Evolving the Internet

Vint Cerf

ARPANET 1968-1975

- Government: (D)ARPA + Academia + Industry
  - Initial packet trial: Lincoln Labs and Systems Dev't Corporation
  - Development of the ARPANET IMP: Bolt Beranek and Newman (BBN)
  - Host/IMP Protocol: BBN
  - Development of the Host Protocols: UCLA, UTAH
    - But see RFC 63 (31 JUL 70)
    - LL, Harvard, MIT, UI, SDC, UCLA, UTAH, MITRE, Raytheon
    - French participation at UCLA
  - TELNET: UCLA, SRI, RAND, BBN, MIT, …
  - FTP: MIT, RAND, UCLA, …
  - EMAIL: BBN, RAND, UCLA, USC-ISI, ARPA(!)…
  - First Public Demonstration: Oct 1972 (ICCC): <everyone!>
  - Operations: BBN, Defense Communications Agency (~1975)

Google

PARRY was running at SAIL and DOCTOR at BBN Tenex, both being accessed from UCLA/SEX. See RFC 439.

Doctor: Good Evening. Tell me your problems. Please terminate input with a period or a question mark.

PARRY: *People get on my nerves sometimes.

Doctor: I am not sure I understand you fully.

PARRY: *You should pay more attention.

Doctor: Suppose you should pay more attention.

PARRY: *You're entitled to your own opinion.

Parry Encounters the Doctor (2)

Doctor: What makes you think I am entitled to my own opinion?

PARRY: *It bothers me just to be around people in general.

Doctor: Please go on.

PARRY: *I went to the track at Bay Meadows a while back.

Doctor: What does that suggest to you?

PARRY: *I went to the races.

Doctor: What else would you like to discuss?

Parry: *Horseracing interests me.

Doctor: Why do you say that just now?

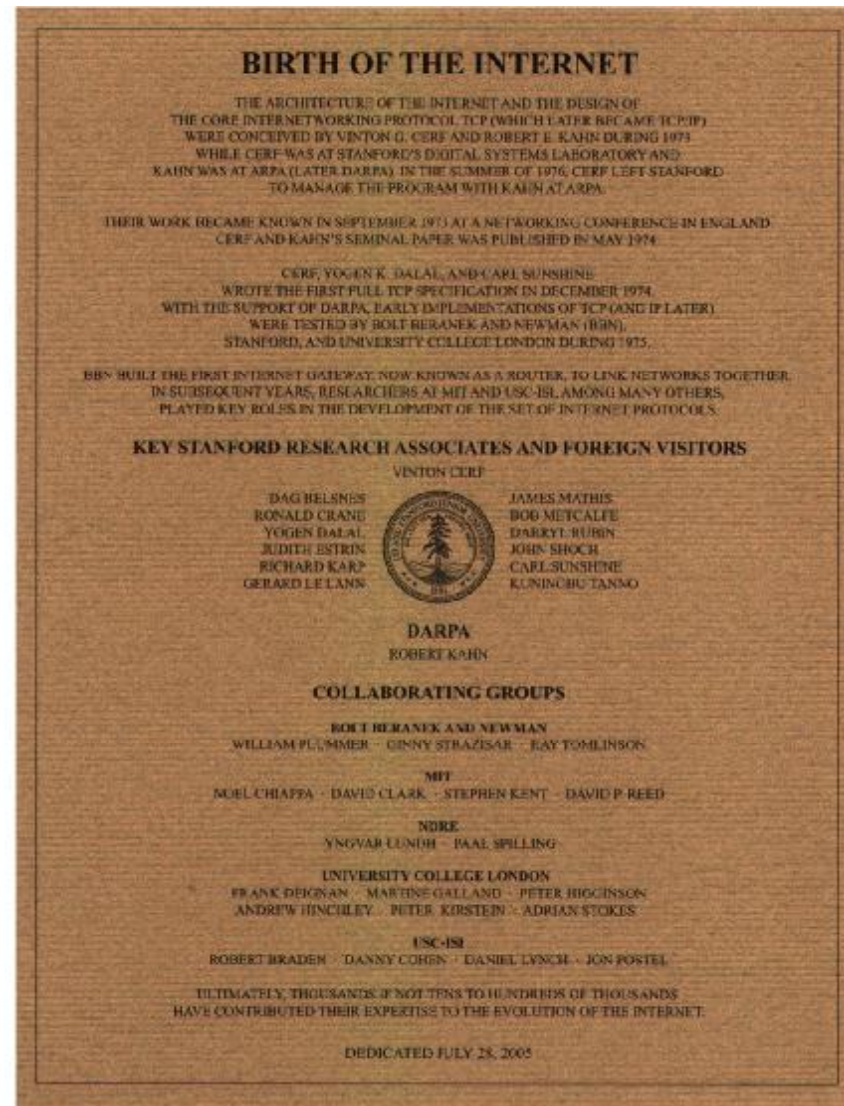Parry: *There's a lot of crooked gambling going on there.

Doctor: I am not sure I understand you fully,…

Parry: *In my opinion you have a one-track mind.

Doctor: What makes you think I have a one-track mind?

Parry: *I used to go to the track every week….

INTERNET (1973-1989)

- Basic Design: (D)ARPA, Stanford (1973-1974)
  - Note International Participation (France, Japan, Norway, UK, Italy, Germany, ….) via INWG and Stanford visitors
  - XEROX PARC PUP/XNS kibitzing @ Stanford + Ethernet

- Implementation of TCP/IP: Stanford, BBN, UCL (1975)

- Broader implementation and refinement (1978-1982)
  - UCB, IBM, UWISC, HP, DEC, MIT, USC-ISI, …

- Internet operational activation: January 1, 1983

- USG Involvement: DOE, NASA, NSF, DARPA = FRICC => FNC

- NSF dramatic expansion: NSFNET + Intermediate Networks

- Commercial engagement
  - 3COM (ethernet), Proteon, Cisco Systems, Bridge, SUN…
  - MCI/CNRI, UUNET, PSINET, CERFNET

The World Wide Web

- 1989 – INQUIRE WITHIN (CERN)

- 1991 – Public release of HTTP/HTML specs for WWW

- 1990s: Erwise, ViolaWWW, MidasWWW, tkWWW, Cello, Spyglass, Internet Explorer, Firefox,…

- 1993 – MOSAIC (NCSA)

- 1994 – Netscape Communications

- 1995 – Netscape goes public (DOT-BOOM!)

Legislative Branch

- Funding for research (DARPA, NSF, DOE, NASA, …)

- National Research and Education Network (NREN)
  - Ca 1987 after 1986 hearing before then Senator Gore

- High Performance Computing Act (1991)
  - National Information Infrastructure

- Boucher Bill (1992)
  - Permitted commercial traffic on the NSFNET
  - Note MCI Mail/NSFNET experimental interconnect in 1989
  - Commercial Internet Exchange (CIX)

LESSONS

- Powerful synergy among government research (persistence and risk), academia (invention, exploration), industry (commercialization), stock market (capitalization), Legislative Branch (regulation/de-regulation)

- Positive reinforcement cycles

- Formal and Informal Collaboration
  - FRICC, FNC, NITRD/NCO
  - Network Working Group (ARPANET), INWG (Internet)
  - XEROX, HP, IBM, DIGITAL Research group collaboration w/ARPA

Interplanetary Internet

- End-to-end information flow across the solar system
- Layered architecture for evolvability and interoperability
- IP-like protocol suite tailored to operate over long round trip light times
- Integrated communications and navigation services