Communication Networks:
Technology & Protocols

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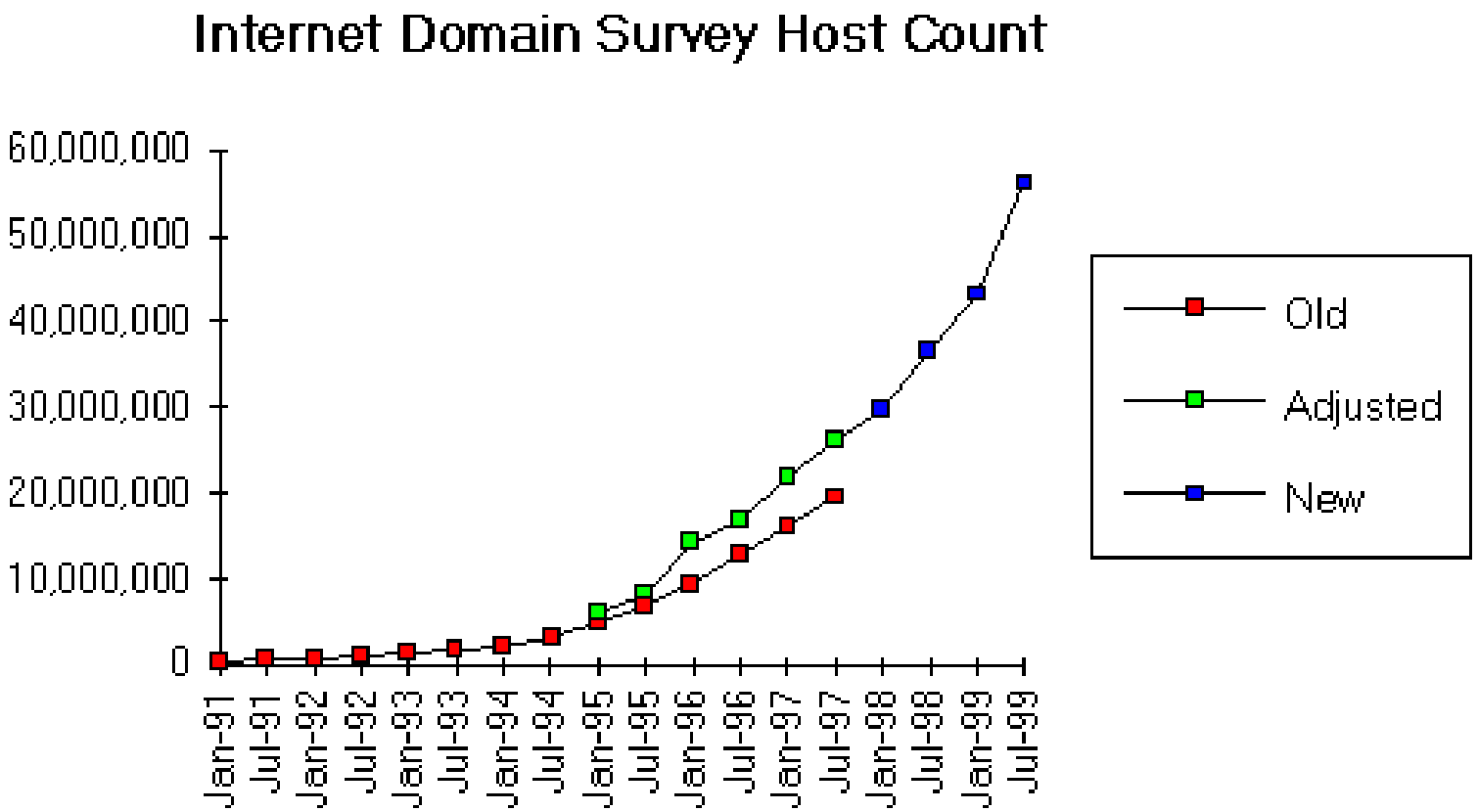
Lecture 2

August 25

Logistics

- Web site:
  - www.cs.berkeley.edu/~amc/eecs122
- Book:
  - Jean Walrand, *Communication Networks, A first course*, **2nd edition**, 1998
- Enrollment:
  - Please check your name on the class list or waiting list (add your name if you are not there already).

Internet Grows Exponentially



Source: Internet Software Consortium (http://www.isc.org/)

Who benefits from the Internet ?

People do.

Who benefits from the Internet ?

- Users:
  - Companies (production cycle, marketing, …).
  - Subscribers (communication, information, shopping, entertainment, …).
- Providers:
  - ISPs, name-administration companies, PTTs.
  - Computer vendors.
  - Network-specialized technology vendors (ethernet cards, IP routers, ATM switches, …).

Who benefits from the Internet ?

The Internet is both
a **product** and a **tool**.

Similar *bearer services*: postal, telephone.

Goal:

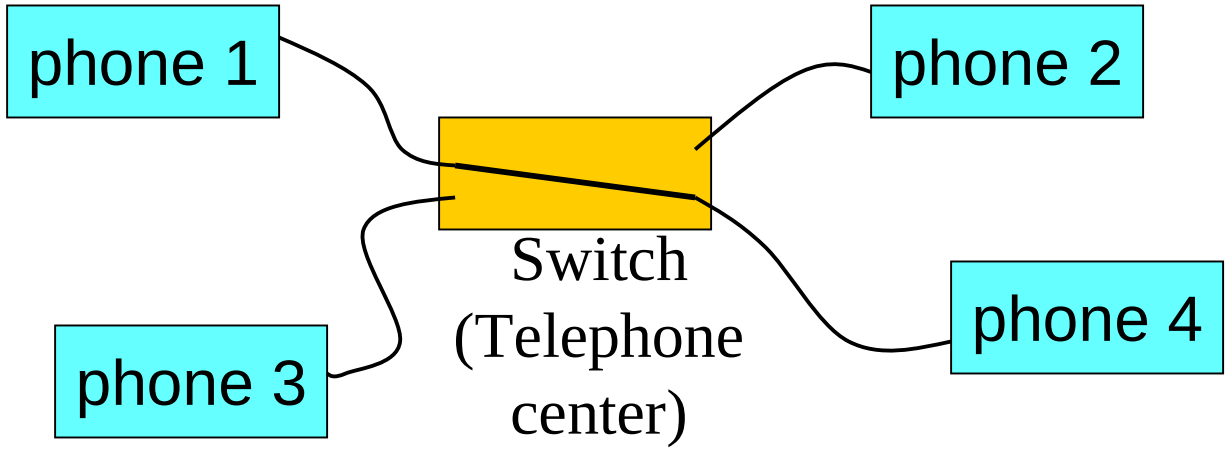
Make the Internet a **useful tool**.

Key requirements:

- **Interoperability.**
- **Diversity / Extensibility.**
- **Scalability.**
- **Performance (Cost-effectiveness).**

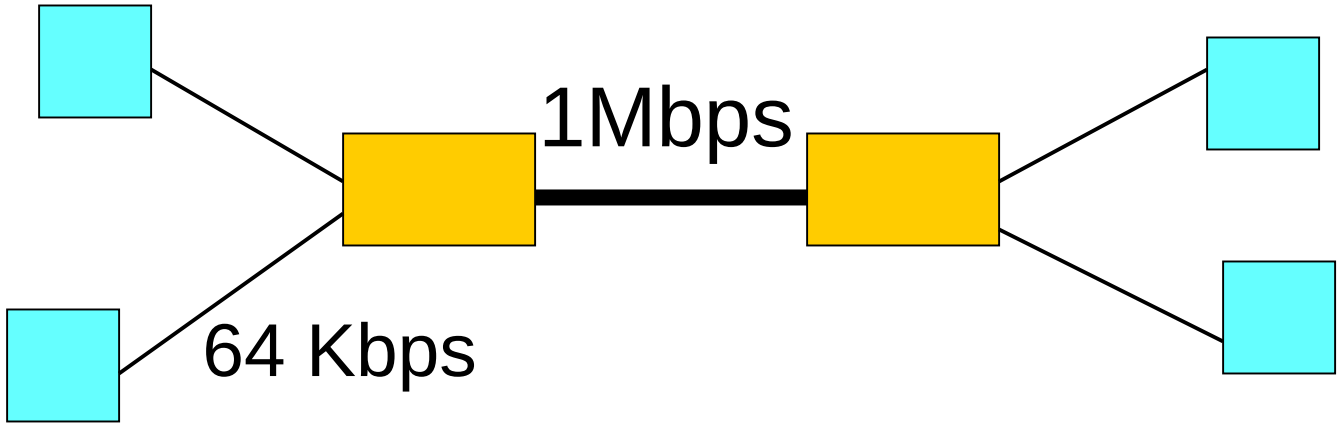
The telephone network: a brief history.

- 1890: analog, switching manual:



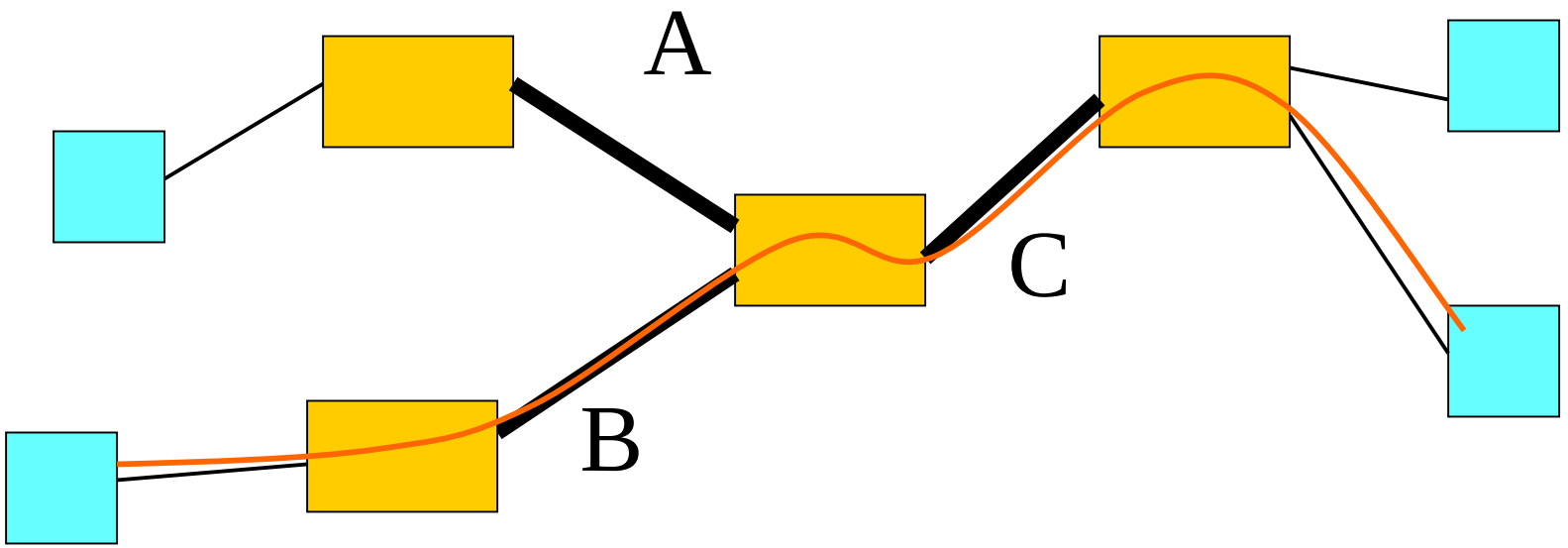
The telephone network: a brief history.

- Today:
  - Digital: voice $\rightarrow$ bit stream (64 Kbps).
  - Switches = computers.
  - Better channel utilization by **multiplexing**:



The telephone network: a brief history.

- **Circuit switched** network:
  - each connection gets 64Kbps end-to-end
  - reservation fixed for the whole transmission

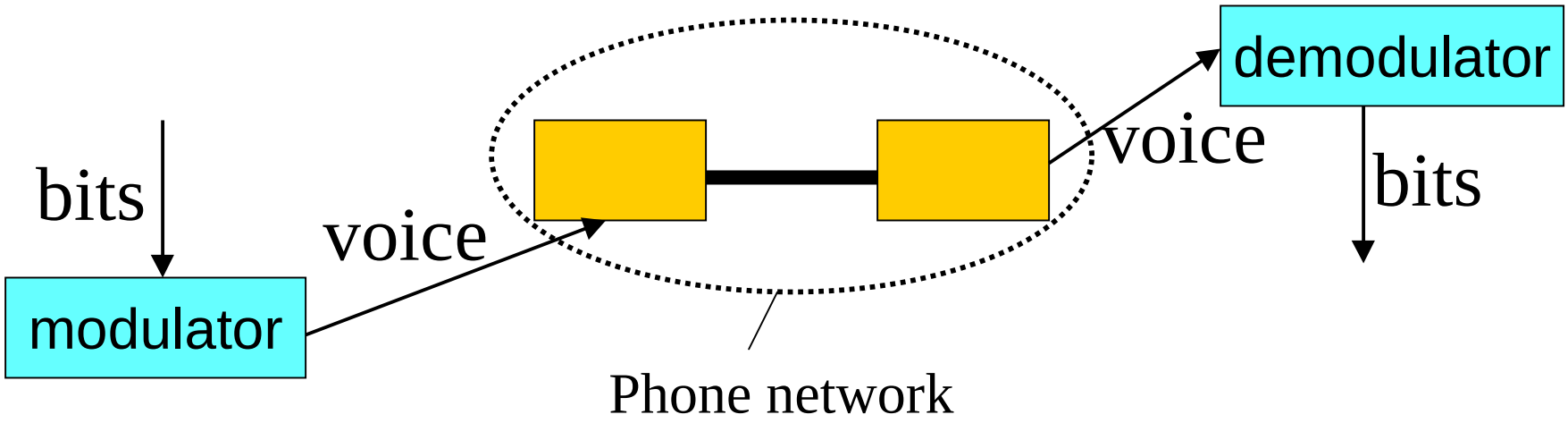


The telephone network: properties.

- Interoperability : good.
- Scalability : good.
- Cost-effectiveness : OK.
- Diversity : limited (constant-bit-rate).
- Extensibility : very limited.

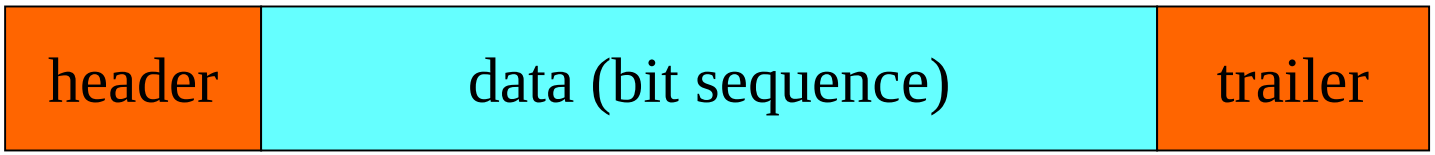
The Internet : a brief history.

- 1969: serial port (RS232) :
  - transmission character-by-character
  - up to ~ 40 Kbps
- 1960s: modems (use phone for data):



The Internet : a brief history.

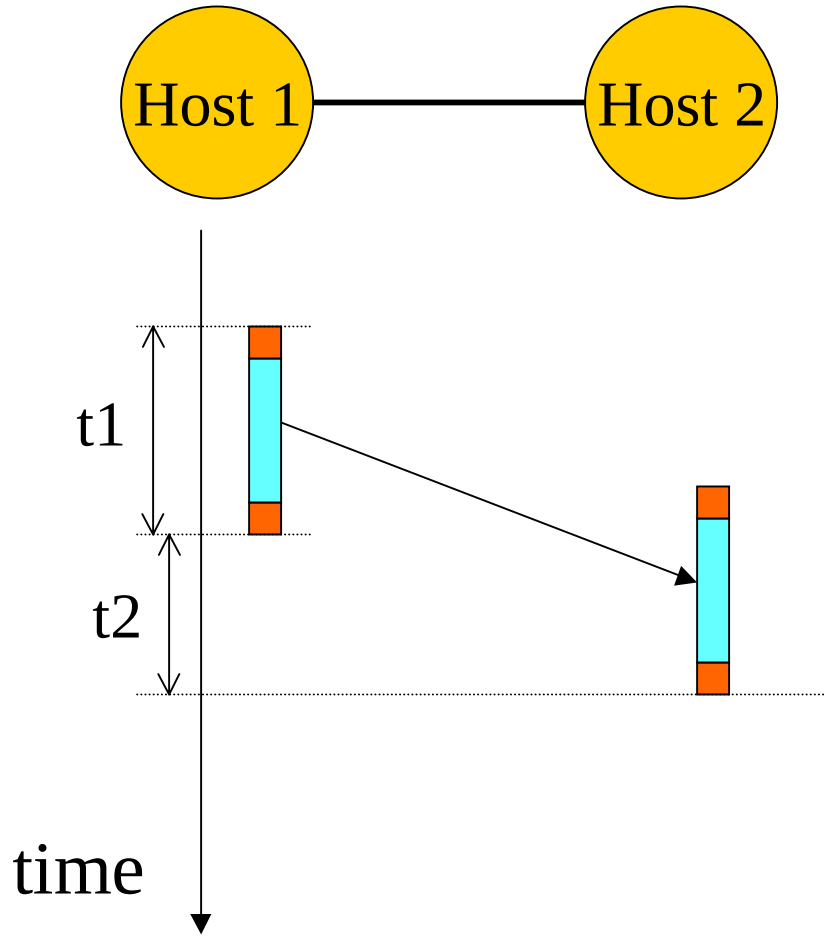
- 1960s: packet links:
  - transmission of a bulk of bits (**packet**):



  - typical rates today:
    - 50 Mbps (copper wire)
    - 155 Mbps (optical fiber)

The Internet : a brief history.

- packet links: connect directly two machines:



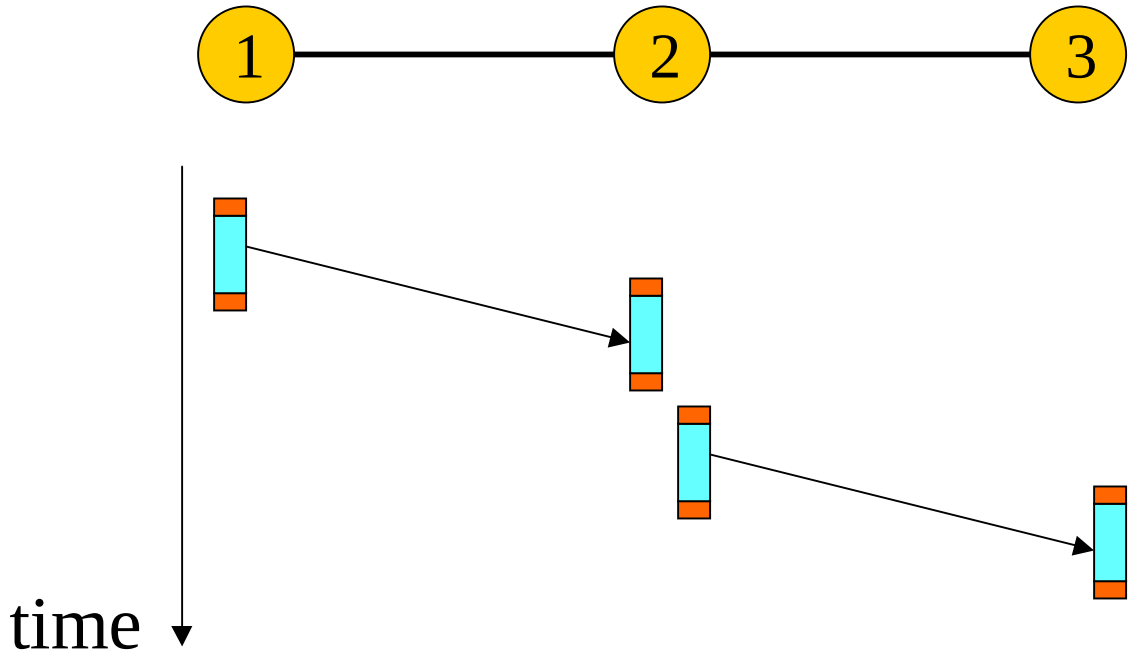
t1 = transmission delay
= packet size / link rate

t2 = propagation delay

The Internet : a brief history.

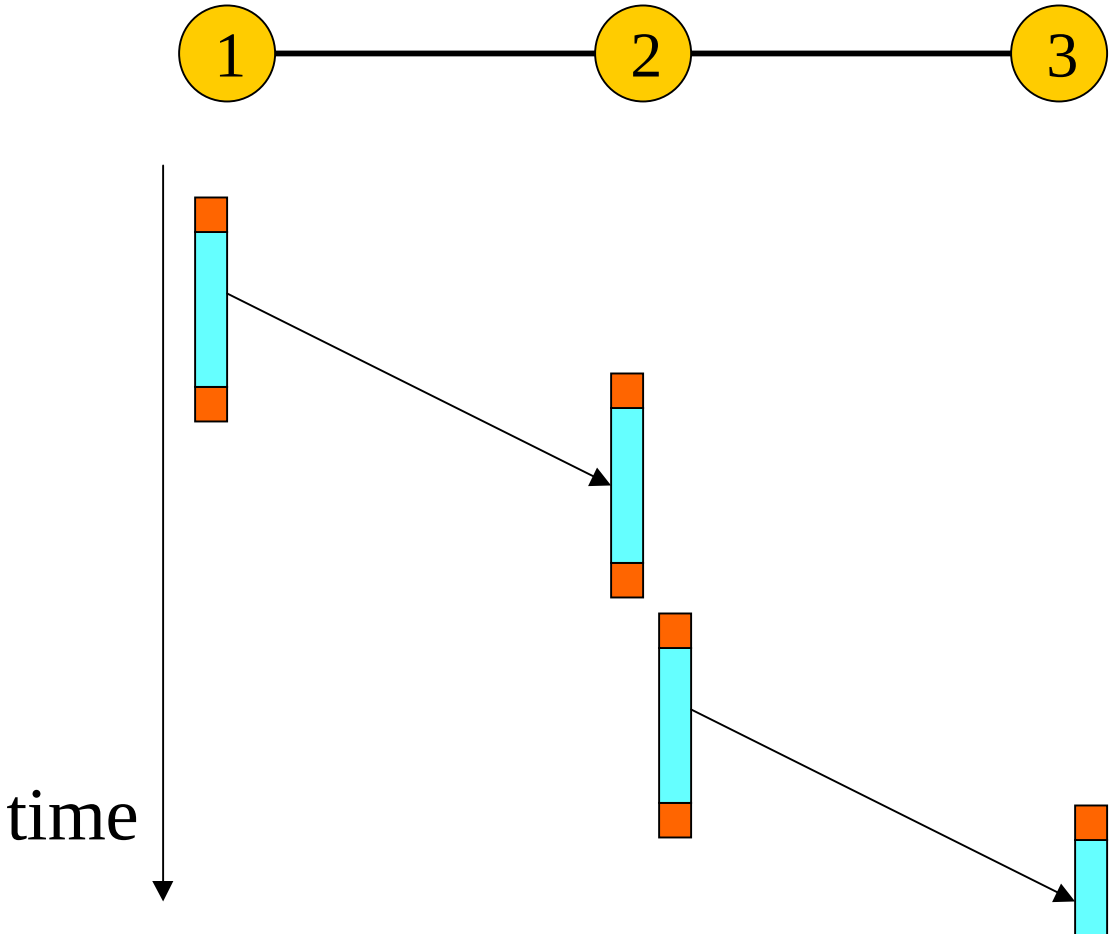
- Store-and-forward:

connect two machines **indirectly**:



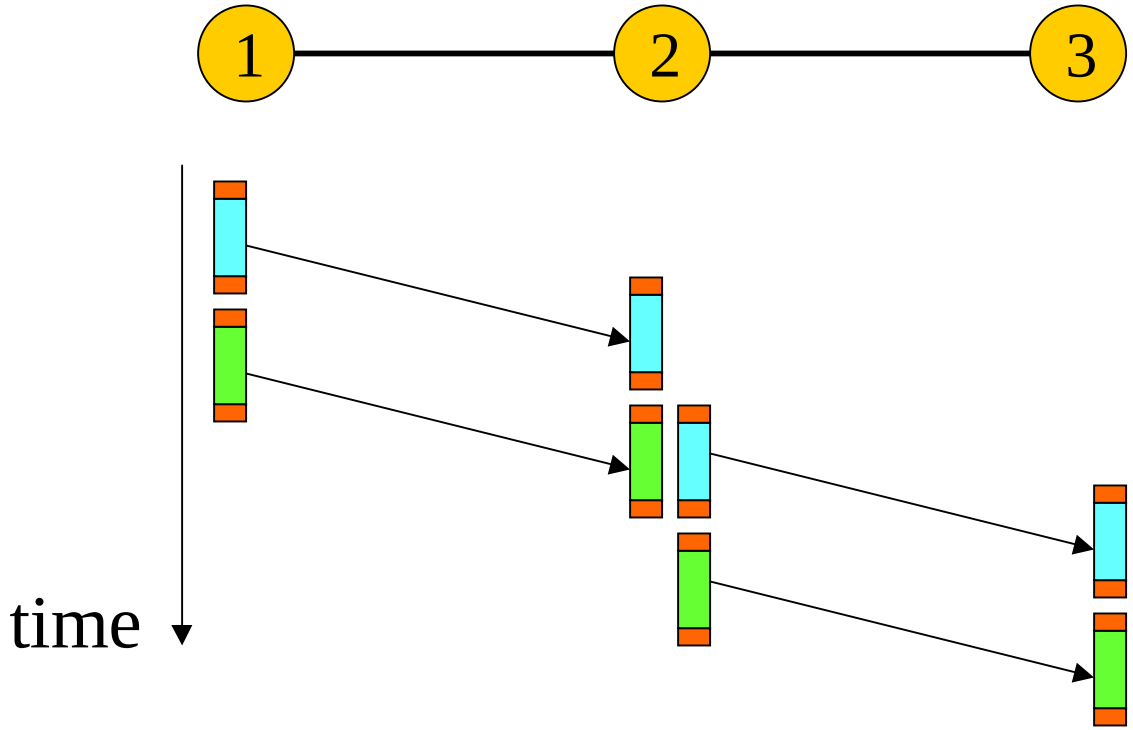
The Internet : a brief history.

- packets shouldn't be too big:



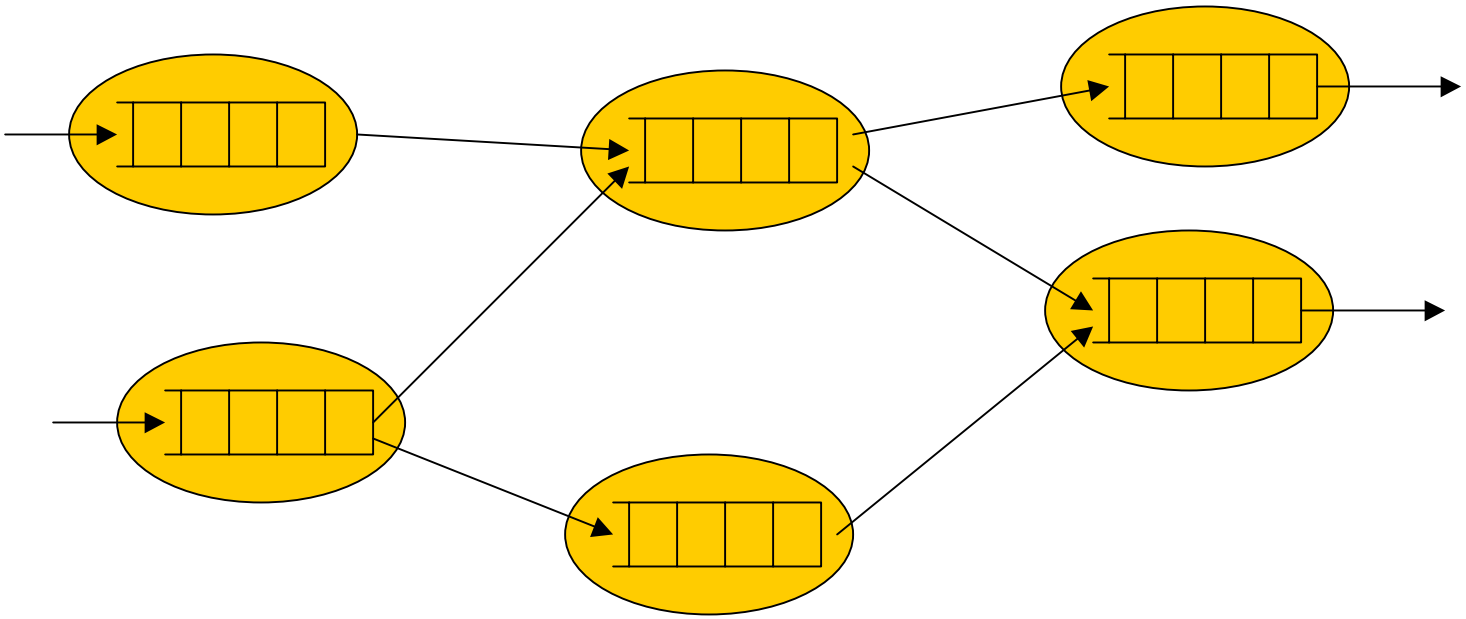
The Internet : a brief history.

- better break up a big packet into small ones:



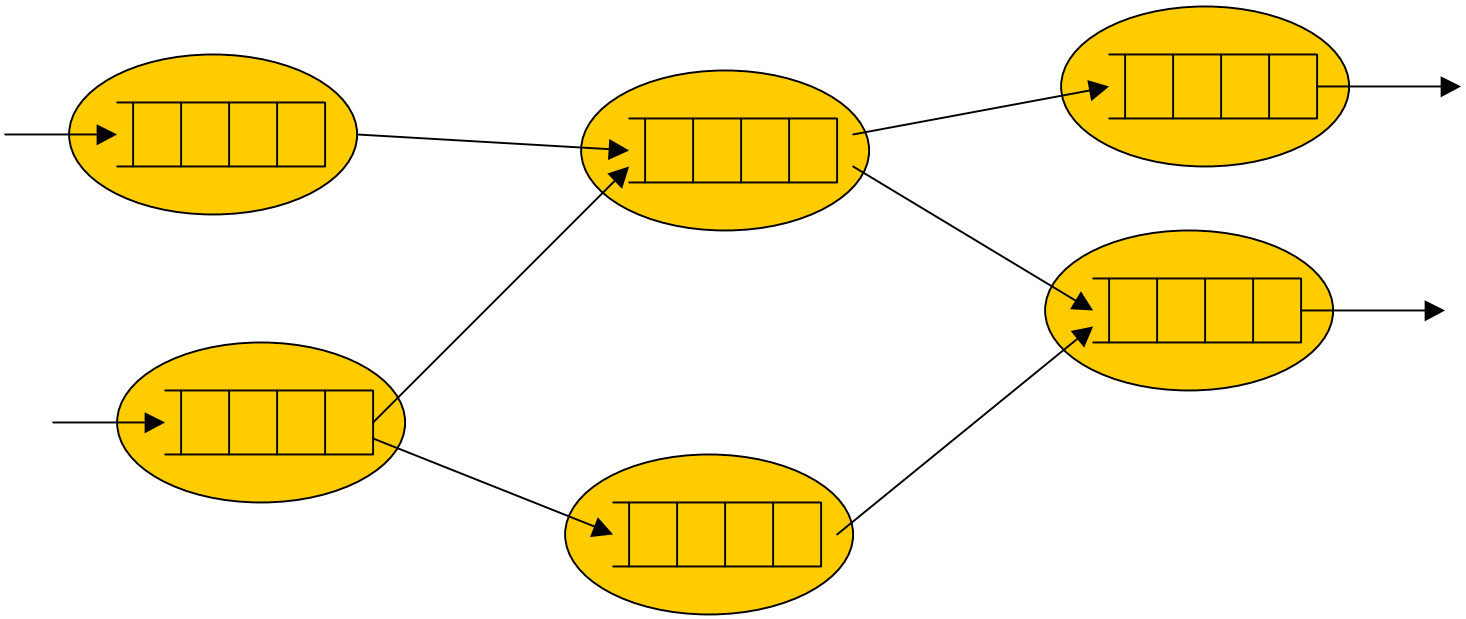
The Internet : a brief history.

- **Packet-switched** network:
  - packets **share** resources (buffers, links)
  - reservation not fixed, but **on-demand**



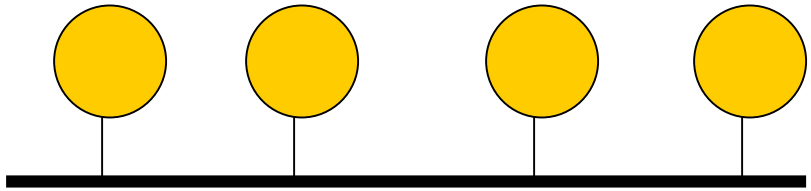
The Internet : a brief history.

- multiple links (connectivity, reliability)
- buffers (store, process, forward)
- control information in packets (s,d,seq#)

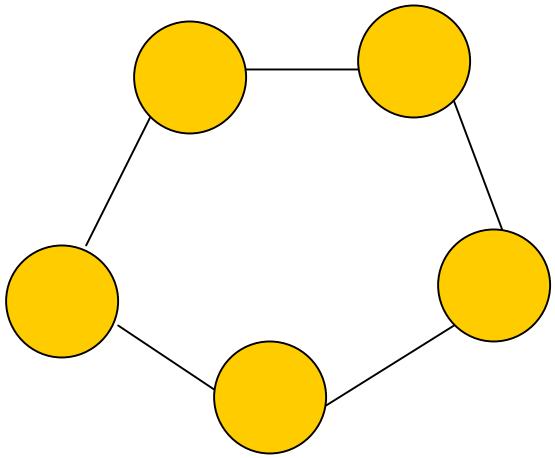


The Internet : a brief history.

- Other architectures: LANs
  - multiple access (e.g., ethernet):



  - token ring (e.g., FDDI):



The Internet: properties.

- Interoperability : good.
- Scalability : good (IP addresses ?).
- Diversity / Extensibility : very high, but no guarantees for applications.
- Cost-effectiveness : very good.

The Internet : how does it do:

- Addressing ?
- Routing ?
- Reliable transmission ?
- Interoperability ?
- Resource management ?
- Quality of service ?

Syllabus:

- Introduction (ends on Friday).
- Applications (e-mail, web, etc).
- Internet: architecture, protocols, addressing, routing.
- LANs (ethernet, token rings, wireless).
- ATM (quality of service).
- Reliable-transmission protocols (error correction, ordered transmission, etc).

Syllabus (continued):

- Congestion control.
- Physical layer: copper, fiber, radio.
- Internet programming (sockets, etc) and network simulation.
- Security.
- Compression.
- Special sessions: invited people will talk about interesting projects in communications going on in UCB.