Computer Network Midterm 104-1

1. Describe four sources of packet delays (1% each delay name, 1% reason of each delay, 8% total)

2. Describe the client-server and peer-to-peer application architectures. (6%)

3. (a) Compare the circuit switching and packet switching on resource usage, performance, and call setup. (6%) (b) List two circuit switching techniques (4%) (c) Draw two figures to explain their operations. (6%) (16% total)

4. (a) Explain Internet protocol stack (1% each layer's name, 1% each layer's functions, 10% total) (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，如 xx 層：yy) (4%)

   (c) For the encapsulation/decapulation processes of the Internet protocol stack, what are the first layers, the second layers, the third layers to perform? (6%，分 encapsulation process 與 decapulation process 兩部分) (20% total)

5. 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）

6. Suppose within your web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that 2 DNS servers are visited before your host receives the IP address from DNS; visiting 1 of them incurs an RTT of D_1 per DNS and visiting each of remaining incurs an RTT of D_2. Further suppose that the web page associated with the link contains 3 very small objects on the same server. Suppose the HTTP running is and let RTT_0 denote the RTT between the local host and the server for each object. Assume zero transmission time of each object, how much time elapses from when the client clicks on the link until the client receives all the objects? (a) non-persistent HTTP with no parallel TCP connections? (b) non-persistent HTTP with the browser configured for three parallel TCP connections? (c) Persistent HTTP with pipelining? (要寫出並說明每項動作的執行時間算式，不能只寫最後答案) (5% each, 15%)

7. Explain the following questions. (8%)

   (a) What TWO services are provided by the domain name system? (2%) (b) Authoritative DNS servers (2%) (c) DNS iterated query (2%) (d) DNS recursive query (2%)

8. Consider a message that is $8*10^6$ bits long that is to be sent from source to destination through <u>4</u> packet switches. Suppose each link is 1Mbps. Ignore propagation, queuing, and processing delays. Suppose the message is segmented into 10000 packets, with each packet being 2000 bits long. How long does it take to move message from source to destination with message segmentation (9%)

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1. Describe four sources of packet delays (1% each delay name, 1% reason of each delay, 8% 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, 1% reason of each delay, 8% total)

2. Describe the client-server and peer-to-peer application architectures. (6%)

Ans: (a) server:

always-on host, permanent IP address (1%)

clients:

communicate with server, do not communicate directly with each other (1%)

may be intermittently connected and have dynamic IP addresses (1%)

(b) peer-to-peer:

no always-on server (1%)

arbitrary end systems directly communicate (1%)

peers are intermittently connected and change IP addresses (1%)

3. (a) Compare the circuit switching and packet switching on resource usage, performance, and call setup. (6%) (b) List two circuit switching techniques (4%) (c) Draw two figures to explain their operations. (6%) (16% total)

Ans:

(a) Circuit-switching: (1% each, total 6%)

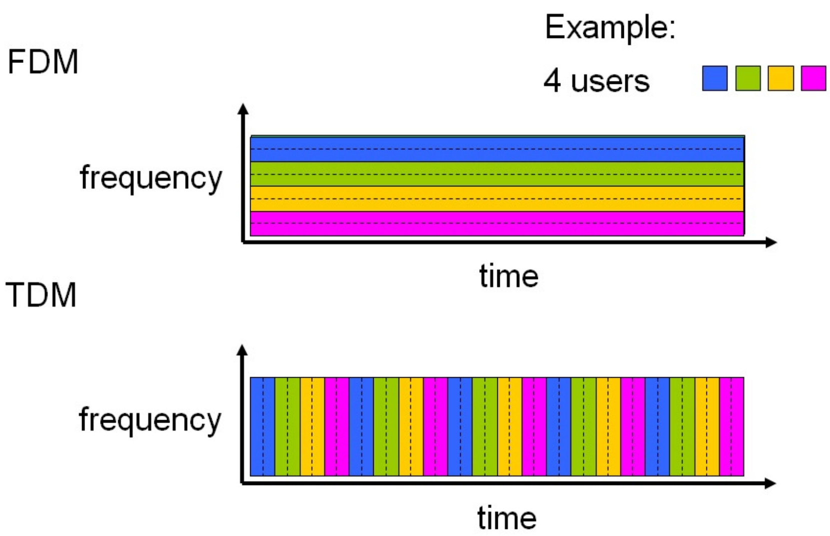
i. end-end resources reserved for "call", like link bandwidth, switch capacity. dedicated resources: no sharing
ii. circuit-like (guaranteed) performance
iii. call setup required

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

(b) FDM and TDM (2% each)

(c) (3% each: time, frequency, user)



4. (a) Explain Internet protocol stack (1% each layer's name, 1% each layer's functions, 10% total)
(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，如 xx 層：yy) (4%)
(c) For the encapsulation/decapulation processes of the Internet protocol stack, what are the first layers, the second layers, the third layers to perform? (6%，分 encapsulation process 與 decapulation process 兩部分) (20% total)

Ans:

(a)

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

(b)

application layer: message
transport layer: segment
network layer: datagram
link layer: frame
各 1%，共 4%

(c)

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

5. 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:

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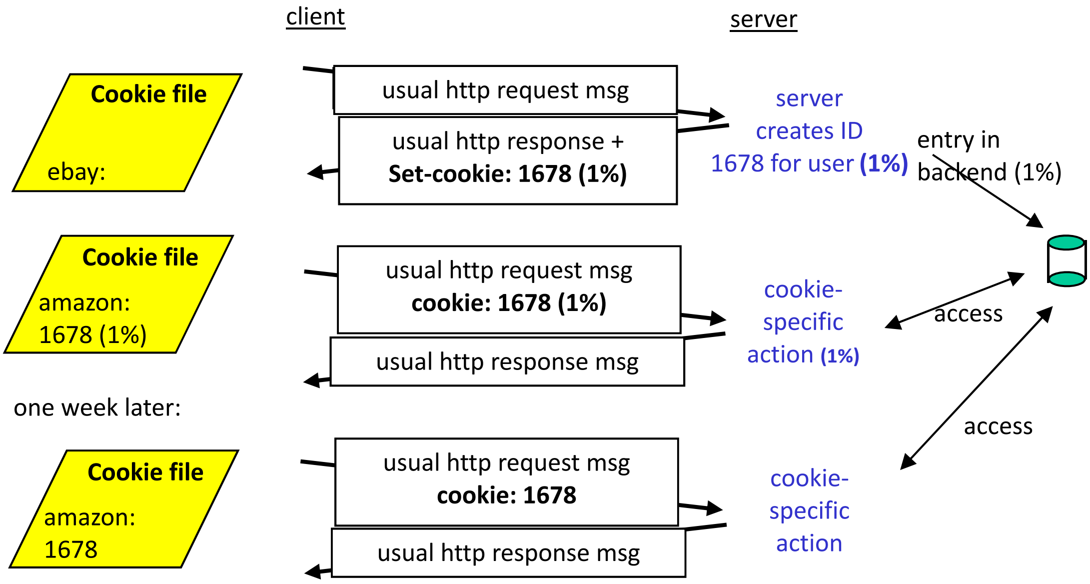
when a user visits a specific web site for first time and initial HTTP requests arrives at site, site creates a unique ID and creates an entry in backend database for recording user states of this ID.
=> keep client's states (cookie-specific action)!



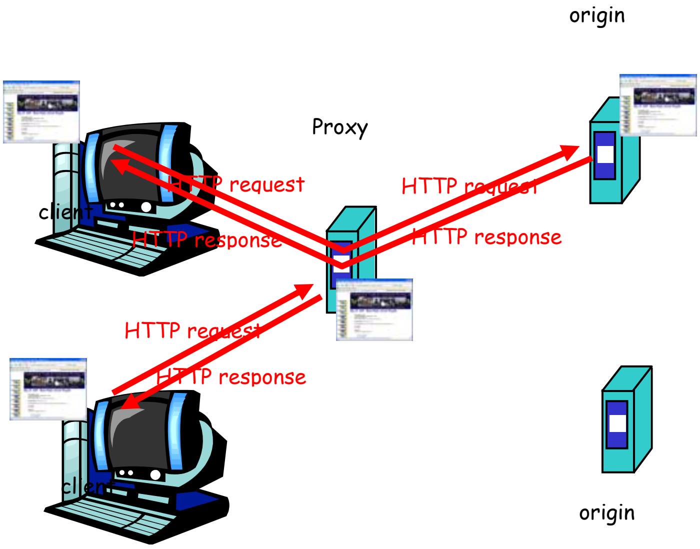
- ❑ web caching:
  - user sets browser: Web accesses via cache
  - browser sends all HTTP requests to cache (2%)

    if object in cache

    cache returns object (2%)

    else

    cache requests object from origin server, then returns object to client (2%)



conditional GET (6%)

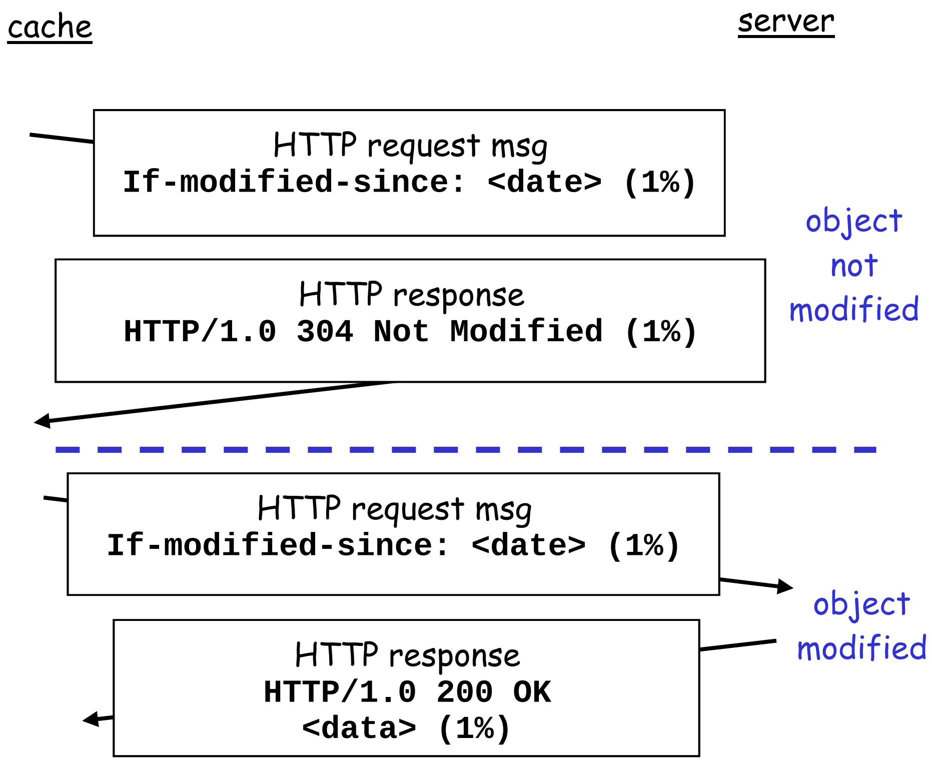
- Conditional GET: don't send object if cache has up-to-date cached version (1%) => reduce traffic loads (delays) on network links! (1%)

  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%)



6. Suppose within your web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that 2 DNS servers are visited before your host receives the IP address from DNS; visiting 1 of them incurs an RTT of D_1 per DNS and visiting each of remaining incurs an RTT of D_2. Further suppose that the web page associated with the link contains 3 very small objects on the same server. Suppose the HTTP running is and let RTT_0 denote the RTT between the local host and the server for each object. Assume zero transmission time of each object, how much time elapses from when the client clicks on the link until the client receives all the objects? (a) non-persistent HTTP with no parallel TCP connections? (b) non-persistent HTTP with the browser configured for three parallel TCP connections? (c) Persistent HTTP with pipelining? (要寫出並說明每項動作的執行時間算式，不能只寫最後答案) (5% each, 15%)

Ans:

a) The total time to get the IP address is $1D_1 + 1D_2$. After this, $2RTT_0$ is required to set up each of the 3 TCP connections and to request and receive each HTTP object. Thus, the total response time is $1D_1 + 1D_2$ (1%) + 1 RTT_0 (TCP handshaking) + 1 RTT_0 (HTTP request/response for web page) (1%) +3* [1 RTT_0 (parallel TCP handshaking) +1 RTT_0 (HTTP request/response for 3 objects)] (1%) = $D_1 + D_2 + 8\ RTT_0$ (2%)

b) $1D_1 + 1D_2$ + 1 RTT_0 (TCP handshaking) + 1 RTT_0 (HTTP request/response for web page) + 1 RTT_0 (parallel TCP handshaking) +1 RTT_0 (HTTP request/response for 3 objects) = $D_1 + D_2 + 4\ RTT_0$

c) $1D_1 + 1D_2$ + 1 RTT_0 (TCP handshaking) + 1 RTT_0 (HTTP request/response for web page) + 1 RTT_0 (HTTP request/response for 3 objects) = $D_1 + D_2 + 3\ RTT_0$

7. Explain the following questions. (8%)
   (a) What TWO services are provided by the domain name system? (2%)
   (b) Authoritative DNS servers (2%)
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   (d) DNS recursive query (2%)

Ans:

(a) DNS services (2%，任選兩個)
- hostname to IP address translation
- host aliasing (Canonical, alias names)
- mail server aliasing

(b) Authoritative DNS server (2%)
- organization's DNS servers, providing authoritative hostname to IP mappings for organization's servers

(c) DNS iterated query: (2%)
- contacted server replies with name of server to contact

(d) DNS recursive query: (2%)
- contacted server forwards the DNS query to next server and waits for the reply

8. Consider a message that is $8*10^6$ bits long that is to be sent from source to destination through <u>4</u> packet switches. Suppose each link is 1Mbps. Ignore propagation, queuing, and processing delays. Suppose the message is segmented into 10000 packets, with each packet being 2000 bits long. How long does it take to move message from source to destination with message segmentation (9%)

Ans:

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

Time at which 1st packet is received at the destination host = $2\ m\sec\times 5\ hops = 10\ m\sec$. (2%)

After this, every 2msec one packet will be received; thus time at which last (10000th) packet is received = $10m\sec + 9999*2m\sec = 20.008\sec$. (5%)