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# ***The Evolution of the Internet***

## **Introduction**

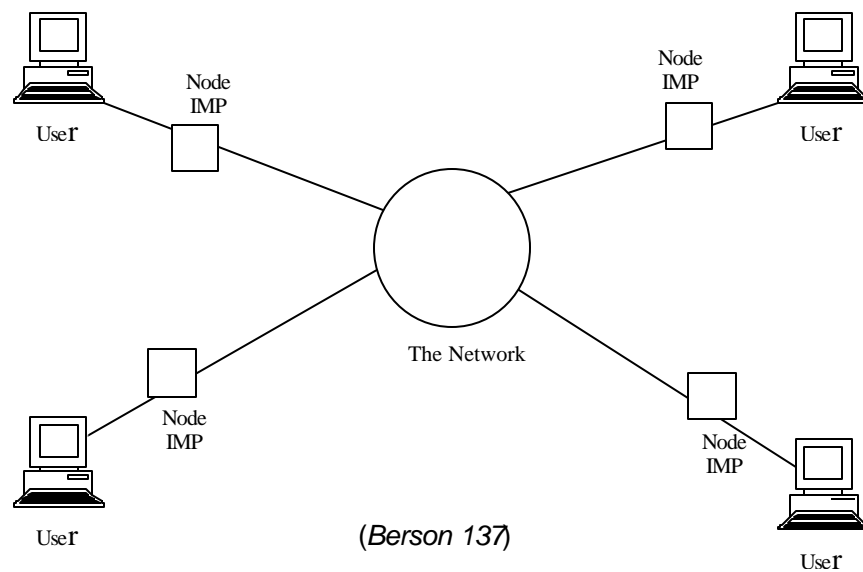
The Internet has had a radical effect on the computer world like no other technology before. The Internet today has the capability of worldwide distribution, a means for information distribution, and a medium for teamwork and interaction between individuals and their computers without regard for geographic location. The Internet is a valuable tool we use today without any regards to how it was invented and developed and through this research paper I hope the reader will get a better understanding of its importance and value. The internet has help us drastically in the way we communicate, gather information, and even at times in the way we conduct business. The Internet is one of the most successful and valuable results of research, development, and dedication of information, and technology. Its groundwork started with the early research in packet switching. The government, and the computer industry have been partners in developing this new and valuable technology as well. The Internet today is a widespread information infrastructure that has no limits and no boundaries. Its influence and affects reaches not only to the technical field of computer communications but throughout society as we move toward increasing use of the Internet to accomplish information gathering, electronic commerce, and personal communication. This research paper will discuss how there was a need for the Internet at first and then it will discuss the many components of the Internet and how they were developed and by whom.

## ARPA and The Internet

The military wanted a way to secure a network of communication between its command and control centers within the United States in an event of a nuclear attack on its land. The military had a centralized system of communication with its armed forces. This gave the enemy the ability to strike one main point of communication and all means of communication would fail leaving them vulnerable to defeat. The military needed a decentralized method of communication, which would give the military the ability to communicate during a time of war even if some communication site were hit. This would allow the President of The United States to command his forces to either shoot or stop shooting during a nuclear war (*Naughton 97*). By 1962 Paul Baran and his colleagues at the RAND Corporation produced 13 reports of which only 11 of them were published, initiated a study to build a national network that could survive a nuclear attack. Baran and his colleagues all came up with the conclusion that “Distributed Adaptive Message Block Switching”, which is now called Packet Switching, is just what the government needed (*Salus 6*). **Packet Switching** is the process of taking individual messages and breaking them down into packets of data and sending them separately over the network. Then they are reassembled at their destination. This process usually takes only a fraction of a second (*Brand 146*).

In 1966, Lawrence G. Roberts who was a researcher at MIT went to DARPA (**D**efense **A**dvanced **R**esearch **P**rojects **A**gency) to develop a computer network for the **D**epartment of **D**efense (DOD). This network was

later called "ARPANET" (*Naughton 99*). In 1968, after Roberts and the DARPA funded a community that redefined the overall structure and specifications for the ARPANET, DARPA agreed to the development of one of the key components, the Interface Message Processors (IMP). The IMP was a node, which is basically a point of connection on a network this is where a message is taken from the network and routed to the proper user (please look at the following diagram).



A group headed by Frank Heart at Bolt Beranek and Newman (BBN) received a contract from DARPA and in December 1968 the BBN team worked on the IMP. Roberts network topology was designed and optimized by working with Howard Frank and his team at Network Analysis Corporation (NAC). Leonard Kleinrock's team at UCLA prepared the network measurement system. Due to Kleinrock's early involvement in the packet switching, his Network Measurement Center at UCLA was selected to be the first node on the ARPANET (*Naughton 138*). All this came together in September 1969, when BBN installed the first node, which was the IMP at UCLA, and the first host

computer was connected. A month later, when SRI was connected to the ARPANET, the first host-to-host message was sent from Kleinrock's laboratory to SRI (*Naughton 139*). Two more nodes were added, at UC Santa Barbara and University of Utah, later on. These last two nodes incorporated application visualization projects, with Glen Culler and Burton Fried at UCSB investigating methods for display of mathematical functions using storage displays to deal with the problem of refresh over the net, and Robert Taylor and Ivan Sutherland investigated 3-D representations over the net (*Roberts 49*). By 1969 four more host computers were connected to the ARPANET, and the Internet was launched afterwards. Computers were later on added to the ARPANET during the following years which caused a growth in the number of computers on the ARPANET. Later, work proceeded on completing a Host-to-Host protocol and other network software. This was a great contribution to research because it linked professors and researchers together without any geographic limitations and as result it became a valuable tool in distributing information.

The ARPANET grew and developed and became the Internet. Internet was based on the idea that there would be multiple independent networks of rather random design, beginning with the ARPANET as the pioneering packet switching network, but soon to include packet satellite networks, ground-based packet radio networks and other networks. The Internet, as we now know it, contains a key technical element, which is open architecture networking (*Mischa 48*). This basically means that the choice of any individual network technology was not dictated by particular network architecture, but rather could be selected by a provider and made to work together with other

networks. Up until that time, there was only one general method for federating networks and that was the traditional circuit switching method (*Naughton 142*). Circuit switching, basically means that an end-to-end circuit must be set up before the connection begins. A fixed share of network resources is reserved for one call, and no other call can use those resources until the original connection is closed. Packet switching on the other hand permits "statistical multiplexing" which means that packets from many different sources can share a line, allowing for a very efficient use of fixed capacity (*Mischa 45*).

In an open-architecture network, the individual networks may be separately designed and developed and each may have its own unique interface that it may offer to users and/or other providers including other Internet providers (*Berners-Lee 122*). A network can be designed in accordance with the specific environment and user requirements of that network. There was generally no one-way of network that can be included or on their geographic scope, but there will be constraints that will be placed on the network and must be addressed accordingly.

## **The TCP/IP**

Robert Kahn who was originally a professor at MIT was the first to introduce the idea of open-architecture networking while working at DARPA in 1972. This work was originally part of the packet radio program, but subsequently became a separate program in its own right. Kahn first wanted to develop a protocol for a local packet radio network, since that would avoid having to deal with the multitude of different operating systems, and

continuing to use NCP **N**etwork **C**ontrol **P**rotocol. However, NCP did not have the ability to address networks further downstream than a destination IMP on the ARPANET and thus some change to NCP would also be required (*Naughton 157*). ARPANET provided end-to-end reliability, which NCP relied on. If any packets were lost, the protocol would come to a halt. In this model, NCP had no end-to-end host error control, since the ARPANET was to be the only network in existence and it would be so reliable that no error control would be required on the part of the hosts.



**Bob Kahn**

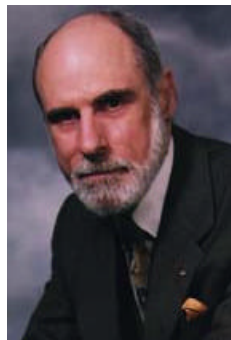
Courtesy of (<http://www.cnri.reston.va.us/bios/kahn.html>)

Thus, Kahn decided to develop a new version of the protocol, which could meet the needs of an open-architecture network environment. This protocol would eventually be called the **T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol (TCP/IP). TCP/IP is the protocol that enables the Internet to work by linking thousands of different networks into one network. TCP is basically responsible for the sending and receiving of messages. IP governs the computer's address on the Internet and routes the message to the proper user (*Cintron 37*). NCP intended to act like a device driver; the new protocol would be more like a communications protocol (*Naughton 312*).

Kahn identified four major characteristics for the network:

1. Each network would have to stand on its own and no internal changes could be required to any such network to connect it to the Internet.
2. There would be no global control at the operations level on the network.
3. If a packet didn't make it, it would be retransmitted from the source.
4. Gateways and routers would be used to connect the networks  
(*Naughton 166*).

Kahn realized that it would be necessary to learn the details of each operating system to have a chance to embed any new efficient protocols. In the spring of 1973, Kahn convinced Vint Cerf a professor at Stanford to work with him on the protocol. Cerf had been very much involved in the original NCP design and development. With Kahn's architectural approach to communications and with Cerf's NCP experience, Cerf-Kahn developed the necessary protocols that became known later on as TCP/IP (*Naughton 163*).



**Vint Cerf**

Courtesy of (<http://www.technos.net/journal/volume7/2cerf.htm>)

The original Cerf-Kahn papers that were first published in 1974 on the Internet described one protocol, called TCP, which provided all the transport and forwarding services in the Internet (*Salus 102*). Kahn had intended that the TCP protocol support a range of transport services, from the totally reliable sequenced delivery of data, to a data gram service in which the application made direct use of the underlying network service, which might imply infrequent lost, corrupted or reordered packets. However, the initial effort to implement TCP resulted in a version that only allowed for virtual circuits. This model worked fine for file transfer and remote login applications, but some of the early work on advanced network applications, in particular packet voice in the 1970s, made clear that in some cases packet losses should not be corrected by TCP, but should be left to the application to deal with. The Cerf-Khan research was a great success but it was not enough to enable reliable communications between different networks. It took six more years to develop a more reliable way to communicate over different networks (*Naughton 164*). This led to a reorganization of the original TCP into two protocols, the simple IP, which provided only for addressing and forwarding of individual packets, and the separate TCP, which deals with service features such as flow control and recovery of lost packets.

A major initial motivation for both the ARPANET and the Internet was resource sharing which would allow users on the packet radio networks to access the time-sharing systems attached to the ARPANET.

*“Time-sharing which is a method of operating large computers, which enables many people a few milliseconds of computing time, but by cycling quickly and continuously between users gives each the illusion of having the machine to him/herself” (Naughton 312).*

Connecting the two together was far more economical than duplicating these very expensive computers. To connect to a computer and using its capabilities which the other computer lacks in is far more economical than purchasing a new computer with the needed capabilities. However, while file transfer and remote login (TELNET, which enables a user to log on to a remote machine over the internet and use its services and capabilities) were very important applications, electronic mail has probably had the most significant impact of the innovations from that era (*Mischa 124*). E-mail provided a new model of how people could communicate with each other, and changed the nature of collaboration, first in the building of the Internet itself and later for much of society.

The early uses of TCP were for large timesharing systems. By the time desktop computers first appeared, it was thought by some, that TCP was too big and complex to run on a personal computer. David Clark and his research group at MIT set out to show that a compact and simple implementation of TCP was possible (*Naughton 179*). They produced an implementation, first for the Xerox Alto (the early personal workstation developed at Xerox PARC) and then for the IBM PC. That implementation was fully interoperable with other TCP's, but was tailored to the application suite and performance objectives of the personal computer, and showed that workstations, as well as

large time-sharing systems, could be a part of the Internet. In 1976, Leonard Kleinrock published the first book on the ARPANET. It included a discussion on the importance of the complexity of protocols and the pitfalls they often introduce.

Widespread development of LANS, PCs and workstations in the 1980s allowed the blossoming Internet to flourish. Ethernet technology, developed by Bob Metcalfe at Xerox PARC in 1973, is now probably the dominant network technology in the Internet and PCs and workstations the dominant computers (*Naughton 310*). This change from having a few networks with a modest number of time-shared hosts (the original ARPANET model) to having many networks has resulted in a number of new concepts and changes to the initial technology. First, it resulted in the definition of three network classes (**A**, **B**, and **C**) to accommodate the range of networks. **Class A** represented large national scale network, which basically contained 16, 777,214 hosts. **Class B**, which is a regional scale, networks which contained 65,534 hosts. Finally **Class C** represented local area networks, which contained 254hosts (*Kleinrock 132*)(*Salus 172*).

## The Domain Name

As a result of the increase in scale of the Internet and its associated management issues there was a major shift in the Internet protocols. To make it easy for people to use the network, hosts were given names, so that it was not necessary to remember the numeric addresses. Originally, there were a fairly limited number of hosts, so it was feasible to maintain a single table of all the hosts and their associated names and addresses. The shift to having a

large number of independently managed networks meant that having a single table of hosts was no longer feasible, and Paul Mockapetris and Jon Postel of ISI and BBN invented the **Domain Name System (DNS)** in 1983 (*Hafner & Lyon 252*). DNS permitted a scalable way for resolving hierarchical host names into an Internet address. In 1985 pressured people to use DNS and in 1986 there was a summit that took place on the West Coast where a number of people that represented the major networks agreed to use DNS (*Hafner & Lyon 253*).

## **Internet Software**

As the Internet evolved, one of the major challenges was how to transmit the changes to the software, mainly the host software. DARPA supported UC Berkeley to investigate modifications to the UNIX operating system, including incorporating TCP/IP developed at BBN. Although Berkeley later rewrote the BBN code to more efficiently fit into the UNIX system (which was developed at AT&T Bell Laboratories in 1969) (*Hafner & Lyon 250*). The integration of TCP/IP into the UNIX system releases proved to be a critical element in dispersion of the protocols to the research community. Much of the CS research community began to use UNIX for their day-to-day computing environment.

Programmers preferred to use UNIX for two major reasons and they are as following:

1. Its flexibility, which allowed them to use it any computer without any drastic changes on the system.

2. The second major reason was the fact that it was portable which allowed them to use it on any system they wanted.

*(Hafner & Lyon 250)*

Looking back, the strategy of incorporating Internet protocols into a supported operating system for the research community was one of the key elements in the successful widespread adoption of the Internet (*Hafner & Lyon 251*).

There was other valuable software that also had a great impact on the Internet and that software was the basic Host-Host software, which made communication between users much easier. The first TCP software was made possible in 1974, which was built for the IMP (*Salus 39*). The characteristics of this software is as follows:

- It was a real-time interrupt-driven program
- Written in assembly language and had the ability to define macro instructions
- Real-time interrupt-handling capacities were calculated based on maximum line speed and message and packet processing requirements (*Salus 39*)

The host-host communication software allowed the user to communicate with other users, which bring us to electronic mail.

## The E-Mail

One major aspect of today's Internet use is the simple E-mail. Today we use it to send personal and professional letters back and forth. This technology we use almost on a daily basis was not around forever it had its origin in history. It all began in 1970 as the **Network Working Group (NWG)** finished the first ARPANET Host-to-Host protocol, which was the NCP. As the ARPANET sites completed implementing NCP. A year later the network users began to develop applications for this network (*Roberts 53*). In 1972 the first electronic mail which was called (NETMAIL) when Ray Tomlinson who used to work at BBN wrote the basic e-mail message send-and-read software, which was an easy coordination mechanism that would basically give the user the ability to fill out certain fields on the email letter and send it (*Salus 95*). In 1973, Roberts expanded the e-mail by writing the first e-mail utility program to list, selectively read, file, forward, and respond to messages. As a result, e-mail took off as the largest network application for over ten years. In 1973 three-quarters of the transactions on the net were electronic mail (*Naughton 141*).

## The Real Electronic Mail

This technology we use today for communicating usually with friends and family members was actually first used in 1973 (*Naughton 140*). In 1973 this technology was mostly used for research purposes, which is somewhat of a frightening thought when compared by today's uses. However this

technology evolved from the electronic mail, even electronic mail was first done on the same machine then it evolved and developed to where electronic mail was sent to different machines as mentioned above (*Naughton 141*). There is a big difference between the electronic mail and the real electronic mail. The difference is that electronic mail is asynchronous which means that the transmitting device can transmit a character whenever it is convenient, and the receiving device will accept that character when it is connected to the net and ready to accept such transitions. The real electronic mail is synchronous which means that the transmitting device can transmit a character as soon as it is executed (*Asynchronous & Synchronous 212*). The term "real electronic mail" was given to the synchronous type of mail, which is somewhat like real life conversation but through the use of computers. This real electronic mail was a very valuable tool for the ARPA because it allowed them to get scattered resources all around the world and use them as soon as they were possible to help them in their development and research. The first real electronic mail was sent in 1973 between Kleinrock and Roberts. The program that was used at that time was named TALK, which had a split screen and allowed two users to talk in real time (*Naughton 142*)(*Hafner & Lyon 188*).

## **ARPANET in The Early 80's**

In 1980 TCP/IP was adopted as a defense standard instead of the NCP. This was a style transition, requiring all hosts to convert simultaneously or be left having to communicate via rather ad-hoc mechanisms. This

transition was carefully planned within the community over several years before it actually took place and went surprisingly smoothly (*Salus 183*). This enabled DOD to begin sharing in the DARPA Internet technology base and led directly to the eventual partitioning of the military and non- military communities. By 1983, ARPANET was being used by a significant number of defense research, development, and operational organizations. The transition of ARPANET from NCP to TCP/IP permitted it to be split into a MILNET in 1983 supporting operational requirements and ARPANET supporting research needs and then it retired and the NSFNET became the backbone of the Internet (*Salus 194*).

By 1985, Internet was already well established as a technology supporting a wide range community of researchers and developers, and was even used by other communities for daily computer communications. Electronic mail was being used largely across several communities, often with different systems, but interconnection between different mail systems was demonstrating the utility of broad based electronic communications between people.

## **The Changes in ARPANET**

At the same time that the Internet technology was being experimented with and widely used among computer science researchers, other networks and networking technologies were being pursued. The usefulness of computer networking, especially electronic mail, demonstrated by DARPA

and Department of Defense contractors on the ARPANET, was not lost on other communities and disciplines, so that by the mid-1970s computer networks had begun to spring up wherever funding could be found for the purpose. The U.S. Department of Energy (DOE) established MFENET for its researchers in **Magnetic Fusion Energy**. NASA also had their Space Physicists followed with SPAN, Lawrence Landweber in 1981 established CSNET for the **Computer Science** community with an initial grant from the U.S. **National Science Foundation (NSF)** (*Salus 199*). AT&T's free-wheeling dissemination of the UNIX computer operating system spawned USENET, based on UNIX built in UUCP communication protocols which made it possible to have one computer call another computer through the use of a telephone line. In 1981, Ira Fuchs and Greydon Freeman devised BITNET, which linked academic mainframe computers in an paradigm (*Naughton 178*).

With the exemption of BITNET and USENET in the early 80's, these early networks were intended for, and largely restricted to, closed communities of scholars; there was resulting in little pressure for the individual networks to be compatible and, indeed, they largely were not (*Salus 135*). In addition, alternate technologies were being pursued in the commercial sector, including XNS from Xerox, DECNET, and IBM's SNA. It remained for the British JANET in 1984 and U.S. NSFNET to explicitly announce their intent to serve the entire higher education community, regardless of discipline (*Salus 186*). Indeed, a condition for a U.S. university to receive NSF funding for an Internet connection was that the connection was made available to all qualified users on campus.

In 1984 NSF also developed named **O**ffice of **A**dvanced **S**cientific **C**omputing. OASC recognized the need for a wide area-networking infrastructure to support the general academic and research community, along with the need to develop a strategy for establishing such an infrastructure on a basis ultimately independent of direct federal funding and policies and strategies were adopted to achieve that end (*Salus 199*). NSF also elected to support DARPA's existing Internet organizational infrastructure, hierarchically arranged under the Internet Activities Board (IAB). The NSF encouraged its regional networks to seek commercial, non-academic customers, which expanded their facilities to serve them, and exploit the resulting economies of scale to lower subscription costs for all (*Salus 209*).

On the NSFNET Backbone - the national-scale segment of the NSFNET - NSF enforced an "Acceptable Use Policy" (AUP), which prohibited Backbone usage for purposes "not in support of Research and Education." The unsurprising result of encouraging commercial network traffic at the local and regional level, while denying its access to national transport, was to encourage the growth of private, competitive, long-haul networks such as PSI, UUNET, ANS CO+RE, and others (*Salus 200*).

In 1988, a National Research Council committee, chaired by Kleinrock and with Kahn and Clark as members, produced a report specially made by NSF titled "Towards a National Research Network" which was presented to congress. This report was influential on a number of Senators including then Senator Al Gore, and as a result congress interest was high, which helped

push for building high-speed networks that later laid the networking foundation for the future information superhighway (*Miller 45*).

In 1990 the ARPANET was finally decommissioned, TCP/IP had become the network protocols worldwide, and IP was well on its way to be the standards of network infrastructure (*Salus 225*). And in 1994, a National Research Council report, chaired by Kleinrock entitled "Realizing The Information Future: The Internet and Beyond" was released. This report, commissioned by NSF, was the document in which a blueprint for the evolution of the information superhighway was expressed and which has had a lasting affect on the way to think about its evolution. It anticipated the critical issues of intellectual property rights, ethics, pricing, education, architecture and regulation for the Internet (*Miller 52*).

NSF's privatization policy culminated in April 1995, with the lack of funding of the NSFNET. The funds thereby recovered were redistributed to regional networks to buy national Internet connectivity from the networks. The backbone had made the transition from a network built from routers out of the research community to commercial equipment. In its 8 1/2 year lifetime, the NSFNET had grown from six nodes with 56 kbps links to 21 nodes with multiple 45 Mbps links. It had seen the Internet grow to over 50,000 networks on all seven continents and outer space, with approximately 29,000 networks in the United States (*Miller 66*). Such was the weight of the NSFNET program's ecumenism and funding and the quality of the protocols themselves.

## The Internet Community

Throughout the evolution and development of the Internet it has proven that it remains a collection of communities, as it is a collection of technologies. Its success is largely attributable to both satisfying basic community needs as well as utilizing the technology to meet these needs in an effective way to move forward, which resulted in moving the infrastructure and technology ahead. This community spirit has a long history beginning with the early ARPANET. The early ARPANET community was made up of researchers who worked as a close community to accomplish the fact that packet switching technology is a true success. Similarly other DARPA computer science research programs were multi community of researchers who put their efforts and time and really utilized whatever available resources and mechanisms to coordinate their efforts, starting with the electronic mail and adding remote access, file sharing, and eventually World Wide Web capabilities. Each of these programs formed a working group, starting with the ARPANET Network Working Group. Due to the fact that ARPANET played a unique role of supporting various research programs, as the Internet started to evolve, the network-working group evolved into Internet working group that where scientist and researchers were focused on sharing limited resources and developing and evolving the Internet.

In the 1980's, several European countries were joining the Internet community. Armando Stettner was the person that was responsible for getting the netnews to Europe through the use of his machines. This news got to Peter Collinson at University of Kent in Canterbury who bought and

brought an American modem to the UK. Then he used it to send news to people in the United States using a X.25 connection. This was the start of The **U**nited **K**ingdom network, which was named UKNET, and the **E**uropean net was also called the EUNET (*Salus 188*).

## **Growth & Changes in ARPA**

In 1983, when Barry Leiner took over management of the Internet research program at DARPA, he recognized that the continuing growth of the Internet community demanded a restructuring of the coordination mechanisms. The Internet Activities Board (IAB) was formed from the chairs of the Task Forces (*Salus 209*).

After changing membership on the IAB, Phill Gross became chair of a revitalized **I**nternet **E**ngineering **T**ask **F**orce (IETF), at the time merely one of the IAB Task Forces. As we saw above, by 1985 there was a tremendous growth in the more practical/engineering side of the Internet. This growth resulted in an explosion in the attendance at the IETF meetings, and Gross was compelled to create substructure to the IETF in the form of working groups (*Salus 210*).

This growth was complemented by a major expansion in the community. No longer was DARPA the only major player in the funding of the Internet. In addition to NSFNET and the various United States and international government funded activities, interest in the commercial sector

was beginning to grow. Also in 1985, Kahn left DARPA and there was a significant decrease in Internet activity at DARPA. As a result, the IAB was left without a primary sponsor and increasingly assumed the shroud of leadership (*Salus 207*).

The growth continued, resulting in even further substructure within both the IAB and IETF. The IETF combined Working Groups into Areas, and designated area directors. An **I**nternet **E**ngineering **S**teering **G**roup (IESG) was formed of the Area Directors. The IAB recognized the increasing importance of the IETF, and restructured the standards process to explicitly recognize the IESG as the major review body for standards. The IAB also restructured so that the rest of the Task Forces were combined into an **I**nternet **E**ngineering **T**ask **F**orce (IETF) chaired by Postel, with the old task forces renamed as research groups (*Salus 209*).

In 1991, The **C**enter for **N**ational **R**esearch **I**nitiatives (CNRI) who Bob Kahn was its President and Vint Cerf was its Vice President announced the establishment of the Internet Society. Cerf became the ISOC's first president in 1992 and then IAB became a part of ISOC (*Salus 211*).

## **The WWW**

The recent development and widespread deployment of the World Wide Web has brought with it a new community, as many of the people working on the WWW have not thought of themselves as primarily network

researchers and developers. This all started by Tim Berners-Lee who was at CERN the international particle-research laboratories in Geneva in the 1980's (*Naughton 211*). He was trying to find an easier way to help physicists use the net more and in a much more efficient way. He did just that and along the way he made a new way of structuring, storing, and accessing information on the web and he called it the **World Wide Web** (WWW). The user can browse the Internet without any concern as to where the data is stored (*Naughton 212*).



**Tim Berners-Lee**

Courtesy of (<http://www.w3.org/People/Berners-Lee/>)

Mosaic is another important element of the WWW; it's a software that uses a user interface on the WWW. It was created and developed at the National Center for Supercomputing Applications at the University of Illinois by Marc Anderson and Eric Bina (*Salus 231*). Mosaic is also the user interface that contains hypertext links that allows the user to click and takes him/her to the requested information.

Thus, over a couple of decades of Internet activity, we have seen a steady evolution in organizational structures and software to help make this internet a more useful and very valuable tool for all the users and the programmers and designers that use it.

## E-Commerce

In the early 1980s, a large number of vendors were incorporating TCP/IP into their products because they saw buyers were headed towards the approach of using networking as a means of commerce. Regrettably they lacked both real information about how the technology was supposed to work and how the customers planned on using this approach to networking. Many people believed that it was very hard to add their own networking solutions to other existing networks. The DOD had mandated the use of TCP/IP (as mentioned earlier) in many of its purchases but gave little help to the vendors regarding how to build useful TCP/IP products (*Salus 234*).

The growth in the commercial sector brought with it increased concern regarding the standards process itself. Starting in the early 1980's and continuing to this day, the Internet grew beyond its primarily research roots to include both a broad user community and increased commercial activity. Increased attention was paid to making the process open and fair. This coupled with a recognized need for community support of the Internet eventually led to the formation of the Internet Society in 1991, under the sponsorship of Kahn's and the leadership of Cerf, then with CNRI (*Hafner & Lyon 254*).

In 1985 Dan Lynch in cooperation with the IAB arranged to hold a three day trade show for all vendors to come learn about how TCP/IP worked and what it still could not do well and called it the INTEROP. The speakers

came mostly from the DARPA research community who had both developed these protocols and used them in their day-to-day work (*Salus 235*). A large number of vendor personnel came to listen to developers and experimenters. The outcome was surprises on both sides: the vendors were amazed to find that the inventors were so open about the way things worked and what still did not work and the inventors were pleased to listen to new problems they had not considered, but were being discovered by the vendors in the field (*Naughton 222*).

Network management provided an example of the interplay between the research and commercial communities. In the beginning of the Internet, the emphasis was on defining and implementing protocols that achieved interoperation. As the network grew larger, it became clear that the sometime ad hoc procedures used to manage the network would not scale. Distributed automated algorithms replaced manual configuration of tables, and better tools were devised to isolate faults. In 1987 it became clear that a protocol was needed that would permit the elements of the network, such as the routers, to be remotely managed in a uniform way. Several protocols for this purpose were proposed, including **S**imple **N**etwork **M**anagement **P**rotocol or SNMP designed, as its name would suggest, for simplicity, and derived from an earlier proposal called SGMP. A series of meeting led to the decisions that HEMS would be withdrawn as a candidate for standardization, in order to help resolve the disagreement, but that work on both SNMP and CMIP would go forward, with the idea that the SNMP could be a more near-term solution and CMIP a longer-term approach. The market could choose the one it found

more suitable. SNMP is now used almost universally for network-based management (*Naughton 246*).

After a years of conferences, tutorials, design meetings and workshops, a special event was organized that invited those vendors whose products ran TCP/IP well enough to come together in one room for three days to show off how well they all worked together and also ran over the Internet. In September of 1988 the first INTEROP trade show was born. The vendors worked extremely hard to ensure that everyone's products interoperated with all of the other products even with those of their competitors (*Hafner & Lyon 254*).

In the same guideline with the commercialization efforts that were highlighted by the INTEROP activities, the vendors began to attend the IETF meetings that were held 3 or 4 times a year to discuss new ideas for extensions of the TCP/IP protocol suite. Starting with a few hundred attendees mostly from academia and paid for by the government, these meetings now often exceeds a thousand attendees, mostly from the vendor community and paid for by the attendees themselves. This self-selected group evolves the TCP/IP suite in an equally supportive manner. The reason it is so useful is that it is comprised of all stakeholders, researchers, end users and vendors (*Naughton 238*).

In the last few years, we have seen a new phase of commercialization. Originally, commercial efforts mainly comprised vendors providing the basic networking products, and service providers offering the connectivity and basic Internet services. The Internet has now become almost a "commodity"

service, and much of the latest attention has been on the use of this global information infrastructure for support of other commercial services. This has been tremendously accelerated by the widespread and rapid adoption of browsers and the WWW technology, allowing users easy access to information linked throughout the globe. Products are available to facilitate the provisioning of that information and many of the latest developments in technology have been aimed at providing increasingly sophisticated information services on top of the basic Internet data communications.

## **Conclusion**

In conclusion this paper should show the reader that in any technology or invention there is always a group of dedicated people whom always succeed at the end. These people saw a need and had no other choice but to meet it and fulfill it. These needs were noble and in the case of the Internet, it was a valuable tool for the military to communicate during time of war. The Internet then evolved to be a valuable tool for research and information gathering then it went on to be a valuable tool for communicating and even at times a means for conducting our businesses. The Internet wasn't just one invention that started today's Internet, but it was a series of inventions that led to today's Internet. This present technology is a very valuable tool that is used today in human life from gathering information, communication, and commerce and should be always viewed with admiration.

## Internet Time Line

- 1962-64** Paul Baran and his colleagues at The RAND Corporation where they produced 13 reports and only 11 of them were published initiated a study to build a national network that can survive a nuclear attack.
- 1969** The first node was installed by Leonard Kleinrock's at UCLA it was the IMP
- 1973** The first real electronic mail was send between Kleinrock and Roberts
- Ethernet technology, developed by Bob Metcalfe at Xerox PARC
- 1974** The original Cerf-Kahn papers that were first published on the Internet described one protocol, called TCP
- 1983** Paul Mockapetris and Jon Postel of ISI and BBN invented the **Domain Name System** (DNS)
- 1985** Dan Lynch in cooperation with the IAB arranged to hold a three-day trade shows for all vendors to come learn about TCP/IP, which was called INTEROP
- 1989** APANET is shutdown

## References

- Berners-Lee, Tim. Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web. New York: Harperbusiness, 2000.
- Brand, Stewart. "Father." Wired March. 2001:145+
- Cintron, Dave. Web Programming. New York: John Wiley & Sons, 1999.
- Hafner, Katie, Matthew Lyon. Where Wizards Stay up Late: The Origins of The Internet. New York: Simon & Schuster, 1996.
- L. Roberts, "Multiple Computer Networks and Intercomputer Communication", ACM Gatlinburg Conf., October 1967.
- Miller, Steven E., Civilizing Cyberspace: Policy, Power & the Information Superhighway New York: Addison-Wesley Longman, 1995
- Naughton, John, A Brief History of The Future From Radio Days to Internet Years In a Lifetime. New York: Peter Mayer, 2000.
- Salus, Peter H., Casting the Net: From ARPNET to Internet and beyond. New York: Addison-Wisley, 1995.
- Schwartz, Mischa. Telecommunication Networks: Protocols, Modeling, and Analysis. New York: Addison-Wesley, 1999.
- Berson, Alex. Client/Server Architecture. New York: Mcgraw-Hill, 1997.