Mid-Semester Test

Instructor: B. Sainath, 2210A, Electrical and Electronics Eng. Dept., BITS Pilani.

Course No./Title : F372/F346/Data Communications and Networks DATE: 7th Oct. 2015

Test duration: 90 Mins.

Acronyms: LAN: local area network, BGP: border gateway protocol, PCM: pulse code modulation, DPCM: differential PCM, IPv4: Internet protocol version 4, CSMA/CD: carrier sense multiple access/collision detection, TCP: transmission control protocol, UDP: user datagram protocol.

Part-I: Multiple choice questions (8 points)

Note: Each question carries 1 point. Write the right answer in your answer book.

1. Which of the following is IEEE 802.11 standard?

A. Wireless LAN B. Ethernet C. Bluetooth D. ZigBee

2. Gateway protocol BGP-4 is a

A. MAC layer protocol B. Path-vector protocol C. Link-state protocol D. Load-sensitive protocol

3. In IPv4 classes, which class IPs are assigned for multicasting?

A. Class A B. Class D C. Class C D. Class B

4. The number of subnets and the number of hosts (of each subnet) that can be produced by subnet mask $255.255.255.224$ are, — and — , respectively.

A. 6, 30 B. 12, 12 C. 2, 62 D. 30, 6

5. Consider an IPv4 subnet with private IP address space 168.111.8.0/23. Total number of IP addresses in this subnet is

A. 256 B. 512 C. 1024 D. 128

6. Consider a SLOTTED ALOHA system. Let a node transmit a frame with probability p. When there are 100 active nodes, the value of p that maximizes the efficiency is

A. 0.1 B. 0.01 C. 0.001 D. 1

7. Consider a pure ALOHA system. If a node is transmits at a rate of 10 Mbps, the effective transmission rate of the system is

A. 1.84 Mbps B. 18.4 Mbps C. 0.184 Mbps D. 0.368 Mbps

8. Match the following:

(i). UDP	A. PHY layer device
(ii). Switch	B. Transport layer
(iii). Router	C. Link layer
(iv). Hub	D. IP layer

Part-II: True or False (2 points)

Note: Each question carries $\frac{1}{2}$ point. Just indicate 'T/F' ('T' for True statement; 'F' for false statement.).

1) Bellman-ford routing algorithm is a centralized and synchronous algorithm.
2) In sliding window protocol, it is possible to completely utilize a link, provided the window size is large enough.
3) TCP is a connection-oriented transport layer service.
4) Delta modulation is nothing but 1-bit DPCM.

Part III: Solve the following.

1. [ALOHA and SLOTTED ALOHA] Consider a radio communication system that uses 10.8 Kbps channel for sending call establishment request messages to a base station. Suppose that each frame is 180 bits long. Compute the following:

a). Frame transmission rate. [1 point]

b). Maximum throughput (in integer number of frames) when ALOHA protocol is used. [1 point]

c). Maximum throughput (in integer number of frames) when slotted ALOHA protocol is used. [1 point]

2. [End-to-end delivery time]

Consider a packet switching network. We need to transfer a 10 KB file from source node **A** to destination node **D** via intermediate nodes **B** and **C**. Neglecting header, each packet has a length of 1 KB. Each of the links is a 10 KM optical fiber with a transmission rate of 10 Mbps. The two intermediate nodes **B** and **C** are store-and-forward devices, and each intermediate node takes processing time of 100 μS. Assuming negligible queuing delay, and speed of light in optical fiber as 2.5×10^8 m/s, compute the following:

a). End-to-end propagation delay. [1 point]

b). Time to send the first packet to destination node **D**. [1 point]

c). Time to send the entire file to the destination node **D**. [2 points]

3. [Ethernet efficiency]

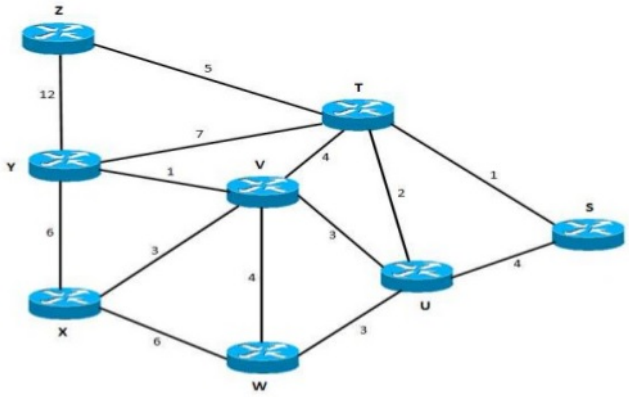
Consider 10 Mbps Ethernet configuration with one hub. Assume the following: propagation delay between communicating end systems is always 20 μS and there are many pairs of end systems trying to communicate using CSMA/CD.

a). Find approximate efficiency of Ethernet for 1 KB packets (including overhead). [2 points]

b). Find the minimum frame size such that Ethernet is more efficient than SLOTTED ALOHA if the fixed frame size is larger than this minimum value. [2 points]

4. [Dijkstra's algorithm]

With the indicated link costs, use Dijkstra's algorithm to compute the shortest path from **S** to all network nodes. Show the functioning of the algorithm by computing a table similar to the one showed in class. (Note: This table shows for each iteration of the algorithm, the current set of nodes whose shortest routes have been found, plus the current cost and previous hop for each destination.) [7 points]



Compute the least-cost and the least-cost path from the node **W** to the node **Z** using Bellman-ford equation [2 points].

ALL THE BEST

STEP	$\mathcal{S}$	d(T), p(T)	d(U), p(U)	d(V), p(V)	d(W), p(W)	d(X), p(X)	d(Y), p(Y)	d(Z), p(Z)
0	{S}	1, S	4, S	∞	∞	∞	∞	∞
1	{S,T}		3, T	5, T	∞	∞	8, T	6, T
2	{S,T,U}			5, T	6, U	∞	8, T	6, T
3	{S,T,U,V}				6, U	8, V	6, V	6, T
4	{S,T,U,V,Y}				6, U	8, V		6, T
5	{S,T,U,V,Y,Z}				6, U	8, V		
6	{S,T,U,V,Y,Z,W}					8, V		
7	{S,T,U,V,Y,Z,W,X}							

Answers

Part I

1. A 2. B 3. B 4. A 5. B 6. B 7. A 8. $(i) \rightarrow B$, $(ii) \rightarrow C$, $(iii) \rightarrow D$, $(iv) \rightarrow A$

Part II

1. F 2. T 3. T 4. T

Part III

1. a). Frame transmission rate = 60 frames/sec.

b). Max. throughput of ALOHA = 11 frames.

c). Max. throughput of SLOTTED ALOHA = 22 frames.

2. All packets are transmitted through 3 links and 2 intermediate nodes.

a). End-to-end propagation delay = $\frac{(10+10+10)\times 1000}{2.5\times 10^8}$ = 120 μS.

b). Each link propagation delay τ_{prop} = 40 μS = 0.04 ms.

Packet transmission time τ_{trans} (for each hop) = 0.8 mS.

(Intermediate-) Node processing delay τ_{proc} = 0.1 mS.

Assume that the source node **A** starts transmission at time 0. The time at which **B** receives and finishes processing the first packet $\tau_{\text{pkt1}} = \tau_{\text{prop}} + \tau_{\text{trans}} + \tau_{\text{proc}} = 0.94$ ms.

The time at which **C** receives and finishes processing the first packet = $2\tau_{\text{pkt1}}$.

Since no processing is needed at the destination, the time at which the destination node **D** receives the first packet $\tau_F = 2\tau_{\text{pkt1}} + \tau_{\text{prop}} + \tau_{\text{trans}} = 2.72$ ms.

c). The time at which the destination node **D** receives all 10 packets = $\tau_F + 9\tau_{\text{trans}} = 9.92\ mS$.

3. a). Ethernet efficiency = 88.9.

b). Ethernet frame size $\geq$ 583 bits.

4. a). Refer to the table shown.

b). Neighbors of **W**: **U**, **V**, **X**.

Easy to see that:

$d_{\mathbf{U}}(\mathbf{Z}) = \mathbf{7}$, $d_{\mathbf{V}}(\mathbf{Z}) = \mathbf{9}$, $d_{\mathbf{X}}(\mathbf{Z}) = \mathbf{12}$. Using,

$$d_{\mathbf{x}}(\mathbf{y}) = \min_{\mathbf{v}}\{\mathbf{c}(\mathbf{x},\mathbf{v}) + \mathbf{d}_{\mathbf{v}}(\mathbf{y})\},$$

we see that, the least cost is 10 and the least cost path is $\mathbf{W} \rightarrow \mathbf{U} \rightarrow \mathbf{T} \rightarrow \mathbf{Z}$.