

In quality service, jitter is variation in delay for packets belonging to the same flow-

The transport layer is responsible for the delivery of a message from one process to another

Which of the protocols at transport layer provides connection oriented service -tcp and udp-

User datagram protocol is called connectionless because -all UDP packets are treated independently-

A flow of data needs resources such as a buffer, bandwidth and -cpu time-

CBR stands for -constant bit rate-

In congestion control, warning message goes directly to the -source station-

A mechanism to control amount and rate of traffic sent to network is called -traffic shaping-

In version field of IPv4 header, when machine is using same other version of IPv4 then datagram is -discarded-

The DoD model has four layers. Which layer of the DoD model is equivalent to the network layer of the OSI model -internet-

Transport layer aggregates data from different applications into a single stream before passing it to -network layer-

In IPv4 layer, datagrams are -packets-

User datagram protocol performs very limited service of -error checking-

Network layer was designed to solve problem of delivery through -several link-

TCP implements an error control mechanism to provide -reliability-

Which of the following does UDP guarantee -none of above-

Transport layer may be responsible for flow and error -data link layer-

UDP is using services of IP to provide -process to process-

Transport layer protocols deal with -application to application-

A port is a TCP name for transport service Access

User datagram protocol is called connectionless because -all UDP packets are treated independently by transport layer-

Field that is used to detect errors -checksum-

IPv6 addresses are 128 bit long and are hierarchical in structure.

IP is a network architecture

TCP ne tür bir bağlantıdır ? cevap = connection-oriented Reliabile

OSI nin tanımlanmasında hangisi kullanılır ? cevap =protokolü

Hangisi statik bir routing algoritmadır? cevap = flooding

Leaky bucket algoritması kendisini gelen akıntıya göre düzenler (cevap Yanlış)

Hangisi virtual circuit kullanmaz = cevap hiçbiri (sıklar ATM, frame relay,x.25 ?)

OSI 'nin 7. katmanı session layerdir (cevap yanlış)

connectionless bağlantıların connection-oriented bağlantılara göre artıları nelerdir?

distance vektor algoritmasının link state algoritmasına göre artıları nelerdir?

Routing olmayan bir Hostun routing uygulamasına ihtiyacı yoktur? Cevap Doğru?

Congestion olduğunda aşağıdakilerin hangilerinin yapılması faydalı olur ? cevap = en son gelen paketlerin atılması + ?

IPC mesajlaşma protokollerini yazın hangi katmanda olduklarınıda belirtin

make file nasıl yapılır ornege iyi calıs sınavda 30 puanlık koydu(bu yok eski)

paket anahtarlama nin devre anahtarlama göre avantajları

#routing,congestion control,quality of service network layerın görevidir.
#router olmasa bile routing bilgisi gereklidir.

#flooding statik bir algoritmadır.

#x.25,frame relay,atm üçü de virtual circuitdir.

#connectionless service avantajları:hata durumunda hatadan daha iyi kurtulma,yüksek bant genişliği(daha fazla avantajı da olabilir bunları yazmışım sadece)

#flooding algoritmasının faydaları:network devre dışı kalması durumuna karşı dayanıklı(özellikle askeri alanlarda kullanılır.),routing gerektirmez

#distance vectorun link state e göre avantajı:her router da daha az işlem gerektirir.Bu karşılık link state daha fazla bilgi değiş tokuşu yapar,otomatik olarak min.span. tree çalıştırır(min.spanning tree kullanarak daha iyi yol bulunur.)

#congestion sebebi ile paketler çöpe atılırken milk and wine yöntemi(eski paketlerin ilk çöpe atılması)faydalıdır.

#OSI nin en iyi tanımı bir ağ mimarisi olmasıdır.

#TCP connection oriented ve reliable dır.

#IPv4 header da source-destination adres ,fragmentation bigisi bulunurken source ve destination port bulunmaz.

#Virtual circuit de datagramdan farklı olarak;geçilen her routerın router id si bilinmeli ,aradaki routerlar durum bilgisi saklamalı,paketler sıralı gönderilir ve daha hızlı aktarım gerçekleşir.

#bi tane formüllü soru vardı onun sadece formülünü yazmışım.c(1mb)+(yunanca bi işaret klavyede bulamadım token bucket doldurma süresini simgeliyo sorudaki değeri=1mbps)*s=cm(cm ninde

sorudaki değeri 6mbps) soruda heralde s isteniyo yanlış hatırlıyor oalbirim ama 0.2 saniye olmalı cevap

- 1) tcp ip de aynı network adresine bağlı kaç tane farklı transport adresi olabilir $2^{16} = 65536$
- 2) open source path forwarding hangi algoritmaya denk düşer link state routing algoritmasına
- 3) Arp olmasada broadcast yapılabilir (true)
- 4) tpdu = 2 transport layer arasındaki veri iletişimidir
- 5) data link layer ---> frame application---> mesaj network layer---> paket ideal durum(buffer olmayan) =mesaj=paket=frame
- 6) herhangi bir tsap ile 1 process konuşabilir birden fazla process konuşamaz
- 7) demultiplex i transport layer yapar birden fazla isteğe cevap verebilmek için
- 8) internet in internetworking den temel farkı her yerde tek bir protocol konuşuyor olmasıdır.
- 9) frame relay= haberleşmeyi noktadan noktaya değil multi hop şeklinde atlamalı hale getirir.
- 10) mpls= sadece bir etikete bağlı olarak network paketinin iletimini sağlar tunneling için oluşturulmuş protokol
- 11) mtu= bir protokollede bir seferde bölünmeye uğramadan aktaracağı paket boyutu mtu reassembly ve fragmentation ortadan kalkar path mtu (max transaction unit)
- 12) mips=işlemci performansını ifade etmek için kullanılan terminoloji
- 13) gateway=birden fazla network protokolunu aynı anda destekleyen routerlara denir
- 14) networklerin bir araya getirilip bir arada çalıştırılmasına internet working denir. Kısaca internet
- 15) datagramı connection oriented a çevirmek istersek ip nin üstüne transport layer koymalıyız.yani (tcp) Çünkü güvenilir olmayan datagram layerların eksikliklerini ortadan kaldırmak için vardır.
- 16) ip 256 farklı protokol taşıyabilir.
- 17) header check sum = bir hata olup olmadığını garanti eder. Burada payload bilgisi yer almaz payloaddan application sorumlu. Time to live (atılacağı hop miktarı sıfır ise çöp) ttl alanı değiştikçe header check sum tekrar hesaplanır.
- 18) header check sum ttl değiştikçe yani paket geldikçe hesaplanır.
- 19) bir hostan diğerine aynı anda hedefe gönderilebilecek maksimum paket sayısı 65536 dır

20) subnet mask arka arkaya gelen 1 ler topluluğu network alanında nerenin subnet olacağını söyler. Arka arkaya gelen 0 larda nerenin host adresi olacağını söyler.

21) A- B –C sınıfından adresler neden kullanım için özel olarak ayrılmıştır :Yeterli IP adres olmamasından dolayı adresler sınıflarına ayrılmıştır.(network/host) her host mutlaka bir sub-net in parçası olmak zorunda.

22) loopback= aynı sistem üzerinde 2 proses konuşmak isterse ikisinin de ip adresi olmalı

23) ipv4 de adresler 32 bit

24) ipv5 deneme sürümleri tek rakam eksikleri var ipv6 kullanımda olan çift

25) 2 adresi aynı anda kullanamıyoruz

26) ağ maskesi tüm alt ağlar için geçerlidir ağ numaraları 1 olur hostlar 0 lanır.

27) A (1- 126) host sayısı 24 bit 2^{24} pc

B(128-191) host sayısı 16

C(192-223) host sayısı 8

28) c için default subnet mask (255 255 255 0) hostlar sıfırlanır tüm alt ağlar için geçerli

Router lar artık a,b,c,d diye sınıflama yapmıyorlar subnet mask nederse onu yapıyorlar. İlk 4 bitin anlamı iptal oluyor. Subnet maskı c class olarak router a specify yapıyor.

29) 192. 24.0.0/21 kaç tane oturma 32-21 =11(host sayısı) 2^{11} =2048 oturma

30) daha çok adresi ifade etmek için network tarafındaki bitlerin azalması hostun çoğalması gerekiyor. Bunun için network tarafı düşük olan seçilir. Böylece host artar.

31) ip de routing için destination adres kullanılır.

32) Routing bir adresi route ederken longest matching prefix her bir çıkış hattı için subnet mask arka arkaya gelen 1 leri sayıyor. Bu adresleri prefix i 22 olana yollanacak bit sayısı en uzun specific yere gelmiş demektir. Msb tarafından birer sayıp routing algoritmasında en uygun hangisiyse ona yolluyor. Router ın karar verme sürecini hızlandırıyor bu instruction.

33) PAT= ADRES dönüştürmedeki 2 yöntem den biri günümüzde sadece port base address translation kullanılıyor.

34) Port no = 16 bittir ve 1 ip adresine denk düşen 2^{16} dan 65536 farklı uygulama olabilir.örneğin 100.000 uygulama için yani 100.000 istek en az 2 ip adresine ihtiyaç vardır.

35) PAT= aynı ip adresinin farklı portlarını kullanarak içerdeki uygulama dışarıya çıkabiliyor. PAT tamamen source address ve source port üzerinde çalışıyor unique liği sağlamak için source portları dönüşüm içinde unique yapıyor

36) Ipv6 da header length ve check sum alanları yok 16 byte source adres ve 16 byte destination adres version dif services + flow label = 32 bit =4 byte ve payload length+ next header+ hop limit =32bit = 4byte toplamda 40 byte ve ip adres uzunluğu 32 bitten 128 bite çıkarılmıştır.

37) Authentication: verification of sender's identity normalde ipv4 header biliniyor. Paketin çıktığı hostun gerçek adresi source da yer almıyor. Digital imza giden taraftaki router ın source adresindeki değerin otantik yani gerçek yani asıl olduğunu sağlar. Ipv6 confidently ve authentication' a olanak sağlar. CIA (confiden + integrity+Authentication)

38) Prefix length= network = L bits

39) Ipv6 da orjinalde fregmentation ile alakalı hiç bir şey yok ipv6 da linli liste yapısı vardır. Next header - bir sonraki offset. Ipv4 de loose ve strict source routing varken ipv6 da loose source routing vardır. Loose source routing strict olmayan uğranılması tavsiye edilen routerların listesi vardır. Strict ise sadece belirli routerlardan geçilecek.

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Fall 2003

Part 1: (42 points - 3 points for each problem)

(C) 1. Which is a collision-free protocol?

(A) pure ALOHA (B) slotted ALOHA (C) binary countdown (D) none of above

(B) 2. Which cable does 100Base-TX use?

(A) thick coax (B) twisted pair (C) thin coax (D) fiber optics

(A) 3. 1000Base-T can support segments of up to

(A) 100 m (B) 200 m (C) 500 m (D) 1000 m

(C) 4. What is the baud rate of the standard 10-Mbps Ethernet?

(A) 5 Megabaud (B) 10 Megabaud (C) 20 Megabaud (D) None of above

(D) 5. The standard for wireless MAN is

(A) 802.3 (B) 802.11 (C) 802.15 (D) 802.16

(A) 6. Which transmission techniques are not specified in 802.11?

(A) QPSK (B) FHSS (C) DSSS (D) OFDM

(B) 7. 802.11b can operate at up to

(A) 54 Mbps (B) 11 Mbps (C) 10 Mbps (D) 2 Mbps

(C) 8. The standard for personal area network is

(A) 802.3 (B) 802.11 (C) 802.15 (D) 802.16

(B) 9. Which 802.16 service is the best choice for large file transfers?

(A) constant bit rate (B) non-real-time variable bit rate service

(C) real-time variable bit rate service (D) best-efforts service

(C) 10. Which device operates in the network layer?

(A) repeater (B) bridge (C) router (D) gateway

(A) 11. Which is a static routing algorithm?

(A) flooding (B) distance vector (C) link state (D) none of above

(A) 12. Based on the QoS, videoconferencing can tolerate low

(A) reliability (B) delay (C) bandwidth (D) none of above

(D) 13. Which byte order is used in the Internet protocols?

(A) forward-endian (B) reverse-endian (C) little-endian (D) big-endian

(D) 14. In which function do we specify SOCK_STREAM in C socket programming?

(A) bind (B) connect (C) listen (D) socket

Part 2: (58 points)

1. A 1480-byte datagram (20-byte IP header plus 1460 bytes of data) arrives for transmission across a network that has the maximum transmission unit (MTU) of 532 bytes. How long will each of the segments be (including the IP header)? (4 points)

Ans: The largest amount of data that can be transmitted is $532 - 20 = 512$ bytes. The last segment

will be $1460 - 512 - 512 = 436$ bytes. The three segments will be 532 bytes, 532 bytes, and 456

bytes. 2. Briefly explain these terminologies. If they are acronyms, also write what they stand for. (12 points)

(a) MAC layer The Medium Access Control (MAC) (sub)layer is the bottom part of the data link layer and deals with sharing the physical channel among several stations.

(b) Bluetooth is a specification for the technology that connects different (mobile) devices through short-range radio.

(c) MANET A Mobile Ad hoc NETWORK (MANET) is a network where the routers are mobile.

(d) AODV Ad hoc On-demand Distance Vector (AODV) is a routing algorithm used to solve the problem of mobile routers.

3. Sixteen stations, numbered 0, ..., 15, are contending for the use of a shared channel using the adaptive tree walk protocol. If only stations 3, 5, 6, 7, 8, and 12 suddenly become busy at once and want to transmit a frame, how many bit slots are needed to resolve the contention? (6 points)

Ans:

A

/\

/\

/\

B C

/\/\

/\/\

D E F G

/\/\/\

H I J K L M N O

/\/\/\/\

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Try A → collision Try B → collision

Try D → 3 transmit Try E → collision

Try J → 5 transmit Try K → collision

6 transmit 7 transmit

Try C → collision Try F → 8 transmit

Try G → 12 transmit

11 slots are needed.

4. The network layer provides both connectionless and connection-oriented services. (8 points)

(a) What subnet for each service is built respectively?

(b) Give one advantage for each service respectively?

(c) Give two applications which fit each service respectively.

(a) A connectionless subnet is a datagram subnet. A connection-oriented subnet is a virtual-circuit subnet.

(b) • The connectionless service has advantages: more potential for adapting to congestion robustness in the face of router failures, various adaptive routing algorithms are possible, it can be used over subnets that do not use virtual circuits inside.

• The connection-oriented service has advantages: buffers can be reserved in advance, sequencing can be guaranteed, shorter headers can be used, and troubles caused by delayed duplicate packets can be avoided.

(c) • Applications fit the connectionless service: email, news transfer, and database query.

• Applications fit the connection-oriented service: file transfer, remote login, bank transactions, and videoconferencing.

5. (a) What does CSMA/CD stand for? Briefly explain CSMA/CD protocol.

(b) Explain the binary exponential backoff algorithm used in CSMA/CD.

(c) What problems would happen if a wireless protocol follows exactly CSMA/CD.

(d) Briefly explain CSMA/CA protocol.

(14 points)

Ans:

(a) Carrier Sense Multiple Access/Collision Detect (CSMA/CD) is the protocol for carrier transmission access in Ethernet networks. On Ethernet, any device can try to send a frame at any time.

Each device senses whether the line is idle and therefore available to be used. If it is, the device begins to transmit its first frame. If another device has tried to send at the same time, a collision is said to occur and the frames are discarded. Each device then waits a random amount of time and retries until successful in getting its transmission sent.

(b) When there is collision, the station waits some time between 0 to $2n - 1$ slotted time at the n 's trial. This is called backoff algorithm.

(c) Hidden and exposed nodes are the problems when CSMA/CD is employed in a wireless environment. Hidden nodes are those nodes which cannot be detected by another node. The collision

could happen during transmission. Exposed nodes are those nodes which are detected but are not the recipients.

(d) Carrier sensing multiple access with collision avoidance (CSMA/CA) is a protocol used in wireless networking. When a node is ready for transmission, it sends a request to send (RTS) frame to the receiver and waits to receive a clear to send (CTS) frame from the receiver. As a result, all nodes within the range will refrain from transmitting a data frame. Once CTS is received, the sender can send packets. Other nodes do not transmit until the receiver sends an acknowledge (ACK) frame to the sender.

6. Complete the following Java TCP echo server. (8 points)


```

import java.net.*;
import java.io.*;

public class TCPServer {

    public static void main (String args[]) throws IOException {

        int serverPort = 7896;

        ServerSocket replySocket = new ServerSocket(serverPort);

        while(true) {

            Socket clientSocket = replySocket.accept();

            Connection c = new Connection(clientSocket);

        }

    }

    class Connection extends Thread {

        DataInputStream in;

        DataOutputStream out;

        public Connection (Socket requestSocket) throws IOException {

            in = new DataInputStream(requestSocket.getInputStream());

            out = new DataOutputStream(requestSocket.getOutputStream());

            this.start();

        }

        public void run() {

            try {

                String data = in.readUTF();

                out.writeUTF(data);

            } catch(IOException e) {System.out.println("IO:"+e.getMessage());}

        }

    }

}

```

7. Describe how the Mobile IP works. (6 points)

Ans:

(a) A mobile node has a home agent which is the proxy of the mobile node during its absence from the home network. It acquires a care-of address that identifies its location in the current network

from the foreign agent.

(b) Each time a user moves the device to a different network, it acquires a care-of address and notifies

its home agent. The home agent then associates its home address with its care-of address.

(c) Traffic for the mobile node is sent to the home network and forwarded by the home agent via tunneling mechanisms to the appropriate care-of address

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Fall 2002

Part 1: (24 points - 3 points for each problem)

(b) 1. OSI 7-Layer Reference Model is a

(a) hardware (b) network architecture (c) protocol (d) software

(a) 2. The known port for the SSH service is:

(a) 22 (b) 23 (c) 79 (d) 80

(a) 3. A link is working at 20 MHz. Each bit data is encoded in 4 pulses. What is the data transfer rate for this link?

(a) 5 Mbps (b) 10 Mbps (c) 20 Mbps (d) 80 Mbps.

(c) 4. Which framing approach is used in PPP?

(a) time framing (b) frequency framing (c) character stuffing (d) bit stuffing

(c) 5. Which one is a wireless network standard?

(a) IEEE 802.3 (b) IEEE 802.5 (c) IEEE 802.11 (d) IEEE 802.12

(b) 6. Which command can be used to show the hardware address of a network interface?

(a) ftp (b) ifconfig (c) telnet (d) ping

(d) 7. Which is not the approach that a switch can use?

(a) datagram (b) virtual circuit (c) source routing (d) None of above.

(d) 8. Which is not examples of virtual circuit technologies?

(a) X.25 (b) Frame Relay (c) ATM (d) None of above.

Part 2: (76 points)

1. Briefly explain these terminologies. If they are acronyms, also write what they stand for. (12 points)

(a) SMTP - Simple Mail Transfer Protocol is a protocol used in sending and receiving e-mail.

(b) Socket - It is an endpoint for communication over a network or an abstraction through which an application can send and receive data.

(c) ADSL - Asymmetric Digital Subscriber Line is a technology for transmitting digital information at a high bandwidth on existing phone lines to homes and businesses. It is called asymmetric because the upstream bandwidth is lower than downstream.

(d) Direct Sequence - It is an approach to spread spectrum modulation for digital signal transmission over the airwaves. A data signal at the point of transmission is combined with a higher data-rate bit sequence (also known as a chipping code). The redundant chipping code helps the signal resist interference and also enables the original data to be recovered if data bits are damaged during transmission.

2. Complete the following table listing the seven layers in the OSI 7-Layer Reference Model. Then, identify three of the four layers used in the TCP/IP protocol suite (write TCP/IP beside them).

Finally, identify where the following protocols belong: TCP, UDP, IP, PPP, FTP. (10 points)

- Layer 7: Application Layer - FTP (TCP/IP)

- Layer 6: Presentation Layer

- Layer 5: Session Layer

- Layer 4: Transport Layer - TCP, UDP (TCP/IP)

- Layer 3: Network Layer - IP (TCP/IP)

- Layer 2: Data Link Layer - PPP (TCP/IP)

- Layer 1: Physical Layer

3. What is the main difference between connectionless and connection-oriented protocols? Give two

examples for each protocol respectively. (6 points)

Ans:

(a) A connection-oriented protocol requires that communication parties set up a link before the communication whereas the connectionless protocol does not.

(b) Connection-oriented protocol: FTP, SMTP, TCP

Connectionless protocol: TFTP, UDP, IP

4. Using the divisor polynomial $x^3 + 1$ for CRC, what frame will be transmitted for the data $M =$

10101100? (7 points)

Ans: $M(x) = 10101100$, $C(x) = 1001$, $r = 3$

10111011

1001)10101100000

1001

1111

1001

1100

1001

1010

1001

1100

1001

1010

1001

11

So the transmission frame $T(x)$ is 10101100011.

5. A video signal at a resolution of 640 x 480 pixels, 2 bytes/pixel color encoding, and 30 frames/second.

(a) Calculate the bandwidth necessary for transmitting in real time.

(b) Suppose your cable modem is up to 10 Mbps. Without loss of the resolution and color, how many frames per second can it transfer?

(6 points)

Ans:

(a) $640 \times 480 \times 2 \times 8 \times 30 = 147456000$ bps

(b) $10 \times 106 / (640 \times 480 \times 2 \times 8) = 2.03$ frames/s

6. Write the functions in sequence which are needed to create a server program using socket API in C.

Briefly explain those functions. (8 points)

Ans:

(a) socket - create an endpoint for communication.

(b) bind - bind a socket to an address. The address is a pair consisting of an IP-address and a port number.

(c) listen - specify the maximum number of outstanding connection requests that can be enqueued; that is, the connection request queue length.

(d) accept - wait to accept an incoming connection request. Use by a server to wait for an incoming request. When a request arrives, a new socket is created and the new socket is used for the connection.

(e) write, sendto - send data using a connection-oriented (TCP), or connectionless (UDP) protocol, respectively.

(f) read, recvfrom - read data using a connection-oriented (TCP), or connectionless (UDP) protocol, respectively.

(g) close - close a connection.

7. (a) What does CSMA/CD stand for? Briefly explain CSMA/CD protocol.

(b) What problems would happen if a wireless protocol follows exactly CSMA/CD.

(c) Briefly explain CSMA/CA protocol.

(16 points)

Ans:

(a) Carrier Sense Multiple Access/Collision Detect (CSMA/CD) is the protocol for carrier transmission access in Ethernet networks. On Ethernet, any device can try to send a frame at any time.

Each device senses whether the line is idle and therefore available to be used. If it is, the device begins to transmit its first frame. If another device has tried to send at the same time, a collision is said to occur and the frames are discarded. Each device then waits a random amount of time and retries until successful in getting its transmission sent.

(b) Hidden and exposed nodes are the problems when CSMA/CD is employed in a wireless environment. Hidden nodes are those nodes which cannot be detected by another node. The collision

could happen during transmission. Exposed nodes are those nodes which are detected but are not the recipients.

(c) Carrier sensing multiple access with collision avoidance (CSMA/CA) is a protocol used in wireless networking. When a node is ready for transmission, it sends a request to send (RTS) frame to the receiver and waits to receive a clear to send (CTS) frame from the receiver. As a result, all nodes within the range will refrain from transmitting a data frame. Once CTS is received, the sender can send packets. Other nodes do not transmit until the receiver sends an acknowledge (ACK) frame to the sender.

8. How do you know the IP address of your machine on Linux and Windows platforms respectively? (6 points)

Ans:

(a) On Linux, use the `/sbin/ifconfig` command.

(b) On Windows, use the `ipconfig` command.

9. Consider the following 6over4 tunnel diagram.

IPv4: 156.26.10.11

Dual Stack Host 1

IPv6: 3ffe:8271:a030:e73::99/127

⇐ IPv4 Infrastructure ⇒

IPv4: 156.26.10.125

Dual Stack Host 2

IPv6:

What IPv6 address should be assigned to Host 2 to get the tunnel established properly ? (5 points)

Ans: 3ffe:8271:a030:e73::98/127 should be assigned because the subnet address consists of 127 bits.

Because the network address in IPv6 has 127 bits. So the Host 2 has to have the same network address. This gives only the least bit to change. Changing the least bit from 1 to 0 gives the following

IPv6 address. This is the only possible address, since the subnet address consists of the 127 most significant bits. The least significant bit is 1 in the address of Host 1, so it must be 0 in the address of Host 2

Fall 2003

Part 1: (27 points - 3 points for each problem)

(B) 1. TCP/IP protocol suite is a

(A) hardware (B) network architecture (C) protocol (D) software

(A) 2. The known port for the FTP service is:

(A) 21 (B) 22 (C) 23 (D) 80

(C) 3. Which one is a wireless network standard?

(A) IEEE 802.3 (B) IEEE 802.5 (C) IEEE 802.11 (D) IEEE 802.12

(A) 4. The maximum number of independent samples in V.90 is 8000. V.90 runs at 56 Kbps. How many data bits are there per sample ?

(A) 7 (B) 8 (C) 14 (D) 16

(D) 5. Which is not the modulation method?

(A) amplitude (B) frequency (C) phase (D) time

(B) 6. An oil pipeline is

(A) a simplex system (B) a half-duplex system (C) a full-duplex system (D) none of the above

(D) 7. Which statement about ADSL is true?

(A) ADSL is always faster than Cable. (B) More users will reduce the performance for existing users.

(C) ADSL is less secure than cable. (D) Most ADSL providers offer a choice of ISPs.

(C) 8. Which is not issues to be concerned with in the data link layer?

(A) framing (B) error control (C) routing (D) flow control

(D) 9. Which framing approach is used in HDLC?

(A) time framing (B) frequency framing (C) character stuffing (D) bit stuffing

Part 2: (73 points)

1. Briefly explain these terminologies. If they are acronyms, also write what they stand for. (12 points)

(a) ATM Asynchronous Transfer Mode is a dedicated-connection switching technology that organizes digital data into 53-byte cell units and transmits them over a physical medium using digital signal technology.

(b) Socket A socket is an endpoint for communication over a network or an abstraction through which an application can send and receive data.

(c) WiFi Wi-Fi (Wireless-Fidelity) is the popular term for the wireless local area network (WLAN)

standard, IEEE 802.11.

(d) QAM Quadrature Amplitude Modulation is a method of combining amplitude and phase modulation to transmit more bits per symbol.

2. What is direct sequence spread spectrum? Give two reasons why it is gaining popularity. (5 points)

Ans:

(a) Direct sequence spread spectrum spreads the transmission signal over an allowed band. A data signal at the point of transmission is modulated with a higher data-rate bit sequence (chipping code) and is mapped back into the original data at the destination.

(b) It has good spectral efficiency and noise immunity.

3. Complete the following table listing the seven layers in the OSI 7-Layer Reference Model. Then, identify three of the four layers used in the TCP/IP protocol suite (write TCP/IP beside them).

Finally, identify where the following protocols belong: TCP, UDP, IP, HDLC, HTTP. (10 points)

- Layer 7: Application Layer - FTP (TCP/IP)
- Layer 6: Presentation Layer
- Layer 5: Session Layer
- Layer 4: Transport Layer - TCP, UDP (TCP/IP)
- Layer 3: Network Layer - IP (TCP/IP)
- Layer 2: Data Link Layer - HDLC (TCP/IP)
- Layer 1: Physical Layer

4. (a) What is the main difference between connectionless and connection-oriented protocols?

(b) Give an example for each protocol respectively.

(c) In which cases unreliable communication is used?

(8 points)

Ans:

(a) A connection-oriented protocol requires that communication parties set up a link before the communication whereas the connectionless protocol does not.

(b) Connection-oriented protocol: TCP, Connectionless protocol: UDP

(c) i. Reliable communication is not available.

ii. The delay in a reliable service might not be acceptable such as real-time applications.

5. An 8-bit byte with binary value 10101111 is to be encoded using an even-parity Hamming code. How

many check bits are needed to ensure that the receiver can detect and correct single bit errors? What

is the binary value after encoding? (7 points)

Ans:

(a) $m \leq 2$

$$r - r - 1, m = 8 \Rightarrow r = 4$$

(b) 1 0 1 0 1 1 1 1

$$\text{Bit 1} = (1 + 0 + 0 + 1 + 1) \bmod 2 = 1$$

$$\text{Bit 2} = (1 + 1 + 0 + 1 + 1) \bmod 2 = 0$$

$$\text{Bit 3} = (0 + 1 + 0 + 1) \bmod 2 = 0$$

$$\text{Bit 4} = (1 + 1 + 1 + 1) \bmod 2 = 0$$

The encoded value is 101001001111.

6. Using the divisor polynomial $x^4 + x + 1$ for CRC, what frame will be transmitted for the data $M = 10101100$? (7 points)

Ans: $M(x) = 10101101$, $C(x) = 10011$, $r = 4$

10110001

10011)101011000000

10011

11010

10011

10010

10011

10000

10011

11

So the transmission frame $T(x)$ is 101011000011.7. A video signal at a resolution of 640 x 480 pixels, 2 bytes/pixel color encoding, and 24 frames/second.

(a) Calculate the bandwidth necessary for transmitting in real time.

(b) Suppose your cable modem is up to 24 Mbps. Without loss of the resolution and color, how many frames per second can it transfer?

(6 points)

Ans:

(a) $640 \times 480 \times 2 \times 8 \times 24 = 117964800$ bps

(b) $24 \times 106 / (640 \times 480 \times 2 \times 8) = 4.88$ frames/s

8. Briefly describe circuit switching, message switching, and packet switching. What is the main advantage

of packet switching over message switching? (8 points)

Ans:

(a) Switching is a technology to connect two end-points.

- In circuit switching a physical path is set up between two end-points duration of the connection.

- In message switching no physical path is established. The message is stored and forwarded to the destination.

- In packet switching no physical path is established. The message is divided into packets, stored and forwarded to the destination.

(b) Packet switching can reduce delay and improve throughput.

9. Draw a diagram to illustrate the general pattern followed by a client and server for connection-oriented

communication using socket API in C. Briefly explain those functions used in the client and server.

(10 points)

Ans:

+-----+

| socket() |

+-----+

|

V

well-known +-----+

port | bind() |

+-----+

|

V

+-----+ +-----+

| socket() | | listen() |

+-----+-----+ Synchronization Point +-----+-----+

| | |

V V V

+-----+ connection establishment +-----+

| connect() | <-----> | accept() |

+-----+-----+ (TCP three-way handshake) +-----+-----+

| |

V V

+-----+ data (request) +-----+

| write() | -----> | read() |

| read() | <----- | write() |

+-----+-----+ data (reply) +-----+-----+

| |

V V

+-----+ +-----+

| close() | | close() |

+-----+ +-----+

(a) socket - create an endpoint for communication.

(b) bind - bind a socket to an address. The address is a pair consisting of an IP-address and a port number.

(c) listen - specify the maximum number of outstanding connection requests that can be enqueued;

that is, the connection request queue length.(d) accept - wait to accept an incoming connection request. Use by a server to wait for an incoming

request. When a request arrives, a new socket is created and the new socket is used for the connection.

(e) write - send data using a connection-oriented (TCP).

(f) read - read data using a connection-oriented (TCP).

(g) close - close a connection

CS 742 Computer Communication Networks Exam 1 - Name:

Wednesday, October 13, 2004

Part 1: (33 points - 3 points for each problem)

(A) 1. SSH is a (A) software (B) protocol (C) hardware (D) network architecture

B

(D) 2. The known port for the domain name service is (A) 22 (B) 23 (C) 25 (D) 53

(C) 3. Which is the personal area networks standard?

(A) IEEE 802.3 (B) IEEE 802.11 (C) IEEE 802.15 (D) IEEE 802.16

(D) 4. Which is not a connection-oriented network?

(A) X.25 (B) ATM (C) POTS (D) none of the above

(C) 5. One symbol is sent at every 125 μ sec. Supposed QAM-128 is used. What is the transfer rate?

(A) 28.8 Kbps (B) 33.6 Kbps (C) 56 Kbps (D) none of the above

(B) 6. Television channels are 6-MHz wide. How many bits per second can be sent on a noiseless television

channel if four-level digital signals are used?

(A) 18 Mbps (B) 24 Mbps (C) 36 Mbps (D) none of the above

(A) 7. Which is a modulation method?

(A) phase (B) analog (C) digital (D) none of the above

(C) 8. Transmission lines suffer from three major problems. Which is not one of them?

(A) attenuation (B) distortion (C) diffraction (D) noise

(B) 9. Which is not used in GSM?

(A) FDM (B) CDMA (C) TDM (D) none of the above

(A) 10. Which is not an issue to be concerned with at the data link layer?

(A) routing (B) framing (C) error control (D) flow control

(B) 11. A bit string, 01111101111110, needs to be transmitted at the data link layer. What is the string to be transmitted after bit stuffing?

(A) 0111110111111010 (B) 0111110011111010 (C) 0111110011111110 (D) none of the above

Part 2: (67 points)

1. (15 pts.) Briefly explain these terminologies. If they are acronyms, also write what they stand for.

(a) Socket A socket is an endpoint for communication over a network or an abstraction through which an application can send and receive data.

(b) ADSL (Asymmetric Digital Subscriber Line) is a technology for transmitting digital information at a high bandwidth on existing phone lines to homes and businesses. It is called asymmetric because the upstream bandwidth is lower than downstream.

(c) QAM (Quadrature Amplitude Modulation) is a method of combining amplitude and phase modulation to transmit more bits per symbol.

(d) CDMA (Code-Division Multiple Access) allows transmissions over entire frequency spectrum.

Multiple simultaneous transmissions are separated using coding theory.

(e) Direct sequence spread spectrum It is an approach to spread spectrum modulation for digital signal transmission over the airwaves. A data signal at the point of transmission is combined with a higher data-rate bit sequence (also known as a chipping code). The redundant enables the original data to be recovered if data bits are damaged during transmission.2. (8 pts.) Complete the following table listing the seven layers in the OSI 7-Layer Reference Model.

Then, identify the four layers used in the TCP/IP protocol suite (write TCP/IP beside them). Finally, identify where the following protocols belong: HTTP, UDP, IP, SMTP.

Layer	Layer Name	TCP/IP suite	Protocol
-------	------------	--------------	----------

7	Application Layer	TCP/IP	HTTP, SMTP
---	-------------------	--------	------------

6	Presentation Layer		
---	--------------------	--	--

5	Session Layer		
---	---------------	--	--

4	Transport Layer	TCP/IP	UDP
---	-----------------	--------	-----

3	Network Layer	TCP/IP	IP
---	---------------	--------	----

2	Data Link Layer	TCP/IP	
---	-----------------	--------	--

1	Physical Layer		
---	----------------	--	--

3. (8 pts.)

(a) What is the main difference between connectionless and connection-oriented protocols?

(b) Give an example for each protocol respectively.

(c) What is a reliable communication?

Ans:

(a) A connection-oriented protocol requires that communication parties set up a link before the communication whereas the connectionless protocol does not.

(b) Connection-oriented protocol: TCP, Connectionless protocol: UDP

(c) The reliable communication is the communication where messages are guaranteed to reach their destination complete and uncorrupted and in the order they were sent.

4. (7 pts.) Suppose that a code consists of the following valid codewords: {000000, 000111, 111000, 111111}.

(a) What is the Hamming distance of the code?

(b) Can a single bit error be detected? Explain.

(c) If 000100 is received with two bit errors, can it be corrected? Briefly explain how it would be corrected, or why it cannot be corrected.

Ans:

(a) The Hamming distance of the code is 3.

(b) Yes, because $3 \geq 1 + 1$.

(c) No, it could be 000000 or 000111. Besides, $3 < 2 \times 2 + 1$.

5. (7 pts.) An 8-bit byte with binary value 10101011 is to be encoded using an even-parity Hamming code.

(a) How many check bits are needed to ensure that the receiver can detect and correct a single bit errors?

(b) What is the binary value after encoding?

Hint: Use the equation $m \leq 2^r - r - 1$

$r - r - 1$. Ans:

(a) $m \leq 2^r - r - 1$

$r - r - 1, m = 8 \Rightarrow r = 4$

(b) 1 0 1 0 1 0 1 1

Bit 1 = $(1 + 0 + 0 + 1 + 1) \bmod 2 = 1$

Bit 2 = $(1 + 1 + 0 + 0 + 1) \bmod 2 = 1$

Bit 3 = $(0 + 1 + 0 + 1) \bmod 2 = 0$

Bit 4 = $(1 + 0 + 1 + 1) \bmod 2 = 1$

The encoded value is 111001011011.6. (7 pts.) Using the divisor polynomial $x^4 + x$

$4 + x$

$3 + 1$ for CRC, what frame will be transmitted for the data

$M = 101011001$?

Ans: $M(x) = 101011001$ $C(x) = 11001, r = 4$

110000001

11001)1010110010000

11001

11001

11001

10000

11001

1001

So the transmission frame T(x) is 1010110011001.

7. (6 pts.) A video signal at a resolution of 320 x 240 pixels, 2 bytes/pixel color encoding, and 25 frames/second.

(a) Calculate the bandwidth necessary for transmitting in real time.

(b) Suppose your cable modem is up to 7.2 Mbps. Without loss of the resolution and color, how many

frames per second can it transfer?

Ans:

(a) $320 \times 240 \times 2 \times 8 \times 25 = 30720000$ bps

(b) $7.2 \times 106 / (320 \times 240 \times 2 \times 8) = 5.86$ frames/s

8. (9 pts.) Draw a diagram to illustrate the general pattern followed by a client and server for connection-oriented communication using socket API in C. Briefly explain those functions used in the client and

server.

Ans:

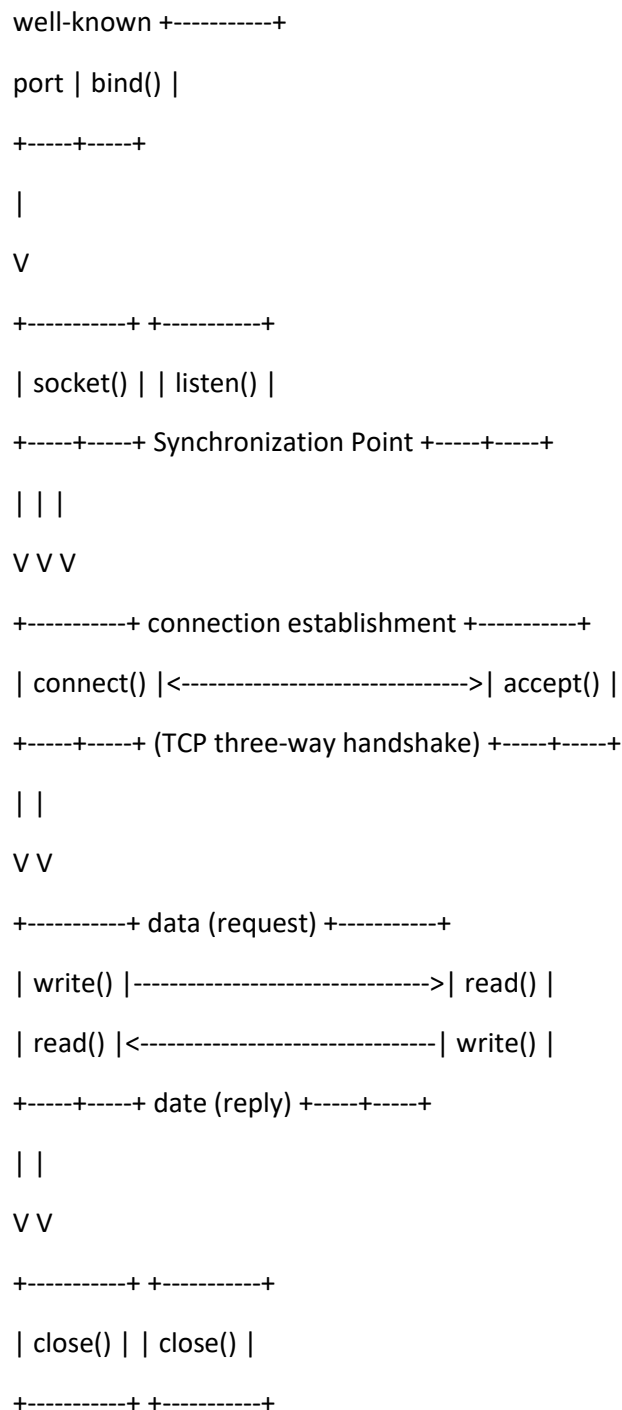
+-----+

| socket() |

+-----+

|

V



(a) socket - create an endpoint for communication.

(b) bind - bind a socket to an address. The address is a pair consisting of an IP-address and a port number.

(c) listen - specify the maximum number of outstanding connection requests that can be enqueued; that is, the connection request queue length.

(d) accept - wait to accept an incoming connection request. Use by a server to wait for an incoming request. When a request arrives, a new socket is created and the new socket is used for the

connection.

(e) write - send data using a connection-oriented (TCP).

(f) read - read data using a connection-oriented (TCP).

(g) close - close a connection

CS 742 Computer Communication Networks Exam 2 - Name:

Fall 2002

Part 1: (30 points - 3 points for each problem)

(C) 1. IP is a (A) hardware (B) network architecture (C) protocol (D) software

(C) 2. The package size of an ATM cell is:

(A) 32 bytes (B) 48 bytes (C) 53 bytes (D) 64 bytes

(A) 3. Which command sends ICMP echo request packets to network hosts?

(A) ping (B) netstat (C) ifconfig (D) arp

(B) 4. What is the header size of a IPv6 packet?

(A) 20 bytes (B) 40 bytes (C) 48 bytes (D) 60 bytes

(D) 5. Which address is shown when we issue the command: ping localhost?

(A) the IP address of the machine (B) 0.0.0.0 (C) 127.0.0.0 (D) 127.0.0.1

(A) 6. Which is a multicast address?

(A) 224.5.6.7 (B) 196.168.2.1 (C) 0.0.0.0 (D) 127.0.0.1

(D) 7. Which byte order is used in the Internet protocols?

(A) forward-endian (B) reverse-endian (C) little-endian (D) big-endian

(C) 8. Which I/O models is used in the select function?

(A) blocking I/O (B) nonblocking I/O (C) I/O multiplexing (D) signal driven I/O

(B) 9. Which function is not used in UDP socket programming in C?

(A) bind (B) listen (C) socket (D) recvfrom

(A) 10. In which function do we specify PF_UNIX or PF_INET?

(A) socket (B) bind (C) connect (D) listen

Part 2: (70 points + 10 bonus points)

1. Briefly explain these terminologies. If they are acronyms, also write what they stand for. (12 points)

(a) RIP - Routing Information Protocol is a widely-used protocol for managing router information

within a self-contained network such as a corporate local area network or an interconnected group of such LANs.

(b) DHCP - Dynamic Host Configuration Protocol is a communications protocol that lets network administrators manage centrally and automate the assignment of Internet Protocol (IP) addresses in an organization's network.

(c) CIDR - Classless Inter-Domain Routing or supernetting is a way to allocate and specify the Internet addresses used in inter-domain routing more flexibly than with the original system of Internet Protocol IP address classes.

(d) BGP - Border Gateway Protocol is a protocol for exchanging routing information between gateway hosts (each with its own router) in a network of autonomous systems.

2. A 1500-byte datagram (20-byte IP header plus 1480 bytes of data) arrives for transmission across a network that has the maximum transmission unit (MTU) of 600 bytes. How long will each of the three segments be (including the IP header)? (4 points)

Ans: The largest amount of data that can be transmitted is $600 - 20 = 580$ bytes. The last segment will be $1480 - 580 - 580 = 320$ bytes. The three segments will be 600 bytes, 600 bytes, and 340

bytes.3. How could the ARP protocol be used to determine if another host on my network is using my IP

address? (4 points)

Ans: Send an ARP broadcast with my IP address. If another host responds, we have identified a host using my IP address. Recall that only the owner of an IP address should respond.

4. True or False questions. If it is false, explain why? (9 points)

(a) An ICMP Echo Request and Reply can be used to determine if we have connectivity between a client and server at the Application Layer?

(b) Each host computer or router can only be assigned one Internet (IP) address.

(c) Only the owner of a given IP address should respond to an ARP request.

Ans:

(a) False, at best it can be used if we have connectivity at the Network Layer because ICMP is a Network Layer Protocol.

(b) False, a host with two ethernet cards should have two IP addresses, also routers always have multiple IP addresses assigned.

(c) True.

5. What is the purpose of the ATM Adaptation Layer (AAL)? What is its convergence sublayers (CS)?
(5 points)

Ans:

(a) Higher layer messages need to be fragmented to the ATM cell. The ATM Adpatation Layer sits between ATM and the variable-length packet protocols to handle fragmentation and reassembly.

(b) Covergence sublayers in AAL are used to support various service in the higher layer including voice, video, and data.

6. An organization has a class C network 192.168.1.0 and wants to form subnets for 3 departments, with

hosts as follows:

A 72 hosts

B 60 hosts

C 40 hosts

There are 172 hosts in all. Give a possible arrangement of network and subnet masks to make this possible. (9 points)

Ans: Department Network Netmask IP Addresses

A 192.168.1.0/25 255.255.255.128 128

B 192.168.1.128/26 255.255.255.192 64

C 192.168.1.192/26 255.255.255.192 64

7. Suppose a router has built up the routing table as shown in the following table. The router can deliver

packets directly over interfaces eth0 and eth1, or it can forward packets to other routers in the table.

Destination Netmask Gateway

156.26.10.0 255.255.255.192 eth0

156.26.10.128 255.255.255.192 eth1

156.26.0.0 255.255.0.0 156.26.10.1

0.0.0.0 0.0.0.0 156.10.1.30

Describe what the router does with a packet addressed to each of the following destinations: (8 points)

(a) 156.26.10.41 - deliver packets directly through eth0

(b) 156.26.10.239 - deliver packets directly through eth1(c) 156.26.1.30 - forward to the router at 156.26.10.1

(d) 129.130.12.27 - forward to the router at 156.10.1.30

8. Consider the following diagram and fill out the routing table of the router R1. Assume R1 connects to

the Network1 with the eth0 interface and with the Network2 with the eth1 interface respectively.

Network1 156.26.0.0/255.255.0.0

R1

Network2 156.26.10.0/255.255.255.192

R2

Network3 156.26.10.128/255.255.255.192

(6 points)

Ans:

Destination Netmask Gateway

156.26.0.0 255.255.0.0 eth0

156.26.10.0 255.255.255.192 eth1

156.26.10.128 255.255.255.192 R2

9. For the network 192.48.12.0/22, answer the following questions: (9 points)

(a) How many IP addresses can be allocated?

(b) What is the last IP address?

(c) What is the netmask?

Ans:

(a) $2^{32-22} = 2^{10} = 1024$.

(b) $(15 + 1 - 12) \times 256 = 1024 \Rightarrow 192.48.15.255$.

(c) The host ranges from 192.48.12.0 to 192.48.15.255. The first, second, and forth part of the netmask

are 255, 255, and 0, respectively. The third part of the netmask $256 - 2$

$24 - 22 = 252$. Hence, the

netmask is 255.255.252.0.

10. Describe how the Mobile IP works. (6 points)

Ans:

(a) A mobile node has a home agent which is the proxy of the mobile node during its absence from the home network. It acquires a care-of address that identifies its location in the current network from the foreign agent.

(b) Each time a user moves the device to a different network, it acquires a care-of address and notifies its home agent. The home agent then associates its home address with its care-of address.

(c) Traffic for the mobile node is sent to the home network and forwarded by the home agent via tunneling mechanisms to the appropriate care-of address.

11. Describe the steps (i.e. classes and methods used) the TCP server goes through in Java socket programming. (8 points)

Ans: The TCP server goes through two steps:

(a) Construct a ServerSocket instance, specifying the local port. This socket listens for incoming connections to the specified port.

(b) Repeatedly do the following:

- Call the accept() method of ServerSocket to get the next incoming client connection. Upon establishment of a new client connection, an instance of Socket for the new connection is created and returned by accept().

- Communicate with the client using the returned Socket's InputStream and OutputStream.

- Close the new client socket connection using the close() method of Socket

CS 742 Computer Communication Networks Exam 2 - Name:

Fall 2003

Part 1: (42 points - 3 points for each problem)

(C) 1. Which is a collision-free protocol?

(A) pure ALOHA (B) slotted ALOHA (C) binary countdown (D) none of above

(B) 2. Which cable does 100Base-TX use?

(A) thick coax (B) twisted pair (C) thin coax (D) fiber optics

(A) 3. 1000Base-T can support segments of up to

(A) 100 m (B) 200 m (C) 500 m (D) 1000 m

(C) 4. What is the baud rate of the standard 10-Mbps Ethernet?

(A) 5 Megabaud (B) 10 Megabaud (C) 20 Megabaud (D) None of above

(D) 5. The standard for wireless MAN is

(A) 802.3 (B) 802.11 (C) 802.15 (D) 802.16

(A) 6. Which transmission techniques are not specified in 802.11?

(A) QPSK (B) FHSS (C) DSSS (D) OFDM

(B) 7. 802.11b can operate at up to

(A) 54 Mbps (B) 11 Mbps (C) 10 Mbps (D) 2 Mbps

(C) 8. The standard for personal area network is

(A) 802.3 (B) 802.11 (C) 802.15 (D) 802.16

(B) 9. Which 802.16 service is the best choice for large file transfers?

(A) constant bit rate (B) non-real-time variable bit rate service

(C) real-time variable bit rate service (D) best-efforts service

(C) 10. Which device operates in the network layer?

(A) repeater (B) bridge (C) router (D) gateway

(A) 11. Which is a static routing algorithm?

(A) flooding (B) distance vector (C) link state (D) none of above

(A) 12. Based on the QoS, videoconferencing can tolerate low

(A) reliability (B) delay (C) bandwidth (D) none of above

(D) 13. Which byte order is used in the Internet protocols?

(A) forward-endian (B) reverse-endian (C) little-endian (D) big-endian

(D) 14. In which function do we specify SOCK_STREAM in C socket programming?

(A) bind (B) connect (C) listen (D) socket

Part 2: (58 points)

1. A 1480-byte datagram (20-byte IP header plus 1460 bytes of data) arrives for transmission across a network that has the maximum transmission unit (MTU) of 532 bytes. How long will each of the segments be (including the IP header)? (4 points)

Ans: The largest amount of data that can be transmitted is $532 - 20 = 512$ bytes. The last segment

will be $1460 - 512 - 512 = 436$ bytes. The three segments will be 532 bytes, 532 bytes, and 456

bytes. 2. Briefly explain these terminologies. If they are acronyms, also write what they stand for. (12 points)

(a) MAC layer The Medium Access Control (MAC) (sub)layer is the bottom part of the data link layer and deals with sharing the physical channel among several stations.

(b) Bluetooth is a specification for the technology that connects different (mobile) devices through short-range radio.

(c) MANET A Mobile Ad hoc NETWORK (MANET) is a network where the routers are mobile.

(d) AODV Ad hoc On-demand Distance Vector (AODV) is a routing algorithm used to solve the problem of mobile routers.

3. Sixteen stations, numbered 0, ..., 15, are contending for the use of a shared channel using the adaptive tree walk protocol. If only stations 3, 5, 6, 7, 8, and 12 suddenly become busy at once and want to transmit a frame, how many bit slots are needed to resolve the contention? (6 points)

Ans:

A

/\

/\

/\

B C

/\/\

/\/\

D E F G

/\/\/\

H I J K L M N O

/\/\/\/\

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Try A → collision Try B → collision

Try D → 3 transmit Try E → collision

Try J → 5 transmit Try K → collision

6 transmit 7 transmit

Try C → collision Try F → 8 transmit

Try G → 12 transmit

11 slots are needed.

4. The network layer provides both connectionless and connection-oriented services. (8 points)

(a) What subnet for each service is built respectively?

(b) Give one advantage for each service respectively?

(c) Give two applications which fit each service respectively.

(a) A connectionless subnet is a datagram subnet. A connection-oriented subnet is a virtual-circuit subnet.

(b) • The connectionless service has advantages: more potential for adapting to congestion robustness in the face of router failures, various adaptive routing algorithms are possible, it can be used over subnets that do not use virtual circuits inside.

• The connection-oriented service has advantages: buffers can be reserved in advance, sequencing can be guaranteed, shorter headers can be used, and troubles caused by delayed duplicate packets can be avoided.

(c) • Applications fit the connectionless service: email, news transfer, and database query.

• Applications fit the connection-oriented service: file transfer, remote login, bank transactions, and videoconferencing.

5. (a) What does CSMA/CD stand for? Briefly explain CSMA/CD protocol.

(b) Explain the binary exponential backoff algorithm used in CSMA/CD.

(c) What problems would happen if a wireless protocol follows exactly CSMA/CD.

(d) Briefly explain CSMA/CA protocol.

(14 points)

Ans:

(a) Carrier Sense Multiple Access/Collision Detect (CSMA/CD) is the protocol for carrier transmission access in Ethernet networks. On Ethernet, any device can try to send a frame at any time.

Each device senses whether the line is idle and therefore available to be used. If it is, the device begins to transmit its first frame. If another device has tried to send at the same time, a collision is said to occur and the frames are discarded. Each device then waits a random amount of time and retries until successful in getting its transmission sent.

(b) When there is collision, the station wait some time between 0 to $2n - 1$ slotted time at the n 's trial. This is called backoff algorithm.

(c) Hidden and exposed nodes are the problems when CSMA/CD is employed in a wireless environment. Hidden nodes are those nodes which cannot be detected by another node. The collision

could happen during transmission. Exposed nodes are those nodes which are detected but are not the recipients.

(d) Carrier sensing multiple access with collision avoidance (CSMA/CA) is a protocol used in wireless networking. When a node is ready for transmission, it sends a request to send (RTS) frame to the receiver and waits to receive a clear to send (CTS) frame from the receiver. As a result, all nodes within the range will refrain from transmitting a data frame. Once CTS is received, the sender can send packets. Other nodes do not transmit until the receiver sends an acknowledge (ACK) frame to the sender.

6. Complete the following Java TCP echo server. (8 points)


```

import java.net.*;
import java.io.*;

public class TCPServer {

    public static void main (String args[]) throws IOException {

        int serverPort = 7896;

        ServerSocket replySocket = new ServerSocket(serverPort);

        while(true) {

            Socket clientSocket = replySocket.accept();

            Connection c = new Connection(clientSocket);

        }

    }

    class Connection extends Thread {

        DataInputStream in;

        DataOutputStream out;

        public Connection (Socket requestSocket) throws IOException {

            in = new DataInputStream(requestSocket.getInputStream());

            out = new DataOutputStream(requestSocket.getOutputStream());

            this.start();

        }

        public void run() {

            try {

                String data = in.readUTF();

                out.writeUTF(data);

            } catch(IOException e) {System.out.println("IO:"+e.getMessage());}

        }

    }

}

```

7. Describe how the Mobile IP works. (6 points)

Ans:

(a) A mobile node has a home agent which is the proxy of the mobile node during its absence from the home network. It acquires a care-of address that identifies its location in the current network

from the foreign agent.

(b) Each time a user moves the device to a different network, it acquires a care-of address and notifies

its home agent. The home agent then associates its home address with its care-of address.

(c) Traffic for the mobile node is sent to the home network and forwarded by the home agent via tunneling mechanisms to the appropriate care-of address

CS 742 Computer Communication Networks Exam 2 - Name:

Date: Monday, November 22, 2004

Part 1: (36 points - 3 points for each problem)

(A) 1. Which framing approach is used in PPP?

(A) character stuffing (B) bit stuffing (C) clock-based framing (D) frequency framing

(A) 2. 1000 stock exchange stations are competing for the use of a single slotted ALOHA channel.

The average station makes 360 requests/minute. A slot is 10 μ sec. What is the total channel load?

(A) 0.06 request/slot (B) 0.1 request/slot (C) 0.6 request/slot (D) none of above

(B) 3. N stations use the bit-map protocol to transmit data frames consisting of d time units. Which statement is incorrect?

(A) There will never be any collisions.

(B) There will be lower average delay at high load than at low load.

(C) Suppose n/2 stations have something to send. The channel efficiency is $d/(d + 2)$.

(D) none of above

(C) 4. Which is the standard for fast Ethernet?

(A) 802.3ae (B) 802.3b (C) 802.3u (D) 802.3z

(B) 5. Each Category 5 UTP can carry up to 125 Megabaud signals, how many UTPs are required to achieve 100 Mbps in Ethernet?

(A) 1 (B) 2 (C) 4 (D) none of above

(B) 6. Which statement about IEEE 802.11b is incorrect?

(A) It operates in a ISM band. (B) It uses OFDM modulation.

(C) It makes possible data rate as high as 11 Mbps. (D) none of the above

(D) 7. Which 802.16 service is intended for transmitting uncompressed voice?

(A) real-time variable bit rate service (B) best-efforts service

(C) non-real-time variable bit rate service (D) none of above

(D) 8. Which statement about Bluetooth is incorrect?

(A) It operates in a ISM band. (B) The gross data rate is 1 Mbps.

(C) The band is divided into 79 channels of 1 MHz each. (D) none of above

(A) 9. Which device operates in the data link layer?

(A) switch (B) repeater (C) hub (D) router

(C) 10. Which routing has the count-to-infinity problem?

(A) shortest path routing (B) flooding (C) distance vector (D) link state

(B) 11. Based on the QoS, which following service doesn't tolerate jitter?

(A) e-mail (B) telephony (C) Web access (D) remote login

(A) 12. Which byte order is used in the Internet protocols?

(A) big-endian (B) little-endian (C) forward-endian (D) reverse-endian

Part 2: (64 points)

1. (12 pts.) Briefly explain these terminologies. If they are acronyms, also write what they stand for.

(a) HDLC High-level Data Link Control (HDLC) is a protocol for transmitting data between direct linked nodes on the data link layer.

(b) OFDM Orthogonal Frequency Division Multiplexing (OFDM) is a spread spectrum technique.

A phase-shift modulation and Quadrature Amplitude Modulation (QAM) are used.(c) L2CAP The Logic Link Control and Adaptation Protocol (L2CAP) is a data link control protocol on top of the Bluetooth baseband layer.

(d) AODV Ad hoc On-demand Distance Vector (AODV) is a routing algorithm used to solve the problem of mobile routers.

2. (8 pts.) Compare datagram and virtual-circuit subnets.

Issue Datagram subnet Virtual-circuit subnet

Circuit setup Not needed Required

Addressing Each packet contains the full source and destination address. VC number. Each packet contains a short

State information Routers do not hold state information about connections. Each VC requires router table space per connection

Routing Each packet is routed independently. Route chosen when VC is set up; all packets follow it.

Effect of router failures None, except for packets lost All VCs that passed through

during the crash the failed router are terminated

Quality of service/ Difficult Easy if enough resources can be

Congestion control allocated in advance for each VC.

3. (8 pts.) Suppose that $2n$ stations use the adaptive tree walk protocol to arbitrate access to a shared

channel. At a certain instant 3 stations become ready. What are the minimum and maximum of bit slots needed to walk the tree if $2n$ is much larger than 1?

Ans:

(a) The minimum number happens when two stations are in two different subtrees two-level down from the root and the third one in a different subtree from the root. Traversing to two stations in the same subtree from the root requires two collision slots and two submission slots. Another slot is needed for traversing the other station in the other subtree from the root. So the minimum number is 5 bit slots.

(b) The maximum number happens when two stations are in the same deepest subtree and the third one can be in any other subtree. Traversing from the root node to these three stations level by level, there are n collision, $n - 2$ non-collision, and 3 submission slots. So the maximum number is $n + n - 2 + 3 = 2n + 1$ bit slots.

4. (6 pts.) Describe how routing for mobile hosts works.

Ans:

(a) A mobile node has a home agent which is the proxy of the mobile node during its absence from the home network. It acquires a care-of address that identifies its location in the current network from the foreign agent.

(b) Each time a user moves the device to a different network, it acquires a care-of address and notify its home agent. The home agent then associates its home address with its care-of address.

(c) Traffic for the mobile node is sent to the home network and forwarded by the home agent via tunneling mechanisms to the appropriate care-of address.

5. (a) (4.5 pts.) What protocol is used in Ethernet for media access control? Briefly explain that

protocol?

(b) (2 pts.) Explain the binary exponential back-off algorithm used in Ethernet.

(c) (3 pts.) What problems would happen if a wireless protocol follows exactly the above protocol?

(d) (4.5 pts.) What protocol is used in 802.11 for media access control? Briefly explain that protocol?

Ans:

(a) Carrier Sense Multiple Access/Collision Detect (CSMA/CD) is the protocol for carrier transmission access in Ethernet networks. On Ethernet, any device can try to send a frame at any time.

Each device senses whether the line is idle and therefore available to be used. If it is, the device begins to transmit its first frame. If another device has tried to send at the same time, a collision is said to occur and the frames are discarded. Each device then waits a random amount of time and retries until successful in getting its transmission sent.

(b) When there is collision, the station wait some time between 0 to $2n - 1$ slotted time at the n 's trial. This is called back-off algorithm.

(c) Hidden and exposed nodes are the problems when CSMA/CD is employed in a wireless environment. Hidden nodes are those nodes which cannot be detected by another node. The collision

could happen during transmission. Exposed nodes are those nodes which are detected but are not the recipients.

(d) Carrier sensing multiple access with collision avoidance (CSMA/CA) is a protocol used in 802.11 wireless networking. When a node is ready for transmission, it sends a request to send (RTS) frame to the receiver and waits to receive a clear to send (CTS) frame from the receiver. As a result, all nodes within the range will refrain from transmitting a data frame. Once CTS is received, the sender can send packets. Other nodes do not transmit until the receiver sends an acknowledge (ACK) frame to the sender.

6. (a) (12 pts.) Complete the following Java UDP echo client code (UDPEchoClient.java) and C server code (udpechoserver.c). Each time the client connects to the server the server will generate a child process to echo the message back to the client.

(b) (4 pts.) Show how to compile the programs and run the client and server on different machines.

```
import java.net.*;
import java.io.*;
public class UDPClient{
    public static void main(String args[]) throws IOException {
        DatagramSocket dataSocket = new DatagramSocket();
        byte [] msg = args[0].getBytes();
        String hostname = args.length <= 1 ? "localhost" : args[1];
        InetAddress host = InetAddress.getByName(hostname);
        int serverPort = 6789;
```

```

DatagramPacket request = new DatagramPacket(msg, args[0].length(), host, serverPort);
dataSocket.send(request);

byte[] buffer = new byte[1024];

DatagramPacket reply = new DatagramPacket(buffer, buffer.length);
dataSocket.receive(reply);

System.out.println("Reply: " + new String(reply.getData()));
}

```

```

#include <sys/socket.h>

```

```

#include <resolv.h>

```

```

int main(int argc, char *args[])

```

```

{

```

```

    int sd, dup_sd; // socket descriptor

```

```

    int childpid;

```

```

    int port=6789; // port number

```

```

    struct sockaddr_in addr, dup_addr; // Internet endpoint address

```

```

    char buffer[1024];

```

```

    if (argc < 2)

```

```

        printf("usage: %s <port>\nUsing default port (%d).\n", args[0], port);

```

```

    else

```

```

        port = atoi(args[1]);

```

```

        sd = socket(PF_INET, SOCK_DGRAM, 0);

```

```

        bzero(&addr, sizeof(addr)); // initialize addr

```

```

        addr.sin_family = AF_INET; // Address Family IPv4

```

```

        addr.sin_port = htons(port); // port number

```

```

        addr.sin_addr.s_addr = INADDR_ANY; // a wildcard address

```

```

        if (bind(sd, (struct sockaddr*)&addr, sizeof(addr)) != 0)

```

```

            perror("bind");

```

```

        while (1)

```

```

        {

```

```

            int bytes, addr_len = sizeof(addr);

```

```

            printf("Waiting for incoming requests\n");

```

```
bytes = recvfrom(sd, buffer, sizeof(buffer), 0,  
(struct sockaddr*)&addr, &addr_len);  
if ((childpid = fork()) < 0) printf("fork error\n");  
else if (childpid == 0) {  
    dup_sd = socket(PF_INET, SOCK_DGRAM, 0);  
    sendto(dup_sd, buffer, bytes, 0, (struct sockaddr*)&addr, sizeof(addr));  
    exit(0);  
}  
}  
close(sd);  
}
```

(b) i. • To compile udpechoserver.c, type `cc -o udpechoserver udpechoserver.c`.

- To compile UDPEchoClient.java, type `java UDPEchoClient.java`.

ii. • To run the server on kirk, type `udpechoserver`.

- To run the client, type `java UDPEchoClient Hello kirk`