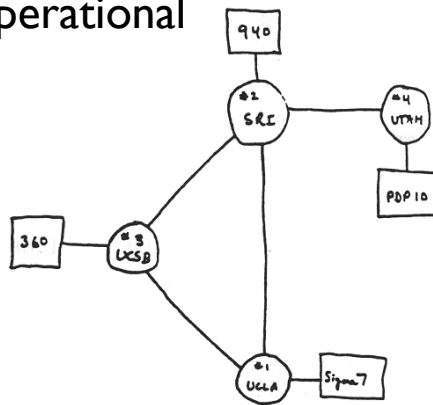


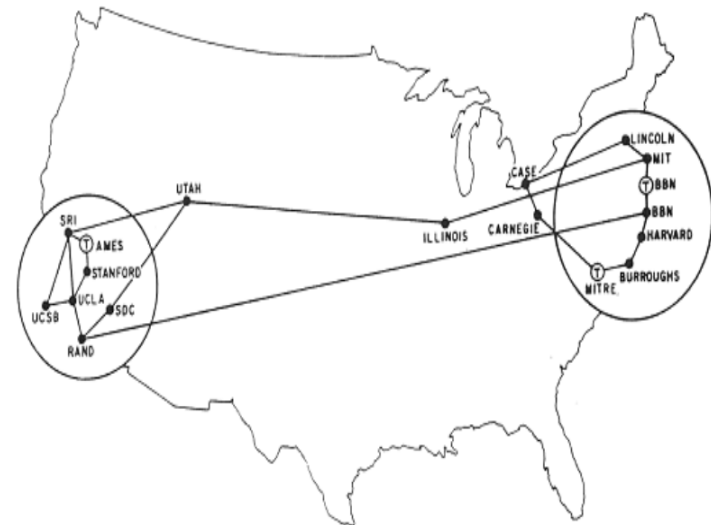
# Internet history

## *1961-1972: Early packet-switching principles*

- ❑ 1961: Kleinrock - queueing theory shows effectiveness of packet-switching
- ❑ 1964: Baran - packet-switching in military nets
- ❑ 1967: ARPAnet conceived by Advanced Research Projects Agency
- ❑ 1969: first ARPAnet node operational
- ❑ 1972:
  - ❖ ARPAnet public demo
  - ❖ NCP (Network Control Protocol) first host-host protocol
  - ❖ first e-mail program
  - ❖ ARPAnet has 15 nodes



THE ARPA NETWORK



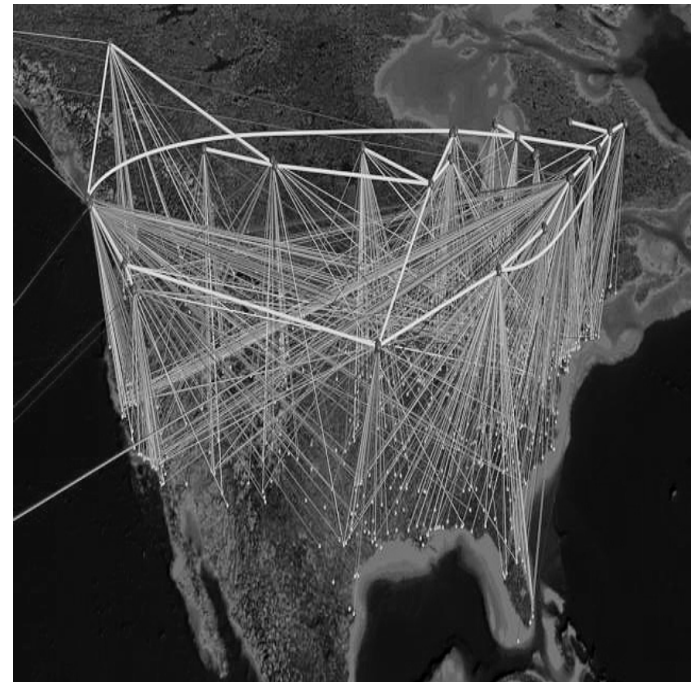
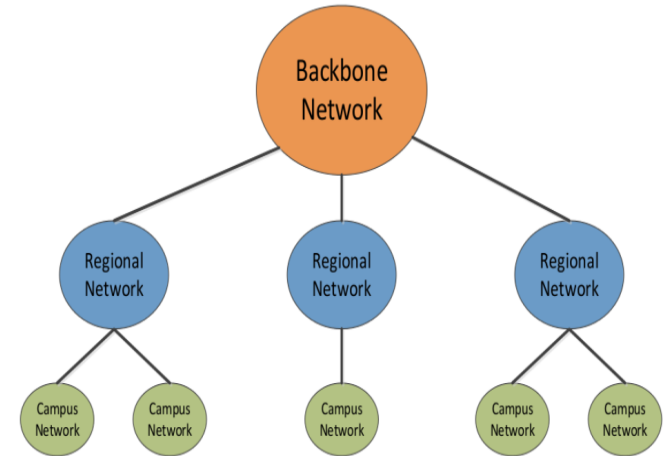
## 1972-1980: Internetworking, new and proprietary nets

### ❑ 1974: TCP/IP

- ❖ Robert Kahn & Vinton Cerf
- ❖ **Protocol**: “language” for devices
- ❖ **Scalable** way to connect hosts
- ❖ Became part of “Internet” in 1983

### ❑ 1985 – 1995: NSFNET

- ❖ Academic research network
- ❖ Not for **commercial** activities until 1990s!
- ❖ **Three tiered** structure
- ❖ Backbone had **14** nodes by 1991



# Internet history

*1980-1990: new protocols, a proliferation of networks*

- ❑ 1983: deployment of TCP/IP
- ❑ 1982: smtp e-mail protocol defined
- ❑ 1983: DNS defined for name-to-IP-address translation
- ❑ 1985: ftp protocol defined
- ❑ 1988: TCP congestion control
- ❑ new national networks: Csnnet, BITnet, NSFnet, Minitel
- ❑ 100,000 hosts connected to confederation of networks

# Internet history

*1990, 2000's: commercialization, the Web, new apps*

## □ early 1990's:

- ❖ ARPAnet decommissioned
- ❖ Internet Service Providers (ISPs)

## □ 1991: NSF lifts restrictions on commercial use of NSFnet

## □ 1995: NSFNET decommissioned, superseded by commercial "Internet"

## □ early 1990s: Web

- ❖ hypertext [Bush 1945, Nelson 1960's]
- ❖ HTML, HTTP: Berners-Lee
- ❖ 1994: Mosaic, later Netscape
- ❖ late 1990's: commercialization of the Web

# Today

## □ number of devices

- ❖ Today: 2 – 3 times more interconnected devices than people
- ❖ 2020: 6 – 7 times ...

## □ mobile devices

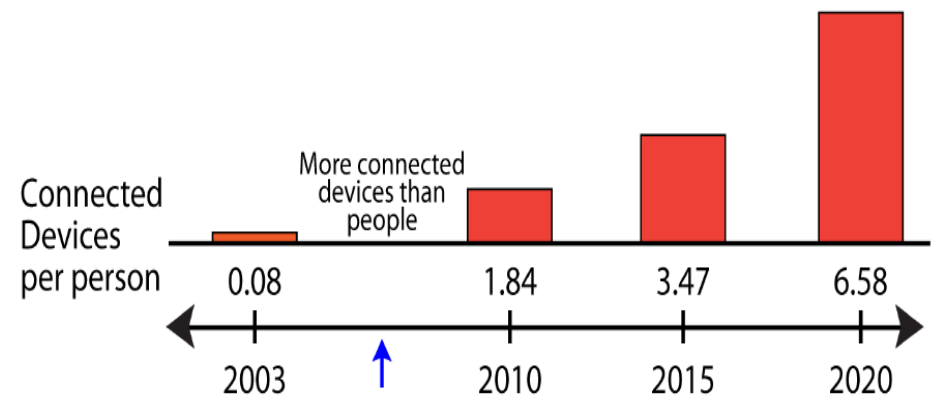
## □ more killer apps:

- ❖ messaging, P2P, social

## □ backbone running at Gbps

## □ network security issues

|                   |             |              |             |             |
|-------------------|-------------|--------------|-------------|-------------|
| World Population  | 6.3 billion | 6.8 billion  | 7.2 billion | 7.6 billion |
| Connected Devices | 500 million | 12.5 billion | 25 billion  | 50 billion  |



# Internet history

## *2005-present*

- ❑ 1B personal computers, 7B **mobile** devices
- ❑ Aggressive deployment of broadband access
- ❑ Increasing ubiquity of high-speed **wireless access**
- ❑ Emergence of online social networks
- ❑ **Content**-centric networking
- ❑ Service providers (Google, Microsoft) create their own networks
  - ❖ Bypass Internet, providing “instantaneous” access to content, search, etc.
- ❑ E-commerce, universities, enterprises running their services in “**cloud**” (eg, Amazon EC2)
- ❑ Security and privacy in the forefront
- ❑ **Internet is critical infrastructure for our society**

# Fathers of the Internet

□ Many claim this title ☺

□ Len Kleinrock:

- ❖ <http://www.lk.cs.ucla.edu/index.html>
- ❖ “The birth of the Internet occurred in his UCLA laboratory (3420 Boelter Hall) when his Host computer became the first node of the Internet in September 1969 and it was from there that he directed the transmission of the first message to pass over the Internet on October 29, 1969”.

□ Vint Cerf and Bob Kahn

- ❖ [http://en.wikipedia.org/wiki/Vint\\_Cerf](http://en.wikipedia.org/wiki/Vint_Cerf)
- ❖ “Co-invented IP and TCP in 1973, the two original protocols of the Internet protocol suite.”
- ❖ Program manager in DARPA. CTO in National Science Board under Obama.
- ❖ Routing+reliable delivery, no congestion control (V. Jacobson)

# The Father or Mother of some Field...

- ❑ The Father of the Web

- ❖ Sir Tim Berners-Lee

- ❑ The Mother of the Internet

- ❖ Radia Perlman

- ❑ [http://en.wikipedia.org/wiki/](http://en.wikipedia.org/wiki/List_of_people_considered_father_or_mother_of_a_field)

- [List\\_of\\_people\\_considered\\_father\\_or\\_mother\\_of\\_a\\_field](http://en.wikipedia.org/wiki/List_of_people_considered_father_or_mother_of_a_field)



# Introduction: summary

## *covered a ton of material*

- ❑ Internet overview
- ❑ what's a protocol?
- ❑ network edge, core, access network
  - ❖ packet-switching vs. circuit-switching
  - ❖ hierarchical structure
- ❑ performance: loss, delay, throughput
- ❑ layering, service models
- ❑ security
- ❑ history

## *you now have:*

- ❑ context, overview, “feel” of networking
- ❑ more depth, detail to follow!