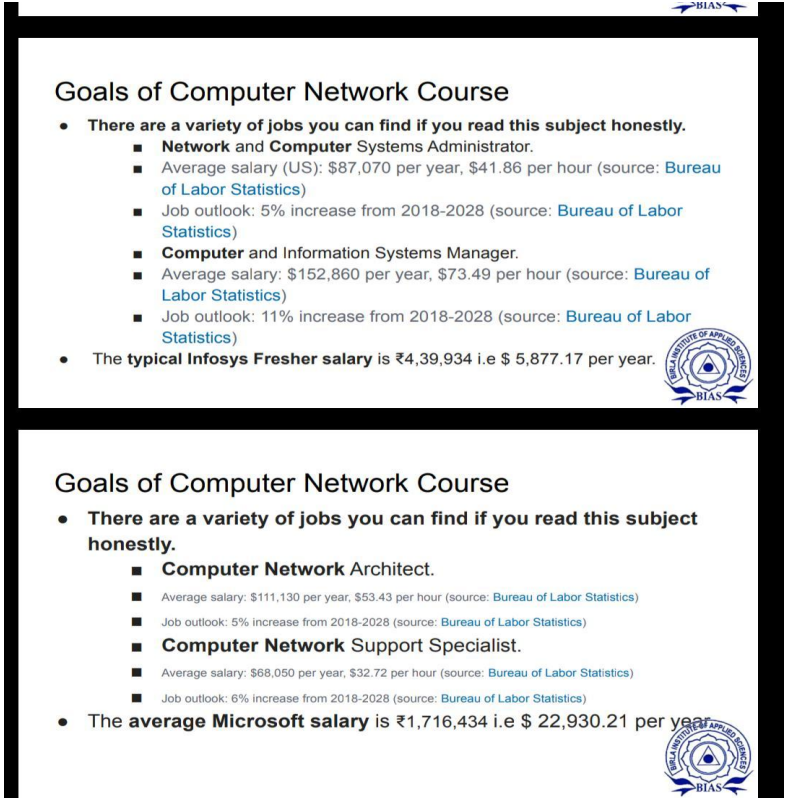
Q&A: Falguni Bisht ask me on WhatsApp. Good evening sir. What are these green and red dots?



Answer:

- Red dot means no link established, it can be any issue sometimes port related issues are also there and also a configuration of router and its routing interface as well
- Green dot means link is established and data flow can take place, it can receive the hellos from other end

Q&A: Sanjeevani Chaurasia asked me on WhatsApp,Sir , this topic , CN unit 1 topic 2 (goals of computer Network), but here It is the goals of computer network Course.



- These are goals of CN Course.
- If you search the skill set required for following Job:
  - Computer Network Architect
  - Computer Network Support Specialist
  - Computer and Network System Administrator
  - Computer and Information System Manager
- Then you will get the answers of Question: What are goals of Computer Network?

Goals of Computer Networks: Simple Answer

- Resource and Load Sharing
- Reduced Cost
- High Reliability
- Inter-process Communication
- Flexible Access
- Compatibility of Dissimilar Equipment and Software
- Scalability

Goals of Computer Networks: Ideal Answer

- Resource and Load Sharing
- Reduced Cost
- High Reliability
- **Inter-process Communication**
- Flexible Access
- Compatibility of dissimilar equipment and software
- Scalability
- If we get expertise in above goals, then we shall get any of the following core job of computer network:
    - Computer Network Architect
    - Computer Network Support Specialist
    - Computer and Network System Administrator
    - Computer and Information System Manager

OUTLINE OF TOMORROW LECTURE: LECTURE 6

- Data Link Layer Protocol:
  - Elementary Protocol:
    - An Unrestricted Simplex Protocol
    - A Simplex Stop-and-Wait Protocol
  - Sliding Window protocol:
    - 1-Bit
    - Go-Back-N
    - Selective Repeat
- Hybrid ARQ