Welcome to

CS 3516: Computer Networks

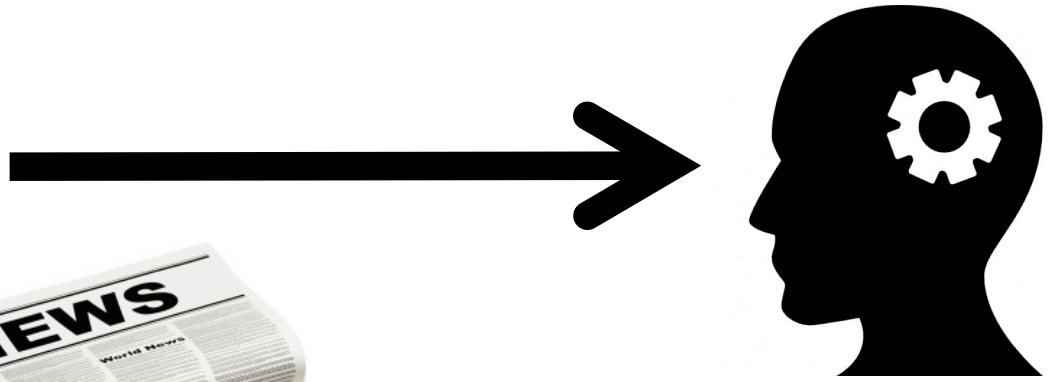
Prof. Yanhua Li

Time: 9:00am –9:50am M, T, R, and F

Zoom Lecture

Fall 2020 A-term

Web changes how people receive/publish information



One Way

On demand

Chapter 2: outline

2.1 principles of network applications

- app architectures
- app requirements

2.2 Web and HTTP

- Overview
- Persistent vs non-persistent
- HTTP message formats
- Project 1 demo
- Web cookies
- Web Proxy

Web and HTTP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Web and HTTP

First, a review…

- *web page* consists of *objects*
- object can be HTML file, JPEG image, Java applet, audio file,…
- web page consists of *base HTML-file* which includes *several referenced objects*
- each object is addressable by a *URL,* e.g.,

`www.someschool.edu/someDept/pic.gif`

host name | path name

Web and HTTP


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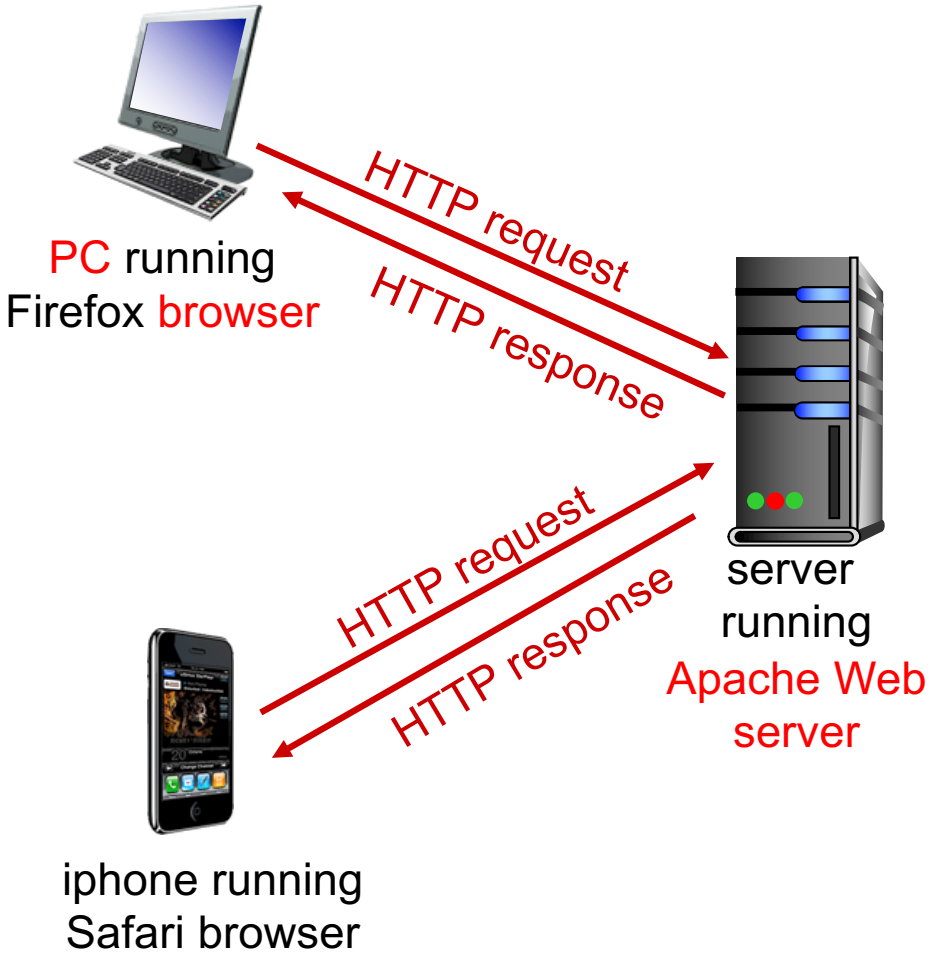
HTTP overview

HTTP: hypertext transfer protocol

- Web's application layer protocol
- client/server model
  - *client:* browser that requests, receives, (using HTTP protocol) and "displays" Web objects
  - *server:* Web server sends (using HTTP protocol) objects in response to requests



HTTP overview (continued)

uses TCP:

- 1. client initiates TCP connection (creates socket) to server, port 80
- 2. server accepts TCP connection from client
- 3. HTTP messages (application-layer protocol messages) exchanged between browser (HTTP client) and Web server (HTTP server)
- 4. TCP connection closed

HTTP is "stateless"

- server maintains no information about past client requests

aside

protocols that maintain "state" are complex!

- past history (state) must be maintained
- if server/client crashes, their views of "state" may be inconsistent, must be reconciled

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HTTP connections

non-persistent HTTP

- at most one object sent over TCP connection
  - connection then closed
- downloading multiple objects required multiple connections

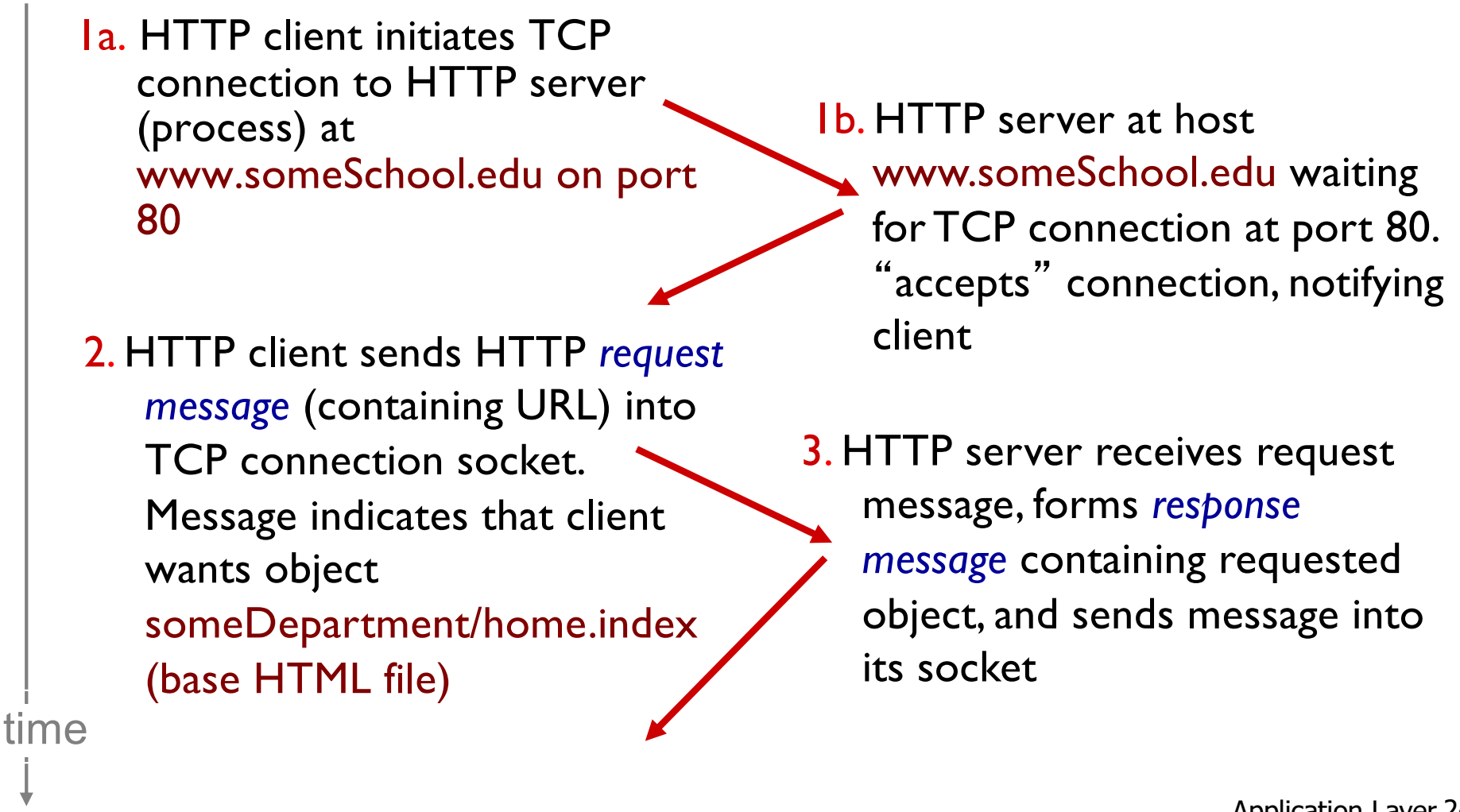
persistent HTTP

- multiple objects can be sent over single TCP connection between client, server

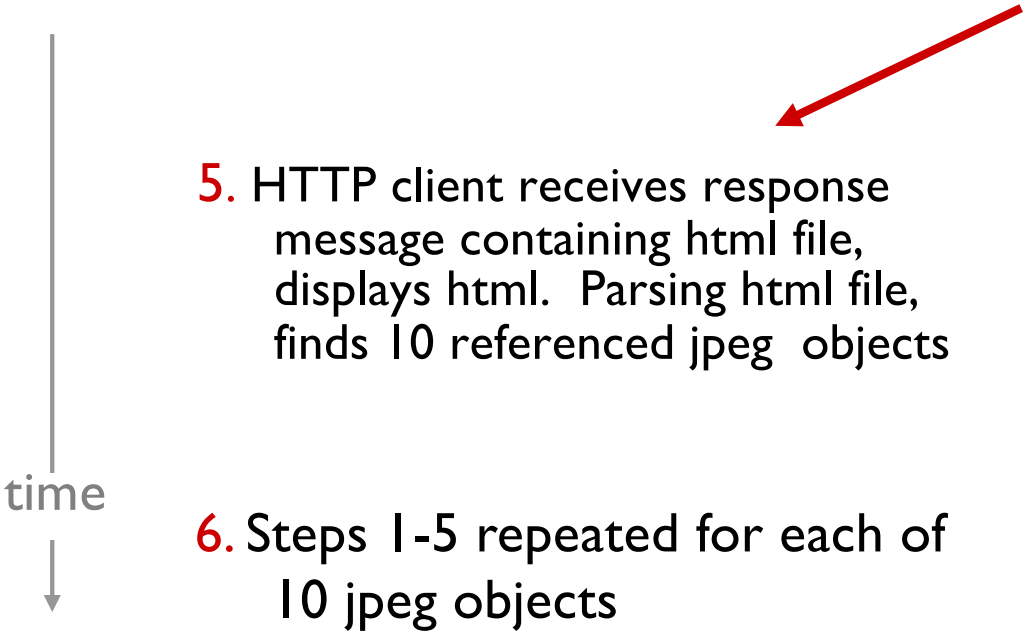
Non-persistent HTTP

suppose user enters URL:
`www.someSchool.edu/someDepartment/home.index`

(contains text, references to 10 jpeg images)



Non-persistent HTTP (cont.)



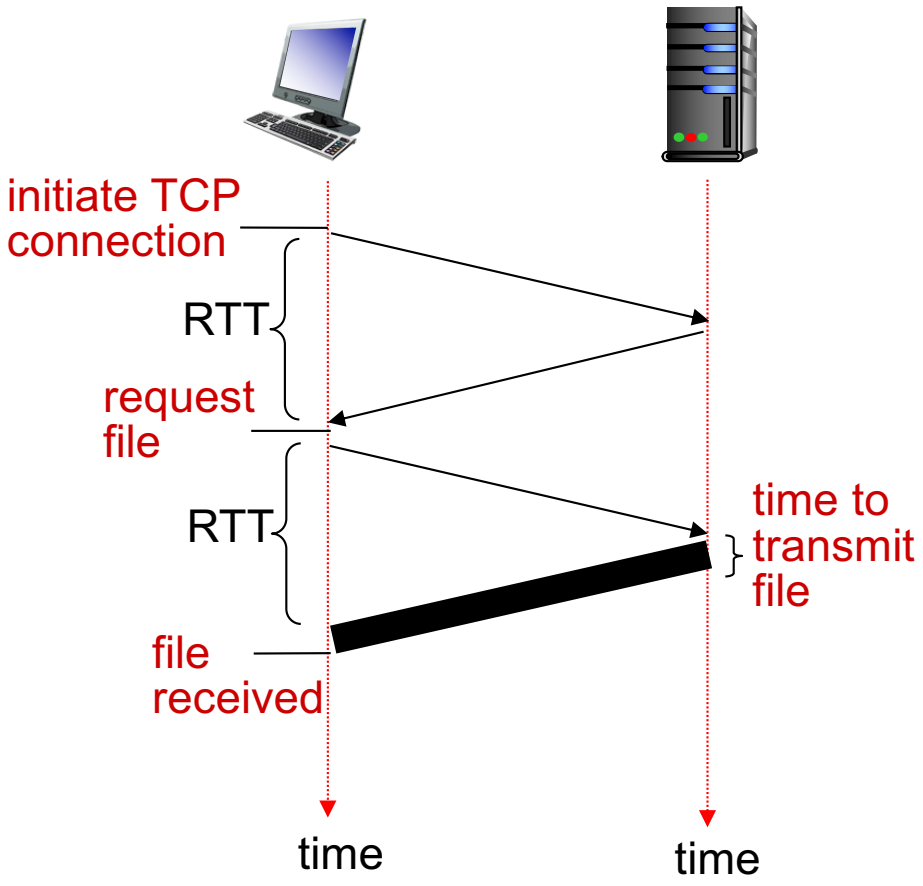
Non-persistent HTTP: response time

RTT (round-trip time): time for a small packet to travel from client to server and back

HTTP response time:

- one RTT to initiate TCP connection
- one RTT for HTTP request and first few bytes of HTTP response to return
- file transmission time
- non-persistent HTTP response time =

  2RTT+ file transmission time



Persistent HTTP (Default)

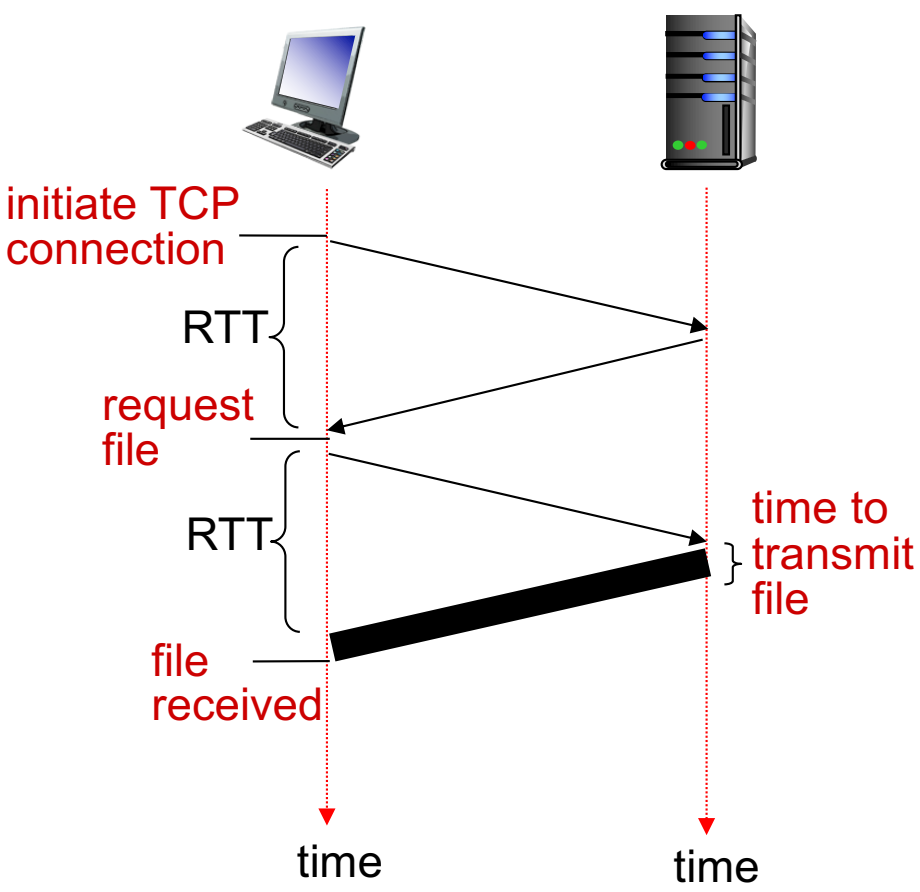
non-persistent HTTP issues:

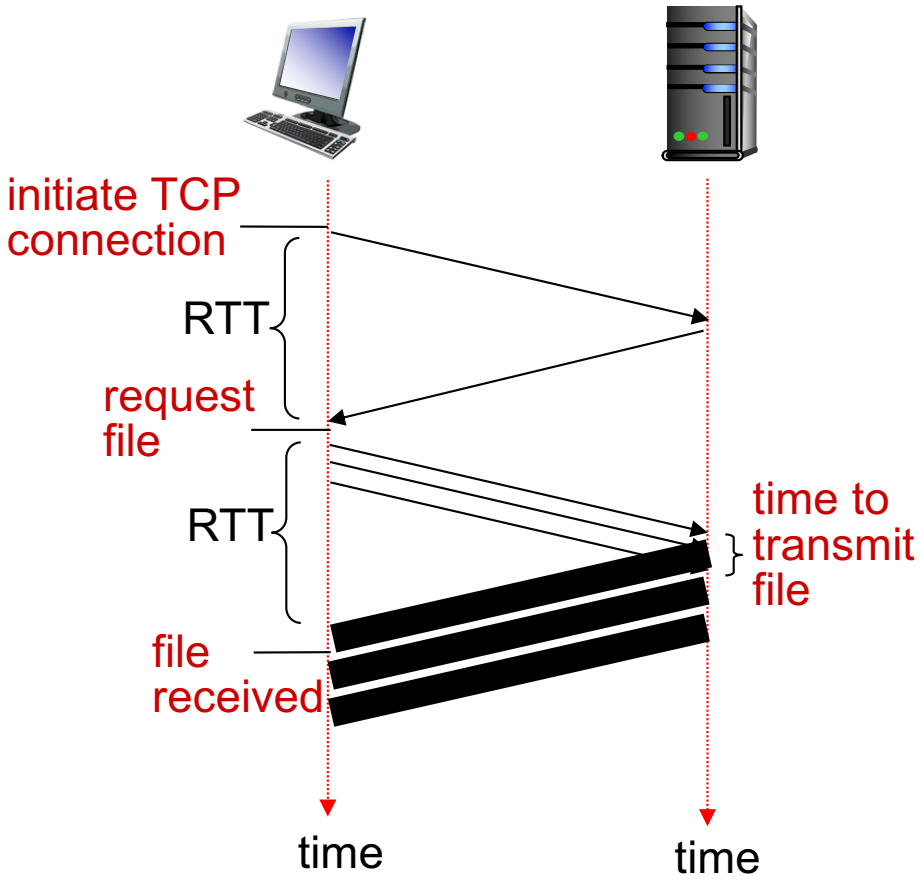
- requires 2 RTTs per object
- OS overhead for *each* TCP connection
- browsers often open parallel TCP connections to fetch referenced objects
  - 5-10
  - Adjustable

persistent HTTP:

- server leaves connection open after sending response
- subsequent HTTP messages between same client/server sent over open connection
- Back-to-back requests/responses: client sends requests as soon as it encounters a referenced object
  - as little as one RTT for all the referenced objects

Non-persistent vs persistent





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- Demo of Project 1

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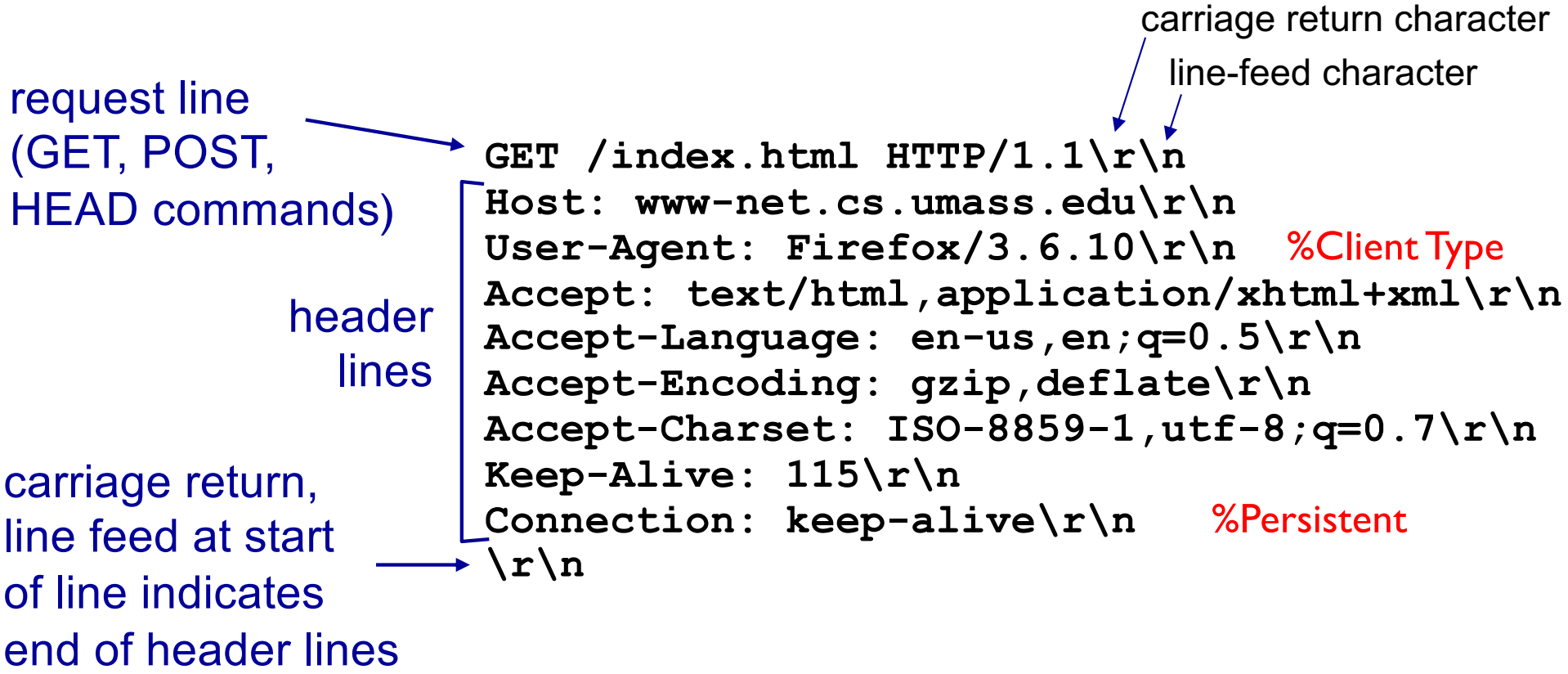
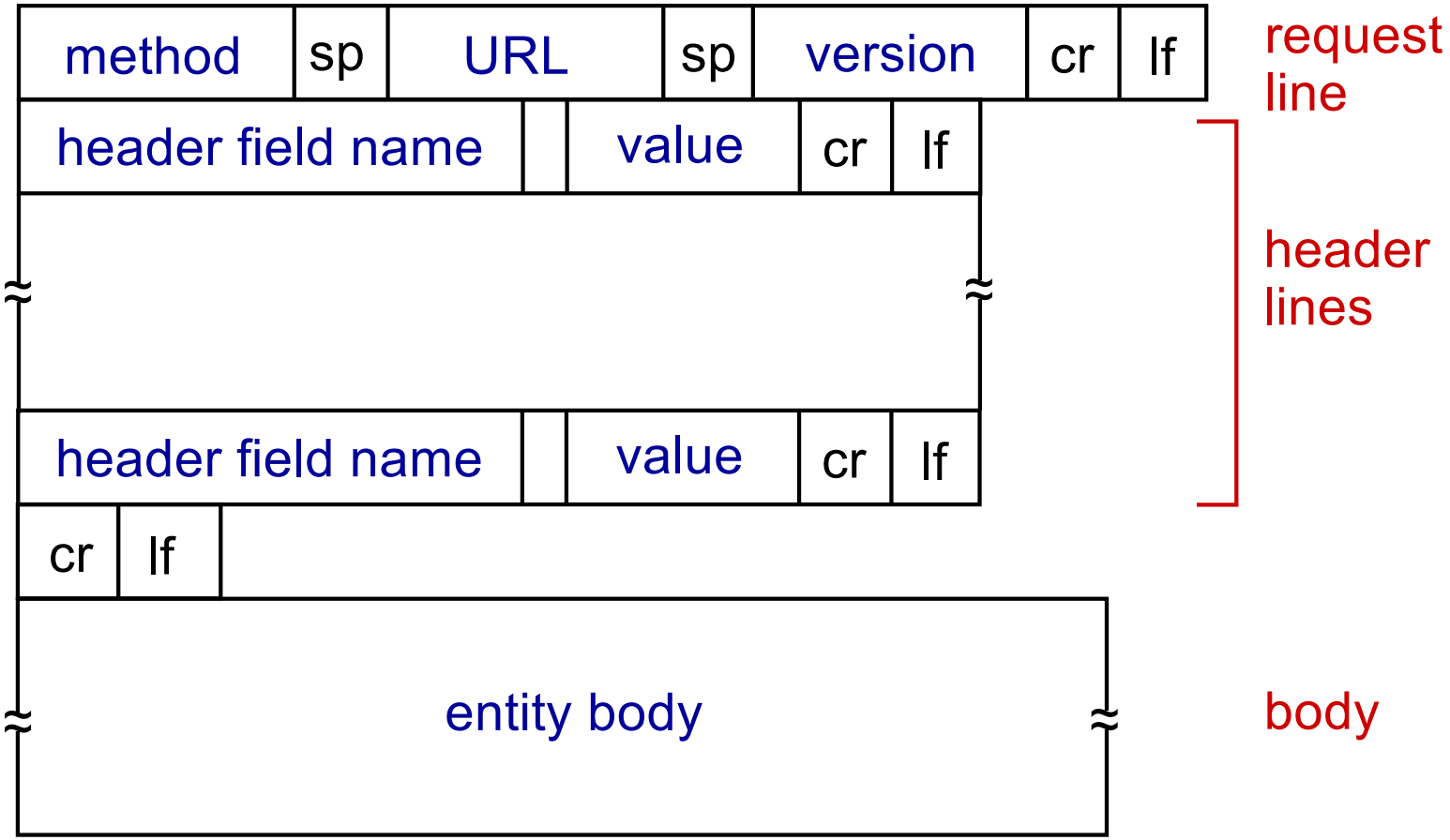
HTTP request message

- two types of HTTP messages: *request, response*
- HTTP request message:
  - ASCII (human-readable format)



HTTP request message: general format



Request from input (POST & GET)

POST method:

- web page often includes input
- input is uploaded to server in entity body

GET+URL method:

- uses GET method
- input is uploaded in URL field of request line:

```
www.somesite.com/animalsearch?monkeys&banana
```

Method types

HTTP/1.0:

- GET
- POST
- HEAD
  - asks server to leave requested object out of response

HTTP/1.1:

- GET, POST, HEAD
- PUT
  - uploads file in entity body to path specified in URL field
- DELETE
  - deletes file specified in the URL field

HTTP response message

status line (protocol status code status phrase)

header lines

data, e.g., requested HTML file

```
HTTP/1.1 200 OK\r\n
Date: Sun, 26 Sep 2010 20:09:20 GMT\r\n
Server: Apache/2.0.52 (CentOS)\r\n
Last-Modified: Tue, 30 Oct 2007 17:00:02
   GMT\r\n
ETag: "17dc6-a5c-bf716880"\r\n
Accept-Ranges: bytes\r\n
Content-Length: 2652\r\n
Keep-Alive: timeout=10, max=100\r\n
Connection: Keep-Alive\r\n
Content-Type: text/html; charset=ISO-8859-
   1\r\n
\r\n
data data data data data ...
```

HTTP response status codes

- status code appears in 1st line in server-to-client response message.
- some sample codes:

200 OK

- request succeeded, requested object later in this msg

301 Moved Permanently

- requested object moved, new location specified later in this msg (Location:)

400 Bad Request

- request msg not understood by server

404 Not Found

- requested document not found on this server

505 HTTP Version Not Supported

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User-server state: cookies

many Web sites use cookies

four components:

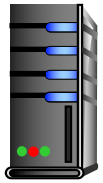
1) cookie header line of HTTP *response* message
2) cookie header line in next HTTP *request* message
3) cookie file kept on user's host, managed by user's browser
4) back-end database at Web site

example:

- Susan always access Internet from PC
- visits specific e-commerce site for first time
- when initial HTTP requests arrives at site, site creates:
  - unique ID
  - entry in backend database for ID

Cookies: keeping "state" (cont.)

client



server

ebay 8734

cookie file

usual http request msg

Amazon server creates ID 1678 for user

create entry

backend database

usual http response
set-cookie: 1678

ebay 8734
amazon 1678

usual http request msg
cookie: 1678

cookie-specific action

access

usual http response msg

time

one week later:

access

ebay 8734
amazon 1678

usual http request msg
cookie: 1678

cookie-specific action

usual http response msg

Cookies (continued)

what cookies can be used for:

- authorization
- shopping carts
- recommendations
- user session state (Web e-mail)

aside

cookies and privacy:

- cookies permit sites to learn a lot about you
- you may supply name and e-mail to sites

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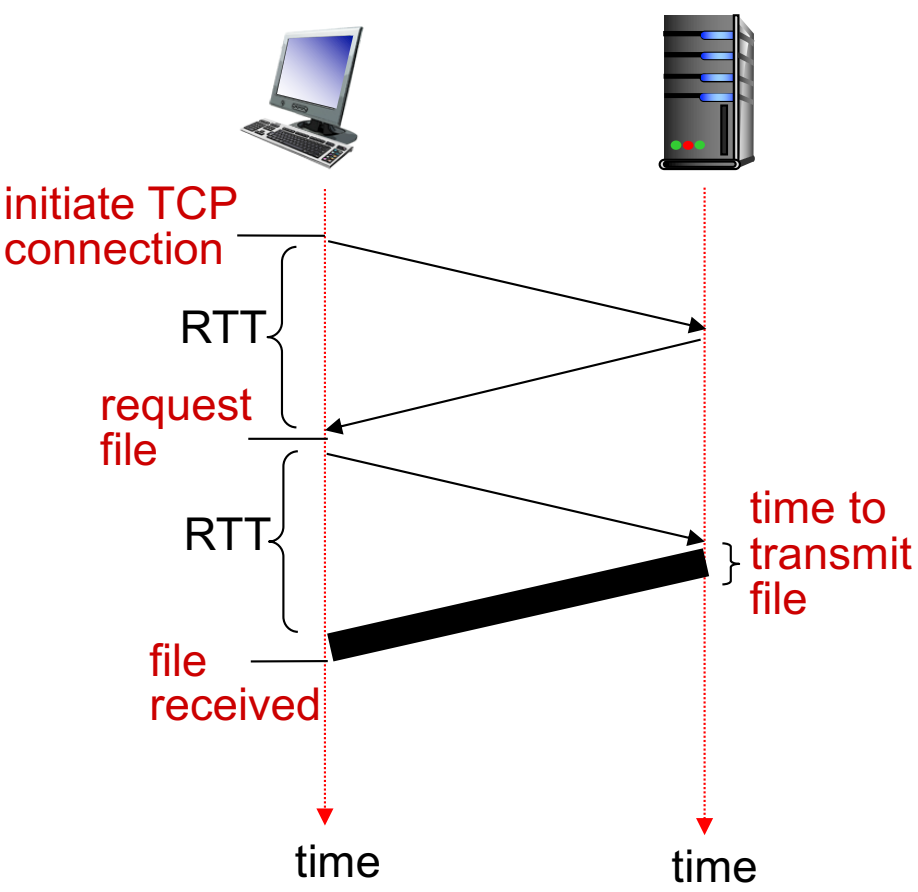
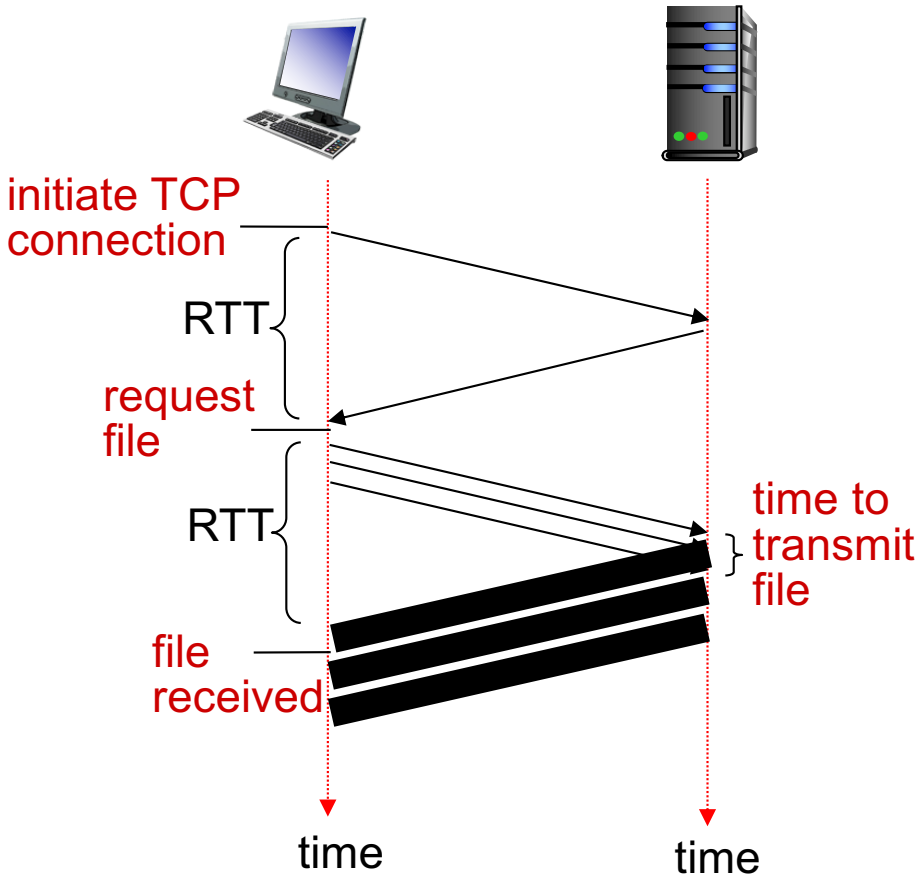
Non-persistent vs persistent





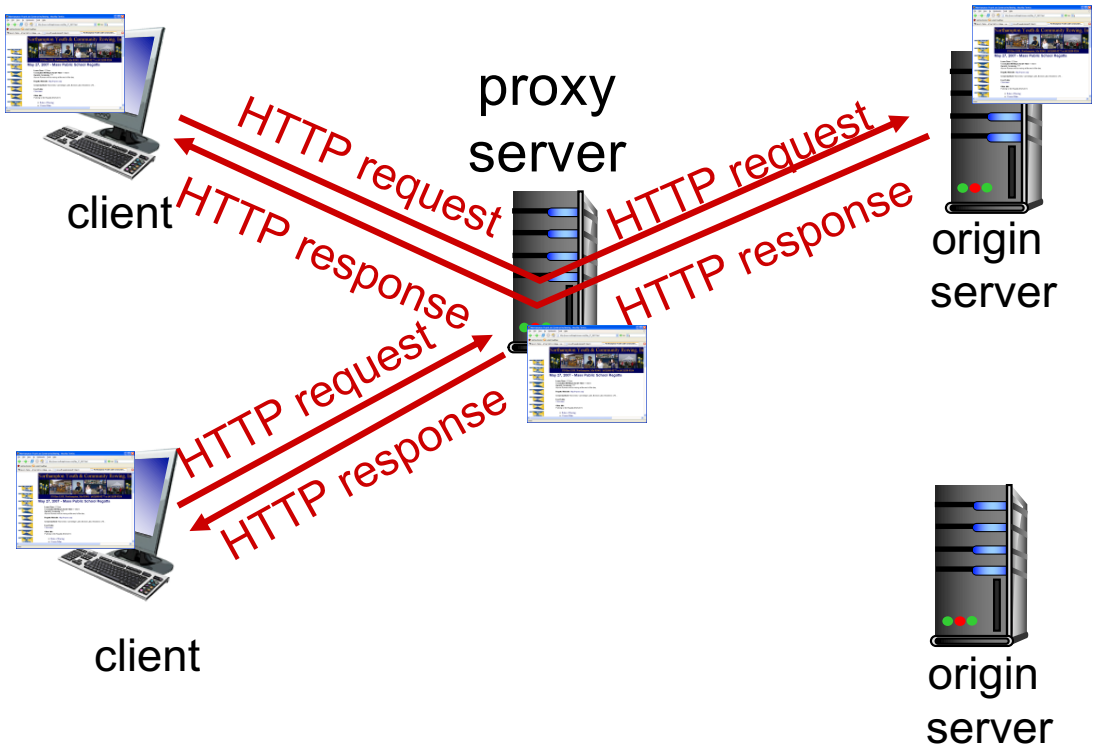
$T=N * (2 * RTT + T_{obj})$

$T=2 * RTT + N * T_{obj}$

Web caches (proxy server)

goal: satisfy client request without involving origin server

- user sets browser: Web accesses via cache
- browser sends all HTTP requests to cache
  - object in cache: cache returns object
  - Else: cache requests object from origin server, then returns object to client

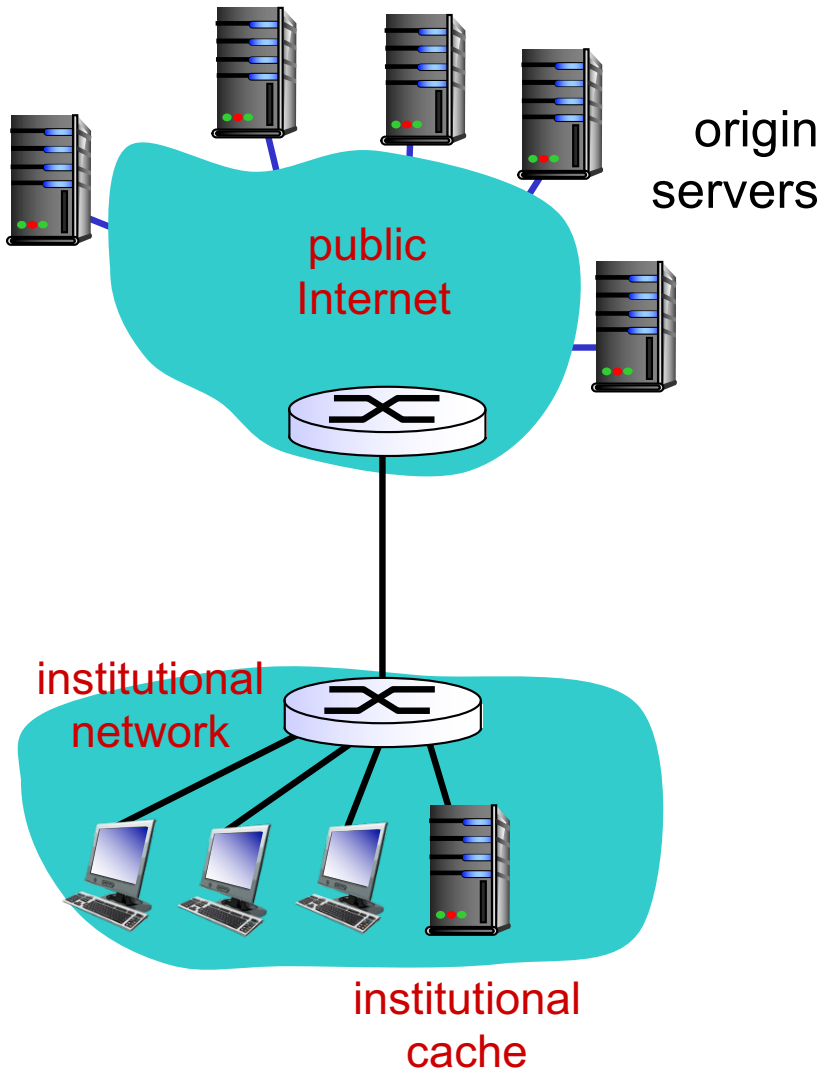


Caching example:

- total delay = Internet delay + access delay + Local area network (LAN) delay

- cache acts as both client and server
  - server for original requesting client
  - client to origin server

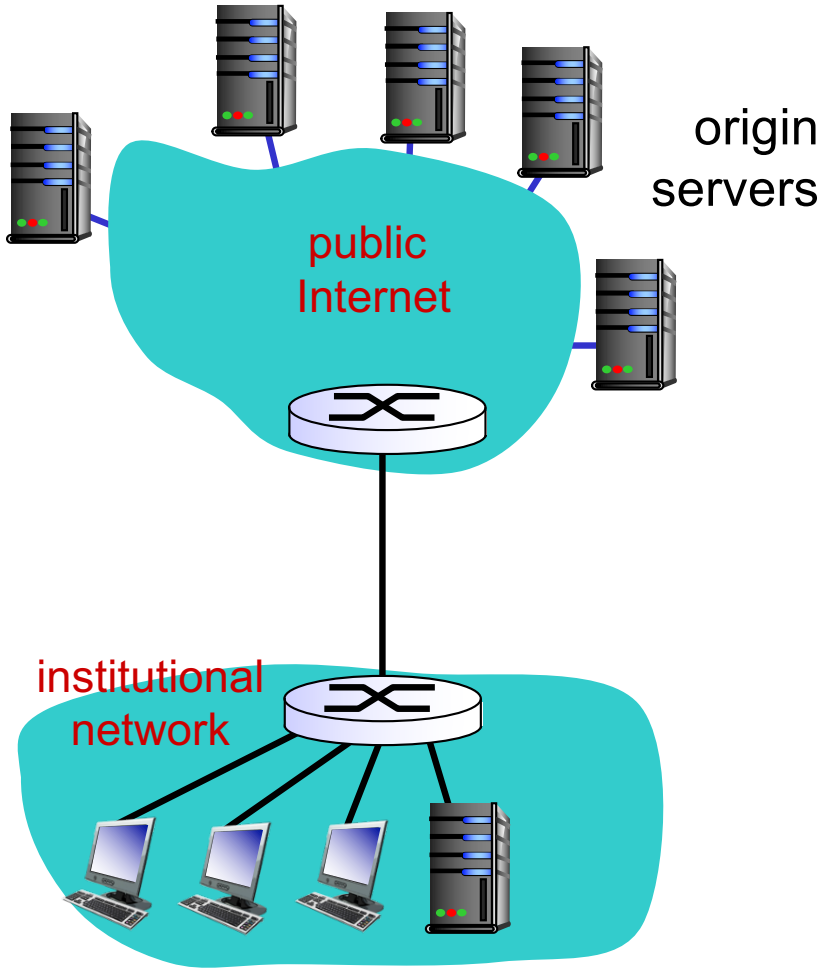
- typically cache is installed by access ISP (university, company, residential ISP)



More about Web caching

why Web caching?

- **Client:** reduce response time for client request
- **Access:** reduce traffic on an institution's access link
- **Internet:** Internet dense with caches: enables "poor" content providers to effectively deliver content (so too does P2P file sharing)



Concepts

- HTTP: HyperText Transfer Protocol
- HTML: HyperText Makeup Language
- URL: Uniform Resource Locator
- Web browser = Web Client
- RTT: Round-Trip Time
- TCP: Transmission control protocol

Questions?