Computer Networks (MC-308)

Assignment - I

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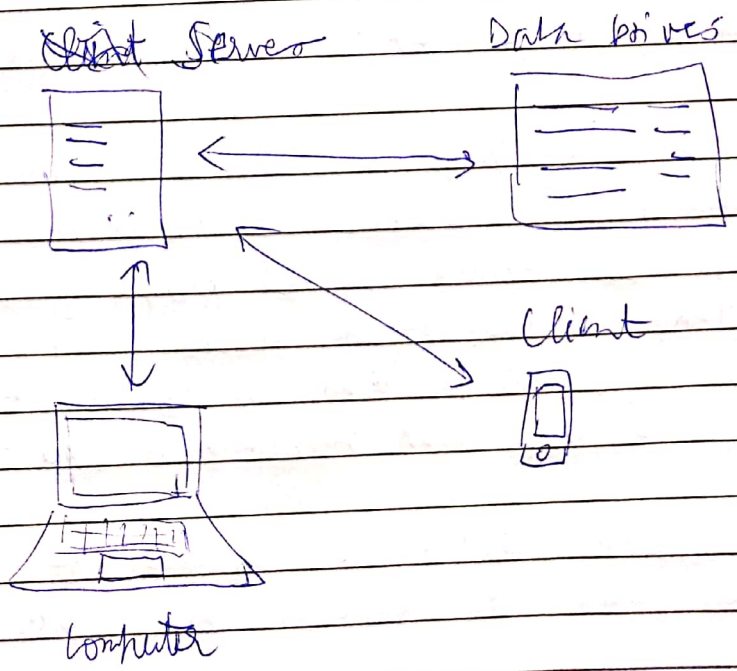
(DTU/2K16/MC/13)

Q1) Explain the client server model with the help of an example

The client server model describes how a server provides resources and services to one or more clients. Examples of servers include web servers, mail servers and file servers. Each of these services provide resources to client devices, such as desktop computers, laptops, tablets and smartphones.

Many servers have one-to-many relationship with clients meaning a single server can provide resources to multiple clients at one time



When a client requests a connection to a server, the server can either accept or reject the connection. If the connection is accepted, the server establishes and maintains a connection with the client over a specific protocol.

Protocols that are used are HTTP, SMTP.

Q2) State and explain the various categories of networks.

i) Personal Area network (PAN)

The smallest and most basic type of network, a PAN is made up of a wireless modem, a computer or 2, phones, printers, tablets etc and revolves around one person in one building.

These types of networks are typically found in small restaurants, residences.

ii) Local Area Network (LAN)

We're confident that you have heard of these types of networks before - LAN's are the most common networks in use. LAN's connect groups of computers and low voltage devices together across short distances to share information and resources. Enterprises typically manage and maintain LAN's.

Using routers, LAN's can connect to wide area networks (WAN) to rapidly and safely transfer data.

Metropolitan Area Network (MAN)

This types of networks are larger than LAN's but smaller than WAN's and it incorporate elements from both types of networks. MAN's cost of an entire geographic area. Ownership and maintenance is handled by either a single person or company

Wide Area Network (WAN)

slightly more complex than MAN, it connects computers accross longer physical distances. This allows computers and low-voltage devices to be remotely connected to each other over one large network to communicate even when they're miles apart.

The internet is the most basic example of WAN connecting all computers together around the world. Because of WAN's vast reach, it is typically owned and connected, administered by multiple administrators or the public

Virtual Private Network (VPN)

By extending private networks across the internet, a VPN lets its users send and receive data as if their devices were connected to a private network.

Q32 What is difference between connection oriented and connectionless service?

Criterion	Connection-Oriented Service	Connectionless service
Analogy	It was built and based upon the telephone system	It can be compared to the postal system
Packets Communication type	Connection-oriented service is preferred by long and steady communication	Connection-less service is performed by bursty communication
Necessity	Connection-oriented service is necessary	Connection-less service isn't compulsory.
Feasibility	Service is feasible	Service isn't feasible
Reliability	Congestion is not possible	Congestion is possible
Congestion	Congestion-oriented service gives guarantee of reliability	There is no guarantee of reliability
Routing	Packets follow the same route in connection oriented service	Packets can follow different routes

Q5] What are the various Network services associated with Physical Layer of OSI model.

Functions of Physical Layer :-

i) Representation of bits : Data in the layer consists of streams of bits. The bits must be encoded into signals for transmission. It defines the type of encoding i.e. how 0's and 1's are changed to signals

ii) Data Rate : This layer defines the rate of transmission which is number of bits per second.

iii) Synchronization : It deals with the synchronization of the transmitter and receiver. The sender and receiver are synchronized at bit level.

iv) Interface : The physical layer defines the transmission interface between devices and transmission medium

v) Line Configuration : This layer connects devices with the medium : Point to point configuration and multi-point configuration.

vi) Topologies : Devices must be connected using the following topologies : Mesh, star, ring, bus etc.

vii) Transmission Modes : Physical Layer defines the direction of transmission between two devices : Simplex, half-duplex, full duplex.

Q6) Write a short note on

i) Analog and digital Data transmission

Analog Transmission

An analog wave form (or signal) is characterized by being continuously variable along amplitude and frequency. In case of telephony, for instance when you speak into a headset, there are changes in the air pressure fall onto the headset.

These changes are then amplified and converted into current or voltage fluctuations. These fluctuations in current are an analog of the actual voice pattern- hence the use of the term analog to describe these signals.

Analog facilities have limited bandwidth, which means they cannot support high-speed data. Another characteristic of analog is that noise is accumulated as the signal traverses the network. As the signal loses power along the network, it loses power and becomes impaired by factors such as moisture in the cable, dirt or a poor contact.

By the time the signal arrives at the amplifier, it is both attenuated and noisy. Each time a signal passes through an amplifier it accumulates noise.

- Digital Transmission

Digital transmission is much simpler than analog transmission ~~For one thing, the signal is much~~ rather than being a continuous wave form, it is a series of discrete pulses, representing one bit — 0 or 1.

In each computer uses a coding scheme that defines what combinations of zero and one constitutes all the characters sets (Alphabet of the language)

It has high bandwidth and can support high speed data applications. It ~~has~~ also has high network capacity as multiplexers can ~~also~~ be used to have multiple data exchanges through the same transmission medium.

The power consumed by digital signals is also lower as only 2 signals — 0 and 1 and discrete pulses rather than continuous time signal.

b) Wireless Transmission Media

There are many different types of wireless transmission media, which are :—

i) Infrared

Infrared (IR) is a wireless transmission medium that sends signals using infrared light waves. Mobile computers and devices such as mouse, printer, and smart phone often have IrDa (Ports) that enables the transfer of data

from one device to another.

IR also has the property that is obstructed by objects in it's path and can hence only be used for short bursts and to devices that are nearby and in the line of sight (LOS). eg remote → TV.

ii) Broadcast Radio

Broadcast Radio is wireless transmission system that distributes radiosignals through the air over long distances such as between cities, regions and countries and short distances such as within an office or home.

Bluetooth, UWB, Wi-Fi and WiMAX telecommunications technologies use radio broadcast. A disadvantage of radiosignals is that it can get attenuated over long distances.

iii) Cellular Radio

Cellular radio is form of broadcast radio that is used widely for mobile communications, specifically wireless modems and cell phones.

Some mobile users connect their notebook computer or their mobile computer to a cell phone to access the Web, send and receive email, enter a chat room etc

iv) Microwaves

Microwaves are radio waves that provide high speed signal transition. Microwave transition are called line-

Wireless, involves sending signal from one microwave station to another. Microwaves can transmit data at rates up to 4500 times faster than a dial up modem.

A microwave station is an earth based reflective dish that contains the antenna, transceivers, and other equipment necessary for microwave communications. Microwaves use line-of sight (LOS) transmission. To avoid possible obstruction, such as buildings or mountains, microwave stations often sit on the top of buildings, towers or mountains.

Microwave transmission is used in environments where installing physical transmission media is difficult or impossible and where line of sight is available.

iv) Communications satellite

A communications satellite is a space station that receives microwave signals from an Earth-based station, amplifies the signals, and broadcasts the signals back over to a wide area to any number of Earth-based stations.

c) IEEE 802.2

IEEE 802.2 is a standard which defines Logical Link Control (LLC) as the upper portion on the data link Layer of the OSI model.

LLC is a software component that provides a uniform interface to user of the data link service, usually the network layer. LLC may offer three types of service

- Unacknowledged connectionless mode service (mandatory)
- Connection mode service (optional)
- Acknowledged connectionless mode service (optional)

Internally, the LLC uses the service of media access control (MAC), which is dependent on the specific transmission medium (Ethernet, token ring etc.)

The IEEE 802.2 sublayer adds some control information to the message created by the upper layer and passed to LLC for transmission to another node on the same data link.

(Q7) Explain the concept of bit stuffing

Data Link Layer is responsible for something called Framing, which is division of stream bits from Network Layer into manageable units (called frames) Frames can be of fixed size or variable size.

In variable-size framing, we need a way to define the end of the frame and the beginning of the next frame.

Bit stuffing is the insertion of non-information bits into data. Stuffed bits aren't the same as control bits.

Overhead bits are non-data bits that are necessary for transition (usually as part of headers)

Application of Bit stuffing:-

- Synchronize several channels before multiplexing
- Rate match two single channels to each other
- Run length limited code

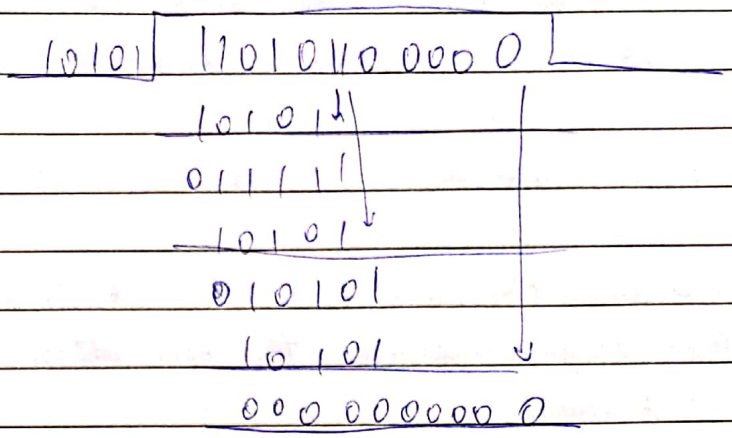
Run length Limited Coding: To limit the number of consecutive bits of the same value (ie. binary values) in the data to be transmitted. A bit of opposite value is inserted after the maximum allowed number of the consecutive bits.

Bit stuffing technique does not ensure that the sent data is intact at the reciever. It is merely a way to ensure that the transmissions starts and ends in correct places.

Disadvantages of bit stuffing
The code rate is unpredictable and the bit stuffing depends on the data being transmitted.

Q8) Check for the error if the datagram consists of the given dataword 1101011 and the polynomial x^4+x^2+1 using CRC method.

Polynomial: x^4+x^2+1
Polynomial Divisor: 10101
Data word = 1101011 + '0000'



As, the remainder is 0, the data word doesn't have any error during transmission.

Q9] Explain one-bit sliding window protocol with the help of an example.

The sliding window protocols are algorithms as a method of control flow for network data transfers.

Data Link Layer (DLL) uses sliding window algorithm, which allows sender to have more than one unacknowledged packet "in flight" time, which improves network throughput.

Both the sender and the receiver maintain a finite size buffer to hold outgoing and incoming packets from the other side.

Every packet sent by sender, must be acknowledged by the receiver. The sender maintains a timer for every packet sent and any packet unacknowledged in a certain time, is resent.

the sender may send a whole window of packets before receiving an acknowledgement for the first packet in the window. This results in high transfer rate, as sender may send multiple packets without waiting for each packet's acknowledgement.

The receiver advertises a window size that tells the sender how much data it can receive, in order for the sender not to fill up the receiver buffer.

Efficiency can also be improved by using full duplex line.

Piggybacking —

When a data frame arrives, instead of immediately sending a separate control frame, the receiver restrains itself and waits till/until the network layer passes it the next packet.

The acknowledgement is attached to the outgoing data frame (using the ack field in the frame header)

The acknowledgement gets a free ride on the next outgoing data frame.

The technique of temporarily delaying outgoing acknowledgements so that they can be hooked onto the next outgoing data frame is piggybacking.

To keep track of the frames, sender sends station requested numbered frames.

Receiver always maintain window size as 1.

The receiver acknowledges a frame by sending Ack frame that includes the sequence number of the next frame expected.

This also explicitly announces that it is prepared to receive the next N frames beginning with the number specified.

This scheme can be used to acknowledge multiple frames. It could receive frame 2, 3, 4 but withhold Ack until frame 4 has arrived. By returning an Ack with sequence 5, it acknowledges that frames 3, 3, 4 at one time.

The receiver needs buffer size of 1.

Example

Need K=1 at sender side
Max size of sender's window

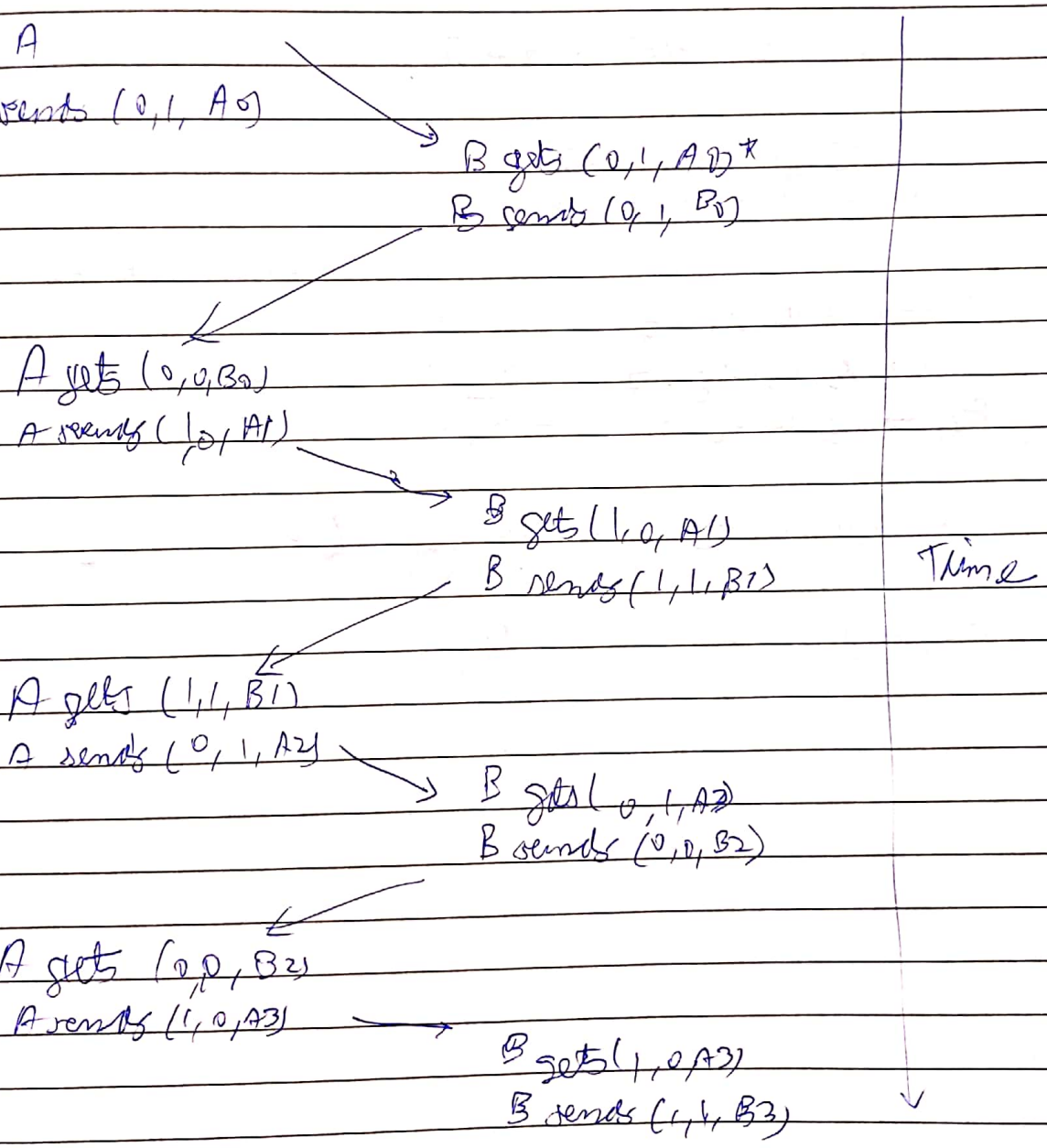
$2^K - 1$

$2 - 1 = 1$

This is same as stop and wait protocol.

A sliding window of size 1 with 3-bit number.

a) Initially
b) After the first frame has been sent.
c) After the first frame has been received.
d) After the first acknowledgment has been received.



Q10) Compute the hamming codeword for the dataword 1010 when there is even parity using hamming code error construction technique.

Dataword = 1010
Data bits = 4 bits
Hamming code Bits = 3

Message bits = 4+3 = 7 bits

d_1	d_2	d_3	d_4	d_5	d_6	d_7
h_1	h_2	1	h_4	0	1	0

even parity bit

$P_1 \rightarrow d_1 d_3 d_5 d_7 - d_1 100$ — 1
$P_2 \rightarrow d_2 d_3 d_6 d_7 - d_2 110$ — 0
$P_4 \rightarrow d_4 d_5 d_6 d_7 - d_4 010$ — 1

So, hamming code bits are $\{(d_1, 1), (d_2, 0), (d_4, 1)\}$

Message = 1011010