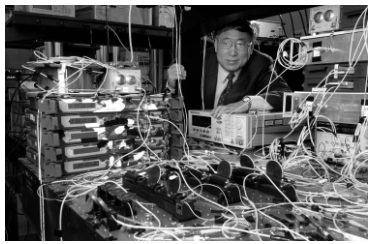
COMPSCI 111 / 111G

Mastering Cyberspace:
An introduction to practical computing

Introduction to Networking and the Internet



From the Telephone to the Internet

1876:
First successful bi-directional transmission of clear speech (Bell and Watson)

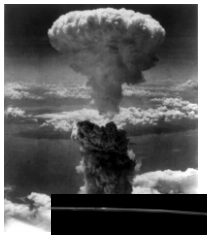
1940:
First successful transmission of digital data through telephone lines (George Stibitz, 1940)

1969:
First ARPANET link between the UCLA and Stanford Research Institute

http://en.wikipedia.org/wiki/History_of_the_Internet

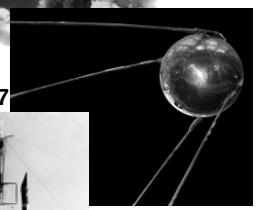
The time the Internet was born

The Cold War
- After World War 2
- Iron Curtain between east and west
- Nuclear arms race between the US and USSR
- Space race
- Real fear of nuclear attack

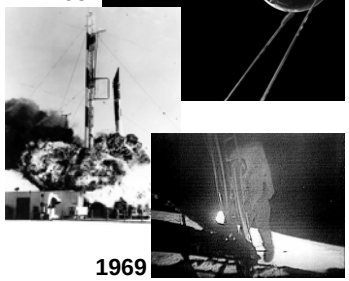


1945

Huge investments for the military
- 1946: Foundation of Project RAND (Research ANd Development)
- 1958: Foundation of the Advanced Research Projects Agency (ARPA) as reaction to Sputnik
- 1969: Bolt, Beranek, Newman Inc. (BBN) get contract to build the ARPANET
- Why? - Remote use of computers
  - Robust communication



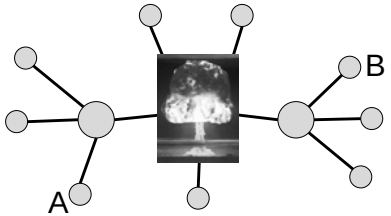
1957



1969

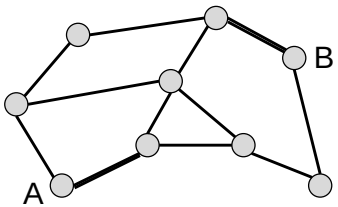
Traditional Networks and the Internet

Traditional (telephone) networks
- Centralized (central exchange nodes)
- Circuit Switching
  - Continuous connection formed
  - Best for real-time data (e.g. voice)



Problem ?
Failure of central node can bring down large parts of the whole network.

Solution: The Internet
- **Decentralized (all nodes are equal)**
- **Packet Switching**
  - Messages broken into packets
  - Each packet sent independently
  - Nodes can route data packages efficiently to their destination, avoiding broken/slow nodes on the way



The Internet Evolves

1969 The Beginning: ARPANET with 4 nodes

1972 ARPANET goes international:
23 Nodes including London, Norway

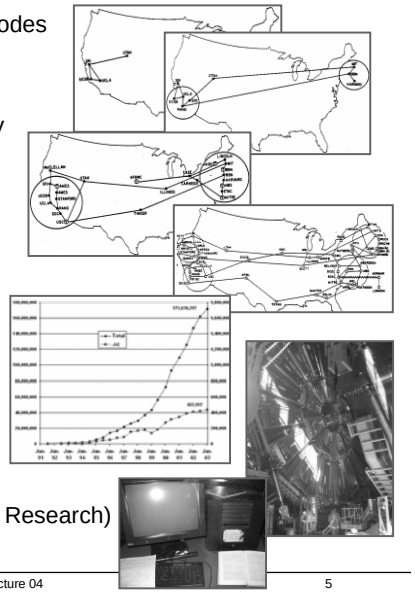
1974 TCP/IP developed at Stanford

1983 ARPA requires TCP/IP for Internet
(56 Kbps)

1984 Domain Name System

1989 New Zealand connects to NSFNET

1991 WWW created at CERN
(European Organization for Nuclear Research)

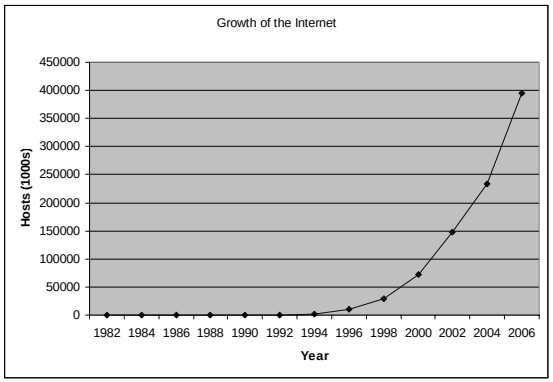


Internet Growth

Year	Hosts
1969	4
04/71	23
06/74	62
03/77	111
05/82	235
10/84	1,024
02/86	2,308
07/88	33,000
10/90	313,000
01/92	727,000
01/94	2,217,000
01/96	9,472,000
01/98	29,670,000
01/00	72,398,092
01/02	147,344,723
01/04	233,101,481
01/06	394,991,609

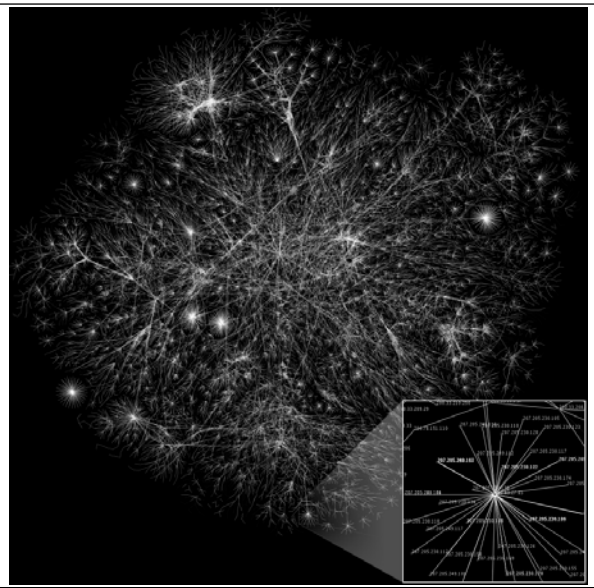
500,000 new web pages each day

Google : *4,285,199,774 pages*
(many more not indexed)

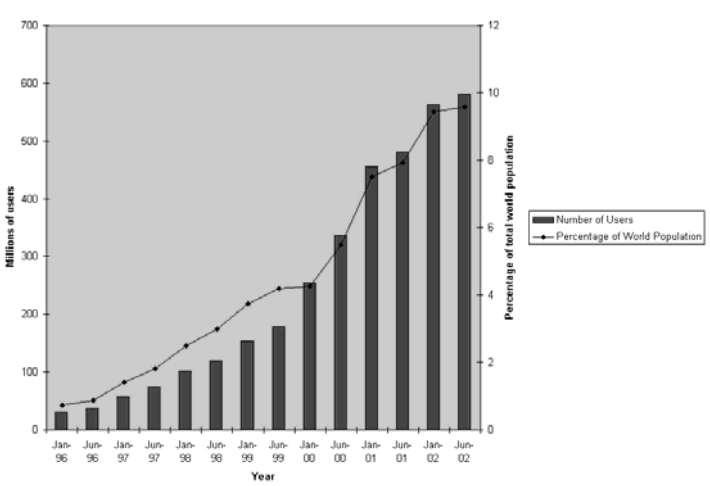


http://www.isc.org/

The Internet



World-wide users



http://www.internetworldstats.com/stats.htm

Internet Statistics

#	Country or Region	Penetration (% Population)	Internet Users Latest Data	Population (2006 Est.)	Source and Date of Latest Data
1	Malta	78.1 %	301,000	385,308	ITU - Sept/05
2	New Zealand	76.3 %	3,200,000	4,195,729	ITU - Sept/05
3	Iceland	75.9 %	225,600	297,072	ITU - Sept/05
4	Sweden	74.9 %	6,800,000	9,076,757	ITU - Oct/05
5	Denmark	69.4 %	3,762,500	5,425,373	ITU - Sept/05
6	Hong Kong	69.2 %	4,878,713	7,054,867	Nielsen//NR
7	Australia	68.4 %	14,189,544	20,750,052	Nielsen//NR
8	United States	68.1 %	203,824,428	299,093,237	Nielsen//NR
9	Canada	67.9 %	21,900,000	32,251,238	eTForecasts
10	Norway	67.8 %	3,140,000	4,632,911	C.I.Almanac

Internet Infrastructure

How does it all work?

Protocols
- Rules about how information is transferred

Domain Names
- Human-readable names for the computers on the Internet

Client / Server Software
- Programs used to access the Internet

Networking Hardware
- Connecting a computer to the Internet

Client	Server
Web Browser	Web Server
Email Client	Email Server
File Sharing Tool	File Sharing Tool

http://computer.howstuffworks.com/internet-infrastructure.htm

Network Categories

Local Area Network (LAN)
- Operates within 1 km radius
- Client-Server LAN
- Peer-to-peer LAN
- Intranet (if set up like the internet)

Wide Area Network (WAN)
- Distances over 1km

An internet
- Several networks connected together

The Internet
- Network of networks that use TCP/IP

Protocols

These are standard methods of communicating.

On a network, both ends agree to use the same protocol to communicate.

Protocols includes a set of rules and procedures for…
- **Initiating and maintaining communication**
- **Sending and receiving data**
- **Terminating communication**

Common Protocols
- TCP / IP – most important, used for transporting data safely
- UDP – used for transporting data unsafely but faster
- FTP – used for transferring files
- HTTP – used for web pages
- POP3 / IMAP / SMTP – used for email

http://en.wikipedia.org/wiki/Protocol_%28computing%29

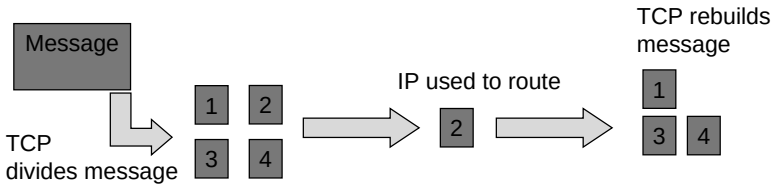
TCP/IP

Transmission Control Protocol (TCP)

- Divides the message into packets
- Checks that all packets arrive (error detection)
- Makes sure that packets are not sent faster than they can be received (flow control)
- Combines packets to reform message

Internet Protocol (IP)

- Defines addresses for computers on the network (e.g. 130.216.34.102)
- Defines routing information



Domain Names

DNS – Domain Name System

- Allows us to associate a human-readable name with an IP address
- Uses a sequence of names separated by periods
- Each domain name must be registered
- DNS server translates names into IP addresses

Example:

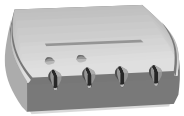
- amati.emba.uvm.edu (132.198.10.22)
- mary.auckland.ac.nz (130.216.35.22)
- myra.com (142.44.2.1)

http://en.wikipedia.org/wiki/Domain_name

Networking Hardware

Modem

- Modulator / Demodulator
- Dial-up Modems (~ 7 KB/s)
- Broadband (DSL) modems (~ 16 – 128 KB/s)
- Allows communication via phone line



Router / Switch

- Connects multiple computers to a network

Network Card

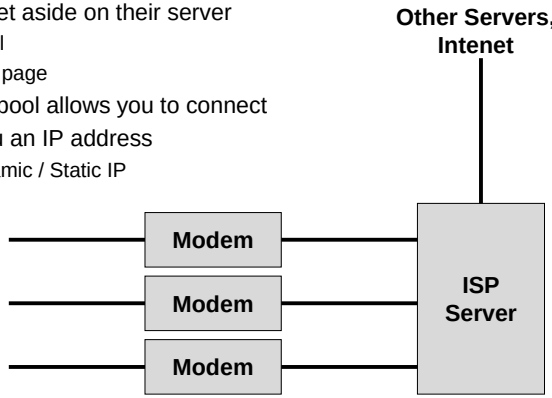
- Ethernet

http://en.wikipedia.org/wiki/Network_hardware

Internet Service Provider (ISP)

Provide an Internet connection for you

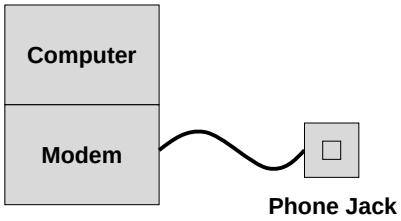
- Set up an account for you
  - Login
  - Password
- Space set aside on their server
  - Email
  - Web page
- Modem pool allows you to connect
- Give you an IP address
  - Dynamic / Static IP



Connecting to the Internet

Dial-up

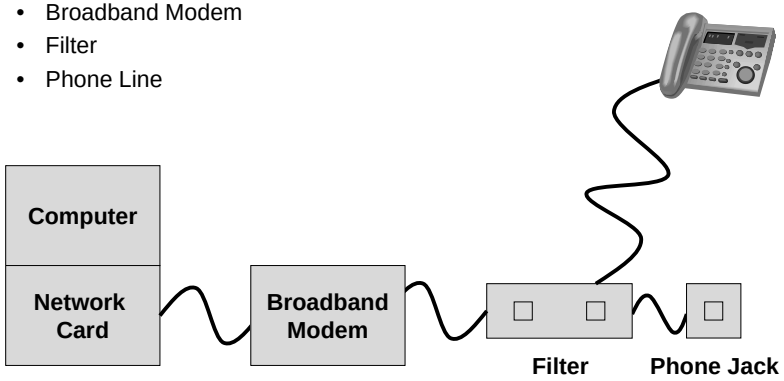
- Computer
- Modem
- Phone line



Connecting to the Internet

Broadband

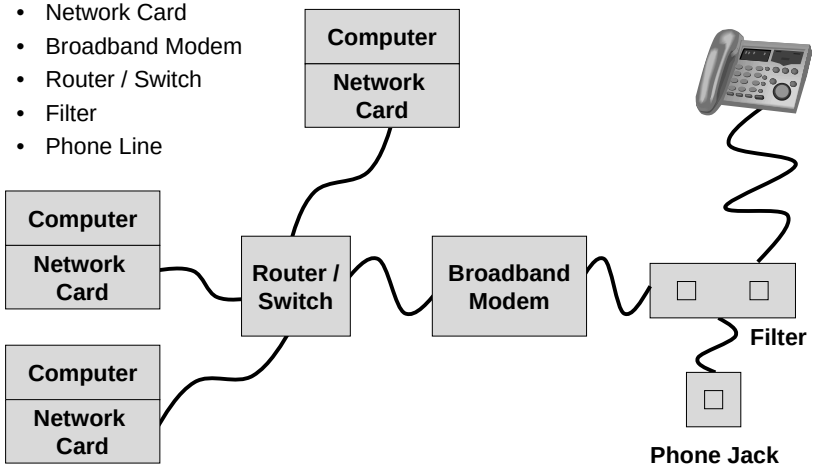
- Computer
- Network Card
- Broadband Modem
- Filter
- Phone Line



Connecting to the Internet

Home Network using Broadband

- Computer
- Network Card
- Broadband Modem
- Router / Switch
- Filter
- Phone Line



Summary

- **The Internet started as a military project to create a robust communication network**
  - Decentralized
  - Packet-Switching
- **The main protocol used on the Internet is TCP/IP**
  - Computers are identified with IP addresses
  - TCP takes care of reliable package transport
- **Domain names (human-readable) can be used instead of IP addresses**
- **Modems allow us to use phone lines to connect to the Internet**

You know you've been online too long when...

Tech support calls you for help.

You type messages to people while you are on the phone with them at the same time.

You find yourself trying to cock your head 90 degrees when you smile ;-)