LUND INSTITUTE OF TECHNOLOGY
Department of Electrical and Information Technology
Exam in Data Communication
Date: 2008-10-22
Room: Victoriastadion
Time: 08.00-13.00

- All solutions should be properly written and justified.
- All calculations have to be shown.

---

1. a) Describe how encapsulation is involved when a message should be delivered through **all** the levels in the OSI-model.

   b) Give the name of the layer and an example of a functionality for the OSI models layers 2 and 6.

   c) Show router W's routing table after processing the distance vector update from router X.

Net	Hops	Router
A	5	X
D	4	Y
E	2	X
F	3	Y
H	4	Z

Router W table

Net	Hops	Router
A	3	Z
B	4	X
E	2	Z
F	1	Y
G	4	Z
H	4	Y

Update from router X

   d) Explain the functionality of binary PSK.

   e) How does *half duplex* work?

   f) Draw a generic figure of the bandwidth division on a subscriber line with ADSL.

2. a) Describe the relation between virtual path and virtual connection in ATM.

   b) How is the problem with hidden stations solved in IEEE 802.11?

   c) Data is to be transferred over two links. For the first link, the following is known: $R_1 = 20$ Mbps, $L_1 = 1500$ b, $d_1 = 20$ km and for the second link $L_2 = 1000$ b, $d_2 = 20$ km. Both links use Stop-and-Wait for flow control. R_2 is the data rate in the second link. Would it be possible to set R_2 so that it gives the same throughput on both links? If so, what should R_2 be set to? If not, show by calculations why it is so.

   d) Describe the underlined fields in the IP packet below thoroughly.

VER	HLEN	**Service**	Total length	
Identification			Flags	Fragmentation Offset
TTL		**Protocol**	Header checksum	
Source IP address				
Destination IP address				

3. a) Draw a figure showing the OSI layers involved in a communication between two end stations (A,B). A is connected to a IEEE 802.3 network (X) which is connected to a IEEE 802.4 network (Y). B is connected to a WAN (Z). Finally, Y and Z are connected.
   b) IPv6 has several advantages over IPv4. Give example of at least two.
   c) Is it possible for a terminal on a network to have more than one IP address?
   d) ALOHA
      i) How does it work?
      ii) What is the difference between *pure* and *slotted*?
      iii) How does this effect the vulnerable periods?
      iv) Which has the highest theoretical throughput? Why?
   e) Explain the difference between *open-loop* and *closed-loop* congestion control.

4. a) Determine whether the following statements are true or false. Each correct answer gives 0.5 points, each wrong answer -0.75 points and unanswered statement 0 points. (The total score of the question cannot be less than zero)
      i) The bandwidth-delay product defines the number of bits that can fill the link.
      ii) Switching in the Internet is done by using the datagram approach to packet switching at the network layer.
      iii) A simple parity-check code can detect an odd number of errors.
      iv) In Selective Repeat ARQ, the size of the sender and receiver window must be at most one-half of 2^n (n=number of bits in the sequence/ack field)
      v) The SCTP and UDP protocols are found on the same level in the OSI model.
      vi) In a Bluetooth scatternet at most 8 stations could be active.
      vii) A choke packet is sent to the sender to inform that the temporary smaller window size not longer is valid (i.e., it could start sending at full rate again).
      viii) An IPv6 address has four times more addresses than an IPv4 address.
      ix) An ARP request is broadcast, and ARP reply is unicast.
      x) A packet filter firewall operates on the network and transport layer.
   b) What is the difference between hard and soft handover in cellular systems?
   c) Assume that the primary HDLC station has sent 6 I-frames to a secondary. The primary's N(S) count was four (100 binary) prior to sending the six frames. If the poll bit is set in the sixth frame, what will be the value of N(R) back from the secondary after the last frame?
   d) Suppose that we use a coaxial cable to transmit information. Why could we only have 75 9.6 kbps channels in the same frequency spectra as we could have 8 100 kbps channels?
   e) What does a port number indicate in a TCP segment?

5. a) What is the difference between the purposes of the destination fields in an IP packet header and an Ethernet frame header?

   b) What would be the CIDR ($\backslash n$) notation for a classful C address?

   c) Describe how a peer-to-peer TCP connection is set up.

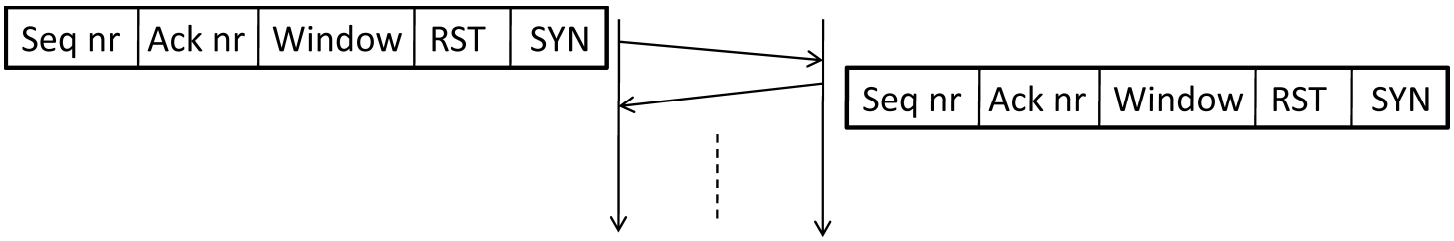
   d) An IP packet (ID=343) of 950 bits should be sent over a network with layer 2 MTU of 512 bits (inclusive a 48 bits header). Illustrate how this will be transferred using the parameters: ID, length, offset and "more"-flag.

   e) For CSMA/CD networks there exist a minimum frame size. What size is this and why is this limitation necessary?

6. a) What is the main pupose of the NAT?

   b) Fill in the time diagram for a TCP connection according to the schedule of events. It is assumed that the transfer time from A/B and B/A is 1 time unit, and that both hosts has a original window and buffer size of 200 bits. For each segment show the values in the sequence number, acknowledgement number, window, RST and SYN fields.

   time 0 A would like to send 80 bits data to B
   time 2 B receives data from A
   time 4 A would like to send 40 bits data to B
   time 6 B receives data from A and reads 40 bits
   time 8 A would like to send 300 bits data to B
   time 10 B receives data from A and reads 60 bits
   time 12 B reads 100 bits



   c) A station on a bus configuration should send a file, of size $8 \cdot 10^6$ bits (at the datalink layer), to another station connected to the same network, with a data rate of 1 Mbps and propagation speed 2/3 c. Each frame is 256 bits (inclusive 80 bits header). An acknowledgement is 88 bits and the Stop-and-Wait ARQ is applied. The stations is 2 km apart and no other communication is active. What would be the

      i) total time for the communication?
      ii) effective throughput?
      iii) utilization of the network?

d) Assume that the White army is trapped in a valley. On both sides of the valley is the Blue army. The White army is larger than any of the Blue armies, but together the Blue army is larger than the White army. If only one of the Blue armies attack it will be defeated, however if both armies attack at the same time they will be victorious, hence the Blue armies would like to attack at the same time. The only way to communicate is to send a messenger through the valley. The White army may capture the messenger. Explain a protocol that for certain will give the victory to the Blue armies.

Have a nice autumn!!