# Lab Session

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# Outline

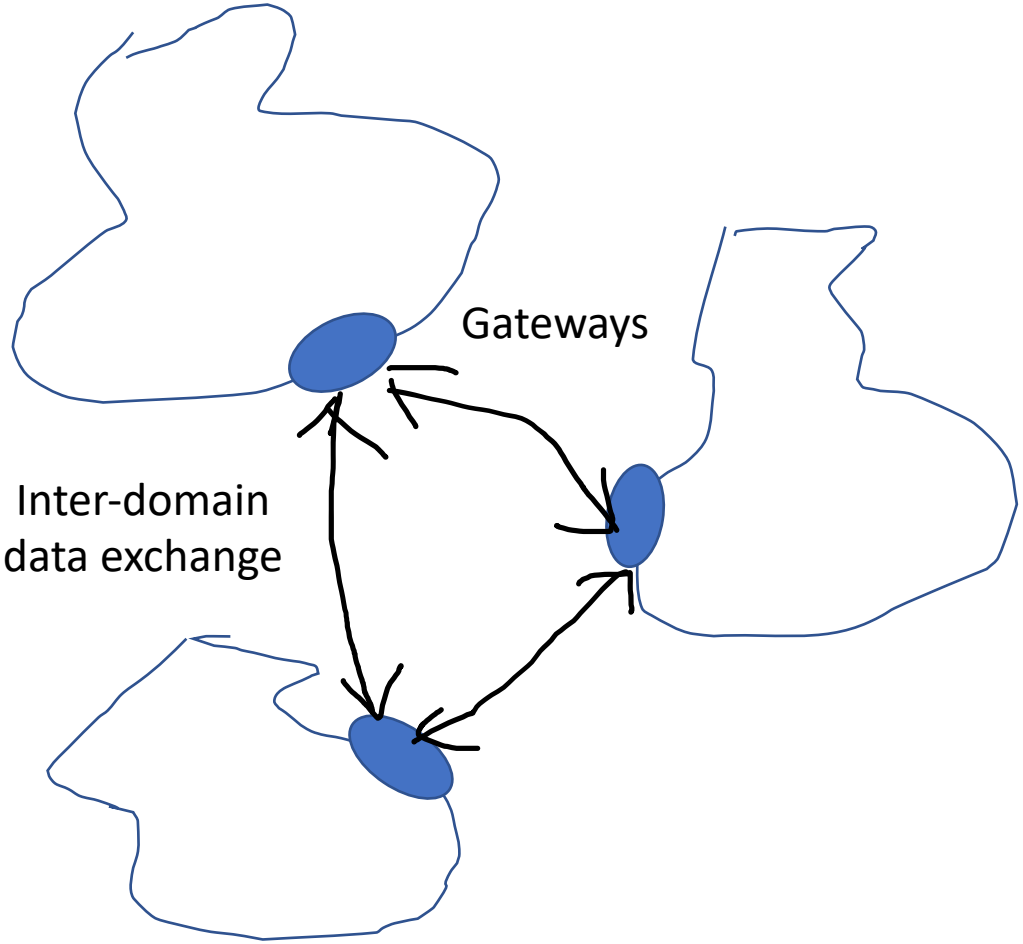
- Goals and Non-goals of Internet
- OSI 5-layer model
- Packet and Circuit-switching network
- System design guidelines
- Q&A

# Reminder

- Office Hour:
  - Course Zoom link
  - Friday, 3:30pm—4:45pm by appointment

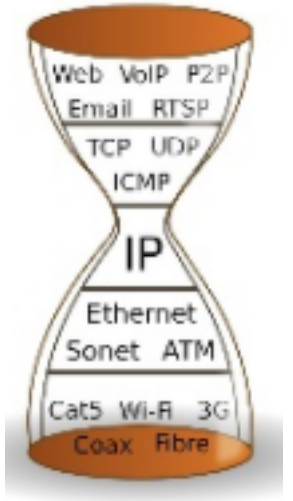
# Goals of Internet

- Low-effort inter-connection
  - inter-domain data exchange goes through GW
  - GW just keeps minimal functionality
    - data forwarding

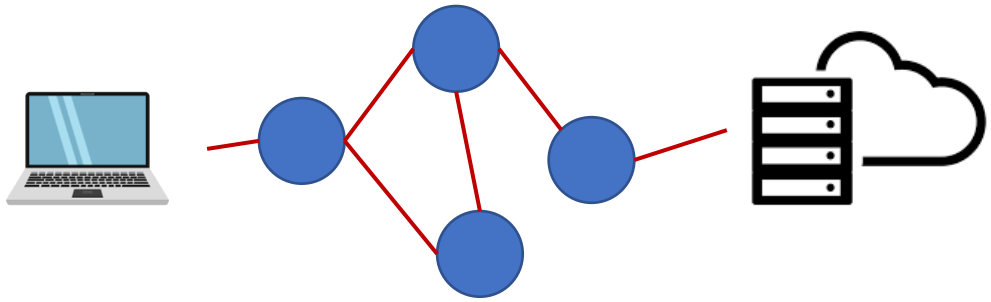


# Goals of Internet

- Generality & Layering
  - general use cases
  - 5 layers
    - Application layer
    - Transport layer
    - Network (Routing) layer
      - Global delivery
    - Link layer
      - Local (end-to-end)
    - Physical layer



# OSI 5-layer model



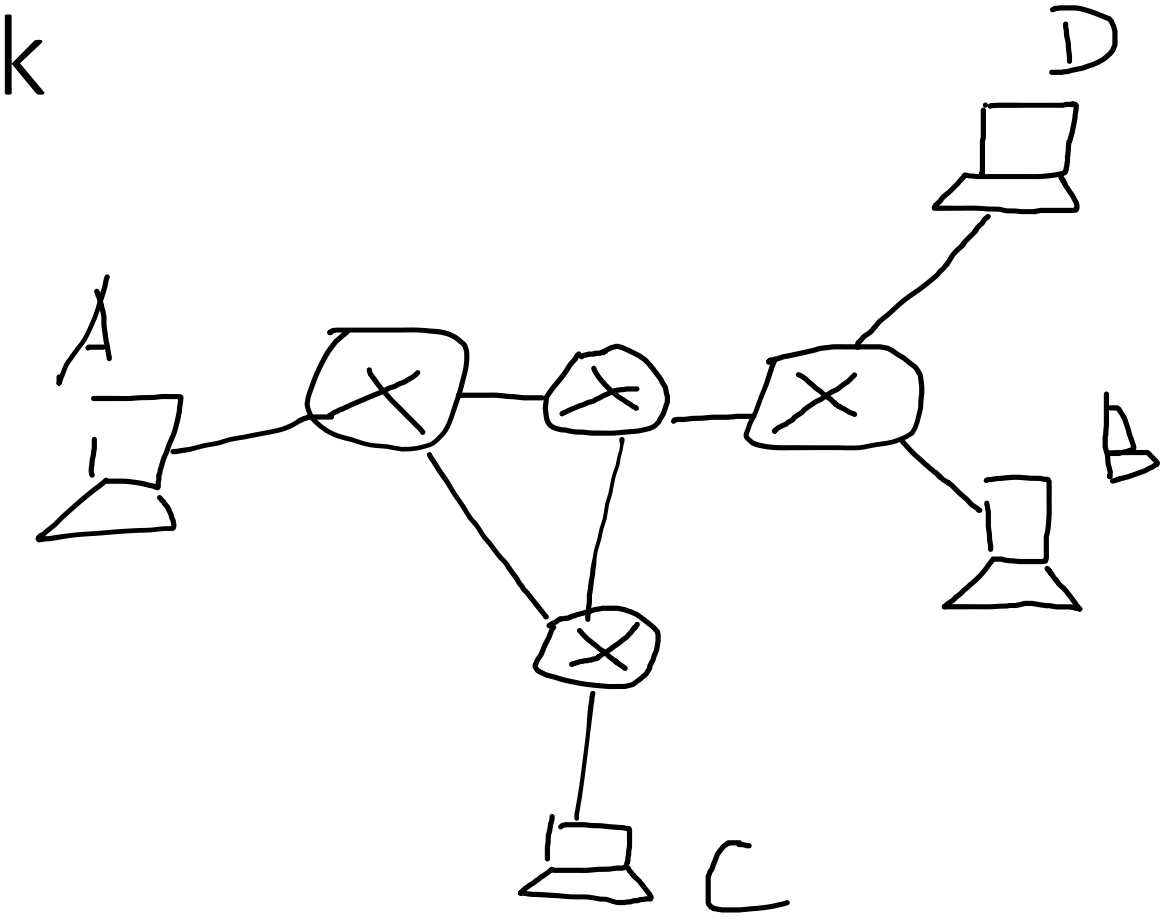
- Application Layer
  - Exchange data (e.g., Zoom, Google, etc.)
- Transport Layer
  - Determines the rate you can send your packets (TCP, UDP, etc.)
- Network (Routing) Layer
  - Determines which path your packets will go (IP, etc.)
- Data Link Layer
  - Prepares frames for packet transmission (e.g., error detection code)
- Physical Layer
  - Coverts frames to hardware medium form (e.g., optical, electronical signals)

# Non-goals of Internet

- Performance
- Security
  - traceroute

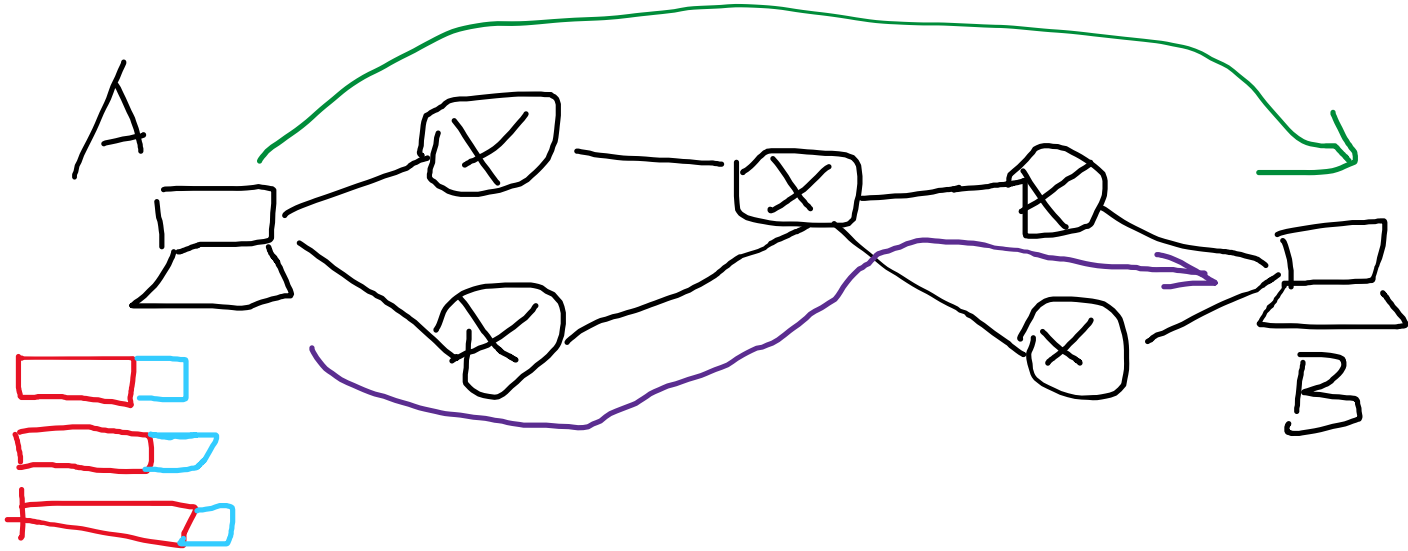
# Circuit-switching network

- path or connection establishment
- dedicate connection
  - can not reallocate connections
- router must be reliable
- router must store states



# Packet-switching network

- divide data into smaller packets
- packets are routed independently
- packets identify its destination in its header
- Pros
  - no dedicate channel
  - multiple path
- Cons
  - contention
  - queue build-up
  - less deterministic performance

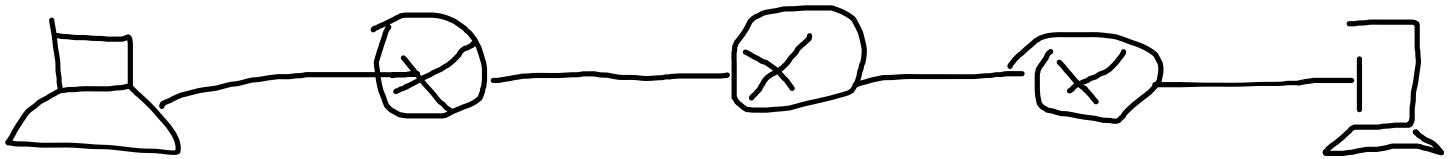


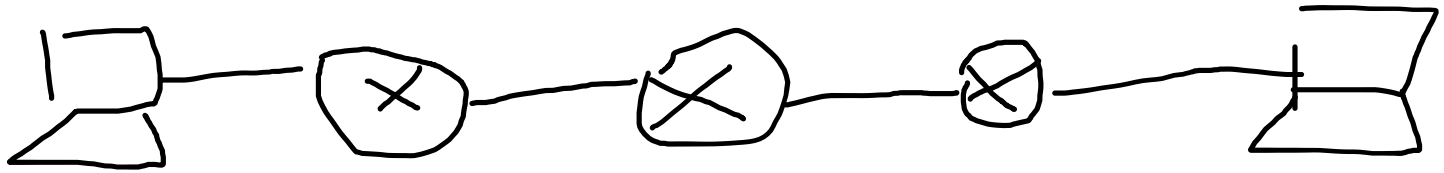
# End-to-end principle

- (1) Push functions to end-host as much as possible
- (2) “Functions placed at low levels of a system may be redundant or of little value when compared with the cost of providing them at that low level”[1]
- Anirudh’s reliable network example
- Duplicate data suppression example

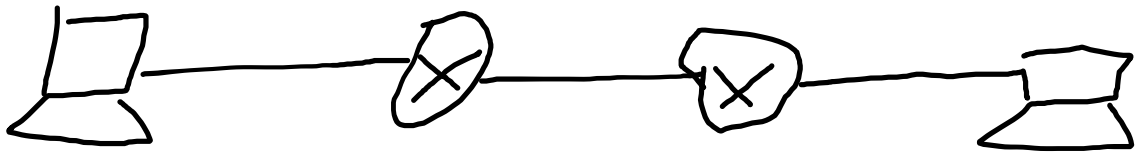
[1] End-to-end arguments in system design

# Providing reliable network

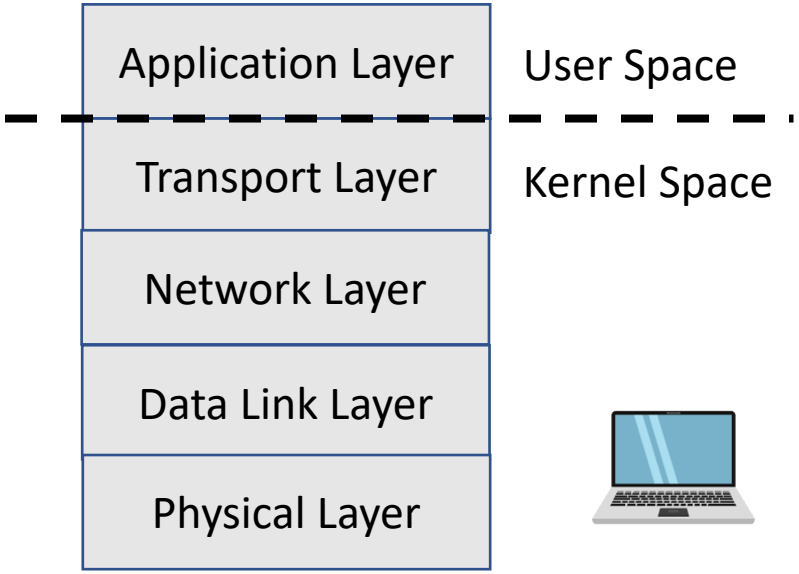


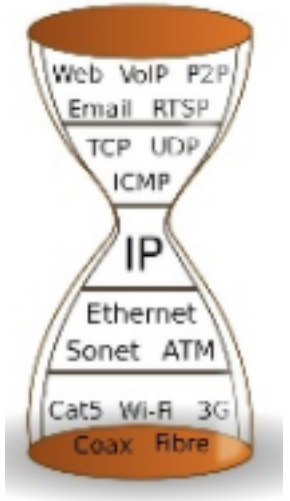


# Duplicate data suppression



# Layering and abstraction



# Another example (website)

# Tradeoff

**Circuit-switching**

- Performance
  - dedicated channel
- Overhead
  - channel establishment time
  - routers must be reliable
  - routers must store states

**Packet-switching**

- Performance
  - shared channel