

Assignment - 1

Q1 5-Networking Devices :-

1. Router :- It is used to connect multiple networks and route packets between them. Provides security features like firewalls, NAT, and VPN support.
2. Switch :- Used to connect multiple devices in a LAN. Uses MAC addresses to forward data frames and reduces network congestion by sending data only to the intended recipient. It supports VLANs.
3. Modem :- Converts digital signals from a computer into analog signals for transmission over telephone lines. Connects to an ISP to provide Internet access. Integrated with routers in modern setups.
4. Wireless Access Point :- Allows wireless devices to connect to a wired network via WiFi. Extends network coverage without more cabling.
5. Firewalls :- Monitors and controls incoming/outgoing network traffic based on security rules. Blocks unauthorized access while permitting legitimate communication and protects against cyber attacks.

Q8:- Difference Between a Switch and Hub.

Hub

Switch

- | | |
|--|--|
| 1. Works on the Physical layers | works on Data-Link layer. |
| 2. Broadcasts Data to all connected Devices | forwards only to Intended Recipient |
| 3. Slower Due to collisions and causes Congestion | faster Due to No collisions and full Duplex Connection |
| 4. All Devices can see Traffic and is Therefore, less Secure | Isolation of Traffic leads to more Security. |

A. Difference Between Router and Modem

Modem

Router.

- 1. Connects to ISP and converts signal Routes Data Between Devices and Network and Internet
- 2. Physical Layer Network Layer.
- 3. Converts Digital Signals to Analog and vice versa Works with Digital Data only
- 4. Gets a public IP from ISP Assigns private IP Addresses and uses NAT to Share a single public IP
- 5. Doesn't include security features Includes firewall, VPN, port forwarding and access control
- 6. Doesn't include WLAN WiFi. Includes WiFi

B. NIC :- a Network Interface Card allows a computer to connect to a network. Its primary role is to facilitate communication between the computer and the network devices. It assigns a MAC Address, and supports network protocols.

Q3 A. How to connect a computer to a switch
Using an Ethernet cable.

1. Gather the Hardware
 - Ethernet cable
 - Switch
 - Computer

2. Power on the switch using its Adapter
3. Plug in one end of the Ethernet cable into the computer's Ethernet port
4. Plug other end into an available port on the switch
5. Check status light on the switch to check its status.

B. Configure IP on ~~Windows~~ windows
use the following to check IP

PS> ipconfig

Configure IP

PS> netsh interface ip set address name="Ethernet"
Static 192.168.1.100 255.255.255.0 192.168.1.1
Set IP Subnet Mask Default Gateway

~~Q~~ A. Modem:- Connects to the ISP and converts
Digital connection.

Switch:- connects Multiple devices together

WAP:- Provides Wi-Fi for Portable Devices

Firewall:- filters Incoming and Outgoing traffic.

VPN Server:- Encrypts Remote Connections.

B. What is a firewall?

A firewall acts as a Digital Barrier Between a trusted Internal Network and External Connections. It does the following:

1. Blocks Unauthorised Access
2. Filters Malicious Traffic
3. Prevents Data Breaches
4. Controls Network Access

How Does it Work?

It uses Various techniques like

1. Packet filtering
2. Stateful Inspection
3. Application-level Inspection
4. Next Generation firewall like Deep packet Inspection, Intrusion Prevention

Assignment - 2

Q1 What is Bit Stuffing?

Bit Stuffing is used in Data communication protocols to ensure Reliable transmission by inserting Extra bits into the Data Stream, it helps the receiver Distinguish Between Data and control signals.

Why is it Necessary?

1. Prevents frame Delimiter Conflicts
2. Ensures Synchronization
3. Avoids Control Signal Ambiguity
4. Improves Error Detection.

Q2 Difference Between Bit Stuffing and Byte Stuffing.

1. Bit Stuffing :- Used in Bit Oriented protocols

→ Inserts an Extra bit to prevent confusion with reserved Bit Patterns

Ex :- Using HDLC Protocol

Original Data - 0 1 1 1 1 0 1

Stuffed Data - 0 1 1 1 1 0 0 1

Q2 Byte Stuffing :- Insert an Extra Byte before reserved bytes like ESC, STX etc and is used in Byte oriented protocols.

for Example :-

Original Data :- Flag 7E
~~Flag~~ Stuffed Data :- ESC SD

Q3

Given Data

0 111110 1101111 1101110 10

Stuffed Data

[Insert 0 after 5 '1's]

0 111110 1011011110 110111010
 Stuffed Bits

Destuffed Data :-

0111110 1101111 1101111010

Assignment 3

Q5

Advantages and Disadvantages of Bit Stuffing.

Advantages

1. Prevents Delimiter Conflicts
2. Simple Hardware Implementation
3. Low Overhead
4. Works in continuous B.T Stream
5. Improves Synchronization

Disadvantages

1. Adds small overhead because transmission time is slightly increased.
2. Not Human Readable
3. Limited to Bit Oriented Protocols
4. Inefficient for Random Data

Assignment - 3

Q1 Compute CRC for 1110 001 with polynomial 1001

Polynomial 1001 Represents $x^3 + 1$, which is degree 3. Therefore padded Bits = 3

Padded Message = 111 001 000

Binary Division

$$\begin{array}{r}
 1001 \quad | \quad 1110 \quad 0100 \quad 0 \quad | \\
 \underline{\oplus} \quad 1001 \\
 01110 \\
 \underline{\oplus} \quad 1001 \\
 0111 \\
 \underline{\oplus} \quad 1001 \\
 01100 \\
 \underline{\oplus} \quad 1001 \\
 01010 \\
 \underline{\oplus} \quad 1001 \\
 0011
 \end{array}$$

Remainder = 011

$$\therefore CRC = 011$$

Transmitted Message = 111 001 011

Q2 Given Generator Polynomial = 111
 Message = 1001101

find CRC and transmitted Message

Generator polynomial = 111. Represents $x^2 + x + 1$
 of degree 2
 \therefore CRC length = 2

\therefore Padded Message = 1001101100

Binary Division

111 | 100 110 100

111

0111

111

000101

111

0100

111

011

Remainder = 011

CRC = 11

Transmited Message = 100110111

Q3

Given Message = 101 001

Polynomial = 11011

Received Message = 101 001 1001

find CRC and verify Received Message.

Polynomial is 11011 which is of Degree 4

\therefore CRC bits = 4

Padded Message = 101 001 00 00

Division $11011 \mid 101 \ 001 \ 00 \ 00$

$100 \ 11$

$011 \ 11$

$110 \ 11$

$\overline{101 \ 00}$

$110 \ 11$

$011 \ 11$

$110 \ 11$

$\overline{101 \ 00}$

$110 \ 11$

$0010 \ 00$

Remainder = 1010

\therefore CRC = 1010

Transmitted Message = 101 001 1010

Verification of Received Message

Division $11011 \mid 101001 \ 1001$

11011

$\overline{01111}$

11011

$\overline{10100}$

11011

01111

11011

$\overline{10100}$

11011

0111

Remainder = 0111

\therefore Remainder is Non zero

Error is Detected.

~~Q5~~

Data = 1011

Generate Hamming code

Bit position	1	2	3	4	5	6	7
Type	P_1	P_2	0	P_3	0	0	0
Value	0	0	1	0	0	1	1

$$P_1 = P_1 \oplus 1 \oplus 0 \oplus 1 = 0$$

$$\therefore P_1 = 0$$

$$P_2 = P_2 \oplus 1 \oplus 1 \oplus 1 = 0$$

$$\therefore P_2 = 1$$

$$P_3 = P_3 \oplus 0 \oplus 1 \oplus 1 = 0$$

$$P_3 = 0$$

∴ Transmitted Message is

0110011

Q5

Received Message 101110

Bit position	1	2	3	4	5	6	7
Type	P ₁	P ₂	D	P ₄	D	D	D
Received	1	0	1	1	1	0	1

To verify Errors and Even Parity

$$P_1 = P_1 \oplus D_3 \oplus D_5 \oplus D_7 = 0$$

→ No Errors

$$P_2 = P_2 \oplus D_3 \oplus D_6 \oplus D_7 = 0$$

→ No Errors

$$P_3 = P_1 \oplus D_5 \oplus D_6 \oplus D_7 = 1$$

→ Errors Detected

Error position is P₁ P₂ P₃ in Binary

∴ Error at $(100)_2$ at positions

∴ correct Message by flipping bit 5

Correct Message = 1010 101

Q6

Given Data 11001

Using Even Parity

Bit Position: 1 2 3 4 5 6 7 8 9

Type: $P_1 \ P_2 \ D_3 \ P_4 \ D_5 \ D_6 \ D_7 \ D_8 \ D_9$

Data: 1 1 0 0 1 1

$$P_1 = P_1 \oplus D_2 \oplus D_5 \oplus D_7 = 0$$

$\therefore P_1 = 0$

$$P_2 = P_2 \oplus D_3 \oplus D_4 \oplus D_5 = 0$$

$P_2 = 1$

$$P_4 = D_2 \oplus D_3 \oplus D_4 = 0$$

$P_4 = 0$

$$P_8 = D_5$$

$$P_8 = 1$$

-- Transmitted Message is
11100 1101