DNS and HTTP

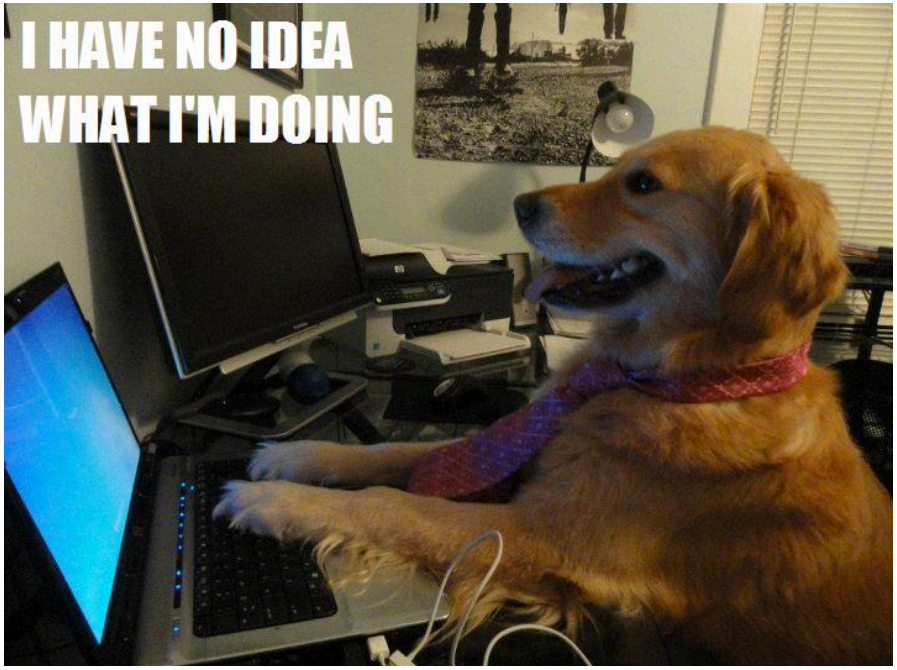
CSE 461 Section (Week 4)

Addressing So Far

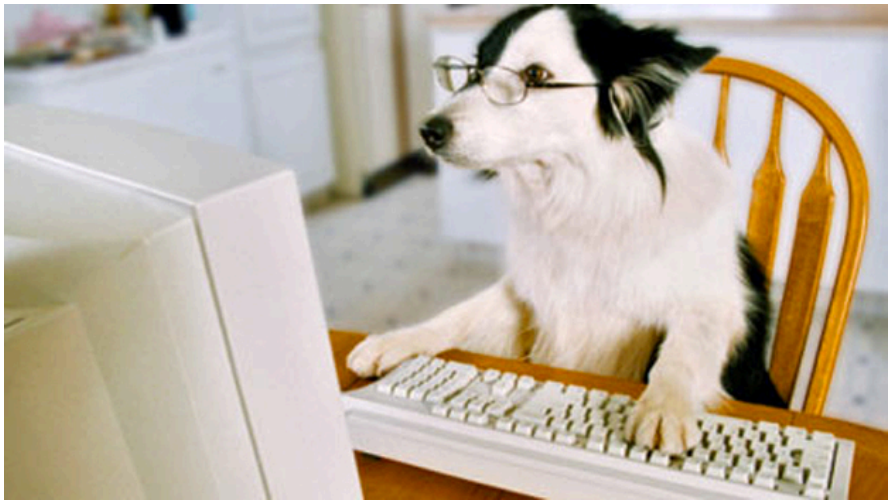
- Port numbers for applications
- MAC addresses for hardware
- IP addresses for a way to send data in a smart, routable way

Problems with MACs/IPs/Ports

- Humans (and dogs!) are bad at remembering strings of numbers
- We need a human-friendly naming system!



Requirements for Human-Readable Naming System



- What do we need?
  - As short as possible
  - Easy to memorize (i.e., not arbitrary)
  - Unique
  - Customizable
  - Hierarchical
  - Reflect organizational structure
  - A way to quickly translate to and from the existing, computer-friendly addressing systems
  - Ideally, we'd like to address specific resources as well

Enter…. Domain Names!

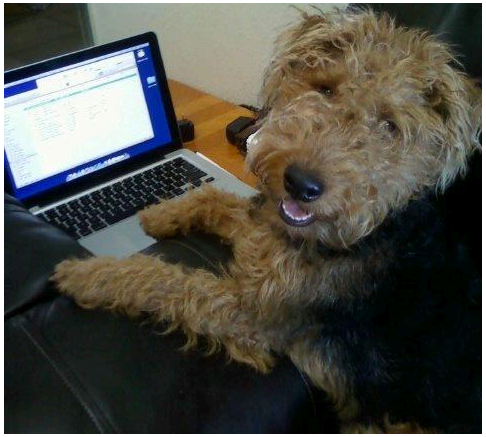
- Human-readable "domain names" map to IP addresses (names < 254 characters)
- A human can type www.google.com into their browser, and the browser will (somehow) know to go to 173.194.33.179
- But how might this be done?
  - Some sort of hash (not really practical)
  - A file of all of the mappings
  - Separate servers to provide the mappings

In the Beginning…

- All domain name/IP address mappings stored in /etc/hosts
- Live demo
- But this sucked… why?
  - Doesn't scale to large number of domain names
  - Not authoritative
  - Errors common

DNS Servers Are the Answer!

- Systems keep a small cache of mappings they know
- When a domain name is used that isn't in the cache, the system queries a name server
- Simple communication on port 53
- Database is distributed
- Hierarchical namespace: it's name servers all the way down



Resolving a Domain Name

- If I type shop.spacex.com, what happens?
  - Check /etc/hosts
  - Check local DNS server
  - Go down hierarchy and ask:
    - Ask . DNS root server
    - Ask .com TLD (Top Level Domain) server
    - Ask spacex.com's NS
    - Send HTTP request to the IP address obtained

Domain Names in Practice

- Who's purchased a domain name before?
- Name registrars
- ICANN
  - Internet Corporation for Assigned Names and Numbers
- Propagation delays

Multiple IP Addresses and Aliasing

- DNS servers can return different IP address results for the same domain name
- Why is this useful?
- Demo
- Also, multiple domain names can map to one IP address
- Why is this useful?
- Demo

Attacks and Other Fun

- What are some ways this system can break?
  - DoS attacks on DNS server
    - Done before, in 2002 and 2007
    - Not much impact due to filtering and caching
  - Return incorrect IP address to a DNS request
  - Could even return the IP of our own server!
    - Commonly done by ISPs
  - Compromise root servers
- Google DNS

HTTP Request Types

- GET
  - Page, please
- HEAD
  - Metadata, please
- POST
  - Here's some data—update what you have
- PUT
  - Here's some data—create a new resource
- CONNECT
  - Make a tunnel for me through your proxy!

CONNECT and Tunneling

- CONNECT requests say, “give me a tunnel!”
- Used for communication via proxies
- It’s a virtual connection—it means “forward all of the packets that I send to the destination, and vice-versa
- You don’t *have* to use CONNECT with proxies…
- But you do when HTTPS/SSL is used… why?

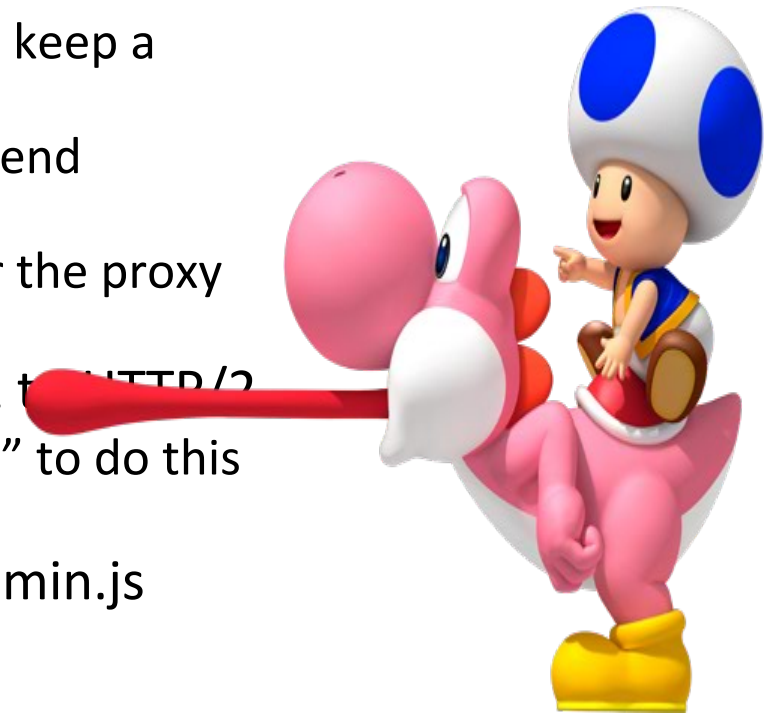
HTTP Headers: Host

- Specifies the hostname (and, optionally, the port) to which to send a request

- Example:
  GET /Passport.aspx?popup=1 HTTP/1.1
  Host: www.bing.com
  User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64; rv:34.0) Gecko/20100101 Firefox/34.0
  Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
  Accept-Language: en-US,en;q=0.5

HTTP Headers: Connection

- Standard header for keep-alives
  - "Connection: keep-alive" is sent to keep a connection alive
  - If you don't want to keep it alive, send "Connection: close"
  - We'll rewrite packets to do this for the proxy project
- Also used to switch from HTTP /1.1 to HTTP/2
  - Client sends "Connection: upgrade" to do this
- Example:
  GET /ajax/libs/jquery/1.7.1/jquery.min.js HTTP/1.1
  Host: ajax.googleapis.com
  Connection: keep-alive
  Accept: */*



Buffering Requests

- When writing a proxy, you may want to buffer requests
- This is a good idea to keep your network traffic and thread consumption reasonable

TCP Streams

- UDP sends a string of messages; no concept of "connection"
- TCP is like a direct pipe from one node to another
  - No concept of message boundaries
  - Easy to associate data with the data that preceded it
  - Gives you guarantees that data you send will arrive