Revision Sheet – Final Fall

Course name: Computer Networks II
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| Essay | MCQ | Total |
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| Fundamentals of WANs | |
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| Which of the following best describes the main function of OSI Layer 1 protocols?<br>a. Framing<br>b. Delivery of bits from one device to another<br>c. Addressing<br>d. Local Management Interface (LMI)<br>e. DLCI | B |
| Which of the following typically connects to a four-wire line provided by a telco?<br>a. Router serial interface<br>b. CSU/DSU<br>c. Transceiver<br>d. Switch serial interface | B |
| Which of the following typically connects to a V.35 or RS-232 end of a cable when cabling a leased line?<br>a. Router serial interface<br>b. CSU/DSU<br>c. Transceiver<br>d. Switch serial interface | B |
| Which of the following functions of OSI Layer 2 is specified by the protocol standard for<br>PPP, but is implemented with a Cisco proprietary header field for HDLC?<br>a. Framing<br>b. Arbitration<br>c. Addressing<br>d. Error detection<br>e. Identifying the type of protocol that is inside the frame | E |
| Which of the following WAN data link protocols on Cisco routers support multiple Layer 3 protocols by virtue of having some form of Protocol Type field?<br>a. PPP<br>b. HDLC<br>c. LAPB<br>d. LAPD<br>e. SDLC<br>f. None of the above | A, B, and C |
| On a point-to-point WAN link between two routers, what device(s) are considered to be<br>the DTE devices?<br>a. The routers<br>b. The CSU/DSUs<br>c. The central office equipment<br>d. A chip on the processor of each router<br>e. None of the above | A |
| Imagine that Router1 has three point-to-point serial links, one link each to three | E |

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| remote<br>routers. Which of the following is true about the required HDLC addressing at Router1?<br>a. Router1 must use HDLC addresses 1, 2, and 3.<br>b. Router1 must use any three unique addresses between 1 and 1023.<br>c. Router1 must use any three unique addresses between 16 and 1000.<br>d. Router1 must use three sequential unique addresses between 1 and 1023.<br>e. None of the above. | |
| What is the name of the Frame Relay field used to identify Frame Relay Virtual Circuits?<br>a. Data-link connection identifier<br>b. Data-link circuit identifier<br>c. Data-link connection indicator<br>d. Data-link circuit indicator<br>e. None of the above | A |
| Which of the following is true about Frame Relay virtual circuits?<br>a. Each VC requires a separate access link.<br>b. Multiple VCs can share the same access link.<br>c. All VCs sharing the same access link must connect to the same router on the other<br>side of the VC.<br>d. All VCs on the same access link must use the same DLCI. | B |
| Which of the following defines a SONET link speed around 155 Mbps?<br>a. T1<br>b. T3<br>c. DS3<br>d. DS155<br>e. OC-3<br>f. OC-12<br>g. OC-48<br>h. OC-155 | E |

**1.** Are DLCI addresses defined by a Layer 2 or Layer 3 protocol?
**Answer: DLCI addresses are defined by a Layer 2 protocol. Although they are not covered specifically in this chapter, Frame Relay protocols do not define a logical addressing structure that can usefully exist outside a Frame Relay network; by definition,the addresses would be OSI Layer 2–equivalent.**

**2.** What OSI layer typically encapsulates using both a header and a trailer?
**Answer: The data link layer typically encapsulates using both a header and a trailer. The trailer typically includes a frame check sequence (FCS), which is used to perform error detection.**

**3.** Define the terms DCE and DTE in the context of the physical layer and a point-to-point serial link.
**Answer: At the physical layer, DTE refers to the device that looks for clocking from the device on the other end of the cable on a link. The DCE supplies that clocking. For example, the computer is typically the DTE, and the modem or CSU/DSU is the DCE. At the data link layer, both X.25 and Frame Relay define a logical DTE and DCE. In this case, the customer premises equipment (CPE), such as a router and a CSU/DSU, is the logical DTE, and the service provider equipment (the Frame Relay switch and the CSU/ DSU) is the DCE.**

**4.** Which layer or layers of OSI are most closely related to the functions of Frame Relay? Why?
**Answer: OSI Layers 1 and 2. Frame Relay refers to well-known physical layer specifications. Frame Relay does define headers for delivery across the Frame Relay cloud, making it a Layer 2 protocol. Frame Relay does not include any routing or logical addressing specifications, so it is not a Layer 3 protocol.**

**5.** What is the name of the field that identifies, or addresses, a Frame Relay virtual circuit?
**Answer: The data-link connection identifier (DLCI) is used to identify a VC.**

**6.** True or False: "A leased line between two routers provides a constant amount of bandwidth—never more and never less." Defend your answer.
**Answer: True. A leased line creates the cabling equivalent of having a cable between the two routers, with the speed (clock rate) defined by the telco. Even when the routers have no data to send, the full bandwidth is available to be used.**

**7.** True or False: "Frame Relay VCs provide a constant amount of bandwidth between two
devices, typically routers—never more and never less." Defend your answer.
**Answer: False. The provider assigns a guaranteed bandwidth, or CIR, for a VC, but the routers on either end of the VC can send more than the CIR of data. As long as the service provider has enough capacity to support it, the frames are forwarded over the VC.**

**8.** Explain how many DS0 channels fit into a T1, and why the total does not add up to the purported speed of a T1, which is 1.544 Mbps.
**Answer: Each DS0 channel runs at 64 kbps. With 24 in a T1, the T1 speed seemingly would be 24 * 64 kbps, or 1.536 Mbps. T1 also includes 8 kbps for management, which, when added to the 1.536 Mbps total, gives you the full T1 rate—1.544 Mbps.**

**9.** Define the term synchronous.

**Answer: The imposition of time ordering on a bit stream. Practically, a device will try to use the same speed as another device on the other end of a serial link. By examining transitions between voltage states on the link, the device can notice slight variations in the speed on each end and can adjust its speed accordingly.**

**10.** Imagine a drawing with two routers, each connected to an external CSU/DSU, which each is connected with a four-wire circuit, as seen in this chapter. Describe the role of the devices in relation to clocking and synchronization.
**Answer: The routers receive clocking from their respective CSU/DSUs. One of the two CSU/DSUs is configured as the master. The other CSU/DSU, as the slave, adjusts its clock to match the speed of the master CSU/DSU.**

**11.** Imagine a drawing with two routers, each connected to an external CSU/DSU, which each is connected with a four-wire circuit, as seen in this chapter. List the words behind the acronyms DTE and DCE, and describe which devices in this imagined network are DTE and which are DCE.
**Answer: DTE stands for data terminal equipment, and DCE stands for data communications equipment. The routers are DTEs, and the CSU/DSUs are DCEs.**

**12.** Imagine a drawing with two routers, each connected to a Frame Relay switch over a local access link. Describe which devices in this imagined network are Frame Relay DTEs and which are Frame Relay DCEs.
**Answer: The routers are DTEs, and the Frame Relay switches are DCEs.**

**13.** Do HDLC and PPP, as implemented by Cisco routers, support protocol type fields and error detection? Explain your answer.
**Answer: Both protocols support a protocol type field and an FCS field to perform error detection. PPP has both fields based on the protocol specification; Cisco added the protocol type field to the standard HDLC header.**

**14.** Imagine a point-to-point leased line between two routers, with PPP in use. What are the names of the protocols inside PPP that would be used on this link? What are their main functions?
**Answer: The PPP Link Control Protocol (LCP) controls and manages the link. The IP Control Protocol (IPCP) also would be used because you need a CP for each Layer 3 protocol. IPCP can assign IP addresses to devices on the other end of a link.**

**15.** What are some of the main similarities between Frame Relay and ATM?
**Answer: Both use an access link to access the service provider. Both use the concept of a virtual circuit between DTE devices. And both allow multiple VCs to cross a single access link.**

**16.** Compare and contrast ATM and SONET in terms of the OSI model.

**Answer: SONET defines the Layer 1 details of passing traffic over optical cabling, whereas ATM provides the Layer 2 functionality, including link-specific addressing, framing, and error detection.**

**17.** Besides HDLC and PPP, list the other four serial point-to-point data-link protocols covered in this lecture.
**Answer: SDLC, LAPB, LAPD, and LAPF.**

**18.** List the speeds of a T1 line, E1, OC-3, and OC-12.
**Answer: 1.544 Mbps, 2.048 Mbps, 155 Mbps, and 622 Mbps.**

| Fundamentals of IP | |
|---|---|
| Which of the following describes the functions of OSI Layer 3 protocols?<br>a. Logical addressing<br>b. Physical addressing<br>c. Path selection<br>d. Arbitration<br>e. Error recovery | A and C |
| Imagine that PC1 needs to send some data to PC2, and PC1 and PC2 are separated by several routers. What are the largest entities that make it from PC1 to PC2?<br>a. Frame<br>b. Segment<br>c. Packet<br>d. L5PDU<br>e. L3PDU<br>f. L1PDU | C and E |
| Which of the following does a router normally use when making a decision about routing TCP/IP?<br>a. Destination MAC address<br>b. Source MAC address<br>c. Destination IP address<br>d. Source IP address<br>e. Destination MAC and IP address | C |
| Imagine a network with two routers that are connected with a point-to-point HDLC serial link. Each router has an Ethernet, with PC1 sharing the Ethernet with Router1, and PC2 sharing an Ethernet with Router2. When PC1 sends data to PC2, which of the following is true?<br>a. Router1 strips the Ethernet header and trailer off the frame received from PC1, never to be used again.<br>b. Router1 encapsulates the Ethernet frame inside an HDLC header and sends the frame to Router2, which extracts the Ethernet frame for forwarding to PC2.<br>c. Router1 strips the Ethernet header and trailer off the frame received from PC1, which is exactly re-created by R2 before forwarding data to PC2.<br>d. Router1 removes the Ethernet, IP, and TCP headers, and rebuilds the appropriate headers before forwarding the packet to Router2. | A |
| Which of the following are valid Class C IP addresses?<br>a. 1.1.1.1<br>b. 200.1.1.1<br>c. 128.128.128.128<br>d. 224.1.1.1<br>e. 223.223.223.255 | B |
| What is the range for the values of the first octet for Class A IP networks?<br>a. 0 to 127 | D |

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| b. 0 to 126<br>c. 1 to 127<br>d. 1 to 126<br>e. 128 to 191<br>f. 128 to 192 | |
| PC1 and PC2 are on two different Ethernets that are separated by an IP router. PC1's IP address is 10.1.1.1, and no subnetting is used. Which of the following addresses could be used for PC2?<br>a. 10.1.1.2<br>b. 10.2.2.2<br>c. 10.200.200.1<br>d. 9.1.1.1<br>e. 225.1.1.1<br>f. 1.1.1.1 | D and F |
| How many valid host IP addresses does each Class B network contain?<br>a. 16,777,214<br>b. 16,777,216<br>c. 65,536<br>d. 65,534<br>e. 65,532<br>f. 32,768<br>g. 32,766<br>h. 32,764 | D |
| How many valid host IP addresses does each Class C network contain?<br>a. 65,536<br>b. 65,534<br>c. 65,532<br>d. 32,768<br>e. 32,766<br>f. 256<br>g. 254 | G |
| Which of the following protocols allows a client PC to discover the IP address of another computer, based on that other computer's name?<br>a. ARP<br>b. RARP<br>c. DNS<br>d. DHCP<br>e. BOOTP | C |
| Which of the following protocols allow a client PC to request assignment of an IP address as well as learn its default gateway?<br>a. ARP<br>b. RARP<br>c. DNS | D |

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| d. DHCP | |
| Which term is defined by the following phrase: “the type of protocol that is being forwarded when routers perform routing.”<br>a. Routed protocol<br>b. Routing protocol<br>c. RIP<br>d. IOS<br>e. Route protocol | A |

ESSAY

1. What are the two main functions of each OSI Layer 3–equivalent protocol?
**Answer: Path selection, which is also called routing, and logical addressing.**

2. Assume that PC1 sends data to PC2, and PC2 is separated from PC1 by at least one router. Are the IP addresses of the PCs in the same IP subnet? Explain your answer.
**Answer: They must be in different subnets. IP addressing rules require that IP hosts separated by a router be in different subnets.**

3. Assume that PC1 sends data to PC2, and PC2 is not separated from PC1 by at least one router. Are the IP, addresses of the PCs in the same IP subnet? Explain your answer.
**Answer: They must be in the same subnet. IP addressing rules require that IP hosts not separated by a router be in the same subnet.**

4. How many bits are present in an IP address?
**Answer: IP addresses have 32 bits: a variable number in the network portion, and the rest of the 32 in the host portion. IP Version 6 uses a 128-bit address!**

5. How many bits are present in an IPX address?
**Answer: IPX addresses have 80 bits: 32 bits in the network portion and 48 bits in the node portion.**

6. How many bits are present in an AppleTalk address?
**Answer: AppleTalk addresses have 24 bits: 16 in the cable-range portion and 8 bits in the node portion.**

7. Name the two main parts of an IPX address. Which part identifies which group this address is a member of?
**Answer: Network number and node number are the two main parts of an IPX address. Addresses with the same network number are in the same group. On LAN interfaces, the**
**node number is made to have the same value as the LAN MAC address.**

8. Name the two main parts of an IP address. Which part identifies which group this address is a member of?

**Answer: Network and host are the two main parts of an IP address. As described in technically there are three portions of the IP address: network, subnet, and host. However, because most people think of the network and subnet portions as one portion, another correct answer to this question, using popular terminology, would be subnet and host. In short, without subnetting, the network part identifies the group; with subnetting, the network and subnet part together identifies the group.**

9. PC1 sends data to PC2 using TCP/IP. Three routers separate PC1 and PC2. Explain why the statement "PC1 sends an Ethernet frame to PC2" is true or false.
**Answer: False. Packets are delivered from end to end across a network, whereas frames simply pass between devices on each common physical network. The intervening routers discard the original Ethernet header, replacing it with other data-link headers as needed.**
**A truer statement would be "PC1 sends an IP packet to PC2."**

10. In IP addressing, how many octets are in 1 byte?
**Answer: One. Octet is a generic word to describe a single byte. Each IP address is 4 bytes,or four octets, long.**

11. Describe the differences between a routed protocol and a routing protocol.
**Answer: The routed protocol defines the addressing and Layer 3 header in the packet that actually is forwarded by a router. The routing protocol defines the process of routers exchanging topology data so that the routers know how to forward the data. A router uses the routing table created by the routing protocol when choosing where to route a packet.**

12. Name at least three routed protocols.
**Answer: TCP/IP (IP), Novell (IPX), OSI (CLNP), DECnet (CLNP), AppleTalk (DDP), and VINES are some examples of routed protocols.**

13. Name at least three IP routing protocols.
**Answer: IP RIP, IP IGRP, IP/IPX/AppleTalk EIGRP, IP OSPF, OSI NLSP, and OSI IS-IS are some examples of routing protocols.**

14. Imagine an IP host on an Ethernet, with a single router attached to the same segment. In which cases does an IP host choose to send a packet to this router instead of directly to the destination host, and how does this IP host know about that single router?
**Answer: Typically an IP host knows to what router to send a packet based on its configured default router. If the destination of the packet is in another subnet, the host sends the packet to the default router. Otherwise, the host sends the packet directly to the destination host because it is in the same subnet and, by definition, must be on the same data link.**

15. Name three items in an entry in any routing table.
**Answer: A number that identifies a group of addresses, the interface out which to forward the packet, and the Layer 3 address of the next router to send this packet to are three items that you will always find in a routing table entry. For instance, IP routes contain subnet numbers, the outgoing interface, and the IP address of the next-hop router.**

16. Name the parts of an IP address when subnetting is used.
**Answer: Network, subnet, and host are the three parts of an IP address. However, many**
**people commonly treat the network and subnet parts of an address as a single part, leaving only two parts, the subnet and host parts.**

17. How many valid IP addresses exist in a Class A network? (You may refer to the formula if you do not know the exact number.)
**Answer: 16,777,214,**

18. How many valid IP addresses exist in a Class B network? (You may refer to the formula if you do not know the exact number.)
**Answer: 65,534,**

19. How many valid IP addresses exist in a Class C network? (You may refer to the formula if you do not know the exact number.)
**Answer: 254,**

20. What values can a Class A network have in the first octet?
**Answer: 1 through 126, inclusive.**

21. What values can a Class B network have in the first octet?
**Answer: 128 through 191, inclusive.**

22. What values can a Class C network have in the first octet?
**Answer: 192 through 223, inclusive.**

23. When subnetting a Class B network, do you create the subnet field by taking bits from the network part of the address or the host part?
**Answer: Host part.**

24. When subnetting a Class B network, using the entire third octet for the subnet part, describe the number of possible subnets created.
**Answer: The subnet part consists of a full octet, which is 8 bits long. You can number 28 things with 8 bits, or 256. However, 2 subnet numbers are reserved, leaving 254 subnets.**

25. When subnetting a Class A network using the entire second octet for the subnet part, describe the number of hosts in each subnet.

**Answer: The host part consists of two entire octets in this case, which is 16 bits long. You can number 216 things with 16 bits, or 65,536. However, 2 subnet numbers are reserved, leaving 65,534 hosts per subnet.**

26. When a router hears about multiple routes to the same subnet, how does it choose which route to use?
**Answer: Routing protocols use a metric to describe how good each route is. The lower the metric is, the better the route is.**

27. What is the primary purpose of a routing protocol?
**Answer: Routing protocols discover the routes in network and build routing tables.**

28. True or false: "Routing protocols are required to learn routes of directly connected subnets."
**Answer: False. Routers add routes to directly connected subnets when the interfaces initialize. No routing protocols are needed.**

30. List the similarities and differences between RARP and BOOTP.
**Answer: Both protocols send broadcasts looking for a server, and they hope to have the server assign them an IP address. BOOTP also can be used to assign other parameters, such as the subnet mask, default gateway, DNS address, and filenames for downloading an operating system.**

31. List the similarities and differences between DHCP and BOOTP.
**Answer: Both protocols send broadcasts looking for a server, and they hope to have the server assign them an IP address. Both can be used to assign a large variety of parameters, such as the subnet mask, default gateway, DNS address, and filenames for downloading an operating system. DHCP does not require that the server be preconfigured with the MAC addresses of all the DHCP client PCs, making it much more**
**scalable.**

32. List the similarities and differences between ARP and DNS.
**Answer: Both protocols send messages with one bit of information, hoping to learn another bit of information. The similarities do not go beyond that fact. DNS requests are unicast IP packets sent specifically to the DNS server, whereas ARP uses a LAN broadcast frame. DNS queries supply a name, expecting to hear the corresponding IP address back from the server. ARP requests supply an IP address, hoping to hear a corresponding MAC address not from a server, but from the host that uses that IP address.**

| Fundamentals of TCP and UDP | |
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| 1. Which of the following protocols are connection-oriented?<br>a. Frame Relay<br>b. TCP<br>c. IP<br>d. UDP<br>e. Ethernet | A and B |
| 2. Which of the following protocols are reliable?<br>a. Frame Relay<br>b. TCP<br>c. IP<br>d. UDP<br>e. Ethernet | B |
| 3. PC1 is using TCP, has a window of 4, and sends four segments numbered 2, 3, 4, and 5<br>to PC2. PC2 replies with an acknowledgment number 5. What should PC1 do next?<br>a. Increase its window to five segments<br>b. Increase its window by five more segments, for a total of nine<br>c. Send segment 6<br>d. Resend segment 5<br>e. Resend segments 2 through 5 | D |
| 4. Which of the following are not features of a protocol that is considered to match OSI<br>Layer 4?<br>a. Error recovery<br>b. Flow control<br>c. Segmenting of application data<br>d. Conversion from binary to ASCII | D |
| 5. Which of the following flow-control methods let the receiver tell the sender how much data the sender is allowed to send before the sender must wait for an acknowledgment?<br>a. Buffering<br>b. Acknowledgments<br>c. Windowing<br>d. Congestion notification<br>e. Congestion avoidance | C |
| 6. Which of the following header fields identifies which TCP/IP application gets data<br>received by the computer?<br>a. Ethernet Type<br>b. 802.3 DSAP<br>c. SNAP Protocol Type | E and F |

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| d. IP Protocol Field<br>e. TCP Port Number<br>f. UDP Port Number<br>g. Application ID<br>h. Congestion Avoidance | |
| 7. Which of the TCP connection-establishment flows sets both the SYN and ACK flags in<br>the TCP header?<br>a. First segment<br>b. Second segment<br>c. Third segment<br>d. Fourth segment<br>e. Fifth segment | B |
| 8. Which of the following is not a typical function of TCP?<br>a. Windowing<br>b. Error recovery<br>c. Multiplexing<br>d. Routing<br>e. Encryption<br>f. Ordered data transfer | D and E |
| 9. Which of the following functions is performed by TCP and UDP?<br>a. Windowing<br>b. Error recovery<br>c. Multiplexing<br>d. Routing<br>e. Encryption<br>f. Ordered data transfer | C |
| 10. Data that includes the Layer 4 protocol header, and data given to Layer 4 by the upper<br>layers, not including any headers and trailers from Layers 1 to 3, is called what?<br>a. Bits<br>b. Chunk<br>c. Segment<br>d. Packet<br>e. Frame<br>f. L5PDU<br>g. L4PDU<br>h. L3PDU<br>i. L2PDU | C and G |

**ESSAY**

**1.** Describe the features required for a protocol to be considered connectionless.
**Answer: Unordered low-overhead delivery of data from one host to another is the service**
**provided in most connectionless protocol services.**

**2.** Name at least three connectionless protocols.
**Answer: LLC Type 1, UDP, IPX, and IP are some examples of connectionless protocols. Remember, Frame Relay, X.25, and ATM are connection oriented, regardless of whether**
**they define error recovery.**

**3.** Describe the features required for a protocol to be considered connection oriented.
**Answer: Either the protocol must exchange messages with another device before data is allowed to be sent, or some pre-established correlation between the two endpoints must be defined. TCP is an example of a connection-oriented protocol that exchanges messages before data can be sent; Frame Relay is a connection-oriented protocol for which a pre-established correlation between endpoints is defined.**

**4.** In a particular error-recovering protocol, the sender sends three frames, labeled 2, 3, and 4. On its next sent frame, the receiver of these frames sets an Acknowledgment field to 4. What does this typically imply?
**Answer: Frames through number 3 were received successfully. The receiver might have not received Frame 4, or Frame 4 might not have passed the FCS check.**

**5.** Name three connection-oriented protocols.
**Answer: TCP, SPX, LLC Type 2, and X.25 are some examples of connection-oriented protocols that provide error recovery. ATM and Frame Relay are also connection oriented, but without error recovery.**

**6.** Describe how TCP performs error recovery. What role do the routers play?
**Answer: TCP numbers the first byte in each segment with a sequence number. The receiving host uses the Acknowledgment field in segments that it sends back to acknowledge receipt of the data. If the receiver sends an acknowledgment number that is a smaller number than the sender expected, the sender believes that the intervening bytes were lost, so the sender resends them. The router plays no role unless the TCP connection ends in the router—for example, a Telnet into a router. A full explanation is provided in the section "Error Recovery (Reliability)."**

**7.** How many TCP segments are exchanged to establish a TCP connection? How many are required to terminate a TCP connection?
**Answer: A three-way connection-establishment sequence is used, and a four-way connection-termination sequence is used.**

**8.** Describe the purpose of the Port Number field in a TCP header. Give one example.
**Answer: The port numbers are used to help computers multiplex received data. For instance, a PC with two web browsers open can receive an IP packet. The destination TCP port number identifies which of the two browsers should receive the data.**

**9.** List the components of a TCP socket.
**Answer: A socket consists of three things: an IP address, a transport layer protocol (TCP or UDP), and the TCP or UDP port number.**

**10.** How many TCP segments must be sent to establish a TCP connection? How many are used with normal TCP connection termination?
**Answer: Three TCP segments are needed to establish the connection, and four are needed to tear it down under normal operation.**

**11.** How many UDP segments must be sent to establish a UDP connection? How many are
used with normal UDP connection termination?
**Answer: UDP does not establish connections because it is not connection oriented.**