

Internet & WWW Basics

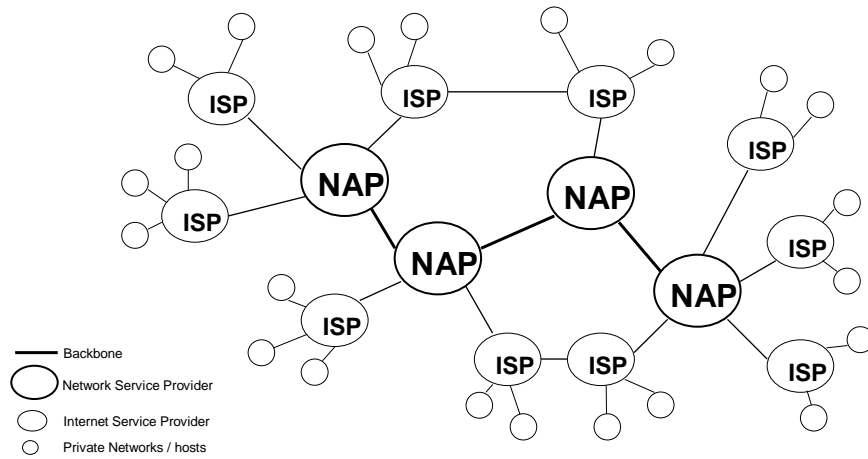
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What is the Internet?

- a network of 1000s of interconnected networks connecting millions of computers
 - Backbones (international reach)
 - Network Service Providers (NSPs)
 - major telecommunication companies
WorldCom, AT&T & Sprint
 - Access/delivery sub-networks
 - local and regional Internet Service Providers (ISPs)
 - Retail providers (e.g. Eastlink, Sympatico, AT&T WorldNet)
 - Private institutional networks
 - connecting organizational servers

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Internet network architecture



Adapted from *Electronic Commerce: A Managerial Perspective*.
Turban, Lee, King and Chung, 2000. Pg. 385

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MCI backbone

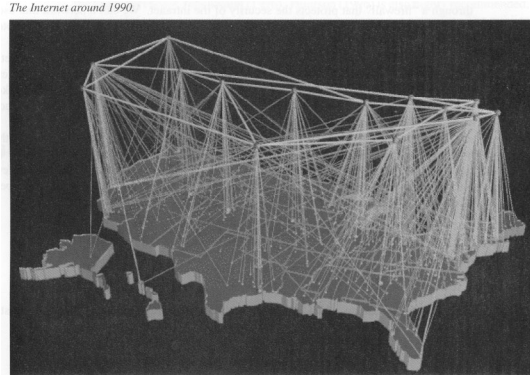


Retrieved from: <http://global.mci.com/about/network/maps/?flash=1&theme=L>, Sept 5/2003

See this site also for interesting network statistics (e.g. latencies)

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The Internet around 1990



Jean Walrand, *Communication Networks, a first course*, McGraw-Hill 1998 (2nd edition).

The first three chapters give you a nice overview of the working of networks and the Internet.

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Distinguishing factor of networks

- **Bandwidth (speed)**
 - capacity of the communication line
 - determined by:
 - the transmission medium
 - the technology used for transmission
 - Measured in bits per second
 - digital modem (28.8 kbps to 56 kbps)
 - DSL (digital subscriber line) (1 – 1.5 mbps)
 - cable connection (up to 10 mbps)
 - T-1 line (1.544 mbps)
 - Internet weakest link is the last mile

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Bandwidth specifications

Technology	Speed	Description	Application
Digital Modem	56 kbps	Data over public networks	Dialup
ADSL	1.5 to 8.2 mbps	Data over public telephone network	Residential and commercial hookups
Cable Modem	1 to 10 mbps	Data over the cable network	Residential hookups
T-1	1.544 mbps	Dedicated digital circuit	Company backbone to ISP
T-3	44.736 mbps	Dedicated digital circuit	ISP to Internet infrastructure or Smaller links in Internet
OC-3	155.52 mbps	Optical fiber carrier	Infrastructure Large company backbone to Internet backbone
OC-12	622.08 mbps	Optical fiber carrier	Internet backbone
OC-48	2.488 gbps	Optical fiber carrier	Internet backbone (i.e. Internet2)
OC-96	4.976 gbps	Optical fiber carrier	Internet backbone

Adapted from *Electronic Commerce 2002: A Managerial Perspective*.
Turban, Lee, King and Chung, 2002. Appendix A, pg. 2

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How big is the Internet today?

– 171,638,297 connected computers (Jan 2003)
“Source: Internet Software Consortium (<http://www.isc.org/>)”

– 605.60 million people online Worldwide (Sep 2002)

- Canada & USA 182.67 million
- Europe 190.91 million
- Asia/Pacific 187.24 million
- Latin America 33.35 million
- Africa 6.31 million
- Middle East 5.12 million

Source: Nua Internet Surveys; retrieved from:
http://www.nua.ie/surveys/how_many_online/ Sept. 5/2003

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INTERNET SOFTWARE CONSORTIUM

<http://www.isc.org>

- Internet Software Consortium (ISC) is a not-for-profit corporation dedicated to developing and maintaining production quality Open Source reference implementations of core Internet protocols. ISC efforts are supported primarily by the donations of generous sponsors.

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History of the Internet

- What motivated creation of the Internet?
- DARPA (US Defense Advances Research Projects Agency)
 - formed a network intended for sharing research and development work among corporate, academic, and government researchers
 - not centralized so that the communications centre could not be wiped out
 - 1969 – ARPANET was established
 - each computer had a unique address

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History of the Internet (cont.)

- Parallel work at MIT (1961-1967), RAND (1962-1965), and NPL (1964-1967)
- 1961: Leonard Kleinrock at MIT published the first paper on packet switching theory
(→ DARPA and Lawrence G. Roberts, MIT)
- 1962 Paul Baran, RAND proposes package switching
- 1962: J.C.R. Licklider of MIT "Galactic Network"
- 1966-69: Early development of ARPANET (1969 first four nodes are connected)
- 1970: Network Working Group (NWG) finished the initial Network Control Protocol (NCP).
- 1974: Vint Cerf and Bob Kahn: TCP
- 1982: TCP/IP protocol suite is defined for ARPANET
- 1984: Domain name system is introduced
- 1986: NFSNET
- 1992: Tim Berners-Lee designs the World Wide Web

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Key enabling technologies – part I

- **Packet Switching**
 - “method of transmitting data by breaking it up into small segments or packets and sending the packets individually in a stream. The packets are not necessarily sent together, but rather are disassembled, transmitted separately, and then reassembled when they arrive at their destination” (Trites pg. 40)
 - 1961 – Leonard Kleinrock (MIT) published a paper on “packet switching”
 - 1969 – First packet switches are installed at UCLA and Stanford
 - 1969 – First packet-switched message is sent from UCLA to Stanford
- **Why was this such an important development?**

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Key enabling technology – Part II

- Transmission Control Protocol (TCP)
 - “a protocol that establishes the connections among sending and receiving computers, handles the assembly of packets at the point of transmission, and their reassembly at the receiving end.” (Laudon & Traver, pg. 116)
 - ensures that two computers can communicate with each other reliably
- Internet Protocol (IP)
 - “a protocol that provides the Internet’s addressing scheme” (Laudon & Traver, pg. 116)
 - ensures that the receiving address of all packets is known

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So, now what?

- Packet switching exploded the available communication capacity
- TCP/IP provided the communication rules
- Is there anything interesting to do on “the Internet”?

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Key enabling technology – Part III

- Client/server computing
 - powerful personal computers (clients) are connected together in a network with one or more computers dedicated to common functions that the clients need (servers).
 - became possible with the development of personal computers and local area networks in late 70's early 80's
 - Benefits
 - Easy to expand
 - Less vulnerable
 - Processing load can be balanced

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The Internet

- 1983 the term *Internet* was coined
- “the word “Internet” is derived from the word *internetwork* or the connecting of two or more computer networks” (Laudon pg. 109)
- Why capital “I”?

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The Canadian Internet

- 1990 – CA*net was created with support from the NRC
 - provide internet connectivity between universities and research organizations in Canada through a high-speed network
- 1995 – used asynchronous transfer mode (ATM) networks which could transmit data faster than previous networks
 - was one of the first national ATM networks in the world
- 1997 – CA*net II linking with international organizations
- 1998 – Federal government and CANARIE started building CA*net 3 based on fiber optic technology
- CA*net was critical to the development of the Canadian Internet because it provided an east-west backbone for the Internet (instead of connecting through the US)

Source: Trites & Pugsley 2003, pg. 41

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Who controls the Internet?

- No one organization fully controls the Internet
- Several governing bodies:
 - Internet Architecture Board (IAB) – helps define the overall structure of the Internet
 - Internet Corporation for Assigned Names and Numbers (ICANN) – oversees the assignment of IP numbers
 - Internet Network Information Center (InterNIC) – assigns domain names
 - Internet Engineering Steering Group (IESG) – oversees standard settings
 - Internet Engineering Task Force (IETF) – forecasts the next step in the growth of the Internet keeping a watch over its evolution and operation
 - Internet Society (ISOC) – monitors Internet policies and practices
 - World Wide Web Consortium (W3C) – sets standards for the Web
- Must also conform to laws

Source: Laudon & Traver 2002, pg. 132

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Limitations of the Internet

- Bandwidth
- Quality of service (latency)
- Network architecture limitations (handling 1000s of requests from a central server)
- Language development (HTML)

■ Internet II

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The Internet2 Project

- Consortium of 180+ universities, government agencies and private businesses
- Giant “test-bed” where new technologies can be tested without impacting the existing Internet
- Goals:
 - Create a leading edge network capability
 - Enable revolutionary Internet applications
 - Ensure the rapid transfer of new network services and applications to the broader Internet community
- Areas:
 - Advanced network infrastructure
 - New networking capabilities
 - Advanced applications

Source: Laudon & Traver 2002, pg. 135-137

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NGI (Next Generation Internet)

- Government-initiated and sponsored
- DARPA, DoE, NSF, NASA, NIST
- High-speed networks interconnecting various research facilities
- Support next-generation applications
 - Health care
 - National security
 - Energy research
 - Biomedical research
 - Environmental monitoring

Source: Laudon & Traver 2002, pg. 135-137

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Internet enables communication

- Email
 - 1971 - first email message was sent from one computer to another
 - Ray Tomlison "Testing, one, two, three."
- FTP (File Transfer Protocol)
 - A communication standard to transfer files over the Internet
- The Web
 - sending and receiving of information in different forms (i.e. text, graphics, animation, sound)
- Internet Relay Chat
 - Communication via chat

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WWW?

- What is the difference between the Internet and the Web?
 - the Internet is a physical network
 - the Web is a capability accomplished with a set of software applications, primarily Web browsers

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History of the World Wide Web

- 1945 & 1960s – Vannevar Bush and Ted Nelson suggest the possibility of organizing knowledge as a set of interconnected pages that users could freely browse
- 1989 – Tim Berners-Lee proposed a worldwide network of hyperlinked documents based on a common markup language called HTML
- He developed the four essential components of the Web:
 1. formatted pages that can be linked using keywords (hyperlinks)
 2. HTML (Hypertext Markup Language) created a modified version of a powerful markup language called SGML
 3. storage of documents on the Internet – a Web server
 4. accessing documents through HTTP (Hypertext Transfer Protocol), an Internet protocol for transferring web page
- This early version of the Web was only text based

Source: Laudon & Traver 2002, pg. 146-147

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History of the World Wide Web

- 1990 - NSF plans and assumes responsibility for civilian Internet backbone and created NSFNET.
- 1993 – Marc Andreessen and others at NCSA created the first graphical browser called Mosaic
 - Mosaic made it possible to view documents on the Web graphically
 - Mosaic ran on any GUI-based interface (Macintosh, Windows, or UNIX)
 - Universal sharing of files – regardless of operating system
- 1994 – Andreessen and Jim Clark founded Netscape which created the first commercial web browser – Netscape Navigator
- 1995 – Microsoft releases Internet Explorer (IE)

Source: Laudon & Traver 2002, pg. 111–113 & 135-137

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Web as “killer app”

- Is the Web a killer application?
- The web is one of the Internet’s most popular services, providing access to over one billion web pages

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References

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- Laudon and Traver. *E-commerce: business, technology, society*. Addison Wesley 2002. Chapter 3.
- Oz. *Foundations of E-Commerce*. Pearson Education Inc. 2002. Chapter 1.
- Trites and Pugsley, David. *E-business: a Canadian perspective for a networked world*. Pearson Education Canada Inc. 2003. Chapter 3, pg. 40 – 45
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Next Class

- Networking
- How does the internet work?

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