Recitation 8: Encapsulation

MIT - 6.033
Spring 2022
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Plan

* What is encapsulation?
* Pros/Cons
* Networking

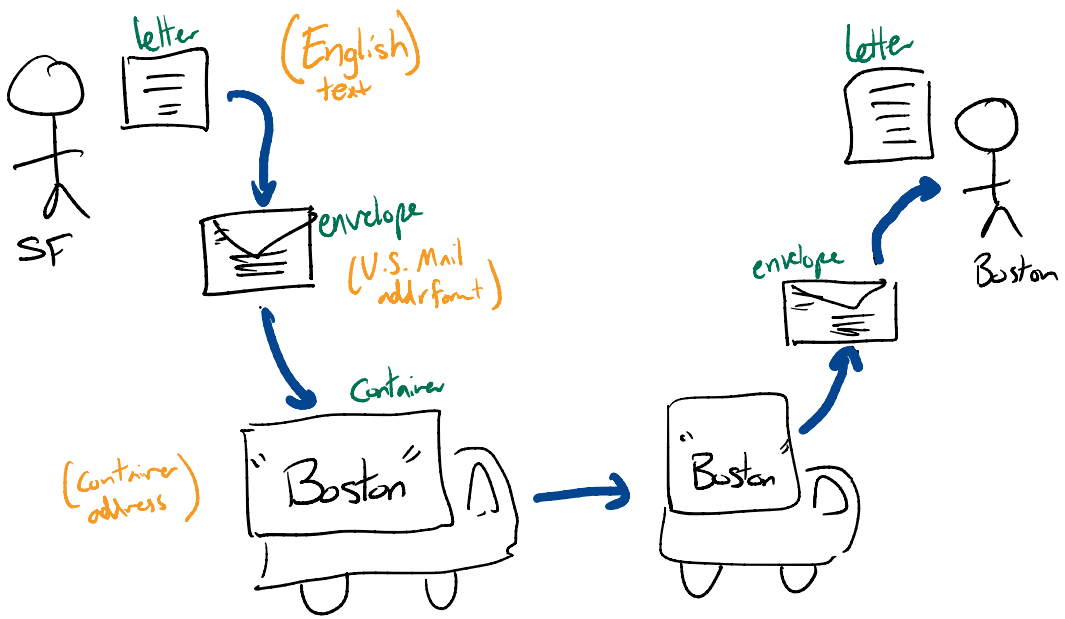
Logistics

* DP Prep report assignment at due 3/30
* Hands-on (Unix) due TODAY at 11:59 pm ET
* Read for Thursday: ROW

Layering & Encapsulation

When we talk about layering in computer systems, it can seem a bit abstract.

Helpful to think about another comm system you may be more familiar with:
U.S. Mail

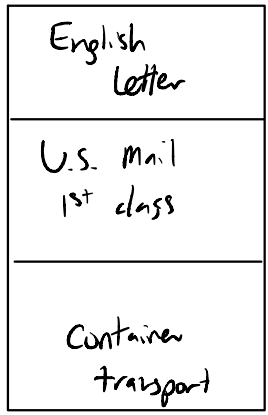


Different "protocols" for boxes, live animals, etc.

Encapsulation

* Need to obey the requirements of layer below
  - ↳ Maximum size + weight
  - ↳ Address well formatted
  - ↳ Return address
  - ⋮

* Need to account for guarantees of layer below
  - ↳ Delivery time
  - ↳ Reliability
  - ↳ Security
  - ⋮



Group Time!

In context of U.S. Mail, what are:

- 3 benefits of layering?
- 3 drawbacks of layering?

Benefits

+ Don't need to worry about implementation of layers below
  ↳ What sorting machine used?

+ Economics of scale: one USPS for many use cases

+ Enables innovation
  ↳ Can completely swap out layer
  ↳ Biz structured around layers

Drawbacks

- Can't prioritize mail easily once it's in the system
- Can't filter junk
- Can't sort easily (all bills go to special addr)
- Can't enforce policy
- Inefficient — might like to batch letters for save resp
- "Dumb network"

Layering in Networks

When you send a packet,

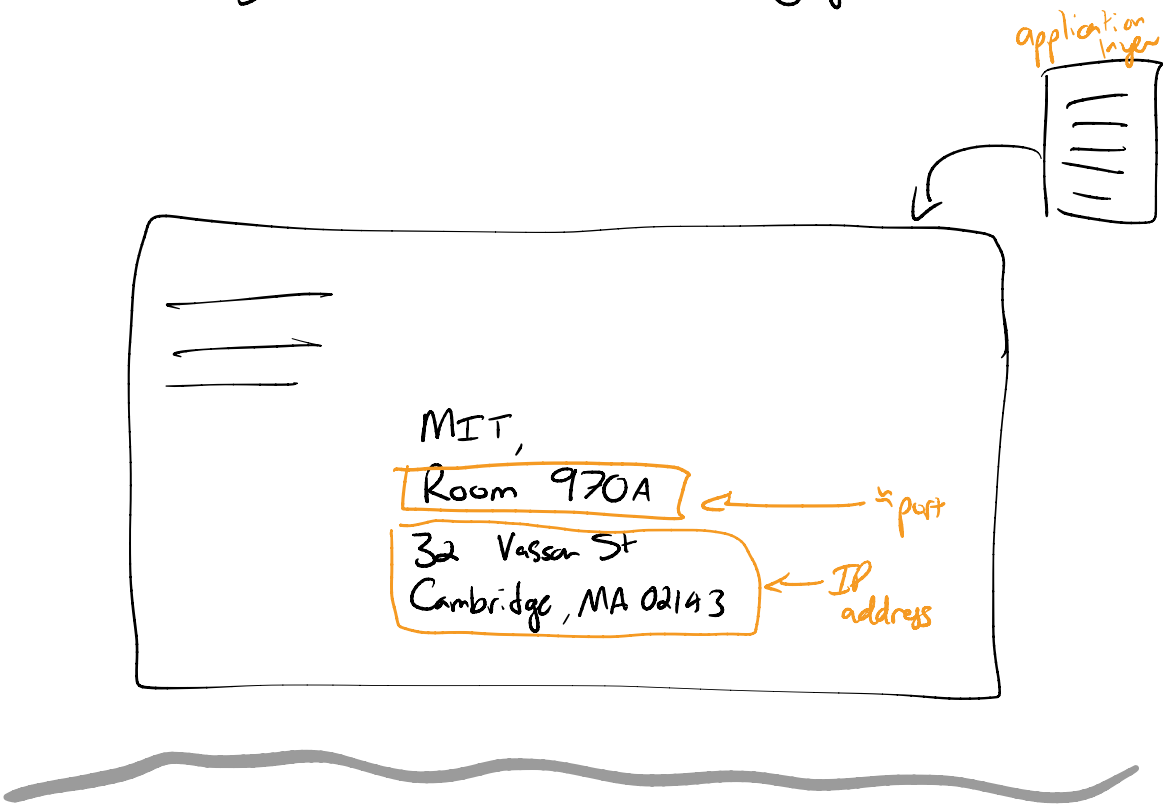
Application data — What do you want?
HTTP, DNS, SSH, FTP, ...

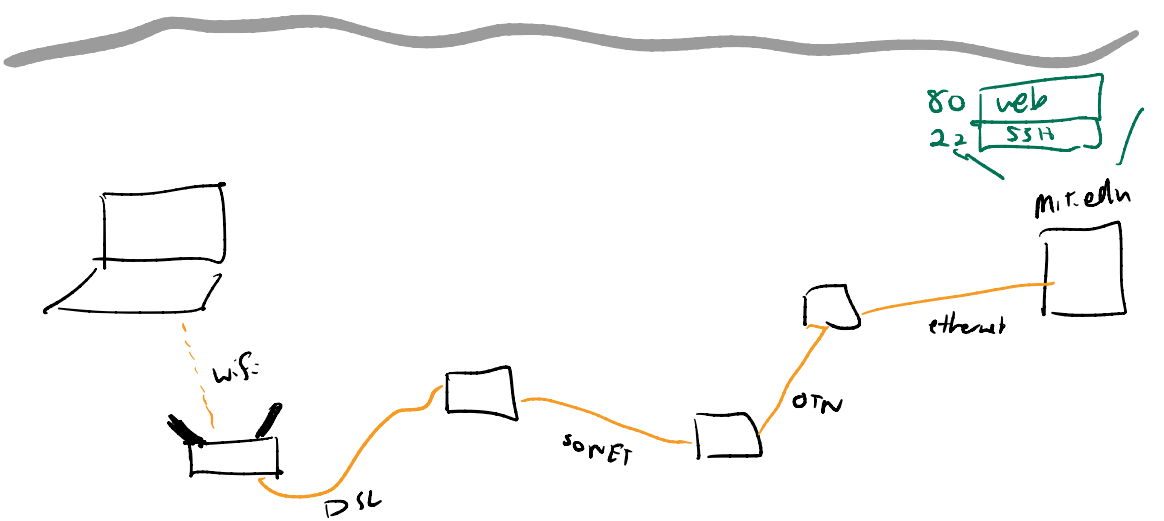
Transport layer — How do you want it?
TCP = stream of bytes
UDP = individual packets
port # (mit.edu : 80)
↳ On one computer, many processes running. Which one gets your packet?

Network layer — Where is it?
IP = address on internet
IP (128.52.129.126)

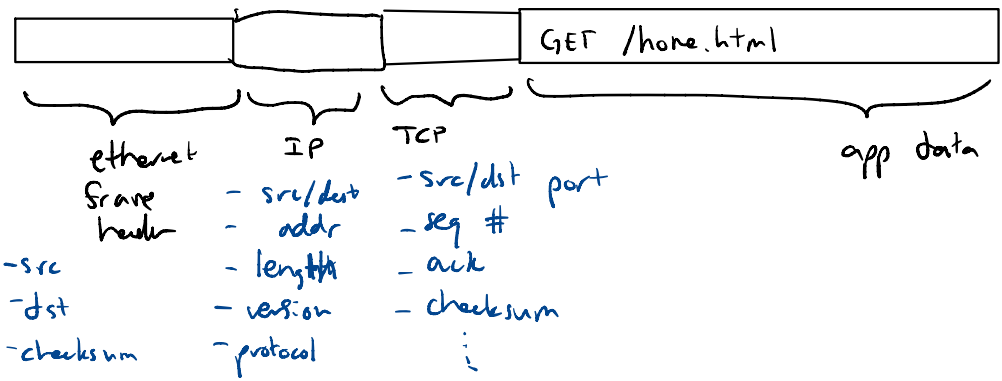
Link layer — How am I going to get there?
Ethernet, Wifi, DSL, PPP, ...
Ethernet (aa:bb:cc:dd:ee:ff)

If you want an analogy

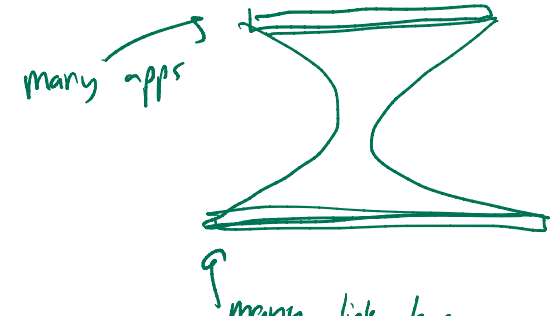




When you send data over internet...



- Each layer has its own addresses!
  - ↳ Often own checksums / techniques for detecting corruption / loss



⇒ Hourglass shape of protocol popularity.

↳ Whole internet uses IP ... common language.

Link layer & app layer have many protocols.

Things to know about IP:

- "Best effort" packet transit
  ↳ Good idea?
- Global addresses
  ↳ Good idea?
- Routing is a big part
  ↳ How to get packet from here to there?

Discussion

↳ Where does security belong in this layering picture?