

## 2: Internet History

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## How did the Internet come to be?

- It started as a research project to experiment with connecting computers together with packet switched networks. It was developed with funding and leadership of the Defense Department's Advanced Research Projects Agency (ARPA).

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## Who invented the Internet?

- Al Gore? No ☺
- Leonard Kleinrock who did early work in packet switching?
- Vint Cerf and Robert Kahn who defined the "Internet Protocol" (IP) and participated in the development of TCP?
- Tim Berners-Lee developed HTTP to support a global hyper-text system he called the World Wide Web? (Internet vs the World Wide Web?)

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## 1958-1961: Connect Computers?

- 1958 - After USSR launches Sputnik, first artificial earth satellite, US forms the Advanced Research Projects Agency (ARPA), the following year, within the Department of Defense (DoD) to establish US lead in science and technology applicable to the military
- 1961 - First published work on packet switching ("Information Flow in Large Communication Nets", Leonard Kleinrock, MIT graduate student)
- 1964 - other independent work in packet switching at RAND Institute and National Physics Laboratory in England

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## 1966 -1968: Connect Computers? Funded

- 1966 - Lawrence Roberts (colleague of Kleinrock from MIT) publishes overall plan for an ARPAnet, a proposed packet switch network
- 1968 - ARPA awards contracts for four nodes in ARPANET to UCLA (Network Measurement), Stanford Research Institute (Network Information Center), UCSB (Interactive Mathematics) and U Utah (Graphics); BBN gets contract to build the IMP switches

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## 1969: First Connections

- 4/7/1969 - First RFC ("Host Software" by Steve Crocker) basis for the Network Control Protocol(NCP)
- 9/2/1969 - Leonard Kleinrock's computer at UCLA becomes first node on the ARPANET
- 10/29/1969 - First packets sent; Charlie Kline attempts use of remote login from UCLA to SRI; system crashes as "G" in entered

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## 1967-1971: So what do we do with it?

- 1967-1972 - Vint Cerf, graduate student in Kleinrock's lab, works on application level protocols for the ARPANET (file transfer and Telnet protocols)
- 1971 - Ray Tomlinson of BBN writes email application; derived from two existing: an intra-machine email program (SENDMSG) and an experimental file transfer program (CPYNET)

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## 1971-1973 Networks Growing

- 1970 - First cross-country link installed by AT&T between UCLA and BBN at 56kbps
- Other networks: ALOHAnet (microwave network in Hawaii), Telenet (commercial, BBN), Transpac (France)
- 1973 - Ethernet was designed in 1973 by Bob Metcalfe at Xerox Palo Alto Research Center (PARC)
- How do we connect these networks together?

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## 1972-1974: Protocol Development

- 1972-1974 - Robert Kahn and Vint Cerf develop protocols to connect networks without any knowledge of the topology or specific characteristics of the underlying nets
- 1972 - Robert Kahn gives first public demonstration of ARPANet (now 15 nodes) at International Conference on Computer Communication

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## 1974-1978: Development of TCP/IP

- 1974 - First full draft of TCP produced
- November 1977 - First three-network TCP/IP based interconnection demonstrated linking SATNET, PRNET and ARPANET in a path leading from Menlo Park, CA to Univ. College London and back to USC/ISI (Marina del Ray, CA)
- 1978 - TCP split into TCP and IP

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## 1981 -1984: Base Protocols In Place

- 1981 - Term "Internet" coined to mean collection of interconnected networks
- 1982 - ISO releases OSI seven layer model; actual protocols die but model is influential
- 1/1/1983 - Original ARPANET NCP was banned from the ARPANET and TCP/IP was required
- 1984 - Cisco Systems founded

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## 1983-1986: Not Just a Research Project Anymore

- 1984 - Domain Name System introduced; 1000+ hosts (200 hosts by end of 1970s; over 100000 by end of 1980s)
- 1986 - NSFNET created to provide access to 5 super computer centers including Theory Center at Cornell (NSFNET backbone speeds 56 Kbps)
- 1983 - ARPANET split into ARPANET and MILNET; MILNET to carry defense related traffic

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## 1988-1989: Growing Pains?

- 1988 - Nodes on Internet began to double every year
- November 1988 – Internet worm affecting about 10% of the 60000 computers on the Internet (Robert Morris, Cornell)
- 1988 - Internet Assigned Numbers Authority (IANA) established in December with Jon Postel as its Director. Postel was also the RFC Editor and US Domain registrar for many years

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## 1990-1993: WWW Explosion

- 1990 – ARPANET ceases to exist
- 1990 – Tim Berners-Lee develops hypertext system with initial versions of HTML and HTTP and first GUI web browser called “WorldWideWeb”
- 1993 – Mosaic, a GUI web browser, written by Marc Andreessen and Eric Bina at NCSA takes world by storm (showed in-line images and was easy to install);
- WWW proliferates at a 341,634% annual growth rate of service traffic

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## 1990-1993: Ready for Public Consumption

- 1990 – First ISP world.std.com
- 1991 – NSFNET lifted restrictions on use of NSFNET for commercial purposes
- 1992 – Internet Society founded
- 1993 – InterNIC created by NSF to provide Internet services; Private companies transition into roles (AT&T – directory and database services; Network Solutions – registration services; CERFnet – information services)

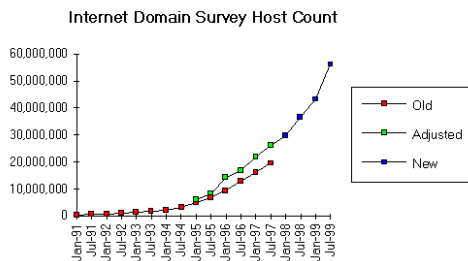
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## 1995: As we know it

- 1995- [NSFNET reverts back to a research network](#). Main US backbone traffic now routed through commercial internet service providers
- 1995 – Sun launches Java
- 1995 – Traditional online dial-up systems ([CompuServe](#), [America Online](#), [Prodigy](#)) begin to provide Internet access
- 1995 – Registration of domain names no longer free

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## Internet Grows Exponentially



Source: Internet Software Consortium (<http://www.isc.org/>)

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## How to make the Internet better?

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## Vint Cerf: Open Challenges

- Vint Cerf: "My primary disappointment has been the slow pace of high speed access for residential customers and the demise of so many competitive local exchange carriers (CLECs) in the US. The second area of disappointment is the slow uptake of version 6 of the Internet protocol (IPv6). Perhaps the third area is the continuing difficulty caused by viruses, worms and distributed denial of service attacks."

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## Tim Berners-Lee: Making the Internet Better

- Tim Berners-Lee: "Nothing can be perfect, but the Web could be a lot better. It would help if we had easy hypertext editors which let us make links between documents with the mouse. It would help if everyone with Web access also had some space they can write to -- and that is changing nowadays as a lot of ISPs give web space to users. It would help if we had an easy way of controlling access to files on the web so that we could safely use it for private, group, or family information without fear of the wrong people being able to access it."

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## Making the Internet Better

- How about you?

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