

Communication Networks: Technology & Protocols



Stavros Tripakis (stavros@eecs)

Lecture 2
August 25

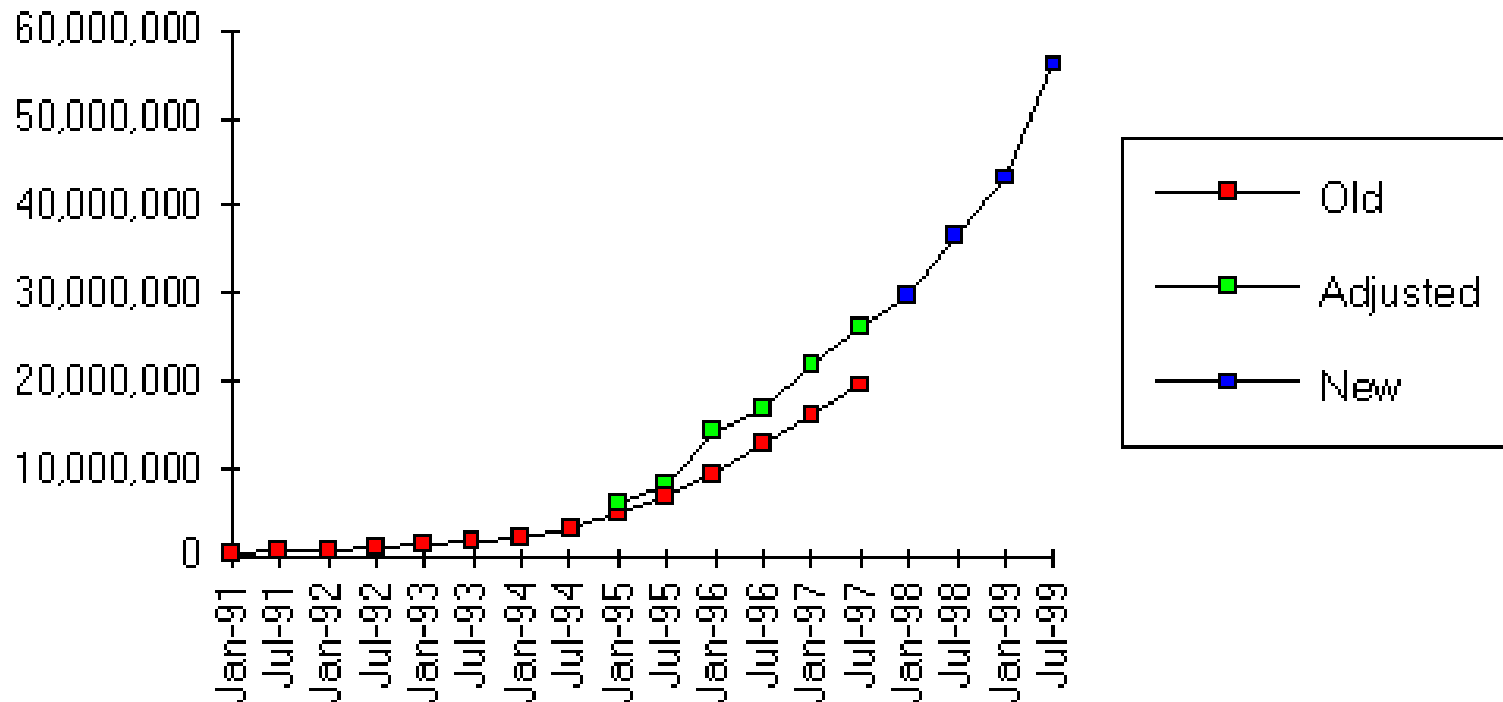
Logistics



- 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

Internet Domain Survey Host Count



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

Who benefits from the Internet ?



People do.

Who benefits from the Internet ?



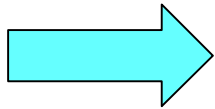
■ Users:

- 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:



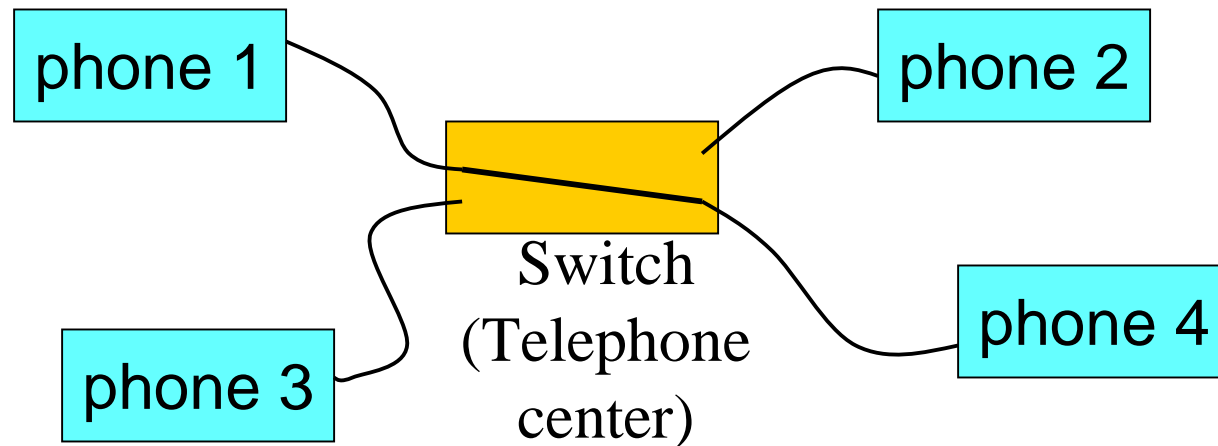
Make the Internet a **useful tool**.

Key requirements:

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

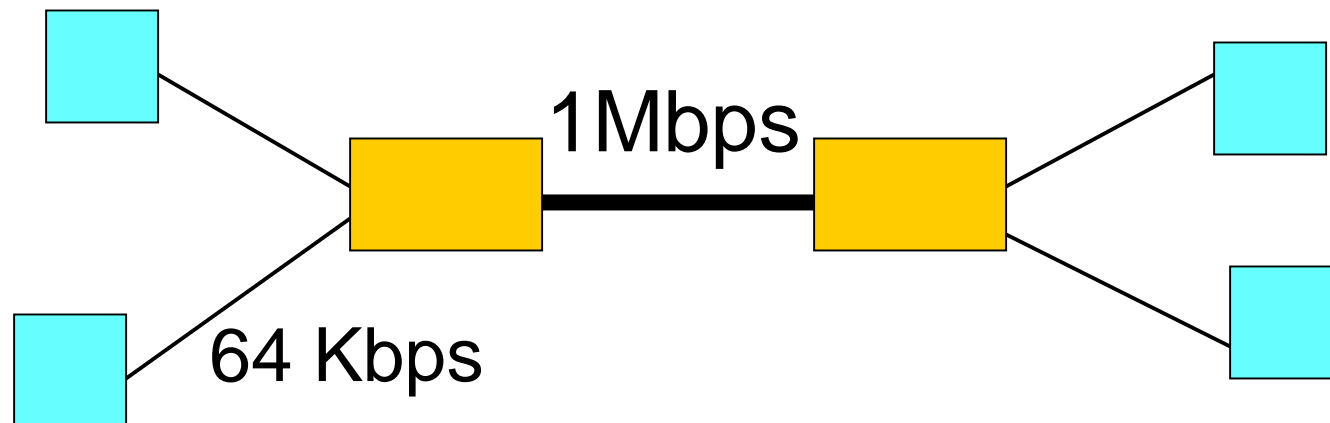
The telephone network: a brief history.

- 1890: analog, switching manual:



The telephone network: a brief history.

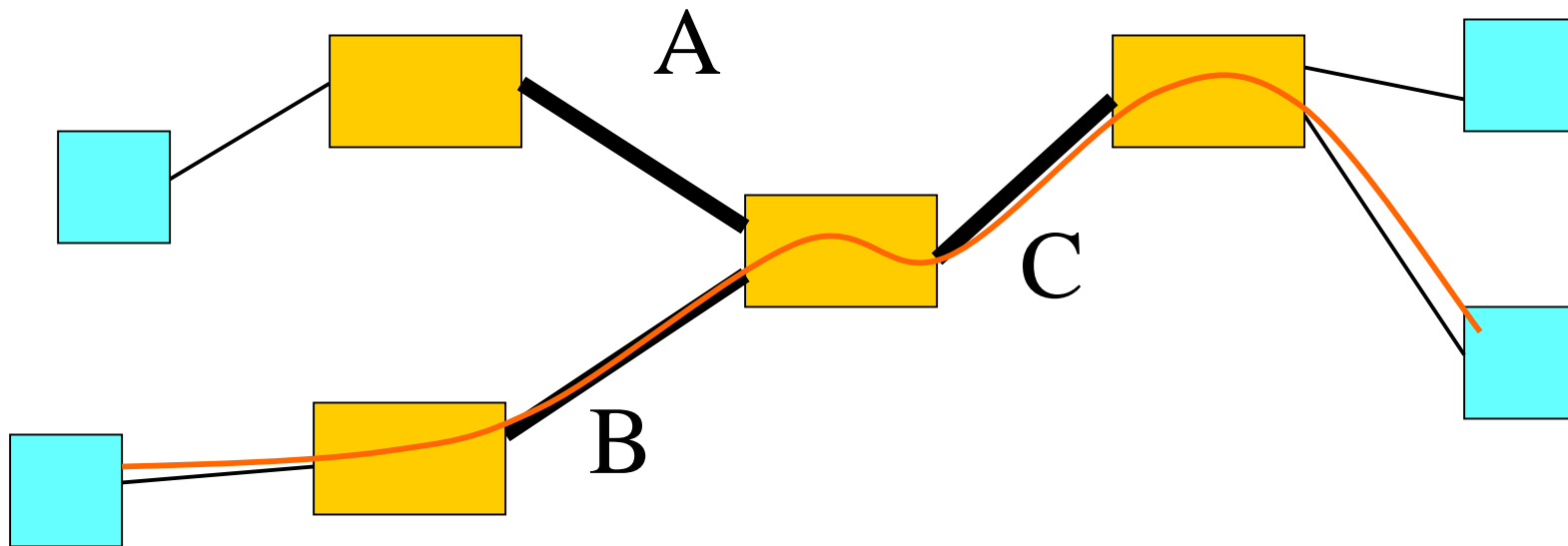
- Today:
 - Digital: voice → bit stream (64 Kbps).
 - Switches = computers.
 - Better channel utilization by **multiplexing**:



The telephone network: a brief history.

■ Circuit switched network:

- each connection gets 64Kbps end-to-end
- reservation fixed for the whole transmission



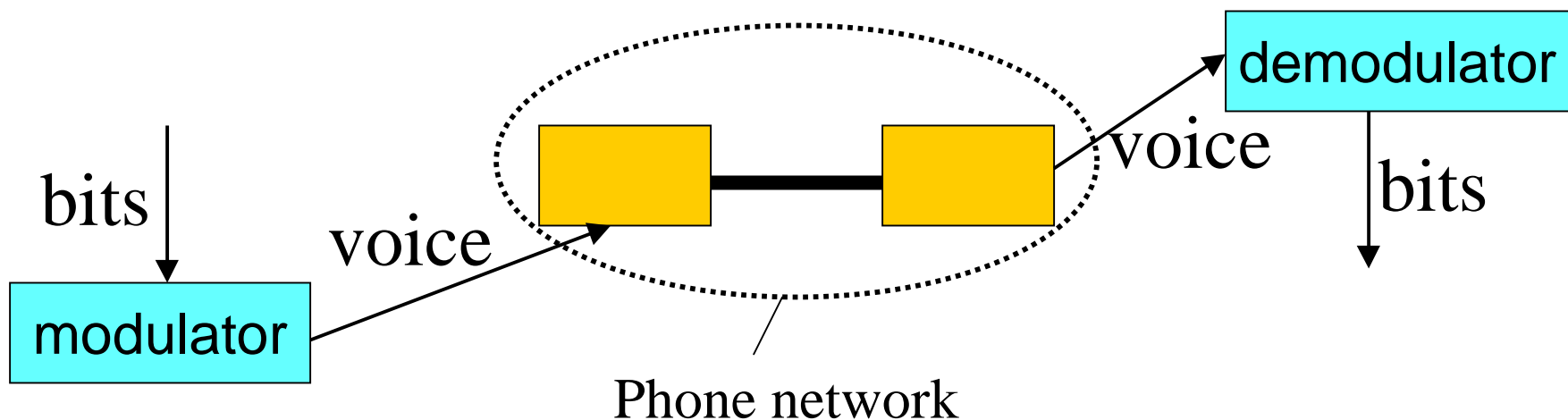
The telephone network: properties.



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

The Internet : a brief history.

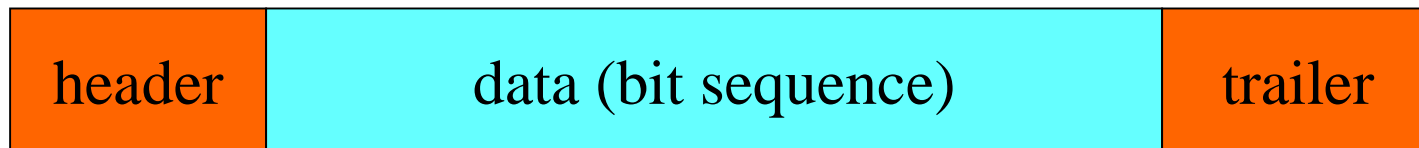
- 1969: serial port (RS232) :
 - transmission character-by-character
 - up to ~ 40 Kbps
- 1960s: modems (use phone for data):



The Internet : a brief history.



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



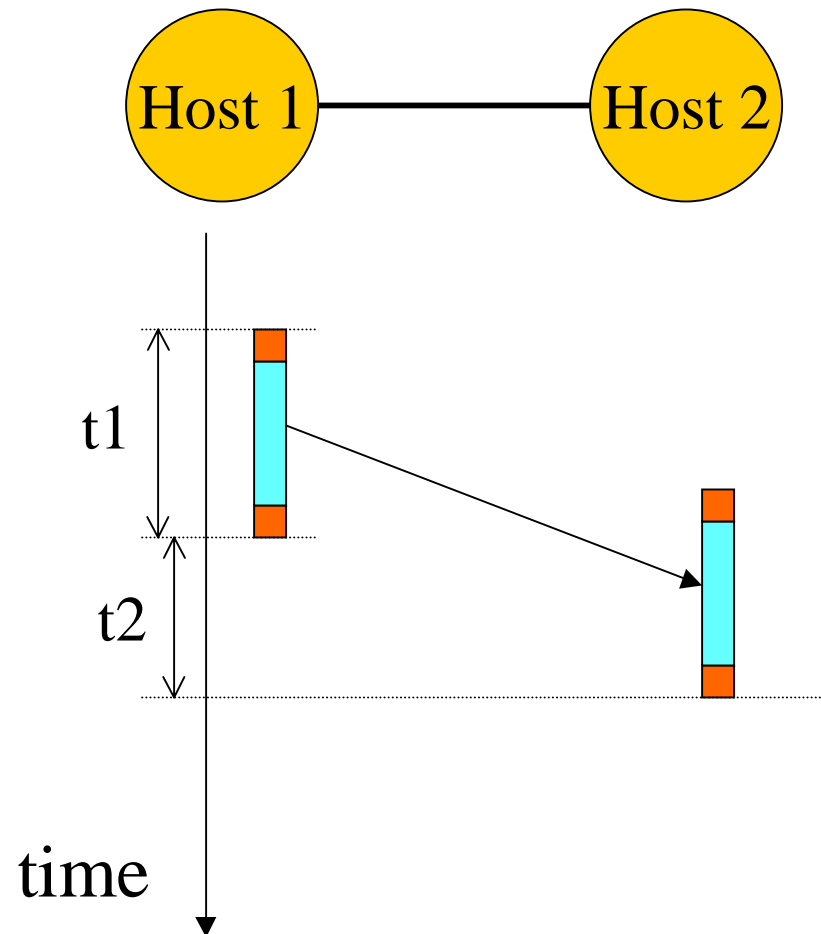
- typical rates today:
 - 50 Mbps (copper wire)
 - 155 Mbps (optical fiber)

The Internet : a brief history.

- packet links:
connect directly
two machines:

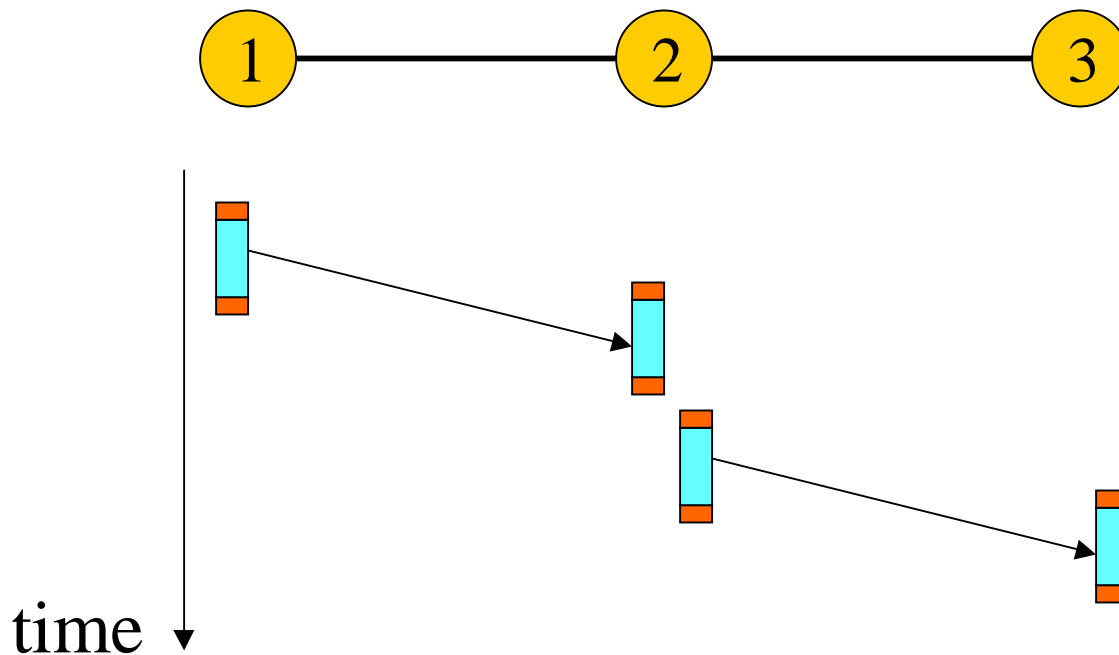
t_1 = transmission delay
= packet size / link rate

t_2 = propagation delay



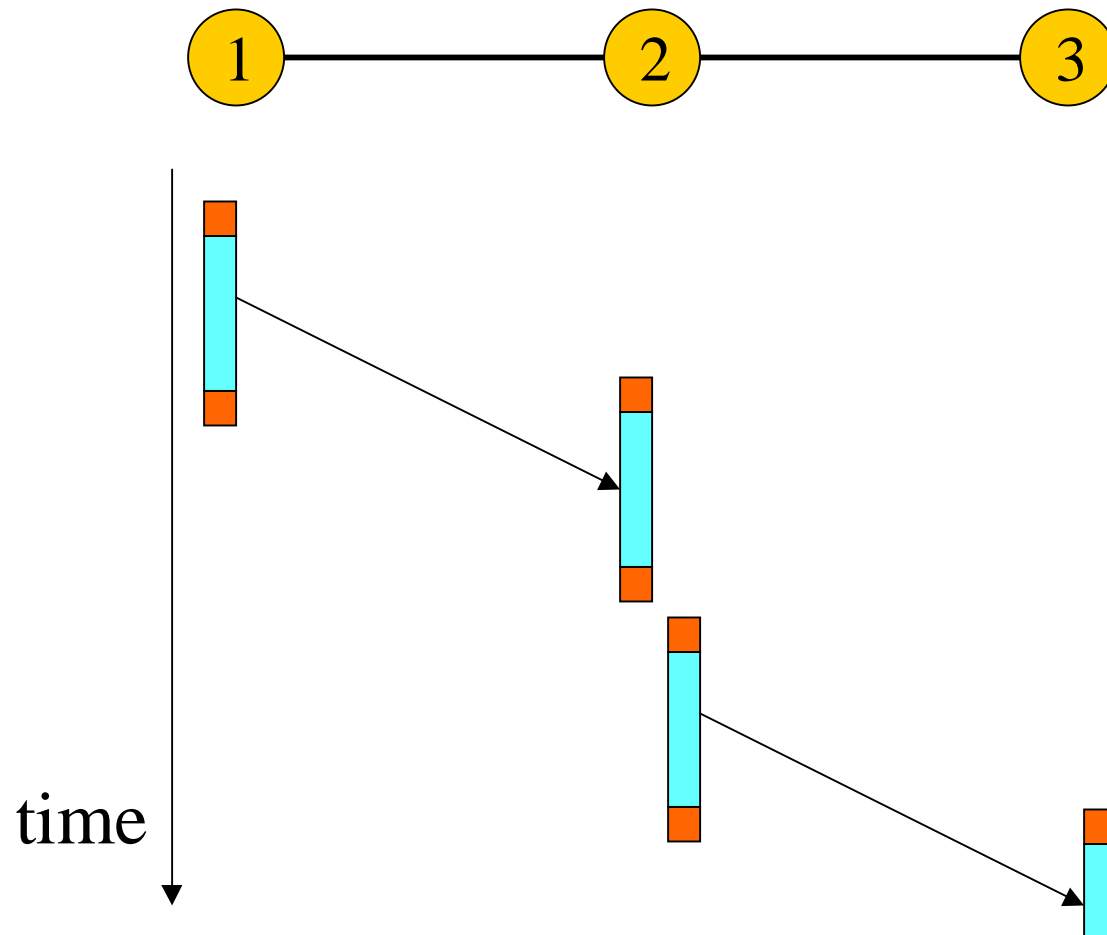
The Internet : a brief history.

- Store-and-forward:
connect two machines **indirectly**:



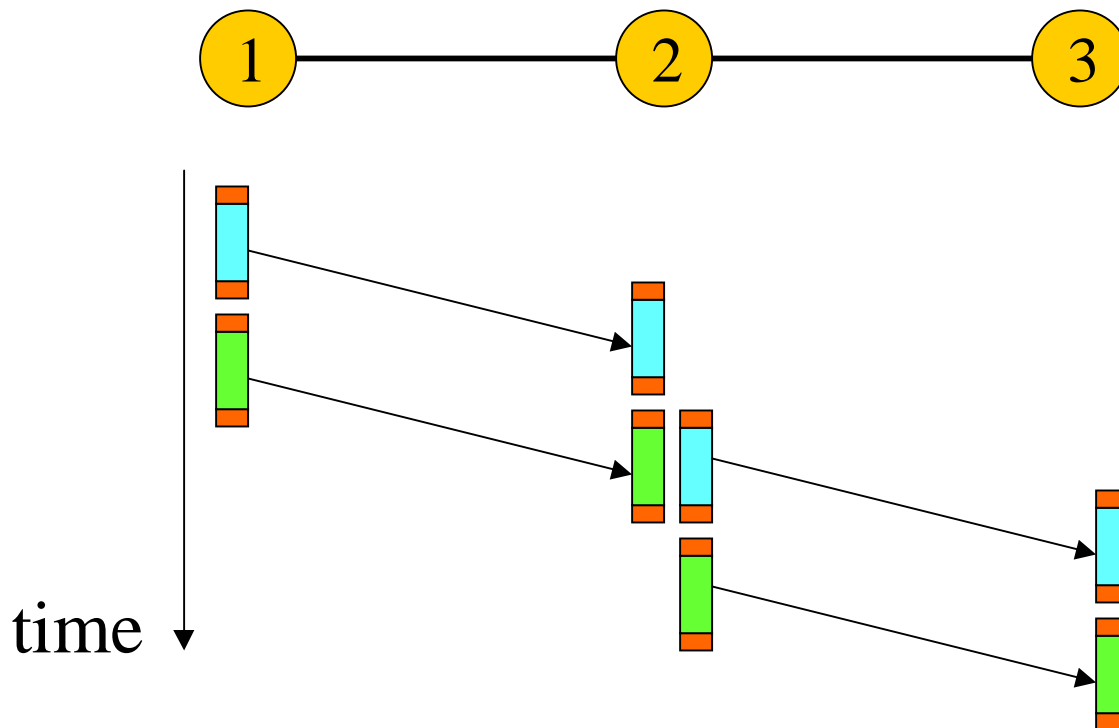
The Internet : a brief history.

- packets shouldn't be too big:



The Internet : a brief history.

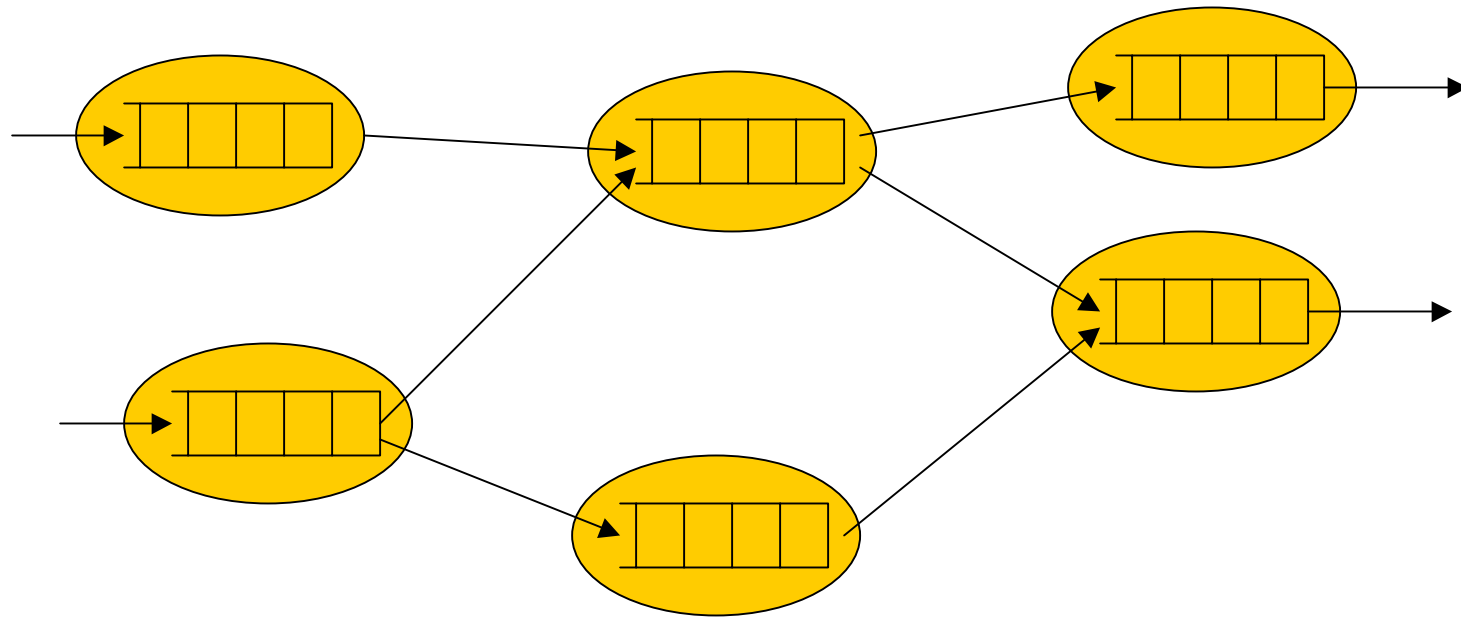
- better break up a big packet into small ones:



The Internet : a brief history.

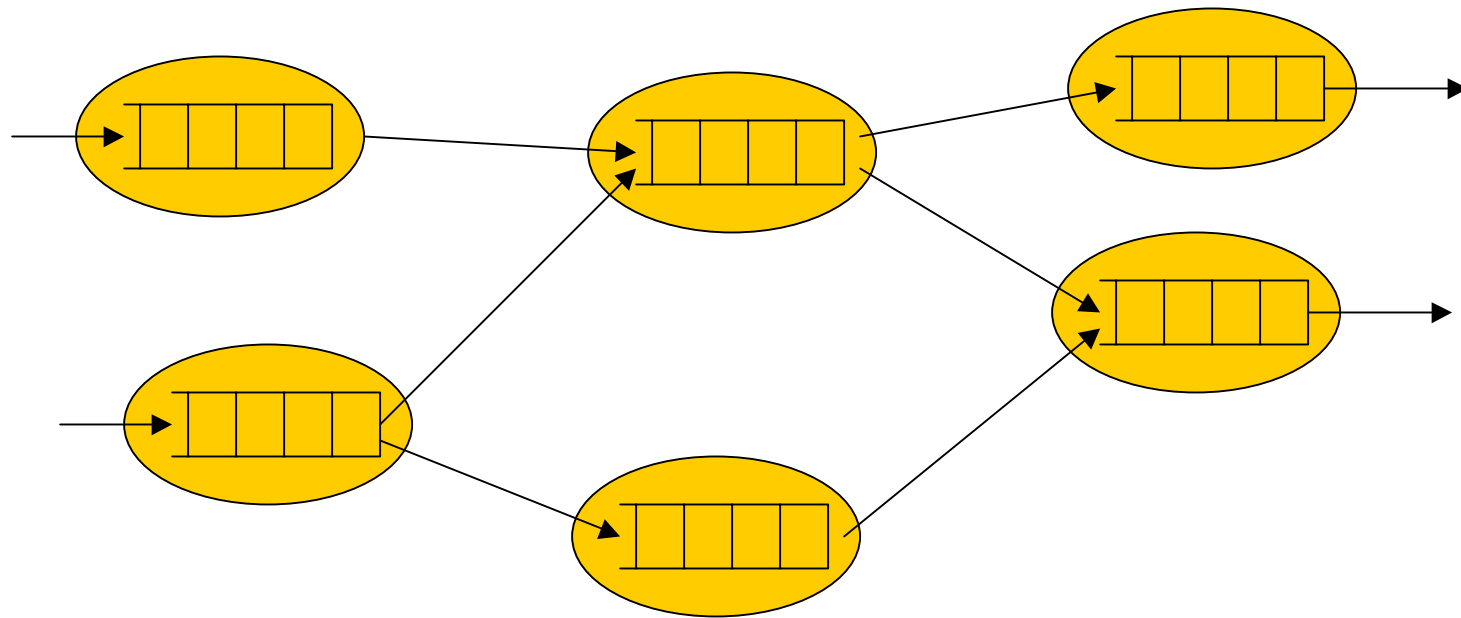
■ Packet-switched network:

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



The Internet : a brief history.

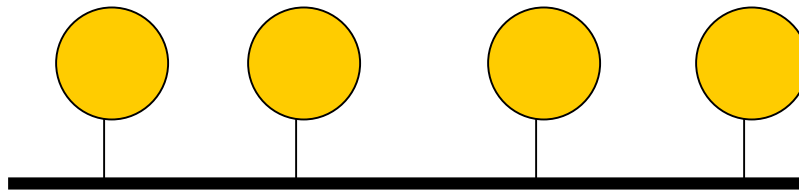
- multiple links (connectivity, reliability)
- buffers (store, process, forward)
- control information in packets (s,d,seq#)



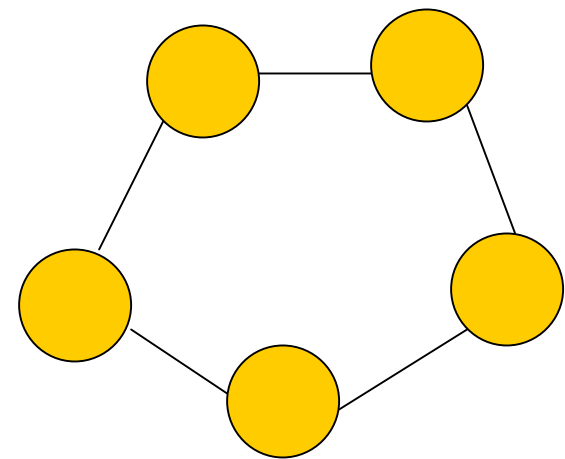
The Internet : a brief history.

■ 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.