1. Why do HTTP, SMTP, and POP3 run on top of TCP rather than on UDP? Which transport protocol does DASH run over and why?

   When HTTP, SMTP, and POP3 protocols on top of TCP, it will require all application data received in the correct order and without gaps. However, when they run on top of UDP will not require all application data received in the correct order and without gaps.

   DASH does run over HTTP or Hypertext Transfer Protocol because DASH enables high quality delivery of streaming service over the internet for example it allows for a video stream to switch between bit rates on the basis of network.

2. Suppose Alice, with a Web-based e-mail account (such as Hotmail or Gmail) sends a message to Bob, who accesses his mail from his mail server using POP3. Discuss how the message gets from Alice's host to Bob's host. Be sure to list the series of application-layer protocols that are used to move the message between the two hosts.

   Firstly, the message will be sent to Alice's host to her mail server via HTTP. Secondly, the message will be sent to Bob's mail server via SMTP. Thirdly, the message will be transfer to Bob's mail server to Bob's host via POP3.

3. Answer the following questions about BitTorrent and overlay networks:
   a. In BitTorrent, suppose Alice provides chunks to Bob throughout a 30-second interval. Will Bob necessarily return the favor and provide chunks to Alice in this same interval? Why or why not?

      It will be not necessary that Bob will return the favor and provide chunks to Alice in this same interval as Alice has to be one of the top 4 neighbors of Bob for Bob to send out chunks to her and it is not definitely that Alice must be one of them.

   b. Consider a new peer Alice that joins BitTorrent without possessing any chunks. Without any chunks, she cannot become a top-four uploader for any of the other peers, since she has nothing to upload. How then will Alice get her first chunk?

      Alice will be selected by optimistic unchoking ie, a peer to peer file sharing method that allows a peer will allocate an upload slot to a randomly chosen uncooperative peer.

   c. What is an overlay network? Does it include routers? What are the edges in the overlay network?

      It is a computer network that is built on top of another network. In the context of data sharing, it is a P2P network with logical links (edges) among networks of nodes. It does not include routers. The edges are the logical connections between peers.

4. Obtain the HTTP/1.1 specification (RFC 2616). Answer the following questions:
   a. Explain the mechanism used for signaling between the client and server to indicate that a persistent connection is being closed. Can the client, the server, or both signal the close of a connection?

      After a certain period of idle times, the persistent connection will close. Yes, if there aren't any data transfer, the client, the server, or both can signal the close of a connection.

   b. What encryption services are provided by HTTP?

      HTTP does not provide encryption services itself.

   c. Can a client open three or more simultaneous connections with a given server?

      Yes, a client can open three or more simultaneous connections with a given server

   d. Either a server or a client may close a transport connection between them if either one detects the connection has been idle for some time. Is it possible that one side starts closing a connection while the other side is transmitting data via this connection? Explain.

      Yes, it is possible. Because in order to establish connection, one must agree to send and one must agree to receive. According to the given context, it is possible that one does not agree to receive and such will result in a closing of the connection.

5. Consider distributing a file of F = 15 Gbits to N peers. The server has an upload rate of u_s = 30 Mbps, and each peer has a download rate of d_i = 2 Mbps and an upload rate of u. For N = 10, 100, and 1000 and u = 300 Kbps, 700 Kbps, and 2 Mbps, prepare a chart (similar to the following charts) giving the minimum distribution time for each of the combinations of N and u for both client-server distribution and peer-to-peer distribution. Be sure to justify your answers.

   F = 15 Gbits = 15 * 1024 Mbits, u_s = 30 Mbps, d_i = 2 Mbps, 300Kbps = 300/1024 Mbps.
   Client Server: min distribution time for client-server distribution $D_{cs}=\max\{NF/u_s , F/d_i\}$

			N	
		10	100	1000
	300 Kbps	7680	51200	51200
u	700 Kbps	7680	51200	51200
	2Mbps	7680	51200	51200

   P2P: min distribution time for P2P distribution $D_{P2P}=\max\{F/u , F/d_{min}, NF/(u+\sum u)\}$

			N	
		10	100	1000
	300 Kbps	7680	25904	47559
u	700 Kbps	7680	15616	21525
	2Mbps	7680	7680	7680

   Please check for conceptual picture and formula if needed from lecture slides: 2-75&2-76