Medium access sublayer &
Data Link Layer

Unit: 2

Computer Networks

KCS 603

B Tech 6th Sem

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Evaluation Scheme

			\multicolumn{3}{c}{Periods}			\multicolumn{3}{c}{Evaluation Scheme}			\multicolumn{2}{c}{End Semester}			
Sl. No.	Subject Codes	Subject	L	T	P	CT	TA	Total	PS	TE	PE	Total	Credit
		SEMESTER- VI										
1	KCS601	Software Engineering	3	1	0	30	20	50		100		150	4
2	KIT601	Data Analytics	3	1	0	30	20	50		100		150	4
3	KCS603	Computer Networks	3	1	0	30	20	50		100		150	4
4	Deptt-Elective-III	Departmental Elective-III	3	0	0	30	20	50		100		150	3
5		Open Elective-I	3	0	0	30	20	50		100		150	3
6	KCS651	Software Engineering Lab	0	0	2				25		25	50	1
7	KIT651	Data Analytics Lab	0	0	2				25		25	50	1
8	KCS653	Computer Networks Lab	0	0	2				25		25	50	1
9	KNC601/ KNC602	Constitution of India, Law and Engineering / Indian Tradition, Culture and Society	2	0	0	15	10	25		50			
10		MOOCs (Essential for Hons. Degree)											
		Total	0	3	6							900	21

Syllabus

Unit	Topic
I	Introductory Concepts: Goals and applications of networks, Categories of networks, Organization of the Internet, ISP, Network structure and architecture (layering principles, services, protocols and standards), The OSI reference model, TCP/IP protocol suite, Network devices and components. Physical Layer: Network topology design, Types of connections, Transmission media, Signal transmission and encoding, Network performance and transmission impairments, Switching techniques and multiplexing.
II	**Link layer: Framing, Error Detection and Correction, Flow control (Elementary Data Link Protocols, Sliding Window protocols). Medium Access Control and Local Area Networks: Channel allocation, Multiple access protocols, LAN standards, Link layer switches & bridges (learning bridge and spanning tree algorithms).**
III	Network Layer: Point-to-point networks, Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP), Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms, IPv6.
IV	Transport Layer: Process-to-process delivery, Transport layer protocols (UDP and TCP), Multiplexing, Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service.
V	Application Layer: Domain Name System, World Wide Web and Hyper Text Transfer Protocol, Electronic mail, File Transfer Protocol, Remote login, Network management, Data compression, Cryptography – basic concepts.

Branch wise Applications

- Resource Sharing
- Server-Client model:
- Communication Medium:
- Access to remote information
- Person-to-person communication
- Electronic commerce
- Cloud-based Applications
- AI and Expert System
- Neural Networks and parallel programming
- Decision support and office automation systems etc.

To develop an understanding of

- To understand computer networking basics.

- **To understand different components of computer networks.**

- To study and understand various protocols.

- The standard models for the layered approach to communication between autonomous machines in a network.

- To study and understand the main characteristics of data transmission across various physical link types.

Course Outcome

At the end of the course, the student will be able

Course Outcomes (CO)	-	Bloom's Knowledge Level (KL)
C603.1	Explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP, networks devices and transmission media, Analog and digital data transmission	K1, K2
C603.2	**Apply channel allocation, framing, error and flow control techniques.**	**K3**
C603.3	Describe the functions of Network Layer i.e. Logical addressing, subnetting & Routing Mechanism	K2, K3
C603.4	Explain the different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism.	K2, K3
C603.5	Explain the functions offered by session and presentation layer and their Implementation.	K2, K3
C603.6	Explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.	K2

Program Outcome

1. Engineering knowledge

2. Problem analysis

3. Design/development of solutions

4. Conduct investigations of complex problems

5. Modern tool usage

6. The engineer and society

7. Environment and sustainability

8. Ethics

9. Individual and team work

10. Communication

11. Project management and finance

12. Life-long learning

The highlighted text shows the mapping of course outcome with PO mapping of this unit

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	Computer Networks (KCS-603)								Year of Study: 2021-22			
C603.1	3	2	3	2	1	1					2	3
C603.2	3	3	2	2	3	2		1			1	3
C603.3	3	2	1		1	2		1	2		1	3
C603.4	2	2	1		1			1	1		1	3
C603.5	2	2	2		1						1	3
C603.6	2	1			3	2		3	1		1	3

Program Specific Outcomes

- **PSO1:** Work as a software developer, database administrator, tester or networking engineer for providing solutions to the real world and industrial problems.

- **PSO2:** Apply core subjects of information technology related to data structure and algorithm, software engineering, web technology, operating system, database and networking to solve complex IT problems.

- **PSO3:** Practice multi-disciplinary and modern computing techniques by lifelong learning to establish innovative career.

- **PSO4:** Work in a team or individual to manage projects with ethical concern to be a successful employee or employer in IT industry.

The highlighted text shows the mapping of course outcome with PSO mapping of this unit

CO	PSO1	PSO2	PSO3	PSO4
C603.1	3	3	2	1
C603.2	3	3	2	1
C603.3	3	3	2	1
C603.4	3	3	1	1
C603.5	3	3	1	1
C603.6	3	3	1	1

Program Educational Objectives

- **PEO1:** able to apply sound knowledge in the field of information technology to fulfill the needs of IT industry.

- **PEO2:** able to design innovative and interdisciplinary systems through latest digital   technologies.

- **PEO3:** able to inculcate professional and social ethics, team work and leadership for serving the society.

- **PEO4:** able to inculcate lifelong learning in the field of computing for successful career in organizations and R&D sectors.

Result Analysis

- Computer Networks Result of 2020-21: 96.97%

- Average Marks: 54.33

B TECH

(SEM-V) THEORY EXAMINATION 20__-20__

OBJECT ORIENTED SYSTEM DESIGN

Time: 3 Hours **Total Marks: 100**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. **Attempt all questions in brief.** **2 x 10 = 20**

Q.No.	Question	Marks	CO
1		2	
2		2	
.		.	
10		2	

SECTION B

2. Attempt any three of the following: **3 x 10 = 30**

Q.No.	Question	Marks	CO
1		10	
2		10	
.		.	
5		10	

SECTION C

3. Attempt any one part of the following: **1 x 10 = 10**

Q.No.	Question	Marks	CO
1		10	
2		10	

4. Attempt any one part of the following: **1 x 10 = 10**

Q.No.	Question	Marks	CO
1		10	
2		10	

5. Attempt any one part of the following: **1 x 10 = 10**

Q.No.	Question	Marks	CO
1		10	
2		10	

6. Attempt any one part of the following: **1 x 10 = 10**

Q.No.	Question	Marks	CO
1		10	
2		10	

7. Attempt any one part of the following: **1 x 10 = 10**

Q.No.	Question	Marks	CO
1		10	
2		10	

- The student should have knowledge of
  - Networking
  - Layout of computer
  - Hardware
- The basic knowledge of C

Brief Introduction to Subject

- Computer network is a group of devices connected with each other through a transmission medium such as wires, cables etc.

- These devices can be computers, printers, scanners, Fax machines etc.

- The purpose of having computer network is to send and receive data stored in other devices over the network.

Topic objective

- Understand the Medium access sub layer of data link layer

- Understand the Functions of MAC

- Find out Channel allocation problem and

- Various multiple access protocols

- It is responsible for flow control and multiplexing for transmission medium.

- The Open System Interconnections (OSI) model is a layered networking framework that conceptualizes how communications should be done between heterogeneous systems.

- The data link layer is divided into two sublayers –
  - The logical link control (LLC) sublayer
  - The medium access control (MAC) sublayer

Functions of MAC Layer

- It provides an abstraction of the physical layer to the LLC and upper layers of the OSI network.

- It is responsible for encapsulating frames so that they are suitable for transmission via the physical medium.

- It resolves the addressing of source station as well as the destination station, or groups of destination stations.

- It performs multiple access resolutions when more than one data frame is to be transmitted. It determines the channel access methods for transmission.

- It also performs collision resolution and initiating retransmission in case of collisions.

- It generates the frame check sequences and thus contributes to protection against transmission errors.

MAC

- MAC address or media access control address is a unique identifier allotted to a network interface controller (NIC) of a device.

- It is used as a network address for data transmission within a network segment like Ethernet, Wi-Fi, and Bluetooth.

- This layer determines who goes next on a multi-access channel

- MAC protocols are mechanisms that allow users to access a common medium or channel.

- Aloha, slotted Aloha, and Carrier Sense Multiple Access protocols are used

- This layer is important in LAN's

- Channel allocation problem
  - Static channel
  - Dynamic channel allocation

Static channel Allocation(CO5)

- For fixed channel and traffic from N users

- Divide up bandwidth using FDM, TDM, CDMA, etc. – FDM and TDM

- problematic with large no. of senders or bursty traffic

- This static allocation performs poorly for bursty traffic
  – Most data transmissions are inherently bursty
  – Allocation to any given user will sometimes go unused = wasteful

Dynamic channel Allocation(CO5)
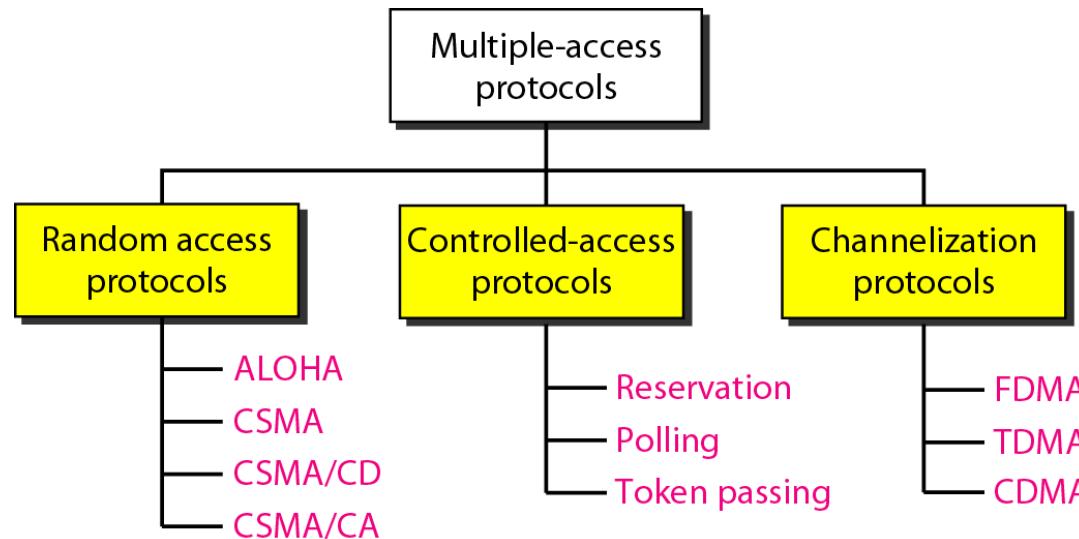
- Dynamic allocation gives the channel to a user when they need it.
- Potentially N times as efficient for N users.

Various schemes

- Independent traffic analysis   Often not a good model, but permits
- Single channel   No external way to coordinate senders
- Observable collisions   Needed for reliability; mechanisms vary

(2+ sending simultaneously)

- Continuous or   Slotting (time divided up into discrete

slotted time   intervals) may improve
performance

- Carrier sense   Can improve performance if
available

no carrier sense

Multiple Access Protocols(CO2)

- Two basic strategies for channel acquisition in a broadcast network:

  1. Contention (e.g., Aloha, CSMA) – preferable for low load because of its low delay characteristics

  2. Collision Free Protocols – preferable at high load
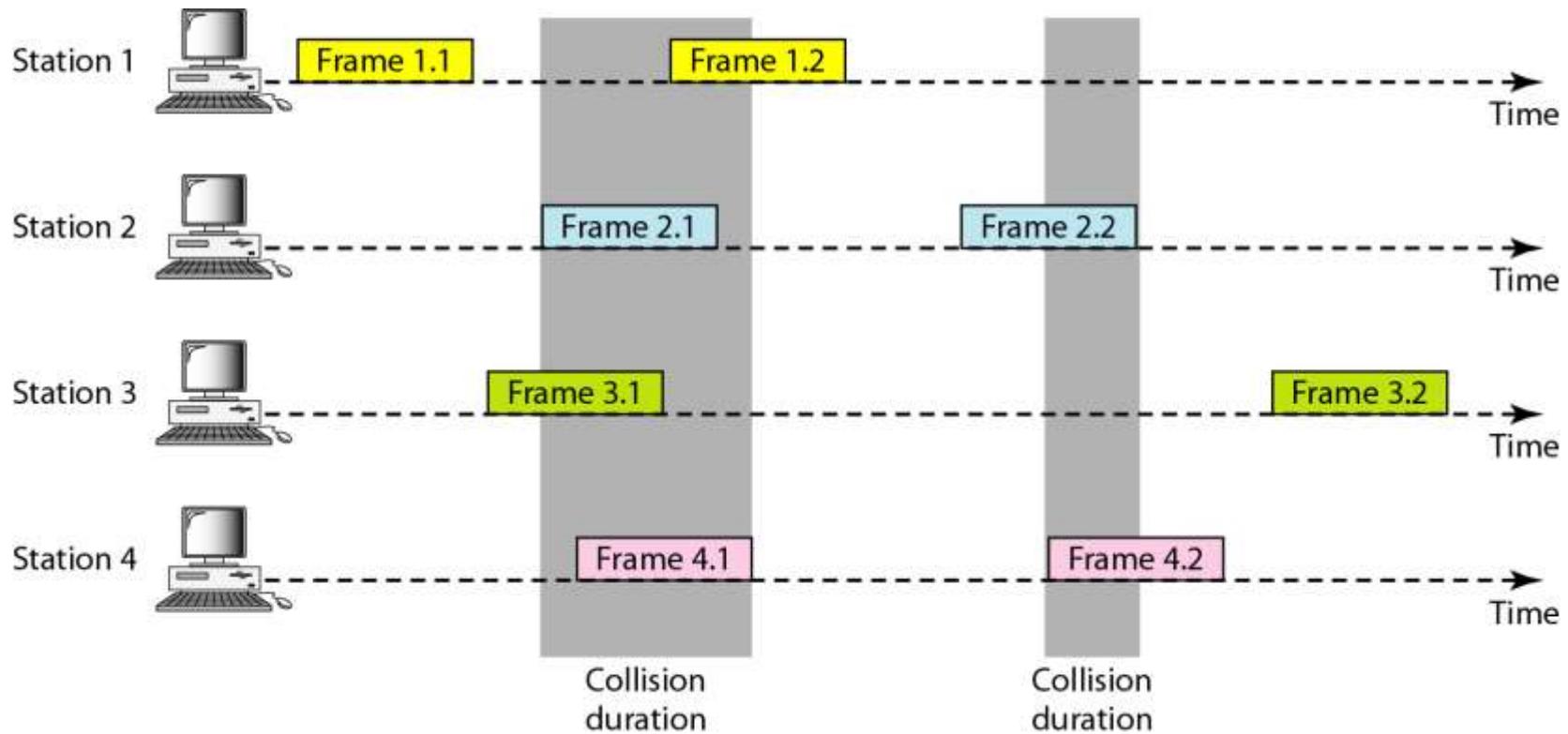
Random access protocols

- random access or contention methods

- no station is superior to another station and none is assigned the control over another.

- No station permits, or does not permit, another station to send.

- At each instance, a station that has data to send uses a procedure defined by the protocol to make a decision on whether or not to send.

Frames are transmitted at completely arbitrary times
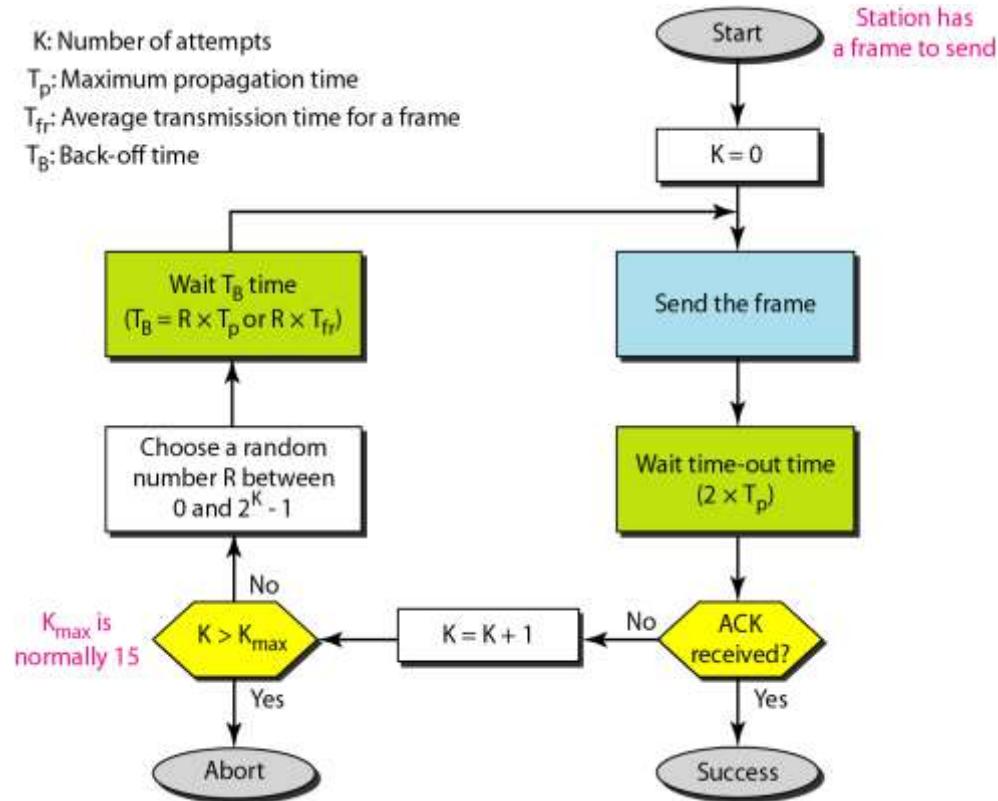
- The throughput for pure ALOHA is $S = G \times e^{-2G}$.

- The maximum throughput

- $S_{max} = 0.184$ when G= (1/2).

K: Number of attempts
T_p: Maximum propagation time
T_{fr}: Average transmission time for a frame
T_B: Back-off time

Station has a frame to send

Start

K = 0

Wait T_B time
$(T_B = R \times T_p$ or $R \times T_{fr})$

Send the frame

Choose a random number R between 0 and $2^K - 1$

Wait time-out time
$(2 \times T_p)$

K_{max} is normally 15

No

K > K_{max}

K = K + 1

No

ACK received?

Yes

Yes

Abort

Success
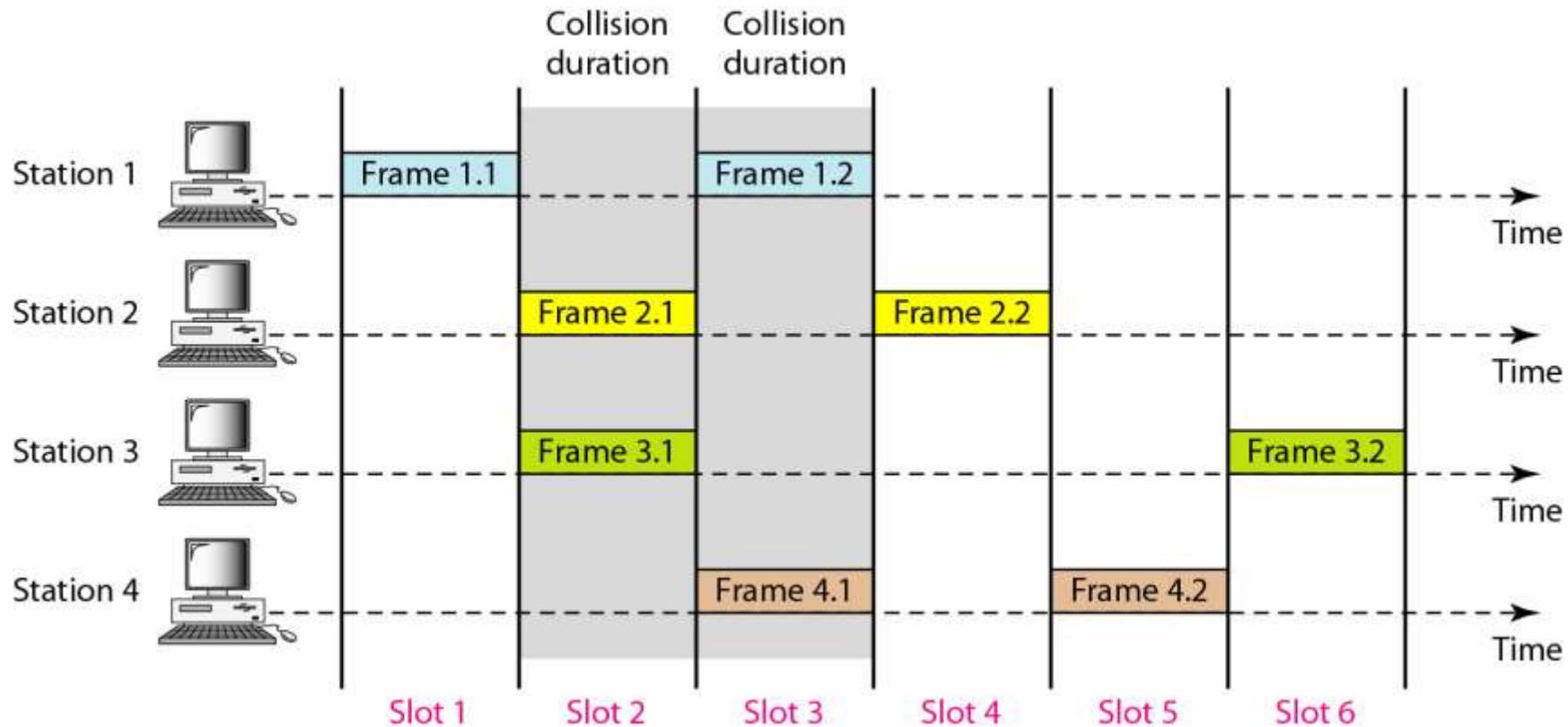
Slotted Aloha

- Time in uniform slot equal to frame transmission time

- Need central clock for synchronisation

- Transmission begins at slot boundary

- The throughput for slotted ALOHA is
  $S = G \times e^{-G}$.

- The maximum throughput
  $S_{max} = 0.368$ when G = 1.

CSMA(CO2)
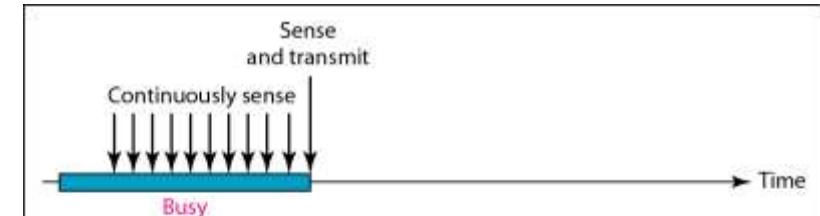
- Carrier Sense Multiple Access (CSMA)

improves on ALOHA by sensing the channel
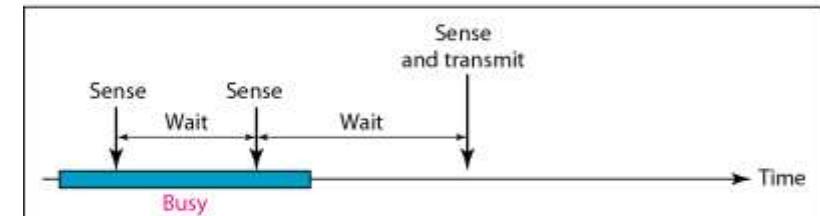
- Variations (within CSMA) on what to do

 if the channel is busy:
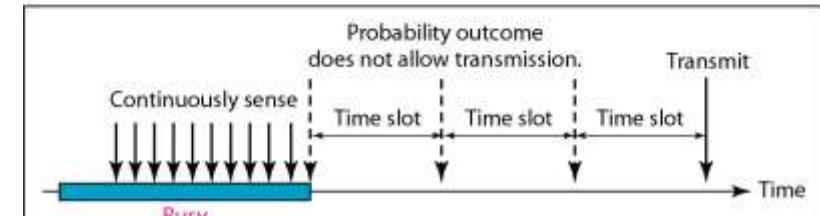
1. 1-persistent
2. Non persistent
3. P-persistent

a. 1-persistent

b. Nonpersistent

c. p-persistent

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CSMA

a. 1-persistent

b. Nonpersistent

c. p-persistent

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CSMA

B starts at time t_1

C starts at time t_2

A   B   C   D

t_1

t_2

Area where A's signal exists

Area where both signals exist

Area where B's signal exists
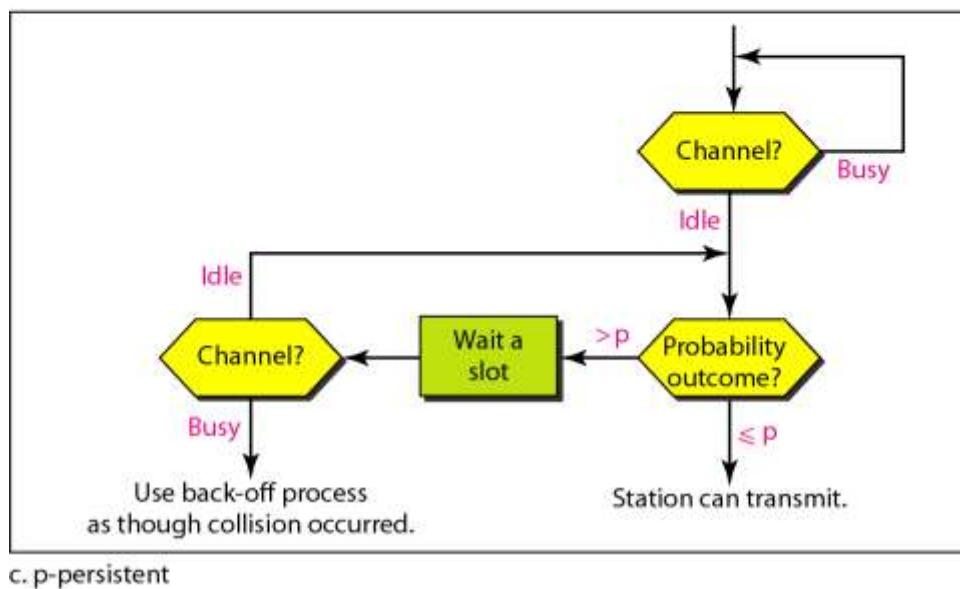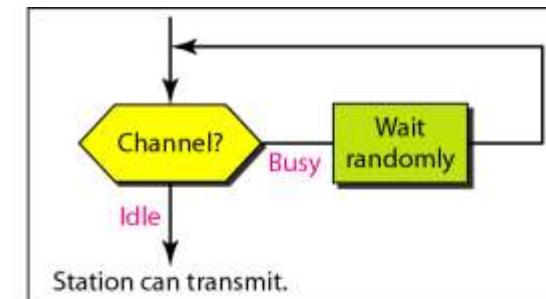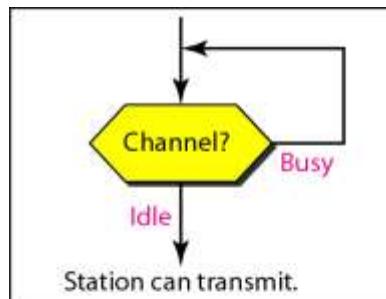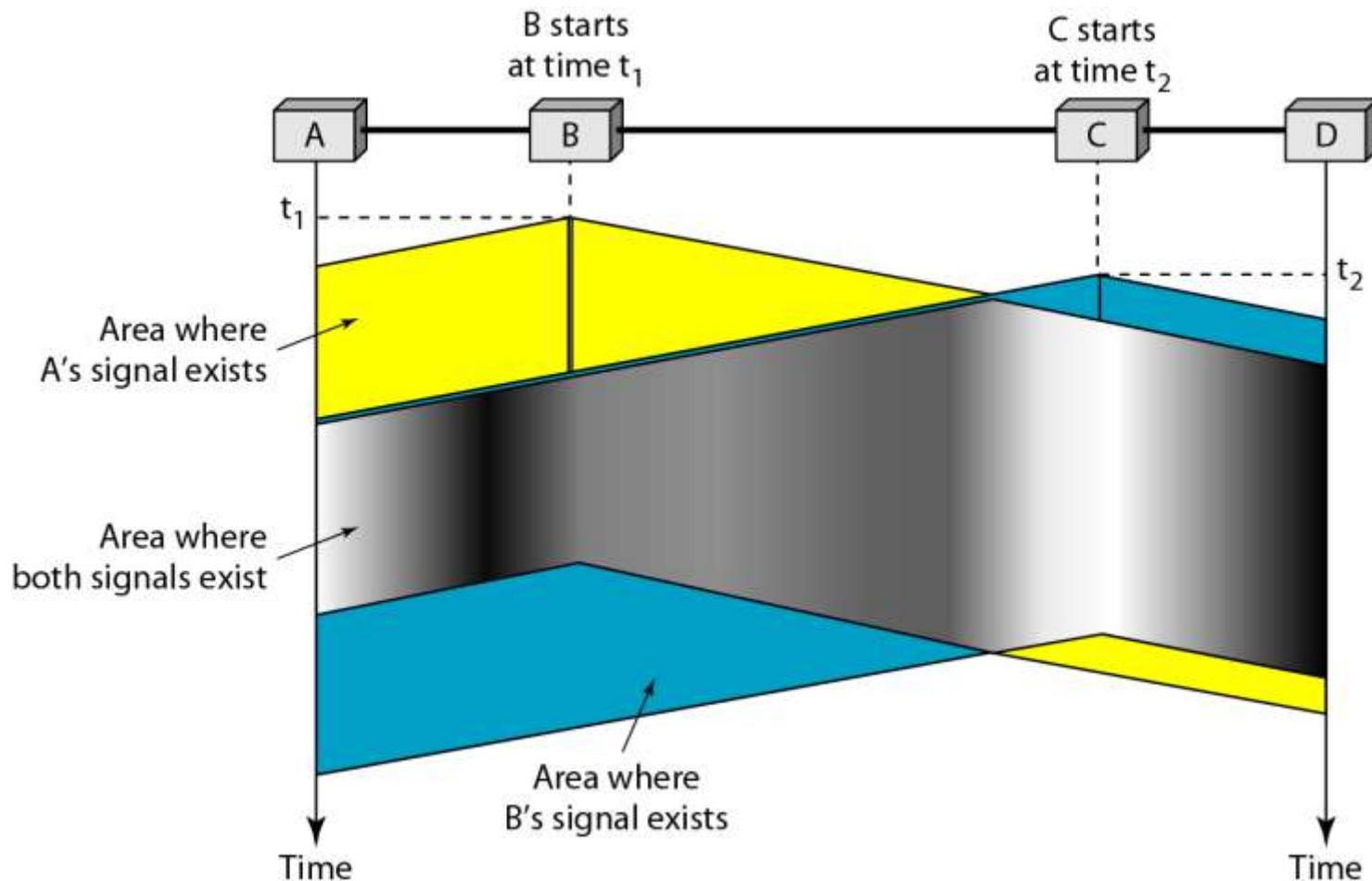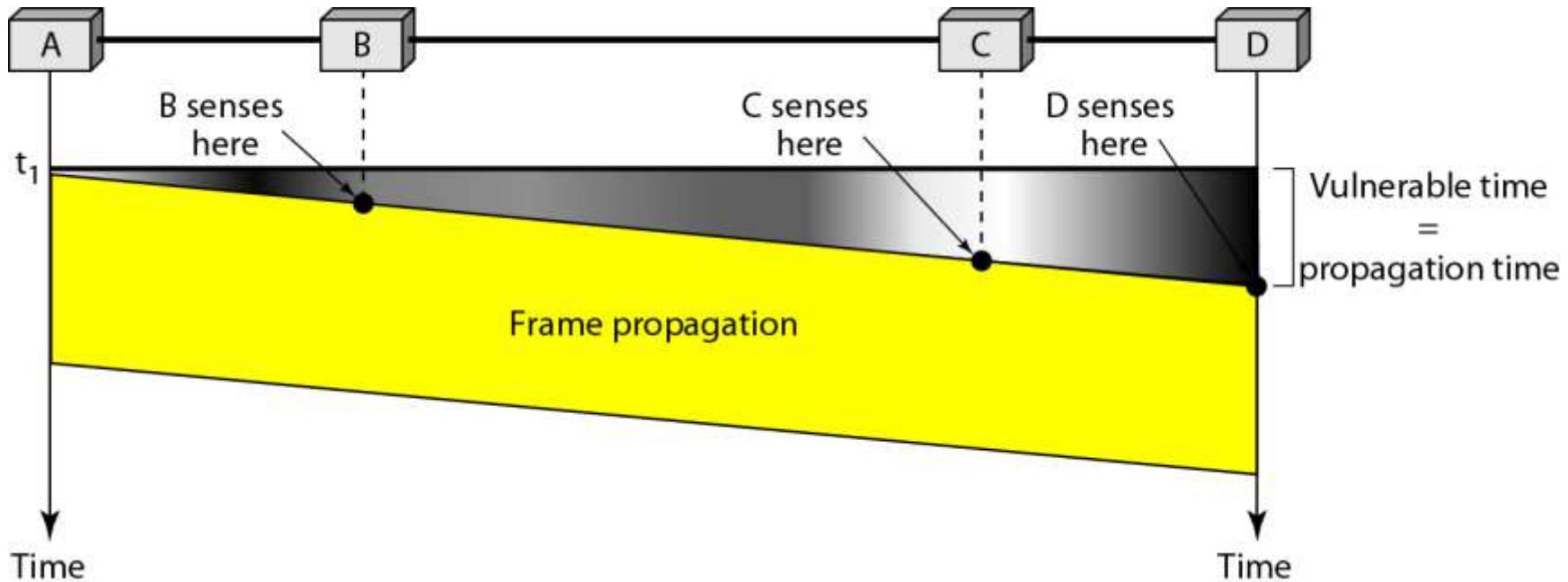
Time

Time

CSMA/CD
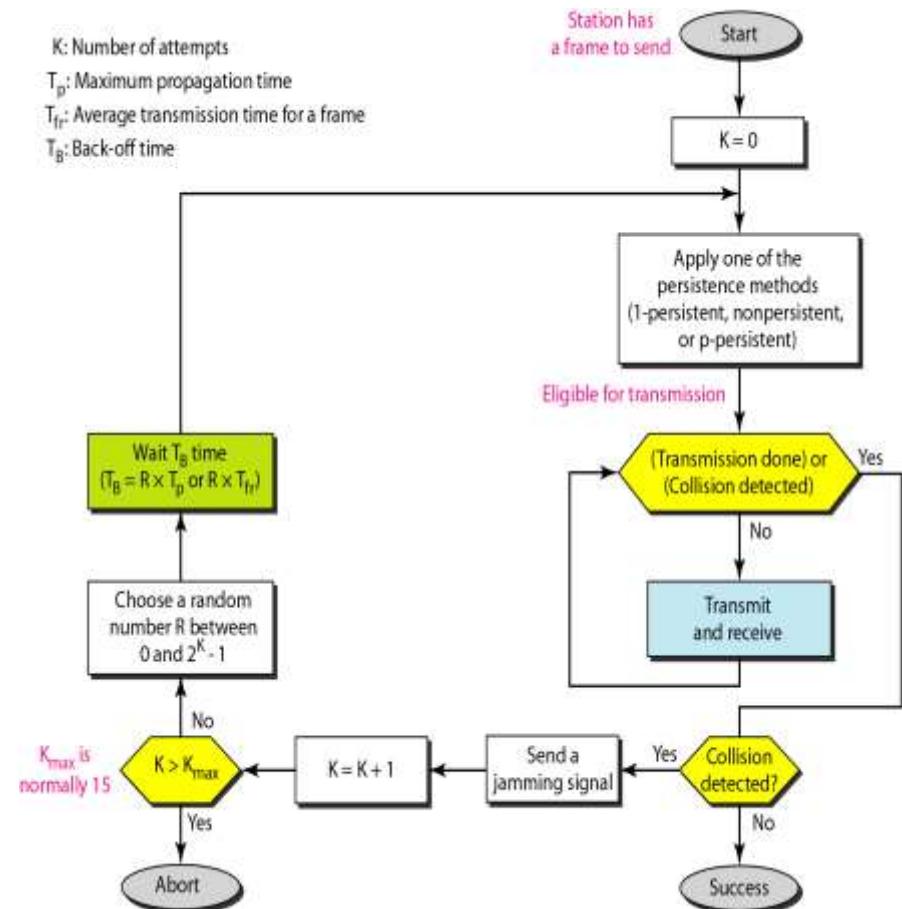
Step 1: Check if the sender is ready for transmitting data packets.

Step 2: Check if the transmission link is idle?

Step 3: Transmit the data & check for collisions.
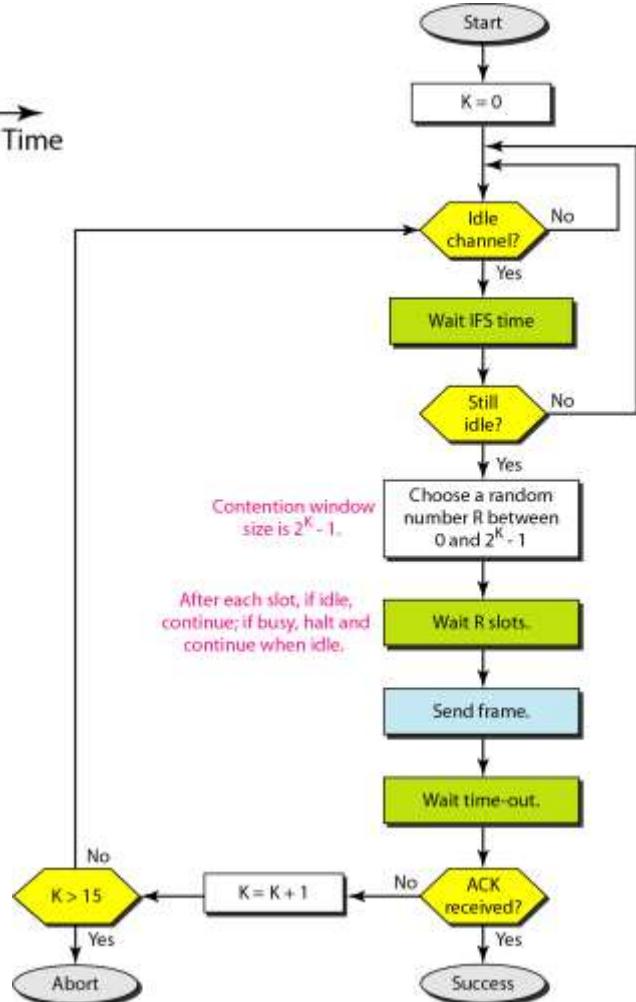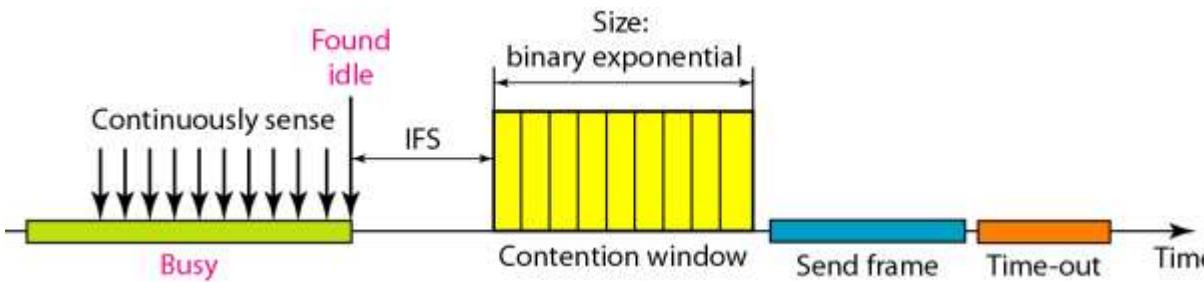
Step 4: If no collision was detected in propagation, the sender completes its frame transmission and resets the counters.

CSMA/CA

- Three type of strategies:

- **InterFrame Space (IFS) –** When a station finds the channel busy, it waits for a period of time called IFS time. IFS can also be used to define the priority of a station or a frame. Higher the IFS lower is the priority.

- **Contention Window –** It is the amount of time divided into slots.A station which is ready to send frames chooses random number of slots as **wait time**.

- **Acknowledgements –** The positive acknowledgements and time-out timer can help guarantee a successful transmission of the frame.

CSMA/CA

Tamanna   KCS 603   CN   Unit Number: 2

Controlled access
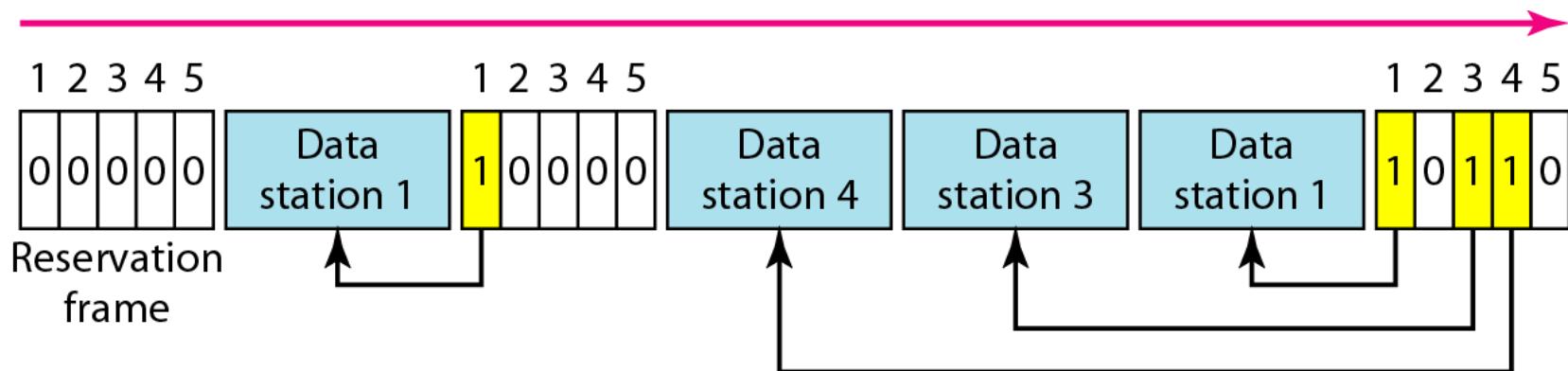
- the stations consult one another to find which station has the right to send.

- A station cannot send unless it has been authorized by other stations.

- Methods
  - Reservation
  - Polling
  - Token Passing

Reservation

- In the reservation method, a station needs to make a reservation before sending data.

- The time line has two kinds of periods:

  – Reservation interval of fixed time length

  – Data transmission period of variable frames.

- If there are M stations, the reservation interval is divided into M slots, and each station has one slot.

- Suppose if station 1 has a frame to send, it transmits 1 bit during the slot 1. No other station is allowed to transmit during this slot.

- In general, i^{th} station may announce that it has a frame to send by inserting a 1 bit into i^{th} slot. After all N slots have been checked, each station knows which stations wish to transmit.

Reservation
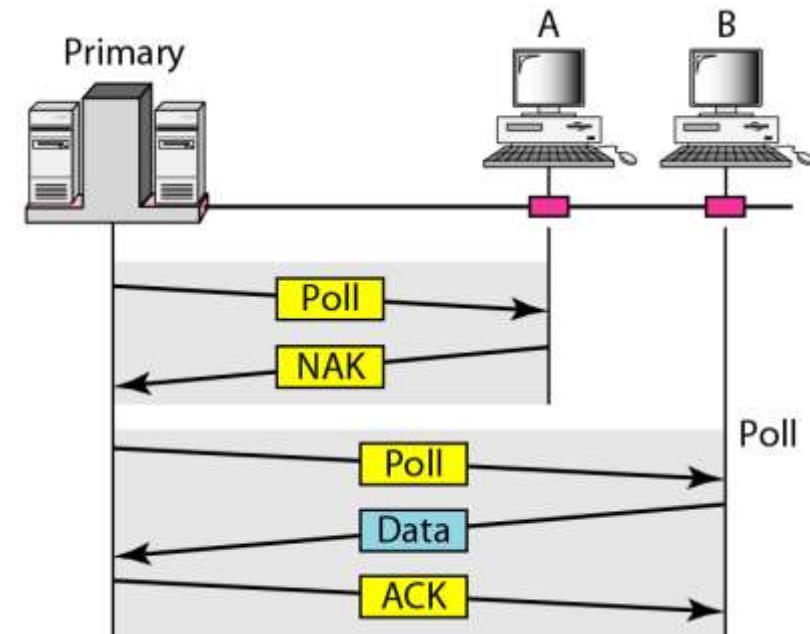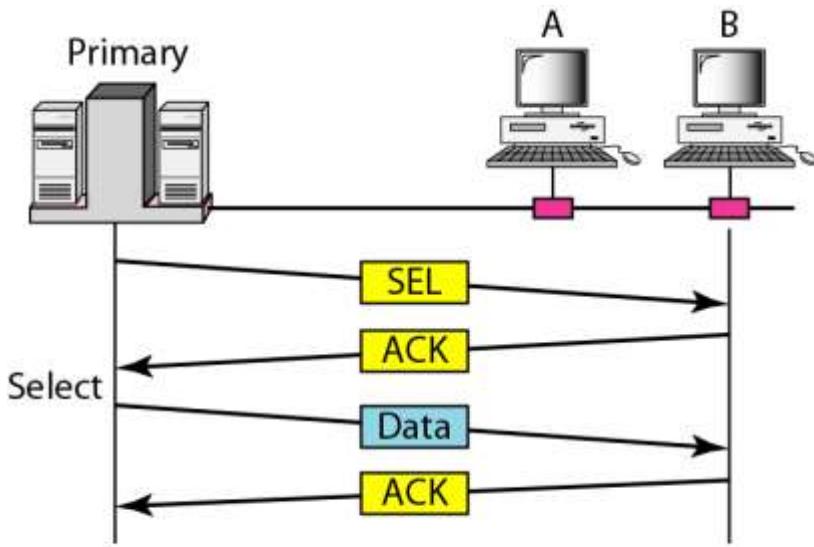
- The stations which have reserved their slots transfer their frames in that order.

- After data transmission period, next reservation interval begins.

- Since everyone agrees on who goes next, there will never be any collisions.

Polling

- Polling process is similar to the roll-call performed in class. Just like the teacher, a controller sends a message to each node in turn.

- In this, one acts as a primary station(controller) and the others are secondary stations. All data exchanges must be made through the controller.

- The message sent by the controller contains the address of the node being selected for granting access.

- Although all nodes receive the message but the addressed one responds to it and sends data, if any. If there is no data, usually a "poll reject"(NAK) message is sent back.

- Problems include high overhead of the polling messages and high dependence on the reliability of the controller.
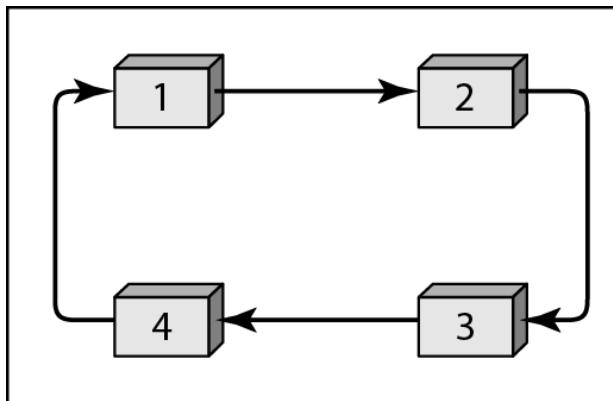
- In token passing scheme, the stations are connected logically to each other in form of ring and access of stations is governed by tokens.

- A token is a special bit pattern or a small message, which circulate from one station to the next in the some predefined order.

- In Token ring, token is passed from one station to another adjacent station in the ring whereas incase of Token bus, each station uses the bus to send the token to the next station in some predefined order.

- In both cases, token represents permission to send. If a station has a frame queued for transmission when it receives the token, it can send that frame before it passes the token to the next station. If it has no queued frame, it passes the token simply.
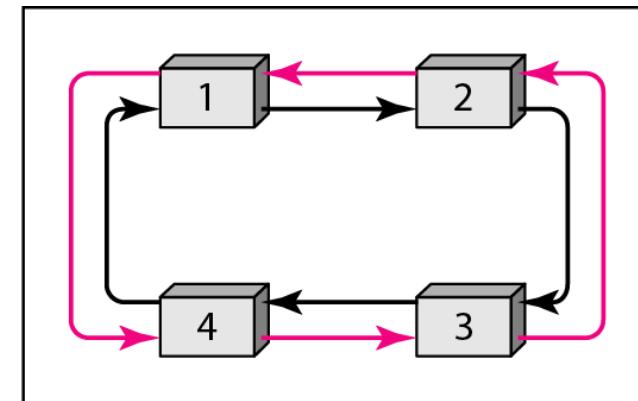
- After sending a frame, each station must wait for all N stations (including itself) to send the token to their neighbors and the other N – 1 stations to send a frame, if they have one.
- There exists problems like duplication of token or token is lost or insertion of new station, removal of a station, which need be tackled for correct and reliable operation of this scheme.
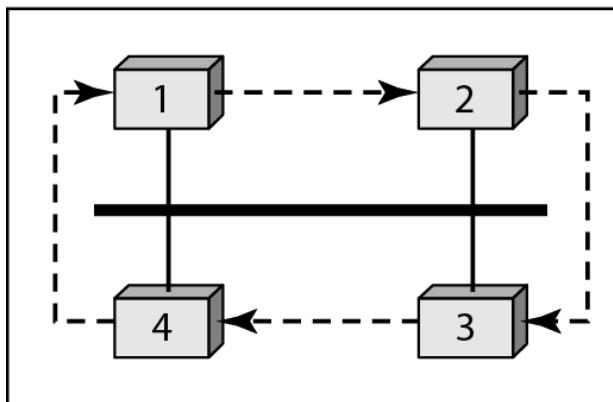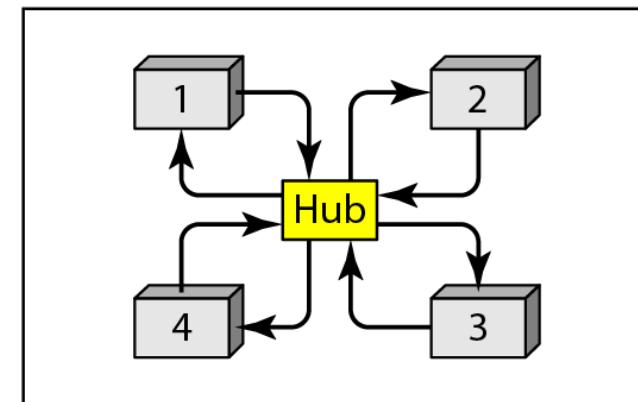
a. Physical ring

b. Dual ring

c. Bus ring

d. Star ring

Topic objective

- Understand the protocols used in Data link layer

- Understand the Noisy and noiseless channels

- Implement the error detection and error correction
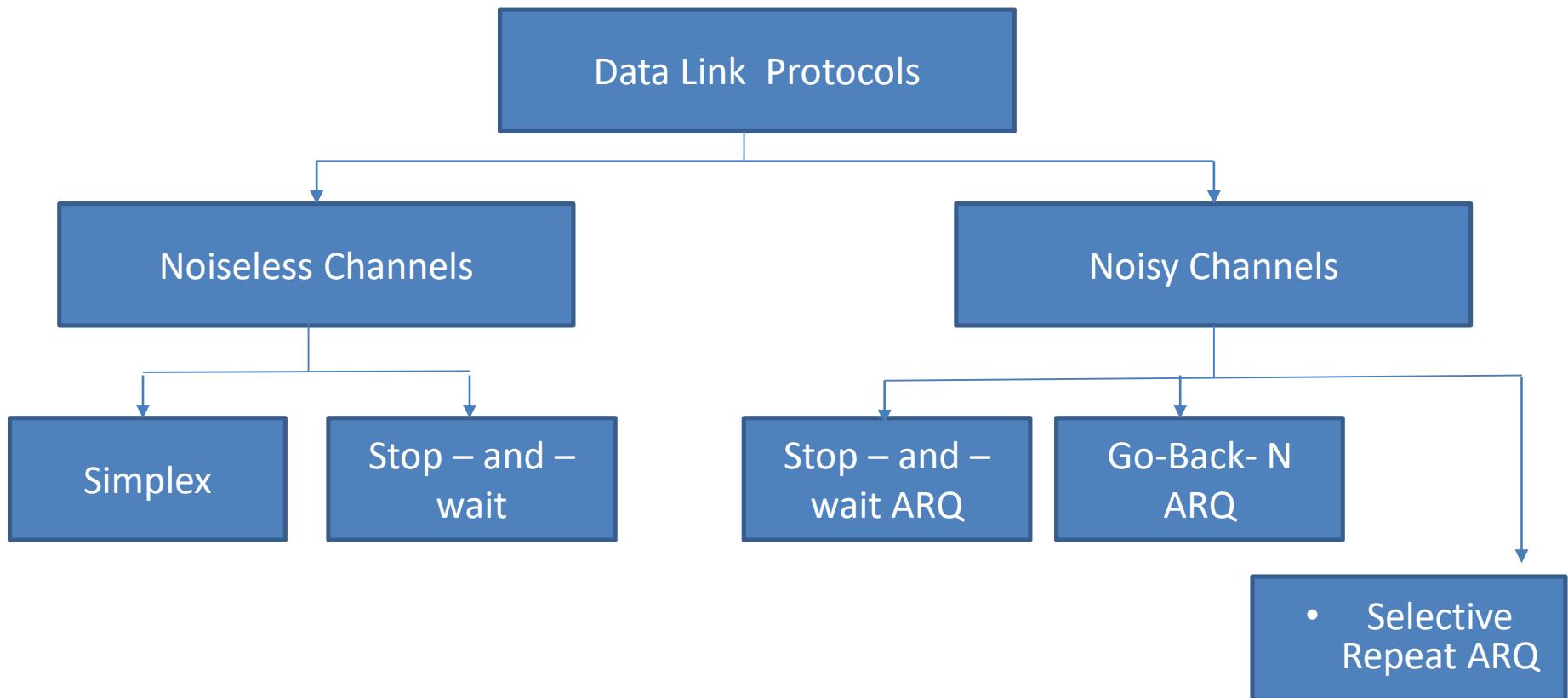
Recap of previous topic

- MAC gives access to multiple channels

- Channel is allocated based on static or dynamic

- Multiple Access protocols are used to allocate channels

- Protocols in the data link layer are designed so that this layer can perform its basic functions:

- Framing - process of dividing bit - streams from physical layer into data frames whose size ranges from a few hundred to a few thousand bytes

- error control - transmission errors and retransmission of corrupted and lost frames

- flow control - regulates speed of delivery and so that a fast sender does not drown a slow receiver.

Protocols

```
                    ┌─────────────────────┐
                    │  Data Link Protocols │
                    └─────────────────────┘
                       │                 │
            ┌──────────────────┐    ┌──────────────────┐
            │ Noiseless Channels│    │  Noisy Channels  │
            └──────────────────┘    └──────────────────┘
             │            │          │         │      │
        ┌─────────┐  ┌──────────┐ ┌──────────┐ ┌──────────┐  ┌──────────────┐
        │ Simplex │  │ Stop–and–│ │ Stop–and–│ │Go-Back- N│  │ • Selective  │
        │         │  │   wait   │ │ wait ARQ │ │   ARQ    │  │  Repeat ARQ  │
        └─────────┘  └──────────┘ └──────────┘ └──────────┘  └──────────────┘
```
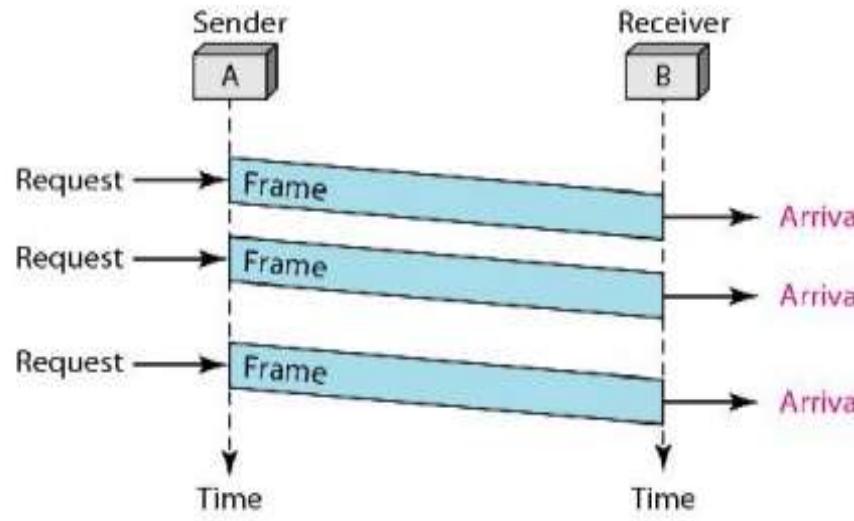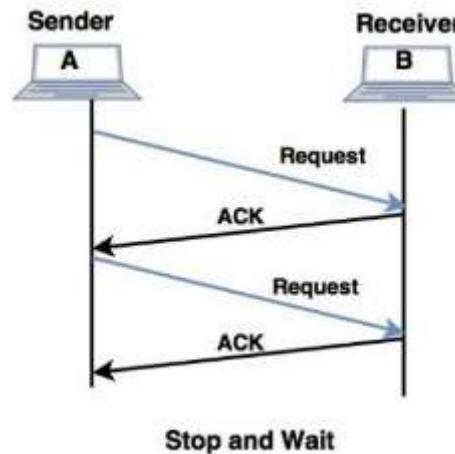
**Simplex Protocol**

- unidirectional data transmission over an ideal channel

- It has distinct procedures for sender and receiver.

- The sender simply sends all its data available onto the channel as soon as they are available its buffer.

- The receiver is assumed to process all incoming data instantly.
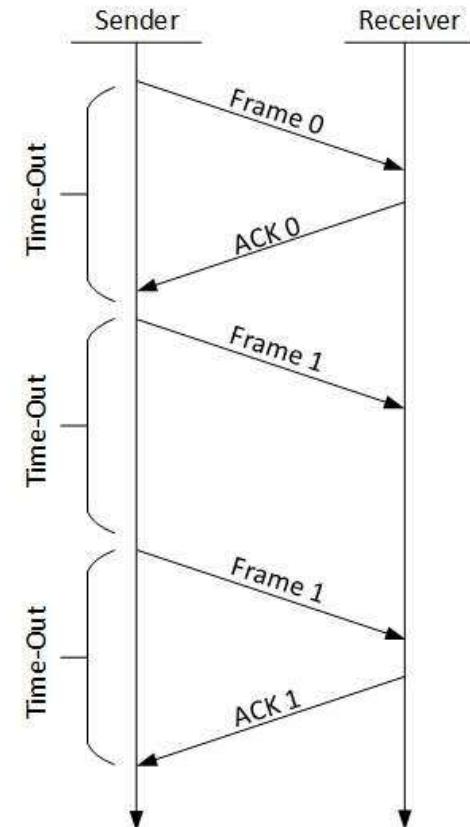
- **Stop – and – Wait Protocol**
- unidirectional data transmission without any error control facilities
- flow control so that a fast sender does not drown a slow receiver.
- The receiver has a finite buffer size with finite processing speed.
- The sender can send a frame only when it has received indication from the receiver that it is available for further data processing.
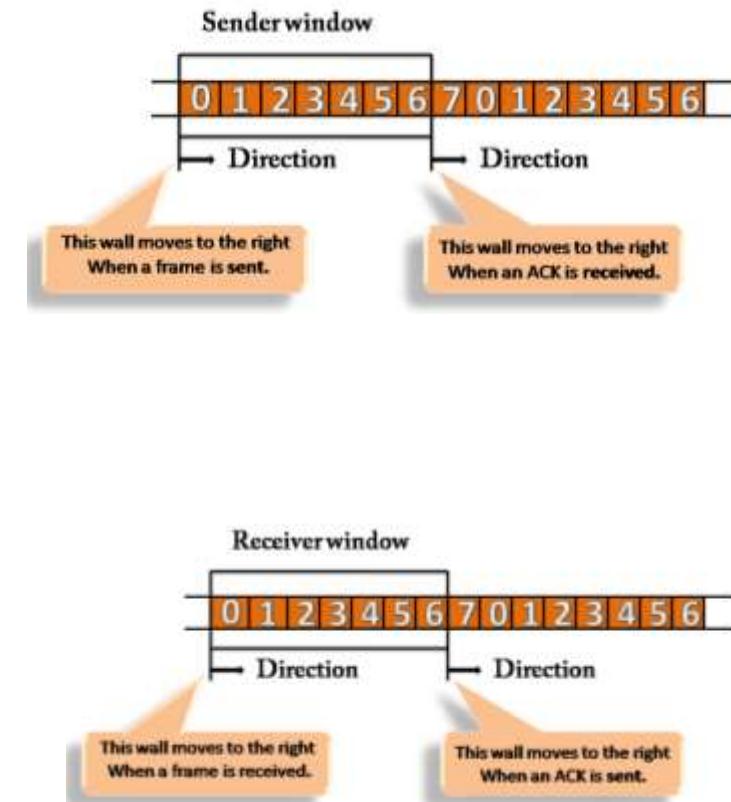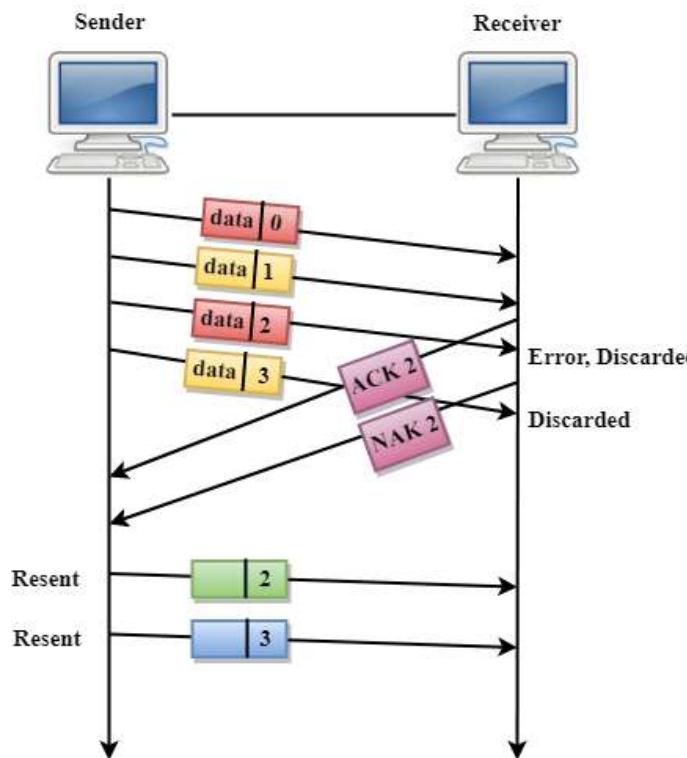
Stop and Wait

- **Stop – and – Wait ARQ (**Automatic Repeat Request)

- with added error control mechanisms

- The sender keeps a copy of the sent frame.

- It then waits for a finite time to receive a positive acknowledgement from receiver.

- If the timer expires or a negative acknowledgement is received, the frame is retransmitted.

- If a positive acknowledgement is received then the next frame is sent.

- **Go – Back – N ARQ**
- sending multiple frames before receiving the acknowledgement for the first frame.
- It uses the concept of sliding window, and so is also called sliding window protocol.
- The frames are sequentially numbered and a finite number of frames are sent.
- If the acknowledgement of a frame is not received within the time period, all frames starting from that frame are retransmitted.
- Reason for retransmission
  - Damaged frame
  - Lost data frame
  - Lost Acknowledgement

Go – Back – N ARQ
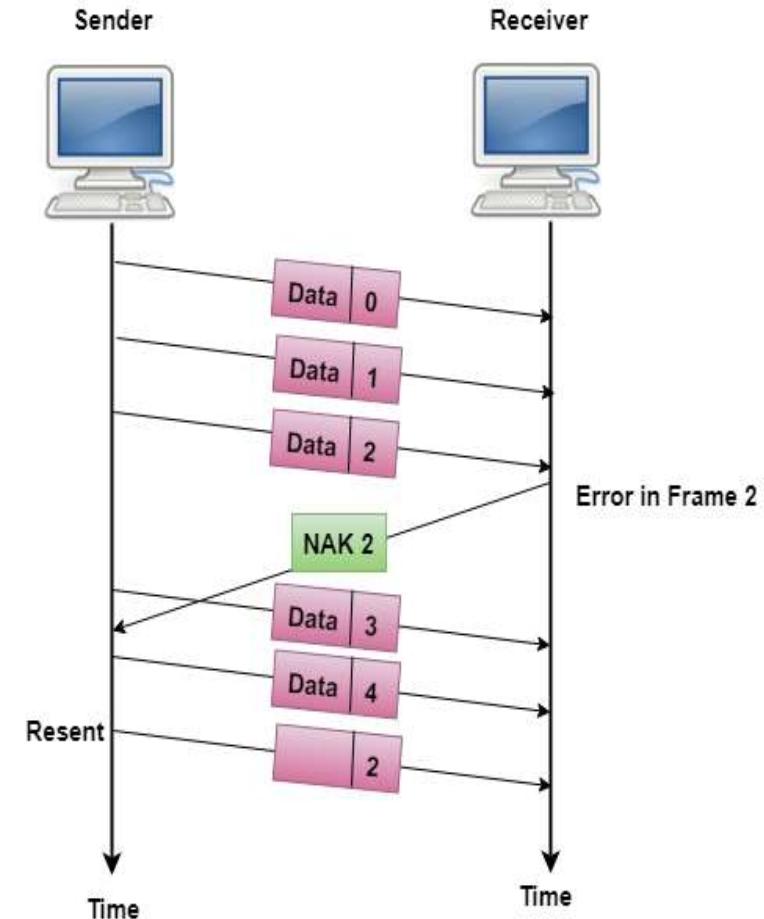
- Piggy backing Technique
  - there is a need for transmitting data in both directions between 2 computers.
  - A full duplex circuit is required for the operation.
  - the data frames and ACK (control) frames in the reverse direction have to be interleaved.
  - An efficient method is to absorb the ACK frame into the header of the data frame going in the same direction. This technique is known as *piggybacking.*
  - When a data frame arrives at an IMP (receiver or station), instead of immediately sending a separate ACK frame, the IMP restrains itself and waits until the host passes it the next message.
  - The acknowledgement is then attached to the outgoing data frame using the ACK field in the frame header.
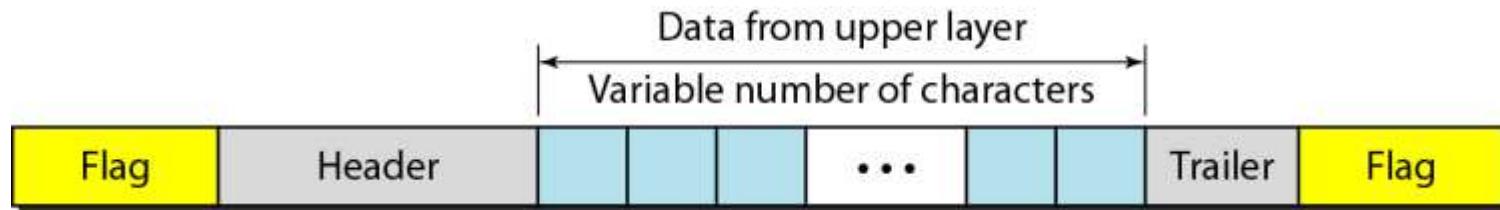
- **Selective Repeat ARQ**

- sending multiple frames before receiving the acknowledgement for the first frame.

- only the erroneous or lost frames are retransmitted, while the good frames are received and buffered.
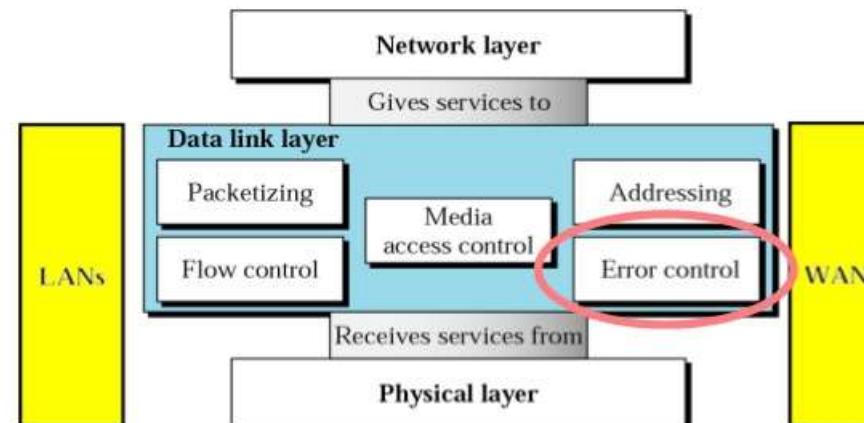
- *The data link layer needs to pack bits into frames, so that each frame is distinguishable from another.*

- The three main functions of the **data link layer** are
  - to deal with transmission errors,
  - regulate the flow of **data**, and
  - provide a well-defined interface to the network **layer**
- **Design issues -Error Control**
  - Dealing with transmission errors.
  - Sending acknowledgement frames in reliable connections.
  - Retransmitting lost frames.
  - Identifying duplicate frames and deleting them.
  - Controlling access to shared channels in case of broadcasting.

Data Link Layer

Network layer

Gives services to

Data link layer

Packetizing

Media access control

Addressing

LANs

Flow control

Error control

WANs

Receives services from

Physical layer
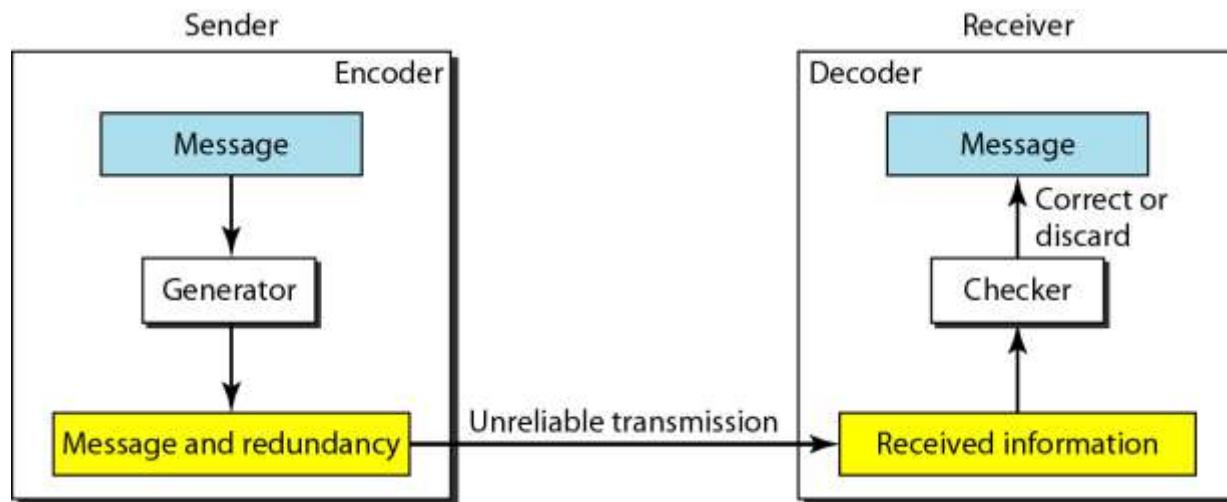
Error detection and correction
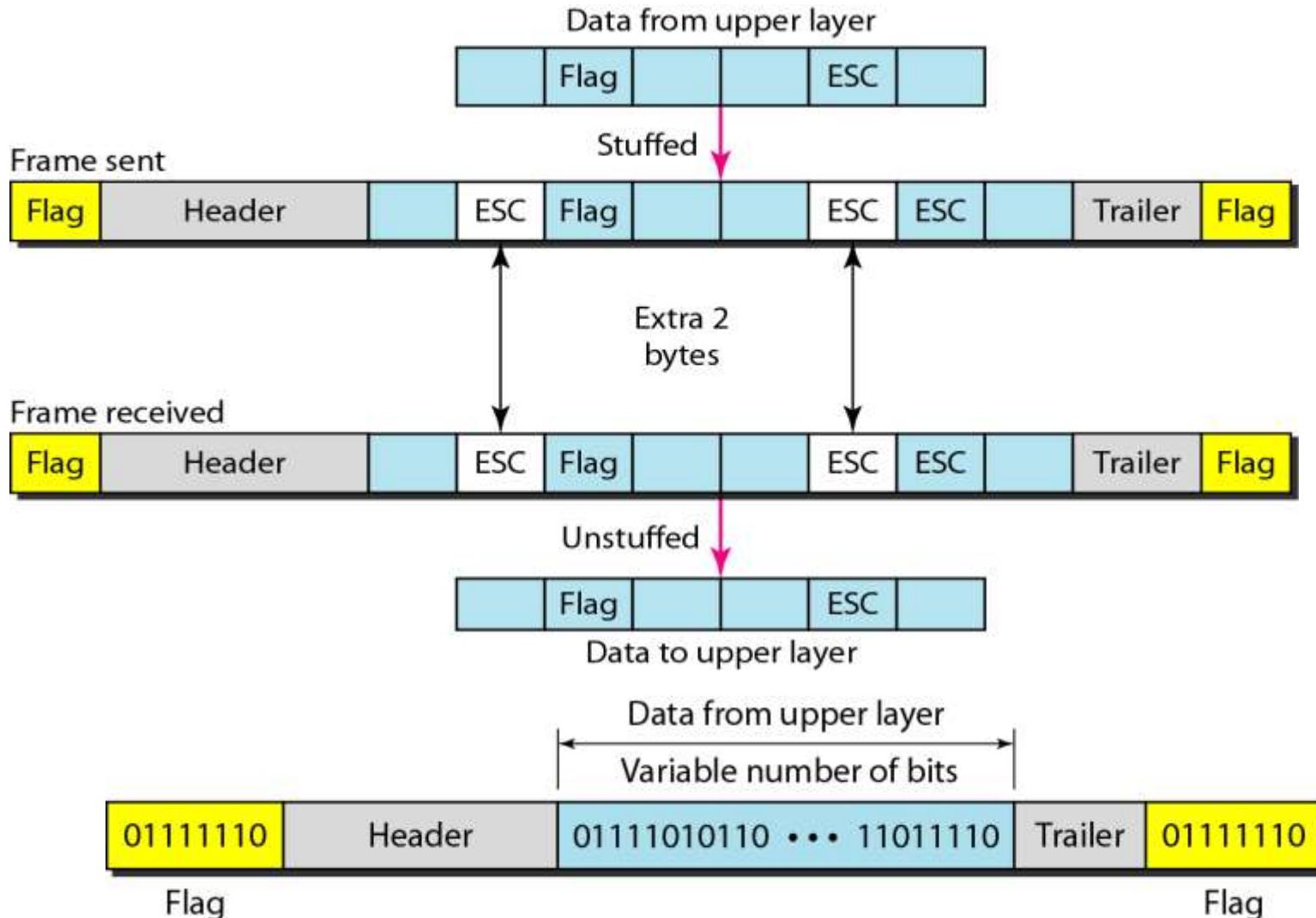
- Data can be corrupted during transmission
- Types of error
  - Bit error
  - Burst error
- To detect or correct errors, we need to send extra (redundant) bits with data.
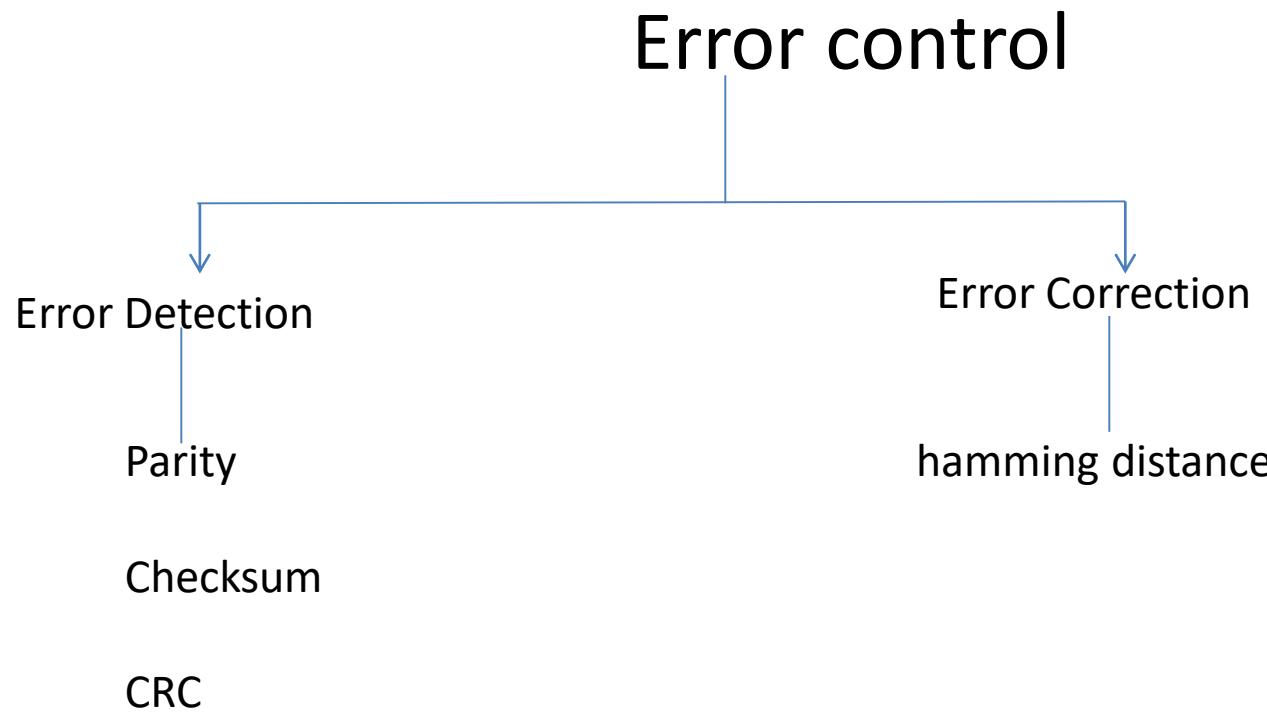
- An error-detecting code can detect only the types of errors for which it is designed; other types of errors may remain undetected.

- Byte stuffing is the process of adding 1 extra byte whenever there is a flag or escape character in the text.

- Bit stuffing is the process of adding one extra 0 whenever five consecutive 1s follow a 0 in the data

Error control

Error Detection

Error Correction

Parity

hamming distance

Checksum

CRC

- **Parity checks**
  - For a data of n size add a parity bit
    - Even parity
    - Odd parity

  For example if a data to be send is 1110001

  Then for even parity   the bit will be 0

        for odd parity the bit will be 1
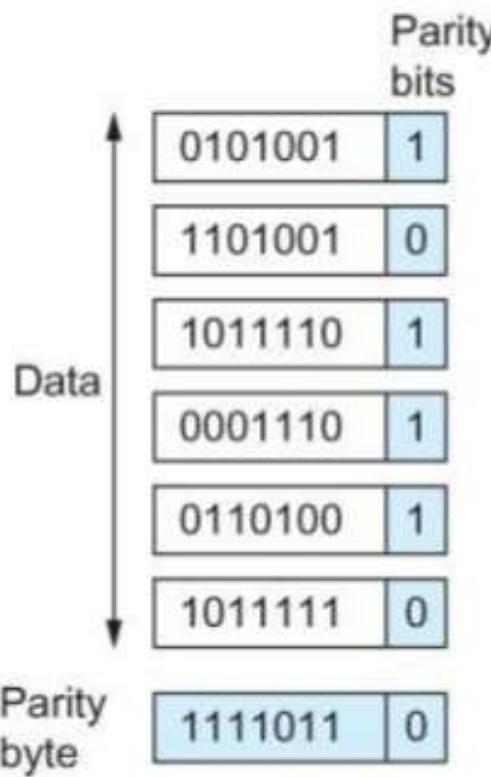
  How many bit errors it can detect?

  Suppose 10001110 is transmitted received as 10011110 -------error detected

  But if   10001110 is transmitted received as 10010110 --------no error detected

- Two dimensional parity checks
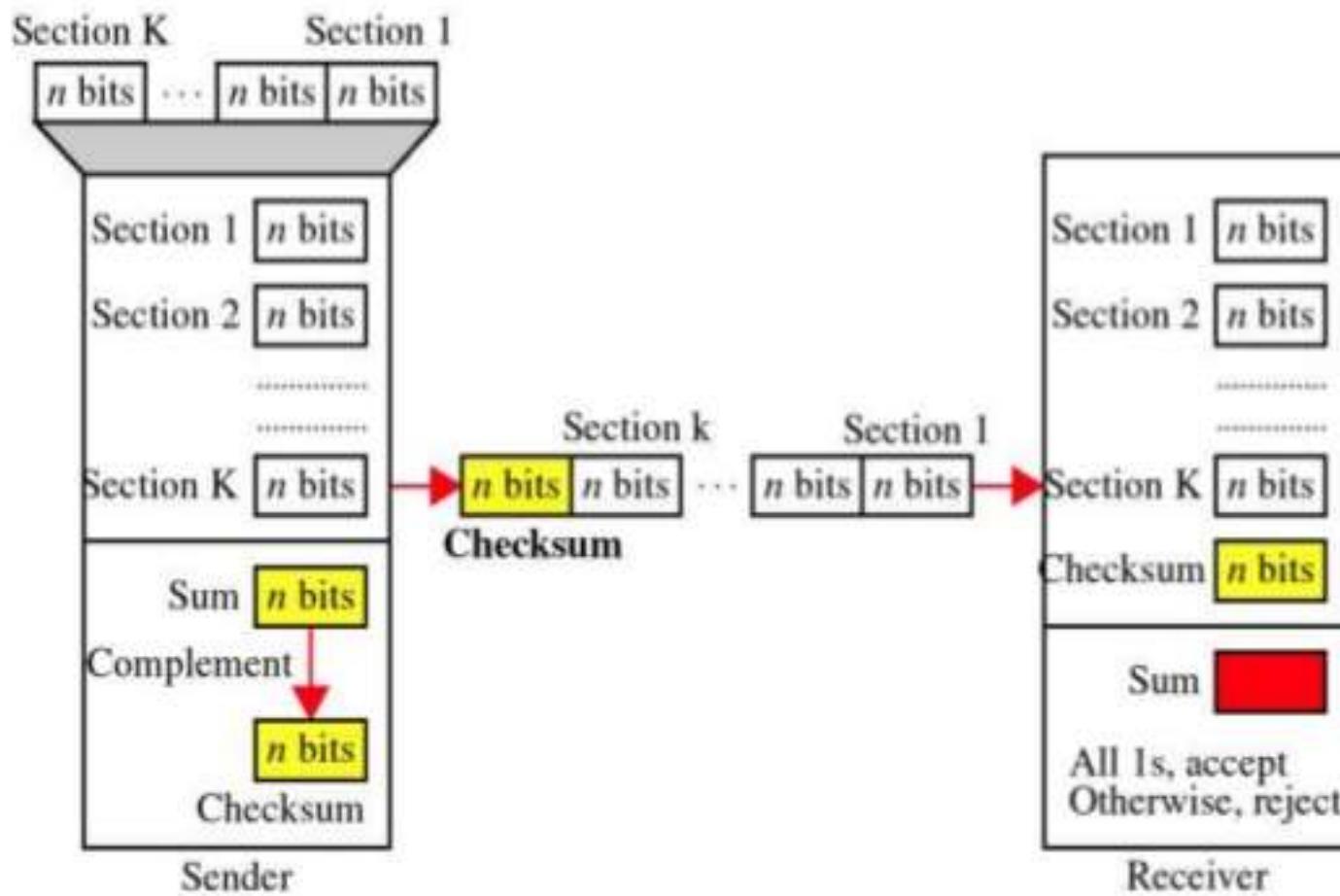
Parity bits

Data	Parity bits
0101001	1
1101001	0
1011110	1
0001110	1
0110100	1
1011111	0

Parity byte: 1111011 | 0

```
1010111        1010111
111100         101100   → parity error
0111011        0111011
-------        -------
1010100        1010100
no errors        parity error
```

Checksum

Tamanna   KCS 603   CN   Unit Number: 2

Checksum

➢ When adding numbers in ones complement arithmetic, a carryout from the most significant bit needs to be added to the result (Wrapping).

Sender Side:

- ➢ The message is divided into 16-bit words.
- ➢ The value of the checksum word is set to 0.
- ➢ All words including the checksum are added using one's complement addition.
- ➢ The sum is complemented and becomes the checksum.
- ➢ The checksum is sent with the data.

Receiver Side:

- ➢ The message (including checksum) is divided into 16-bit words.
- ➢ All words are added using one's complement addition.
- ➢ The sum becomes the new checksum.
- ➢ If the value of checksum is 0, the message is accepted; otherwise, it is rejected.

- ## Checksum

Frame Data: 01101101 10010011 01101101

n=8

Sender Side:

Calculating Checksum,

    01101101

    10010011

    01101101

    01101101 --------→1's Compliment--→ 10010010

Checksum = 10010001

So data transmitted over the link is: 01101101 10010011 01101101 **10010010**

Receiver Side: (without Error)

Received Data: 01101101 10010011 01101101 10010001

Calculating Sum,

    01101101

    10010011

    01101101

    10010010

    11111111 ----> All 1's So accepted (No error)

Receiver Side: (with Error)

Received Data: **1**1101101 10010011 01101101

    11101101

    10010011

    01101101
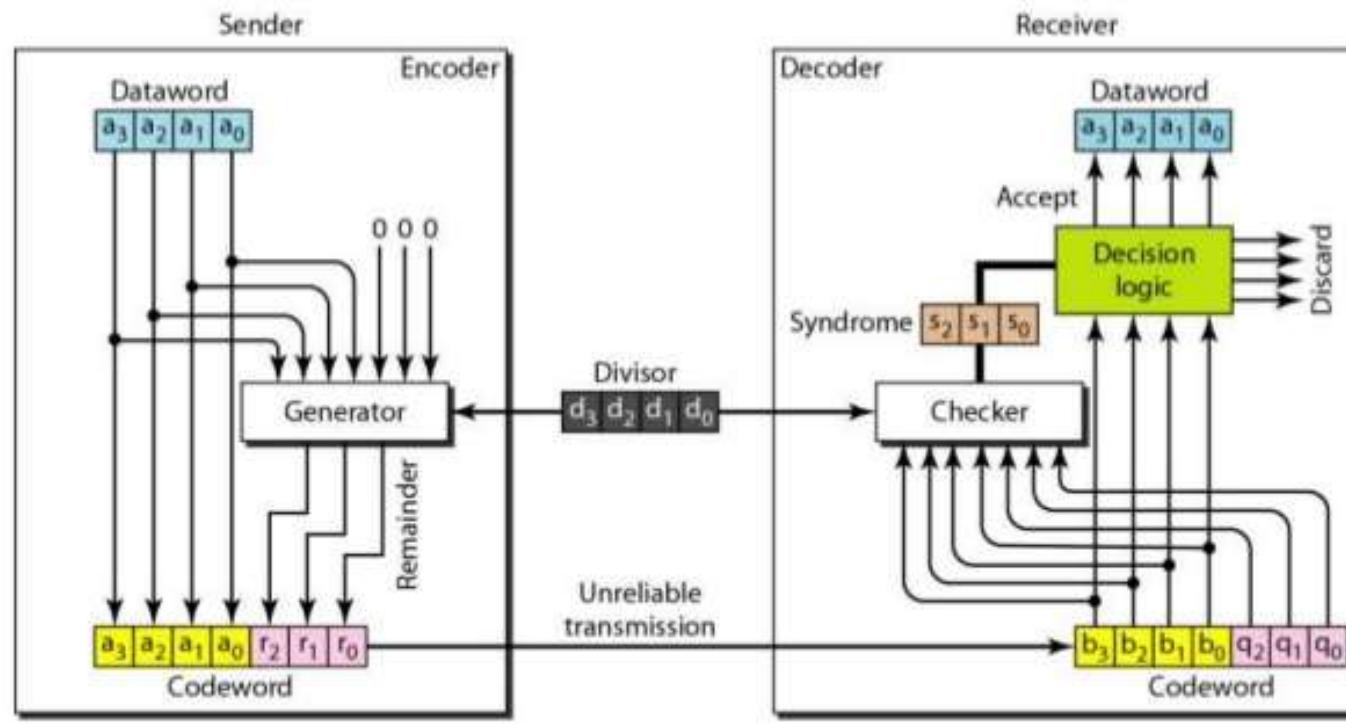
    10010010

    01111111 ---> Not all 1's. So not accepted (Contains Error)

- ## Cyclic Redundancy check (CRC)
  - Packet of data transmitted as a polynomial   1101 = x^3+x^2+1
  - At sender end - the polynomial is divided by the given generating polynomial
  - Remainder is attached to the end of the message
  - Quotient is discarded
  - Message is transmitted
  - Receiver divides the message with same polynomial
  - If remainder not equal to zero then error occurred
  - Else equal to zero then no error

CRC Encoder/Decoder
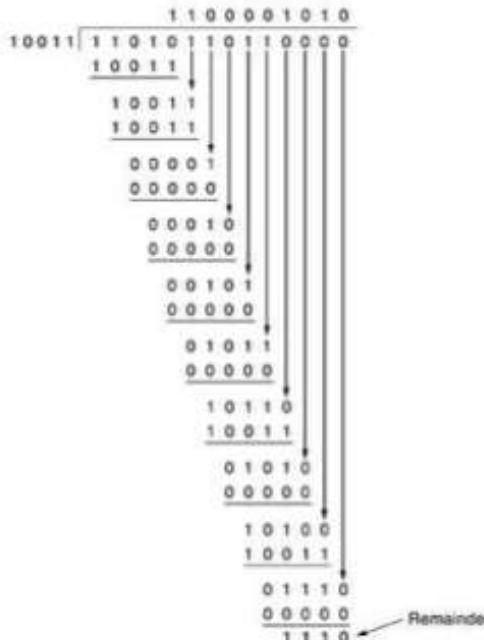
Error Detection

CRC - Example

Frame : 1101011011
Generator: 10011
Message after 4 zero bits are appended: 11010110110000

```
                1 1 0 0 0 0 1 0 1 0
10011  1 1 0 1 0 1 1 0 1 1 0 0 0 0
       1 0 0 1 1
         1 0 0 1 1
         1 0 0 1 1
           0 0 0 0 1
           0 0 0 0 0
             0 0 0 1 0
             0 0 0 0 0
               0 0 1 0 1
               0 0 0 0 0
                 0 1 0 1 1
                 0 0 0 0 0
                   1 0 1 1 0
                   1 0 0 1 1
                     0 1 0 1 0
                     0 0 0 0 0
                       1 0 1 0 0
                       1 0 0 1 1
                         0 1 1 1 0
                         0 0 0 0 0   ← Remainder
                           1 1 1 0
```

Transmitted frame: 11010110111110

Frame – 1101011011

$G(x) = x^4 + x + 1$

Transmitted frame:

11010110110000 –

00000000001110
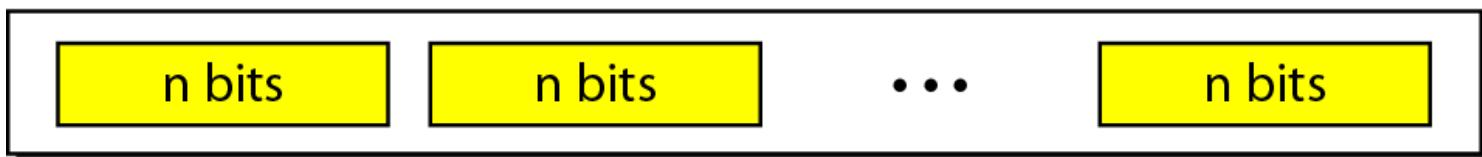
11010110111110

- K= 11010110110000
- N= 10011

- C = k+n-1 =14
- Remainder = 1110
- 11010110110000
-                     1110
- Codeword =11010110111110
- N = 10011

Error Correction

- Block coding
  - *In block coding, we divide our message into blocks, each of k bits, called* *datawords*.
  - *We add r redundant bits to each block to make the length n = k + r.*
  - *The resulting n-bit blocks are called* *codewords*.
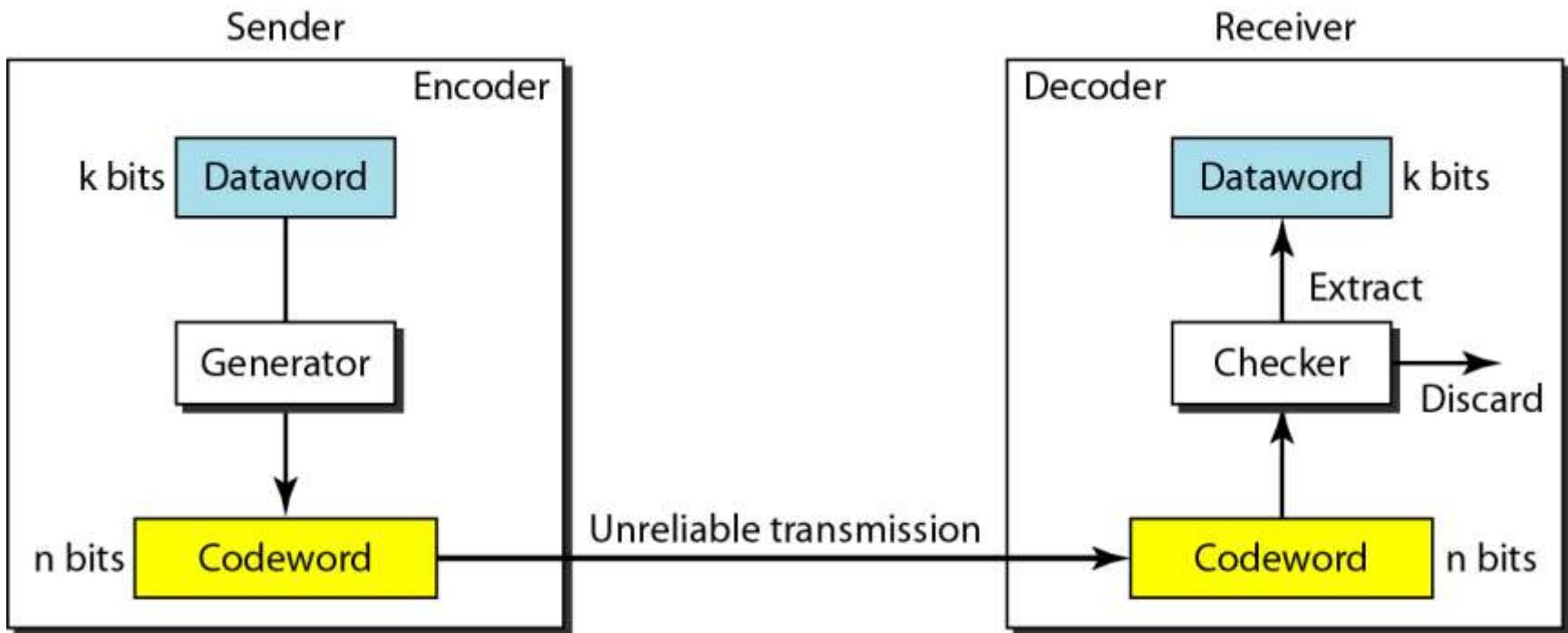
2^k Datawords, each of k bits

2^n Codewords, each of n bits (only 2^k of them are valid)

Block coding

- Hamming distance
    - The Hamming distance between two words is the number of differences between corresponding bits.
    - The minimum Hamming distance is the smallest Hamming distance between all possible pairs in a set of words.
    - To guarantee the detection of up to s errors in all cases, the minimum Hamming distance in a block code must be d_{min} = s + 1.
    - To guarantee correction of up to *t* errors in all cases, the minimum Hamming distance in a block code must be d_{min} = 2*t* + 1.

Hamming distance

- The Hamming distance d(000,011) is 2
  000 XOR 011 is 011

Similarly for designing a code minimum hamming distance is used
Which is the smallest hamming distance between all possible pairs
Ex 1. For d(000,011)=2   d(000,101) =2   d(000,110) =2
d(011,101)=2
       d(011,110) =2   d(101,110)=2

Ex. For d(00000,01011)= 3   d(00000,10101)   =3
d(00000,11110)=4
Error detected =3
Error corrected =2

Topic objective

- Understand the IEEE standards

- Various standard designed for IEEE

Recap of previous topic

- What are protocols?

- Protocols used for data link layer

- Implement error detection and correction code

IEEE Standards(CO2)

- In 1985 The Computer society started a project called Project 802
- Enable intercommunication among various devices
- Specify functions of physical layer and data link layer of LAN protocols
- Various IEEE 802 standards are as
- IEEE 802.1 High Level Interface
- IEEE 802.2 Logical Link Control(LLC)
- IEEE 802.3 Ethernet
- IEEE 802.4 Token Bus
- IEEE 802.5 Token Ring
- IEEE 802.6 Metropolitan Area Networks
- IEEE 802.7 Broadband LANs
- IEEE 802.8 Fiber Optic LANS
- IEEE 802.9 Integrated Data and Voice Network
- IEEE 802.10 Security
- IEEE 802.11 Wireless Network

- 802.2 Logical Link Control
    - "the standard for the upper Data Link Layer sublayer also known as the Logical Link Control layer. It is used with the 802.3, 802.4, and 802.5 standards (lower DL sublayers)."
    - specifies the general interface between the network layer (IP, IPX, etc) and the data link layer (Ethernet, Token Ring, etc).
    - It is responsible for flow and error control.

- 802.3 Ethernet
  - standard for CSMA/CD (Carrier Sense Multiple Access with Collision Detection).
  - This standard encompasses both the MAC and Physical Layer standards.If there is no data, any node may attempt to transmit, if the nodes detect a collision, both stop transmitting and wait a random amount of time before retransmitting the data.
  - The original 802.3 standard is 10 Mbps (Megabits per second). 802.3u defined the 100 Mbps (Fast Ethernet) standard, 802.3z/802.3ab defined 1000 Mbps Gigabit Ethernet, and 802.3ae define 10 Gigabit Ethernet.
  - Commonly, Ethernet networks transmit data in packets, or small bits of information.
  - A packet can be a minimum size of 72 bytes or a maximum of 1518 bytes.

- 802.4 Token Bus
  - Token bus standards as broadband computer networks
  - Logically, the stations are organized into a ring
  - When the logical ring is initialized, the highest numbered station may send the first frame. The token and frames of data are passed from one station to another following the numeric sequence of the station addresses.
  - The token does not follow the physical ordering of workstation attachment to the cable,there is no collision as only one station possesses a token at any given time.

- 802.5 Token Ring
  - designed to use the ring topology and utilizes a token to control the transmission of data on the network.
  - The token is a special frame which is designed to travel from node to node around the ring. When it does not have any data attached to it, a node on the network can modify the frame, attach its data and transmit. Each node on the network checks the token as it passes to see if the data is intended for that node, if it is; it accepts the data and transmits a new token. If it is not intended for that node, it retransmits the token on to the next node.

- FDDI (Fiber Distributed Data Interface)
  - a set of ANSI and ISO standards for data transmission on fiber optic lines in a local area network (LAN) that can extend in range up to 200 km (124 miles). The FDDI protocol is based on the token ring protocol
  - An FDDI network contains two token rings, one for possible backup in case the primary ring fails.

- The FDDI data frame format is:

PA	SD	FC	DA	SA	PDU	FCS	ED/FS
16 bits	8 bits	8 bits	48 bits	48 bits	up to 4478×8 bits	32 bits	16 bits

- Where
- **PA** is the preamble,
- **SD** is a start delimiter,
- **FC** is frame control,
- **DA** is the destination address, **SA** is the source address,
- **PDU** is the protocol data unit (or packet data unit),
- **FCS** is the frame check Sequence (or checksum), and
- **ED/FS** are the end delimiter and frame status.

- 802.11 Wireless Network Standards
  - collection of standards setup for wireless networking.
  - the three popular standards: 802.11a, 802.11b, 802.11g and latest one is 802.11n.
  - Each standard uses a frequency to connect to the network and has a defined upper limit for data transfer speeds.
  - 802.11a was one of the first wireless standards.
  - 802.11b standard was popular due to higher prices and lower range.
  - 802.11g is a standard operates in the same band as 802.11b, 802.11g is compatible with 802.11b equipment.
  - Wireless LANs primarily use CSMA/CA - Carrier Sense Multiple Access/Collision Avoidance. It has a "listen before talk" method of minimizing collisions on the wireless network.
  - This results in less need for retransmitting data.

1. _____ address is a unique identifier allotted to a NIC of a device.

2. Full form of NIC is _____

3. The latest standard of 802.11 is _____

4. The full form of PDU is _____

5. The standard for the upper Data Link Layer sublayer also known as the _____

6. The _____between two words is the number of differences between corresponding bits.

7. Slotted Aloha need central clock for _____

8. _____regulates speed of delivery and so that a fast sender does not drown a slow receiver

1. How will you find out how many Hamming code bits should be incorporated?   CO2

2.For the given data using bit stuffing method. How data will be sent?
    0110111110111111101111101111111011   CO2

3. Find out the LRC & VRC for the below characters?   CO2

0   0   1   1   0   1

1   1   0   1   0   0

0   1   1   0   1   0

0   0   1   0   1   1

4.For the data given below : how it will be sent using character stuffing method?   CO2

abcdefghijka DLE 123456789RAMARAO DLE

5.Prove that the channel utilization is 18% in ALOHA and 37% slotted ALOHA.   CO2

6. Given the dataword 101001111 and the divisor 10111, show the generation of the CRC codeword at the sender site.   CO2

7. A sender has two data items to send $(4567)_{16}$ and $(BA98)_{16}$. What is the value of the checksum?   CO2

8. Assuming even parity, find the parity bit for each of the following given data   CO2
i. 1001011   ii. 0001100   iii. 1000000   iv. 1110111

9. Assume we need to create codewords that can automatically correct a one-bit error. What should the number of redundant bits (r) be, given the number of bits in the dataword (k)? Remember that the codeword needs to be n = k+r bits, called C(n,k). After finding the relationship, find the number of bits in r if k is 1,2,5,50 or 1000   CO2

10. Explain the different IEEE formats.   CO2

1. IEEE standard for Wireless LANs is
A. 802.5
B. 802.8
C. 802.11
D. 802.12

2. The full form of CRC is
A. Cyclic redundancy check
B. Cyclic repetitive check
C. Check redundancy code
D. Check redundancy cycle

3. The error correcting and detecting properties of a code depends on its
A. Distance
B. Hamming distance
C. Lambda
D. Parity bit

4. Which layer changes the sequence of bits into electromagnetic signals
A. Session layer
B. Network layer
C. Data link layer
D. Physical Layer

5. _____ is explained as unsynchronized transmission at any instant

A. Pure Aloha

B. Slotted Aloha

C. CSMA

D. CSMA/CD

6. If byte stuffing is used for a data fragment A ESC FLAG B, then output after stuffing will be

A. ESC A ESC FLAG B

B. A ESC ESC FLAG B

C. A ESC ESC ESC FLAG B

D. A ESC FLAG B ESC

7. Which layer changes the sequence of bits into electromagnetic signals

A. Session layer

B. Network layer

C. Data link layer

D. Physical Layer

8. _____ are based on treating bit strings as representation of polynomials with coefficients of 0 and 1 only

A. Polynomial code

B. CRC

C. Both A & B

D. None

Youtube/other Video Links

https://www.youtube.com/watch?v=xmMcfwbWaHk

https://www.youtube.com/watch?v=IftFvfSywCQ

- 18-19
- https://drive.google.com/open?id=17OUMNnX0kFDc9UB8tx8qd8zyEj7lCD5P
- 17-18
- https://drive.google.com/open?id=1oFmw__qC7wdUP85gUkKbkohZvd9Vopm_
- 16-17
- https://drive.google.com/open?id=1eDrOkj2wVsxdTZPb7-A78YuYn16HC1ob
- 15-16
- https://drive.google.com/open?id=1ljNxmZP1_pl10rbxJvK6xB1ybG7AMuqU
- 14-15
- https://drive.google.com/open?id=1tjERKPwEA9icWcQTBZQnKUq_ttqBDeo5

- What is the function of Data Link Layer.   CO2

- What is piggybacking?   CO2

- What are the different types of Ethernet available.

                                              CO2

- Draw the frame format of MAC   CO2

- Explain CSMA/CA and CSMA/CD with suitable diagram

                                              CO2

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Paper Id: **110262**   Roll No. [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

B.TECH
(SEM-VI) THEORY EXAMINATION 2018-19
COMPUTER NETWORK

Time: 3 Hours   **Total Marks: 70**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1.   **Attempt all questions in brief.**   2 x 7 = 14

   a.   What are header and trailers and how do they get added and removed?

   b.   A large FDDI ring has 100 stations & a token rotation time of 40msec. The token holding time is 10msec. What is the maximum achievable efficiency of the ring?

   c.   What is the difference between network layer delivery and the transport layer delivery?

   d.   If a class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?

   e.   What is count-to-infinity problem?

   f.   What is the difference between a user agent (UA) and a mail transfer agent (MTA)?

   g.   What is time-to-live or packet lifetime?

SECTION B

2. **Attempt any *three* of the following:** 7 x 3 = 21

    a. Define topology and explain the advantage and disadvantage of Bus, Star and Ring topologies.

    b. A channel has a bit rate of 20 kbps. The stop and wait protocol with frame size 4500 bits is used. The delay for error detection and sending ACK by the receiver is 0.25 seconds because of a fault. Find the maximum efficiency of the channel if the destination is 30000km away and the speed of the propagation of the signal is 2.8×10^8 m/s. Find the decrease in efficiency due to the fault.

    c. What is unicast routing? Discuss unicast routingprotocols.

    d. Explain about the TCP header and working of TCP protocoland differentiate between TCP and UDP with frameformat.

    e. (i) How is TFTP different from FTP?
       (ii)What three functions can SNMP performto manage network devices?

SECTION C

3. **Attempt any *one* part of the following:** 7 x 1 = 7

    (a) What is OSI Model? Explain the functions; protocols andservices of each layer?

    (b) Encode the data-stream 10011010 using the following encoding scheme:
        (i) Unipolar
        (ii) Bipolar NRZ-L
        (iii) Bipolar NRZ-I
        (iv) RZ

(v) Manchestor
(vi) Differential Manchestor
(vii) AMI

4. **Attempt any *one* part of the following:**   7 x 1 = 7

(a) A slotted ALOHA network transmits 400-bit frames on a shared channel of 400
kbps. What is the throughput if the system (all stations together) produces –
(i) 1000 frames per second
(ii) 500 frames per second
(iii) 250 frames per second

(b) Explain ARQ Error Control technique, in brief.

5. **Attempt any *one* part of the following:**   7 x 1 = 7

(a) Write advantages of Next-generation IPV6 over IPV4.

(b) The IP network 200.198.160.0 is using subnet mask 255.255.255.224. Design
the subnets.

6. **Attempt any *one* part of the following:**   7 x 1 = 7

(a) The following is the dump of a TCP header in hexa decimal format:
05320017 00000001 00000000 500207FF 00000000
(i) What is the sequence number?
(ii) What is the destination port number?
(iii) What is the acknowledgment number?

(iv) What is the window size?

(b) What do you understand by Quality of service, parameters? List various Quality of service parameters.

7. **Attempt any *one* part of the following:** 7 x 1 = 7

(a) (i) How is the BOOTP different from DHCP?

(ii) What is the purpose of the Domain Name System? Discuss the three main divisions of the domain name space.

(b) Write short notes on any two:

(i) SMTP

(ii) TELNET

(iii) HTTP

Summary

- Channel Allocations Dynamic and static

- Various LAN Protocols – including ALOHA protocols

- Overview of IEEE standards - FDDI.

- Data Link Layer – various Elementary Data Link Protocols

- Error Handling using correction and detection.

Text Books

1. Behrouz Forouzan, "Data Communication and Networking", McGraw Hill

2. Andrew Tanenbaum "Computer Networks", Prentice Hall.

3. William Stallings, "Data and Computer Communication", Pearson.

1. Forouzen, "Data Communication and Networking", TMH

2. A.S. Tanenbaum, Computer Networks, Pearson Education

3. W. Stallings, Data and Computer Communication, Macmillan Press

4. Gary R.Wright,W.Richard Stevens "TCP/IP Illustrated,Volume2 The Implementation" Addison-Wesley

5. Michael A. Gallo and William M. Hancock "Computer communucation and Networking Technology" Cengage Learning

6. Bhavneet Sidhu, An Integrated approach to Computer Networks, Khanna Publishing House

7. Anuranjan Misra, "Computer Networks", Acme Learning

8. G. Shanmugarathinam, "Essential of TCP/ IP", Firewall Media

Thank You