

# **ECE 435 – Network Engineering**

## **Lecture 18**

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# Announcements

- Project ideas, only have 6 peoples
- Will try to post HW#8 soon
- Usenet, September that never ended



# Internet Applications

- Often Client/Server
- Server “daemon”
- Listens on port – IANA “well-known” ports 0-1023, Registered ports: 1024-49151, Dynamic/Private 49152-65535
- Start at boot time? Old days inetd, these days systemd



# Server Types

- Concurrent – handle multiple connections at time (forks or threads)
- Iterative – handles one connection at a time, rest wait on queue
- Iterative Connectionless – common+trivial, short lived
- Iterative Connection – high latency
- Concurrent Connectionless – when need fast turnaround,



low latency DNS, NFS

- Concurrent Connection – widely used. WWW.



# Protocols

- What type of protocol should talk?
- Fixed-length binary?
- Free-form ASCII text?
- 7-bit ASCII vs Unicode?



# Domain Name System (DNS)

- Why do we need it? Send e-mails to vince@192.168.8.1?  
What if server moves?
- Hierarchical distributed database
- RFC 1034, 1035
- Maps hostnames to IP addresses
- In early days NIC.arpa has a “HOSTS.TXT” file you downloaded occasionally with all known machines. Didn't really scale.
- /etc/hosts is a relic of this, usually checked first



- On Linux this is configured via `/etc/nsswitch.conf`





# Domain Names

- Which ones can you name? .com/.org/.gov/.edu/.net/.mil
- Country codes (.us/.uk/.ie etc)
- Huge expansion in the last few years (.horse)
- Owner of a domain can subdivide, i.e. eece.maine.edu
- How do you buy them? Used to be fairly expensive and only for two years at a time from a single registrar. Not so much anymore.



- whois will show you info on who owns

- rules? single-digit? non-ascii chars?

Can have 127 levels, each 1-63 chars. Usually total name cannot exceed 253 chars. LDH (letters,digits,hyphens, cannot start with hyphen, not all numbers) International names: “punycode”. Trouble, why? Foreign letters that look like ASCII ones.

First commercial name 15 March 1985 symbolics.com  
example.com set aside (why be careful with your example names?) Shortest? g.cn. Various one-letter domains (like x.org) but they were later reserved.



Typosquatting, domain squatting, copyrighted names, etc.

- punycode – snowman example <http://xn--n3h.net/>



# DNS Server

- Listens on port 53, usually UDP
- Zone records
  - Owner, TTL (how long to cache)
  - Class (usually IN for internet)
  - Type and RDATA (resource data)
  - Common types
    - SOA – start of authority (parameters) primary source, e-mail of admin
    - A – IPv4 address of host (32bit int)



linux.deater.net 86400 IN A 1.2.3.4 can have multiple and be cycled through round-robin

- AAAA – IPv6
- MX – Mail exchange (can have multiple, specify priority)
- NS – name sever (name server for this domain)
- CNAME – Canonical name, allows aliases
- PTR – alias for IP, for reverse lookup  
4.3.2.1.in-addr.arpa
- HINFO – cpu and OS type (text) (uncommon)
- TXT – raw ASCII text



- Can you store other things in records? Text adventure?  
File transfer? Tunneling (iodine?)



# DNS client

- Name resolver, translate from ASCII (still?) name to IP addr
- First check `/etc/nsswitch.conf` which might say to check `/etc/hosts` and maybe NIS/LDAP first
- Query via UDP local nameserver (`/etc/resolv.conf`)
- If it's the official nameserver, get authoritative response otherwise might be cached
- If local DNS server doesn't know about it, it has to ask up the chain.



- If not known, query “root” server. So if looking up weaver-lab.eece.maine.edu will ask root, which will direct to .edu DNS server
- Used to be (still?) 13 root servers, mostly in US
- Recursive query It will not likely know but will know about maine.edu, so ask that one, which will ask eece.maine.edu, etc, and then passed back
- Result is then cached along the way (TTL) caching up to 68 years (or none at all). Why low values? Why can that be bad?
- Caching also means usually the root server does not have





to respond to each request

- Can also do non-recursive (iterative)
- breaking out of circular queries
- Packet format
- BIND/named
- dig / nslookup tools



# e-mail

- Been around since more or less start of networks
- ARPANET, Ray Tomlinson credited with first modern e-mail around 1971, decided to use '@' char
- UNIX mail, just a mail spool on your computer. Could use command line "mail" to send it.  
`/var/spool/mail/username`
- biff to interrupt you when mail came in (used to be exciting)
- mbox vs maildir. mbox format, tell each new e-mail via



From:. So has to be escaped, you'll see this sometimes.

Locking

- Want to send machine-to-machine e-mails. Various ways to do this. UUCP, etc.
- UUCP bang paths
- Big push for standards. X.400, but regular e-mail won out



# Internet e-mail

- Compose message, send to outgoing server
- deliver to mailbox, collected
- user@host.network
- can often leave off subhost, looks up mailserver for domain via DNS



# e-mail process

- Sender machine: MUA (mail user agent) sends by SMTP (simple mail transport protocol) to
- MTA (mail transfer agent) to
- Receiving MTA
- to mail delivery agent (puts into file/mailbox)
- Receive MUA on local machine via POP3/IMAP
- MUA – editor (optional) mutt/pine/thunderbird/outlook  
Often these days replaced by browser app  
can you use telnet as MUA?



- MTA – sendmail/qmail/postfix  
speaks SMTP. sendmail was standard, has more or less incomprehensible config setup
- MDA – fetchmail? deliver mail to mailbox. Possibly just a single file, can also be series of directories
- MCA – retrieve e-mail via IMAP or POP



# e-mail layout

- envelope
- header/body
- RFC 822/2822/5322
- originally plain 7-bit ASCII, anything more needs MIME and other extensions
- Headers
  - From:
  - Reply-to:
  - Received: (each transfer agent adds in)



- Return-path:
- To:
- CC: (carbon copy)
- BCC: (blind carbon copy)
- Message-In:
- In-Reply-To:
- Subject:
- Date:
- X-





# MIME

- How do you send unicode/8-bit ASCII (accents) or Chinese/Japanese
- How do you attach audio/images?
- Multipurpose Internet Mail Extensions (RFC-1341)
- Backwards compatible
- Message headers:
  - MIME-Version:
  - Content-Description:
  - Content-Id:



- Content-Transfer-Encoding:
- Content-Type:
- Encodings:
  - regular e-mail 7-bit ASCII lines less than 1000 chars
  - Same, but 8-bit
  - base64 – groups of 24 bits broken into 4 6-bit parts, each a legal ASCII. A=0 B=1 then lower case digits, + /
  - quoted-printable – 7-bit ASCII but higher characters encoded with = sign (hex digits) equal sign =3D
  - multipart

