Midterm Review

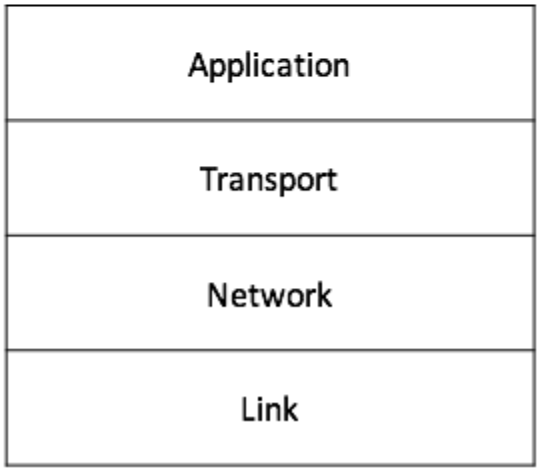
Originally By David Wetherall (djw@), Modified By Qian Yan (qiany7@)

Time & Scope

- Next Mon: 12:30 - 1:20
  - Online on canvas
  - No need to come to lecture
- Everything up until TCP congestion control

Internet Reference Model - Layering

- The classic OSI model has seven layers
- In practice, there are more like four



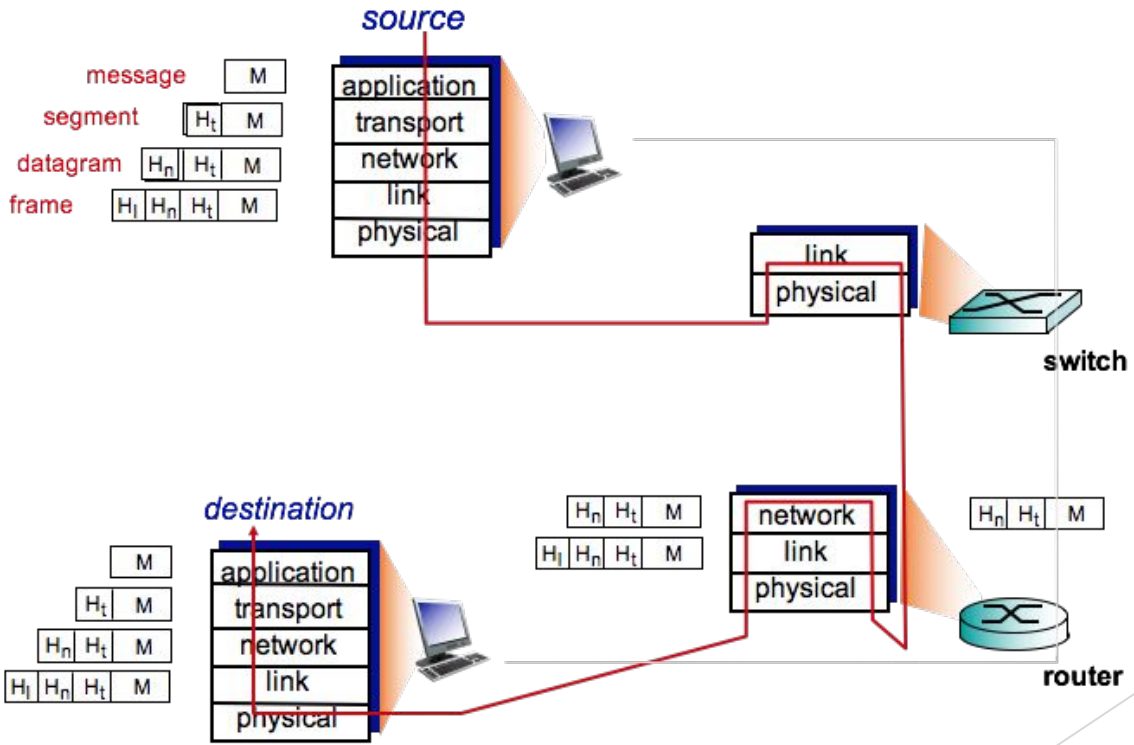
Application-specific data
HTTP, SMTP, POP (project 0)

Move data between applications anywhere on the Internet.
UDP, TCP

Move data from one machine to another, anywhere on the Internet.
IP

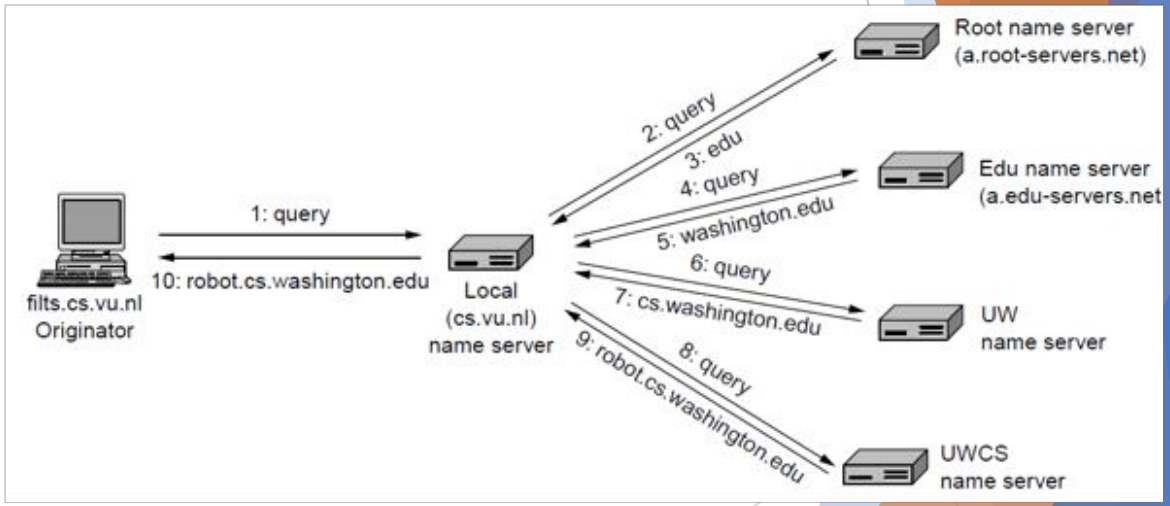
Move data between nodes that can hear each other's transmissions.
Ethernet, WiFi

Encapsulation/Decapsulation



Application Layer - DNS

- Built on UDP messages, port 53
- Names ←→ Addresses
- Resolution
- Iterative vs recursive
- Cache



Application Layer - HTTP

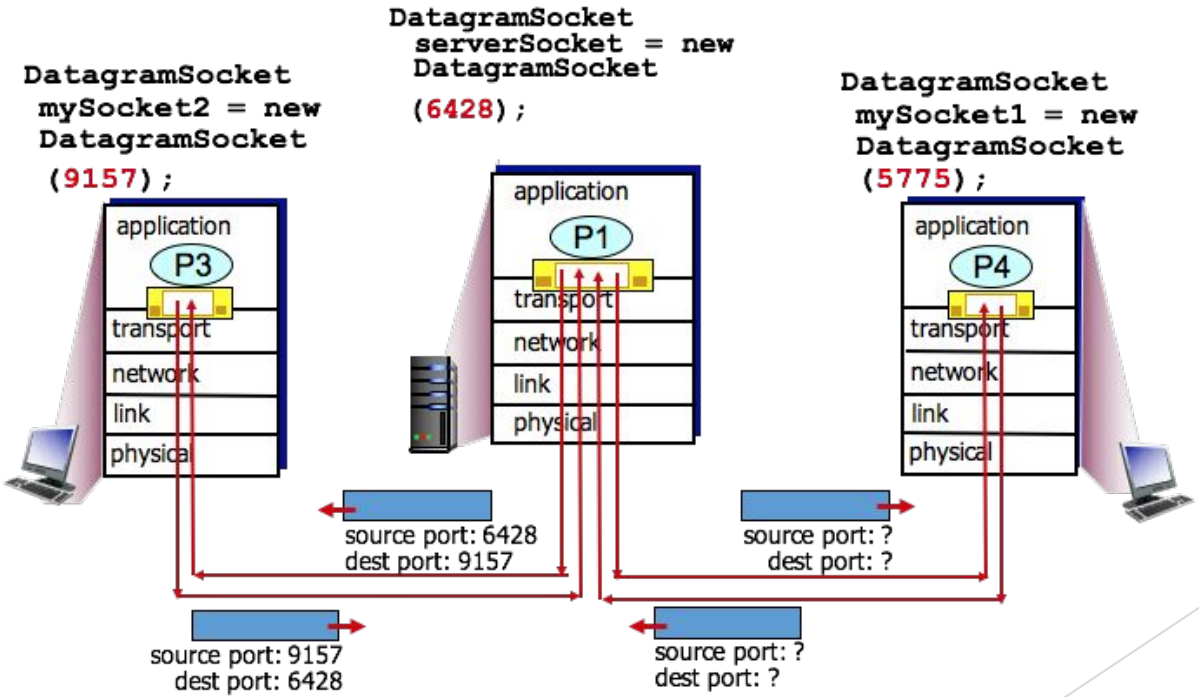
- Static vs Dynamic Web pages
- URL structures
- Browser steps:
  - Resolve the server name to an IP address (DNS)
  - Set up a TCP connection to the server
  - Send HTTP request for the page
  - Wait for and then read HTTP response
  - (Assuming no errors) Process response data and render page
  - Clean up any idle TCP connections
- HTTP methods
- HTTP response codes
- HTTP 1.0 vs HTTP 1.1 vs HTTP 2.0

Transport

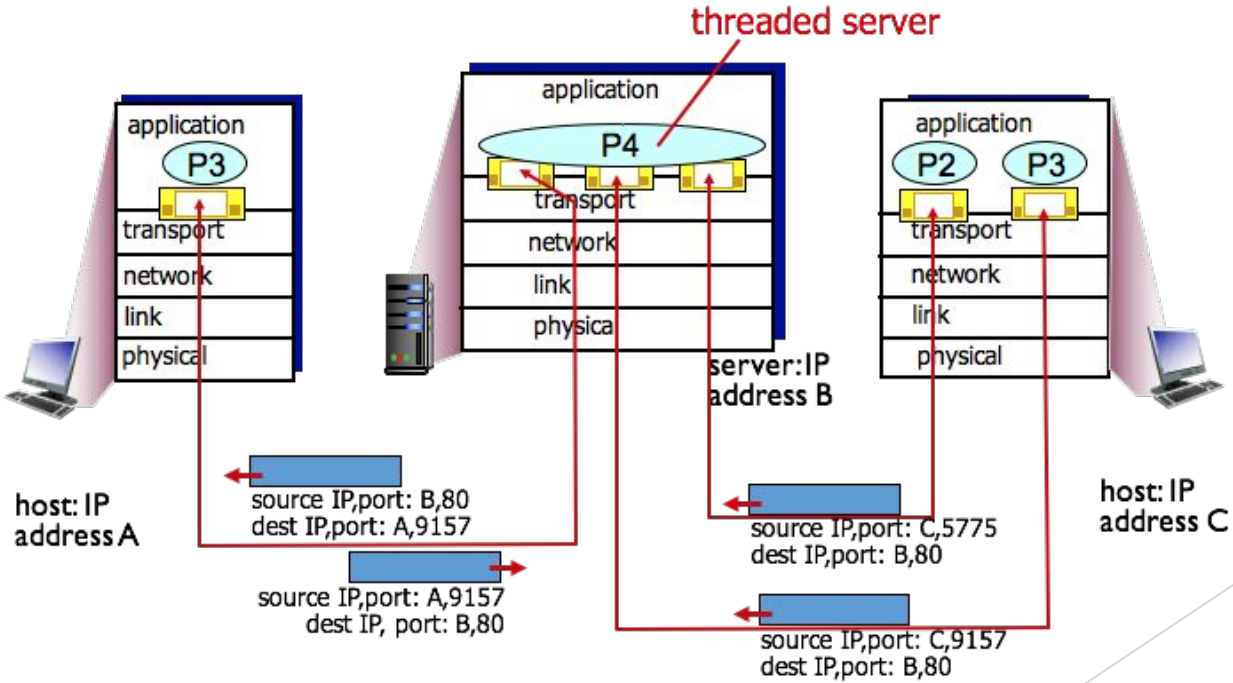
	Reliable	Unreliable
Packets		Datagrams (UDP)
Bytestream	Streams(TCP)	

TCP	UDP
Streams	Datagrams
Connections	Connectionless
Bytes are delivered to receiving app reliably (once, and in order)	Packets may be lost, reordered, duplicated (but not corrupted)
Arbitrary length content	Fixed maximum datagram size
Connection latency	No delay
Segment delivery latency ("nagling")	Datagram is sent now
Flow control matches sender's rate to receiver's capability	No flow control (can lead to many lost datagrams)
Congestion control matches sender's rate to network's capability	No congestion control (can lead to many lost datagrams)

Transport – Mux/demux – UDP



Transport – Mux/demux –TCP



Transport – TCP

- Reliable transfer – retransmission
  - Stop-and-wait
  - Sliding windows
  - Go-Back-N
  - Selective Repeat

Transport – TCP

- Connection establishment
- Flow control
- Sliding windows
- Connection teardown