History and background of SRI ARC and NIC
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In the mid-1960s computers were large in size and small in capacity and were very expensive to purchase. They were usually located in computer centers, were operated by a cadre of specially trained personnel, and were complex to operate. Users at the time were primarily scientists or business users. They submitted “jobs” to the computer center by way of a stack of punched cards, which were then fed into the computer through a card reader. Programming was done in assembly language or in one of the standard programming languages of the time – Fortran, Algol, and Cobol. In general, only programmers had direct access to computers. Users received output as fan-fold paper printouts from a printer attached to the computer. Users rarely touched the computer itself, as it took knowledgeable and trained personnel to run one.

Networking at this time was in its infancy, and to the extent that it existed at all, consisted primarily of direct-access telephone lines or terminal-to-computer dial-up access via a modem. This access permitted the user to “time-share” a large computer, i.e., for a given amount of money or assigned permission, a user was allotted a share or “pie-slice” of a large computer. This shared the cost of the computer, and used its available cycles more efficiently. It also allowed a user to access a computer from a remote location. Early timesharing was often used to access or update large, centrally-maintained data bases, as well as to do individual work Machines were crowded and access was slow, expensive, and unreliable.

The nation was in the midst of the Cold War – a time after World War II when we were not officially at war, but were in an adversarial clash with the USSR, Communist China, and other communist countries. There was great research emphasis on nuclear physics and space exploration. Government laboratories engaged in nuclear physics research, had large computers and computing centers associated with them to assist with this research. The government was interested in ways to make these computers more readily available to researchers not located at such a facility, such as graduate students, government contractors, and the like. There was also great interest in intelligence, as well as a space race going on. During the 1960s, the country became mired in the Vietnam War.

All of these activities were computer intensive. Although many universities had computer centers, few had a computer science curriculum. Most basic research and much applied research were funded by the government. It was common for universities to have research grants or contracts from several branches of the government - particularly from the Department of Defense or from agencies whose efforts were related to the cold war and defense.

When the Soviets surprised the world in 1957 by launching Sputnik, then President Dwight Eisenhower established an agency called the Defense Advanced Research Projects agency (DARPA) as part of the Department of Defense (DoD). DARPA was to lead the nation in innovative research especially applicable to national defense. At first DARPA dealt with the space race, but over time evolved into several basic research activities, one of which was command, control, and communications (CCC). In 1962 DARPA created the Information Processing Techniques Office (IPTO) that became a major driving force in the evolution of information technology in the United States until 1986 when IPTO was disbanded. IPTO, as part of the CCC effort at DARPA, was also

instrumental in establishing and funding innovations in computers and networking – particularly development of the Arpanet that eventually evolved into the Internet we all use today.

In the early days of IPTO, several people were instrumental in supporting great strides in information technology, artificial intelligence, and computer communications. Foremost among these were: J.C.R. Licklider, Robert Taylor, Larry Roberts, Craig Fields, Barry Leiner, Vinton Cerf, Steven Crocker, and Robert Kahn. All of these men, as well as many others, wanted to fund and encourage cutting-edge research in information technology and computer communication.

Not long after DARPA was founded, a researcher named Paul Baran, at Rand Corporation, came up with an innovative idea for networking that was more secure, robust, and reliable than existing network technology. It was called "packet switching." At the same time the Univ. of Hawaii was implementing packet radio technology, a similar technology using radio communication; and European labs were also pursuing packet-switching approaches.

DARPA was very interested in funding research in these technologies because packet switching looked to be more reliable and faster than existing network technologies. DARPA selected several universities and research establishments to use the packet-switching technology to build a packet-switched research network called the Arpanet. The first four of these sites were: The University of California at Los Angeles (UCLA), Stanford Research Institute (SRI) in Menlo Park, CA, the University of California at Santa Barbara (UCSB), and the University of Utah (UTAH). The idea was to use the Arpanet to test packet switching as a concept, and at the same time to connect several universities and research centers together. Originally, each center was to share it's particular resources with other members of the network, i.e., the Arpanet was to be a "resource sharing" network.

Dr. Douglas Engelbart, who joined Stanford Research Institute (SRI) as a research engineer in 1957, had built and demonstrated a unique computer system he called NLS. He and his team made up SRI's Augmentation Research Center (SRI ARC). The NLS system allowed a "knowledge worker" to interact with a computer in a way that was truly unique at the time, and was the forerunner of today's office automation and personal computing. Using NLS, the user sat in front of a television monitor and could interact directly with a computer to do everything from text editing, sending email, programming, debugging, and hypertext journaling (among others). SRI ARC had also built an online and hardcopy library of networking and related documents. The online document system was a subsystem, embedded within the NLS system, called the ARC Journal. Note: Almost no documents existed online at this time, and no File Transfer Protocol (FTP) or email protocols existed. DARPA was interested in putting the NLS system on the Arpanet as one of the services users could access, including making the ARC Journal available to users.

There is a great deal of confusion concerning the name "Stanford Research Institute" because SRI is not a part of Stanford University. In the very early days, the two institutions had the same board of directors. In 1971, SRI severed even that tie with Stanford University and changed its name to SRI International. Today there are no formal ties between the two organizations, although there are many informal ones. SRI International (formerly Stanford Research Institute) is an independent, not-for-profit

research organization located in Menlo Park, CA, whereas Stanford University is located in Stanford, CA.

As the Arpanet evolved, two main user service centers were created on it. One was the Network Control Center (NOC), located at Bolt, Beranek and Newman Inc. (BBN) in Boston; MA and the other was the Network Information Center (NIC) located at SRI in Menlo Park, CA. Both of these service centers were initially funded by DARPA contracts, and later by the Defense Communications Agency (DCA) contracts.

In the beginning, the BBN NOC was responsible for the network node equipment interface message processors (IMPs), and the overall operation of the Arpanet. The SRI NIC provided network information services to users, and coordinated the distribution of information needed for doing network research and development. Both companies were also involved in the building and development of the network itself.

As mentioned above, Dr. Engelbart had amassed a large private collection of offline documents while building the NLS system. This collection became the hardcopy holdings of the NIC, and it was referred to as XDOC. The NLS system also had the online Journal system embedded within it, which allowed users to submit, transmit, and retrieve documents online – very innovative at the time.

NLS was built by SRI under NASA and DARPA contracts. It was then further tested by adding users at various military facilities, such as Rome Air Development Center (RADC) at Griffith Air Force Base in Rome, New York, the Ballistics Research Lab. (BRL) at Aberdeen Proving Ground, Md., and the Army Materiel Command (AMC) at Ft. Belvoir, VA, as well as DARPA headquarters. These facilities acted as military test-beds for the new technology and, along with the SRI researchers, made up the bulk of the NLS user community.

In 1973, operation of the Arpanet was turned over to the DCA. DARPA still maintained administrative control over the research projects being carried out on the Arpanet by its many contractors; however, it was no longer responsible for Arpanet operations.

SRI sold the NLS system to Tymshare Corp. in 1977. Engelbart and many of his staff working on the NLS system left SRI to join Tymshare. At that time the name of Engelbart's system was changed from NLS to Augment. Feinler and the NIC (by this time a separate project funded by DCA) stayed at SRI to continue offering information services to the Arpanet and the DDN Internet.

A new suite of protocols was developed as part of the networking research carried out on the Arpanet. The two new basic protocols were known as the Transmission Control Protocol (TCP) and the Internet Protocol (IP). In 1982, the DoD selected the TCP/IP protocols as military standards for its operational military networks, and at that time all of the operational military networks were bundled under one "umbrella" network called the Defense Data Network (DDN). The Arpanet was split into two unclassified segments – the Arpanet and the Milnet. Each then became one segment of the DDN. The DDN was made up of five segments – Arpanet, Milnet, Minet, Sacdin, and TS/SCI. What these networks had in common was that they were all using the packet-switching technology and protocols developed by DARPA researchers; all network segments were under DCA operational control, and they were all DoD networks. Several other non-DoD government networks, such as those of NSF, NASA, and NBS, had also adopted the

same protocol suite; and all were interconnected into one large Internet. This Internet was still funded by the government and was not a commercial network. However, in the early 1990s commercial traffic, controlled by gateways, was allowed onto the Internet, and the Worldwide Web was developed, and the network soon exploded into the worldwide Internet service we all use today.

The NIC project at SRI lasted from 1970 until 1991. Funding for the NIC project initially came from DARPA; but after 1974, funding came from DCA. The initial mandate of the NIC was to service the users of the Arpanet. As the network expanded to become the DDN, the NIC serviced all segments of the DDN and its contractors. SRI NIC was the original NIC. As such it functioned as a kind of "NIC of NICs" by providing information to other network information centers on various other networks, such as NSFnet, the NASA Science Internet, CSnet, and others. The SRI NIC was a forerunner of the network search services we are all using today, and was kind of the "prehistoric Google" service of its day.

In the beginning the NIC provided information to users mostly as hardcopy documents, as very few items were then created online or were available online. Documents at the time were written on typewriters and were typeset for publication. In its first years (1970-72), the NIC distributed upwards of 80,000 hardcopy documents to users.

Originally, the NIC project provided users with network access to NLS, and the NIC used NLS to provide its services to users. However, computers then had little capacity, and users had to log in to the SRI-ARC computer to use NLS. In addition, users needed NLS training. As the network expanded, the ARC/NIC host computer was overwhelmed by users trying to access it; consequently, the NIC services evolved into services provided by network servers, wherein the user did not have to have much computer experience or an account on the NIC machine to use the services. Features like the file transfer protocol (FTP) and email, made it easier to provide information services by other means - usually by dedicated information servers such as WHOIS.

NIC services split between hardcopy distribution and online distribution, and this continued until the project ended in 1991. However, over time the balance tipped from hardcopy to online distribution. The NIC also maintained an 800 information telephone "hotline" service throughout its existence.

Feinler left SRI in 1989. She was replaced as NIC PI, first by Dr. Franklin Kuo, and finally by Dr. Jose Garcia Luna Aceves. The NIC project left SRI in 1992, when the contract was competed and went to a consortium composed of AT&T, Network Solutions, Inc. (NSI), and the University of California at San Diego (UCSD). It's former services were split among these three organizations. Feinler joined Sterling Software, a NASA contractor providing the NASA Science Internet for NASA users, and located at NASA Ames Research Center in Mountain View, CA. Several of the former SRI NIC staff joined Feinler at NASA Ames to assist with running the NASA Science Internet NIC and the NASA Globe NIC. Dr. Garcia Luna Aceves became a professor at the University of California at Santa Cruz. Dr. Kuo remained at SRI until he retired.

McDonnell Douglas bought out Tymshare Corp. in 1984; who, in turn, sold rights to Augment to Bell Northern of Canada. Dr. Engelbart left McDonnell Douglas in 1989 and began the Bootstrap Institute jointly with his daughter, Christina Engelbart. The Bootstrap Institute, located initially at Logitech in Fremont, CA., then became the

Bootstrap Alliance. Dr. Engelbart returned to SRI as Senior Technical Advisor Emeritus. In 2008 the Bootstrap Alliance changed its name to the Douglas Engelbart Institute (DEI). His daughter, Christina Engelbart, is now Executive Director of DEI, and Dr. Engelbart was named Founder Emeritus. For further detail on Dr. Engelbart and DEI see www.sri.com and http://www.dougengelbart.org/history/engelbart.html

Today (2011), NIC type services have largely been replaced by Google-type search services built upon the World Wide Web. More and more documents, as well as indexes to them, are now produced online and are accessible online. Hypertext creates the underpinning for the web. Large machines have been replaced by smaller and smaller computers or hand-held devices. Gigabytes and terabytes of storage have replaced kilobytes; and are available on chips that one can hold in the palm of one's hand or on a fingertip. Naming and addressing on the Internet has become a multimillion-dollar business. Networks and networking software are almost all commercial off the shelf (COTS) products. The Internet is still running TCP/IP protocols, and the IETF has evolved into a bona fide standards body as part of the Internet Society (ISOC) function.