1 OSI Concept / Reference Model

1. What do the following terms, used in the OSI reference model, stand for?
   layers, service, interface, protocol
2. What are the most significant advantages of the separation of service, interface, and protocol?
3. What are the drawbacks of the OSI Model?
4. What does the horizontal aspect mean in OSI reference model?
5. What does the vertical aspect mean in OSI reference model?
6. Explain with the help of diagram the relationship between a service and a protocol.

2 Nesting

1. What do the abbreviations SDU, PDU and PCI stand for?
2. Explain nesting of data units.
3. A system has an n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h-byte header is added. What fraction of the network bandwidth is filled with headers? In an additional step, reformulate the equation in a way that it can be applied to the case of non-equal header sizes?
4. Given a sequence of 750 Bytes seen on the wire. Assume that the following protocols have been used: IP (20 Bytes header), Ethernet (14 Bytes header), UDP (8 Bytes header) and no overhead is generated in the physical layer. Any frame check sequence can be ignored. Complete the following table. Finally, what fraction of bandwidth is wasted on headers?

l	*layer*	$size\ of...\ (bytes)$		
		$(l) - PCI$	$(l) - SDU$	$(l) - PDU$
4	Transport			
3	Network			
2	Data Link			
1	Physical			

3 Layers

1. Consider below task descriptions each standing for a layer of the OSI model. Bring these in order (use numbers 1-7), start with the one closest to the transmision media.

   - synchronization, e.g. after lost connection
   - coding, modulation, and physical transmission
   - addressing and routing
   - application related services, e.g. email transfer
   - machine independent representation, e.g. UTF
   - per-hop data transfer, medium access control
   - end-to-end connection between hosts

2. Consider the 7 items above and the terms below. Chose the best-describing term for each one of the 7 items.

   data link, application, physical, session, transport, presentation, network

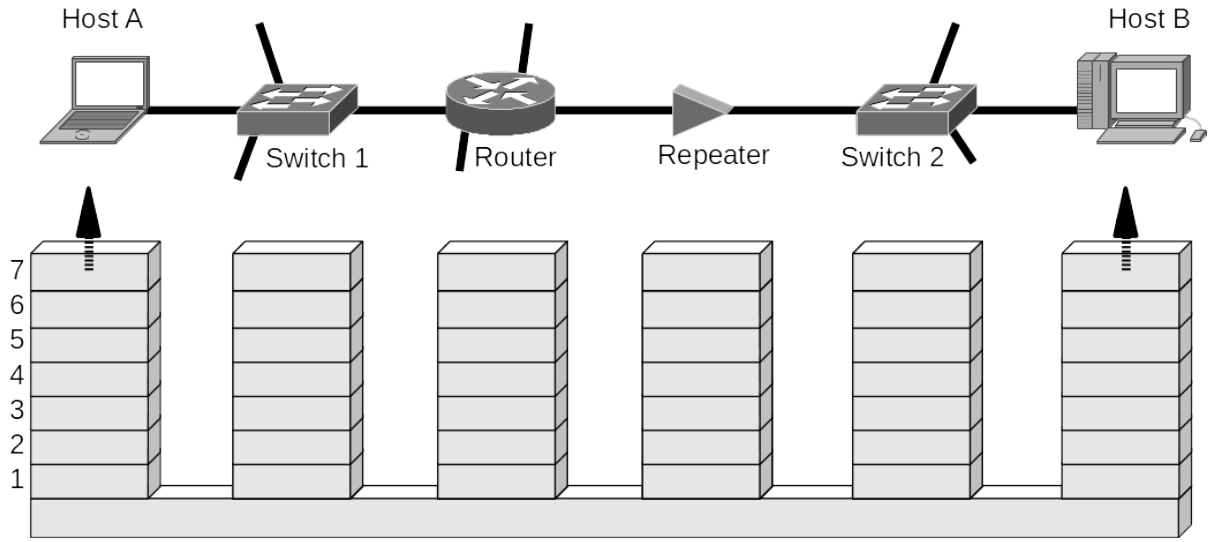
   Compare your solution with the OSI reference model.

3. What layer are these protocols associated with?

   - HTTP - Hypertext Transfer Protocol
   - IP - Internet Protocol (used for addressing and routing in the Internet)
   - SMTP - Simple Mail Transfer Protocol
   - UDP - User Datagram Protocol (connectionless end-to-end data transfer)
   - Ethernet

4 Intermediate Systems

1. The hosts A and B are physically interconnected over below network consisting of a router, switches, and a repeater. Below illustration shows for each of the involved devices and the 2 hosts, an empty protocol stack and below the channel of the transmission system. Sketch the physical communication path between hosts A and B for layer 7 messages and remove, i.e., strike through, the unused layers.



2. Which of the intermediate systems components such as routers, switches, repeaters, gateways can provide end-to-end flow control?

3. Which of the intermediate systems components such as routers, switches, repeaters, gateways can use automatic repeat request (ARQ) for retransmission of erroneous or lost data frames?