Lecture 13: Networking

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Peer Edits

- Due tonight at 11:55 PM
- Submit a file with the links to the pull requests you commented on
- Make sure some of your comments are more in depth than grammar mistakes
  - Structural/Content comments are the best
- Grammar/spelling mistake comments are fine too but should be a mix of both

Paper Advice

- We're seeing too little focus in your introduction paragraphs.
    - They should be concise and to the point of what you are analyzing in the paper
    - Should almost be a summary of your entire paper

- Too much code
    - Your code is going be distributed alongside the PDF
    - No need to insert your entire file into the pdf…
    - The code you insert should be small snippets showing off a unique point

Paper Advice cont...

- You should have 50% content, 50% background info
  - More content the better
- Cover page does not count in page count
- The final draft must be using the correct template
- This paper is going to be public so make sure you are confident in it
- Do not have an intro to spark that takes multiple paragraphs. Your papers should almost have completely disjoint content

This Week: Revisions

- Spend time iterating on your paper
- Submit your second version of the paper next week as your progress report
- We expect significant improvements, not just a few grammar fixes
- You can always ask for your TA to read your paper and give advice
- There is two weeks left before everything is due

Final Presentations

- Short 2-3 min presentations on your topic
- 2-3 slides, nothing fancy
- We don't want you reading off your slides
- TAs will ask a few questions after you finish

All of Networking in 10 minutes

- What happens when you type in google.com and hit enter?

All of Networking in 10 minutes

- What happens when you type in google.com and hit enter?
  - Starting at the network level, your laptop first goes to a DNS Server to figure out what google.com's IP address is
    - IP Addresses (Internet Protocol) are like a postal address
    - DNS (Domain Name Servers) convert website names to IP addresses
      - Google.com -> 72.36.125.243 or 72.36.125.253 or 72.36.125.246 and many more
        - Why so many?
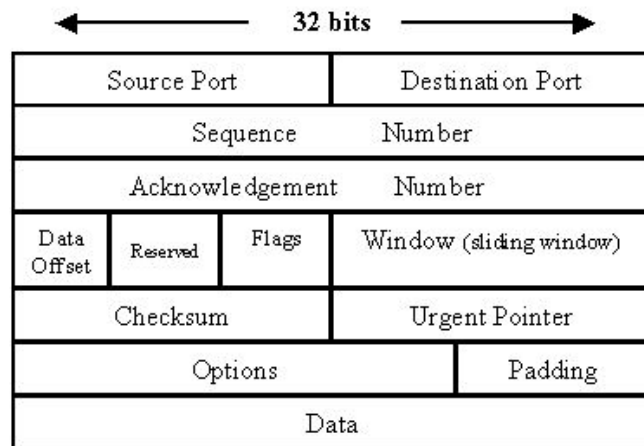
All of Networking in 10 minutes

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      - Google.com -> 72.36.125.243 or 72.36.125.253 or 72.36.125.246 and many more
        - Why so many?
  - Once we have an IP we send an HTTP request to google.com
    - HTTP (Hypertext Transfer Protocol) sends a get request for the google.com page
    - HTTP is text, not binary (Though HTTP/2 is coming and its binary)
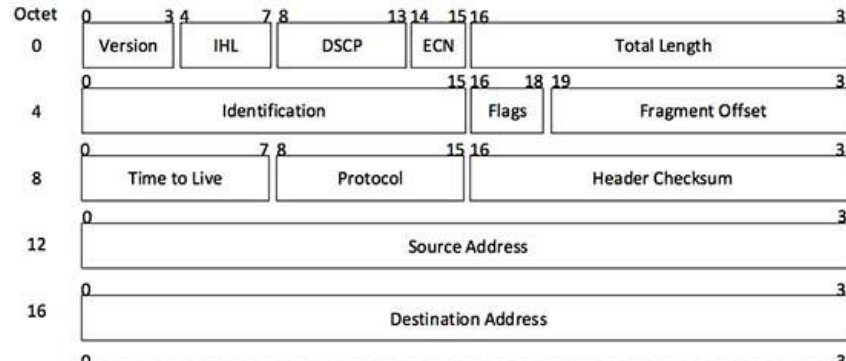
      GET / HTTP/1.1
      Host: www.google.com

All of Networking in 10 minutes

- ● What happens when you type in google.com and hit enter?
  - ○ Now we have an IP to connect to. We open a TCP connection to that IP at port 80
    - ■ TCP (Transmission Control Protocol) is a reliable error correcting protocol
      - ● Networking is noisy
      - ● TCP guarantees delivery
      - ● You treat a connection like a file
    - ■ Port 80 is the standard HTTP port
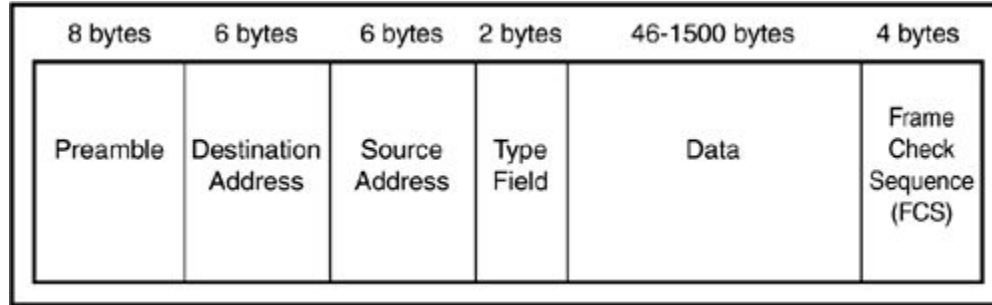 - ○ TCP sends a hello message to google.com over IP

All of Networking in 10 minutes

- What happens when you type in google.com and hit enter?
  - When we initiate a TCP connection, it is run on top of an IP connection
    - IP is how one computer talks to another
    - Each IP message contains the source and destination IP addresses
    - Each computer also knows the general direction in which to get to a different IP
      - For instance your computer doesn't know google.com directly but knows that your router said it knew how to get closer to google.com.
  - IP then sends the TCP hello message to google.com by sending ethernet frames

Octet	0	3	4	7	8	13	14	15	16	31
0	Version		IHL		DSCP			ECN	Total Length	

	0	15	16	18	19	31
4	Identification		Flags		Fragment Offset	

	0	7	8	15	16	31
8	Time to Live		Protocol		Header Checksum	

	0	31
12	Source Address	

	0	31
16	Destination Address	

All of Networking in 10 minutes

- IP runs on top of yet another layer, typically the Ethernet layer if wired or the 802.11 layer if wireless
  - Ethernet is made up of messages called frames which also contain source and destination addresses
    - But the source and dest have to be directly connected
  - Ethernets transmits the IP messages over fiber optics to the router closer to google.com

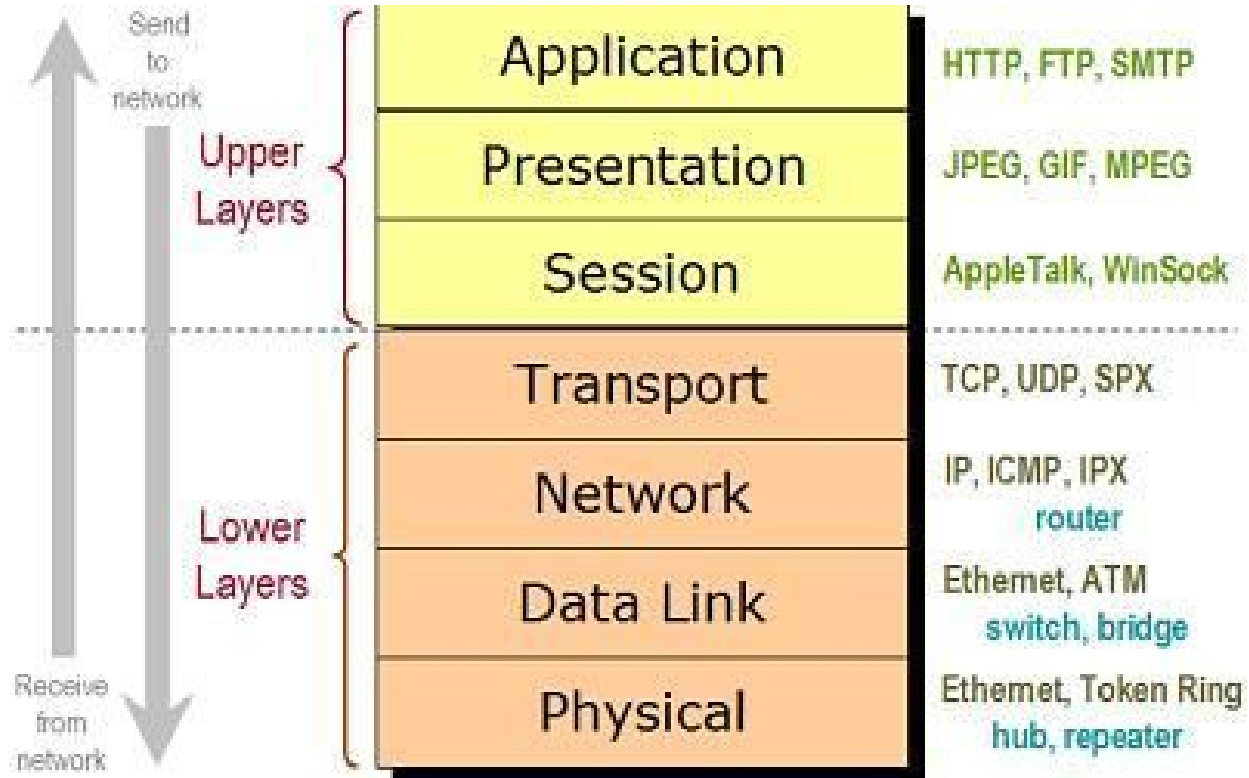| 8 bytes	6 bytes	6 bytes	2 bytes	46-1500 bytes	4 bytes
Preamble	Destination Address	Source Address	Type Field	Data	Frame Check Sequence (FCS)

All of Networking in 10 minutes

- Ethernets transmits over a physical medium, normally copper wiring or fiber optics
  - By bouncing certain pulses of light we can send the ethernet frame to your router
  - That router then does another IP connection to another router which is closer to google.com and so on until google.com receives your http message

All of Networking in 10 minutes

- Google.com does a bunch of stuff internally and then redoes the entire process with minor changes we just went over again to the webpage back to you.

All of Networking in 10 minutes

Send to network ↑

Upper Layers
- Application — HTTP, FTP, SMTP
- Presentation — JPEG, GIF, MPEG
- Session — AppleTalk, WinSock

Lower Layers
- Transport — TCP, UDP, SPX
- Network — IP, ICMP, IPX — router
- Data Link — Ethernet, ATM — switch, bridge
- Physical — Ethernet, Token Ring — hub, repeater

Receive from network ↓

All of Networking in 10 minutes

- How long did all that take?

All of Networking in 10 minutes

- How long did all that take?
  - 200 milliseconds

- 200 ms is an eternity in computer time
  - Modern computers can do 720,000 clock cycles in that amount of time

Meet with your TAs