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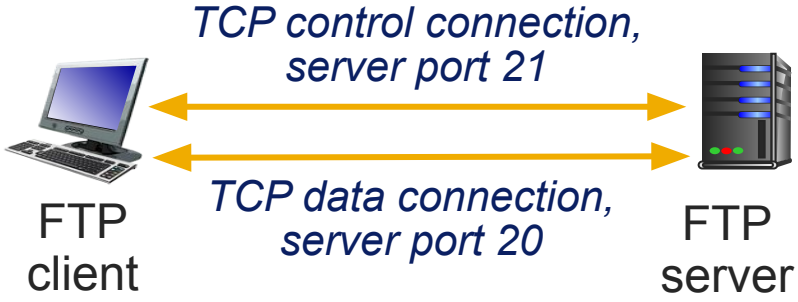
Chapter 2

FTP, SMTP, and DNS

File Transfer Protocol (FTP)



- FTP communicates over two connections
  - Port 21 for control information
  - Port 20 for data

- Differences from HTTP
  - Control communication “out-of-band”
  - Server maintains per client state: authentication, current directory

- FTP procedure:
  - FTP client contacts FTP server at port 21, using TCP
  - Client authorized over control connection
  - Client browses remote directory, sends commands over control connection
  - When server receives file transfer command, server opens 2nd TCP data connection (for file) to client
  - After transferring one file, server closes data connection

Why use a separate control connection?

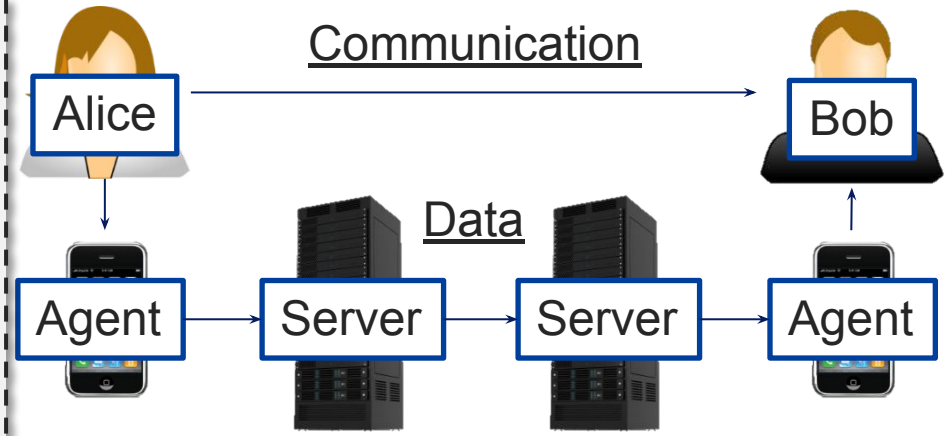
Simple Mail Transfer Prot. (SMTP)

```
MAIL FROM: <mike.wittie@montana.edu>

RCPT TO: <mwittie@gmail.com>

DATA
Subject: Hello

there.
.
```



- Differences with HTTP
  - Much older – all content encoded as 7bit ASCII (no utf-encoded strings)
  - Even more verbose
  - SMTP primarily a push protocol, HTTP primarily pull

- Questions
  - Why not send the message directly between agents?
  - Why not have Alice's agent contact Bob's server directly?
  - How is email different from online social networks?

Domain Name System (DNS)

- People like mnemonics
  - Ex. `montana.edu`
- Routers like fixed width addresses
  - Ex. `153.90.3.95`
- How to map between the two?

- Domain Name System:
  - Database of mappings between host mnemonics and IP addresses
  - Application layer protocol
    - Hosts communicate with DNS to resolve names
    - Lookups over UDP on port 53

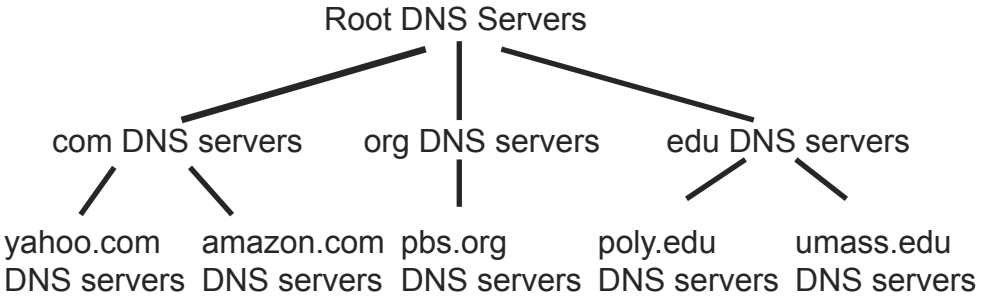
- Example:

Demo

Come up with an architecture for DNS

DNS architecture

- A distributed database
  - No DNS server has all the records!
  - Hierarchical organization
- Root DNS servers
  - Responsible for TLD servers
- Top-level domain (TLD) servers:
  - Responsible for com, org, net, edu
  - And top-level country domains, e.g.: uk, fr, ca, jp
- Authoritative DNS servers:
  - Organization's own DNS with up-to-date records



- Local DNS servers
  - Not part of the hierarchy
  - Acts as proxy for local DNS queries
  - May contain cached records
- Complexity at the "network edge"

DNS root servers

DNS Services

- DNS services
  - Hostname to IP address translation

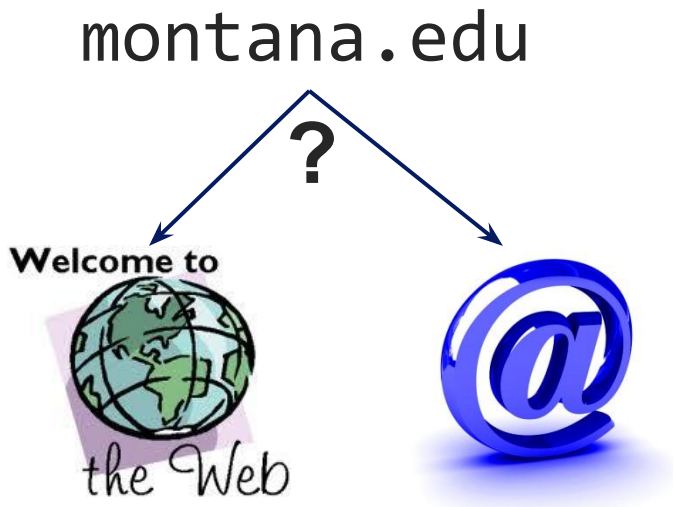
    `host montana.edu`
  - Hostname to IPv6 address translation
    - `host -t AAAA montana.edu`
  - Host aliasing

    `host -t CNAME img.huffingtonpost.com`
  - Mail server aliasing

    `host -t MX montana.edu`
  - Load distribution

    `host huffpost.com | grep "address" | sed -n -e 's/^.*address //p'`
  - Redirection
    - Look up same host from servers in different regions

    `host google.com 8.8.8.8`

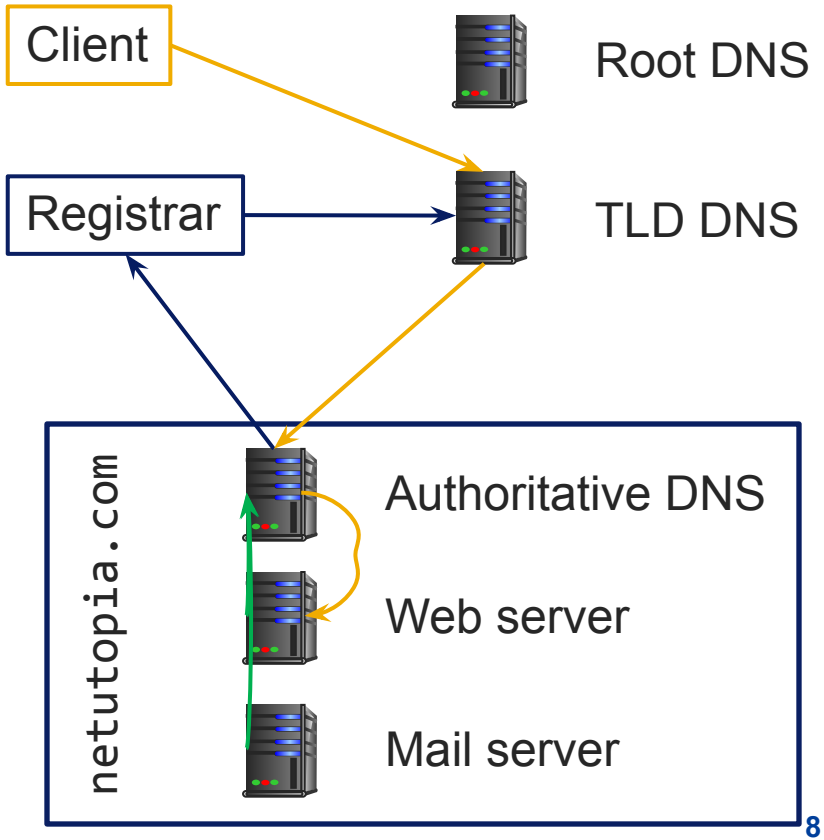


Inserting DNS records

- Want `netutopia.com`
- Contact registrar
  - (eg. Network Solutions)
  - Provide IP of authoritative DNS
- Registrar updates .com TLD

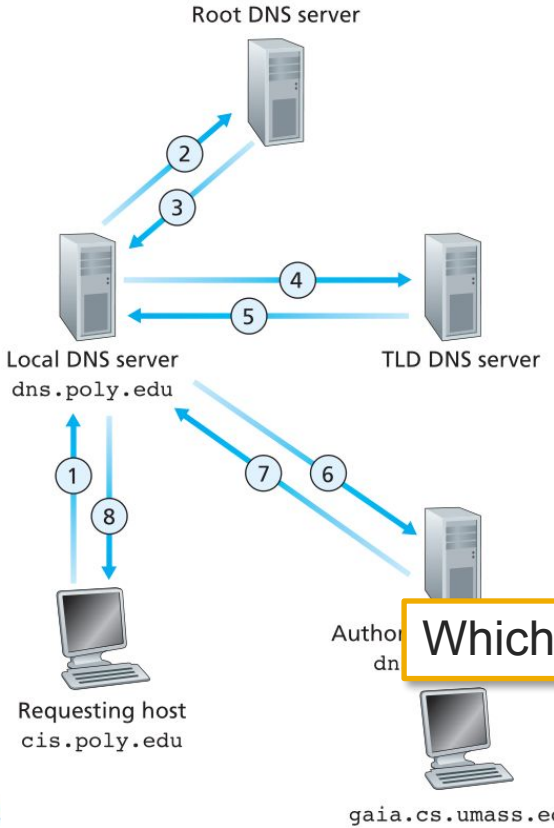
```
(netutopia.com, dns1.netutopia.com, NS)
(dns1.netutopia.com, 212.212.212.1, A)
```

- Update own DNS with type `A` and `MX` records

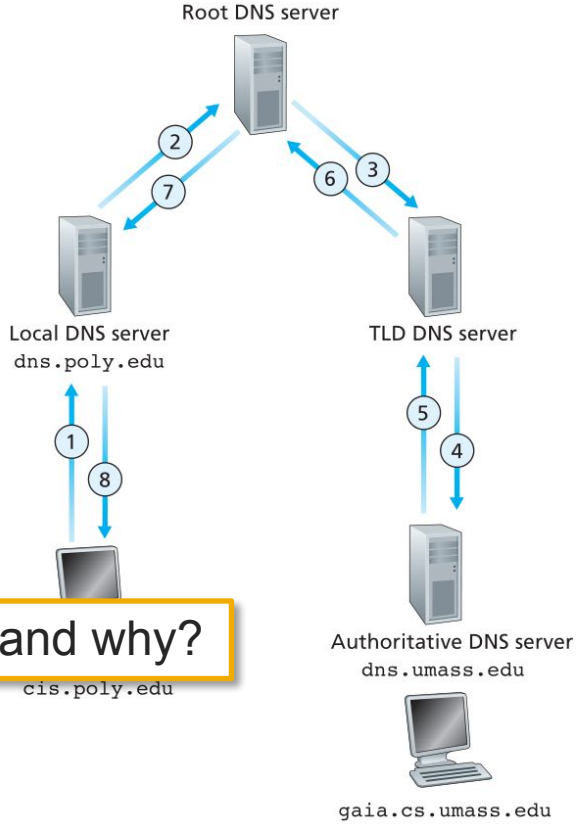


DNS lookup process

Iterative lookup



Recursive lookup



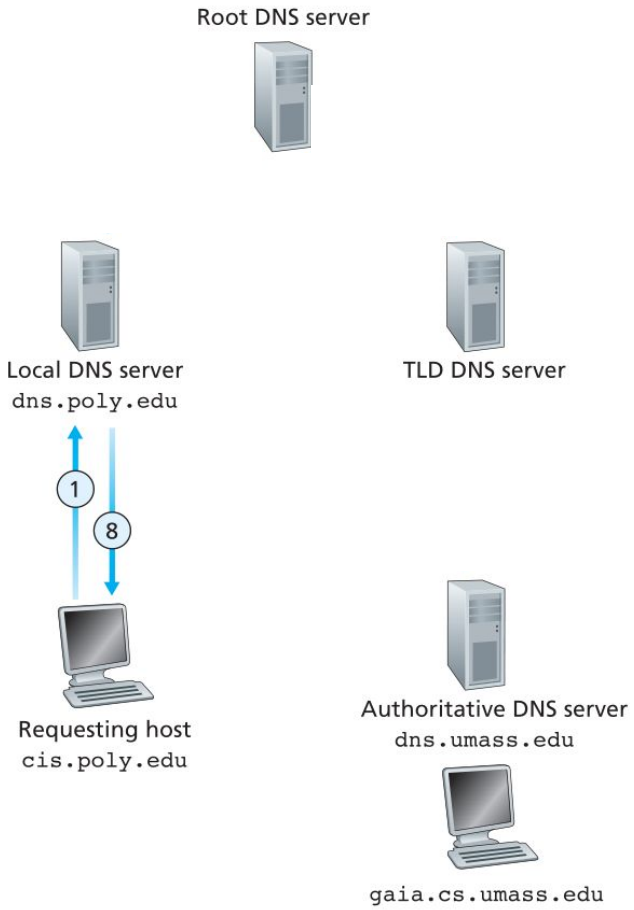
Which method is faster and why?

DNS caching

- Local DNS saves records after lookup
  - Host mappings
  - TLD addresses

- Changing DNS mappings
  - Cache entries have time to live (TTL)
  - Authoritative servers push updates to TLDs through UPDATE requests
  - Authoritative lookup (getting around the cache)

```
host -t NS montana.edu
host montana.edu dns1.msu.montana.edu
```

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