

# Recitation 13: 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 Mar 31 
- \* Technical feedback on OPR: April 8
- \* Spring break next week!

# 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

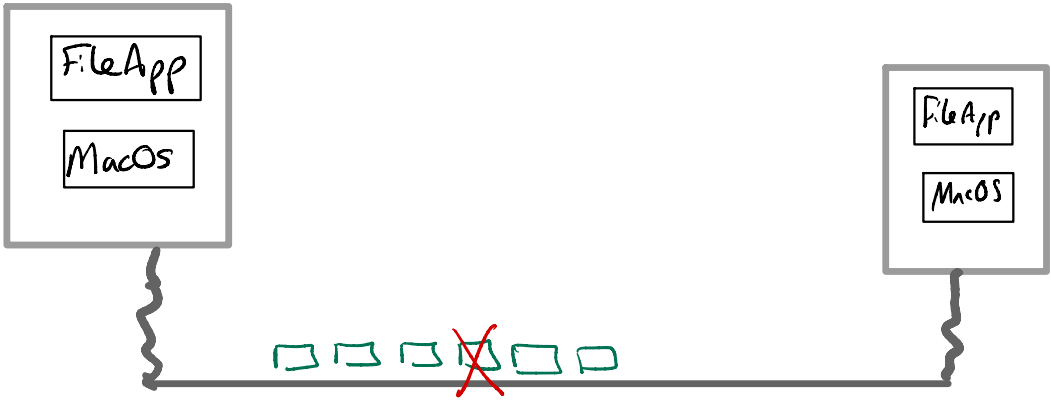
↳ Let the application handle it.  
\* Your job (e.g. as the network) is to do the minimum necessary and get out of the way.

\* 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 computer 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  $\approx$  3000 instructions
  - RISC V = 50 (base)
  - ↳ Good idea?

# Small Groups

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  
e.g. 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