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DATA COMMUNICATION AND COMPUTER NETWORKS

By: Baijnath Kaushik
M.Tech. Computer

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QUESTION PAPER

(June – 2019)

(Solved)

DATA COMMUNICATION AND COMPUTER NETWORKS

Time: 3 Hours] *[Maximum Marks: 100*

Note: *Question Number* ***1*** *is* ***compulsory.*** *Attempt any* ***three*** *questions from the rest.*

Q. 1. ***(a)*** **How does 802.11 deal with the problem of a noisy channel ? Explain with an example.**

Ans. Ref.: See Chapter-8, Page No. 86, 'The 802.11 MAC Sublayer Protocol'.

(b) **Discuss the two advantages of QAM over FM and AM.**

Ans. 1. Improved signal to noise ratio w.r.t. to man-made interference.

2. Smaller geographical interference between neighboring stations.

The main advantages of QAM over FM are:

Although QAM appears to increase the efficiency of transmission for radio communications systems by utilizing both amplitude and phase variations, it has a number of drawbacks. The first is that it is more susceptible to noise because the states are closer together so that a lower level of noise is needed to move the signal to a different decision point. Receivers for use with phase or frequency modulation are both able to use limiting amplifiers that are able to remove any amplitude noise and thereby improve the noise reliance. This is not the case with QAM.

The second limitation is also associated with the amplitude component of the signal. When a phase or frequency modulated signal is amplified in a radio transmitter, there is no need to use linear amplifiers, whereas when using QAM that contains an amplitude component, linearity must be maintained. Unfortunately linear amplifiers are less efficient and consume more power, and this makes them less attractive for mobile applications

(c) **Describe Class A, Class B, Class C, Class D and Class E IP addresses.**

Ans. Ref.: See Chapter-9, Page No. 100, 'IPV 4 Address Class'.

(d) **What is count-to infinity problem? Explain through an example.**

Ans. Ref.: See Chapter-10, Page No. 107, 'Count to Infinity Problem'.

(e) **Differentiate between stream ciphers and block ciphers with the help of examples.**

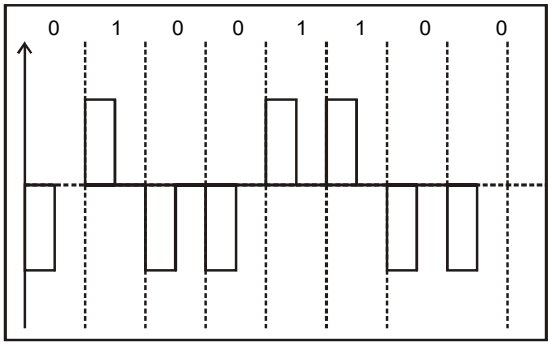
Ans. Ref.: See Chapter-15, Page No. 148, 'Stream Ciphers ' and Page No. 147, 'Block Ciphers'.

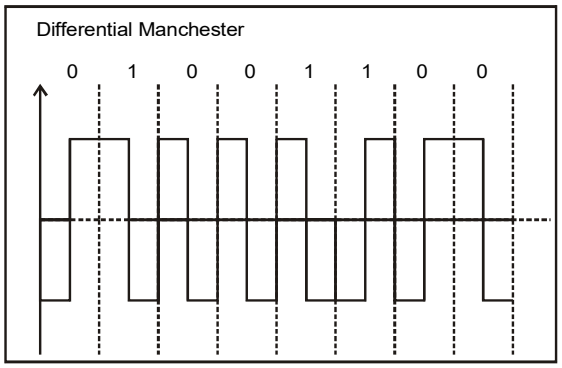
(f) **Consider a signal where the amplitude varies between + 3.2 V to — 3.2 V. If we want to quantize it into 64 levels, what would be the quantized value corresponding to signals of 3.6 V and + 0.88 V?**

Ans. The voltage interval is 3.2 V + 3.2 V = 3.2 V = 6.4 V. This interval is to be quantized into 64 levels, that is 6.4/ 64 = .1. Therefore, each level should have difference of. iV. Strating form 0 to – 3.6 V. We have –3.6 V/ .1 V = – 36 levels and + .88V corresponds to + .88/.1 = 8.8 level.

(g) **Draw RZ and Differential Manchester encoding for the following bit stream: 01001100.**

Ans. Return to Zero (RZ) Bit Stream: 01001100





Q. 2. ***(a)*** **How does TCP's congestion control algorithm work? Explain with the help of an illustration.**

Ans. Ref.: See Chapter-14, Page No. 142, 'TCP Congestion Control'.

(b) **Explain Selective Repeat ARQ through an illustration.**

Ans. Ref.: See Chapter-6, Page No. 75, 'Selective Repeat ARD'.

(c) **What is silly window syndrome? What is Clark's solution for it?**

Ans. Ref.: See Chapter-14, Page No. 141, 'Silly Window Syndrome' and Page No. 142, 'Clark's Solutions'.

Q. 3. ***(a)*** **List various types of cryptographic techniques. Explain RSA algorithm with the help of an example.**

Ans. Ref.: See Chapter-15, Page No. 157, Q. No. 1 and Page No. 154, 'RSA' (Rivest Shamir-Adleman Algorithm).

(b) **Why CSMA/CD cannot be used in wireless LAN environment? Discuss.**

Ans. The physical characteristics of WiFi make it impossible and impractical for the CAMA/CD mechanism to be used. This is due to CSMA/CD's nature of 'listening' if the medium is free before transmitting packets. Using CSMA/CD, if a collision is detected on the medium, end-devices would have to wait a random amount of time before they can start the retransmission process. For this reason, CSMA/CD works well for wired networks, however, in wireless networks, there is no way for the sender to detect collisions the same way CSMA/CD does since the sender is only able to transmit and receive packets on the medium but is not able to sense data traversing that medium.

Therefore, CSMA/CA is used on wireless networks. CSMA/CA doesn't detect collisions (unlike CSMA/CA) but rather avoids them through the use of a control message. Should the control message collide with another control message from another node, it means that the medium is not available for transmission and the back-off algorithm needs to be applied before attempting retransmission.

(c) **How is MACAW differ from MACA?**

Ans. Ref.: See Chapter-8, Page No. 93, Q. No. 3.

(d) **Differentiate between the following :**

(i) **Circuit switching and Packet switching**

Ans. Ref.: See Chapter-4, Page No. 60, Q. No. 22.

(ii) **2-way handshake and 3-way handshake methods**

Ans. Three-way Handshake: The three-way handshaking is a TCP/IP (Transmission Control Protocol/Internet Protocol) method used to create a connection between two hosts. It exchanges the SYN (SYNchronize) and ACK (ACKnowledgement) packets before starting the actual data communication.

- In three-way handshaking, Host 1 sends a connection request SYN segment with a sequence number "x" to Host 2.
- Host 2 replies to Host 1 with an ACK segment acknowledge for "x" and its own initial sequence number "y".
- Finally, Host 1 sends ACK segment acknowledgement for "y" to the host 2 with a sequence number of first data segment.

Two-way handshake

The two-way handshaking is a TCP/IP method used to create a connection between two hosts. It exchanges the SYN and ACK packets before starting the actual data communication.

- In two-way handshaking, Host 1 sends a connection request SYN segment with a sequence number "x" to Host 2.
- Host 2 replies to Host 1 with an ACK segment acknowledge for "x" with a sequence number of first data segment.

Q. 4. ***(a)*** **Discuss the following IPM header fields :**

(i) **Time to live**

Ans. The time-to-live (TTL) is the number of hops that a packet is permitted to travel before being discarded by a router.

Sample Preview of The Chapter

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DATA COMMUNICATION AND NETWORKS

INTRODUCTION TO DATA COMMUNICATION AND COMPUTER NETWORK CONCEPTS

Introduction to Computer Networks

1

INTRODUCTION

The computer industry is still young compared to other industries (e.g., automobiles and air transportation), computers have made spectacular progress in a short time. As a result of rapid technological progress, these areas are rapidly converging and the differences between collecting, transporting, storing, and processing information are quickly disappearing. Organizations with hundreds of offices spread over a wide geographical area routinely expect to be able to examine the current status of even their most remote outpost at the push of a button. As our ability to gather, process, and distribute information grows, the demand for ever more sophisticated information processing grows even faster.

The merging of computers and communications has had a profound influence on the way computer systems are organised. These systems are called computer networks. The design and organisation of these networks are the subjects of this chapter.

The computer-communications revolution has produced several remarkable facts:

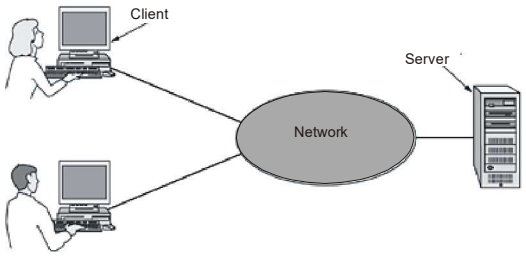
- There is no fundamental difference between data processing (computers) and data communications (transmission and switching equipment).
- There are no fundamental differences among data, voice, and video communications.
- The lines between single-processor computer, multi-processor computer.
- Local network, metropolitan network, and long-haul network have blurred.

Throughout the chapter we will use the term "computer network" to mean a collection of autonomous computers interconnected by a single technology. Two computers are said to be interconnected if they are able to exchange information. The connection need not be via a copper wire; fibre optics, microwaves, infrared, and communication satellites can also be used. Networks come in many sizes, shapes and forms, as we will see later. In this chapter, you will be learning about some of the basic concepts for networks, their applications, topology, protocols used for communication, models for networks such as OSI and TCP/IP.

In this chapter, we will also discuss about some of the popular networks such as NOVELL network, ARPANET, and ATM networks, their applications and architecture.

CHAPTER AT A GLANCE

WHAT IS A COMPUTER NETWORK?



The term "computer network" means a collection of autonomous computers interconnected by a single technology. Two computers are said to be interconnected if they are able to exchange information. The aim of connecting two or more autonomous systems is to provide:

- Resource sharing, and the goal is to make all programs, equipment, and especially data available to anyone on the network without regard to the physical location of the resource and the user. For wxample, a group of office workers share a common printer.
- A more important than sharing physical resources such as printers, scanners, and CD burners, is sharing information. Every large and medium-sized company and many small companies are vitally dependent on computerized information such as sharing file.
- Thus, computer network increases the productivity of computers through a form of network.

A networked system may have operating system for client and server. The connection among the systems need not be via a copper wire; fibre optics, microwaves, infrared, and communication satellites can also be used.

Networks come in many sizes, shapes and forms, such as:

Local Area Network (LAN): Local area networks, generally called LANs, are privately-owned networks within a single building or campus of up to a few kilometers in size. They are widely used to connect personal computers and workstations in company offices and factories to share resources (e.g., printers) and exchange information.

Wide Area Network (WAN): A wide area network, or WAN, spans a large geographical area, often a country or continent. It contains a collection of machines intended for running user (i.e., application) programs.

Metropolitan Area Network (MAN): A metropolitan area network, or MAN, covers a city. The best-known example of a MAN is the cable television network available in many cities.

The characteristics components that are required by a computer networks are:

Topology: Refers to physical organisation of computer system in some form such as star, ring, tree or bus topology.

Protocol: A protocol is used for communication between entities in different systems.

Architecture: A network architecture may be based on client/server or peer-to-peer architecture.

Network Goals and Motivations

The aim of network designers is to see that their network should satisfy the basic goals. A network can be designed to meet and satisfy variety of purposes. These goals may be:

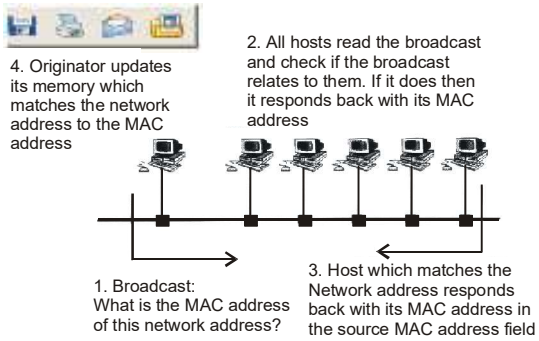
- The purpose is to share resources and the goal is to make all programs, equipment, and especially data available to anyone on the network without regard to the physical location of the resource and the user. This will reduce the cost.
- A second goal of setting up a computer network has to do with people rather than information or even computers. A computer network can provide a powerful communication medium among employees. For example, e-mail, video conferencing, electronic commerce etc.
- A network should provide high throughput by allowing movement of large volume of data among remote locations.
- A network should provide high reliability by having multiple sources of data.
- The delivery time should be reduced.
- The design upgradation, expansions, and changes in network should be done without affecting the overall operation of computer network.
- The chosen standards and protocols shall allow the different networks to share the information among them.

Classification of Networks

A network can be broadly classified into two categories:

- Broadcast Networks
- Point-to-Point Networks Or Switched Networks

Broadcast Networks



Network interface cards are usually programmed to listen for three types of messages. They are messages sent to their specific address, messages broadcast to all NICs, and messages that qualify as a multicast for the specific card. There are three types of addressing:

1. **Unicast:** A transmission to a single interface card.
2. **Multicast:** A transmission to a group of interface cards on the network.
3. **Broadcast:** A transmission to all interface cards on the network. RFC 919 and 922 describe IP broadcast datagrams.
   - **Limited Broadcast:** Sent to all NICs on the same network segment as the source NIC. It is represented with the 255.255.255.255 TCP/IP address. This broadcast is not forwarded by routers so will only appear on one network segment.
   - **Direct Broadcast:** Sent to all hosts on a network. Routers may be configured to forward directed broadcasts on large networks. For network 192.168.0.0, the broadcast is 192.168.255.255.

All other messages are filtered out by the NIC software unless the card is programmed to operate in promiscuous mode to perform network sniffing.

Broadcasting

The types of broadcasting uses on TCP/IP are:

1. ARP on IP
2. DHCP on IP
3. Routing table updates. Broadcasts sent by routers with routing table updates to other routers.

The ethernet broadcast address in hexadecimal is FF:FF:FF:FF:FF:FF. There are several types of IP broadcasting:

- The IP limited broadcast address is 255.255.255.255. This broadcast is not forwarded by a router.
- A broadcast directed to a network has a form of x.255.255.255, where x is the address of a Class A network. This broadcast may be forwarded depending on the router program.
- A broadcast sent to all subnetworks. If the broadcast is 10.1.255.255 on network 10.1.0.0 and the network is subnetted with multiple networks 10.1.x.0, then the broadcast is a broadcast to all subnetworks.
- A broadcast sent to a subnet in the form 10.1.1.255 is a subnet broadcast if the subnet mask is 255.255.255.0.

Multicasting

Multicasting may be used for streaming multimedia, video conferencing, shared white boards and more as the internet grows. Multicasting is still new to the internet and not widely supported by routers. New routing protocols are being developed to enable multicast traffic to be routed. Some of these routing protocols are:

Hierarchical Distance Vector Multicast Routing Protocol (HDVMRP)

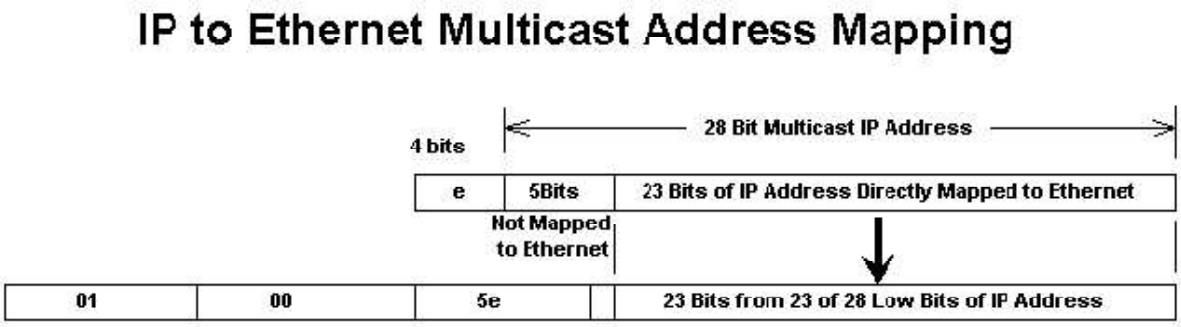
Multicast Border Gateway

Protocol Independent Multicast

Since IP is not a reliable network protocol, a new reliable multicast protocol that works at the transport layer and uses IP at the network layer has been developed. It is called Multicast Transport Protocol (MTP).

Ethernet Addressing: The internet assigned numbers authority (IANA) allocates ethernet addresses from 01:00:5E:00:00:00 through 01:00:5E:7F:FF:FF for multicasting. This means that there are 23 bits available for the multicast group ID.

IP Addressing: An IP multicast address is in the range of 224.0.0.0 through 239.255.255.255. In hexadecimal the range is from E0.00.00.00 to EF.FF.FF.FF. To be a multicast address, the first three bits of the most significant byte must be set and the fourth bit must be clear. In the IP address, there are 28 bits for multicasting. Therefore, there are 5 multicasting bits that cannot be mapped into an ethernet data packet. The 5 bits that are not mapped are the 5 most significant bits.



The 28 IP multicast bits are called the multicast group ID. A host group listening to a multicast can span multiple networks. There are some assigned hostgroup addresses by the internet assigned numbers authority (IANA). Some of the assignments are listed below:

224.0.0.1 = All systems on the subnet

224.0.0.2 = All routers on the subnet

224.0.1.1 = Network time protocol (NTP)

224.0.0.9 = For RIPv2

224.0.1.2 = Silicon graphic's dogfight application

Being on the MBONE means you are on a network that supports multicasting. Usually you must check with your internet service provider (ISP) to see if you have this capability. IGMP described in the next section is used to manage broadcast groups.

Broadcast network can be of three types:

- Packet Radio Networks
- Satellite Networks
- Local Area Networks

Packet Radio: Packet radio is a Fixed or mobile nodes that communicate via radios.

Advantages:

- Fast (re)deployment and set-up of network
- Ability to support mobile nodes

Disadvantages:

- complications due to Communications medium
- Dynamic nature of the network topology
- Half-duplex operation
- Single hop vs. multi-hop
- Ad-hoc networks vs. fixed networks

Satellite Networks: Satellite networks do not need radio repeaters as of Radio networks.

Local Area Network: A local-area network is a communications network that interconnects a variety of devices and provides a means for information exchange among those devices. There are several key distinctions between LANs and WANs:

1. The scope of the LAN is small, typically a single building or a cluster of buildings.

This difference in geographic scope leads to different technical solutions.

2. It is usually the case that the LAN is owned by the same organisation that owns the attached devices. For WANs, this is less often the case, or at least a significant fraction of the network assets are not owned. This has two implications.

First, care must be taken in the choice of LAN, as there may be a substantial capital investment (compared to dial-up or leased charges for wide area networks) for both purchase and maintenance. Second, the network management responsibility for a local network falls solely on the user.

3. The internal data rates of LANs are typically much greater than those of wide area networks.

LANs make use of a broadcast network approach rather than a switching approach. With a broadcast communication network, there are no intermediate switching nodes. At each station, there is a transmitter/ receiver that communicates over a medium shared by other stations. A transmission from any one station is broadcast to and received by all other stations. A simple example of this is a CB radio system, in which all users tuned to the same channel may communicate.

POINT-TO-POINT OR SWITCHED NETWORKS

Point-to-point Networks and Topology of Networks

● **Line Configuration:** Line configuration is the way in which two or more communication devices attach to a link. A link is the physical communication pathway that transfers data from one device to another. For communication to occur, two devices must be connected in some way to the same link at the same time. There are two possible line configurations—point-to-point and multipoint networks.