

High-speed and Programmable Networks

ECE/CS598HPN

Instructor: Radhika Mittal

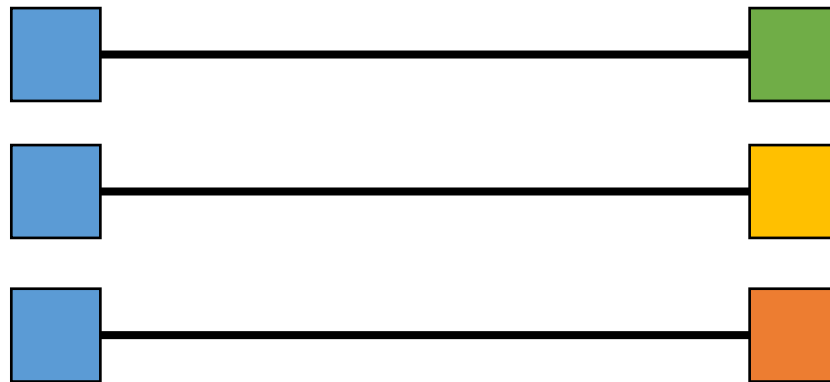
History of Internet

1876: Alexander Graham Bell invented telephone.



History of Internet

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Such a design cannot scale!

History of Internet

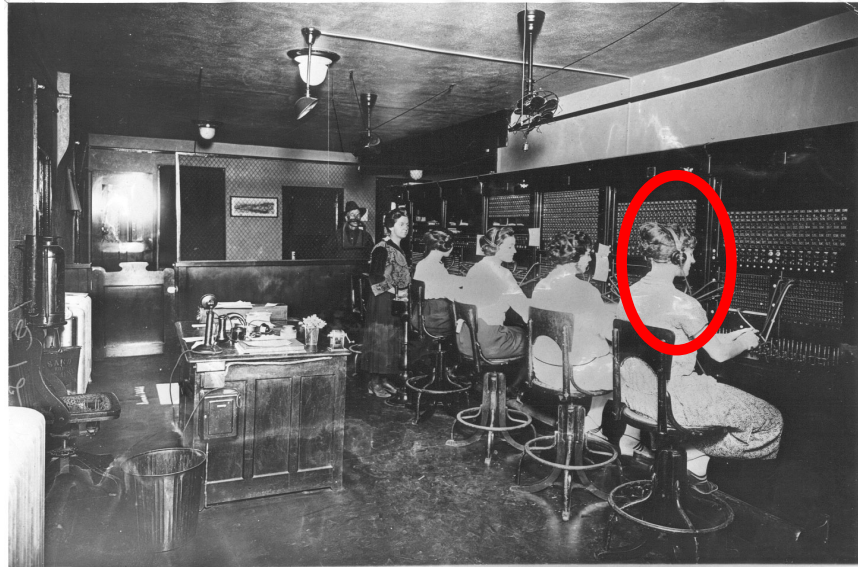
Soon evolved to Public Switched Telephone Network.



Earliest circuit-switched network!

History of Internet

Soon evolved to Public Switched Telephone Network.



Strowger's
competitor's
wife

Earliest circuit-switched network!

History of Internet

1889: AB Strowger invents first mechanical circuit switch.

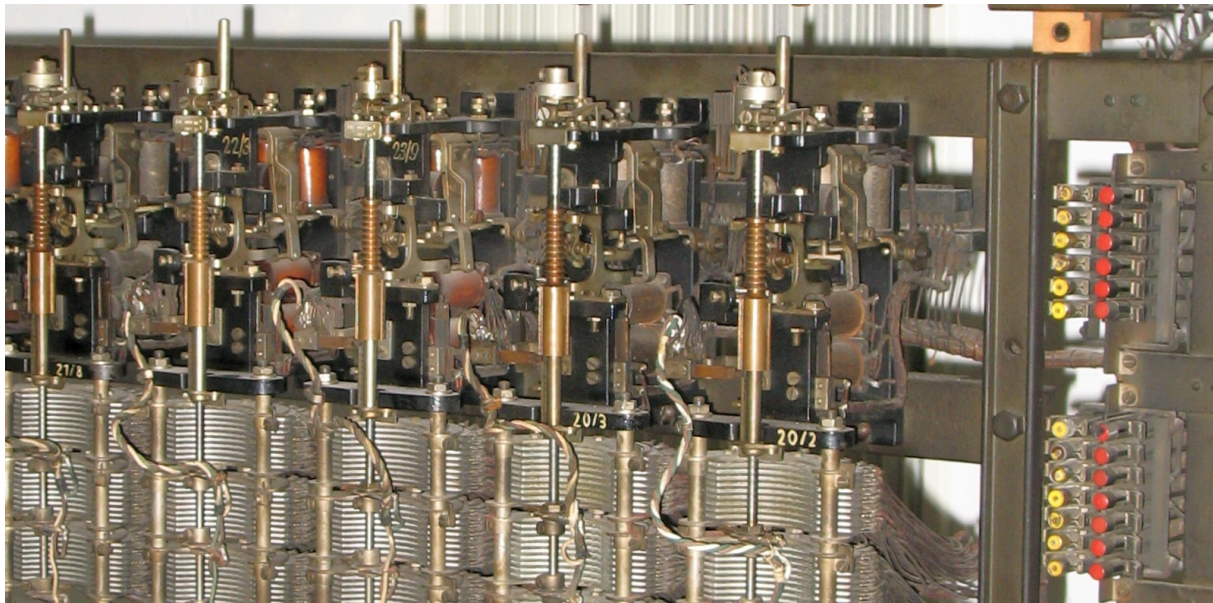


Strowger's
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Earliest circuit-switched network!

History of Internet

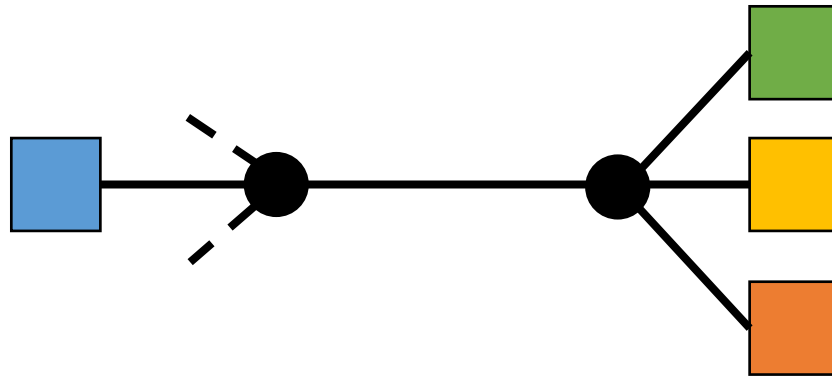
1889: AB Strowger invents first mechanical circuit switch.



Earliest mechanical circuit-switched network!

History of Internet

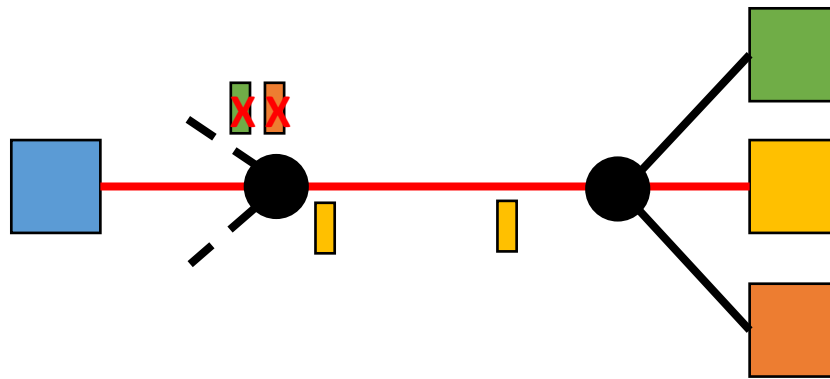
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Earliest mechanical circuit-switched network!

History of Internet

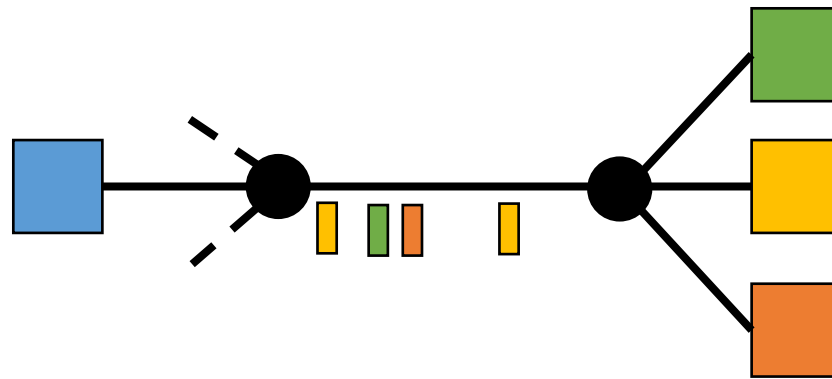
1889: AB Strowger invents first mechanical circuit switch.



Circuit switching is wasteful!

History of Internet

Packet switching is designed:
1959(Paul Baran), 1961(Leonard Kleinrock), 1965 (Donald Davies).



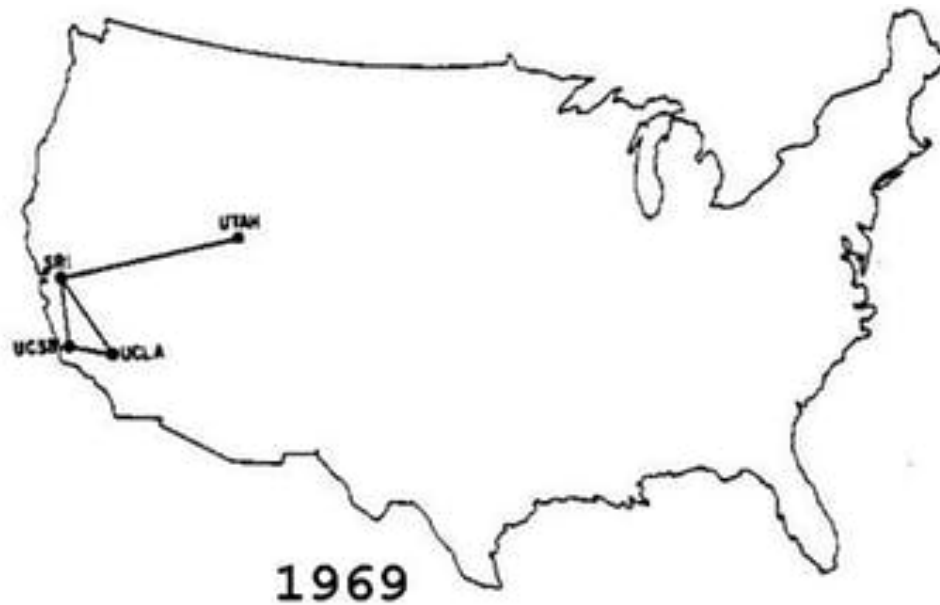
History of Internet

- Simultaneously, growing interest in connecting computers.
- Lawrence Roberts meets Davies' teammate at 1967 SOSP, and decides to use packet-switching for a network to connect computers.
- Roberts, Davies, Kleinrock, and Baran get together to design ARPANET.

History of Internet

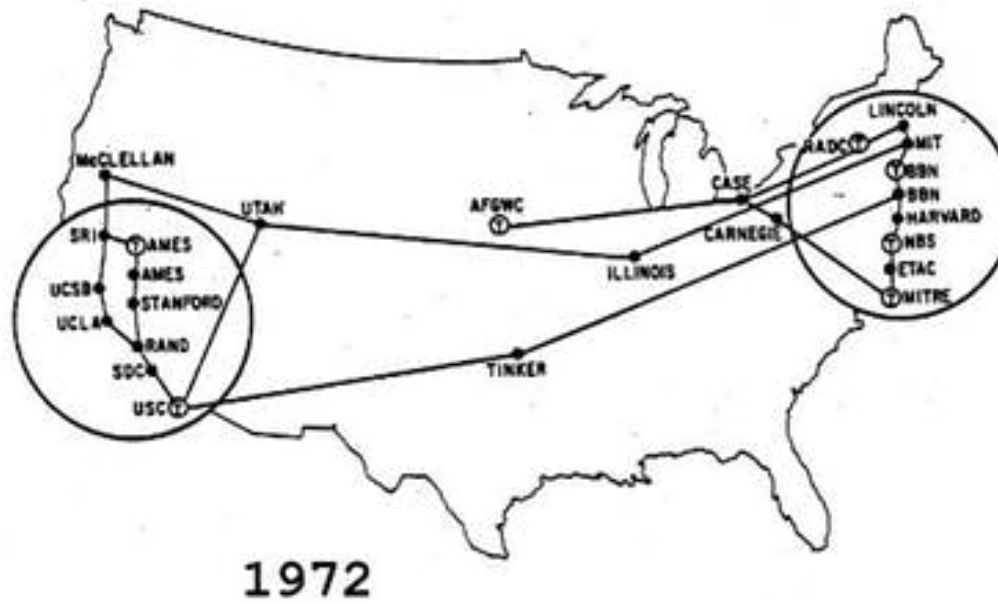
1965: Two computers in MIT communicate using packet-switching.

1969: ARPANET is developed.



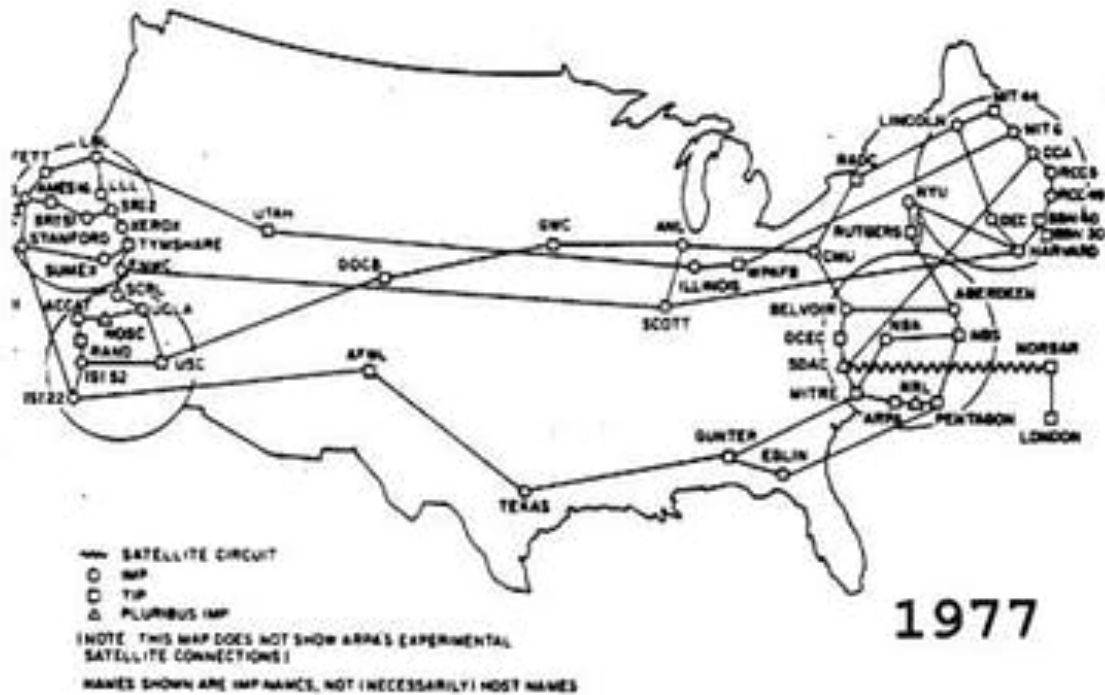
History of Internet

Early 1970's: Vint Cerf develops NCP for transport and addressing.



History of Internet

1973: European nodes added to ARPANET. The term Internet is born.



History of Internet

- mid-1970's: Vint Cerf and Bob Kahn develop TCP/IP, separating reliability from addressing.
- 1983: NCP becomes obsolete; all nodes switch to TCP/IP.
- Late 1970's: Adaptive routing protocols were developed.
- 1986: Series of congestion collapse; congestion control added to TCP.
- More interconnected networks emerge (Internet grows).
 - Early 1990's: BGP introduced for inter-domain routing.

Since then....

- No fundamental change in how we operate and use networks.
 - Distributed management of hardware switches.
 - Packet switching with store-and-forward design.
 - Endhost implements a TCP/IP stack in the kernel.

- Innovations in:
 - Transmission technology: wireless, cellular, more bandwidth.
 - Applications: HTTP, TLS, SSL, DNS.
 - Specific details: Congestion control algorithms, hierarchical addressing, etc.

But, changes have emerged in the last decade...

This course tells the story of these changes.

Key enablers of the changes

- Increasing scale:
 - greater need to make networks *easier to manage*.
- More functionality:
 - greater need to make networks *more evolvable*.
- Commercialization:
 - greater emphasis on performance.

Key enablers of the changes

Emergence of large private networks.



In this course...

- What changes have been made to the networking infrastructure in the last decade?
- Why were the changes introduced?
- What do these changes enable?

In this course...

- Week 1: Review relevant concepts.
- Week 2: Historical perspective.
- Week 3-7: Switching infrastructure.
- Week 7-11: Endhost infrastructure.
- Week 12: Middleboxes.

Questions?

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