Florida Institute of Technology

Comprehensive Examination

Spring 2015

Computer Networks

Read Carefully: Resolve each of the following problems without any reference material (closed books and closed notes). **Calculators are allowed**. Please **fully explain** your response, and make sure to specifically address the questions asked. If additional space is needed please attach a blank page and add your student ID to it. There are 6 questions on this exam, please budget your time accordingly.

Student ID: _____

Date: _____

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Question 01 (10 points): Explain the difference between a reliable transport protocol (such as TCP) and an unreliable transport protocol (such as UDP). Also provide at least one application example for each case, and explain why each example requires a reliable/unreliable transport protocol.

Question 02 (15 points): Consider the following message (as a sequence of bits).

Message: 10010110101011001101

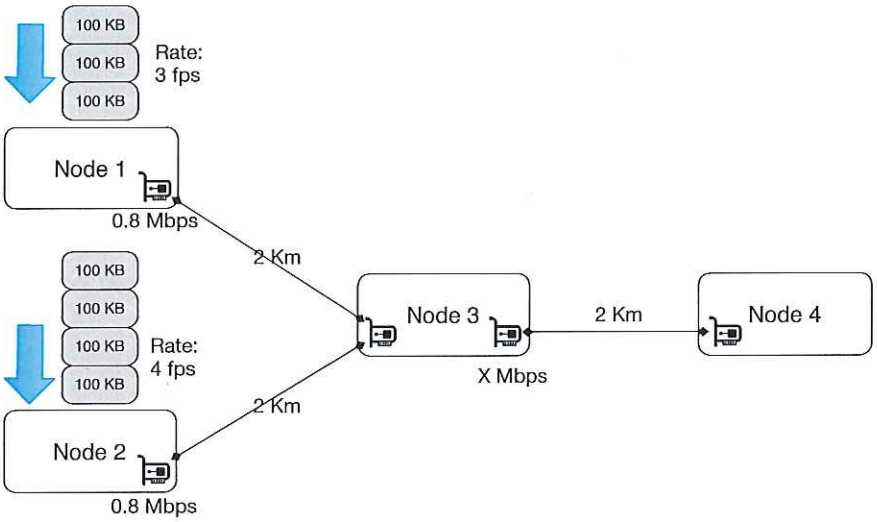
Assuming that both the transmitter and the receiver share the generator (1011) for CRC calculation, answer the following questions:

Generator: 1011

a. How long (in number of bits) is the full message that will be transmitted by the sender, once the CRC is appended.

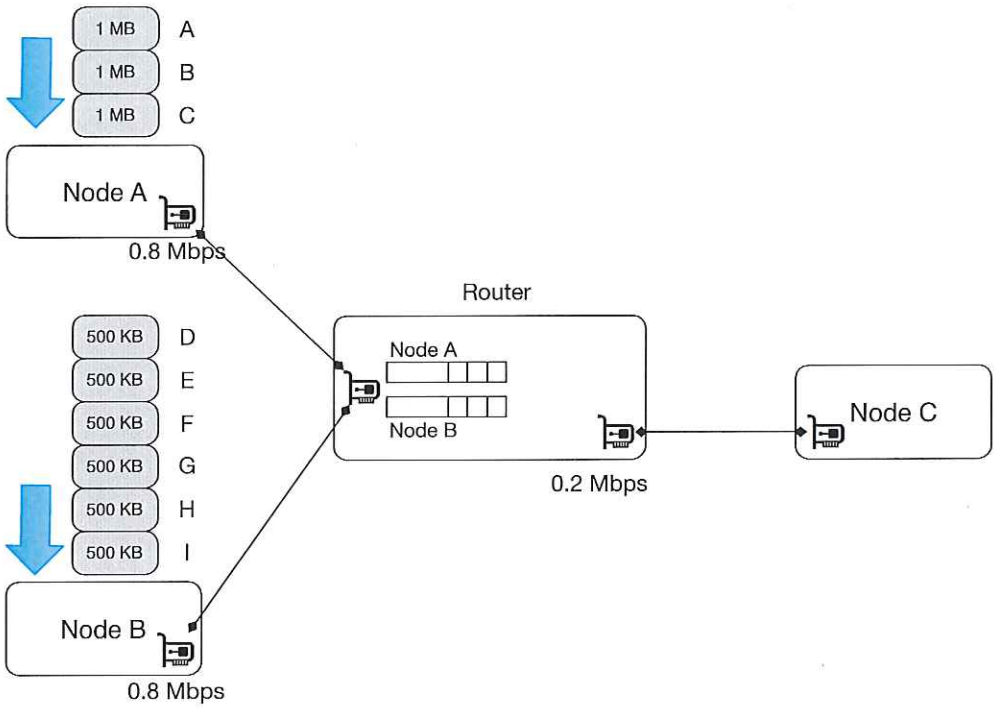
b. Calculate the CRC that will be used to transmit the message?

Question 03 (20 points): Consider the network illustrated in the figure below. Assume that each of the nodes in the network (i.e. nodes 1, 2, 3 and 4) has very high processing power, so the processing time for individual frames is negligible (i.e. processing delay is zero). Also consider that the link between all nodes is reliable and error-free, that is, there are no frame losses or frame corruptions on any of the links. The propagation speed in all links is $2 \cdot 10^8 m/s$, and the length of each link is shown in the figure.



Consider that at time t0 (zero) node 1 starts receiving 3 frames per second (fps) for transmission to node 4 (at a constant frame rate), and node 2 start receiving 4 frames per second (fps) for transmission to node 4 (at a constant frame rate). Given the bandwidth of the interfaces on nodes 1 and 2, calculate the required transmit bandwidth of node 3 (X Mbps) to maintain a constant queue length at node 3. Note that there are no bandwidth limitations on the receiving interface on node 3.

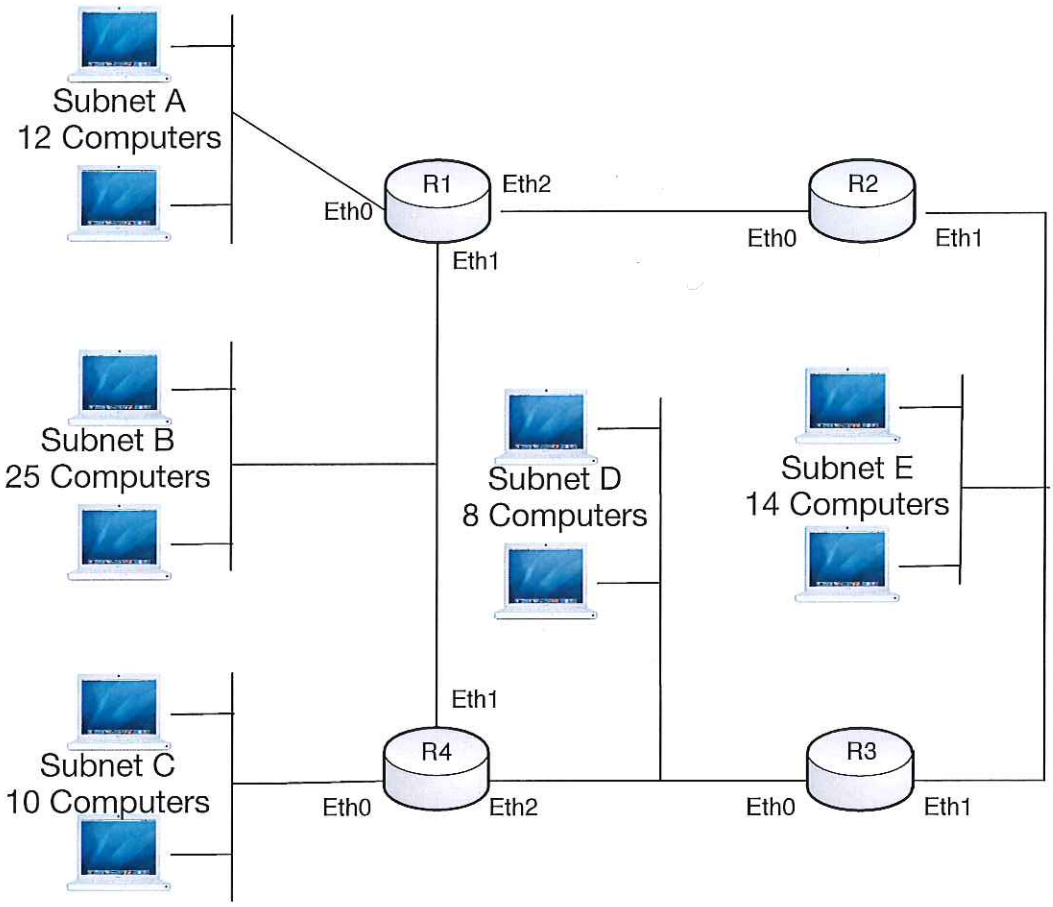
Question 04 (20 points): In the scenario below, each of the transmitting nodes (A and B) is sending a short sequence of data segments to node C. The router in the center of the network uses a priority queuing algorithm and maintains a separate queue for each of the connections. The propagation delay on all links is negligible and can be ignored. Assume that the receive bandwidth of all interfaces is unlimited – that is, nodes can receive data as fast as it is delivered to the receive interface. Note that each frame is labeled (A through I).



a) Please describe the **letter sequence** (i.e. A, B, C, …) in which frames will be received at node C, assuming that the router uses a **fair queuing scheduling** algorithm for packet delivery.

b) Please describe the **letter sequence** (i.e. A, B, C, …) in which frames will be received at node C, assuming that the router uses a **round-robin scheduling** algorithm for packet delivery.

Question 05 (15 points): You were given the responsibility to design the IP address allocation for the five subnets illustrated in the figure below. The number of hosts indicated in each subnet is the minimum number of Computes (or IP Addresses) required for the subnet (assume that each computer will use a single IP Address). You are only allowed to use the following network address block: **10.15.30.0/24,** which was chosen to avoid conflicts with other networks.



a) Allocate a compatible IP Address and a Netmask to each of the interfaces of the routers (as illustrated in the figure)

Node	IP Address	Netmask
R1 Eth0		
R1 Eth1		
R1 Eth2		
R2 Eth0		
R2 Eth1		
R3 Eth0		
R3 Eth1		
R4 Eth0		
R4 Eth1		
R4 Eth2		

Question 06 (20 points): The Domain Name Service (DNS) is a hierarchical naming system widely used on the Internet and most private networks. Based on your understanding on how the system works, briefly answer each of the following questions:

a) Explain how the domain name space is subdivided and organized into zones.

b) Explain how the address resolution mechanism works. Make sure to describe the role of root servers play in the process, and refer to your answer in (a).

c) Explain what are Authoritative and Non-Authoritative responses from DNS servers.

d) Explain what are reverse DNS lookups, and how they work.

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	