CSC4200/5200 – COMPUTER NETWORKING

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NETWORKED APPLICATIONS – EMAIL AND DNS

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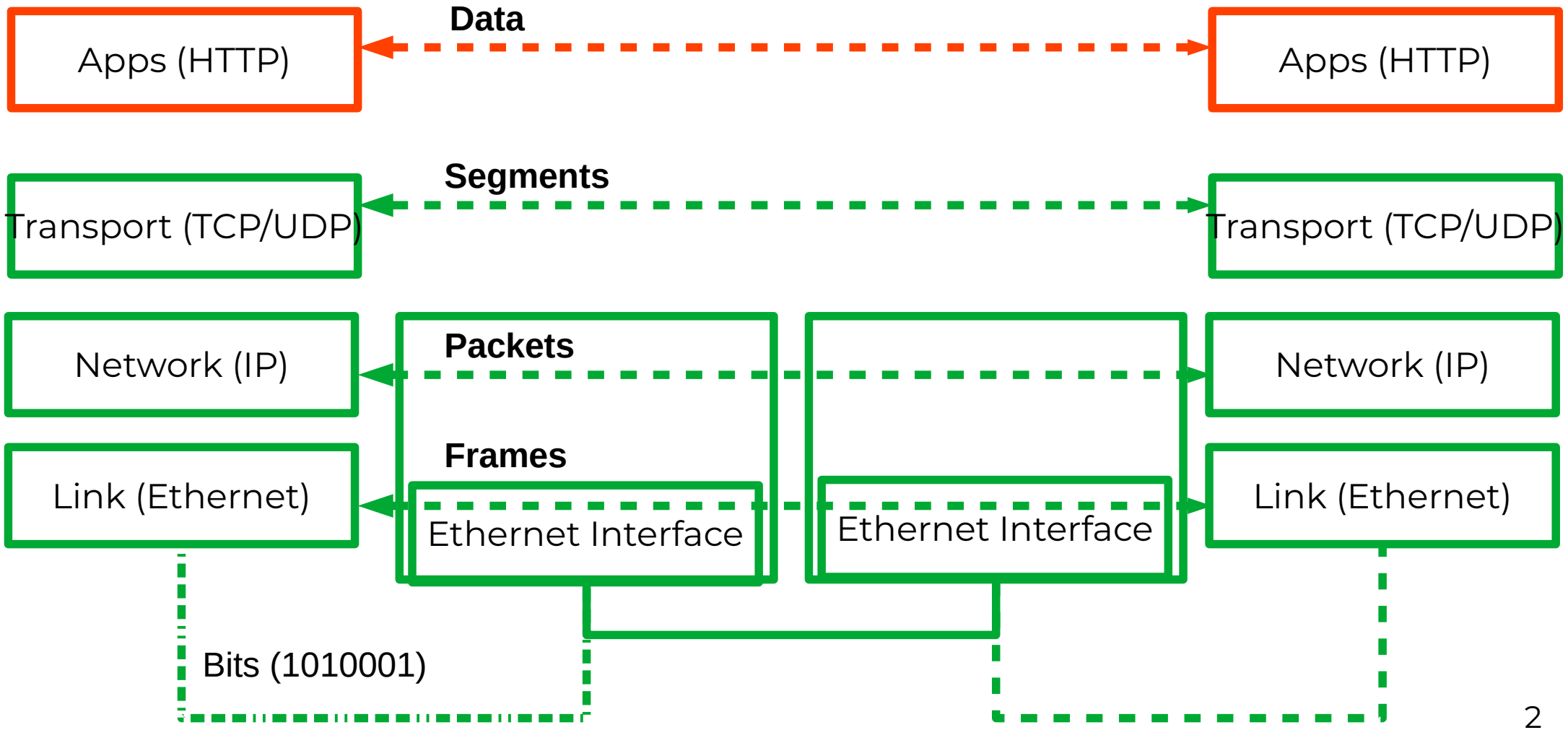
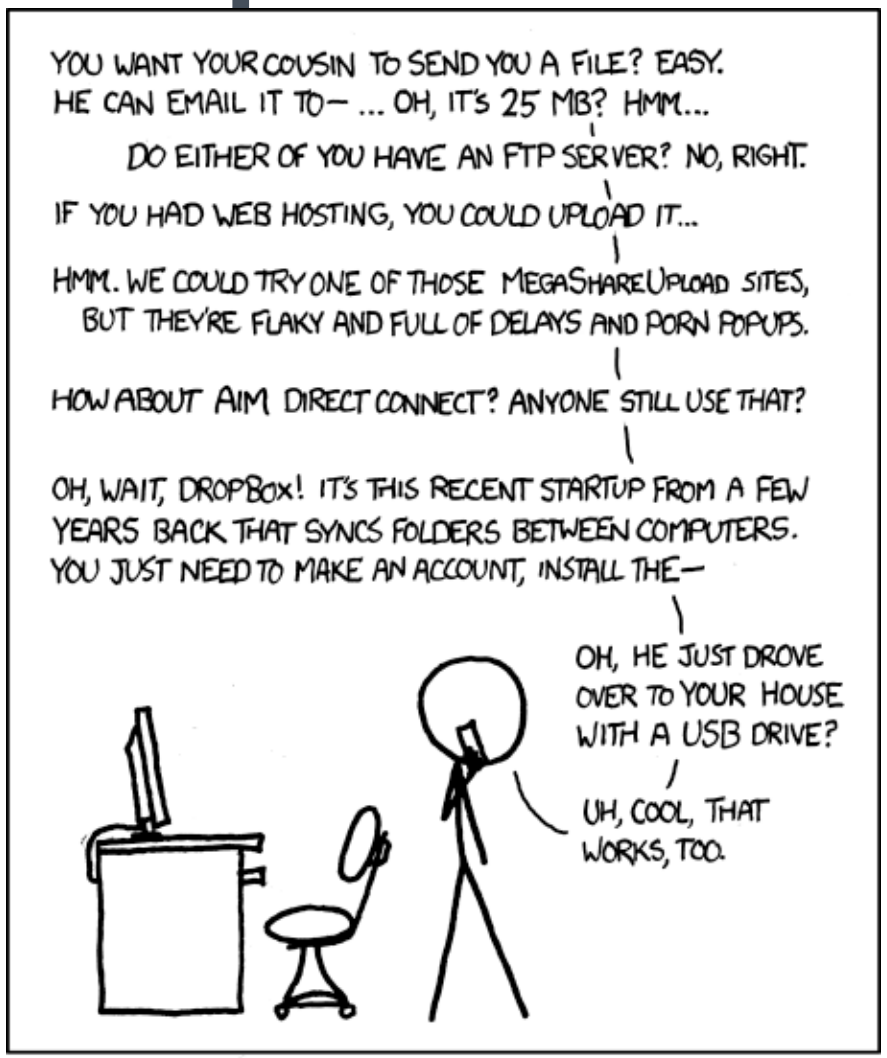
Tennessee TECH


Apps (HTTP)
Data
Apps (HTTP)
Transport (TCP/UDP)
Segments
Transport (TCP/UDP)
Network (IP)
Packets
Network (IP)
Link (Ethernet)
Frames
Ethernet Interface
Ethernet Interface
Link (Ethernet)
Bits (1010001)

How do you send the cat picture?

Looked at Web

- How about email?



https://xkcd.com/949/

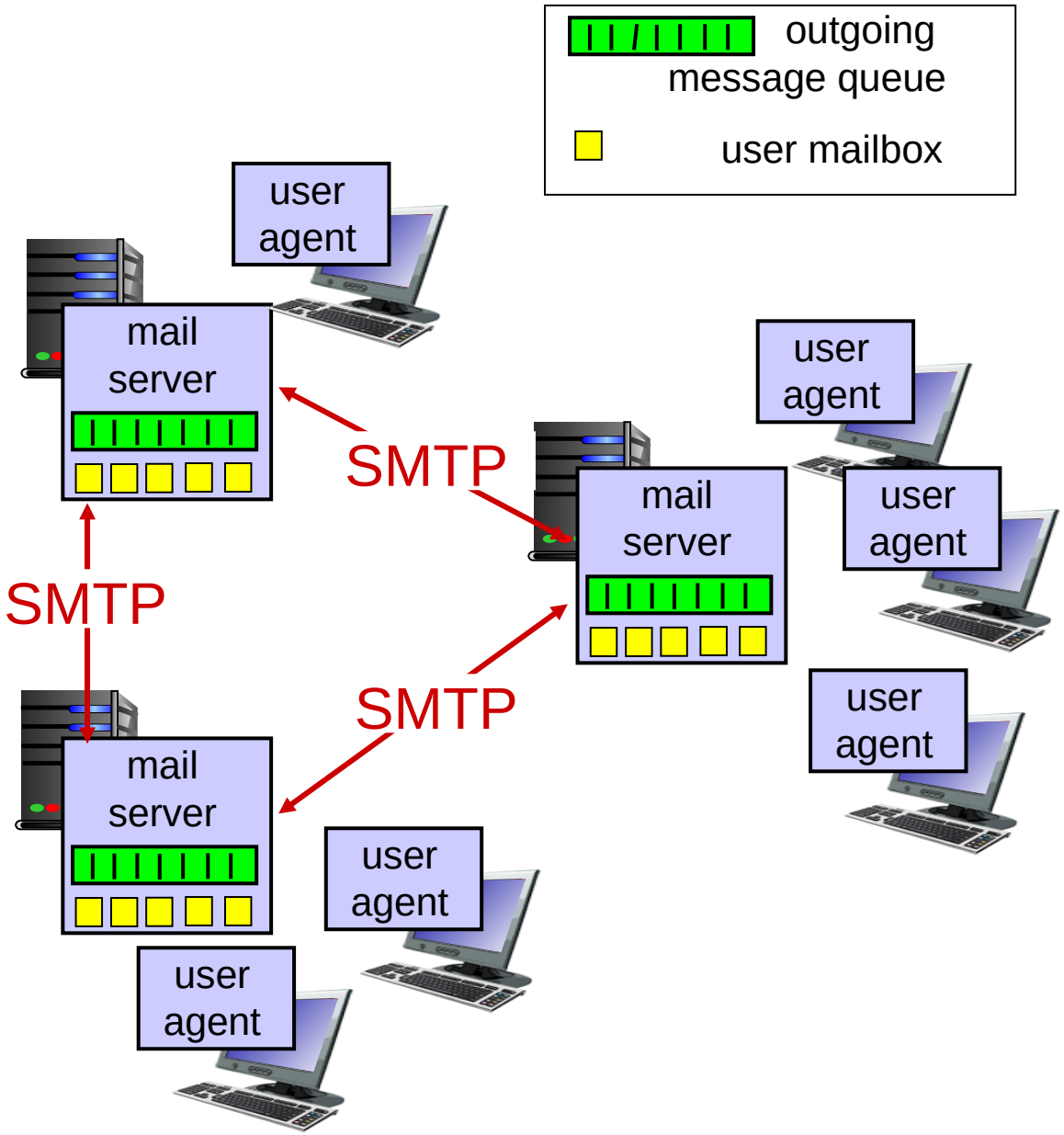
Electronic mail

Three major components:

- user agents
- mail servers
- simple mail transfer protocol: SMTP

User Agent

- a.k.a. “mail reader”
- composing, editing, reading mail messages
- e.g., Outlook, Thunderbird, iPhone mail client
- outgoing, incoming messages stored on server

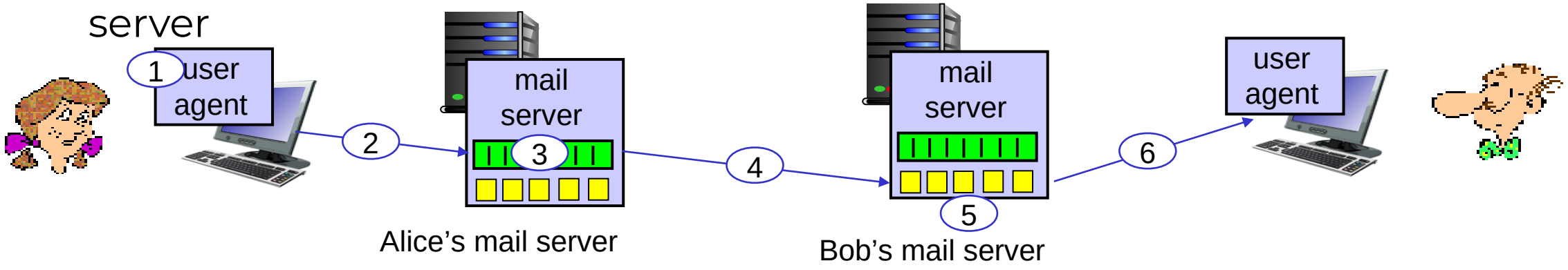


Electronic Mail: SMTP [RFC 2821]

- uses TCP to reliably transfer email message from client to server, port 25
- direct transfer: sending server to receiving server
- three phases of transfer
  - handshaking (greeting)
  - transfer of messages
  - closure
- command/response interaction (like HTTP, FTP)
  - commands: ASCII text
  - response: status code and phrase
- messages must be in 7-bit ASCI

Scenario: Alice sends message to Bob

1) Alice uses UA to compose message “to” `bob@someschool.edu`
2) Alice’s UA sends message to her mail server; message placed in message queue
3) client side of SMTP opens TCP connection with Bob’s mail server
4) SMTP client sends Alice’s message over the TCP connection
5) Bob’s mail server places the message in Bob’s mailbox
6) Bob invokes his user agent to read message



Sample SMTP interaction

```
S: 220 hamburger.edu
C: HELO crepes.fr
S: 250  Hello crepes.fr, pleased to meet you
C: MAIL FROM: <alice@crepes.fr>
S: 250 alice@crepes.fr... Sender ok
C: RCPT TO: <bob@hamburger.edu>
S: 250 bob@hamburger.edu ... Recipient ok
C: DATA
S: 354 Enter mail, end with "." on a line by itself
C: Do you like ketchup?
C: How about pickles?
C: .
S: 250 Message accepted for delivery
C: QUIT
S: 221 hamburger.edu closing connection
```

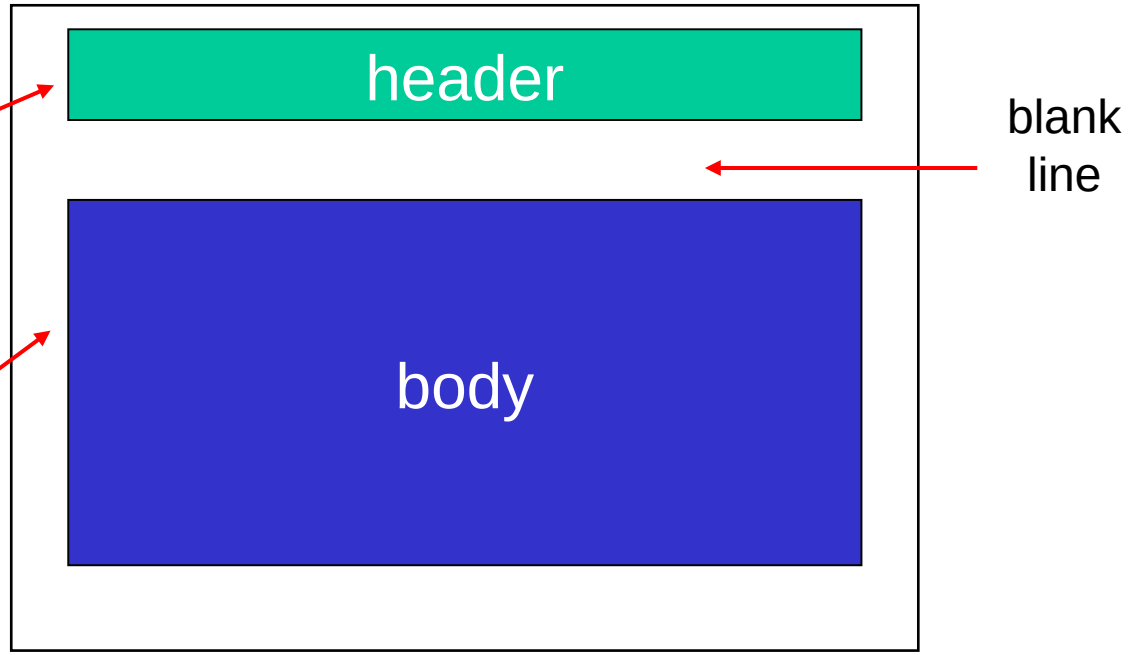
Mail message format

SMTP: protocol for exchanging email msgs

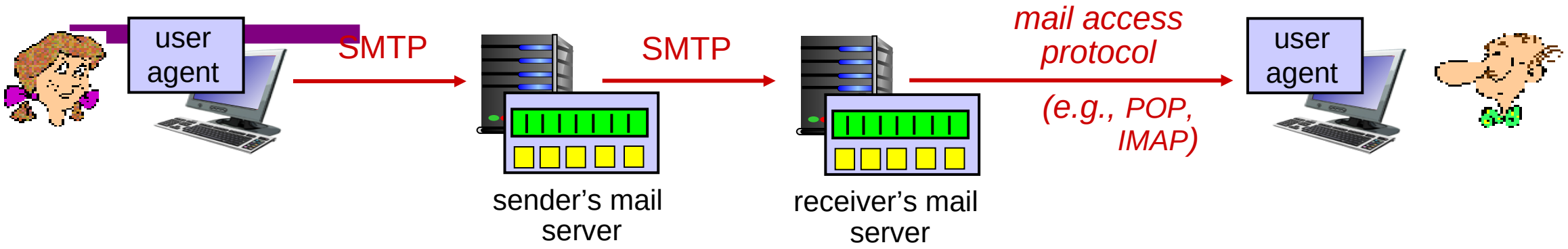
RFC 822: standard for text message format:

- header lines, e.g.,
  - To:
  - From:
  - Subject:

  different from SMTP MAIL FROM, RCPT TO: commands!
- Body: the “message”
  - ASCII characters only



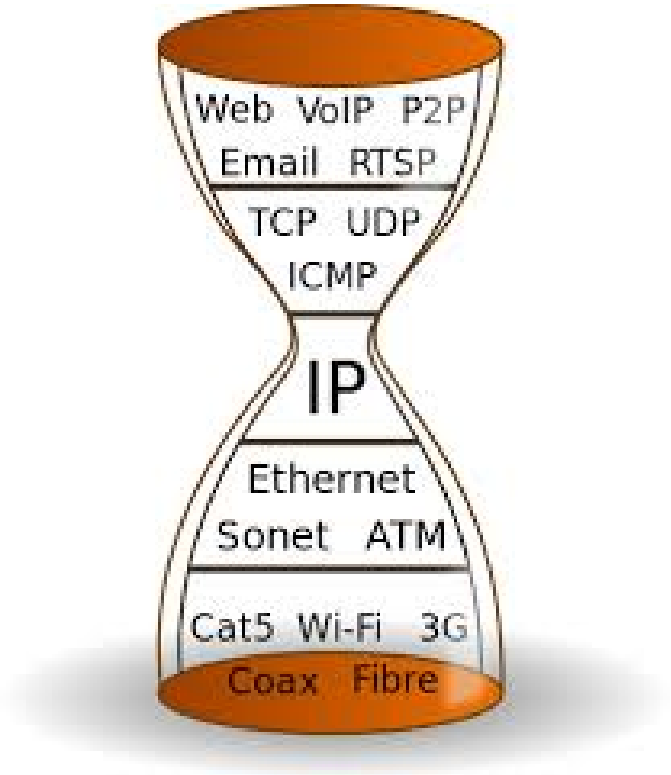
Mail access protocols

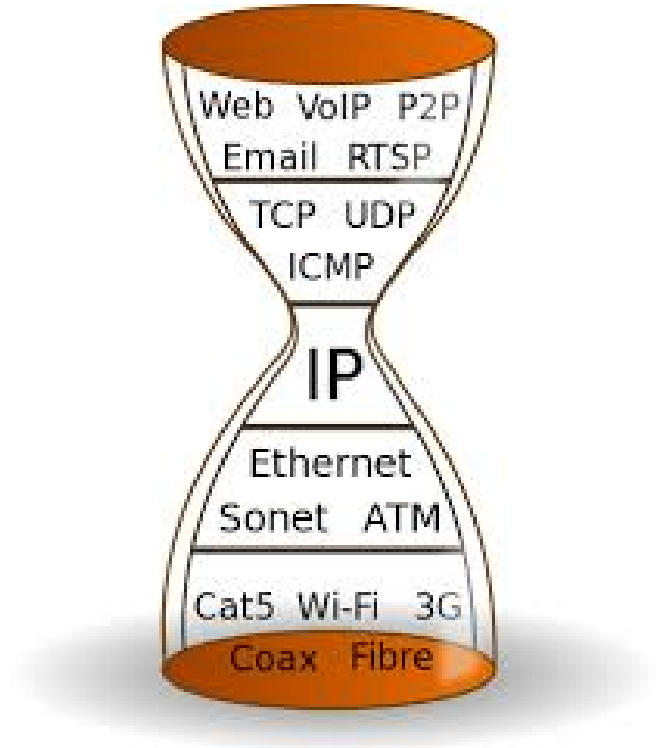


- SMTP: delivery/storage to receiver's server
- mail access protocol: retrieval from server
  - POP: Post Office Protocol [RFC 1939]: authorization, download
  - IMAP: Internet Mail Access Protocol [RFC 1730]: more features, including manipulation of stored msgs on server
  - HTTP: gmail, Hotmail, Yahoo! Mail, etc.

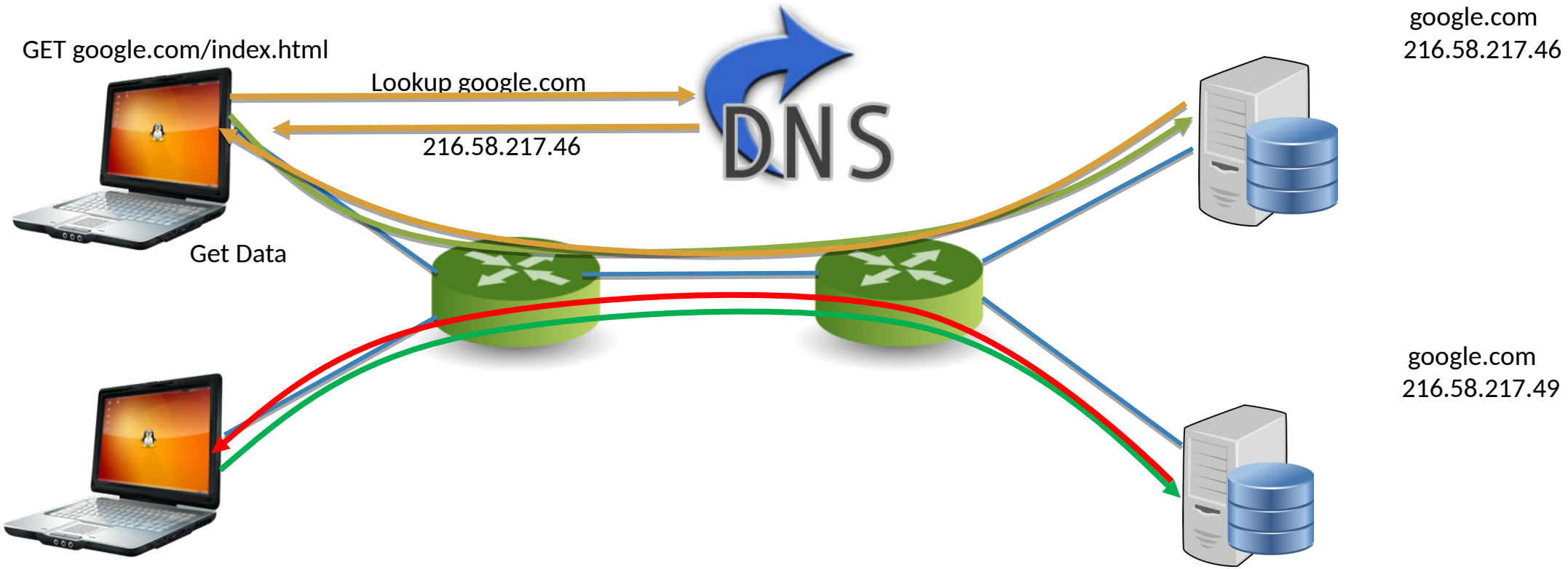
IP Based Communication

youtube.com/catvideo1





IP Based Communication



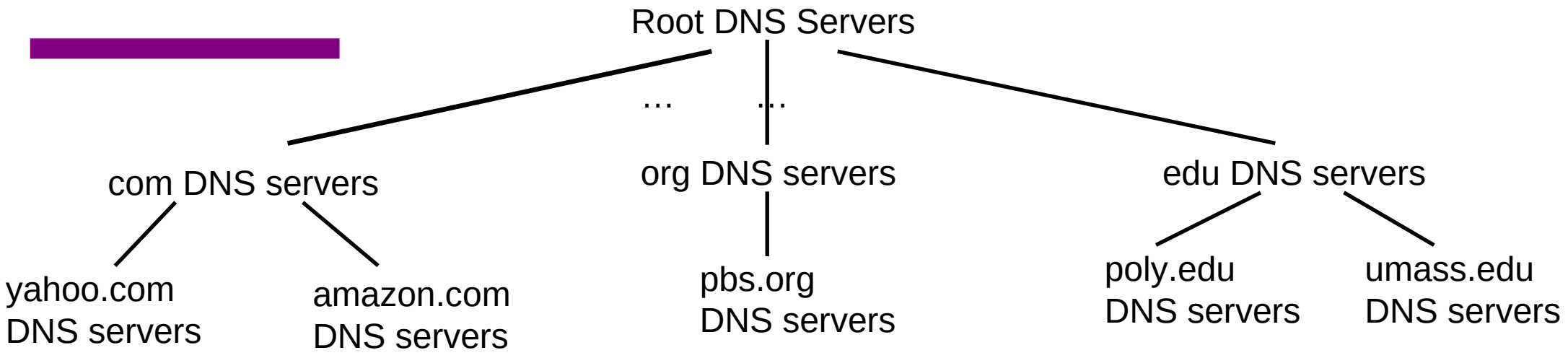
DNS – IP to Name

People: Good with names
Machines: Good with numbers

Ask a person to remember 100s of Ips
- May not work well

DNS maps IP addresses to human readable names.

DNS: a distributed, hierarchical database

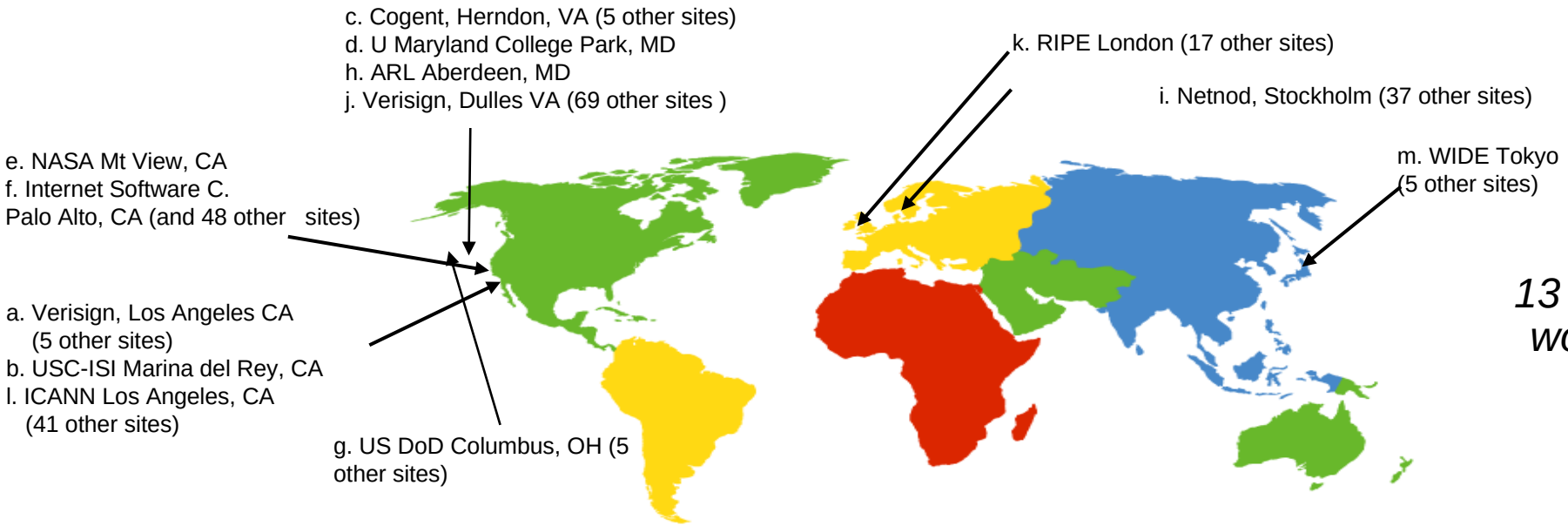


client wants IP for www.amazon.com;

1) client queries root server to find com DNS server
2) client queries .com DNS server to get amazon.com DNS server
3) client queries amazon.com DNS server to get IP address for www.amazon.com

DNS: root name servers

- contacted by local name server that can not resolve name
- root name server:
  - contacts authoritative name server if name mapping not known
  - gets mapping
  - returns mapping to local name server



13 root name "servers" worldwide

TLD, authoritative servers

top-level domain (TLD) servers:

- responsible for com, org, net, edu, aero, jobs, museums, and all top-level country domains, e.g.: uk, fr, ca, jp
- Network Solutions maintains servers for .com TLD
- Educause for .edu TLD

authoritative DNS servers:

- organization's own DNS server(s), providing authoritative hostname to IP mappings for organization's named hosts
- can be maintained by organization or service provider

Local DNS name server

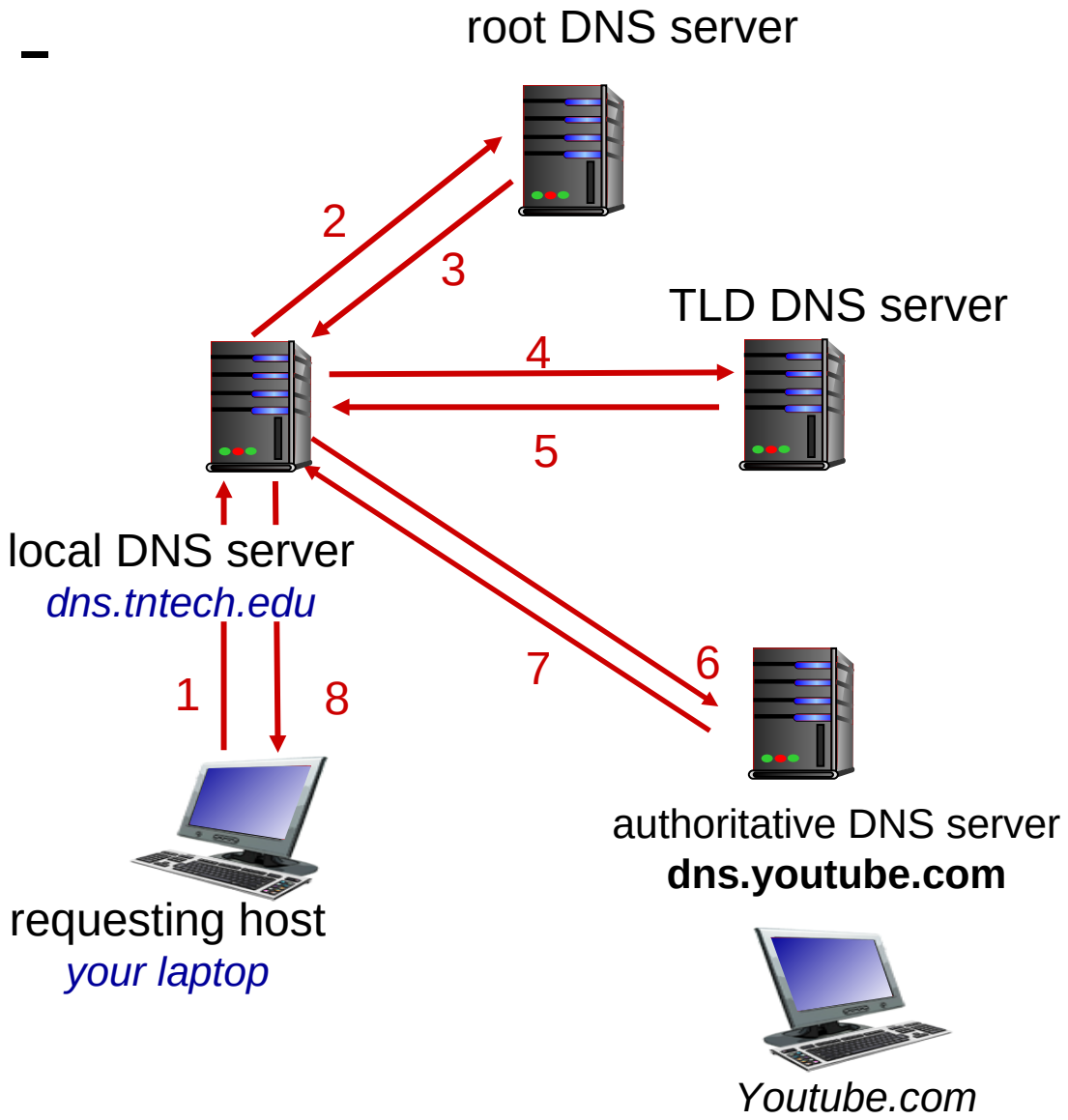
- does not strictly belong to hierarchy
- each ISP (residential ISP, company, university) has one
  - also called “default name server”
- when host makes DNS query, query is sent to its local DNS server
  - Served from cache
  - Looked up
  - Attack?

DNS name resolution example - Iterative

- host at tntech.edu wants IP address for youtube.com

iterated query:

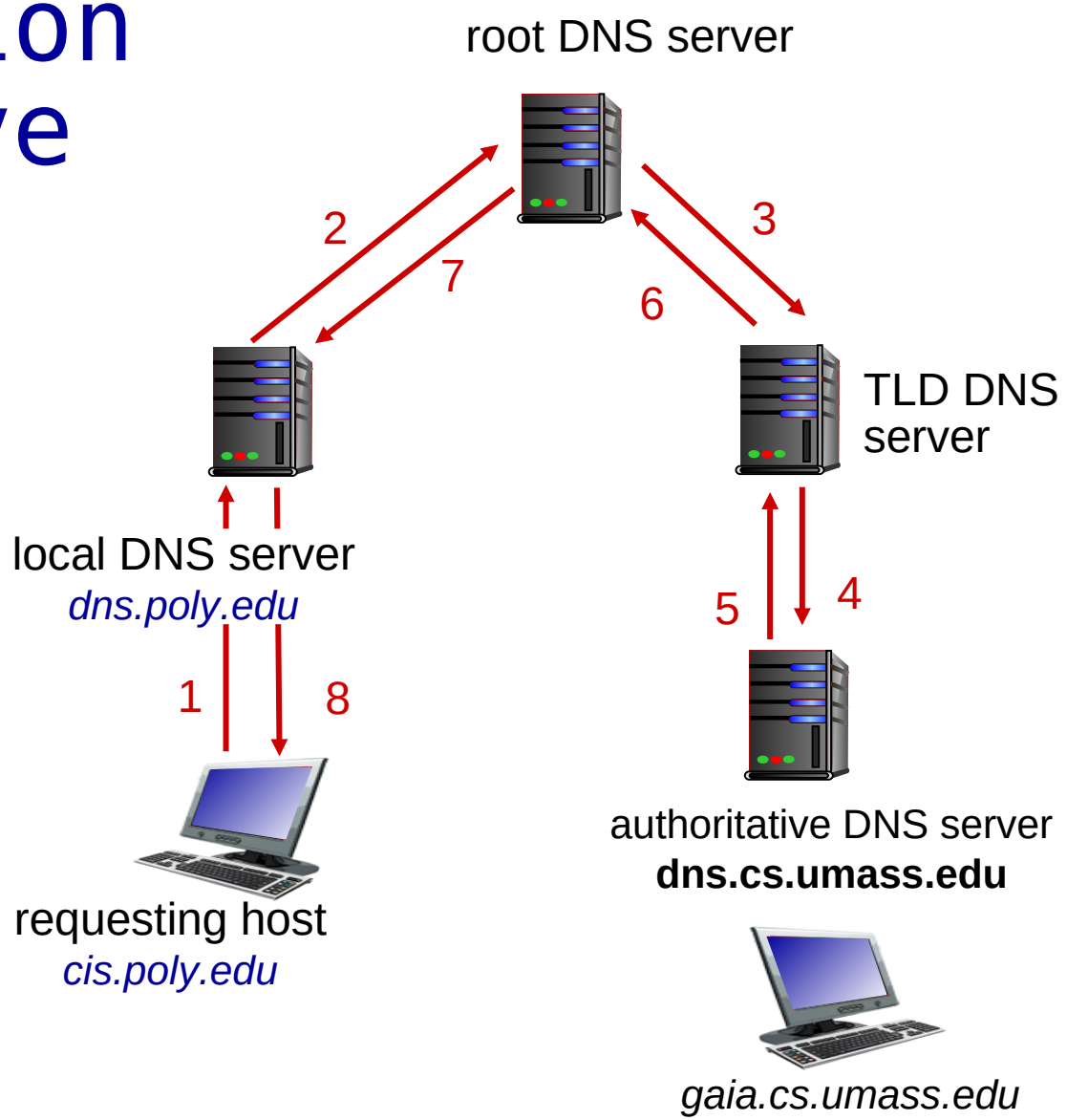
- contacted server replies with name of server to contact
- "I don't know this name, but ask this server"



DNS name resolution example- Recursive

recursive query:

- puts burden of name resolution on contacted name server
- heavy load at upper levels of hierarchy?

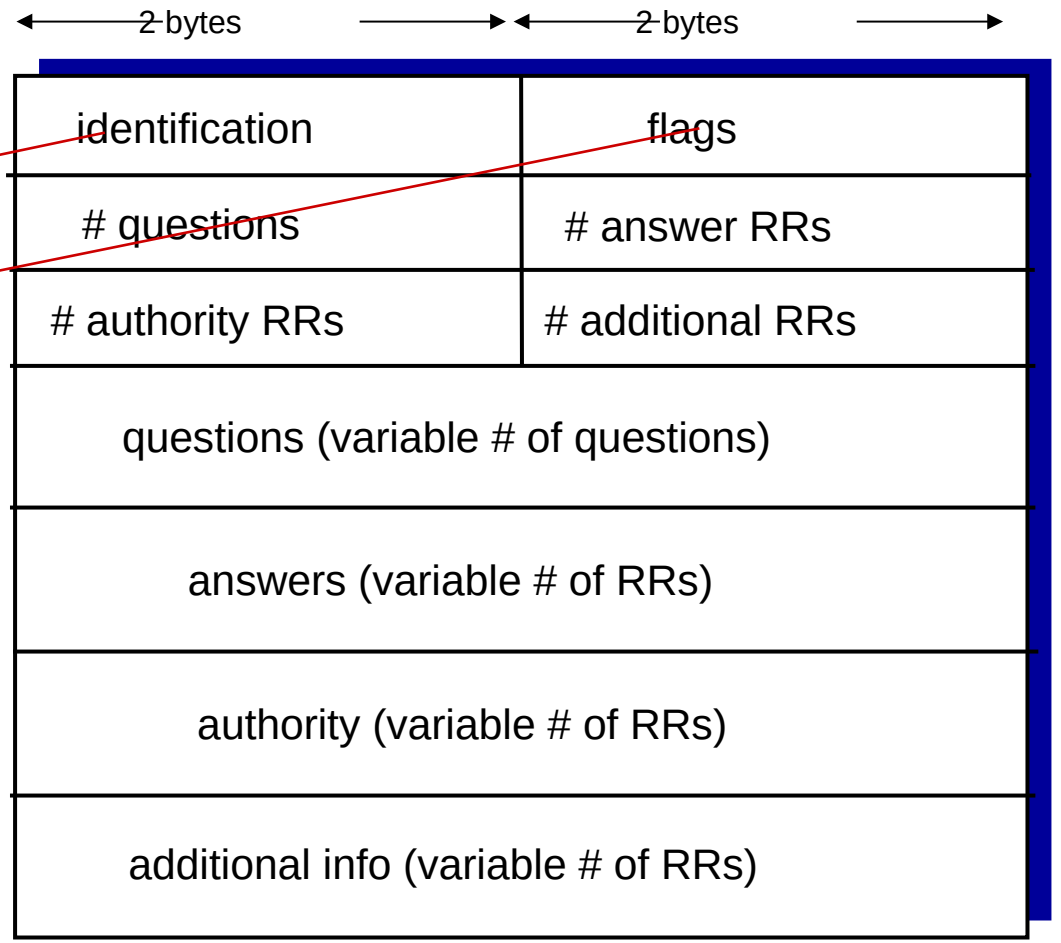


DNS protocol, messages

- *query* and *reply* messages, both with same *message format*

msg header

- identification: 16 bit # for query, reply to query uses same #
- flags:
  - query or reply
  - recursion desired
  - recursion available
  - reply is authoritative



Inserting records into DNS

example: new startup “tornadogurard”

- register name tornadoguard.com at *DNS registrar* (godaddy, gandi.net)
  - Tell them the IP of your local DNS server and name
  - registrar inserts two RRs into .com TLD server

Attacking DNS

DDoS attacks

- Bombard root servers with traffic
  - Not successful to date
  - Traffic Filtering
  - Local DNS servers cache IPs of TLD servers, allowing root server bypass
- Bombard TLD servers
  - Potentially more dangerous

Redirect attacks

- Man-in-middle
  - Intercept queries
- DNS poisoning
  - Send bogus relies to DNS server, which caches

Exploit DNS for DDoS

- Send queries with spoofed source address: target IP
- Requires amplification

Sequence number

(AdvertisedWindow)≥(Delay)×(Bandwidth)

SequenceNum)≥(Maximum Segment Lifetime)×(Bandwidth)