City University of Hong Kong
Department of Electronic Engineering

EE3009 Data Communications & Networking

Solution to Test 1

1. 50 Mbps/5 Mbps = 10.

2. a. $\binom{8}{2}(0.4)^2(0.6)^6 = 0.2090$

   When two users are transmitting, required bandwidth is 20 Mbps. So, 2/5 of link capacity is used.

   b. probability that the total required bandwidth exceeds the link capacity: $\binom{8}{6}(0.4)^6(0.6)^2 + \binom{8}{7}(0.4)^7(0.6) + \binom{8}{8}(0.4)^8 = 0.04980$

   Therefore, the probability that the link capacity is sufficient to serve the total bandwidth required by users =1-0.04980 = 0.9502.

3. DSL over telephone line: home
   Cable network: home
   1 Gbps switched Ethernet: enterprise
   4G: wide-area wireless.

4. Yes, both segments will be directed to the same socket. For each received segment, at the socket interface, the operating system will provide the process with the IP addresses to determine the origins of the individual segments.

5. It means that UDP segments may be lost or delivered out of order.

6. For one link:
   propagation time = $\frac{2500\times10^3}{2.5\times10^8}$ = 0.01
   Transmission time = $\frac{2000\times8}{2\times10^6}$ = 8×10^{-3}
   Total time = 0.018 s.

   Since there are two identical links, total time between transmitter and receiver = 0.036s.

7. 100 kbps

8. Express the host address 150.32.64.34 and subnet mask in binary form:
   10010110 00100000 01000000 00100010
   11111111 11111111 11110000 00000000

   With the AND operation, subnet address is:
   10010110 00100000 01000000 00000000 => 150.32.64.0

   The first host address is:
   10010110 00100000 01000000 00000001 => 150.32.64.1

   The last host address is:
   10010110 00100000 01001111 11111110 => 150.32.79.254

9.
   128.56.24.0/24 = 10000000.00111000.00011000.00000000
   128.56.25.0/24 = 10000000.00111000.00011001.00000000
   128.56.26.0/24 = 10000000.00111000.00011010.00000000
   128.56.27.0/24 = 10000000.00111000.00011011.00000000
   Mask = 11111111.11111111.11111100.00000000
   The resulting prefix is 128.56.24.0/22

10. Given:
   IP packet = 1600 data bytes, with 20 bytes of header and 1580 of payload
   MTU = 500 bytes
   IP header = 20 header bytes
   Maximum possible data length per fragment = MTU – IP header = 500 – 20 = 480 bytes.
   The data length of each fragment must be a multiple of eight bytes; since 480 is a multiple of 8, the number of data bytes that can be carried per fragment is 480.

   The data packet must be divided into 4 frames, as shown by the following calculations:

   480 + 480 + 480 + 140 = 1580
   20 + 20 + 20 + 20
   500 500 500 160

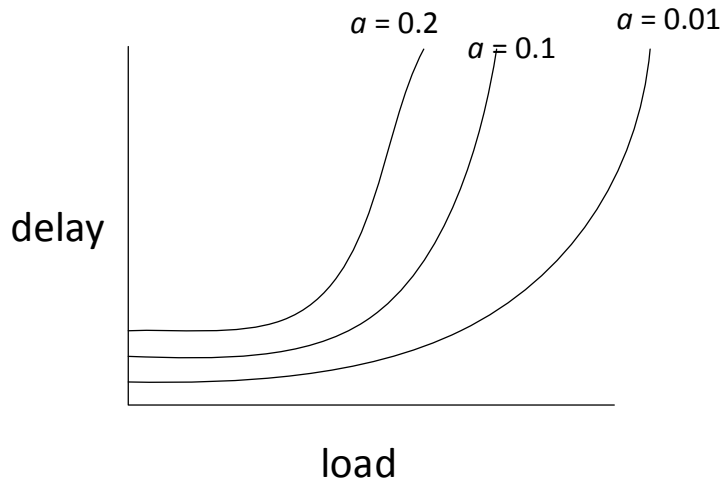
   The sequence of frames and packet headers is shown below:

	Total length	Id	Mf	Fragment Offset
Original Packet	1600	291	0	0
Fragment 1	500	291	1	0
Fragment 2	500	291	1	60
Fragment 3	500	291	1	120
Fragment 4	160	291	0	180

11. IPv6, DHCP and NAT

12. In a single network, when a source host wants to send a packet to another host in the same network but only knows the IP address of the destination host, it can use Address Resolution Protocol to map the IP address to the MAC address of the destination host.

13.



14. Infrastructure mode, ad hoc mode.