

On the Origins of the Internet

(Ian Peter)

The following exchange occurred in email during October 2004, a few days after publication of our October 2004 newsletter. Most of the exchange was on Dave Farber's mailing list.

The exchange involved many of the early pioneers of the Internet, including

- Leonard Kleinrock, one of the three pioneers of packet switching
- John Shoch, a key figure in early Internet protocols
- Bob Taylor, who headed the Pentagon's ARPANET project

The exchange reveals some interesting tensions. read on...

Leonard Kleinrock

Dave, I believe your IP readership will be very interested in the following event.

UCLA Holds 35th Anniversary of the Internet Symposium October 29 Google CEO Eric Schmidt to be Keynote Speaker

LOS ANGELES The University of California, Los Angeles (UCLA) will celebrate the 35th anniversary of the birth of the Internet with an exciting, thought-provoking symposium on Friday, October 29. Many of the Internet's early pioneers, influential industry leaders and insightful young visionaries will offer their perspectives on how the Internet came to be what it is today and what it will be like tomorrow.

The keynote address, "Conversation with Eric Schmidt" will be an interactive exchange with Google Inc.'s chairman of the executive committee and chief executive officer, Eric Schmidt.

On October 29 1969, UCLA computer science professor Leonard Kleinrock led a team of engineers in launching the first Internet message from UCLA to Stanford Research Institute.

"When we sent that first message, it marked the birth of a new method of global communications that has forever changed the course of business, politics, entertainment, education and social interaction," said Kleinrock. "Now, 35 years later, the Internet has become so pervasive that even my 97-year-old mother uses it."

John Shoch

Dave, There was a lot of great work done on both the Arpanet (packet switching) and the Internet (internetworking), and lots of people deserve credit.

But the packets in 1969 were not internet packets, had no internet addressing, could not have been forwarded to a different network, etc., etc.

This is rather like dating television back to Marconi -- a stretch.

Rick Adams

The history of the Internet depends on whose marketing department is putting out the press release.

In this case, UCLA put out the release, so UCLA takes the position most beneficial to UCLA.

MCI press releases give credit to Vint Cerf.

GTE pushes BBN.

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Netscape press releases gave credit to Andreessen.

CERN & W3C push Berners-Lee.

Etc.

Because there is no real answer (because of the large number of people involved over a long period of time) every organization pushes the version that is to their greatest advantage however tenuous the actual claim is.

Proof of how main-stream the Internet has become.

Ian Peter

Hi Dave,

there's been a bit of a debate about Internet beginnings in our Internet History newsletters (see www.nethistory.info) over the last couple of months. To paraphrase:

In "Where Wizard Stay Up Late", we hear of a difference of opinion between Bob Kahn (Co-inventor of TCP/IP) and Bob Taylor (head of the Arpanet Project where the Internet supposedly began) as to whether the beginning is Arpanet (1969) or TCP/IP (1973).

In the History of the Internet Ebook, I wrote as follows

"Neither the Pentagon nor 1969 hold up as the time and place the Internet was invented. A project which began in the Pentagon that year, called Arpanet, gave birth to the Internet protocols sometime later (during the 1970's), but 1969 was not the Internet's beginnings. Surviving a nuclear attack was not Arpanet's motivation, nor was building a global communications network."

"What Arpanet did in 1969 that was important was to develop a variation of a technique called packet switching. In 1965, before Arpanet came into existence, an Englishman called Donald Davies had proposed a similar facility to Arpanet in the United Kingdom, the NPL Data Communications Network. It never got funded; but Donald Davies did develop the concept of packet switching, a means by which messages can travel from point to point across a network. Although others in the USA were working on packet switching techniques at the same time (notably Leonard Kleinrock and Paul Baran), it was the UK version that Arpanet first adopted." (www.theinternettapes.com)

Kim Veltman of the McLuhan Institute (see the link from our International Histories page at www.nethistory.info) takes the "packet switching equals the Internet" argument a little further, and suggests that the Europeans invented the Internet if that's the case. He points to Louis Pouzin, who introduced the idea of data grams and an Englishman, Donald W. Davies, who was one of the inventors of packet-switching as being important in the origins.

To quote Kim's paper,

"The National Physical Laboratory in Great Britain set up the first test network on these principles [of packet switching] in 1968. Shortly afterward, the Pentagon's Advanced Research Projects Agency decided to fund a larger, more ambitious project in the USA. Hence an English project of 1968 inspired the beginnings of the US Internet in 1969".

Ronda Hauben disputes the packet switching theory. To quote her forthcoming paper,

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"The history of the ARPANET and of packet switching, however, is not the history of the Internet. To quote Robert Kahn, "What the ARPANET didn't address was the issue of interconnecting multiple networks and all the attendant issues that raised."

And in our October newsletter Mitra Ardron takes it further with another theory altogether.

"I would suggest that defining the history of the internet by the particular protocol that won is only one way to do it. Ask yourself - would it still be the internet if we were using ATM, or X.25 or any of the other competing protocols? Of course it would.

An alternative view of history tracks the history of the Internet as the ubiquitous use of electronic "online" communications. The history belongs at the applications level - with the development of email, with the progression from proprietary databases to Gopher and Wais to the World Wide Web, and from newsgroups and conferencing through mailing lists and blogs.

One very significant trend which tends to get ignored is the various online systems, the early Source, CompuServe, Dialcom, and of course APC networks, Fidonet etc. If anything, the history of the use of the Internet, at least from the point of view of the public, owes more to that stream of development than the more common version.

From that perspective, the switch from X.25 to TCP/IP around say '92 for the transport was just something that was done when cost/benefit of TCP/IP dropped below that of X.25."

So I don't think we have a defining birth date yet!

John Shoch

Dave, and others....

Well, I got a number of replies (directly and indirectly) to my short note on the direct vs. indirect ancestry of the Internet.....Several people asked for more commentary on this view.

I have long observed that the idea of internetworking emerged against a diverse set of inputs: packet networks with "message interfaces" (Arpanet), packet networks with stream interfaces (X.25, Tymnet, Telnet, etc.), packet networks with packet interfaces (the packet radio net), local area networks (Ethernet, DCS at Irvine, and maybe a hundred more!), and others.

But all of these networks had some form of homogeneity, and there were no provisions for interconnecting different networks: no higher level of internet addressing, independent of any particular network; no accommodation for packet fragmentation due to packet size limits in some networks; no generalized mechanisms for multi-network flow control or congestion control; no end-to-end reliability protocols that could be abstracted from any single network; no internetwork routing schemes; etc., etc.

The need for internetworking, and ideas about implementing it, came together in the summer of 1973 at the INWG meetings, especially with the proposal from Vint and Bob.

Things then got even more complicated, as the general ideas for internetworking evolved into multiple designs and implementation efforts. There were different "internet" designs and implementations (with a lower case "i"), eventually leading to a dominant internet based on TCP/IP which became the Internet (with a capital "I").

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Suffice it to say that the TCP/IP-based Internet had many, many inputs. I've tried to stay out of this debate, and don't propose to recount it here.

Bob Taylor

Hello Dave. I agree with you that Rick Adams was "right to the point". Here is some more ARPAnet history background.

In February of 1966 I initiated the ARPAnet project. I was Director of ARPA's Information Processing Techniques Office (IPTO) from late '65 to late '69. There were only two people involved in the decision to launch the ARPAnet: my boss, the Director of ARPA Charles Herzfeld, and me.

From 1962 to 1970, beginning with J.C.R. Licklider, Ivan Sutherland, and then me, IPTO funded several of the first projects devoted to the creation of interactive computing -- then referred to as time-sharing. In '64 - '65, I witnessed that within each local site when users were first connected by a time-sharing system, a community of people with common interests began to discover one another and interact through the medium of the computer. I was struck by the fact that this was a wonderfully new and powerful phenomenon.

The next obvious step was to connect those sites with an interactive network. To me, computing was about communication, not arithmetic. Hence the ARPAnet. This theme is elaborated in a paper Lick and I wrote in 1968 entitled, "The Computer as a Communications Device". Google can find it for you. On the last couple of pages there is a scenario that is reminiscent of today's Internet.

Numerous untruths have been disseminated about events surrounding the origins of the ARPAnet. Here are some facts:

The creation of the ARPAnet was not motivated by considerations of war. The ARPAnet was created to enable folks with common interests to connect to one another through interactive computing even when widely separated by geography.

The singularly most important contribution to the architectural design of the ARPAnet/Internet came from Wesley Clark: the interface message processor (IMP). Wes is the designer of the LINC which was arguably the first personal computer. Wes' ARPAnet concept ensured the critically valuable distributed architecture of the ARPAnet. Prior to Wes' contribution, Larry Roberts, whom I hired in Dec '66 to be ARPAnet's program manager, was considering a single, central ARPAnet control computer at a military base in Nebraska. Fortunately, Wes quickly disabused Roberts of this notion.

The most significant role in actually building the ARPAnet was played by Frank Heart and his Bolt, Beranek & Newman team: Severo Ornstein, Will Crowther, Bob Barker, Bernie Cosell, Dave Walden, and Bob Kahn.

Two suspicious claims relating to the ARPAnet were an important part of the case for awarding the 2001 Draper Prize to Kahn and Kleinrock.

1. Kahn has claimed far and wide to be "responsible for the systems design of the ARPAnet" while a member of the BB&N team. Since no other team member agrees, I doubt the validity of this claim.
2. Roberts and Kleinrock (close friends since college) began to claim in 1995, more than 30 years after the fact, that Kleinrock invented packet switching. Most of us believe that Donald Davies in England and Paul Baran in the U.S. independently invented packet switching in the early '60s.

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I believe these two claims are false but they are recorded as facts on the web sites of the National Academy of Engineering and the Computer History Museum. The worst property of self-promotion is that it takes credit away from the people who actually made the contributions. Roberts, Kahn, and Kleinrock have, however, made other important contributions. These can only be tarnished by extravagant claims.

Packet switching is an important part of modern networking, but it is not the only key piece. The multiplicity of the applications and the openness of the standards also played critical roles in ARPAnet development, as did Steve Crocker's initiation and management of the RFC process.

I believe the first internet was created at Xerox PARC, circa '75, when we connected, via PUP, the Ethernet with the ARPAnet. PUP (PARC Universal Protocol) was instrumental later in defining TCP (ask Metcalfe or Shoch, they were there).

For the internet to grow, it also needed a networked personal computer, a graphical user interface with WYSIWYG properties, modern word processing, and desktop publishing. These, along with the Ethernet, all came out of my lab at Xerox PARC in the '70s, and were commercialized over the next 20 years by Adobe, Apple, Cisco, Microsoft, Novell, Sun and other companies that were necessary to the development of the Internet.

The ARPAnet was not an internet. An internet is a connection between two or more computer networks. The ARPAnet, with help from thousands of people, slowly evolved into the Internet. Without the ARPAnet, the Internet would have been a much longer time in coming.

Peter Denning

Dave Farber sent me the correspondence concerning the traditions handed down to us from the early days of the Internet, with the lament in the subject line "CSNet is never mentioned". I thought I would comment because there are good stories to be told from this somewhat forgotten critical piece of Internet history.

CSNET does have a chapter in WHEN WIZARDS STAY OUT LATE.

The four of us (Landweber, Farber, Hearn, and I) proposed CSNET in 1980 because the ARPANET was closed and the few universities connected were pulling way ahead of the others in terms of research capability and contribution. We proposed CSNET as a technology clone of ARPANET that would bring the functionality to the entire CS research community. At the time the ARPANET was closed, to about 180 DoD contractor nodes, a handful of which were universities.

The NSF wanted to help but was very cautious. They insisted that we be set up within the umbrella of UCAR, because they wanted CSNET to become self supporting within 5 years and UCAR had experience making university consortia work. We were funded for \$5M for 5 years with this mandate. By 1985 we had achieved the primary goal of connecting all 120 CS PhD departments and industry labs. We had a governance structure that was self supporting. We created and provided several technologies to make the network usable for the community: Phonetnet (based on MMDF and SMTP) that exchanged email by phone dialup; Telenet, a version of TCP/IP that ran over X.25 on GTE Telenet, thus providing the ARPANET protocols to those willing to pay the bill; a nameserver; and a bridge to the ARPANET. We negotiated two key deals between ARPA and NSF: (1) A policy statement that declared NSF grantees within the CSNET to be authorized users of ARPANET facilities; and (2) A policy statement that allowed commercial companies such as IBM and HP to put traffic on CSNET (and hence on ARPANET). These were the key policy statements that opened up

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the network to non-DOD and to commercial members.

By 1985, the success of CSNET was quite visible within the NSF communities. Many others started asking NSF to provide networking for them as well -- connecting the supercomputing centers and giving them network access to them and to each other. NSF responded by creating committees to help it create and implement NSFNET. These committees were initially populated by alumni of the CSNET project.

The NSFNET backbone became the Internet backbone and ... well, "the rest is history". Thus CSNET was a critical driver in helping NSF get into the networking area and making the transition to the modern Internet. Without CSNET, the modern Internet would not have developed, at least not in the way it did.

Curiously, with NSFNET, NSF abandoned its insistence that the research community pay for its own networking. A generation of graduate students grew up thinking networking is free and ought to be free, an attitude that has become part of the spam problem.

So ... please put CSNET into your story book.