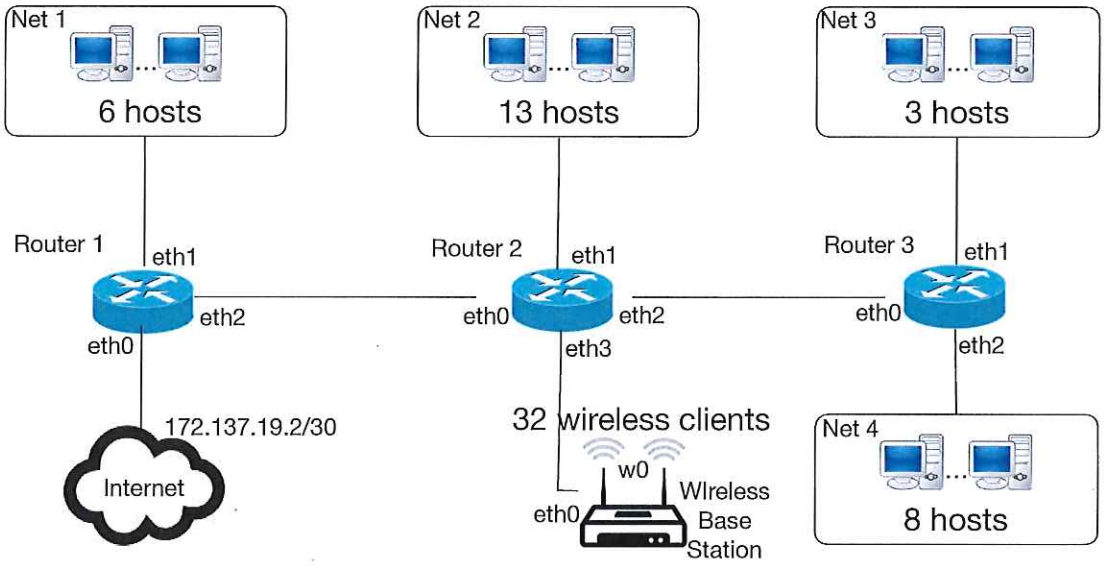
Computer Networks Comprehensive Examination Fall 2015

Read Carefully: Work each of the following problems without any reference material (closed books and closed notes). **Calculators are allowed**. Please **fully explain** your response, and address the questions asked. If additional space is needed please attach a blank page and add your name.

STUDENT ID: _____ DATE: _____

Question 1 (20 points) You were requested to design the IP address allocation for the network illustrated in the figure below. You are only allowed to use the following network address block: **10.10.10.0/24,** which was chosen to avoid conflicts with other networks. Each sub-network block contains the minimum number of hosts that needs to be supported, and all routers and interfaces are labeled.



With the information above, and considering the requirements identified below, please **allocate the appropriate network address and net masks** for each of the subnets (including the wireless sub-network), and also **identify the IP address and net mask assigned to each of the router interfaces.**

Sub-network	Network Address	Network Mask
NET 1		
NET 2		
NET 3		
NET 4		
Wireless Subnet		

Device	iface	Network Address	Network Mask
Router 1	eth0		
	eth1		
	eth2		
Router 2	eth0		
	eth1		
	eth2		
	eth3		
Router 3	eth0		
	eth1		
	eth2		
Base Station	eth0		
	w0		

Question 2 (20 points) Assuming the allocation proposed in Question 1, please provide the routing table for all routers. Make sure to describe all routes to all networks, and please use the table format illustrated below.

a) Routing table for Router 1:

Network Address	Net Mask	Next Hop IP or Interface Name	Metric

b) Routing table for Router 2:

Network Address	Net Mask	Next Hop IP or Interface Name	Metric

c) Routing table for Router 3:

Network Address	Net Mask	Next Hop IP or Interface Name	Metric

d) Wireless Base-Station:

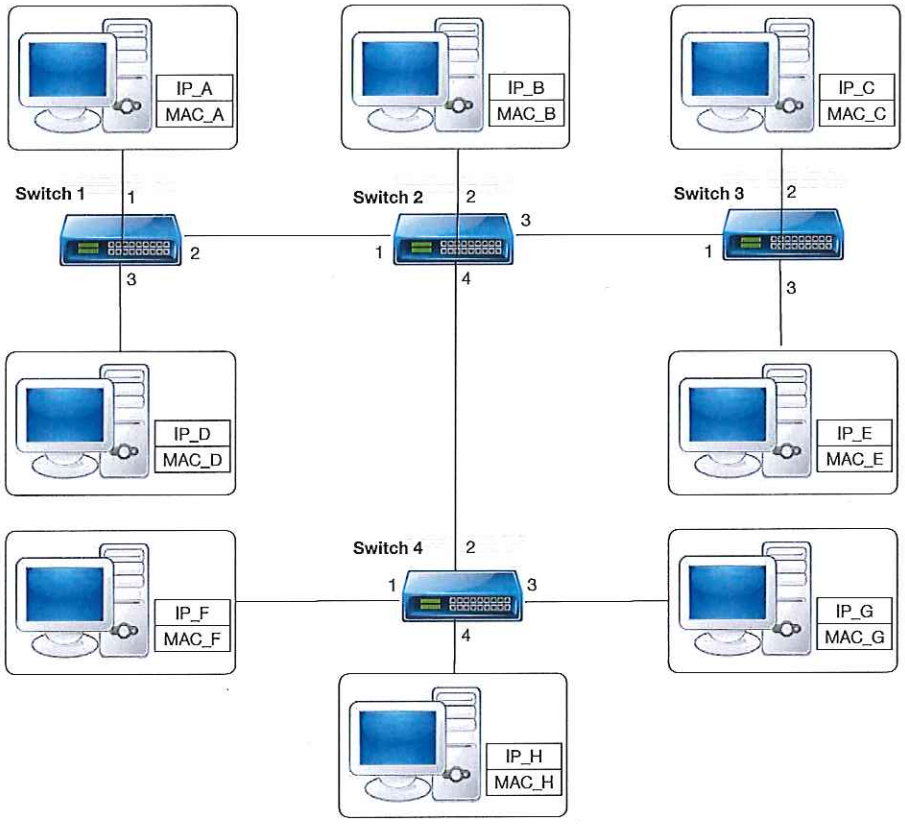
Network Address	Net Mask	Next Hop IP or Interface Name	Metric

Question 3 (20 points) Still assuming the network configuration described for question 1, let us consider that the bandwidth of all interfaces of all routers and computers are 10 Mbps. Let us also assume that the length of the links is too short to create any significant propagation delay or any data loss. Consider a store-and-forward model, that the MTU over all links is 1400 Bytes, and that a total of 98 bytes needs to be added to each transmitted packet (for headers and checksums). Under these assumptions, calculate how long would it take for a node in NET 4 to fully receive 210 MB of data transmitted by a node in NET 1.

Question 4 (10 points) Consider the OSI communications model, which layer implements the Address Resolution Protocol (ARP)? Also, explain what is the purpose of the protocol, and how it works.

Question 5 (10 points) A well-known protocol associated with the Medium Access Control in ad hoc wireless networks is the "hidden-node" problem. Briefly explain that issue suing a simple diagram, and describe how protocols like 802.11 handle the issue.

Question 6 (10 points) Consider the switched network topology shown in the figure. Please describe the state of the virtual circuit tables for all the 4 switches after all the sequence of connections described in the timetable below have started. Assume that the sequence of connections is cumulative; that is, the first connection is still up when the second connection is established, and so on. Also assume that the VCI assignment always picks the lowest unused VIC on each link, starting with 0, and that the VCI is consumed for both directions of a virtual circuit



Time t = 0: Node A starts transmitting to node E
Time t = 1: Node D starts transmitting to node G
Time t = 2: Node H starts transmitting to node D
Time t = 3: Node F starts transmitting to node C

VC Table for Switch 1:

IN	VC_IN	OUT	VC_OUT

VC Table for Switch 2:

IN	VC_IN	OUT	VC_OUT

VC Table for Switch 3:

IN	VC_IN	OUT	VC_OUT

VC Table for Switch 4:

IN	VC_IN	OUT	VC_OUT

Question 7 (10 points) Still considering the switched network described in question 6, let us know assume that an observer can capture all the traffic traversing the link between switched 2 and 4. In that case, and assuming the same sequence of connections described in Question 6, please list ALL unique IP and MAC addresses that the observer would have seen in his packet captures. Note that the MAC and IP addresses of each host are labeled in the figure as (IP_X, and MAC_X). Please assume the same notation for the MAC addresses of the switches (if necessary). For example, refer to the MAC address of interface 2 of switch 1 as: MAC_S1_2.

Binary	Hex	Quad Dec	2^n	CIDR	Number of addresses	
00000000000000000000000000000000	00000000	0.0.0.0	2^{32}	/0	4,294,967,296	4 G
10000000000000000000000000000000	80000000	128.0.0.0	2^{31}	/1	2,147,483,648	2 G
11000000000000000000000000000000	C0000000	192.0.0.0	2^{30}	/2	1,073,741,824	1 G
11100000000000000000000000000000	E0000000	224.0.0.0	2^{29}	/3	536,870,912	512 M
11110000000000000000000000000000	F0000000	240.0.0.0	2^{28}	/4	268,435,456	256 M
11111000000000000000000000000000	F8000000	248.0.0.0	2^{27}	/5	134,217,728	128 M
11111100000000000000000000000000	FC000000	252.0.0.0	2^{26}	/6	67,108,864	64 M
11111110000000000000000000000000	FE000000	254.0.0.0	2^{25}	/7	33,554,432	32 M
11111111000000000000000000000000	FF000000	255.0.0.0	2^{24}	/8	16,777,216	16 M
11111111100000000000000000000000	FF800000	255.128.0.0	2^{23}	/9	8,388,608	8 M
11111111110000000000000000000000	FFC00000	255.192.0.0	2^{22}	/10	4,194,304	4 M
11111111111000000000000000000000	FFE00000	255.224.0.0	2^{21}	/11	2,097,152	2 M
11111111111100000000000000000000	FFF00000	255.240.0.0	2^{20}	/12	1,048,576	1 M
11111111111110000000000000000000	FFF80000	255.248.0.0	2^{19}	/13	524,288	512 k
11111111111111000000000000000000	FFFC0000	255.252.0.0	2^{18}	/14	262,144	256 k
11111111111111100000000000000000	FFFE0000	255.254.0.0	2^{17}	/15	131,072	128 k
11111111111111110000000000000000	FFFF0000	255.255.0.0	2^{16}	/16	65,536	64 k
11111111111111111000000000000000	FFFF8000	255.255.128.0	2^{15}	/17	32,768	32 k
11111111111111111100000000000000	FFFFC000	255.255.192.0	2^{14}	/18	16,384	16 k
11111111111111111110000000000000	FFFFE000	255.255.224.0	2^{13}	/19	8,192	8 k
11111111111111111111000000000000	FFFFF000	255.255.240.0	2^{12}	/20	4,096	4 k
11111111111111111111100000000000	FFFFF800	255.255.248.0	2^{11}	/21	2,048	2 k
11111111111111111111110000000000	FFFFFC00	255.255.252.0	2^{10}	/22	1,024	1 k
11111111111111111111111000000000	FFFFFE00	255.255.254.0	2^{9}	/23	512	
11111111111111111111111100000000	FFFFFF00	255.255.255.0	2^{8}	/24	256	
11111111111111111111111110000000	FFFFFF80	255.255.255.128	2^{7}	/25	128	
11111111111111111111111111000000	FFFFFFC0	255.255.255.192	2^{6}	/26	64	
11111111111111111111111111100000	FFFFFFE0	255.255.255.224	2^{5}	/27	32	
11111111111111111111111111110000	FFFFFFF0	255.255.255.240	2^{4}	/28	16	
11111111111111111111111111111000	FFFFFFF8	255.255.255.248	2^{3}	/29	8	
11111111111111111111111111111100	FFFFFFFC	255.255.255.252	2^{2}	/30	4	
11111111111111111111111111111110	FFFFFFFE	255.255.255.254	2^{1}	/31	2	
11111111111111111111111111111111	FFFFFFFF	255.255.255.255	2^{0}	/32	1	