DA-IICT **Dhirubhai Ambani Institute of Information & Communication Technology**

Final Examination, Semester I 2017-18

Course Title	IT304 Computer Networks	**PART-B**	**Max Marks**	30%
Date	30 November 2017	**CLOSED BOOK**	**Time**	2 Hours

All questions carry 5 marks each.

[MODEL SOLUTIONS]

1. A TCP sender is transmitting data to a receiver. The initial congestion window size is 2KB and the threshold is 16KB. Maximum segment size is 64KB. The first 4 RTT value measured by the sender are (in milliseconds) [400, 300, 900, 100].
    a. What is the congestion window size after the 4 successive ACKs are received?
    b. Assuming the smoothing parameter (weight given to old value) $\alpha = 0.9$, what is the estimated RTT for the next packet sent?
    c. What is the value of the Timeout Timer?

    a. After 3 ACKs, the window size is 16KB. After the 4th ACK, it increases linearly to **18KB**. (1 mark)
    b. $\langle RTT\rangle_{new} = (1-\alpha)\,\langle RTT\rangle old + \alpha\, RTT$
    After 1st RTT, estimate is 400. After 2nd RTT estimate is 400*.9 + 300*.1 = 390. After 3rd RTT, estimate is 390*.9 + 900*.1 = 441. After 4th RTT, estimate is 441*.9 + 100*.1 = **407** ms. (2 marks)
    c. $RTO = \langle RTT\rangle + 4D$
    $D_{new} = \beta\langle D_{old}\rangle + (1-\beta)\,|RTT - \langle RTT\rangle|$
    After 1st ACK, D=0. After 2nd ACK, D is 0 + (390-300)*.8 = 72. After 3rd ACK, D is 72*.2 + (900-441)*.8 = 381.6. After 4th ACK, D is 381.6*.2+ (407-100)*.8 = 321.9 ms. **RTO** = 407 + 4*321.9 = **1695** ms. [marks are given if a value of β other than .2 is used.] (2 marks)

2. An organization has some 500 nodes in its network divided into 3 segments. This can be done by sub-netting one class B address block. Using specific addresses explain the subnetting mechanism. How does routing between subnets take place?

    Class B IP address: Range 128-191 (0.5 marks deducted if it is not in range)

    1: For 3 subnets minimum 3 bits are required (all 0's and all 1's are reserved so 2 bits are not enough. However, no deduction if using 2 bits only)
    16 + (3 or 2) i.e. 18 or 19 are for network id

    2: For 500 subnets minimum 3 bits are required (2^9) (23 bits are for network id and 9 bits are for host id). If division of 500 host for subnet is considered, (200,200,100) then 8 bits are for host id and 24 bits are for network id.

    Worked out example to be given.

    Explanation of network bits and host bits are required. - **2 marks.** 3 subnet address should be written - **1 mark.** Subnet mask should be written - **1 mark.** Routing: given Ip address should be masked(Logical AND) with subnet mask. This will give subnet id. Packet should be transferred to that subnet id's interface – **1 mark**

3. Using clear examples, briefly explain how DHCP, NAT, and CIDR help in more efficient use of the Internet address space.

DHCP: DHCP dynamically allocates a IP address from a pool of available addresses. For this purpose request is made by the client machine. DHCP server leases the IP address for a given time. Client has to make new request, once lease time is out.
If all users are not loggef at same time, a smaller pool can be used to give address to a large group of users. [*some suitable example*]

NAT: It is used for address translation. Intranet (local) address to internet (global) address. *[With necessary diagram, table structure and example.]* NAT table is looked up to transmit the respective packet back to client. Local IP address can be used (with only one internet IP address) to allow outward connection to client. Different organizations may use same pool of private network IP addresses.

CIDR: Classless inter domain outing. Save addresses space by assigning e.g. a group of class C address instead of a class B address without having multiple entries in the routing table. Address: net ID = host ID, prefix length for net ID. e.g. IP: 128.1.2.3/24, 128.1.2.0 is the net ID
Routing is done based on the both IP and the prefix. *[With appropriate example]*

4. Explain how tunneling is used to allow incremental deployment of IPv6 and co-existence of IPv4 and IPv6?

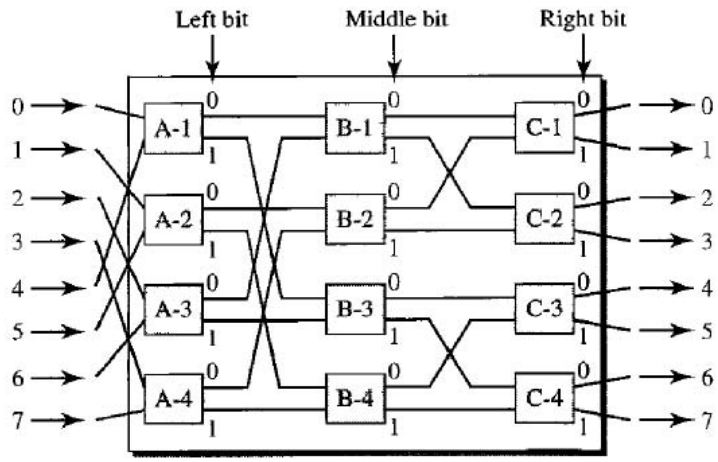
A packet of one protocol, when encapsulated as payload of a packet of a different protocol, is said to be tunneled.

Tunneling is used to connect IPv6 islands (group of connected IPv6 routers) through the intermediate IPv4 routers. Each IPv6 island has a 4-6 gateway router. As a packet reaches a gateway router, it is encapsulated in a IPv4 packet and sent to the destination gateway IPv6 router where the original packet is extracted and delivered to the destination. 4-6 routers participate in both IPv4 and IPv6 routing protocols and maintain two separate routing tables. This mechanism allows for incremental deployment of IPv6 routers.

5. What are switching element and switching fabric? Draw the schematic of an 8x8 Banyan switch. Using an example, show that Banyan design leads to internal blocking?

Switching element: 2x2 block responsible for the transport of data across a network.
Switching Fabrics : It is interconnection of links and switching elements.
Routing rule: if 0, send packet to upper output, else to lower Output and If both packets to same output, buffer or drop.

Banyan Switch :
A banyan switch is a multistage switch with switching elements at each stage that route the packets based on the output port represented as binary string. For n inputs and n outputs, we have $\log_2(n)$ stages with n/2 microswitches at each stage. The first stage routes the packet based on the high order bit of the binary string. The second stage routes the packet based on the second high order bit, and so on in below figure.



Internal blocking: Because of the design of banyan switch there is possibility of internal collision due to the shared paths leading to different output ports. E.g. pkts for output ports 6 and 7 at input ports 2 and 3 respectively will block internally.

6. In the context of IEEE 802.3 (Ethernet) LAN protocol, answer the following:
   a. Derive an expression for the maximum length L_{max} of a LAN as a function of relevant LAN parameters (e.g. link capacity C, min packet size P_{min}, max packet size $P_{max,}$ propagation speed V etc.)
   b. Explain the need of exponential back-off mechanism in 1-presistent CSMA/CD.

IEEE 802.3 protocol specifies that the collision should be detected while the data frame is still being transmitted. In the worst case (when the two transmitting nodes are at the opposite end of the LAN), the time lag between the onset of transmission and detection of collision is equal to the RTT (round trip time). The time to transmit a packet on the link is equal to P_{min}/C.
Hence $P_{min}/C > RTT = 2L_{max}/V$. This gives $L_{max} = (V*P_{min})/2*C$.

If the number of active nodes N is known then optimal p=1/N. However, it is assumed that N is not known and that it changes rapidly as a function of time. Hence, to keep the latency low, an aggressive 1-persistent mechanism is used. Further, to minimize the number of contention slots before success, a backoff doubling (exponential backoff, analogous to binary search mechanism) is used.