Computer Networks
COL 334/672

Towards building a computer network

Slides adapted from KR slides

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This Lecture

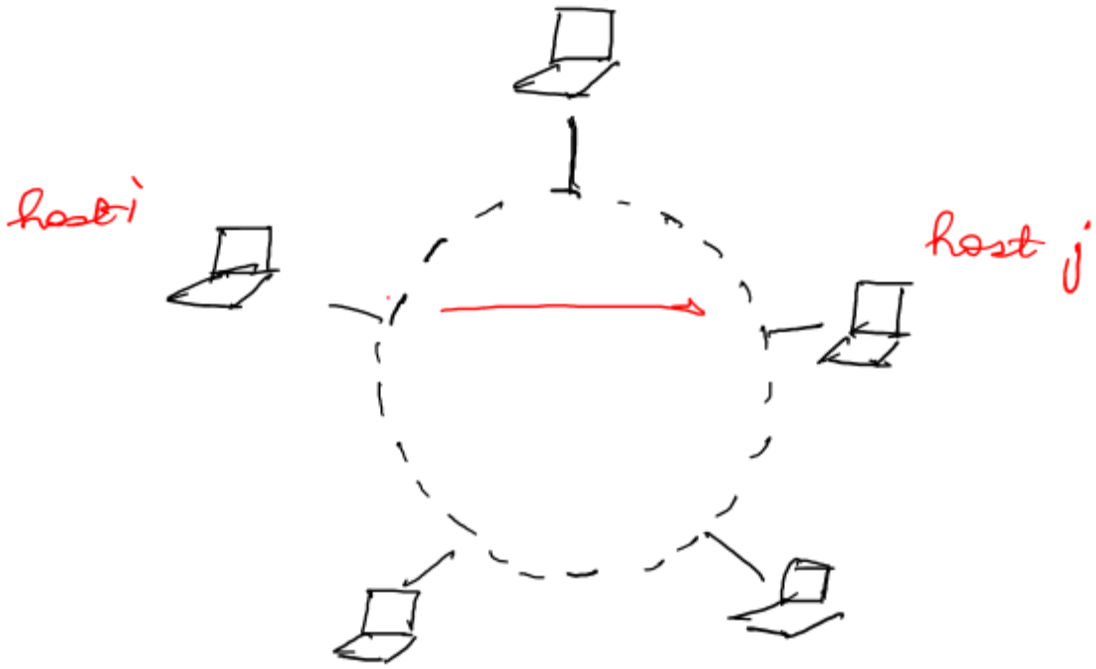
- Design a network from first principles
  - Discuss the key design decisions
  - Choices made by the **I**nternet

- **Outcome**: Understand the structure of the **I**nternet

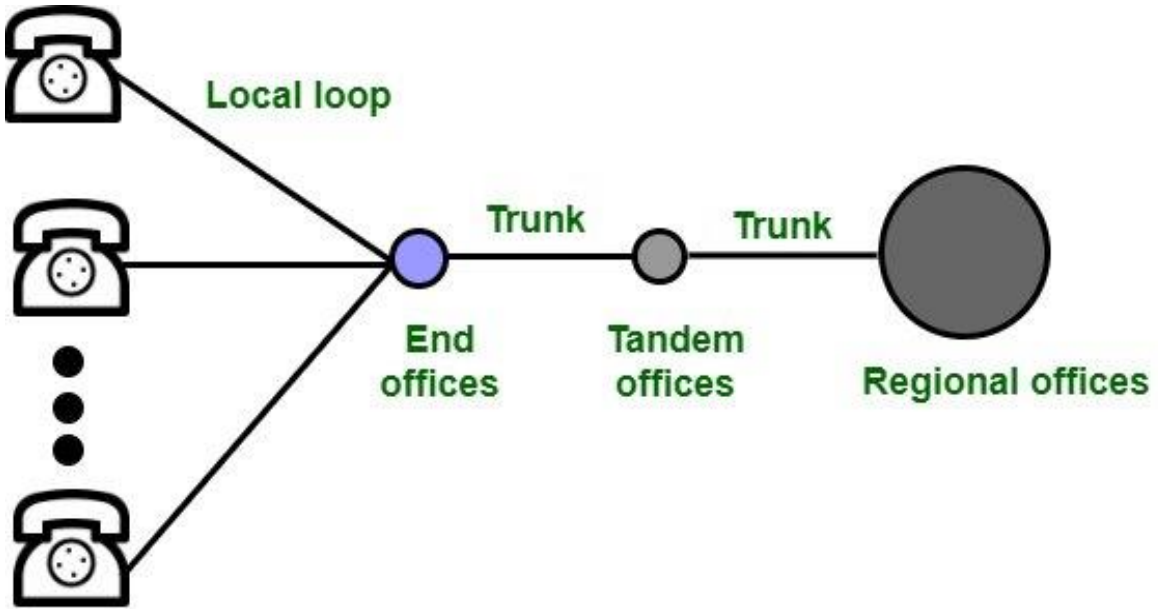
Imagine you are a researcher in 1960s and are tasked to design a computer network? How would you go about designing it?

What is a Computer Network?

- **Computer Network:** A set of interconnected computers that can communicate with each other



Traditional Networks



Carry voice data

Broadcast video

What is a Computer Network?

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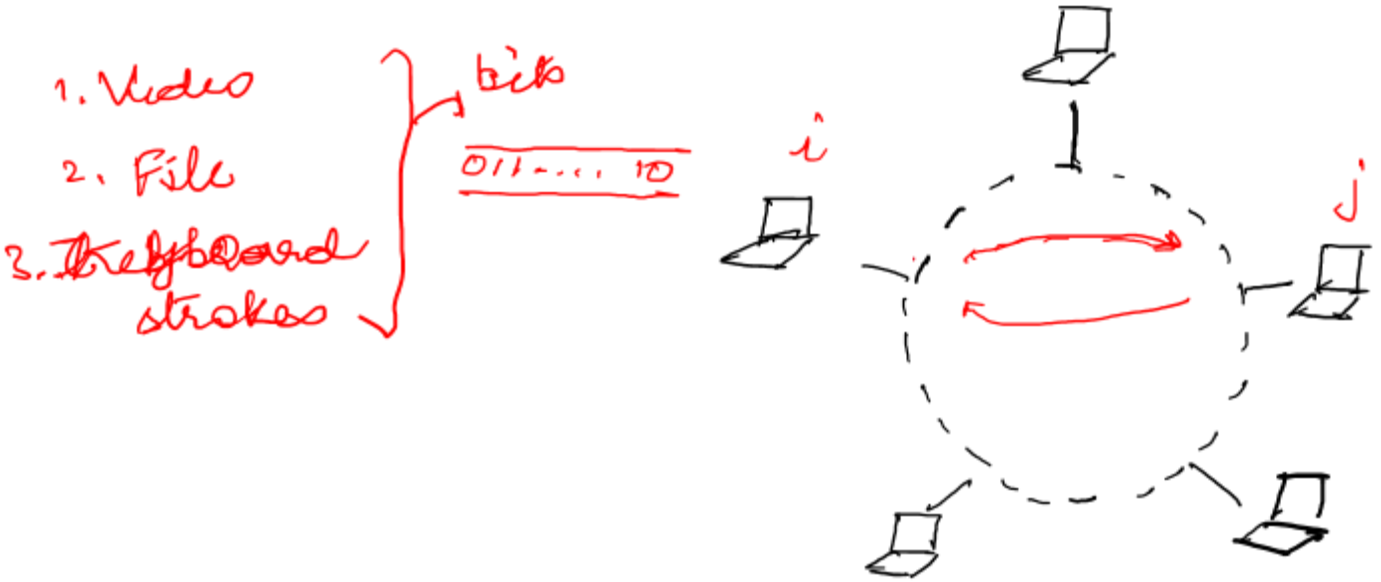


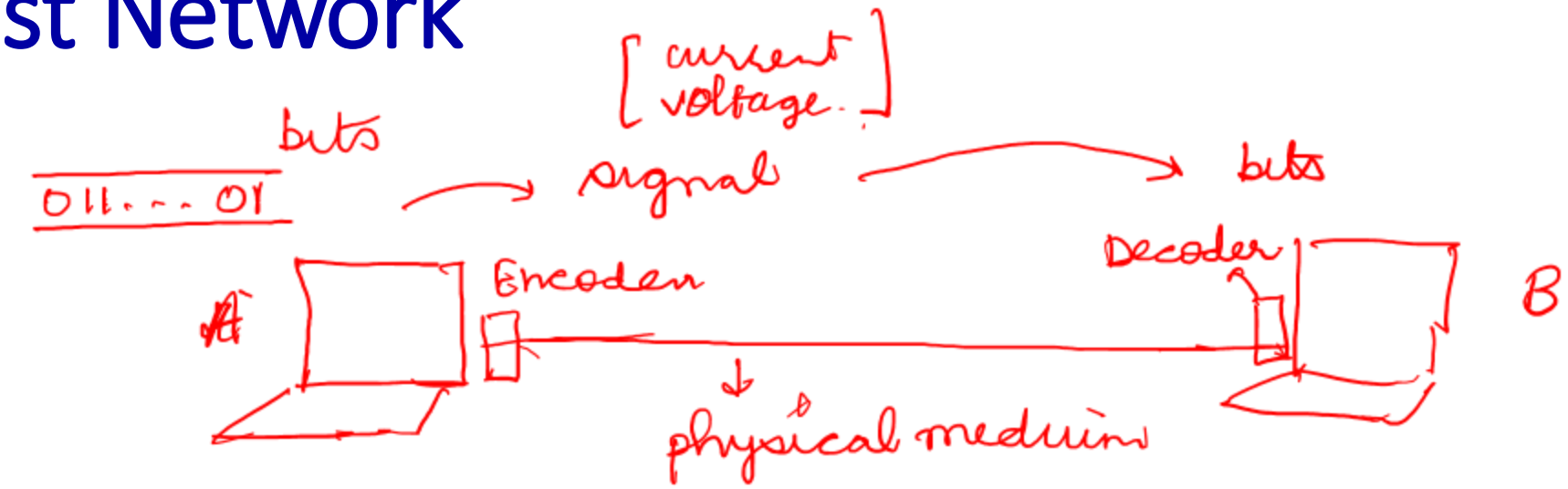
- **Key distinction:** Computer networks are built to carry different kinds of data and for general-purpose hardware

Design goals

1. Scalable
2. Efficient
3. Resilient

Imagine you are tasked to design such a computer network? How would you go about designing it?

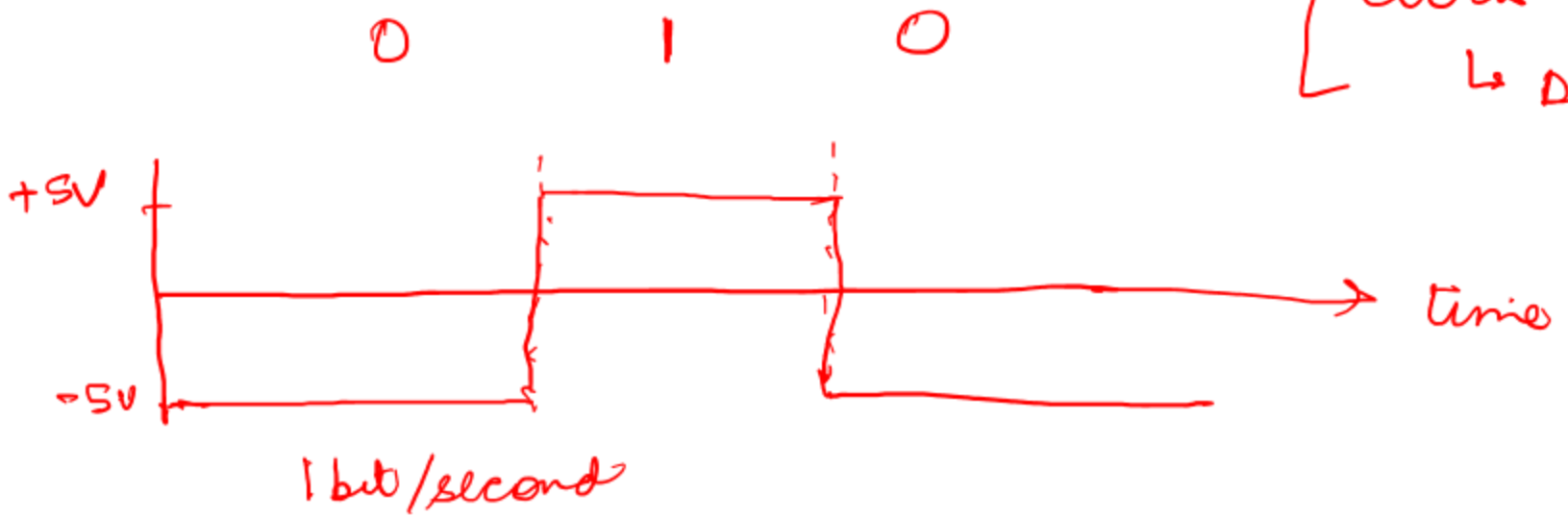
Simplest Network



① Optical fibers

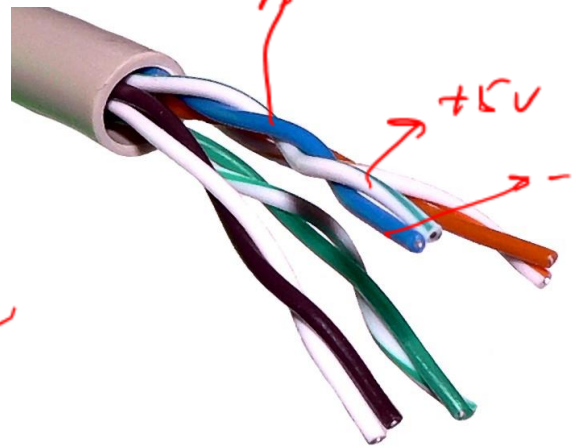
② Copper cables

③. ~~Sound~~ Radio / Wireless



Physical Medium

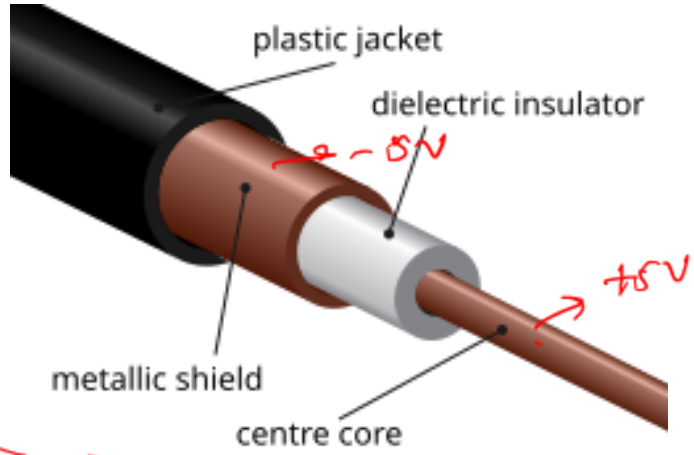
Twisted pair



Wired media

Wireless medium

Coaxial cable



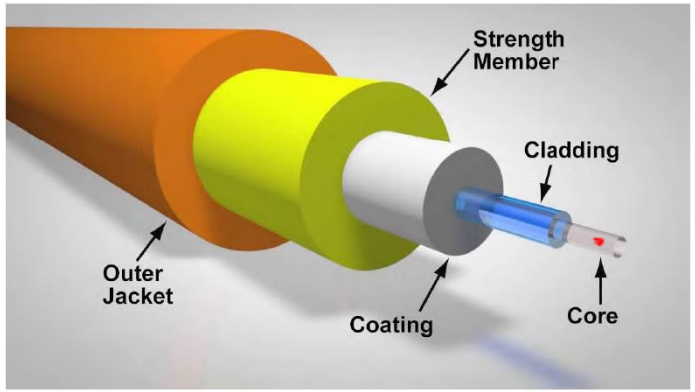
Attenuation

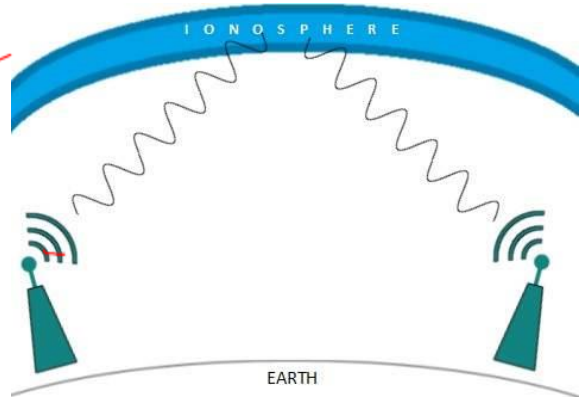
loss of signal strength as it traverses

$10 \log \frac{P_{out}}{P_{in}}$

dB or decibels

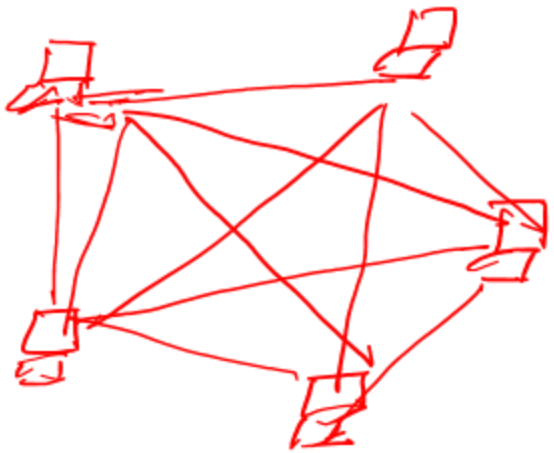
Optical Fiber





How do we build a network of *n (n>2)* computers?

Mesh topology



① $O(n^2)$ connections

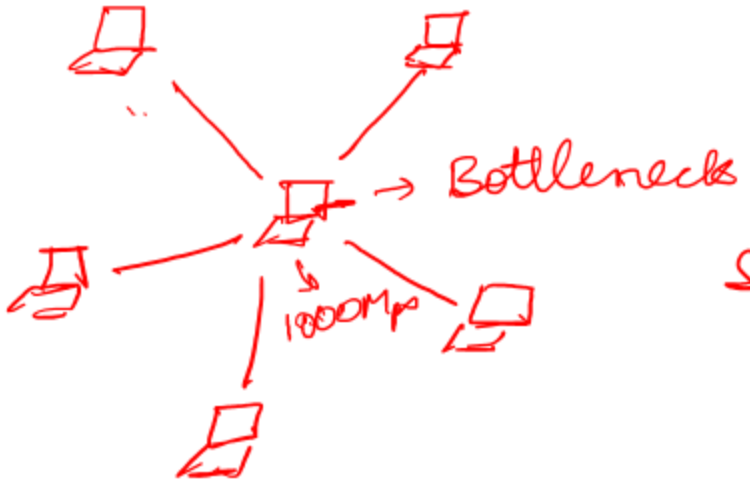
↳ Not scalable

Paul Baran

(RAND technology)

↓

Each node if it is connected to at least 3 nodes



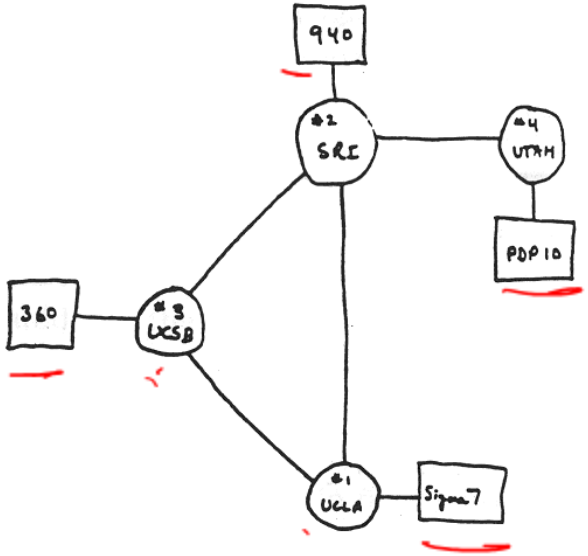
Star topology

O(n) connections

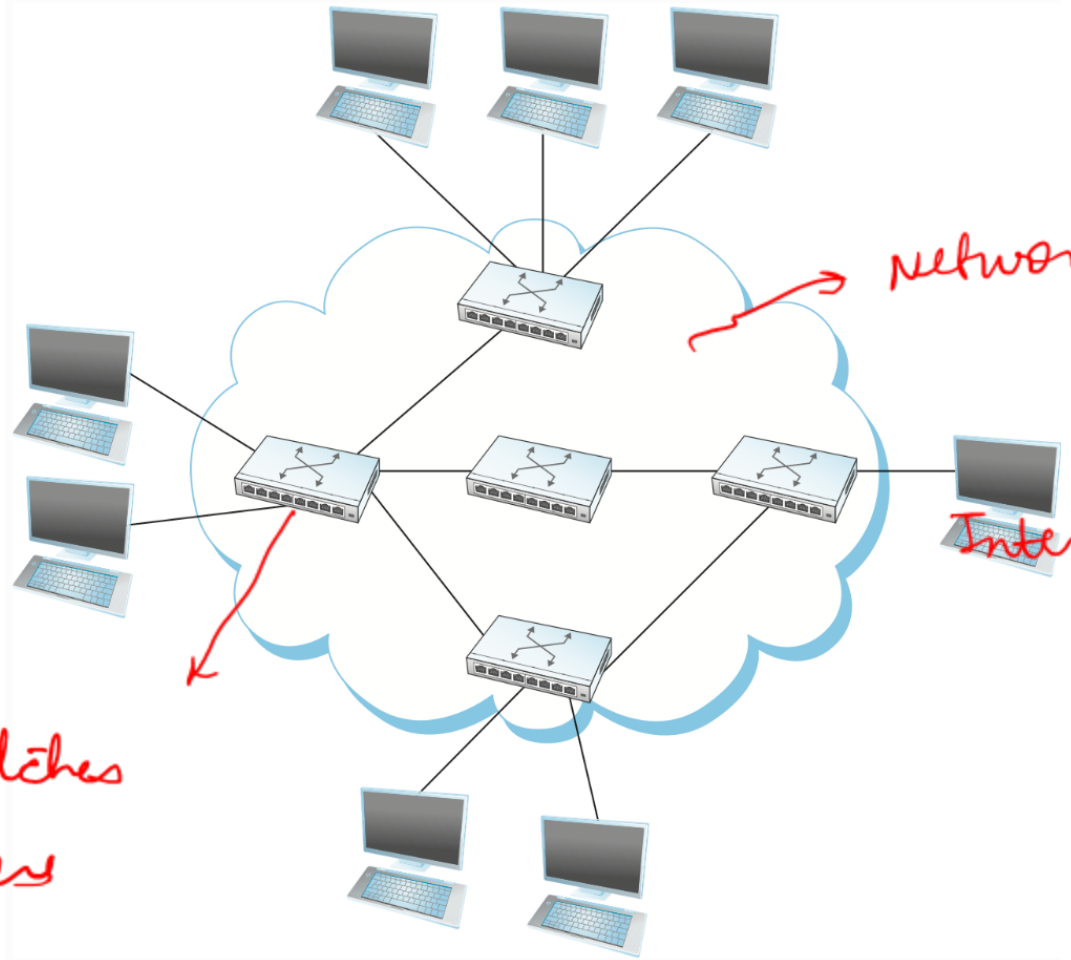
① Resilience → Single point of failure

② Performance
- latency
- Throughput

How do we build a network of *n (n>2)* computers?



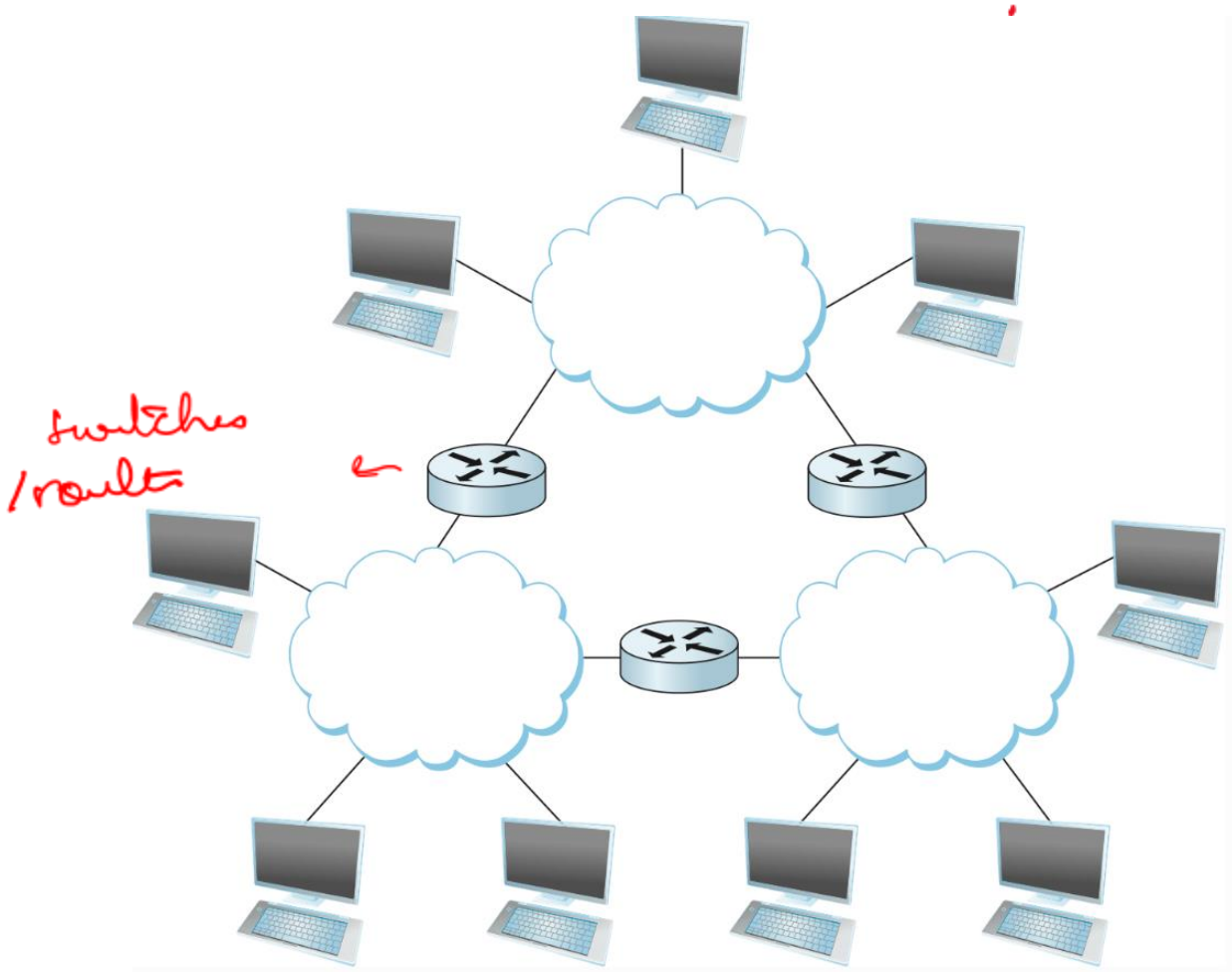
THE ARPA NETWORK



switches / Routers

[Routing

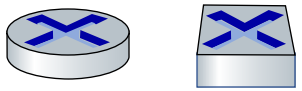
How do we connect n machines over the globe?



The Internet: a network of networks

Billions of connected computing *devices*:

- *hosts = end systems*
- running *network apps* at Internet's "edge"



Packet switches: forward packets (chunks of data)

- *routers, switches*

Communication links

- fiber, copper, radio, satellite
- transmission rate: *bandwidth*

Networks

- collection of devices, routers, links: managed by an organization