National University of Computer & Emerging Sciences

CS 3001 - COMPUTER NETWORKS

Lecture 07

Chapter 2

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Office Hours: 02:30 pm till 06:00 pm (Every Tuesday & Thursday)

Chapter 2: outline

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.,

$$\underbrace{\texttt{www.someschool.edu}}_{\text{host name}}\underbrace{\texttt{/someDept/pic.gif}}_{\text{path name}}$$

Uniform Record Locator (URL)

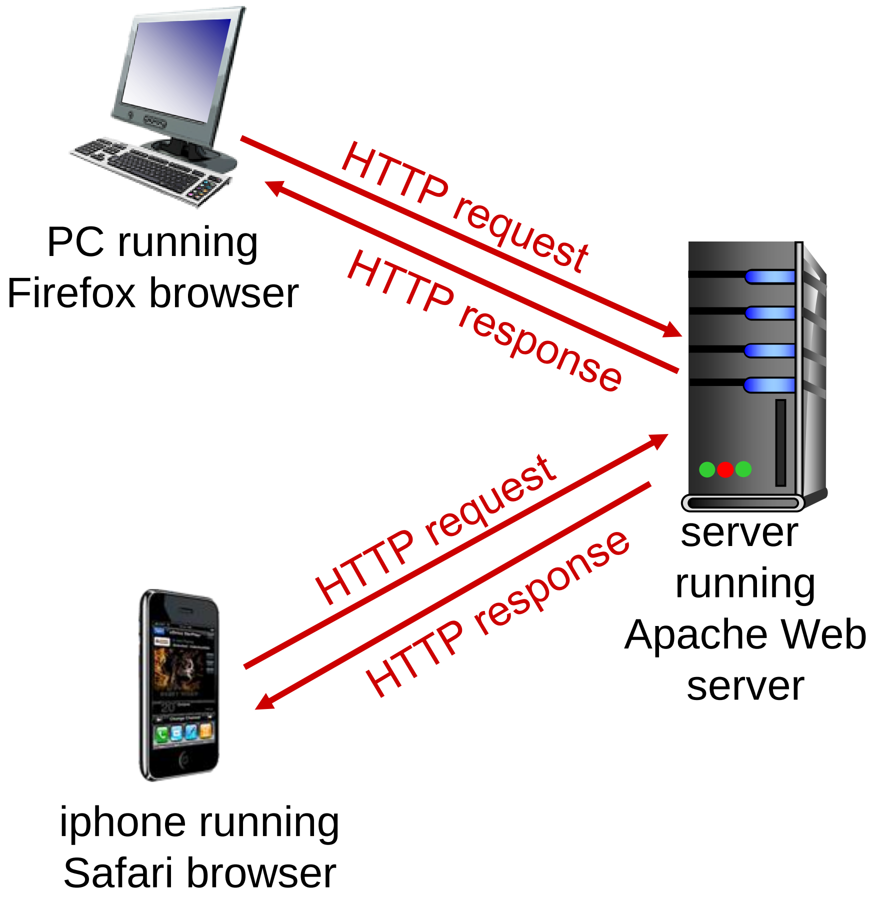
```
protocol://host-name[:port]/directory-path/resource
```

- *protocol*: http, ftp, https, smtp, rtsp, *etc.*
- *hostname*: DNS name (or domain name), IP address
- *port:* defaults to protocol's standard port; *e.g.* http: 80 https: 443
- *directory path*: hierarchical, reflecting file system (on the server side)
- *resource*: Identifies the desired resource

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 request
HTTP response
PC running Firefox browser
server running Apache Web server
HTTP request
HTTP response
iphone running Safari browser

HTTP overview (continued)

uses TCP:

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

HTTP is "stateless"

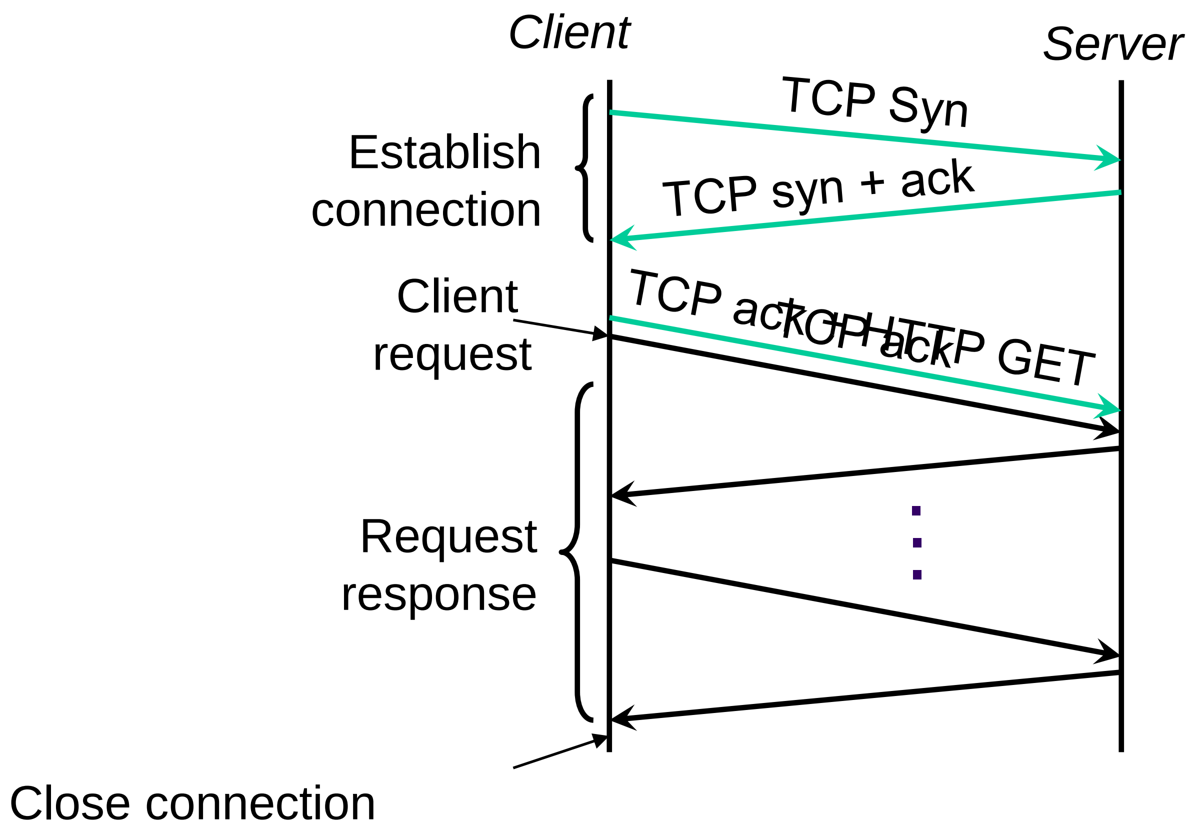
- server maintains no information about past client requests

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

Steps in HTTP Request/Response



HTTP connections

non-persistent HTTP

- at most one object sent over TCP connection
  - connection then closed
- downloading multiple objects required multiple connections
- Default in HTTP/1.0

persistent HTTP

- multiple objects can be sent over single TCP connection between client, server
- Default in HTTP/1.1 (with pipelining)

Non-persistent HTTP

suppose user enters URL:

`www.someSchool.edu/someDepartment/home.index`

(contains text, references to 10 jpeg images)

1a. HTTP client initiates TCP connection to HTTP server (process) at www.someSchool.edu on port 80

1b. HTTP server at host www.someSchool.edu waiting for TCP connection at port 80. "accepts" connection, notifying client

2. HTTP client sends HTTP *request message* (containing URL) into TCP connection socket. Message indicates that client wants object someDepartment/home.index

3. HTTP server receives request message, forms *response message* containing requested object, and sends message into its socket

time

Non-persistent HTTP (cont.)

4. HTTP server closes TCP connection.

5. HTTP client receives response message containing html file, displays html. Parsing html file, finds 10 referenced jpeg objects

time

6. Steps 1-5 repeated for each of 10 jpeg objects

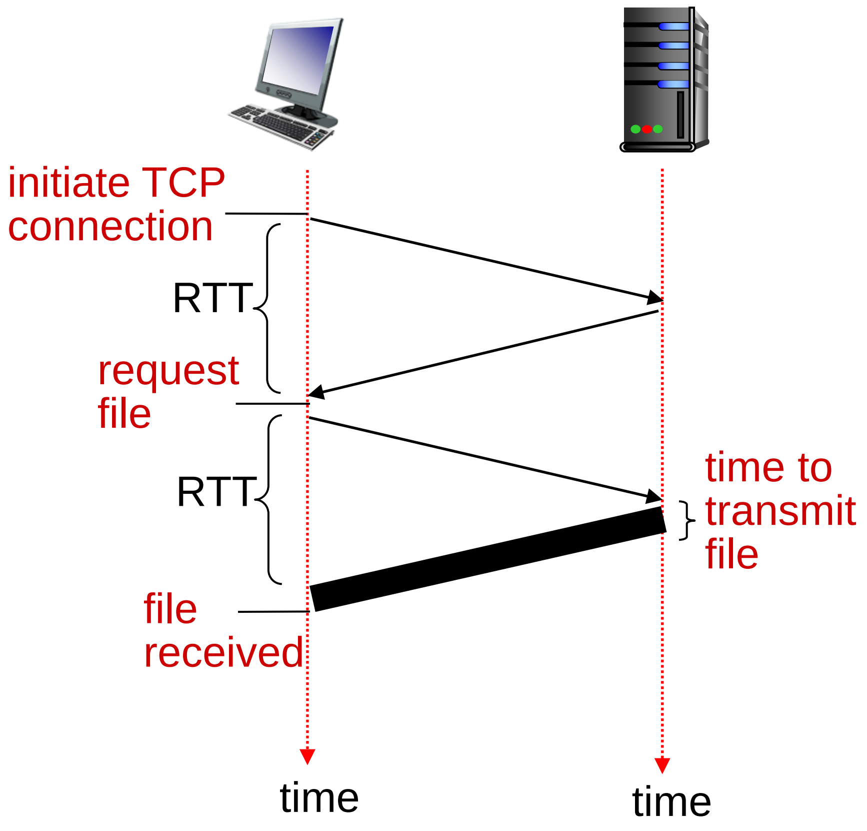
Non-persistent HTTP: response time

RTT (definition): 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



Non Persistent HTTP Shortcomings

- Most Web pages have multiple objects
  - *e.g.*, HTML file and a bunch of embedded images
- How do you retrieve those objects (naively)?
  - *One item at a time*
- Brand New TCP connection per requested object! (even for small object), thus significant TCP resources need to be allocated at both server & client side (TCP buffers)
- Burden on Web Servers which are servicing multiple simultaneous clients
- Also each object suffers a delivery delay of 2 RTTs (one to establish the TCP connection and one to request & receive the object)

Persistent HTTP

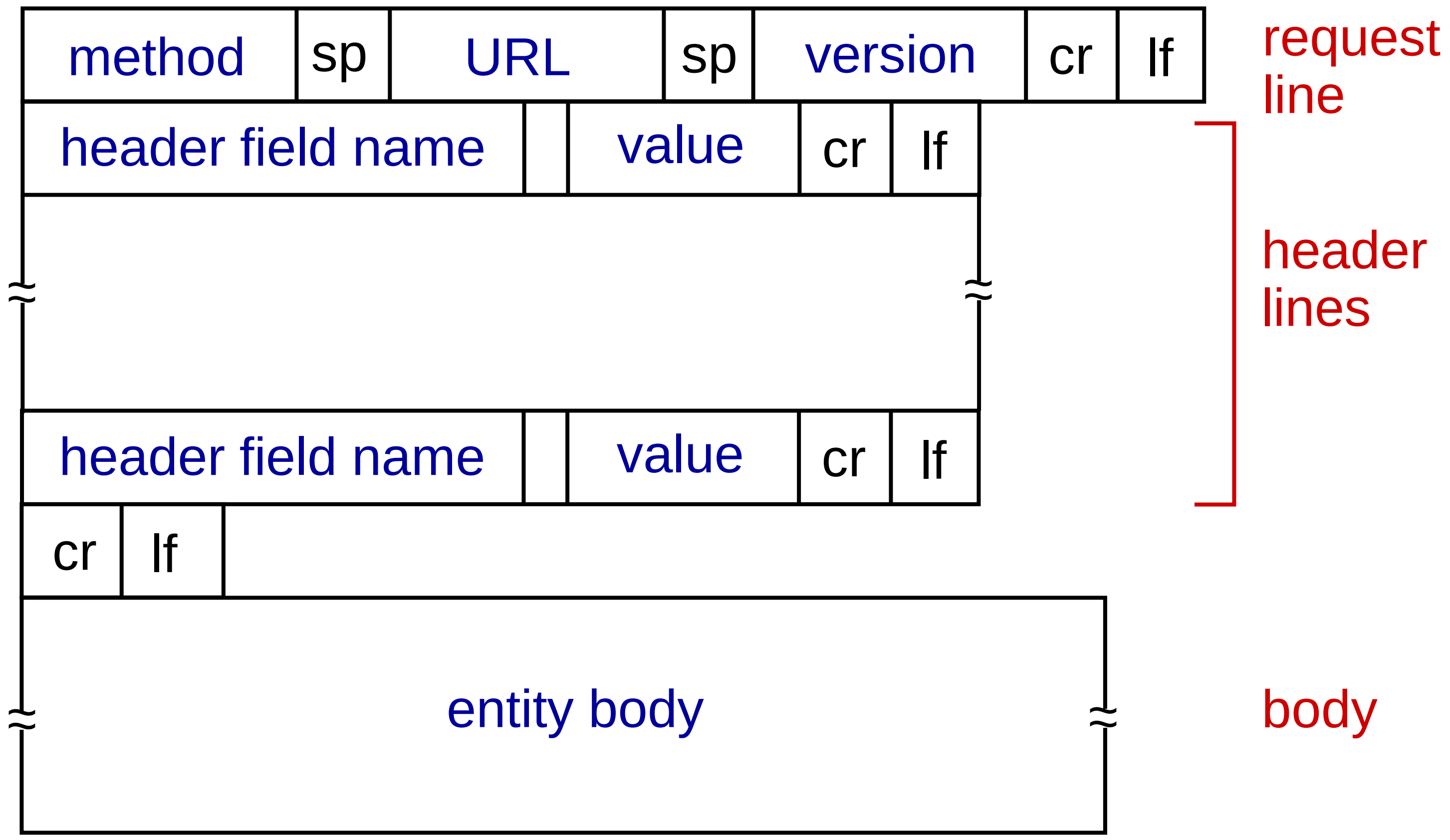
non-persistent HTTP issues:

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

persistent HTTP:

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

HTTP request message: general format



HTTP request message

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

carriage return character

line-feed character

request line (GET, POST, HEAD commands)

header lines

carriage return, line feed at start of line indicates end of header lines

```
GET /index.html HTTP/1.1\r\n
Host: www-net.cs.umass.edu\r\n
User-Agent: Firefox/3.6.10\r\n
Accept: text/html,application/xhtml+xml\r\n
Accept-Language: en-us,en;q=0.5\r\n
Accept-Encoding: gzip,deflate\r\n
Accept-Charset: ISO-8859-1,utf-8;q=0.7\r\n
Keep-Alive: 115\r\n
Connection: keep-alive\r\n
\r\n
```

Client-to-Server Communication

- HTTP Request Message
  - Request line: method, resource, and protocol version
  - Request headers: provide information or modify request
  - Body: optional data (*e.g.*, to "POST" data to the server)

request line

header lines

carriage return line feed indicates end of message

```
GET /somedir/page.html HTTP/1.1
Host: www.someschool.edu
User-agent: Mozilla/4.0
Connection: close
Accept-language: fr
(blank line)
```

Uploading form input

POST method:

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

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 (generally used for debugging)

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 ...
```

Server-to-Client Communication

- HTTP Response Message
  - Status line: protocol version, status code, status phrase
  - Response headers: provide information
  - Body: optional data

status line
(protocol, status code, status phrase)

header lines

data
e.g., requested HTML file

```
HTTP/1.1 200 OK
Connection close
Date: Thu, 06 Aug 2006 12:00:15
GMT
Server: Apache/1.3.0 (Unix)
Last-Modified: Mon, 22 Jun 2006
...
Content-Length: 6821
Content-Type: text/html
(blank line)
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`

Trying out HTTP (client side) for yourself

1. Telnet to your favorite Web server:

```
telnet cis.poly.edu 80
```

opens TCP connection to port 80 (default HTTP server port) at cis.poly.edu. anything typed in sent to port 80 at cis.poly.edu

2. type in a GET HTTP request:

```
GET /~ross/ HTTP/1.1
Host: cis.poly.edu
```

by typing this in (hit carriage return twice), you send this minimal (but complete) GET request to HTTP server

3. look at response message sent by HTTP server!

(or use Wireshark to look at captured HTTP request/response)

Quiz # 1 (Chapter – 1)

- *Quiz # 1 for Chapter 1 to be taken in the class on Thursday, 15th September, 2022 during the lecture time*
- *Quiz to be taken for own section only*

No Retake

Be on time