ELEC / COMP 177 – Fall 2015

Computer Networking
→ HTTP Revisited

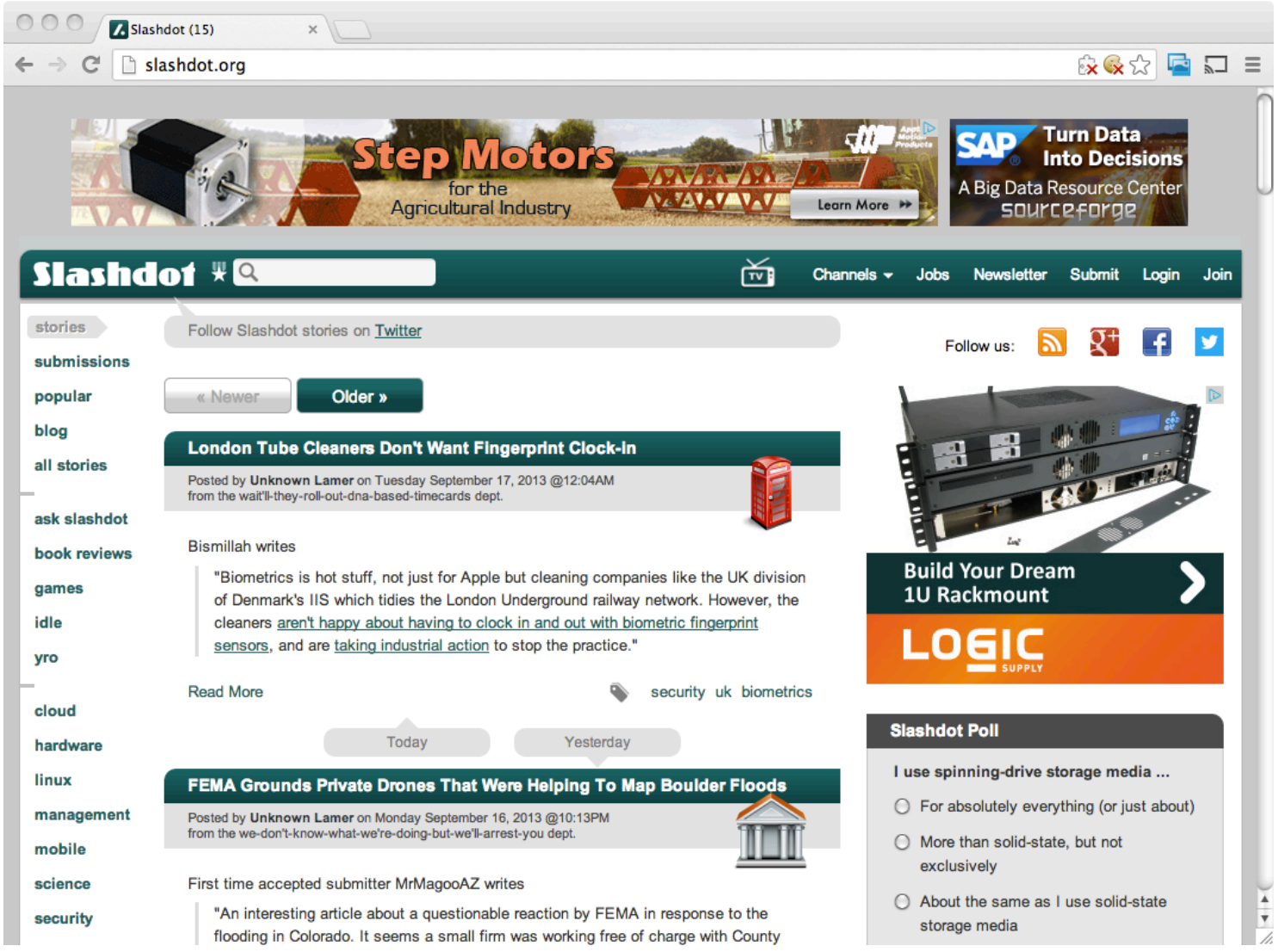
Some slides from Kurose and Ross, *Computer Networking*, 5th Edition

Upcoming Schedule

- **Project 2 – Python HTTP Server v2**
  - Starts next week!
- Checkpoint 1 - **Due Oct 4th**
- Checkpoint 1 - **Due Oct 11th**
- Final Project - **Due Oct 18th**

HTTP Operation - Revisited

State-of-the-Web



State-of-the-Web

- Loading `slashdot.org`
  - 99 requests for files
    - 15 HTML
    - 3 stylesheets
    - 36 images
    - 35 scripts
    - 2 XHR
    - 8 "other" (empty – ads?)
  - 760 KB

How can we do this quickly / efficiently?

HTTP/1.0 Operation

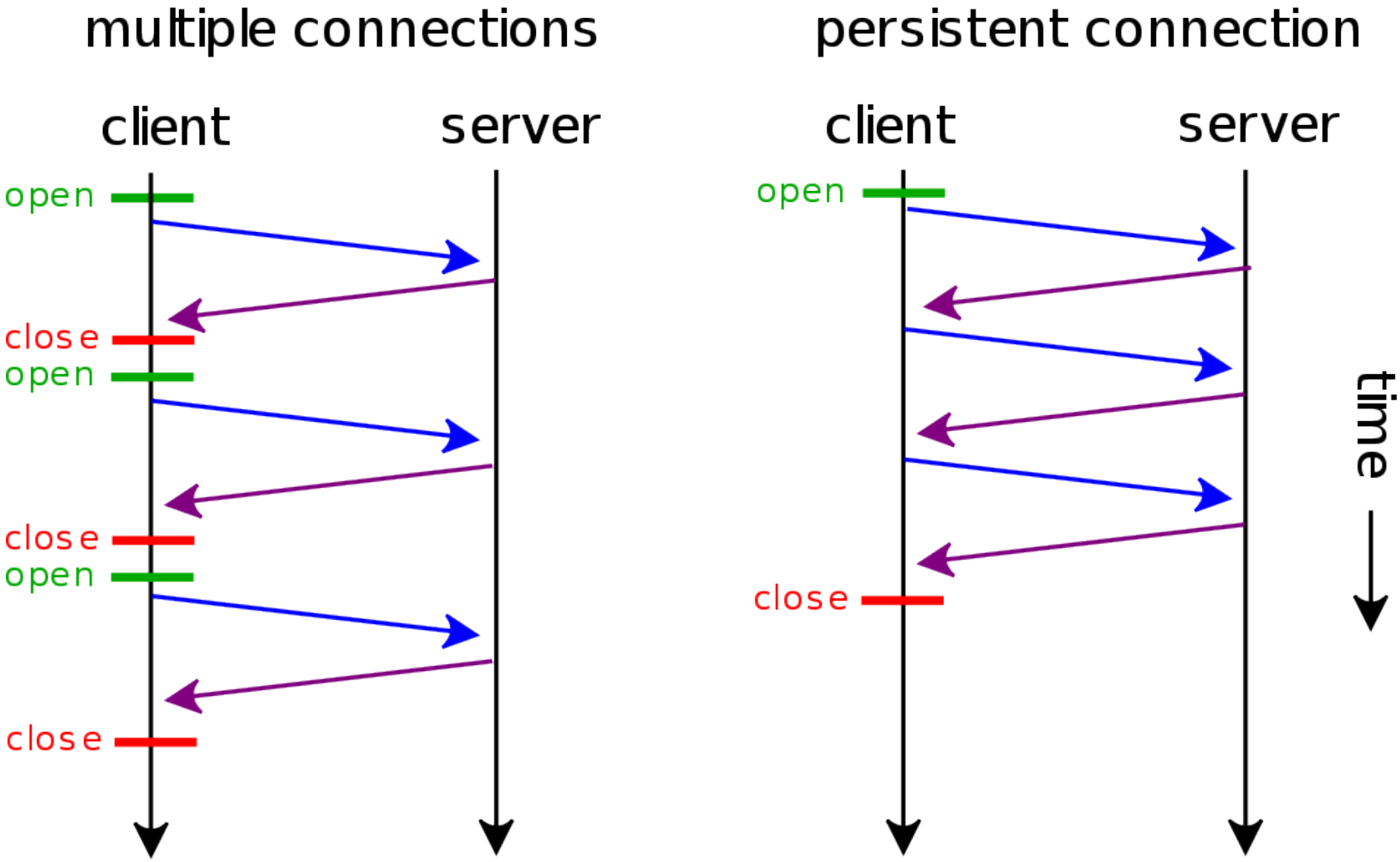
- 1 file transferred per socket connection
  - **Client** opens socket
  - **Client** sends request
  - **Server** sends reply
  - **Server** closes socket

Opportunity for improvement here…

HTTP/1.1 Operation
(with Persistent Connections, aka Keep-Alive)

- Multiple files transferred per socket connection
  - **Client** opens socket
  - **Client** sends request 1
  - **Server** sends reply 1
  - **Server** keeps socket open for "a while"
  - **Client** sends request 2
  - **Server** sends reply 2
  - **Server** keeps socket open for "a while"

Persistent Connections



http://en.wikipedia.org/wiki/File:HTTP_persistent_connection.svg

Persistent Connections

- **What are the advantages of persistent connections?**
  - **Client:** Reduced latency for requests 2-*n* (no need to open a new connection)
  - **Server:** Reduced CPU/memory usage (fewer connections to manage)

Persistent Connections

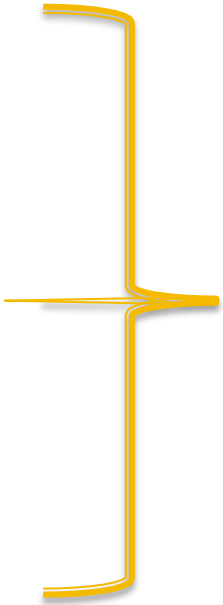
- The `content-length` header (provided by the server response) is the length of the file in bytes
- **Why is this header required when using persistent connections?**
  - The client needs to know when the **file is finished**
  - *Previously, the server closing the socket would signal the end-of-file condition*

Persistent Connections

- **What if I don't know the length of the file at the beginning? (e.g. dynamic content)**
- **HTTP Chunked Encoding**
  - New header (`Transfer-encoding: chunked`)
  - Send a "chunk" of data with a known length
  - Can send subsequent chunks with known length
  - Final chunk at end with length of zero bytes
- Client always knows
  - How much data to expect next
  - When the end-of-file is reached

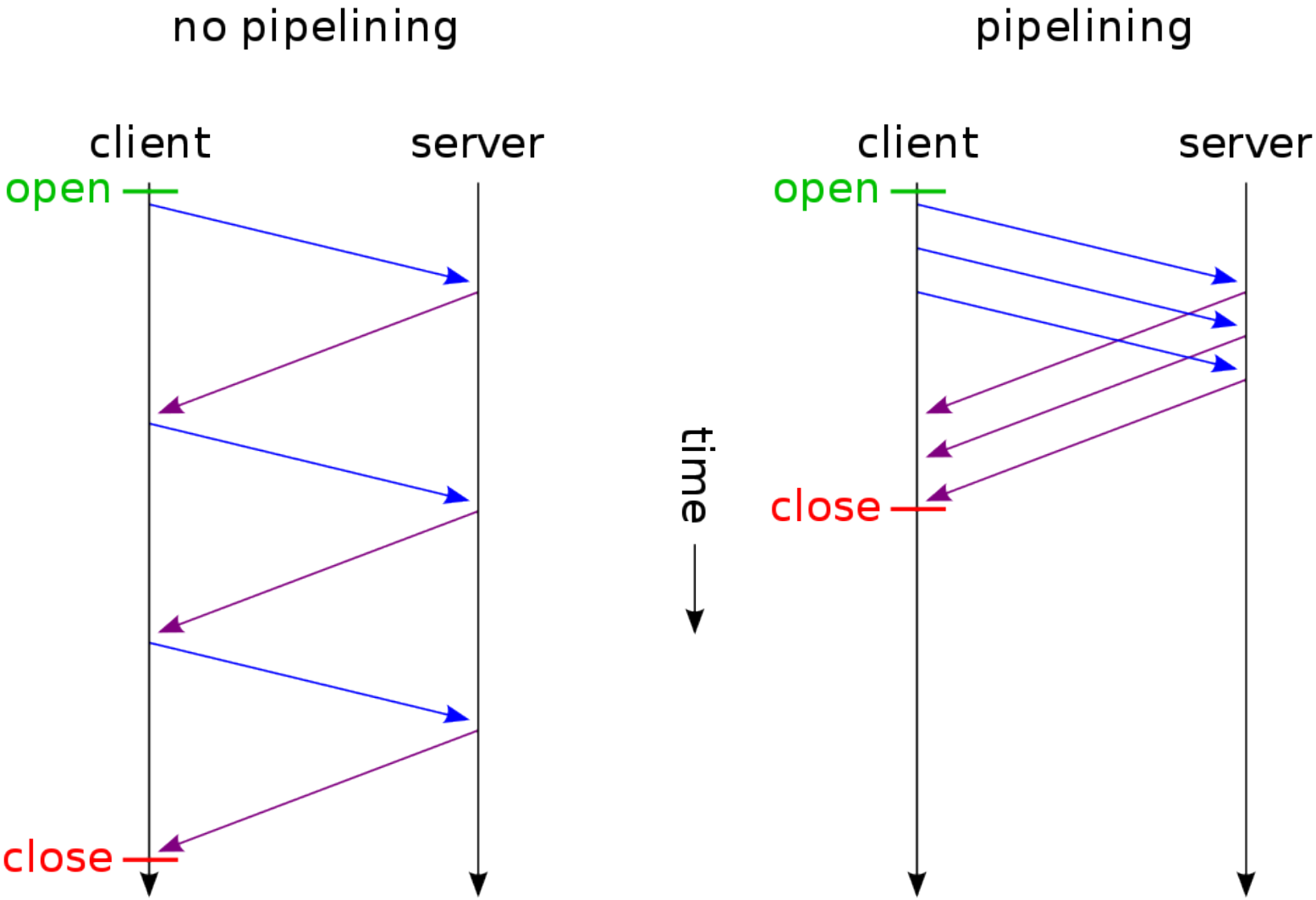
HTTP/1.1 Operation
(with Pipelined Connections)

- Multiple files transferred per socket connection
  - **Client** opens socket
  - **Client** sends request 1
  - **Client** sends request 2
  - **Client** sends request *n*
  - **Server** sends reply 1
  - **Server** sends reply 2
  - **Server** sends reply *n*
  - **Server** keeps socket open for "a while" (i.e. keep-alive)



Client and server communication can overlap. The server does not have to wait for the client to finish sending requests to reply to the first request…

Pipelined Connections



http://en.wikipedia.org/wiki/File:HTTP_pipelining2.svg

Pipelined Connections

- **What are the advantages of pipelined connections?**
  - **Client:** Reduced latency for requests 2-*n* (server can immediately send subsequent files)

- **Note:** You can have both persistent and pipelined connections together