Computer Network Midterm 101-1

1. (a) Describe FTP operations (8%). Which port does the FTP client contact with the FTP server? (2%) (b) Why is it said that FTP sends control information “out-of-band”? (3%)

2. Describe the client-server and peer-to-peer application architectures. (12%)

3. Compare the circuit switching and packet switching on resource usage, performance, and call setup. (total 12%)

4. Explain Internet protocol stack (1% each layer’s name, 1% each layer’s functions, 10% total)

5. For the encapsulation/decapulation processes of the Internet protocol stack, (a) what are the first layers, the second layers, the third layers to perform? (6%，分 encapsulation process 與 decapulation process 兩部分) (b) Besides, you have to write the name of data unit of upper four layer. (寫出最上面四層資料單位的專有名稱) (8%)

6. Describe detailed operations of HTTP cookie, web caching and conditional GET. (6*3=18%)（說明其用處，並畫圖加解釋每步驟）

7. What are the major differences between SMTP and POP3? (4%) Draw a figure to show the mail-sending flow and all necessary modules among two end users. (7%) (11% total)

8. Consider a message that is $8*10^6$ bits long that is to be sent from source to destination through four packet switches. Suppose each link is 1Mbps. Ignore propagation, queuing, and processing delays. Suppose the message is segmented into 4000 packets, with each packet being 2000 bits long. How long does it take to move message from source to destination with message segmentation (10%)

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1. (a) Describe FTP operations (8%). Which port does the FTP client contact with the FTP server? (2%) (b) Why is it said that FTP sends control information "out-of-band"? (3%)

Ans:

(a)

- FTP client contacts FTP server at port 21, specifying TCP as transport protocol (4%)
- Client obtains authorization and sends commands over control connection (2%)
- When server receives a command for a file transfer, the server opens a TCP data connection to client. (2%) After transferring one file, server closes connection. (2%)

(b)

FTP uses two parallel TCP connections, one connection for sending control information (such as a request to transfer a file) and another connection for actually transferring the file. Because the control information is not sent over the same connection that the file is sent over, FTP sends control information out of band. (3%)

2. Describe the client-server and peer-to-peer application architectures. (12%)

Ans: (a) server:

always-on host, permanent IP address (2%)

clients:

communicate with server, do not communicate directly with each other (2%)

may be intermittently connected and have dynamic IP addresses (2%)

(b) peer-to-peer:

no always-on server (2%)

arbitrary end systems directly communicate (2%)

peers are intermittently connected and change IP addresses (2%)

3. Compare the circuit switching and packet switching on resource usage, performance, and call setup. (total 12%)

Ans: Circuit-switching: (2% each, total 12%)

i. end-end resources reserved for "call", like link bandwidth, switch capacity. dedicated resources: no sharing
ii. circuit-like (guaranteed) performance
iii. call setup required

Packet-switching:

i. each end-end data stream divided into *packets.* User A, B packets *share* network resources *as needed*

ii. resource contention may degrade performance.

iii. no call setup required

4. Explain Internet protocol stack (1% each layer's name, 1% each layer's functions, 10% total)

Ans: application: supporting network applications
transport: host-host data transfer
network: routing of datagrams from source to destination
link: data transfer between neighboring network elements
physical: bits "on the wire" (1% each layer's name, 1% each layer's functions, 10% total)

application
transport
network
link
physical

5. For the encapsulation/decapulation processes of the Internet protocol stack, (a) what are the first layers, the second layers, the third layers to perform? (6%，分 encapsulation process 與 decapulation process 兩部分) (b) Besides, you have to write the name of data unit of upper four layer. (寫出最上面四層資料單位的專有名稱) (8%)

Ans:

(a)

Source encapsulation process: application layer -> transport layer -> network layer
Destination decapulation process: physical layer -> link layer -> network layer 各 1%，共 6%

(b)

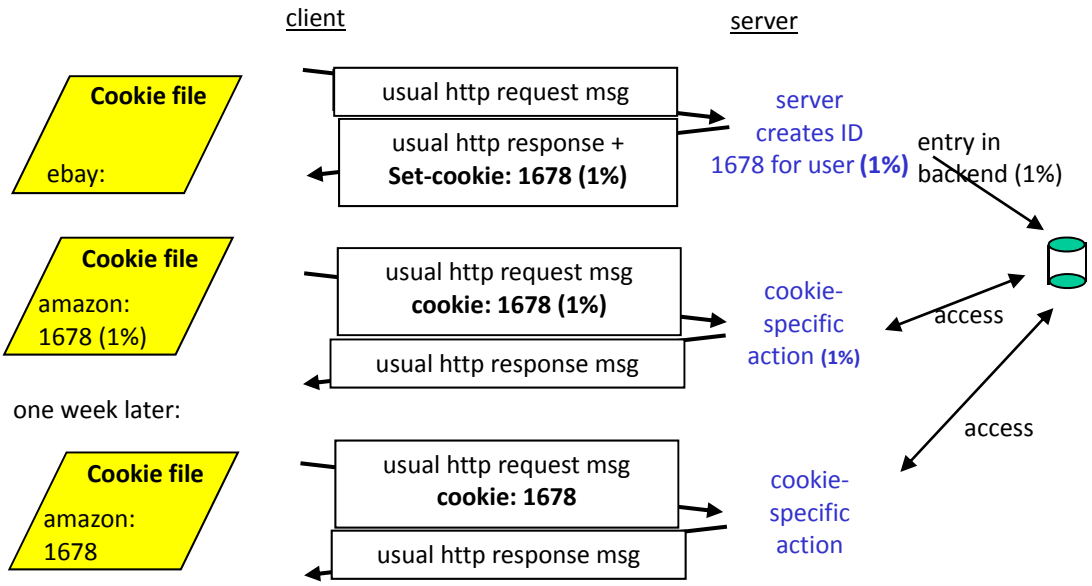
application layer: message
transport layer: segment
network layer: datagram
link layer: frame
各 2%，共 8%

6. Describe detailed operations of HTTP cookie, web caching and conditional GET. (6*3=18%)（說明其用處，並畫圖加解釋每步驟）

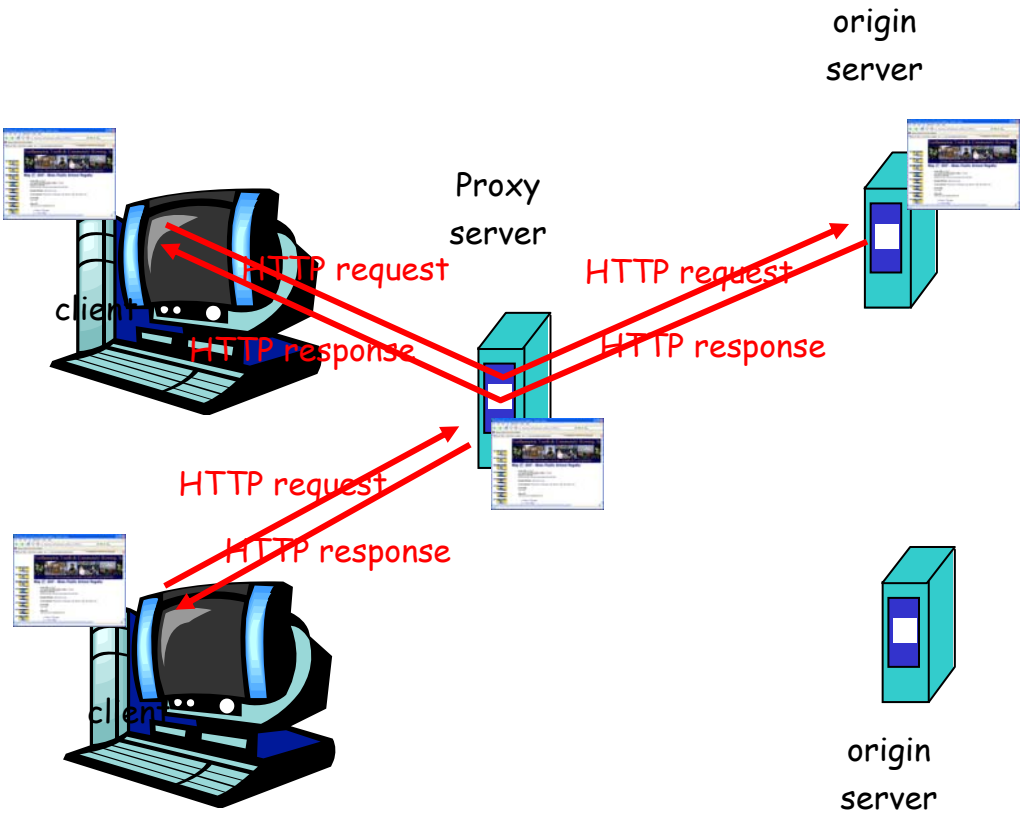
Ans:

- cookie:
  when a user visits a specific web site for first time and initial HTTP requests arrives at site, site creates a unique ID and creates an entry in backend database for recording user states of this ID.
  => keep client's states (cookie-specific action)!

Computer Network Midterm 101-1

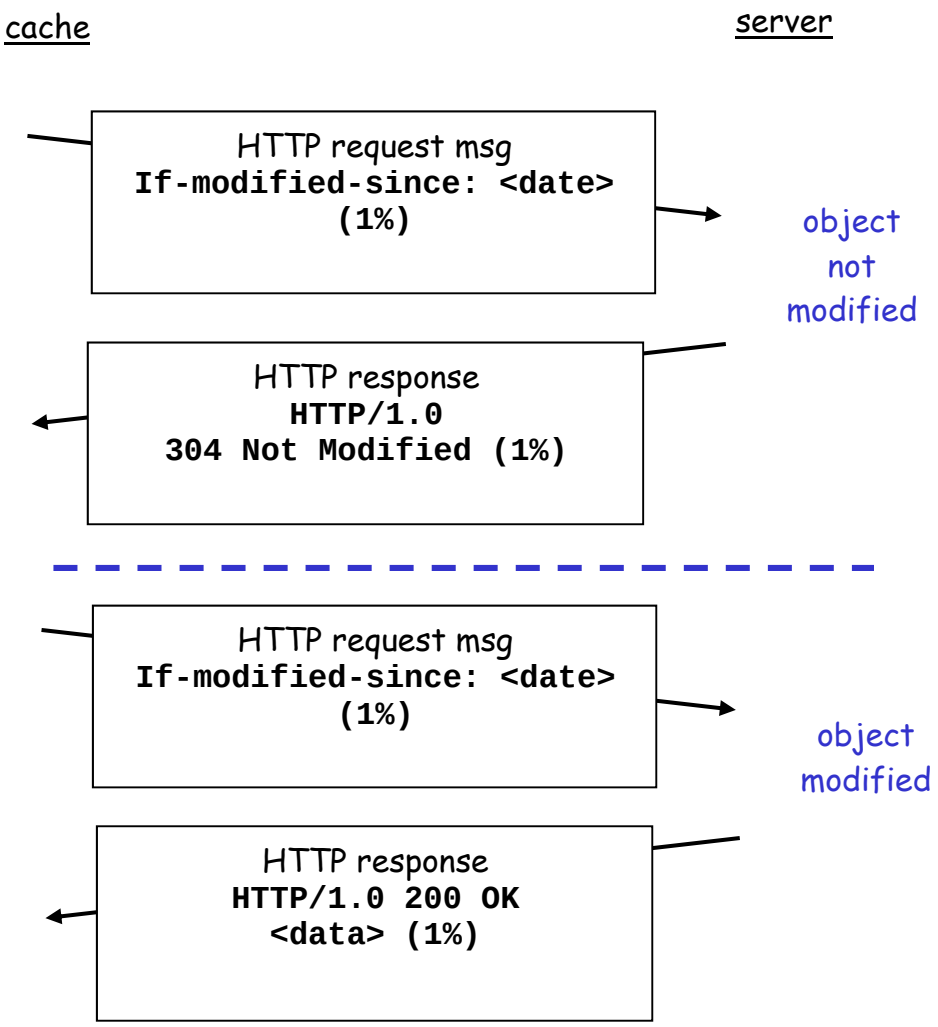


- web caching:
  - user sets browser: Web accesses via cache
  - browser sends all HTTP requests to cache (2%)
    if object in cache
    cache returns object (2%)
    else
    cache requests object from origin server, then returns object to client (2%)



conditional GET (6%)

- Conditional GET: don't send object if cache has up-to-date cached version (1%) => reduce traffic loads (delays) on network links! (1%)
  cache: specify date of cached copy in HTTP request (1%)
  If-modified-since: <date> (1%)
  server: response contains no object if cached copy is up-to-date: (1%)
  HTTP/1.0 304 Not Modified (1%)



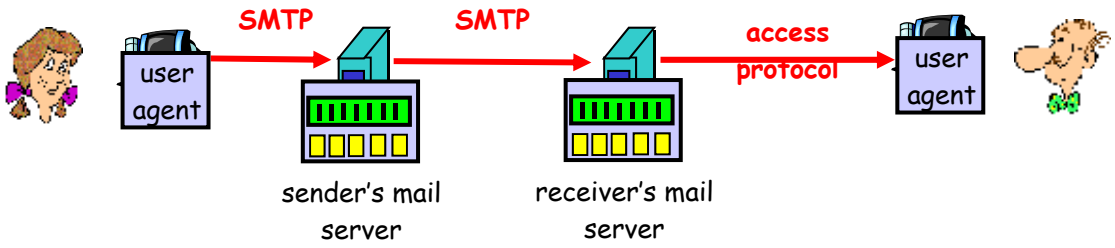
7. What are the major differences between SMTP and POP3? (4%) Draw a figure to show the mail-sending flow and all necessary modules among two end users. (7%) (11% total)

Ans:

POP: Mail access protocol: retrieval from server (說明 2%)

SMTP:

- direct transfer between mail servers to send email messages (說明 2%)



(1% each, 7% total)

8. Consider a message that is $8*10^6$ bits long that is to be sent from source to destination through four packet switches. Suppose each link is 1Mbps. Ignore propagation, queuing, and processing delays. Suppose the message is segmented into 4000 packets, with each packet being 2000 bits long. How long does it take to move message from source to destination with message segmentation (10%)

Ans:

a) Time to send 1st packet from source host to first packet switch = $\frac{2\times10^3}{1\times10^6}\text{sec} = 2\,m\text{sec}$. (2%)

Time at which 2nd packet is received at the first switch = time at which 1st packet is received at the second switch = $2\times 2\,m\text{sec} = 4\,m\text{sec}$

Time at which 1st packet is received at the destination host = $2\,m\text{sec}\times 5\,hops = 10\,m\text{sec}$. (2%) After this, every 2msec one packet will be received; thus time at which last (4000^{th}) packet is received = $10m\text{sec} + 3999 * 2m\text{sec} = 8.008\text{sec}$. (6%)

Computer Network Midterm 101-1

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4. (0.5%, 10%)

Application	Application layer protocol	Transport layer protocol	Data Loss	Elastic Bandwidth	Time Sensitive
File transfer					
e-mail					
Web					
Internet telephony					

5. (a) Web page consists of base HTML-file which includes several referenced objects. Which identifier is used to address each object? (2%)
   (b) This identifier consists of two parts. List them. (4%)
   (c) Describe operations of HTTP between client and server processes. (4%)

6. Describe four sources of packet delays (1% each delay name, 2% reason of each delay, 12% total)

7. Suppose you click a hyperlink (http://www.ncue.edu.tw) to obtain a Web page. The IP address for the associated URL is cached in your local host, so a DNS lookup is not necessary to obtain the IP address. Suppose that *n* DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of RTT_1,…, RTT_n. Further suppose the HTML file references ten very small objects on the same server. Assuming RTT_0 denotes the round trip time between your host and the server containing the object. Assuming zero transmission time of the object, how much time elapses with (a) nonpersistent HTTP with no parallel TCP connections, (b) persistent HTTP without pipelining, (c) persistent HTTP with pipelining, from when the client clicks on the link until the client receives the Web page and the five objects? (說明每項的動作，畫出過程的時間圖，並解釋如何計算時間，12%)

8. Explain the following terms (a) bandwidth (b) IETF RFC (c) List two kinds of wireless access networks (d) List any two types of Access networks. (e) How do loss occur in router buffers? (2% each, 14% total)

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1. Explain Internet protocol stack (1% each layer's name, 1% each layer's functions, 10% total)

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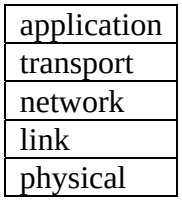

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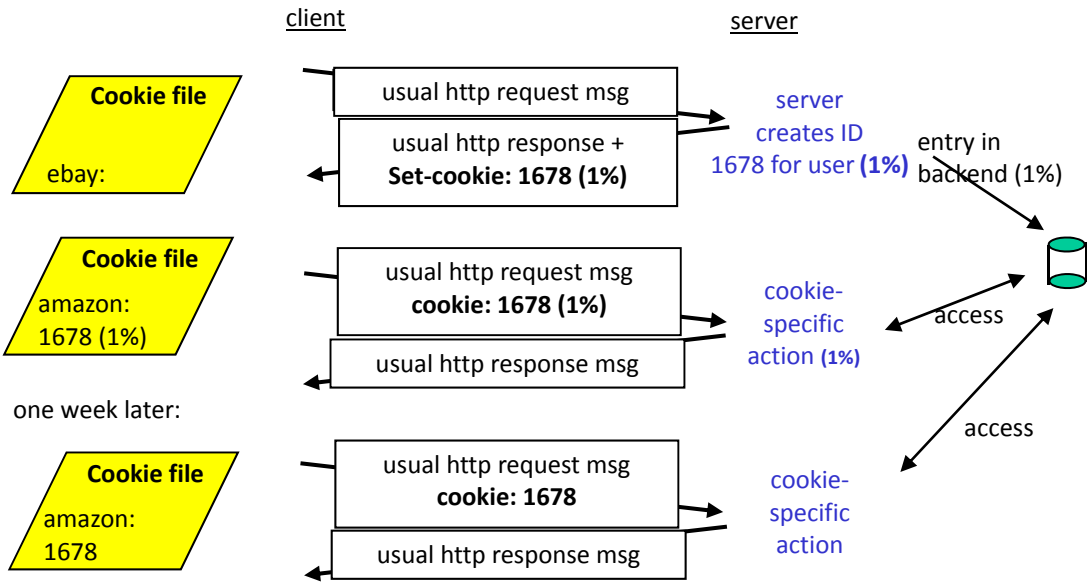

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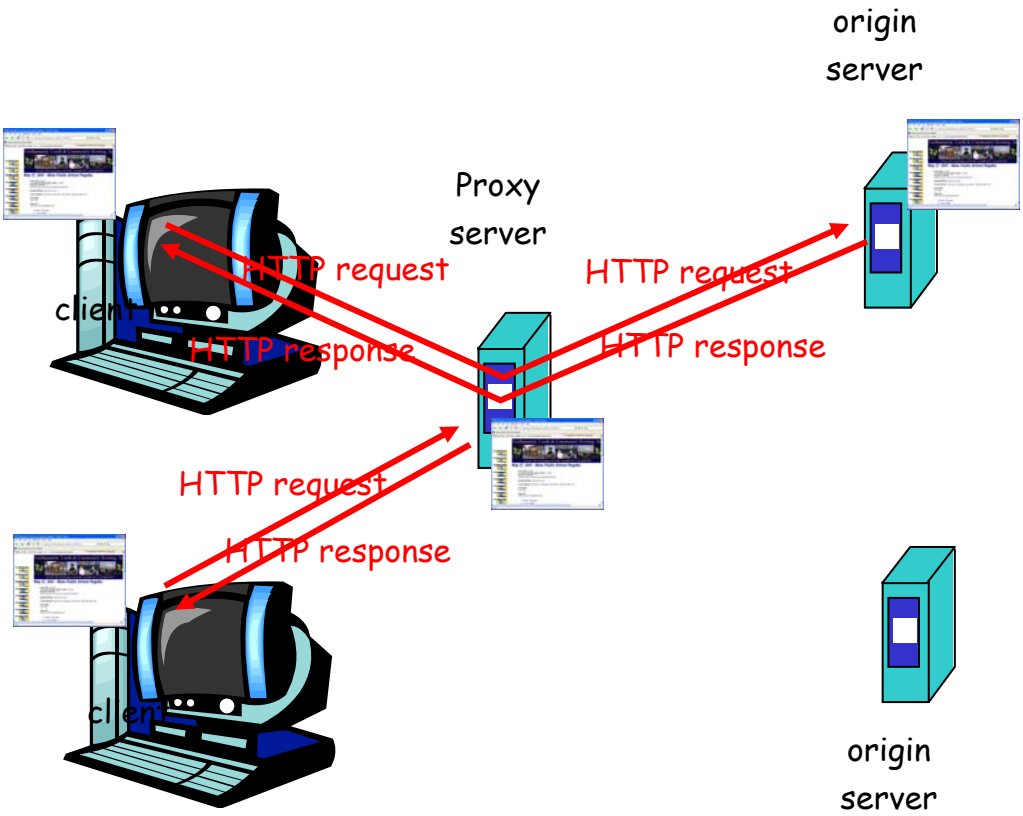

conditional GET (6%)

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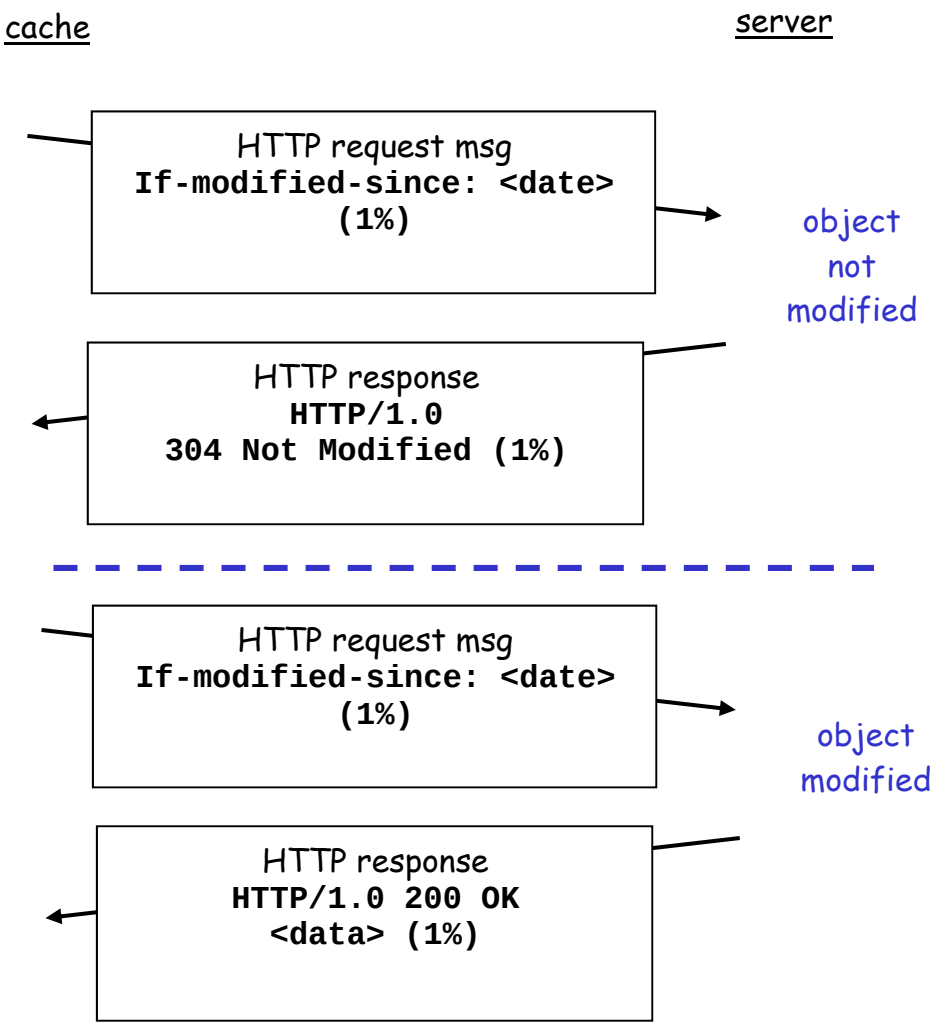

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Application	Application layer protocol	Transport layer protocol	Data Loss	Elastic Bandwidth	Time Sensitive
File transfer	FTP	TCP	No	Yes	No
e-mail	SMTP	TCP	No	Yes	No
Web	HTTP	TCP	No	Yes	No
Internet telephony	proprietary	UDP	Yes, loss-tolerant	No	Yes, 100's msec

5. (a) Web page consists of base HTML-file which includes several referenced objects. Which identifier is used to address each object? (2%)

(b) This identifier consists of two parts. List them. (4%)
(c) Describe operations of HTTP between client and server processes. (4%)

Ans:

a) by a URL (2%)
b) host name and path name (4%)
c) HTTP: hypertext transfer protocol
   - *HTTP client:* browser that requests, receives, "displays" Web objects (2%)
   - *HTTP server:* Web server sends objects in response to requests (2%)

6. Describe four sources of packet delays (1% each delay name, 2% reason of each delay, 12% total)

Ans:

(a) nodel processing delay: check bit errors, determine output link

(b) queueing delay: time waiting at output link for transmission, depends on congestion level of router

(c) transmission delay: R=link bandwidth (bps) L=packet length (bits), time to send bits into link = L/R

(d) propagation delay: d = length of physical link, s = propagation speed in medium, propagation delay = d/s (1% each delay name, 2% reason of each delay, 12% total)

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Ans:

Once the IP address is known, RTT_O elapses to set up the TCP connection and another RTT_O elapses to request and receive the Web object.

(a) nonpersistent HTTP without parallel TCP connections:

At most one object is sent over a TCP connection. *(2%)*

[1 RTT_0 (TCP handshaking) + 1 RTT_0 (HTTP request/response)]* 11 objects (1 Web page + 10 objects) = $\underline{22\ RTT_0}$ (2%)

(b) persistent HTTP without pipelining:

Multiple objects can be sent over single TCP connection between client and server. The browser first waits to receive a HTTP response from the server before issuing a new HTTP request. *(2%)*

1 RTT_0 (TCP handshaking) + 1 RTT_0 (HTTP request/response) * 10 objects = $\underline{11\ RTT_0}$ (2%)

(c) persistent HTTP with pipelining:

The browser issues requests as soon as it has a need to do so, without waiting for response messages from the server. (*2%)*

1 RTT_0 (TCP handshaking) + 1 RTT_0 (HTTP request/response for web page) + 1 RTT_0 (HTTP request/response for 10 objects) = $\underline{3\ RTT_0}$ (2%)

12% total

8. Explain the following terms (a) bandwidth (b) IETF RFC (c) List two kinds of wireless access networks (d) List any two types of Access networks. (e) How do loss occur in router buffers? (2% each, 14% total)

Ans: (a) bandwidth: link transmission rate (2%)

(b) IETF RFC: Internet standards (2%)

(c) wireless LANs and wider-area wireless access (4%)

(d) Dial-up Modem (任 2 個，4%)

Digital Subscriber Line (DSL)

cable modems (HFC: hybrid fiber coax)

Fiber to the Home

Ethernet Internet access

(e) arriving packets dropped (loss) if no free buffers (2%)