Recitation 12: End-to-end argument

MIT - 6.033

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Plan

* Recitation Qs
* Recap: Layers
* E2E Overview
* Breakout rooms
    pros & cons
* Name that layer

Logistics

* Midterm on April 6.
* No recitation on April 6 !
* Hands-on assignment out April 2
* Technical feedback on DPR: April 9
* Volunteers for recitation Qs next week (April 8)

Recitation Qs

1. What is the end-to-end argument?
   - Functionality should be provided at the highest "layer" possible

2. How is E2E argument used in practice?

3. Do you agree w/ E2E arg? Why?

Layering (Recap)

Application — HTTP, SSH, ...

Transport — TCP/UDP

Network — IP

Link — Ethernet, wifi, ...

Physical — Cable, RF

One way to think about E2E:
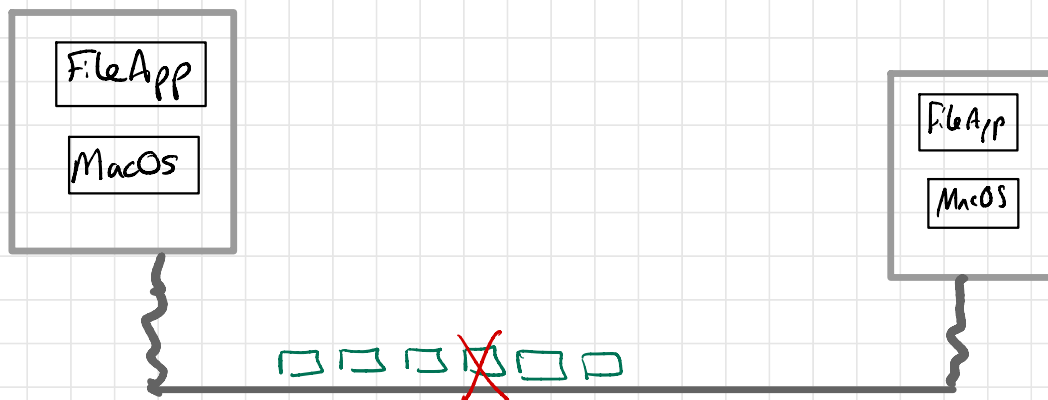 It's the libertarian view of systems
  ↳ Let the application handle it.
   * Your job (e.g. as the network)
     is to do the minimum necessary
     and get out of the way.

   * Full freedom for app
      ↳ more work
      ↳ more flexibility
      ↳ more chances to get it wrong

  "Dumb network"

Case study: Robust file Xfer

Where should acks happen?

Examples in compute systems

- Unix file system
  ↳ File is just a stream of bytes not a Database

- Ethernet CRC check
  ↳ Good idea?

- Security in Ethernet, IP
  ↳ There is none?
  Left to application

- RISC versus CISC

  x86-64 ≈ 3000 instructions

  RISC V = 50 (base)

  ↳ Good idea?

Breakout rooms

Benefits of E2E ("let application do it") versus implementing functionality at lower layers? Drawbacks?

Examples of E2E not in Computer systems?

- Car with radio?

Benefits of E2E

+ Flexibility — explain TCP versus UDP
　　　　　eg. UDP for gaming, streaming,...

+ Simplicity of impl

+ Separation of concerns

+ Less waste , less redundancy

Drawbacks

− Redundancy — every app has to reimplement it

　　e.g. your computer has many crypto libraries.
　　　　must keep all patched

− Lose opportunities for optimization

　　e.g. caching in network
　　e.g. prioritization in network
　　e.g. error correction in network (?)

Poll: which layer? why?

- Authentication

- Encryption

- Denial-of-service prevention

- Prioritization of traffic
- Guarantee of tx/rx rate
- Fault tolerance
- Internet censorship
- Firewalling / blocking malicious traffic
- Caching