Chapter 19

Networked E-mail

Compiled by David Walden

This chapter, compiled from communications with the participants, describes BBN's involvement in the development of networked e-mail

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The broader story of the development of networked e-mail in the early years is well told in chapter 7 of Katie Hafner and Matthew Lyon's book, *Where Wizards Stay Up Late*.[1,2] This chapter emphasizes BBN's role in the overall story. Craig Partridge, one of the coauthors of Chapter 17 of this book, has also written a more scholarly history of networked e-mail that extends beyond the early days and BBN contributions.[3] (No coverage is given to e-mail activities prior to ARPANET e-mail.)

This section was compiled by Dave Walden with contributions and quotations from many participants in the BBN e-mail story. These contributors are noted throughout the chapter, and their contributions are greatly appreciated. Except for final copy edits in 2010, Walden's compilation effort stopped on August 21, 2003.

19.1 Tomlinson's initial demonstration

Of course, like many innovations (and most Internet innovations), networked e-mail as it exists today has evolved from the efforts of many key contributors over the years. E-mail with a single machine had existed for some time; for example on the CTSS machine at MIT. According to Ray Tomlinson,[4] a program called SNDMSG originated with the Berkeley-developed SDS 940 time-sharing system that BBN was using before TENEX.[5] Tomlinson rewrote SNDMSG for TENEX and started embellishing it in various ways. SNDMSG was used for sending an e-mail within TENEX; the system's Type (a file) command was used to read e-mails.

In 1971, with two TENEX systems available at BBN and with both of them connected to the ARPANET, the possibility of e-mail among users on multiple machines occurred to Tomlinson. Without hesitation he implemented the first instance of networked e-mail between the two TENEX machines.[6] This implementation included SNDMSG as the first network e-mail sending program, the @-sign separator, the business memo format (consisting of lines for To, Subject, From, Date, and CC), the use of the computer's Type (a file) command as a readmail command,[7] and an experimental file transfer protocol (CPYNET) to convey e-mail messages across the network. Today, almost 40 years later, after much iteration and refinement, the outline of Tomlinson's basic implementation model can still be seen in networked e-mail.

Networked e-mail is clearly one of the major components that make the Internet what it is today. Networked e-mail was also the first Internet "killer app" and, when it burst onto the scene in 1971, gave the first tangible indication of how far the Internet might go in becoming the ubiquitous anyone-anywhere-to-anyone-anywhere communication system it has become. E-mail succeeded because it provides interaction

at the convenience of the users (they don't have to think in lockstep), but still fast enough for several turnarounds a day (far faster than Post Office mail), supporting a high metabolism of interaction and collaboration. Unlike telephone conversations, it is in a written form and thus creates a record for easy filing and forwarding to other collaborators. Since it is network based, e-mail reaches users worldwide. All of these critical elements were present in the networked e-mail system first demonstrated by Ray Tomlinson.

For his original inspiration and demonstration, Tomlinson received the 2004 IEEE Internet Award (jointly with networked e-mail codifier Dave Crocker), "For their key roles in the conceptualization, first implementation, and standardization of networked e-mail." Tomlinson's early e-mail work (particularly his choice of the at-sign in mail addresses) has also been honored with several other awards.

19.2   A succession of e-mail programs

Many e-mail programs were written by members of the ARPANET community to improve the user interface beyond what Tomlinson provided in his first demonstration. John Vittal, who came to BBN from ISI in 1976, remembers the history as follows.[8] Originally, the TENEX systems ran two programs to send and receive messages: SNDMSG and READMAIL. Next came RD, a set of TECO macros from Larry Roberts at ARPA, that let you selectively read messages from your e-mail inbox. In 1972 Barry Wessler (then at ARPA) started writing a program called NRD (New RD), which was to be a successor to RD, but which was never completed or distributed.

NRD evolved into two e-mail programs, BANANARD and MSG. First, in late 1973 and early 1974, Martin Yonke (then at ISI) and John Vittal got Wessler's code running and called the result WRD for Wessler's RD. Yonke recalls that WRD was only around briefly and was largely Wessler's code with bug fixes but otherwise unchanged.[3] Then Yonke took WRD and changed the interface to make BANANARD, and in parallel Vittal took WRD and BANANARD and made significantly more changes creating MSG.

BANANARD and MSG were the first mail systems on the ARPANET to integrate message reading and creation functions by providing a single user interface; both invoked SNDMSG (as a subprocess) for mail creation. MSG provided a different functionality than BANANARD; specifically, it added a user profile, a more concise user interface, multiple folders for message filing, and the the first instances of the Forward and Answer (reply) commands.[9]

As Vittal remembers, getting the semantics right for the Answer command took some experimentation, which resulted in innovations such as providing options of sending only to the originator of the message or to all recipients, and filling in the subject field with "Re:" the subject of the original message.

The availability of MSG spread by word of mouth and by the mid-1970s it had an active user community of more than 1,000 people. Vittal reports that MSG was never officially funded or supported, other than by him in his spare time. Nonetheless, it clearly had an impact. It went into UNIX and became the starting point for e-mail systems such as MH, MM, and MS. In 1976 Vittal joined BBN, where he continued to maintain MSG mostly on his own time. After the early 1980s, Vittal ceased maintaining MSG, even though it was still in use by a few people as late as the mid-1990s.

Jim Calvin was another BBN person who brought an e-mail program with him when he came to BBN. He says,[10] "I joined BBN in May of 1974 and brought an e-mail program with me I'd done at Case. In 1974 and 1975, I rewrote this program (going from a SAIL implementation to PDP-10 assembler) which became known as Mercury, or HG. I did this on my spare time and actually caused a few headaches for the Mailsys/Hermes

guys.[11] HG was much faster until the main mail file had more than ~600 items in it. HG was a full-featured mail program and was used by quite a few people at BBN. It was around into the early 1980s when I was just too busy to keep it going."

19.3   Codification of the e-mail standard

Developing a standard for networked e-mail was a torturous process that took many years and included much (sometimes acrimonious) debate. Different e-mail programs (such as some of those mentioned in the previous subsection) needed different e-mail protocol capabilities. Also, different computer operating systems had more or less difficulty with various aspects of networked e-mail. As the source of TENEX, probably the most popular computer system on the ARPANET in the early days, BBN played a considerable (not always welcome) role in this standardization. (Of course, much work also was done and documented in RFCs and elsewhere by non-BBN people.)

In 1972, the developers of the FTP (file transfer protocol) specification[12] included the possibility of "piggybacking" Tomlinson's networked e-mail messages on FTP, eliminating the need for CPYNET.

In 1973, RFC 561, entitled "Standardizing Network Mail Headers," was published by Abhay Bhushan and Ken Pogram of MIT, Ray Tomlinson of BBN, and Jim White of SRI. Ken Pogran remembers[13] his interest in this standardization effort. He was working on MIT's Multics system and struggling with properly displaying the user who sent a message, date and time sent, and so forth. The Multics e-mail system displayed a message header based on the Multics user IDs, but this was a system process on Multics, not the user who actually sent the message from another site. As a courtesy, the e-mail programs on each ARPANET computer pre-pended to the actual user-generated text some rudimentary header information, but each e-mail program provided this courtesy in a little different fashion. This was OK for some of the more popular computer systems (e.g., TENEX) and e-mail systems (e.g., MSG), which worked relatively consistently with each other. However, in the early days there was only one Multics on the ARPANET, and Pogran did not want Multics to appear "less equal," particularly to the ARPA program managers, who all used TENEX. Thus, Pogran needed some standard that Multics could follow. Abhay Bhushan was better known in the ARPANET community (e.g., as a leader of the specification of FTP) than Pogran, who had recently graduated from MIT; and Bhushan was already in contact with Tomlinson. White was involved because the Network Information Center at SRI wanted to distribute ARPANET documents (e.g., RFCs) via e-mail rather than the postal service and desperately needed a standard.

In 1975, Ted Myer and Austin Henderson of BBN published RFC 680, entitled "Message Transmission Protocol," an improvement on the e-mail protocol.

In May 1977, Ken Pogran of MIT (he joined BBN in 1980); John Vittal and Austin Henderson, both of BBN by that point; and Dave Crocker of RAND published RFC 724, entitled "Proposed Official Standard for the Format of ARPA Network Messages." This assertion of a "standard" was not well received by some in the ARPANET community.[14] Undaunted, in November 1974, Crocker, Vittal, Pogran, and Henderson published a revision of RFC 724 — RFC 733, entitled "STANDARD FOR THE FORMAT OF ARPA NETWORK TEXT MESSAGES." However, RFC 733 didn't end the e-mail protocol debates; in particular, it was incompatible with Vittal's own highly popular MSG e-mail program, according to Hafner's book.

The real "standard" finally was written by Dave Crocker (by then at the University of Delaware) as RFC 822, entitled "STANDARD FOR THE FORMAT OF ARPA INTERNET TEXT MESSAGES" and obsoleting RFC 733. The multiyear effort culminating in this RFC is a primary reason Crocker shared the 2004 IEEE Internet Award with Ray Tomlinson.

Later MIME and other capabilities were added to networked e-mail, but BBN was no longer significantly involved.

19.4   Other BBN e-mail systems

In addition to the BBN systems mentioned in this section, there were also significant e-mail components of CSNET (see Chapter 17), Diamond (Chapter 18), and perhaps other applications systems.

Hermes

According to Jerry Burchfiel,[15] DARPA program manager Steve Walker supported development of a "real" mail system, as opposed to the quick hacks Ray Tomlinson and Larry Roberts had done (SNDMSG, READMAIL, RD, etc.). He funded BBN's development of HERMES, managed by Ted Myer with contributions from Austin Henderson, Ron Brackman, Art Pope, Frank Ulmer, and others. Burchfiel remembers that Walker also funded work at USC ISI. Walker's director at ARPA challenged him to come up with a realistic scenario for transition of this technology into the services, and Walker originated the Military Message Experiment (MME) at CINCPAC, Camp Smith, Hawaii. Both the ISI system and BBN's (early stage) HERMES went out there for two years of testing and evaluation.

Steve Walker remembers[16] that when he got to DARPA, ISI was already working to some extent with people from NRL and CINCPAC on an e-mail demonstration. He became aware of BBN's e-mail work and decided that two approaches might improve the chances of something usable's being produced for CINCPAC. (Al Vezza at MIT also offered an e-mail system for testing without funding from DARPA.[17])

According to John Vittal,[18] sometime in 1975, ARPA funded the Military Message Experiment (MME) to produce an e-mail system that could support multilevel security and priority traffic for the Navy.

In December 1975, John Vittal and BBN's Austin Henderson met at the first e-mail standards meeting in Los Angeles, and Henderson told Vittal that Walker had told BBN to look at MSG so "Hermes could get it right." Eventually, Vittal was offered a job with the Hermes group and joined BBN in July 1976. When Vittal joined the Hermes project, Austin Henderson, Doug Dodds, and Charlotte Mooers[19] were working on the Hermes project, under the leadership of Ted Myer. Jim Miller joined the project next, and Debbie Deutsch joined the project in January 1977. Later Barbara Wagriech joined the project.[20]

In the end, ISI won the MME fly-off (". . . it became obvious," says Vittal, "that ISI's effort[21] was preordained to win the experiment"). Thus, BBN's funding dried up.[22]

Debbie Deutsch remembers,[23] "Hermes attempted to be very flexible/complete compared with its predecessors such as MSG. In particular, it had what amounted to a database capability built into its message store. Plus, it had a template facility to control the display of message fields (presence, order). Hermes had a great many commands with specific names which represented particular combinations of basic commands (such as to display a message) and modifiers (such as a display template). In retrospect, the flexibility/complexity of Hermes' interface made it difficult to approach for new users, and probably worked to its detriment." Users wanted to be able to do e-mail simply. Vittal adds,[24] "[Hermes'] functionality had something for everyone — it really was a research tool to find out what people needed when they did e-mail. However, the defaults were such that it was difficult to use and understand; the system got in the way of *doing* e-mail. Had we had the funding or prescience to run human factors[25]

and user interface testing experiments on Hermes, we could have provided a sufficient wealth of design criteria that would have guided e-mail clients to the current day." Steve Walker,[26] however, notes that he personally liked Hermes because it practically could be used as a database management system. He remembers building a system himself in Hermes to handle all the registrations of the First DoD Computer Security Conference.

BBN tried to promote Hermes within the government. According to Deutsch,[27] perhaps the "apex of Hermes deployment came when it was used early in the Carter administration in the Executive Office of the President," says Deutsch. "You would not believe the level of support we gave them. I remember being on call while on vacation. I have hazy memories of Hermes being used when Carter took a vacation trip to the Snake River in Idaho. I have no idea how they connected to the net." Attempts were made to commercialize Hermes. Deutsch remembers when she and Ted Myer visited Telenet, the packet-switching common carrier BBN had founded and partially funded, but they weren't interested. "They felt that e-mail would never be a big thing, since executives wouldn't be caught dead using keyboards or having them in their offices. Since secretaries would be doing all the sending and receiving, what improvement did it offer?" Still, Vittal remembers that eventually Ted Myer left BBN and joined Telenet to try to commercial e-mail.

Intelpost

Julie Sussman was the primary source of information regarding Intelpost,[28] although a little bit of information came from Ray Tomlinson. (In some of the following I paraphrase Sussman and Tomlinson rather than quoting them.) Others participating in the project included Bob Clements and Jim Miller.

In the late 1970s, many people did not yet have access to fax machines, and special delivery was expensive. Thus, the USPS contracted with Comsat to demonstrate a system to scan letters the users brought to a post office and to transmit them to other post offices, perhaps in other countries. Comsat contracted with BBN to do the software for the system.

BBN started work in 1978, coding in BCPL for a PDP-11 and using TCP with routing hard-coded into the software. In June 1979, BBN did a four-node test. The January 1980 brochure for the official "First Day of Transmission" and the October 1980 public Intelpost brochure list, between them, the following countries as participating in the Intelpost system: Argentina, Belgium, Canada, France, Germany, Iran, Netherlands, Switzerland, and the United Kingdom. A June 1980 announcement from the U.S. Postmaster General says the kickoff of service was between Canada and the United Kingdom (not the United States, due to regulatory problems). Sussman remembers that Iran and France wanted to be up first, "but Iran had a revolution and France's PTT (postal and telecommunications) heads were bickering too hard over which half (P or T) was doing this project (since it was both telecommunications and postal service) to actually do anything [August 1979, Datamation]." By September 1981, Buenos Aires was on line for demonstrations.

BBN's software was delivered to each of the sites. Sussman says, "Basically I think we finished, tested, and fixed the software, and configured it for additional sites and for foreign languages (in the operator interface). I think our role was over by the end of 1980, except for delivering a Buenos Aires system in 1981."

InfoMail

In 1980, Dave Walden and John McQuillan wanted to move from networking R&D and consulting to something more commercial (and independent of Frank Heart's division).

They talked with BBN president Steve Levy and with Mike Lavigna, BBN's corporate business development person, and wrote a business plan for a commercial e-mail product; as a result BBN started BBN Information Management Corporation with Walden and McQuillan leading it.[29] The e-mail product was named Infomail.[30] Walden served as president of BBN IMC and was "Mr. Inside," managing the day-to-day operation of the business and leading the product development effort; McQuillan served as vice president and was "Mr. Outside," leading the marketing, sales, and customer support.[31]

InfoMail almost certainly was the first multiplatform e-mail system (certainly BBN billed it that way at the time[32]). The hope was that companies and other institutions beginning to adopt e-mail would choose InfoMail because it could run on all of their computer systems. Up until that time, e-mail systems had tended to be machine or operating-system dependent. To support this portability, InfoMail was written in RATFOR, the language preprocessor from the UNIX world that converted a C-like programming language into Fortran; of course, Fortran compilers were available for virtually all computers and operating systems.[33] Version of InfoMail ran under UNIX (for the Digital PDP-11 and the BBN C/70), Digital's VAX\VMS, IBM MVS, and IBM CICS.[34]

Unlike Hermes (discussed above), InfoMail had a succinct set of commands focused on the e-mail task that users seemed comfortable with. InfoMail displayed (primitively, on a terminal screen or page) a desktop, file drawer, and file folders for message management.[35] Nonetheless, while InfoMail system was sold to some companies and institutions, it was not in sufficient volume for this BBN start-up business to be a success. BBN and the ARPANET community were ahead of most of the rest of the world in adopting e-mail.[36] After a couple of years, BBN Information Management Corporation was shut down and its staff and product merged into BBN Communications Corporation. At BBNCC, InfoMail was widely deployed in the Defense Data Network, where it was highly regarded and used for many years.

Notes and References

1. Katie Hafner and Matthew Lyon, *Where Wizards Stay Up Late*, Touchstone imprint of Simon & Schuster Inc., New York, paperback edition, 1998.

2. See also, Ian R. Hardy, "The Evolution of ARPANET email," History Thesis Paper, University of California at Berkeley, spring 1996, available at `http://tinyurl.com/y9tle7a`

3. Craig Partridge, "The Technical Development of Internet Email," *IEEE Annals of the History of Computing*, vol. 30, no. 3, April–June 2008, pp. 3–29.

4. E-mail of September 18, 2003.

5. See page 523 of section 21.2.

6. According to Partridge,[3] Tomlinson deliberately did not go in the direction suggested by Dick Watson of SRI in RFC-196 (July 1971).

7. Later Tomlinson wrote an explicit readmail program in assembly language and still later another version in BCPL. At least the latter was named READMAIL.

8. E-mails of July 28, 2003, and April 8–10, 2010.

9. John Vittal, "MSG: A Simple Message System," in *Computer Message Systems*, ed. Ronald P. Uhlig, New York: North Holland Publishing Co., 1981.

10. E-mail of March 6, 2003.

11. More about Hermes later in this section.

12. Abhay Bushan at MIT, Alex McKenzie at BBN, and others.

13. E-mail of July 30, 2003.

14. Alex McKenzie, in Frank Heart's computer division, with its more primitive computing capabilities than were available in the division doing TENEX, spoke out relatively publicly against the complexities of the proposed standard, which he worried would require a more powerful e-mail program or better computer terminals than those he was using.

15. E-mail of August 7, 2003.

16. E-mail of August 20, 2003.

17. Editor's note: In all likelihood, this was within the Dynamic Modeling Group at MIT, which at that point was J. C. R. Licklider's group, managed by Vezza.

18. E-mail of July 31, 2003.

19. Wife of Calvin Mooers ["Calvin Mooers, the NOL Computer Project, and John Vincent Atanasoff: An Introduction," and "The Computer Project at the Naval Ordnance Laboratory," *IEEE Annals of the History of Computing*, vol. 23, no. 2, pages 50–67], the inventor of TRAC, which had an early (perhaps its first) implementation on BBN's PDP-1 by Peter Deutsch.

20. At the time, BBN was trying to find situations suitable to hire some handicapped people. Barbara Wagriech was deaf and blind. Charlotte Mooers learned to finger talk with her.

21. Named SIGMA and built on top of BBN's TENEX.

22. With the end of Hermes funding, funding for another communications research effort also ended. Starting in about 1977, John Vittal developed a system he called R2D2 (after the circa 1977 "Star Wars" movie — R2D2 stood for Research-to-Development-Tool). The idea was to have programs be transported and executed remotely, with communication back to the originator. John used e-mail as the communication mechanism. This work was documented in a book chapter by Vittal ("Active Message Processing: Messages and Messengers," *Computer Message Systems*, Ronald P. Uhlig, ed., North Holland Publishing Co., New York, 1981) and was the first publication on "active messaging."

23. E-mail of February 11, 2003.

24. E-mail of July 31, 2003.

25. BBN had an outstanding in-house human factors group, as described in Chapter 8.

26. E-mail of August 8, 2003.

27. E-mail of July 30, 2003.

28. E-mail of March 26, 2003.

29. That people from the BBN division where the e-mail work had not previously been done were starting BBN's commercial e-mail activity was a bit distressing to the people working on Hermes in the "e-mail division."

30. Pete Kaiser, Morris Keesan, and Elise Sargent (e-mails of July 30, 2003), John McQuillan (e-mail of August 4, 2003), and Ken Turkewitz (e-mail of August 5, 2003) helped compiler Dave Walden remember the people names and computer systems relevant to InfoMail.

31. The rest of the InfoMail development team that gathered over time included: Curt Sanford (who later was one of the earliest employees of Lucent), Pete Kaiser (who brought IBM experience), Rick Chatranon, Elise Sargent, Ken Turkewitz, Audrey Mack (who brought IBM experience), Morris Keesan, and Bonnie Friedman. Now-renowned U.C. Berkeley professor Randy Katz was part of the development group briefly after he received his PhD, until he concluded a few months later that he was better suited to an academic environment and joined the faculty of the University of Wisconsin. Chris Souter, who had been a saleswoman for IBM (of typewriters, perhaps) was hired to lead the InfoMail sales effort. First Marianne Steiner and later Linda Ridlon managed customer support. Mary Gillis was also involved in business development. Melinda Thedens wrote and producing documentation. Arlene Scherer did customer training. Rob Jevon was the third person involved with the project, after Walden and McQuillan, on loan part-time from the corporate accounting staff; later Tricia Hanafin provided accounting support. There were a few

others involved with BBN Information Management Corporation whose names currently escape us.

32. J. M. McQuillan and D. C. Walden, "Portable Software for Electronic Mail Makes it Hardware-Independent," *Electronics*, March 10, 1981, pp. 167–171.

33. For at least one of the IBM ports of InfoMail, RATPL1 was used. The InfoMail team (primarily Ken Turkewitz) retargeted RATFOR to PL/1

34. Morris Keesan remembers that relatively late in the InfoMail business, he ported InfoMail "to a not-quite-UNIX operating systems called Unos that ran on an M68000-based machine made by Charles River Data Systems. It was part of a larger system that involved automated retrieval of stored mail from 3M 'WhisperWriter' portable terminals."

35. J. M. McQuillan and D. C. Walden, "Designing Electronic Mail Systems That People Will Use," *SIGOA Newsletter*, May l980, vol. 1, no. 2; *InfoMail User Guide*, BBN Information Management Corporation, Cambridge, MA.

36. As with the Hermes project, the InfoMail people heard repeatedly that no executive would ever do *his* own typing.