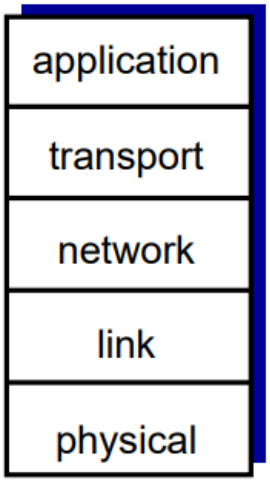
Short Answer Questions:

1. What are the layers in TCP/IP protocol stack?

Internet protocol stack

- *application:* supporting network applications
  - FTP, SMTP, HTTP
- *transport:* process-process data transfer
  - TCP, UDP
- *network:* routing of datagrams from source to destination
  - IP, routing protocols
- *link:* data transfer between neighboring network elements
  - Ethernet, 802.11 (WiFi), PPP
- *physical:* bits "on the wire"



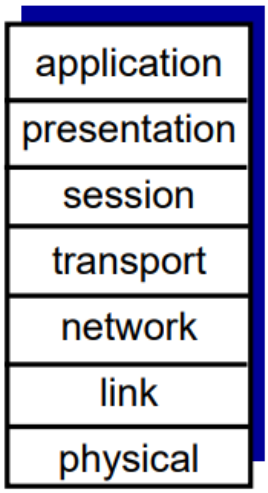
Answer:
-Application
-Transport
-Network
-Link
-Physical

Example Questions:
Question 1: What are the names of the 5 layers of TCP/IP protocol stack?
*Answered above!
Question 2: Which layer is used for logical/logic? communication between process and process?
Answer: Transport layer.
Question 3: Which layer is used for logical/logic? Communication between machine and machine?
Answer: Network layer.

2. What are the layers in OSI reference model?

ISO/OSI reference model

- *presentation:* allow applications to interpret meaning of data, e.g., encryption, compression, machine-specific conventions
- *session:* synchronization, checkpointing, recovery of data exchange
- Internet stack "missing" these layers!
  - these services, *if needed,* must be implemented in application
  - needed?



Answer:
-Application
-Presentation
-Session
-Transport
-Network
-Link
-Physical

3. What is the major difference between packet switching and circuit switching?

Answer:
Packet switching allows for sharing of end-end resources (*which can allow for more users to use a network), while circuit switching does not (*which can provide dedicated resources and guaranteed performance).

Professor's answer:
Circuit switching will reserve some resources for dedicated use. Packet

switching allows sharing.
*You don't need to write a long answer, all that matters is that you are right.

4. What is the difference between routing and forwarding?

Answer:
Routing is the process that determines what source-destination route it is that packets take, whereas forwarding is the process that moves packets from the router's input to the appropriate router output.

Professor's answer:
Routing is global, whereas forwarding is local. Routing is relatively global.
It's for one source and designation; decide a path between them.
Forwarding is happening locally on each router. For any input decide what's the output link.

Short answer: Routing is global, whereas forwarding is local.

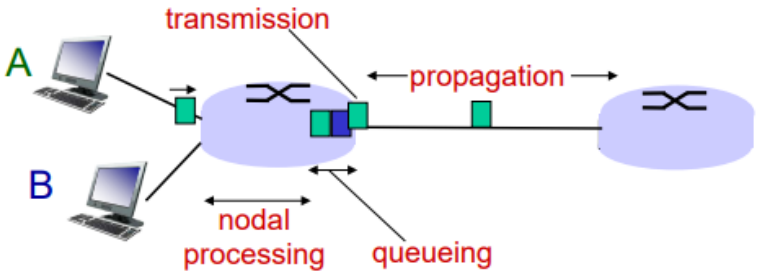
5. What is the relationship between routing and forwarding?

Answer:
Routing is the process that forwarding uses to determine where to send packets.

Professor's answer:
Short answer: Interplay.
The routing results will help configure the local forwarding at each router.

6. How many types of packet delay does network have?

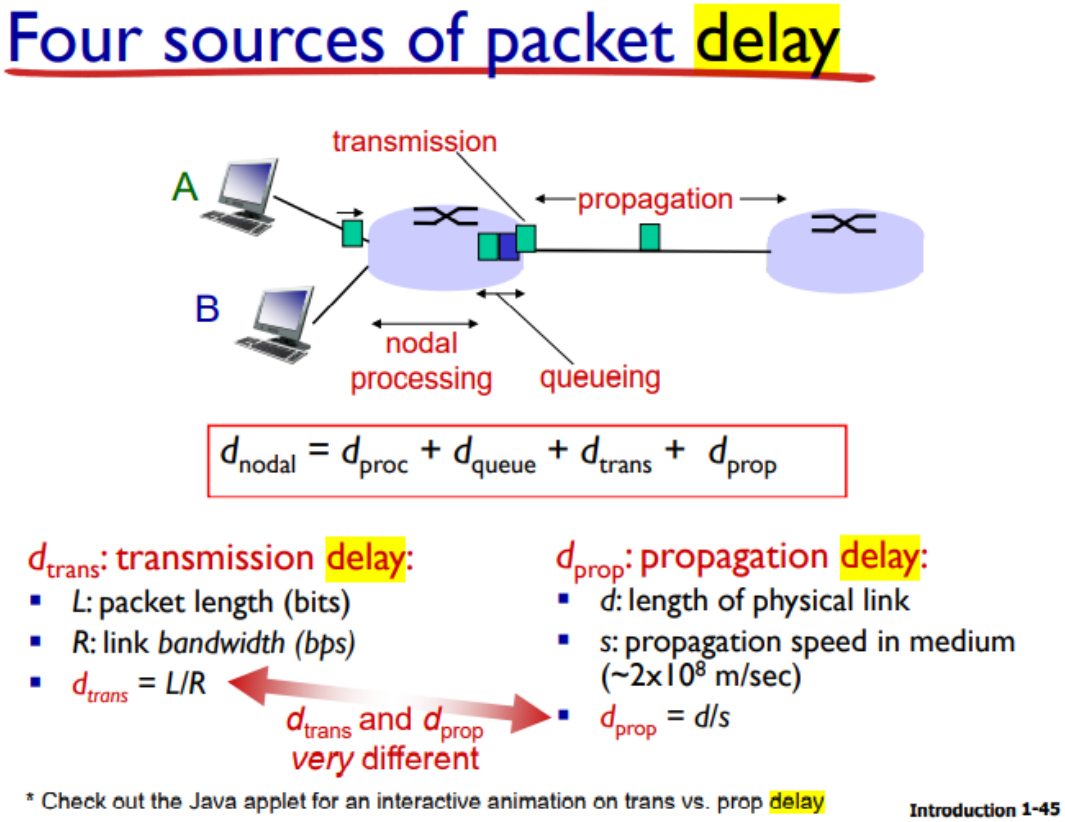
Four sources of packet delay



$$d_{nodal} = d_{proc} + d_{queue} + d_{trans} + d_{prop}$$

d_{proc}: nodal processing
- check bit errors
- determine output link
- typically < msec

d_{queue}: queueing delay
- time waiting at output link for transmission
- depends on congestion level of router



Answer:
There are four types of packet delay. They are: nodal processing, queueing delay, packet transmission delay, and packet propagation delay.

7. Which tool/utility/program can be used to find out the IP address of the routers on the path from one source and destination?

Answer:
Traceroute on Linux. Tracert on Windows.

8. Which tool/utility/program can be used to intercept and analyze the network packets?

Answer:
Packet sniffer/Packet analyzer.
Wireshark?

9. On which layer is SSL/TLS implemented for network security?

Answer:

At the application layer.

10. What does DDoS mean?

Answer:
Distributed Denial of Service.

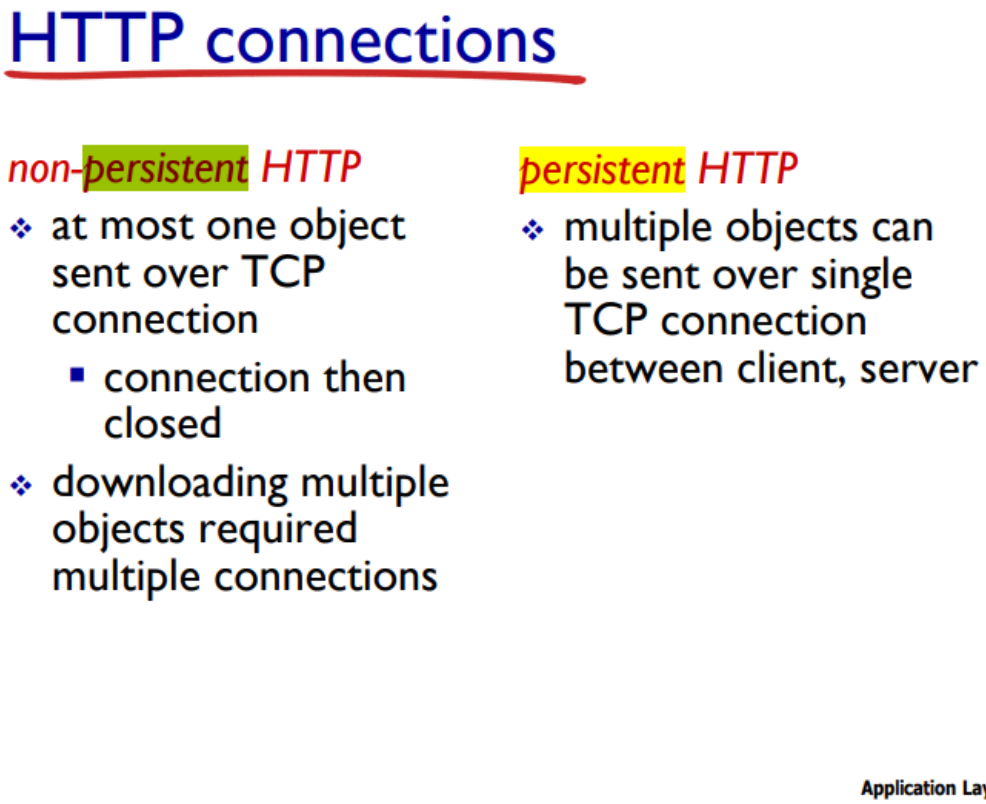
11. Among HTTP, FTP, SMTP, DNS, which protocols(s) use TCP service?

Answer:
HTTP, FTP, and SMTP. DNS does not use TCP in this case because DNS is based on UDP. The thing about DNS is that at many times, you do not know where the DNS server is, so you will have to find out.

12. What are the service port numbers for HTTP, FTP, SMTP, DNS servers respectively?

Answer:
HTTP: 80
FTP: 21 and 20
SMTP: 25
DNS: 53

13. What is the major difference between persistent and non-persistent modes of HTTP?

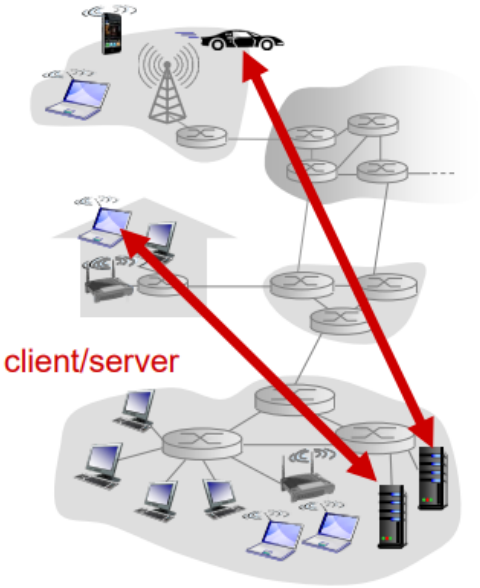


Answer:
Persistent modes of HTTP can have multiple objects be sent over a single TCP connection between the client and server, whereas non-persistent modes of HTTP can only send at most one object per TCP connection.

Professor's answer:
Persistent allows one connection, one TCP connection, shared by object transmissions. Non-persistent requires one separate TCP connection for each object transmission.

14. What is the major difference between Client/Server model and P2P model?

Client-server architecture



server:

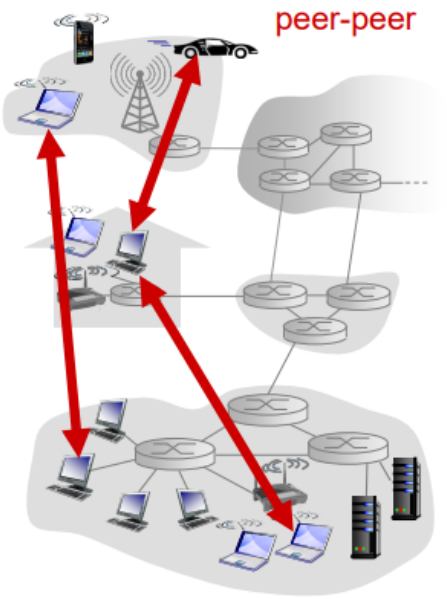
- always-on host
- permanent IP address
- data centers for scaling

clients:

- communicate with server
- may be intermittently connected
- may have dynamic IP addresses
- do not communicate directly with each other

P2P architecture

- *no* always-on server
- arbitrary end systems directly communicate
- peers request service from other peers, provide service in return to other peers
  - *self scalability* – new peers bring new service capacity, as well as new service demands
- peers are intermittently connected and change IP addresses
  - complex management

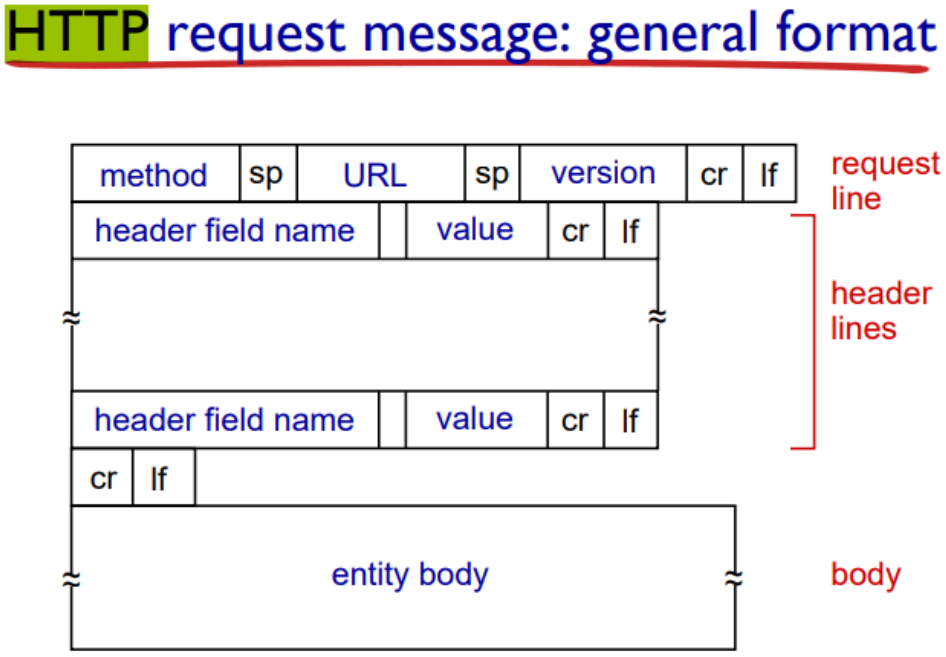


Application Layer 2-8

Answer:
The Client/Server model has an always-on host, whereas the P2P model doesn't.

Professor's answer:
Client/Server model has one always-on server, 24/7. In P2P model everyone is a peer in this case. Everyone is a client, everyone is a server for P2P.

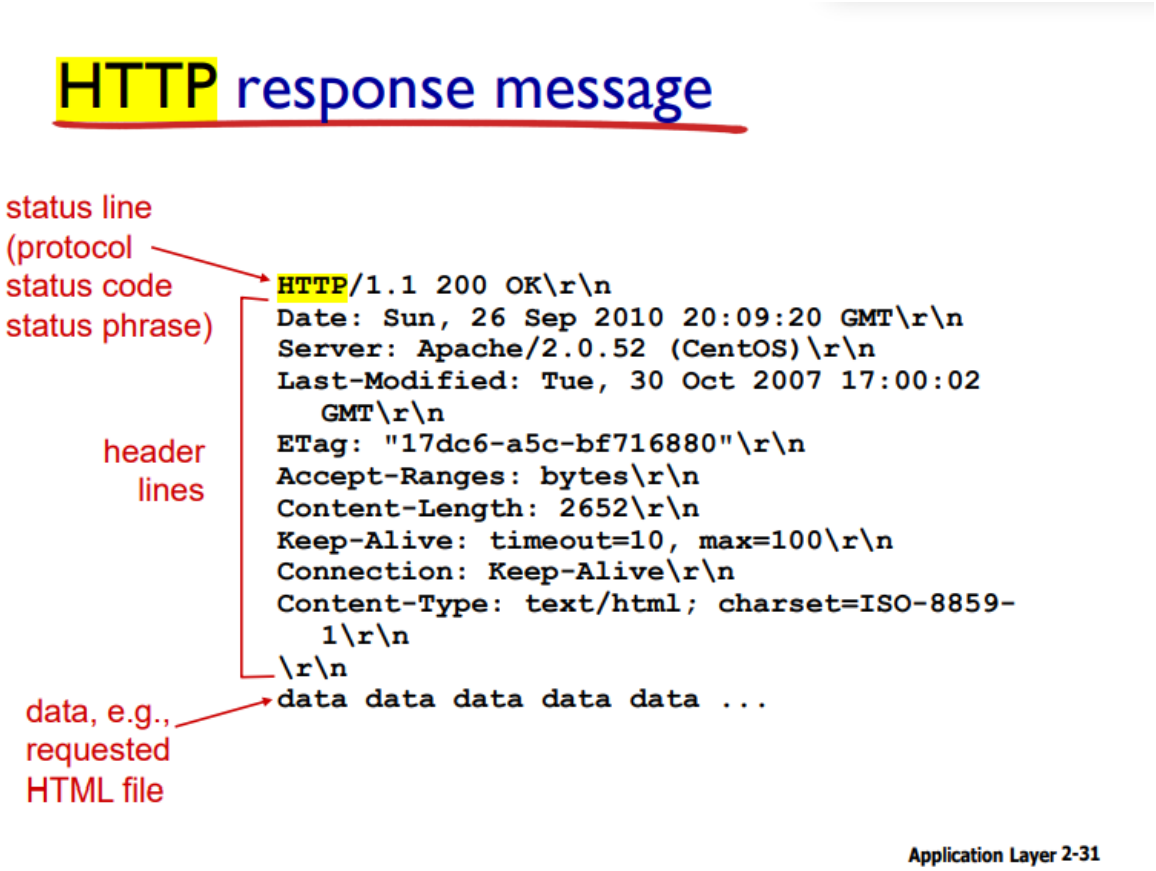
15. Where is URL specified in HTTP request format?



Answer:
The URL is specified in the request line.

Professor's answer:
The URL is specified in the first line (*first line, second field) or in the request line.

16. Where is the status code specified in HTTP response format?



Answer:
The status code is specified in the status line.

Professor's answer:
The status code is specified in the first line or in the status line in this case.

17. Is Web Cache a client or server for the original browser who sent the request to get one object?

Answer:
The cache acts as both a client and server. It is a server for the original requesting client, and the client to the origin server.

Professor's answer:
For the original browser, the web cache is a server. So, the answer is server.

18. What benefits come from the Conditional Get technology? Please give at least two.

Answer:
1. It doesn't send an object if the cache has up-to-date cached version, meaning no object

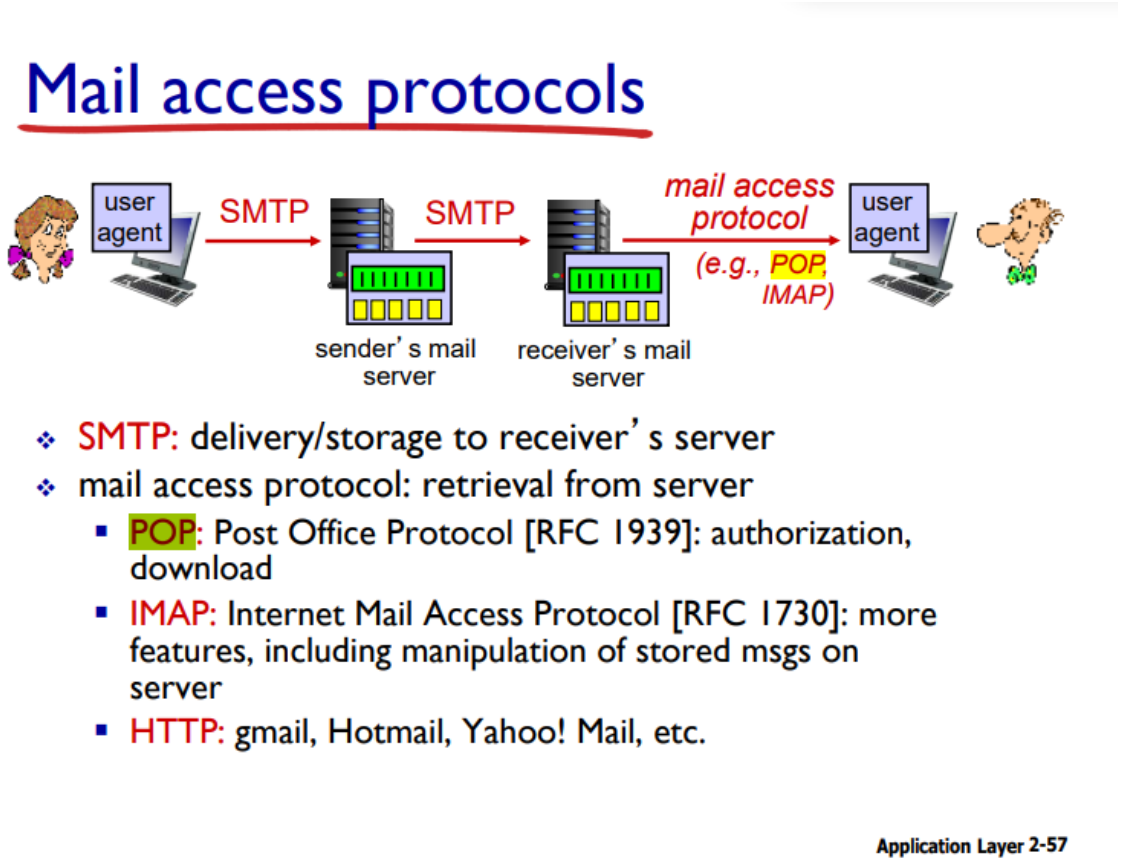
transmission delay.
2. It also allows for lower link utilization.

Professor's answer:
1. No object transmission delay.
2. Lower link transmission

or

1. Save time.
2. Save bandwidth.

19. What is the major difference between SMTP and POP/IMAP?

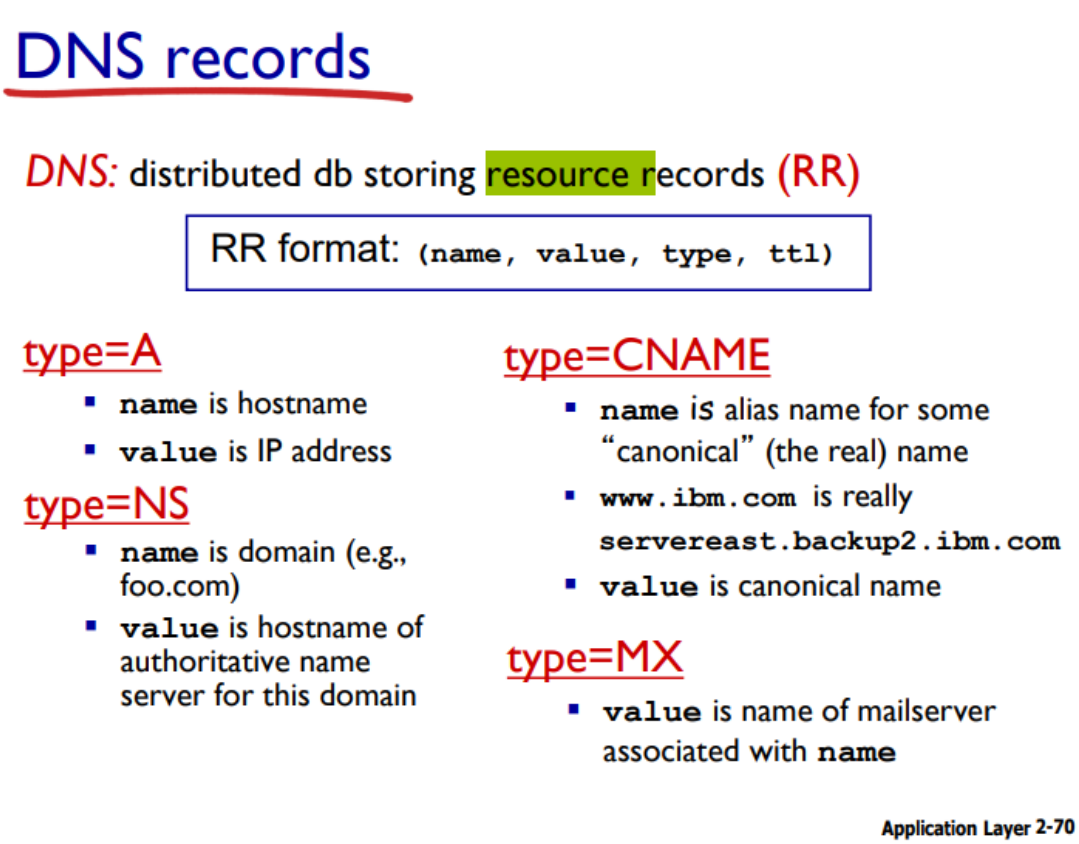


Answer:
SMTP allows delivery/storage to the receiver's server, whereas POP/IMAP simply involves retrieval from the server.

Professor's answer:
SMTP is a push protocol, whereas POP/IMAP are pull protocols.

20. What is the format of DNS resource records (RR)?

Answer:



Professor's answer:
RR format: (Name, value, type, ttl)
*Could also ask: What if type is NS? What does that mean?
*Could also ask: Can you give me the resource records to specify the IP address for my web server, for my company is a.b.c.d.

21. Among the socket library functions (socket, send, sendto, recv, recvfrom, close, bind, accept, connect, listen, etc.), what are used by TCP, and what are used by UDP?

Answer:
TCP: socket, send, recv, close, bind, accept, connect, and listen.

UDP: socket, sendto, recvfrom, close, and bind.

Professor's answer:
Socket is used by both TCP and UDP, but with different parameters. TCP parameter is called SOCK_STREAM, UDP parameter is called SOCK_DGRAM. Send is used by TCP, Sendto

is used by UDP. Recv is used by TCP, recvfrom is used by UDP. Close is used by both. Bind is used by both. Accept is used by TCP. Connect is used by TCP. Listen is used by TCP.

22. What is the major difference between TCP and UDP?

Answer:
UDP provides an unreliable datagram transport service, whereas TCP provides a reliable, byte stream-oriented transport service.

Professor's answer:
Reliable vs. unreliable.
Or
Connection vs. connectionless.

True or False Questions:

1. Internet is a single network. [redacted]
False. It is a network of networks.

2. DNS runs on routers as it's a network core function. [redacted]
False. DNS does not run on routers. DNS runs on end systems. It's indeed a network function, DNS is indeed a network core function, but it runs on end systems.

3. A network layer does not need to rely on any service from its below layer. [redacted]
False. Every layer needs to use service from its below layer.

4. TCP is a protocol on Application Layer. [redacted]
False. TCP is a protocol on the transport layer.

5. FDM/TDM is a packet switching protocol. [redacted]
False. FDM/TDM are a circuit switching protocol because they will reserve resources for dedicated use. FDM = Frequency Division Multiplexing, TDM = Time Division Multiplexing.

6. It's impossible to have packet loss as the network is supposed to guarantee reliability. [redacted]
False. It is always possible to have packet loss. Even in TCP a packet may be lost, the difference being that TCP can always ask a sender to retransmit (*the data was still lost, even if you retransmit the data, the original copy was already lost).

7. All the packet headers are added to data at Application layer when the data leaves the application program. [redacted]
False. The packet headers are added layer by layer. Application may generate data

from the applications. Transport layer adds the transport layer header, network layer adds the network layer header, data link layer adds the data link layer header (*see slides about encapsulation and animation).

8. Routers support all the seven layers of OSI reference model. [redacted]
False. (*See slides about encapsulation) Routers only support 3 layers of OSI reference model. Routers are a 3 floor building in that they only support the physical layer, data link layer, and the network layer. Routers do not have the transport layer nor the application layer.

9. SMTP is a P2P protocol as there is no client in its communications. [redacted]
False. SMTP is a client-server model, not a P2P model.

10. SMTP is a pull protocol. [redacted]
False. SMTP is a push protocol, HTTP is a pull protocol.

Multiple Choice Questions:

1. A network protocol defines:
(a) Message syntax and semantics
(b) Order of messages sent and received
(c) Actions taken on message transmission and receipt
(d) All of above

Answer: D

2. Node A sends data to Node C via intermediate node B. Suppose the throughput of the link between A and B is X (Mbps) and that between B and C is Y (Mbps), what is the effective throughput of the logical link between A and C?
(a) X
(b) Y
(c) max (X, Y)
(d) min (X, Y)

Answer: D (*See slides about definition of a bottleneck) Smallest link will constrain the entire throughput.

Long Answer Questions:

1. Cookie scenario in slides of Chapter 2. How many components to make cookie system function? What are they respectively? What are their functionalities respectively? Especially, what cookie header lines in the first HTTP response message and next HTTP request messages?

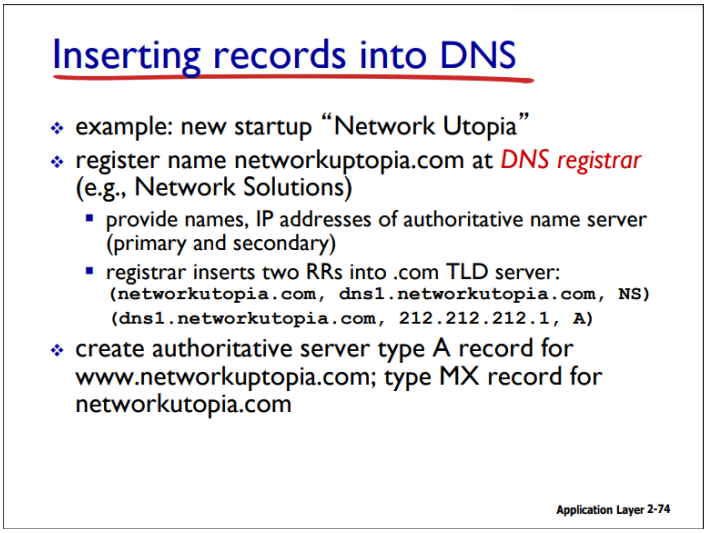
4 components are needed to make the cookie system function. They are the cookie header

line of HTTP response message, cookie header line in next HTTP request message, cookie file kept on user's host, and the back-end database. The cookie header line of HTTP response message is used for… The cookie header line in next HTTP request message is used for… The cookie file kept on user's host, which is managed by the user's browser, is used for… The back-end database at the website, is used for…

Professor's answer:

4 components are needed to make the cookie system function. They are the (1) cookie file, (2) database on the server side, (3) the one header line in the first response message from server, then (4) the header line from the third message (*that message will be from the client to the server). Database on the server side will contain all the information in the database about a particular client. Cookie files on the server will contain all your cookie IDs. The header lines from the response message and from the server to the client will set the cookie ID. And then, all the future client to server messages will contain that same header line and their functionality is to make sure the server can recognize the client. The cookie header line from the first HTTP response message will be given by set-cookie from the first response message, then we have a cookie with the ID, which will be the new header line for the future client to server request messages.

2. To insert resource records into DNS, what steps are needed? What RRs are inserted?
Refer to slides of Chapter 2.



For the primary DNS, you need 2 lines, for the secondary, you need another 2 lines.
???
(*See 3/15 video around 26:00).

3. Questions about the first socket programming assignments. Code? Functions?

(*See slides!)

DNS works on routers?
False!