THE INTERNET: LOOKING BACK ON HOW WE GOT CONNECTED TO THE WORLD

Summer 2004

THE BIRTH OF THE INTERNET

While some may think the Internet is a new communication tool, its history is remarkably similar to other areas of communication:

- People had something to share;
- Common languages developed; and
- The common languages were transmitted across physical media.

In Internet terms, the elements to be shared were information and computing time, the common languages were data communications protocols, and phone circuits carried it all.

As computer use spread after WWII, it didn't take long for people with limited computer access to want to tap into the excess capacity of those with computers.

Since, in the 1950s, the U. S. government was the primary owner of high-powered computers, it was in association with the Nation's SAGE air-defense system that the first sharing of computer power occurred.

But early experiments in sharing the Nation's computing power didn't satisfy all the growing needs. So, researchers working with DOD's Advanced Research Project Agency (ARPA) built upon the early 1960s development of packet switching theory and visions of a "Galactic Network" to figure out a way to link the Nation's scientists and engineers via a cross-country computer network. A 1965 test of a wide area network (known as the "Experimental Network") between MIT and Stanford showed that such a nationwide network was possible.

Building upon this, and other similar tests, in 1967 Lincoln Lab scientists working with ARPA put forward plans for connecting most of the
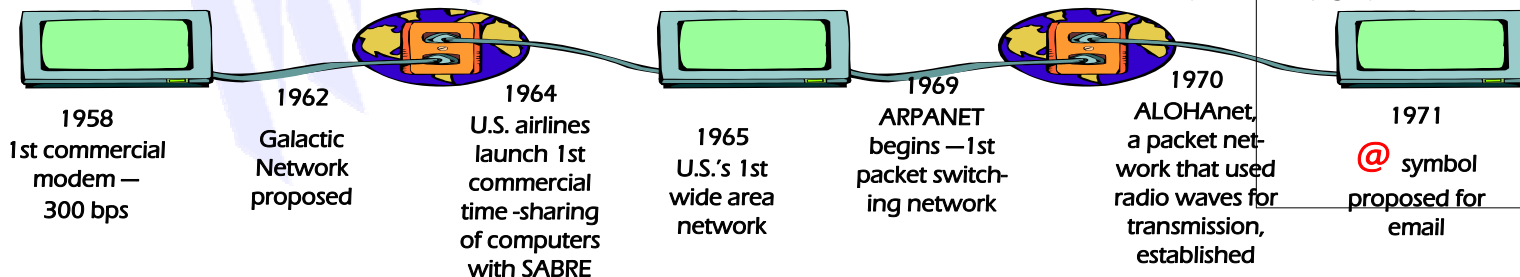
Standards and Protocols: Making sure the Message Gets Through

- 1963—American Standard Code for Information Interchange (ASCII) adopted. This was the first universal standard to allow computers from different manufacturers to exchange data.

- 1969—Request for Comments (RFC) first issued. The RFC is a series of standards for computer networking. RFC 1 detailed the operating standards of ARPANET, the world's first packet switching network. Today there are nearly 4000 RFC's.

- 1974—Transmission Control Protocol (TCP-RFC 793) proposed. This standard allowed network-to-network connections. In 1978 the Internet Protocol (IP-RFC 791) joined TCP. Together, these
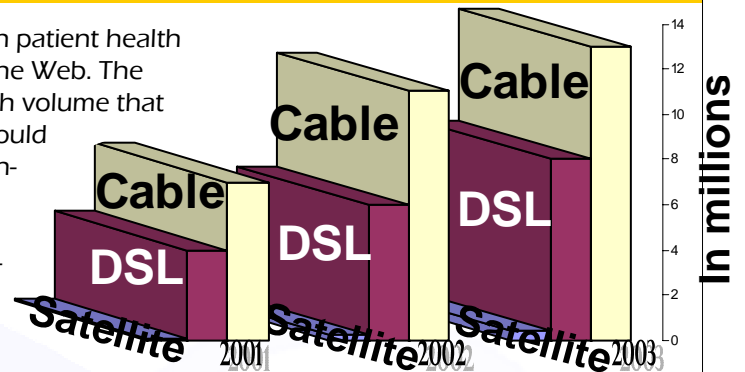
FCC: A LONG-TERM INTEREST

- 1966—Computer I Notice of Inquiry.
- 1973—Agency approves first application for value-added carrier to provide specialized communication services to computer users (Telenet).
- 1980—Computer II Final Order establishes distinction between regulated telecommunications services and unregulated information services.
- 1985—Computer III proceeding released.
- 1998—FCC affirms that Internet Service Providers will continue to be treated as "end users," thus paying lower access fees.

| 1958 1st commercial modem — 300 bps | 1962 Galactic Network proposed | 1964 U.S. airlines launch 1st commercial time-sharing of computers with SABRE | 1965 U.S.'s 1st wide area network | 1969 ARPANET begins —1st packet switching network | 1970 ALOHAnet, a packet network that used radio waves for transmission, established | 1971 @ symbol proposed for email |

BROADBAND-AT-HOME: WHERE THE INFORMATION SUPERHIGHWAY SPEEDS UP

BROADBAND SUBSCRIBERS

A technology in operation for less than 10 years would not usually qualify for historical treatment. However, in the case of residential broadband Internet access, the explosive growth of this technology may be rewriting all the rules regarding the history of new technologies.

Begun in 1996, when Rogers Communications introduced the first cable modem service in Canada, broadband encompasses several digital technologies (cable, satellite, phone lines, power line, and wireless) that provide consumers integrated access to voice, high-speed (faster than 200 Kbps) data, video-on-demand, and interactive delivery services.

The Congressional Research Service says that "broadband access, along with the content and services it might enable, has the potential to transform the Internet—both what it offers and how it is used. For example, a two-way, high-speed connection could be used for interactive applications such as online classrooms, showrooms, or health clinics, where teacher and student (or customer and salesperson, doctor and patient) can see and hear each other through their computers. An "always on" connection could be used to monitor home security, home

automation, or even patient health remotely through the Web. The high speed and high volume that broadband offers could also be used for bundled service where, for example, cable television, video-on-demand, voice, data, and other services are all offered over a single line. In truth, it is possible that many of the applications that will best exploit the technological capabilities of broadband, while also capturing the imagination of consumers, have yet to be developed."

But despite these many advantages, as late as 1999, when the FCC issued its first report on broadband, it reported that "the consumer broadband market is in the early stages of development."

The first attempt, in 1969, to connect computers at the first two ARPANET universities crashed the system. On the second try the connection was made successfully and the Internet's predecessor was begun.

But broadband did not stay in its early stages for long. *The Bandwidth Report*, based on Nielsen// NetRatings surveys, finds that between 2000 and 2001 broadband subscriptions rose over 50%; and, there was another 48% growth in 2003. Today, it is estimated that over 27 million businesses and households (45% of Internet households) use broadband to access the Internet.
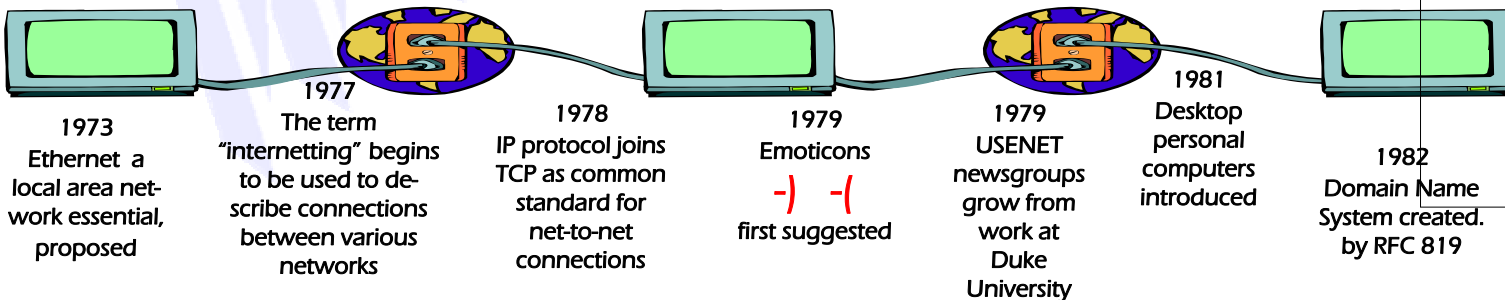
Interestingly, these studies also find that adults between the ages of 55 and 64 are more active adopters of broadband than young adults. Researchers don't know if this is an indication of pricing issues or that young people already accept broadband. But, it does indicate that getting fast access to the Internet is no longer just a fad for the young. And, since broadband Internet users tend to spend more time and visit more pages online, accessing the Internet via broadband is also beginning to show up as an alternative to entertainment alternatives such as watching tv.

Besides continuing growth in broadband acceptance, new ways of using and delivering broadband are opening new vistas and creating new challenges. Ideas ranging from using electric lines as a broadband transmission medium to placing long distance phone calls via broadband may offer more services at lower prices—but, will also require flexible and creative thinking about many of our traditional utility and communication services.

In millions

Bar chart — BROADBAND SUBSCRIBERS, y-axis "In millions" (0–14), categories Cable, DSL, Satellite for years 2001, 2002, 2003.

1973
Ethernet a local area network essential, proposed

1977
The term "internetting" begins to be used to describe connections between various networks

1978
IP protocol joins TCP as common standard for net-to-net connections

1979
Emoticons
-) -(
first suggested

1979
USENET newsgroups grow from work at Duke University

1981
Desktop personal computers introduced

1982
Domain Name System created. by RFC 819

FCC: A LONG-TERM INTEREST   *(continued from page 1)*

- 1999—FCC releases Local Competition and Broadband Report and Order.

- 2002—FCC proceedings on Internet Access over Cable and Internet Access over DSL find that these methods of Internet access are information services.

  These proceedings also set forth four guiding principles in regard to broadband:

  1. Encourage the ubiquitous availability of broadband Internet access to all Americans.

2. Promote competition across different platforms for broadband services.

3. Ensure that broadband services exist in a minimal regulatory environment that promotes investment and innovation.

4. Develop an analytical framework that is consistent, to the extent possible, across multiple platforms.

- 2003—FCC hosts Voice over IP Forum.

The ARPANET experienced its first virus in 1980. This virus shut down the ARPANET for a short while. The first worm struck in 1988 and infected 10% of ARPANET hosts.

THE BIRTH OF THE INTERNET   *(continued from page 1)*

Nation's research computers over phone circuits. This plan was carried out in 1969 when the ARPANET, using 50 Kbps circuits, connected computers at four universities in California and Utah.

But the commercial sector did not allow the ability to network computers to belong only to academics and scientists for very long. By 1974 the FCC had already approved three applications for what were called "value-added carriers." These organizations added equipment to leased transmission lines in order to provide services to computer users. Telenet became the first packet data service to go public in 1974.

With more and more networks developing around the world (ARPANET, ALOHAnet, MERIT, SATNET, Telenet, Tymnet, Transpac), the idea to interconnect or "internet" the various networks took hold. But, for different networks—

with different equipment and different operating systems—to talk to each other some common language had to be developed.

The ARPANET initially used the Network Control Program (NCP) as this common transmission language. However, in 1983 ARPANET changed its common language to the Transmission Control Protocol/ Internet Protocol (TCP/IP). TCP/IP remains today's most commonly used protocol because of its reliability and proven track record.

Many additional improvements in what came to be known as the Internet (a loose federation of networks) continued during the 1970s and 1980s. These included:

- Standards for email and newsgroups,

- Protocols for managing networks (SNMP),
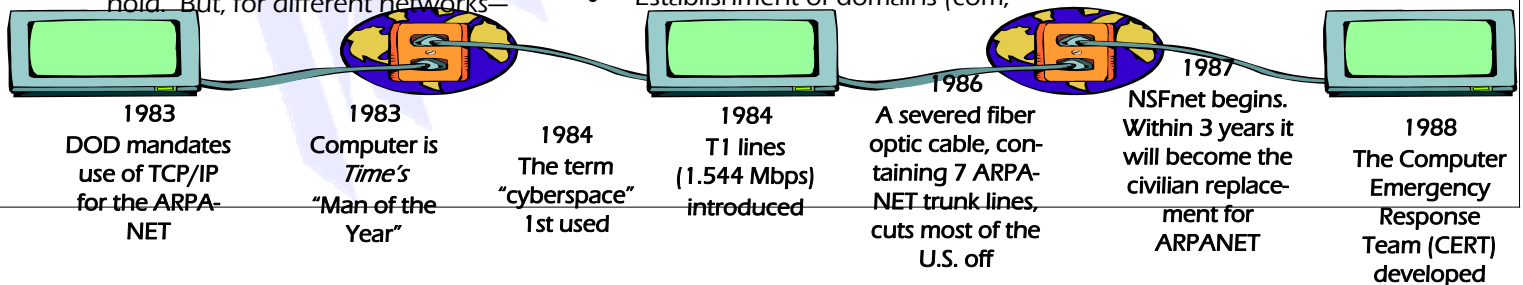
- Establishment of domains (com,

mil, gov, edu, org), and

- Upgrades to the transmission backbone.

But most of these improvements were known only to academics, government employees, and government-sponsored researchers and contractors until the late-1980s.

The Internet we know today began to seem possible in 1989 when the first commercial email carriers (MCI Mail and CompuServe) began business. That same year the first commercial dial-up Internet Service Provider (World Comes on Line) also started operating. And, in 1991, all restrictions on commercial use of the Internet were lifted.

At that time there were more than 100,000 Internet hosts. Less than three years later, there were over a million Internet hosts. In January 2004, there were over 250 million hosts.

1983
DOD mandates use of TCP/IP for the ARPANET

1983
Computer is *Time's* "Man of the Year"

1984
The term "cyberspace" 1st used

1984
T1 lines (1.544 Mbps) introduced

1986
A severed fiber optic cable, containing 7 ARPANET trunk lines, cuts most of the U.S. off

1987
NSFnet begins. Within 3 years it will become the civilian replacement for ARPANET

1988
The Computer Emergency Response Team (CERT) developed

GROWTH OF THE INTERNET

Number of Internet Hosts

Chart values (y-axis): 1,000,000 / 900,000 / 800,000 / 700,000 / 600,000 / 500,000 / 400,000 / 300,000 / 200,000 / 100,000 / 0

Data labels: 4, 25, 100, 1000, 100,000, 1,000,000

X-axis years: 1969, 1972, 1975, 1978, 1981, 1984, 1987, 1990

Source: Hobbes Internet Timeline

Standards and Protocols
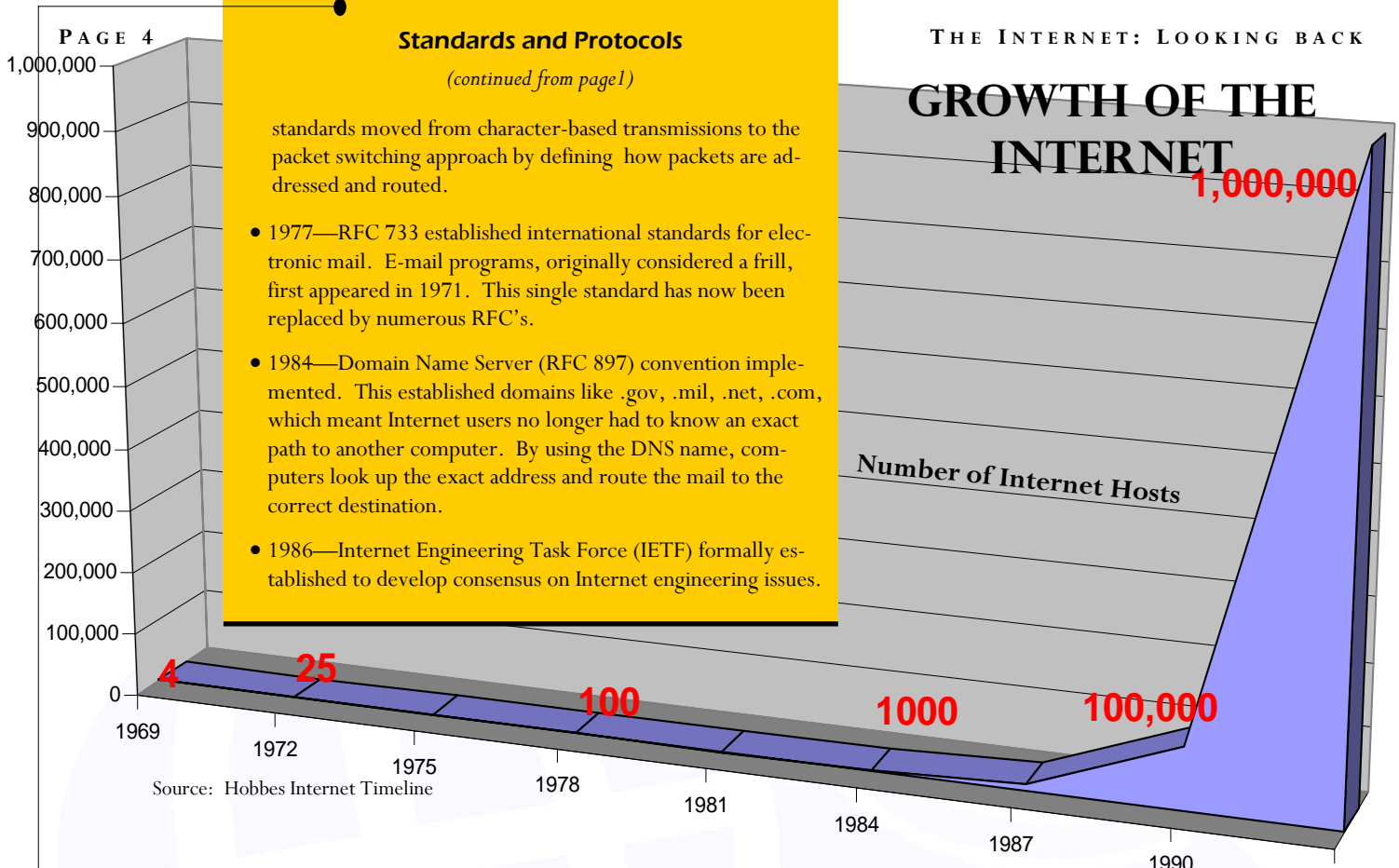
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standards moved from character-based transmissions to the packet switching approach by defining how packets are addressed and routed.

- 1977—RFC 733 established international standards for electronic mail. E-mail programs, originally considered a frill, first appeared in 1971. This single standard has now been replaced by numerous RFC's.

- 1984—Domain Name Server (RFC 897) convention implemented. This established domains like .gov, .mil, .net, .com, which meant Internet users no longer had to know an exact path to another computer. By using the DNS name, computers look up the exact address and route the mail to the correct destination.

- 1986—Internet Engineering Task Force (IETF) formally established to develop consensus on Internet engineering issues.

DO YOU KNOW HOW FAST YOU ARE GOING?

BPS—A measure of data transmission speed between two computers over a modem. Original computer terminal access to the Internet occurred at 300 bps. Today's typical dial-up modem is 56 kilobits per second (Kbps). One Kbps is 1,000 bits per second. DSL and cable (broadband) modems often transmit in the megabits per second (Mbps) range—or 1million bits per second. A T1 phone line supports data transmissions of 1.544 Mbps.

Backbone—the primary transmission lines that connect the various networks that collectively make up the Internet. The Internet backbone is largely comprised of DS3 lines supporting data transmission rates of about 43 Mbps.

Bandwidth—the amount of data that can be transmitted within a certain period of time.

ISDN—Integrated Services Digital Network is an international standard for transmitting voice, video, and data over phone lines. ISDN supports transfer rates of 64 Kbps.

DSL—a category of digital subscriber lines where sophisticated schemes are used to transmit data through copper phone lines. DSL supports download speeds up to 1.5 Kbps today..

POTS—Plain Old Telephone Service or PSTN (Public Switched Telephone Network) provides Internet access for most American households via a dial-up service provider. These non-digital lines are generally limited to 56 Kbps.

Cable modem—tapping into the coaxial cable that is already bringing television into 2/3rd's of American homes, a cable modem is a digital device that connects a computer to the Internet at speeds currently up to 3 Mbps.

Dial-up Modem—short for Modulator/Demodulator, this device or computer program converts a computer's digital signals into analog signals that can be sent over a standard phone line. And, the modem reverses the process (analog to digital) when receiving data.

Test Your Speed:

These sites are just two of many that offer free speed tests for your Internet connection.

- http://www.zdnet.com.au/supercentre/broadband/speedtest/

- http://bandwidthplace.com/speedtest/index.php

1990
ARPANET formally decommissioned

1991
Restrictions on commercial use of Internet lifted

1995
Maintenance of the U.S. Internet backbone moves from the federal government to the private sector

1995
1st Internet telephony service offered

1996
1st North American cable modem service offered

1998
ICANN established to manage the Internet's addressing, naming, and protocol resources.

1999
Internet backbone upgraded to 2.5 Gbps