CMSC417 Spring 2016 Lecture #20 4/20/2016

Agenda:
⇒ p4 due Friday

⇒ finish up checksums / MAC
- jamming signals — no magic signal, just any signal
- why catch errors at L2?
- using only one register — jnz, not, jnz in assembly
- polynomial division rules

⇒ HTTP / REST
⇒ Software-Defined Networking (SDN)

⇒ caches, proxies, middleboxes
⇒ rich headers: user-agent, last-modified, etc.

CMS417 Spring 2016 Lecture #20 4/20/2016

HTTP - HyperText Transfer Protocol

⇒ protocol used to access web pages
⇒ generally fetches HTML and the other content needed to display it
  - images
  - audio
  - video
  - code - javascript
⇒ can transfer nearly anything

Protocol Outline

⇒ request/response, client/server protocol
⇒ spoken over TCP
⇒ text-based and thus easy for humans to read
⇒ message format:

```
<start-line> <crlf>
<headers-one-per-line> <crlf>
<crlf>
<optional-body>
```

- start-line: either <action> <URL> <protocol> (request)
  or <protocol> <code> <status> (response)
- headers: colon-separated key-value pairs, e.g., "Content-Length: 4096"
- body: empty for MOST requests, data encoded using MIME for messages w/ bodies

CMSC417 Spring 2016 Lecture #20 4/20/2016

HTTP actions:

- ⇒ GET – give me the object at the URL
- ⇒ HEAD – just give me the metadata about the object
- ⇒ POST – put the body under the URL
- ⇒ PUT – put the body at the URL
- ⇒ DELETE – delete the object at the URL
- ⇒ TRACE – send me the body back (sees how/if modified)
- ⇒ CONNECT – used to set up connections through others
- ⇒ OPTIONS – figure out available options
  - GET, HEAD, TRACE, CONNECT and OPTIONS are "safe" b/c they don't change server state

status codes:

- ⇒ 1xx – informational
- ⇒ 2xx – success
- ⇒ 3xx – redirection
- ⇒ 4xx – client error
- ⇒ 5xx – server error

example:

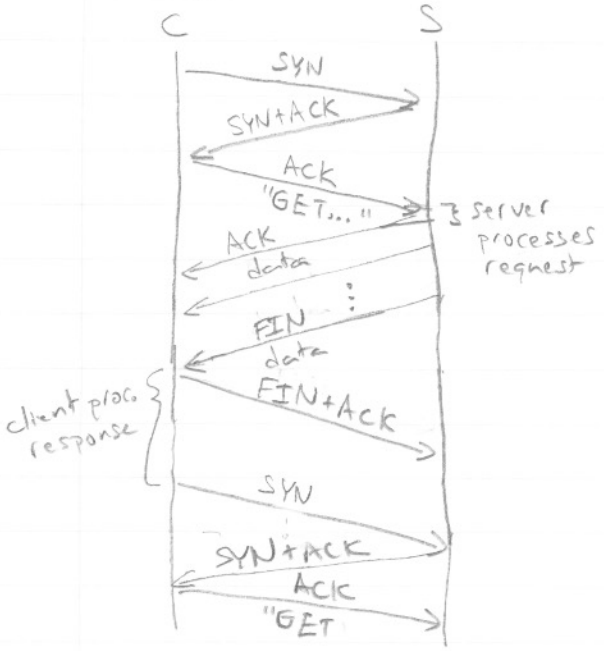
http://www.cs.umd.edu/index.htm

- http → protocol
- www.cs.umd.edu → DNS to IP
- /index.htm → resource to talk about

1) establish TCP connection to the IP address
2) send "GET /index.htm HTTP/1.1"
2) recv "HTTP/1.1 200 OK
   ⋮
   <HTML>
   ⋮
   </HTML>"

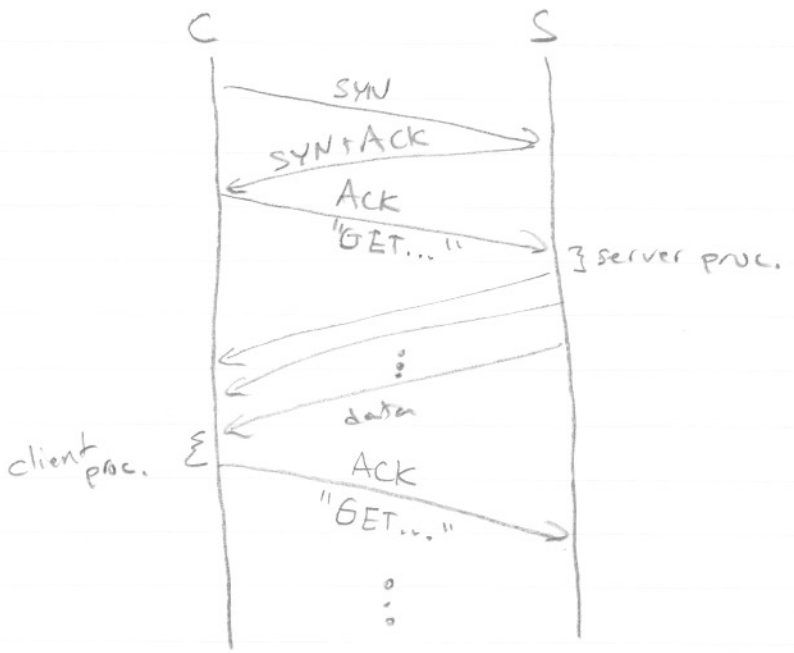
CMSC417 Spring 2016 Lecture #20 4/20/2016

HTTP 1.0



⇒ one TCP connection per item needed

HTTP 1.1 "persistent connections"



⇒ one TCP connection for many items

Persistent connections

⇒ reduce load on server — fewer connection establishments

⇒ congestion window works b/c connections last long enough for it to matter

⇒ save an RTT from every request after the first

⇒ Bad: server doesn't as easily know when it can close a connection b/c they don't know when a client is "done"

○ expire them after a timeout and deal

CMSC 417 Spring 2016 Lecture #20 4/20/2016

REST - REpresentative State Transfer

⇒ Allow for Remote Procedure Calls (RPCs) over HTTP using existing actions
  ⇒ GET ≈ getters in object oriented prog.
  ⇒ PUT ≈ setters in " " "
  ⇒ POST ≈ function call in " " "
  ⇒ DELETE has the obvious meaning
  ⇒ URLs become the objects

Good things about REST

⇒ HTTP is everywhere and has tons of good tools and libraries to work with it
⇒ Human readability makes troubleshooting, debugging, playing easy
⇒ pretty much <u>everything</u> has a REST API
  - github
  - facebook
  - twitter
  - ...

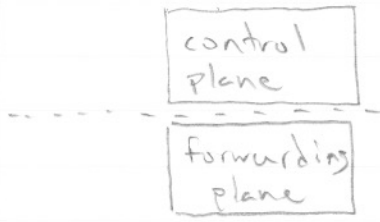
Bad things about REST

⇒ relatively high-overhead and expensive to parse, encode, and decode operations
⇒ deep application semantics can be hard to easily provide and describe using only GET, PUT, POST and DELETE

CMSC417 Spring 2016 Lecture #20 4/20/2016

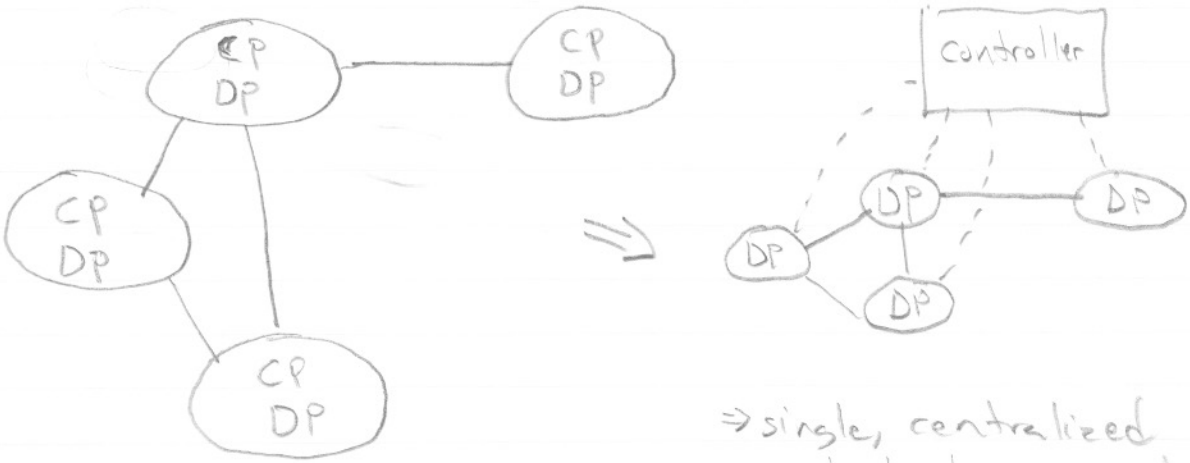
Software-Defined Networking (SDN)

⇒ traditional routers/switches:



⇒ runs on commodity CPUs
⇒ speaks STP, OSPF, RIP, etc.
⇒ runs on custom ASICs
⇒ uses table-lookups on tables populated by the control plane

⇒ key SDN realization:
- most of the new ideas in networking were modifying the control plane
- this is hard and slow b/c you need to do it to all switches/routers in a network and likely develop standards so it will work between diff. companies' switches/routers
- if we instead standardized the interface between the control and data planes, we could develop new stuff faster



⇒ control plane & data plane on every device

⇒ single, centralized control plane = controller
⇒ network devices only have data planes