WHAT IS EMAIL? AND, WHO INVENTED IT?

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Summary

Email is the electronic replica of the interoffice (inter-organizational) mail system – a system intended for enabling collaboration in the business office environment. Email, the system, is not to be confused with simple methods for the electronic exchange of text messages dating back to the Morse Code of the 1800s. Email was created in the late 1970s at the University of Medicine and Dentistry of New Jersey, located in Newark, NJ. Email, moreover, does not require the Internet. Prior to the creation of the World Wide Web (WWW) in 1993, email was utilized on intranets, local area networks (LANs) and wide area networks (WANS) for business office application. The invention of email in Newark, NJ demonstrates the possibilities for urban innovation when critical elements of an ecosystem for innovation are present.

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I. Introduction

Certain aspects of modern life can become so pervasive that we fail to notice just how prevalent they actually are and from where they originated. Email is a good example. Though almost completely unknown to the public before the 1990s, in 2014 there were approximately 4.1 billion email accounts worldwide – with the number projected to reach 5.2 billion accounts by 2018.

Email is far and away the most widely used means of communication in the business world, but it's also become a new form of identification. Today, an email address is now a requirement for signing on to social networking sites, file sharing accounts, and online retailers. By 2018, business emails alone will total approximately 140 billion messages per day.

Email is clearly a revolutionary development in the history of human communication. For most of us, it's probably difficult to fathom how anything ever got done without it. Yet, it's actually quite a recent development. In the great scheme of things, email is new.

II. The "Email" Before Email

To see exactly what's new about email, however, it's important to look at what's not new about it. The basic concept for email existed over many decades as the so-called *interoffice (or inter-organizational) mail system*, a cumbersome but once effective means of collaboration for sharing typewritten, hard copy, paper documents within a business environment. Secretaries, primarily women, were the main operators of this system and responsible for the creation and processing, as well as managing the transport, of the paper documents,.

The interoffice mail system was *an interconnected system of systems* that used paper documents to enable collaboration, cooperation and communication among **users of differing expertise** within the business office environment. This system consisted of **multiple, linked and cooperating systems and processes** including:

I) the "secretary's desktop"

II) the "interoffice memo" and "interoffice envelope"

III) multiple methods for processing:

IV) transportation systems

<u>I. The Secretary's Desktop</u>

The desktop was the physical desk as well the accessories used by the secretary. Atop the secretary's desktop was a typewriter (for writing the interoffice memo), an INBOX (to receive incoming mail), OUTBOX (to hold mail to be sent), the DRAFTS

box (where memos in progress were stored), an ADDRESS BOOK (containing contacts), paper clips for attaching documents e.g. ATTACHMENTS to the "interoffice memo." Nearby the secretary's desk was steel case FOLDERS for archiving paper documents and a TRASH CAN. There were also other components: paper white paper, carbon paper for making copies, white liquid or white paper tape for correcting errors made on the typewriter, pencils, writing pad for taking notes, etc.

II. Interoffice Memo & Interoffice Envelope

The "interoffice memo" consisted of a either one or many paper documents. The cover memo included a template format with sections: "To:," "From:," "Date:," "Subject:," "Cc:," (a viewable listing to all recipients who received a copy of the memo), "Bcc:," (the name of a recipient who received a copy, but not known to others except the sender), the "Body:" containing the actual text of the memo, and the "Encl:" section for listing the documents, if any, that were attached to the memo. If there were attachments, a paper clip was used to hold the documents. The memo was placed into a long 9" by 12" "interoffice envelope," typically yellow or grey, with a red drawstring to close and seal the contents.

III) Multiple Methods for Processing Mail

Mail was processed in many ways. Incoming mail was first SCANNED and then SORTED based on various attributes e.g. origin, priority, urgency of response, junk mail, etc. Any junk mail was DELETED. Some mail was ARCHIVED into folders.

Sometimes a memo of interest was FORWARDED by providing a distribution list of forwardees. New mail was COMPOSED on the typewriter, and went through multiple rounds of EDITING. Some outbound mail had RETURN RECEIPT PROCESSING, for ensuring delivery and receipt of the mail. There were many other processes such BROADCASTING a single memo (sending a memo to multiple recipients). But these were the basics.

IV. Mail Transport and Processing Systems

The mail transport and processing systems consisted of personnel who picked up and transported the interoffice envelope from the OUTBOX to the INBOX. Physical hardware consisting of pneumatic tubes, cars, trucks and vans to move interoffice envelopes from one location to another. Sorting and distribution took place in local mail office rooms using trained personnel and mailroom clerks.

If, for example, someone in a company's Personnel Department wanted to inform executives about a recruiting interview, they would create an interoffice memo, using their typewriter, and attach to that memo, the interviewee's resume, hard copy report, and place the memo and the attachments, into the interoffice mail envelope.

The name of the intended recipient would then be written on the outside of the envelope, which would be picked up by mailroom personnel for delivery. Once the recipient had reviewed the resume and read the report, he or she could add

comments to the report, and write the name of a new recipient on the outside, to "forward" the document to that recipient.

In this way, interoffice mail could circulate throughout the company until it eventually became a multi-document file, including the original report plus comments and feedback from everyone who received the envelope. Depending on the urgency of the circumstance, this could usually happen over the course of a single day. The interoffice mail system was the workhorse communications tool for getting business done, and the memo was the medium for such collaboration. Hiring of personnel, grant proposals, discussion of new research, and more were done through the collaborative medium of the interoffice mail system.

III. The Computing Ecosystem at UMDNJ, Circa 1978

In 1975, the interoffice mail system was fully in place at the College of Medicine and Dentistry of New Jersey (CMDNJ) at the time. I was hired at CMDNJ as an experimental high-energy physicist from Brookhaven National Laboratories to join the IT department. I had some general scientific computing experience and an interest in using *minicomputers*, the small computers of the time, to control and acquire data from laboratory experiments. I created the Laboratory Computer Network (LCN) group at CMDNJ shortly after arriving.

CMDNJ was then a young organization. It was a freestanding public institution comprising several medical schools, a dental school, a school for health related

professions, and a graduate school of the biomedical sciences. Absent were the STEM fields (science, technology, engineering and mathematics). A goal of CMDNJ, at the time, was to establish itself as a major academic health sciences institution, which it later accomplished as the University of Medicine and Dentistry of New Jersey (UMDNJ), and on far grander scale with its more recent merger with Rutgers University.

The IT department, at the time, although small, included a scientific data processing group. The group was populated with several biostatisticians and mainframe computer experts. The staff interacted with faculty from numerous departments both in the clinical and basic sciences and became quite adept at introducing machine computation to life scientists, although many of them had little experience using computers. The main local computing device at the time, an IBM remote job entry terminal, was connected to remote batch and time sharing machines operated by an educational consortium known as the New Jersey Educational Computer Network (NJECN).

Computers at that time were predominantly used for administrative business processing, scientific calculation and machine-aided design for engineering problems. However, while the role of computation in the broader context of human endeavor lay in the distance, the LCN and I hoped to explore those areas, and was open to finding others who wanted to participate in the exploration.

It was within this backdrop that the LCN staff met Shiva Ayyadurai.

IV. "I've Got a Smart Son"

In 1977, Martin Feuerman, an accomplished applied mathematician and a Senior Systems Analyst and Biostatistician at UMDNJ, was acquainted with Ms. Meenakshi Ayyadurai, a colleague, who was also a mathematician, statistician and a Systems Analyst in UMDNJ's Data Processing Department. Ms. Ayyadurai and her family had moved to the United States from India seven years earlier in 1970. Ms. Ayyadurai sought advice from Feuerman on how to guide her precocious son, Shiva, who had already completed Calculus while attending 9th grade in the Livingston, New Jersey school system. The high school had no other mathematics courses to offer Shiva.

Feuerman shared with Ms. Ayyadurai, a news clipping of a special program at New York University's Courant Institute of Mathematical Sciences for a select group of 40 high school students to study computer science. He passed it on to her with a note, "Meena, I thought you'd be interested in this,"

The NYU program had been created by Professor Henry Mullish, a visionary computer scientist, who foresaw a need for skilled software engineers. Shiva was selected as one of 40 students to learn six programming languages -- COBOL, PL/1, ARTSPK, FORTRAN, BASIC, SNOBOL – and to enroll in the NYU course on digital hardware and processing. Shiva was the only Sophomore in high school, and the

only student from New Jersey selected into in this program. The other students were either Juniors or Seniors.

Meenakshi - I thought you'd be interested in this.

WEDNESDAY, MARCH 29,1978 WASHINGTON SQUARE NEWS Page 11

NYU Invites High School Students

By DAVE RUDIN

High school students will be able to earn college credit in eight NYU courses to be offered this summer.

Students will pay $117 per credit.

Washington Square and University College is offering five four-credit courses and the School of the Arts is offering two four-credit classes, and a two-credit course.

Students may register for any combination of courses and earn up to eight credits.

Those who wish to may live in a dormitory.

The program, which began two years ago, originally offered courses in the School of Education, Health, Nursing and Arts Professions, but those were terminated because of low enrollment, according to John Wells, director of university summer sessions.

In 1976, total enrollment was

JOHN WELLS

51 students, mostly high school juniors, who registered for 171 credits. Last year, 48 students enrolled, taking 240 points.

Wells added that acceptance into the summer program "doesn't guarantee admission to the university," and high school students may register for regular university summer classes if qualified.

The Summer Course in Computer Programming is being offered again this year. The 15-year-old program is free to qualified high school sophomores and juniors.

Henry Mullish, the program's supervisor, said the unique aspect of the free non-credit program is that classes are taught by former students.

About 250 students usually apply for the computer program and 50 are accepted.

"Business Futures for Women" is being offered for the third year. The free two-week program for high school women features six field trips to places such as the New York Stock Exchange and large corporations, plus discussions with women in business.

News Photo by Neal Winzelberg

ID System Behind Schedule Because of 'Slow Turnout'

by DON BRODERICK

Distribution of new photo identification cards is behind schedule due to a "slow turnout of students," according to Identification Supervisor Jamie Leikauf.

Leikauf said she expected over 2000 I.D.s to have been processed last Monday, but only 1200 showed up by then. She expects there will be a "usual," in the last two ration in May.

Now however, Leikauf said anybody can be processed for a new card at any time. The original school divisions were intended to pace the flow of students, she said.

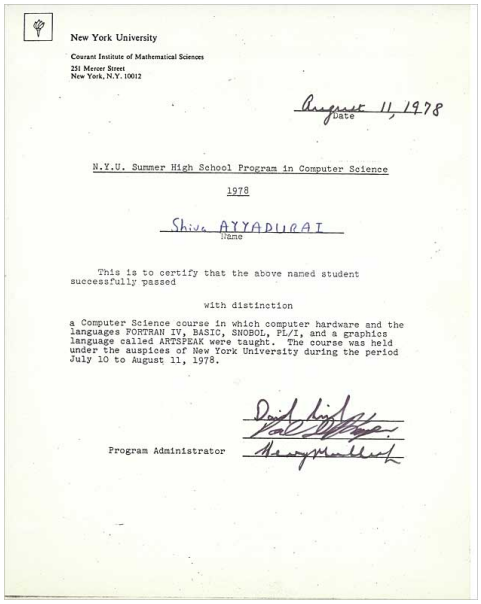
Students will receive their new cards immediately after having their photos taken. Processing is being held on the A-level of Bobst Library. Leikauf was unsure of where the photos would be taken

The Washington S

Handwritten note from Martin Feuerman to Meenakshi Ayyadurai
from Meenakshi Ayyadurai Estate (March, 1978)

Daily travel from New Jersey to New York City for a young teenager was not a normal occurrence. His mother drove him to Newark Penn Station in the early mornings, to catch the PATH trains to Manhattan. Shiva's schedule at NYU was intensive, typically from 8AM to 8PM. He graduated with Honors from the NYU program at the top of his class in the summer of 1978.

After Shiva completed the program, Feuerman and Ms. Ayyadurai introduced him to me. His mother said, "I've got a smart son." And, I thought to myself, every mother says that about her kid. But, the truth was this 14-year-old was really smart, in actuality, a prodigy.



New York University

Courant Institute of Mathematical Sciences
251 Mercer Street
New York, N.Y. 10012

August 11, 1978
Date

N.Y.U. Summer High School Program in Computer Science

1978

Shiva AYYADURAI
Name

This is to certify that the above named student successfully passed

with distinction

a Computer Science course in which computer hardware and the languages FORTRAN IV, BASIC, SNOBOL, PL/I, and a graphics language called ARTSPEAK were taught. The course was held under the auspices of New York University during the period July 10 to August 11, 1978.

Program Administrator

Formal Letter Certifying Shiva Ayyadurai's Honors Graduation from Computer Science Program at NYU. Now at Smithsonian National Museum of American History (NMAH).

Discussions with Shiva developed into an exciting diversion from the major focus of LCN's work. He was hired to work in the laboratory at UMDNJ with the official title, initially as a Research Scholar, (and later as a Research Fellow, paid $1.25 per hour). It was made clear to Shiva that he would be treated as every other employee, and professional behavior would be expected of him.

The hiring of a teenager was a first for UMDNJ at the time. The concept of a 14-year-old leaving Livingston High School (LHS) in the middle of the class day to travel to Newark was unconventional for the LHS school system. Shiva's independent study teacher, Ms. Stella Oleksiak worked with LCN leadership and petitioned Melvin Klein, the Superintendent of the Livingston School system, for approval. After significant lobbying by Ms. Oleksiak, the LHS school system agreed.

V. The Motivation for Email

At that time, a few were beginning to ponder the role minicomputers might play in general human interactions. The LCN staff was already familiar with simple interactivity between humans and machines. After all, much of the software being developed at LCN was to manage lab experiments that required this kind of interactivity. The LCN was also familiar with the methods and protocols by which computers could exchange messages with other similar types of computers. The minicomputers, used within the LCN, manufactured by the Hewlett Packard (HP) Corporation, were provisioned with subsystems that supported this type of communication.

Human interaction was mediated through teletypewriters and relatively primitive CRT-based display devices. Meanwhile, the interoffice mail system, the primary modality of workplace written communication and collaboration, remained in wide use at UMDNJ as it was everywhere else. Although beyond the scope of LCN's primary responsibility, there was an eagerness to explore the use of small computers beyond the sphere of numerical calculation and experiment control.

The notion of automating the entire interoffice, inter-organizational paper mail process was appealing for several reasons. It was a change that would benefit everybody, the mechanics of which, at least superficially, could be understood by anyone; automation could significantly reduce the timeframe of transactions; and,

there were multiple ways in which electronic automation could extend the utility of the interoffice memorandum.

As far as the LCN knew, no one else in 1978 had attempted to take on such a task.

So the creation of an electronic version of the interoffice, inter-organizational paper mail process became an object of LCN's attention and intention. Aware that Shiva was an exceptional student, he was offered what turned out to be one of most innovative (and fun) projects the LCN had ever to undertake. In return, it demanded that this fourteen-year-old teenager channel all of his energies into the project. It was made clear that he would be a full-fledged member of the LCN team, treated, as an adult, and that nothing less would be expected from him.

The lasting contribution of Shiva's work began with his systems analysis of the entire interoffice mail system that the LCN hoped would lead him to an implementation, beyond the mere automation of a manual process. In this regard, his mission was to develop a sustainable logical and functional framework that would add significant value and lead to further innovations over time.

Shiva's first task was to learn how the interoffice mail system was used at the UMDNJ. Who wrote them and to whom? What were all the functions they expected? What was their place in the hierarchy of written documentation? What was the sender's expectation of a reply? What volume of text could we anticipate? And, of

course, what could we do to improve the utility of this modality? Users surely would want more features. Could we be one step ahead of that demand?

Addressing and solving these questions were a genuine turning point in the history of communication – initially in business communication, but soon in a much larger universe. It was literally the invention of email, and a 14-year-old boy named Shiva Ayyadurai accomplished it in Newark, New Jersey, starting in 1978.

To provide some historical context, creating an electronic replica of the interoffice or inter-organizational mail system was of no interest to electronic messaging researchers of the Advanced Research Projects Agency Network (ARPANET) even as late as December 1977. In fact, ARPAnet experts, of the time, had concluded it was "impossible" to invent a full-scale electronic emulation of the interoffice mail system. Specifically, in the RAND Report, published on December 1977, which summarized the state of electronic messaging at the time, its author David Crocker -- a leading member of the Advanced Research Projects Agency Network (ARPANET) community – described the impossibility of creating such a system:

> *"…**no attempt** is being made to emulate a full-scale, inter-organizational mail system… The fact that the system is intended for use in various organizational contexts and by users of differing expertise makes it almost **impossible to build a system which responds to all users' needs**."*

Moreover, the ARPA brochure of 1978, and even the one of 1986 (eight years later) makes no reference to the word "email," "e-mail" or "Electronic Mail" in the brochure or the index of their brochure.

The ARPANET community was focused on methods of simple exchange text messages. For example, researchers such as Ray Tomlinson, known for the use of the '@' symbol, modified a pre-existing program SNDMSG, which was a local user command for appending text to a file, using borrowed code from CPYNET, a file transfer protocol, to allow a user on one computer to append text to a file on another computer. The user had to type in cryptic commands to make this happen. It was a rudimentary version of a networked "Post-It" note system, at best, for appending text messages on remote files, but not email.

The challenge to invent email, however, required Shiva to go far beyond simply creating a means to exchange basic text messages over the internal computer network. Instead, his challenge was to create an entire communications platform including a sophisticated database and workflow systems architecture. And this should be usable by anyone in the workplace – from upper level managers to entry-level office workers through an easy-to-use user interface. The goal was a fundamental transition from the world of typewriters and paper into a realm of pure electronic communication to replicate the entire *system* of interoffice mail. At the very least, this would be a full-fledged replacement for the long established and

seemingly indispensable interoffice mail system, and eventually it would be much more.

VI. The Invention of Email

As mentioned, at that time there was an internal computer network at UMDNJ, used mainly for business and healthcare data processing. It existed independently of any other networks, including the ARPANET

The components Shiva used to create email were:

1) computer hardware;

2) an operating system;

3) terminals and a keyboard;

4) a network;

5) a programming language; and,

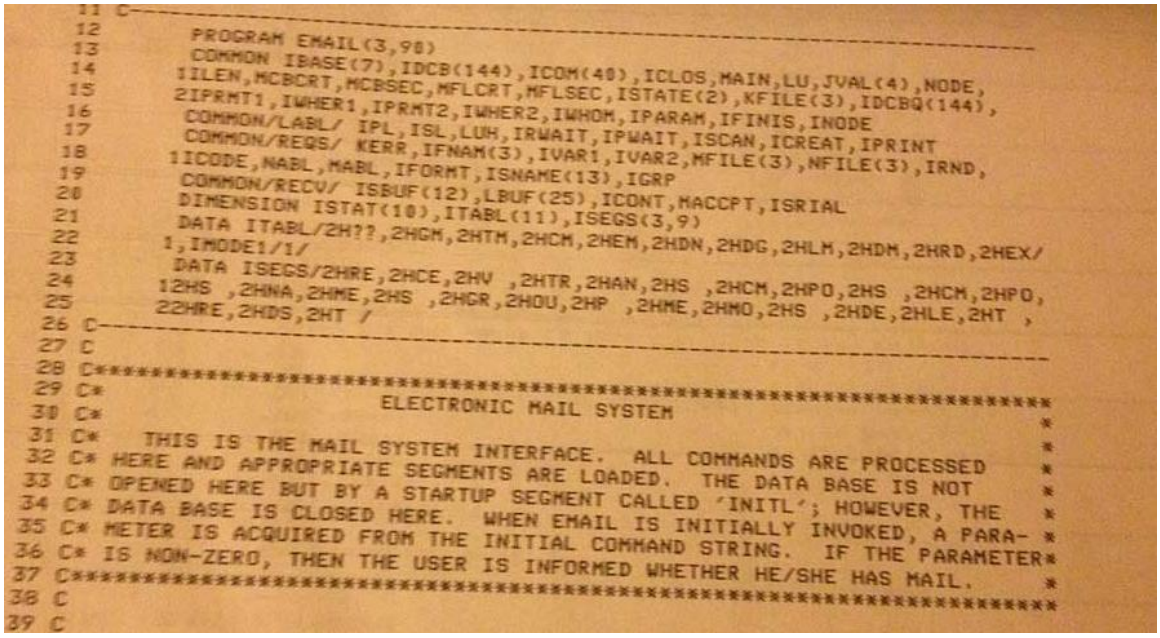
6) a database system.

The software tools at UMDNJ were relatively primitive compared to today. A FORTRAN IV compiler with restrictive variable naming conventions and lacking intrinsic file system access; a non-relational, hierarchical database management system; and a simple networking environment that permitted static routing among nodes in a predetermined mesh. These tools ran on the HP1000 platform, a real-time environment not particularly optimal for the kind of development we envisioned.

These impediments turned out to be of little consequence, but certainly upped the complexity of the programmer's task and by some measure, Shiva's accomplishment. In fact, the inflexibility of the development and execution environment turned out to be somewhat serendipitous. The project combined the attributes of both the interoffice memorandum and paper mail systems. The FORTRAN IV compiler limited variable names to six characters. Moreover, the RTE/IVB operating system running on our HP1000 computers limited process names to five characters.

Did we hear "EMAIL?" That five-character limitation resulted in Shiva creating the word "EMAIL" to name his system of computer programs – a word that was non-existent in 1978, and not so obvious.

By late 1978, the first version of email had been designed and implemented with a few users, and by 1979 hundreds of users across UMDNJ were using email. Shiva had written some nearly 50,000 lines of FORTRAN code across nearly 35 cooperating processes that communicated within a node and across the UMDNJ at LCN.



```
C-------------------------------------------------------------------------
      PROGRAM EMAIL(3,98)
      COMMON IBASE(7),IDCB(144),ICOM(40),ICLOS,MAIN,LU,JVAL(4),NODE,
     1ILEN,MCBCRT,MCBSEC,MFLCRT,MFLSEC,ISTATE(2),KFILE(3),IDCBQ(144),
     2IPRMT1,IWHER1,IPRMT2,IWHER2,IWHOM,IPARAM,IFINIS,INODE
      COMMON/LABL/ IPL,ISL,LUH,IRWAIT,IPWAIT,ISCAN,ICREAT,IPRINT
      COMMON/REQS/ KERR,IFNAM(3),IVAR1,IVAR2,MFILE(3),NFILE(3),IRND,
     1ICODE,NABL,MABL,IFORMT,ISNAME(13),IGRP
      COMMON/RECV/ ISBUF(12),LBUF(25),ICONT,MACCPT,ISRIAL
      DIMENSION ISTAT(10),ITABL(11),ISEGS(3,9)
      DATA ITABL/2H??,2HGM,2HTM,2HCM,2HEM,2HDN,2HDG,2HLM,2HDM,2HRD,2HEX/
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      DATA ISEGS/2HRE,2HCE,2HV ,2HTR,2HAN,2HS ,2HCM,2HPO,2HS ,2HCM,2HPO,
     12HS ,2HNA,2HME,2HS ,2HGR,2HOU,2HP ,2HME,2HMO,2HS ,2HDE,2HLE,2HT ,
     22HRE,2HDS,2HT /
C-------------------------------------------------------------------------
C
C**************************************************************************
C*                                                                        *
C*                      ELECTRONIC MAIL SYSTEM                            *
C*                                                                        *
C*    THIS IS THE MAIL SYSTEM INTERFACE.  ALL COMMANDS ARE PROCESSED      *
C* HERE AND APPROPRIATE SEGMENTS ARE LOADED.  THE DATA BASE IS NOT        *
C* OPENED HERE BUT BY A STARTUP SEGMENT CALLED 'INITL'; HOWEVER, THE      *
C* DATA BASE IS CLOSED HERE.  WHEN EMAIL IS INITIALLY INVOKED, A PARA-    *
C* METER IS ACQUIRED FROM THE INITIAL COMMAND STRING.  IF THE PARAMETER   *
C* IS NON-ZERO, THEN THE USER IS INFORMED WHETHER HE/SHE HAS MAIL.        *
C**************************************************************************
C
C
```

First page of the computer program showing Shiva's naming the program "email," thus defining email to be the electronic interoffice mail system (c. 1978), now at the Smithsonian National Museum of American History (NMAH).

On a formal launch day, the LCN called a seminar and filled a large lecture hall at the New Jersey Medical School with technical staff and other parties that were fascinated by the work Shiva had done. Here were all of these people: IT professionals, administrators, academicians, medical students, family and friends to learn what Shiva had done. Multiple screens and white boards filled with charts, "screen shots" and flow diagrams kept everyone's attention, but the most astounding aspect was that the presenter was not a distinguished scientist or clinician from UMDNJ or some other vaunted institution, but rather a kid with a fascinating story of ingenuity and determination.

The new service, email, was electronic and it combined many if not all of the characteristics of paper mail. Email moved the secretary's desktop which forced

her to be tied to a physical office and desk to, what we now call the, “cloud.” Her desktop became virtual and she could access it from anywhere as long as she could connect to any one of the three minicomputers on the network.

Shiva was the author of the entire EMAIL program code and system. The environment that fostered such innovation and development was an environment of collaboration and teamwork, in the heart of Newark, New Jersey. Such interaction expanded his Livingston High School educational experience not only to become an adept software programmer but also, to evolve his leadership skills, in becoming an engineering professional, which were an important foundation for his continued success as a scientist and inventor.

His interactions, for example, with Robert Field, a systems programmer, who was very proficient in FORTRAN and database systems, for example, provided him critical insights to overcome many of the memory limitations and constraints of the RTE-IVB operating system. The late Phil Goldstein, who was an early innovator in the educational use of time-sharing systems, and nearly 50 years his senior, provided all of us an example of a scientist-programmer, who worked in a disciplined and methodical manner to solve complex problems.

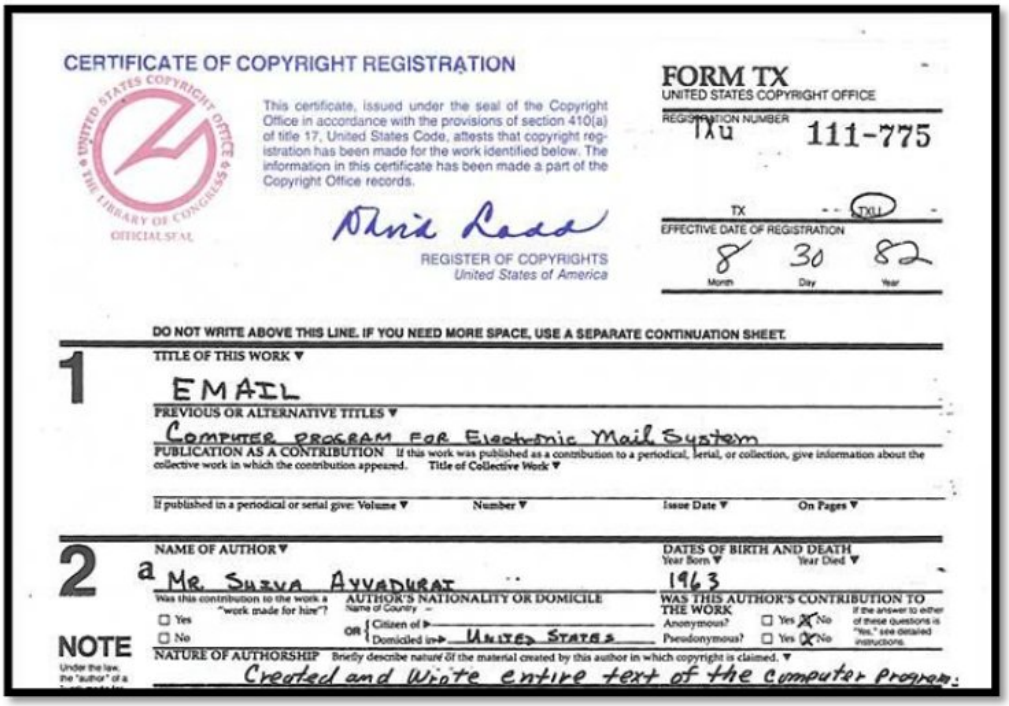
Shiva’s discussions with Dave Ritacco, a wunderkind studying engineering at the Stevens Technical Institute, who began working with our laboratory to develop user interfaces for graphics systems, predecessor to modern day presentation graphics

products such as PowerPoint, provided Shiva insights on how to evolve EMAIL's user interface to address end user needs. Marilyn Bodow and Tina Brezenoff, statistical programmers in our group, were Shiva's early Beta users, and provided him critical feedback on the EMAIL User's Manual --- documentation necessary to train others at UMDNJ in using the first email system. They setup a wonderful training room to teach and educate hundreds of other personnel on the use of email.

VII. Formal Recognition for Email's Invention

The invention of email did not go unnoticed. Shiva won one of the prestigious Westinghouse Science Talent Honors Awards (today know as the Intel Awards) for his invention, and was lauded by various letters including from New Jersey's U.S. Senator. He received some local news recognition.

More importantly, he was officially recognized as email's inventor by the United States government. An important point needs to be made here concerning the United States laws for invention at the time. At the time of Shiva's invention in 1978, there were no laws for intellectual property protection of software: neither patents nor copyright allowed protection of software inventions. The U.S. Supreme Court was not recognizing software patents in 1978. Only in 1994 (sixteen years after email's invention) did the Federal Court of Appeals recognize software as a "digital machine" and allow it to be patented.



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If published in a periodical or serial give: Volume ▼ Number ▼ Issue Date ▼ On Pages ▼

2 NAME OF AUTHOR ▼
a Mr. Suzva Ayyadurai
DATES OF BIRTH AND DEATH
Year Born ▼ 1963 Year Died ▼
Was this contribution to the work a "work made for hire"? ☐ Yes ☐ No
AUTHOR'S NATIONALITY OR DOMICILE Name of Country
OR Citizen of ▶ Domiciled in ▶ United States
WAS THIS AUTHOR'S CONTRIBUTION TO THE WORK Anonymous? ☐ Yes ☒ No Pseudonymous? ☐ Yes ☒ No
If the answer to either of these questions is "Yes," see detailed instructions.
NATURE OF AUTHORSHIP Briefly describe nature of the material created by this author in which copyright is claimed. ▼
Created and Wrote entire text of the Computer Program.

NOTE Under the law, the "author" of a

Official US Copyright Notice for “Email” Issued on August 30, 1982, now, in the Smithsonian Institution National Museum of American History (NMAH).

The Copyright Act of 1976 did not allow for the copyrighting of software. In 1980, however, this Act was amended to become the Computer Software Act of 1980, enabling software inventors to use Copyright to protect software inventions. Only after Shiva attended MIT in 1981 and after meeting with then MIT President Paul E. Gray did he receive some fortuitous advice to apply for a U.S. Copyright to protect the invention.

On August 30, 1982, Shiva received the first U.S. Copyright for “Email,” officially recognizing him as the inventor of email. Had lawmakers in Washington, DC and public policy been in step with software innovation in 1978 and had patents been

allowed to protect the creation of a young 14-year-old immigrant inventor, beyond receiving recognition as email's inventor, he would likely have benefitted economically in an enormous way. Regardless, the rest became history. What is also another important to emphasize concerning the invention history is that there is no doubt, given the historical advances in office automation and computing, someone would have invented email (perhaps calling it something else). However, the fact remains, a 14-year-old teenager working in Newark, New Jersey was the first to do it.

VIII. The Triumph of Email

As it turned out, the great accomplishments of contemporary email – the triumphs of email, if you will – are multifaceted. First, it really does duplicate or exceed all the capabilities of the interoffice mail system. An original document in the form of a digital file can be circulated to one recipient or to hundreds, edited, commented upon, downloaded, printed, or even deleted. Moreover, the almost simultaneous nature of these functions – the fact that they can happen virtually at once, in real time, with many participants – means that email can be a truly collaborative medium.

Grant applications, for example, which frequently go through many versions, can be collaboratively executed in a time frame infinitely shorter than would be possible using hard copy documents. Manuscripts can be edited and circulated in hours

instead of weeks. Contracts can be negotiated and signed. We take these things for granted now, but not long ago they were beyond imagining.

It's true, as aforementioned, ARPANET researchers and other were experimenting with rudimentary digital communications in the 1970s. These methods were developed for the military, for instance – but it was one dimensional, hierarchical, and technically demanding. It was a limited and esoteric communications medium. In contrast, email is simple, collaborative, and egalitarian. A military officer sending a terse one-on-one electronic command is very different from an executive's message inviting comments and collaboration from other executives, or even from everyone in the company. In this sense email has been not just a technical advance but also a profound social innovation, an innovation that ultimately became the gateway, introducing the general public to the digital age. Email turned out to be a "killer app."

IX. Email: An Urban Innovation

The history of innovation in the field of electronic messaging is long and rich, dating back to the Morse code of the 1800s. There is much credit to spread around the vast community of academic, industrial and military researchers and engineers who eclipsed the industrial revolution with their contributions to computer science and computer and network engineering. No credit should be taken where it is not due.

The LCN, however, can stand firmly for email --- the innovation that took place at a health sciences institution, for what some may think an unlikely venue for this kind of work. However, in many ways, perhaps even retrospectively, it makes sense why email, a system for collaboration, would emerge from a health sciences institution where collaboration, cooperation, and collegiality within an ecosystem of "users of differing expertise" are necessary ingredients in accomplishing various day-to-day business as well as research-oriented tasks.

Email had emerged from a unique collaboration, but not from the typical ingredients for innovation, much focused on by many businesses experts today, such as the triangle of big universities, military and large companies. Instead, email was developed within a very different ecosystem: dedicated teachers from the Livingston High School public school system, a passionate group of collegial professionals who Shiva was lucky enough to work with at UMDNJ, and a caring Indian-American immigrant family, who inspired hard work and commitment.

The incentive was not fame nor fortune, but rather a challenge that arose from a shared experience and desire to take on a challenge, which placed faith on the resources of a 14-year-old student from Livingston, New Jersey, who was disciplined and found a way to come to Newark, New Jersey to work.

There is a larger story here, one that should be evident by now. Innovation can happen anywhere, anytime by anyone. The sooner we embrace this truth, the

sooner our lives will be enriched by the thousands of other “Shivas” that do not have the luxury of working in the established bastions of innovation, but nevertheless have the intellect and drive to make big contributions.

X. Acknowledgements

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