Department of Information & Communication Technology

Faculty of Technology

University of Ruhuna

Lab Assignment 01

ICT3243 - Network, Computer and Application Security

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Question 1

01. A computer network is a collection of computers and other devices which are interconnected to sharing resources and data communication over wired or wireless network.

02. The network architecture means the structural and logical layout of a network which shows how the devices of the network interconnected.

03.

- **PERSONAL AREA NETWORK (PAN)** - a personal area network - a network for interconnecting devices centered around an individual person's workspace.

- **LOCAL AREA NETWORK (LAN)** - LANs are computer networks that connecting the devices within a limited area such as home, school, campus, office building, railway platform, etc.

- **METROPOLITAN AREA NETWORK (MAN)** - These are the network which connects the computers within a metropolitan area. It may be a single city of multiple cities.

- **WIDE AREA NETWORK (WAN)** - These are the networks which connects large number of devices in a large geographical area.

04. Network topology is how the computer network is arranged to form the network for communication.

- **Bus Topology** - In bus topology all the devices in the network connected by a one central network cable which is known as backbone.

- **Ring Topology** - Ring topology is a type of network topology in which each device is connected to two other devices on either side via an RJ-45 cable or coaxial cable.

- **Star Topology -** Star topology is a network topology in which each network component is physically connected to a central node such as a router, hub, or switch.

- **Tree topology** - A tree topology, or star-bus topology, is a hybrid network topology in which star networks are interconnected via bus networks.

- **Mesh topology** - A mesh topology is a network setup where each computer and network device are interconnected with one another.

- **Hybrid Topology** -

A hybrid topology is a type of network topology that uses two or more differing network topologies. These topologies can include a mix of bus topology, mesh topology, ring topology, star topology, and tree topology.

05.
- **Simplex mode** - Simplex mode is a transmission mode in which information is sent in one direction only, also known as unidirectional.

- **Half-Duplex mode** - 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

- **Full-duplex mode** - In full-duplex mode, both stations can transmit and receive simultaneously. In full-duplex mode, signals going in one direction share the capacity of the link with signals going in another direction.

Question 2

01. It is conceptual model that describes the universal for communication function of a telecommunication system.
02.
- **Physical Layer –** Transmit raw bit stream over the physical medium.
- **Data Link Layer –** Defines the format of data on the network.
- **Network Layer** – Decide which path the data will take.
- **Transport Layer –** Transmit data using transmission protocols including TCP & UDP.
- **Session Layer –** Maintains connection and it responsible for controlling ports and sessions.
- **Presentation Layer –** Ensure that data is in usable format and is where data encryption occur.
- **Application Layer -** Human computer interaction layer, where applications can access the network services.

03. TCP/IP Model helps you to determine how a specific computer should be connected to the internet and how data should be transmitted between them.
TCP/IP is a layered server architecture system in which each layer is defined according to a specific function to perform. All these four TCP IP layers work collaboratively to transmit the data from one layer to another.
- Application Layer
- Transport Layer
- Internet Layer
- Network Interface

04. **TCP** - TCP stands for Transmission Control Protocol a communications standard that enables application programs and computing devices to exchange messages over a network. It is

designed to send packets across the internet and ensure the successful delivery of data and messages over networks.

UDP – User Datagram Protocol is one of the core members of the Internet protocol suite. With UDP, computer applications can send messages, in this case referred to as datagrams, to other hosts on an Internet Protocol network.

05. **Switch** - transmits data from one device to another in form of frames.
Router - transmits data from one network to another in form of packets.
Hub - transmits data from one device to another in form of binary bits.

06.
DHCP - The Dynamic Host Configuration Protocol is a network management protocol used on Internet Protocol networks for automatically assigning IP addresses and other communication parameters to devices connected to the network using a client–server architecture.

Firewall - a firewall is a network security system that monitors, and controls incoming and outgoing network traffic based on predetermined security rules.

VPN - A virtual private network extends a private network across a public network and enables users to send and receive data across shared or public networks as if their computing devices were directly connected to the private network.

Proxy server - a proxy server is a server application that acts as an intermediary between a client requesting a resource and the server providing that resource.

Classes of Network - There are five classes of subnetworks: Class A, Class B, Class C, Class D, and Class E. Each class relates to a specific range of IP addresses. Classes A, B, and C are used the most often by different networks.

Question 3

01.
Unipolar - There are signal levels at both the bottom and top of the axis. Binary one ('1') of the unipolar signaling type encodes the presence of a pulse, while binary zero ('0') encodes the lack of a pulse. As a result, it is called "ON-OFF Keying."
Ex – NRZ

Polar – A particular axis should have voltages on both sides. The polar signaling type encodes one ('1') as a positive pulse and zero ('0') as a negative pulse.
Ex - Ex: NRZ-L, NRZ-I, RZ, differential Manchester, and Manchester

Bipola - Have negative, positive, and zero voltages. There are three voltage levels in the bipolar signaling type: positive, negative, and zero. The binary code "0" represents neutral

zero volts. Based on its various placements, the binary value "1" is represented as either a positive or a negative pulse. Positive and negative voltages that alternate are used to map binary ones.

Ex - Pseudoternary and AMI

02. A communication channel known as a transmission medium is used to transmit information from a sender to a receiver. Electromagnetic signals carry data during transmission.

   a. **Guided Transmission Media** - It is known as wired or bounded transmission media. Physical linkages are used to direct and constrain the signals that are being transmitted along a certain path.

   Features:
   - High Speed
   - Secure
   - Used for comparatively shorter distances

   b. **Unguided Transmission Media** - It is also known as wireless or unbounded transmission media. Electromagnetic signals can be transmitted without any physical medium.

   Features:
   - The signal is broadcasted through air
   - Less Secure
   - Used for larger distances

03. Sending numerous signals or streams of data over a communications network simultaneously in the form of a single, complex signal is known as multiplexing, also known as muxing. It reduces the number of electrical connections/Wireless Channels for transmission of several signals. So that is the reason for why multiplexing.

04. In computer networks, switching is the technique that aids in selecting the optimum path for data transmission when there are numerous paths in a bigger network.

05.

   Circuit Switching - Circuit switching is a style of network design in which a physical path is acquired and set aside for the duration of a dedicated connection between two endpoints in the network. Circuit switching is used in standard voice phone service. The duration of a call is when this reserved circuit is utilized. The circuit can only be used for the duration of the call.

   Packet Switching - Small data packets are sent between different networks using packet switching. These data "packets" or "chunks" enable quicker, more effective data transport. When a user transfers a file over a network, it frequently travels in smaller data packets rather than all at once.

Message Switching - Before packet switching was invented, a technology called message switching was created as an alternative to circuit switching. When using message switching, end users converse by sending and receiving messages that contain all of the shared data. The smallest individual unit is a message.
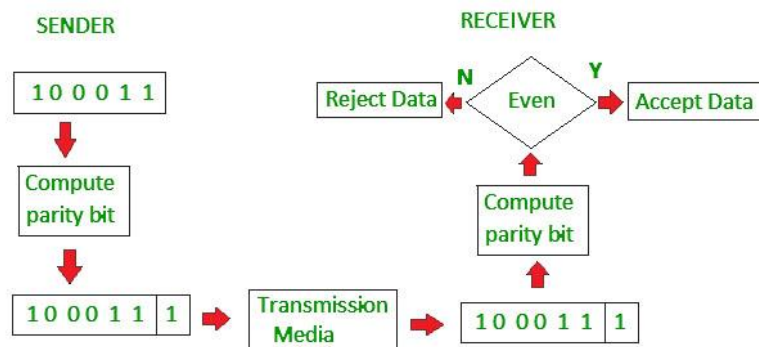
Question 4

01.

1 Simple Parity check

A check bit or parity bit generator form is applied to blocks of data from the source, and a parity of:

If the block has an odd number of ones, one is added, and if it has an even number, zero is added.
Even parity checking, as the name implies, ensures that the total number of 1s is even.
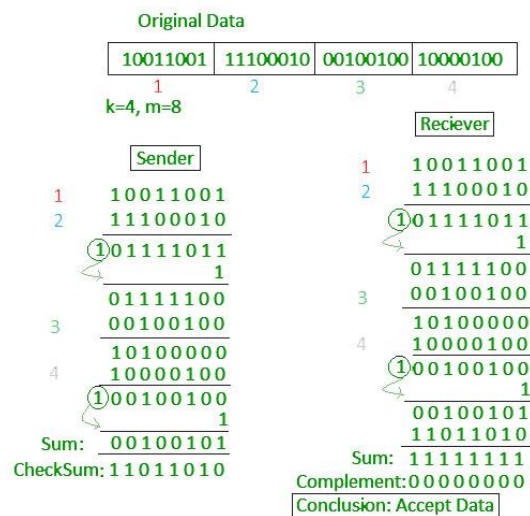

2 Parity check in two dimensions

For each row, parity check bits are calculated, which are the same as a single parity check bit. For each column, parity check bits are also calculated, and both are subsequently delivered with the data. These are contrasted with the parity bits generated from the received data at the receiving end.
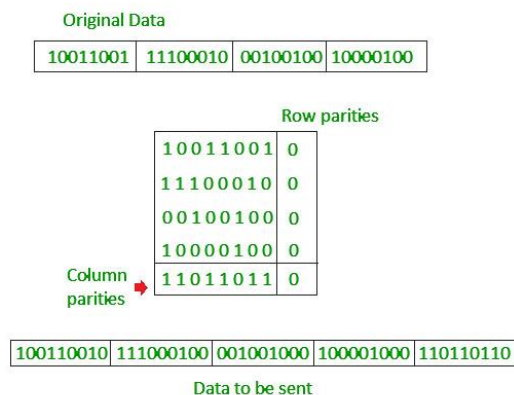

3 Checksum

- The data is separated into k segments, each with m bits, in the checksum error detection system.
- The sender's end adds the segments together using the 1's complement method to obtain the sum. The checksum is obtained by complementing the sum.
- Along with the data segments, the checksum segment is sent.
- The sum is calculated at the receiver's end by adding each segment that was received using the 1's complement method. This complements the total.
- The incoming data is accepted if the result is zero; else, it is discarded.

Original Data

10011001	11100010	00100100	10000100
1	2	3	4

k=4, m=8

Sender

```
1     10011001
2     11100010
      ‾‾‾‾‾‾‾‾
   (1)01111011
            1
      ‾‾‾‾‾‾‾‾
      01111100
3     00100100
      ‾‾‾‾‾‾‾‾
      10100000
4     10000100
   (1)00100100
            1
      ‾‾‾‾‾‾‾‾
Sum:  00100101
CheckSum: 11011010
```

Reciever

```
1     10011001
2     11100010
      ‾‾‾‾‾‾‾‾
   (1)01111011
            1
      ‾‾‾‾‾‾‾‾
      01111100
3     00100100
      ‾‾‾‾‾‾‾‾
      10100000
4     10000100
   (1)00100100
            1
      ‾‾‾‾‾‾‾‾
      00100101
      11011010
      ‾‾‾‾‾‾‾‾
Sum:  11111111
Complement: 00000000
Conclusion: Accept Data
```

4 Cyclic redundancy check (CRC)

- CRC is based on binary division, as opposed to checksum method, which is based on addition.
- To make a data unit exactly divisible by a second, preset binary number, cyclic redundancy check bits, a series of redundant bits, are attached to the end of the data unit.
- The incoming data unit is divided by the same number at the destination. If there is no remnant at this stage, the data unit is deemed to be accurate and is thereafter accepted.
- A residual means the data unit must be rejected since it was damaged during transmission.
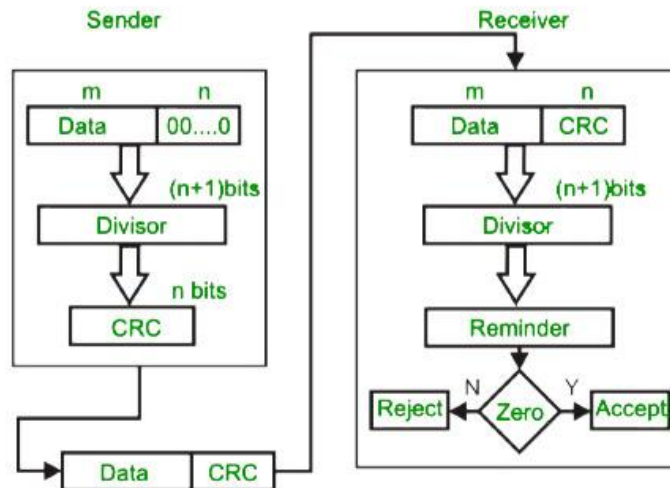
02. The process of identifying mistakes in sent communications and reassembling the original, error-free data is known as error correction. Error correction makes ensuring that the receiver side receives repaired and error-free messages.
Techniques:
Hamming Code
Alpha Numeric Codes

03. The process of assigning each of network equipment a specific, identifiable address.

04. An IPv4 addressing architecture known as classful addressing divides addresses into five classes. The first eight bits of an IP address previously identified the network that a specific host belonged to. This is known as classful addressing. This would have reduced the number of networks on the internet to just 254.

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Types:

Static Routing - Static routing is a process in which we have to manually add routes to the routing table.

Dynamic Routing - According to the current state of the route in the routing database, dynamic routing automatically modifies the routes. Dynamic routing finds network destinations and the pathways to get there by using protocols. The most effective dynamic routing protocols are RIP and OSPF.

Question 5

01. The client-server paradigm, often known as the client-server architecture, is a distributed application framework that assigns duties to servers and clients that either share a system or connect via a computer network or the Internet. In order to use a service provided by a server, the client must make a request to another software. One or more applications are run on the server to share resources and divide work across clients.

02. An established set of guidelines that govern how data is transferred between various devices connected to the same network is known as a network protocol.
    - **DNS -** The DNS protocol, which uses human-readable hostnames rather than numerical IP addresses to enable network devices and Internet users find websites, makes this possible.
    - **FTP -** On a computer network, the File Transfer Protocol (FTP) is a common communication protocol used to transfer data from a server to a client. FTP uses distinct control and data connections between the client and the server in a client-server architecture.
    - **Telnet -** Telnet is a network protocol that allows for two-way, collaborative, text-based communication between two computers as well as remote computer access.
    - **SMTP -** An internet-standard protocol for transmitting electronic mail is called Simple Mail Transfer Protocol (SMTP). SMTP is a protocol that allows mail servers and other message transfer agents to send and receive mail messages.
    - **SNMP -** An Internet Standard protocol called Simple Network Management Protocol (SNMP) is used to gather, organize, and modify data about managed devices over IP networks to alter device behavior. Cable modems, routers, switches, servers, workstations, printers, and other devices frequently support SNMP.
    - **HTTP -** For networked, collaborative, hypermedia information systems, the Hypertext Transfer Protocol (HTTP) is an application layer protocol in the Internet protocol suite model. The World Wide Web's data communication is built on HTTP.

03. Encryption is the process by which a readable message is converted to an unreadable form to prevent unauthorized parties from reading it.

    Decryption is the process of converting an encrypted message back to its original (readable) format. The original message is called the plaintext message. The encrypted message is called the ciphertext message.

04. Symmetric and asymmetric encryption are the two major types of encryptions. Public key encryption is another name for asymmetric encryption.

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