

**ADDIS ABABA UNIVERSITY**

**CENER OF INFORMATION TECHNOLOGY AND SCIENTIFIC COMUPUTING**

DEPARTMENT OF SOFTWARE ENGINEERING

THE EVOLUTION OF THE INTERNET

SUBMITTED BY:

1. Natnael Bekabtu – ATR/7198/11

SUBMITTED TO: Mr. Fitsum Alemu

March 2019

# **History of the internet**

The Internet is an invention that has revolutionized the ways of instant information dissemination by closing the geographical barrier prohibiting communication. Any person can access any piece of information from any location in the globe. These days civilization depends on the internet, especially with the invention of social media platforms in recent years, for many activities including communication, shopping, and education. While the complete history of the Internet could easily fill multiple books, this paper mainly tries to address the major events starting from the year 1969 (the year invention of the ARPANET) that followed before this phenomenon actually came to be and how it dominated the majorities’ lives.

The first recorded description of a community through a network was actually observed in a series of memos written by Dr. Joseph Carl Robnett Licklider of MIT in August of 1962. He described his idea as a “galactic network”. In this “galactic network”, people can easily access any data of program from this network of computers. At the time Licklider was head of DARPA (defense advanced research projects agency). He conveyed his ideas to his successors Ivan Sutherland, Robert Taylor, and MIT researcher Lawrence G. Roberts, of the importance of this concept.

## **The ARPANET**

The ARPANET was the first new technology that used the concept of packet switching. Packet switching is a method of transferring data in a network in the form of units called packets. In order for this transfer to work efficiently, the data must be broken down into smaller pieces. These pieces are assembled back to their original format when they reach the destination machine in the network. A packet basically composes of payload and various control information.

Packet Switching uses Store and Forward technique while switching the packets. The store and forward technique works by storing the message transmitted by the source device on an intermediary device, generally a server during a hop (a physical device during packet transmission like a switch, router, or a server). The server then locates the destination device from it database of subscribers, initiates a connection and transmits the data packet that was originally sent by the source device. More than one path is possible between a pair of source and destination. Each packet contains Source and destination address using which they independently travel through the network. In other words, packets belonging to the same file may or may not travel through the same path. This enables the packets to choose different paths if there is congestion at some of the other possible paths. Leonard Kleinrock at MIT published the first paper on packet switching theory in July 1961 and the first book on the subject nearly three years later. Kleinrock convinced his colleague at the time Lawrence Roberts of the theoretical feasibility of communications using packets rather than electronic circuits, which was a major step along the path towards computer networking.

In late 1966 Roberts went to DARPA with this idea and quickly put together his plan for the “ARPANET” (Advanced Research Projects Agency Network), publishing it in 1967. At the conference where he presented the paper, there was also a paper on a packet network concept from the UK by Donald Davies and Roger Scantlebury of NPL (National Physical Laboratory). Scantlebury also discussed with Roberts about the NPL work as well as that of Paul Baran, another pioneer researcher, and others at RAND. The RAND group had written a paper on packet switching networks for secure voice communication in the military in 1964. It happened that the work at MIT (1961-1967), at RAND (1962-1965), and at NPL (1964-1967) had all proceeded in parallel without any of the researchers knowing about the other work. The word “packet” was adopted from the work at NPL and the proposed line speed to be used in the ARPANET design was upgraded from 2.4 kbps to 50 kbps. The overall architecture including the network topology and the economics were designed by Bob Kahn along with Roberts and Kleinrock’s team at UCLA.

Due to Kleinrock’s early development of packet switching theory and his focus on analysis, design and measurement, his Network Measurement Center at UCLA was selected to be the first node (a physical device on a computer network) on the ARPANET. On September of 1969 the first Interface Message processors (IMPs), which are basically a packet switching node that connected participant hosts on a network, were installed on the computers essentially making them the first host computer. This led to the historic day October 29, 1969, when computers at Stanford and UCLA connected to the ARPANET for the first time. They were the first hosts on what would one day become the modern day Internet. Another major parallel milestone in this time was the inception of UNIX whose design heavily influenced that of Linux and BSD, operating systems popular in today’s web servers and hosts. One of the biggest reasons for using UNIX is networking capability. With other operating systems, additional software must be purchased for networking. With UNIX, networking capability is simply part of the operating system. UNIX is ideal for such things as worldwide e-mail and connecting to the Internet. Computers were added quickly to the ARPANET during the following years, and work proceeded on completing a functionally complete Host-to-Host protocol and other network software.

## **Email**

One of the most significant of the early network software was the Email. Email was first developed in 1971 by Ray Tomlinson, who also made the decision to use the “@” symbol to separate the user name from the computer name (which later on became the domain name). Tomlinson first demonstrated his idea at the International Computer Communication Conference (ICCC) – organized by Bob Kahn. In March 1972, Tomlinson at BBN ()wrote the basic email message send and read software, motivated by the need of the ARPANET developers for an easy coordination mechanism. In July, Lawrence Roberts, an essential figure in the design of the ARPANET expanded its service by writing the first email utility program that lists, selectively reads, files, forwards, and responds to messages. From there email took off as the largest network application for over a decade. This was a harbinger of the kind of activity we see on the World Wide Web today, namely, the enormous growth of all kinds of “people-to-people” traffic.

## **NCP implementation**

By the end of 1969 only four host computers were connected into ARPANET. Computers were added quickly to the ARPANET during the following years, and work proceeded on completing a functionally complete Host-to-Host protocol and other network software. In December 1970 the Network Working Group (NWG) working under S. Crocker finished the initial ARPANET Host-to-Host protocol, called the Network Control Protocol (NCP). This early protocol was basically as paved the way to the modern day protocol for data transmission TCP in the 1980s. NCP allowed users to access and use computers and devices at remote locations and to transmit files between computers. It provided the middle layer of the protocol stack, and enabled application services such as email and file transfer. As the ARPANET sites completed implementing NCP during the period 1971-1972, the network users finally could begin to develop applications.

## **The idea of open-architecture network**

Internet is based on the idea that there are multiple independent networks, all with different designs and topologies, starting from the ARPANET and expanding it to including other satellite and radio networks. In this approach, the choice of any individual network technology was not dictated by a particular network architecture but rather could be selected freely by a provider and made to interwork with the other networks through a meta-level “Internetworking Architecture”. This was done with s traditional circuit switching method where networks would interconnect at the circuit level, passing individual bits on a synchronous basis along a portion of an end-to-end circuit between a pair of end locations. But packet switching provided a better way of interconnecting these individual networks.

The idea of open-architecture networking was first introduced by Kahn shortly after having arrived at DARPA in 1972. This work was originally part of the packet radio program, but subsequently became a separate program in its own right. At the time, the program was called “Internetting”. Key to making the packet radio system work was a reliable end-to-end protocol that could maintain effective communication in the face of jamming and other radio interference, or withstand intermittent blackout such as caused by being in a tunnel or blocked by the local terrain. Kahn first contemplated developing a protocol local only to the packet radio network, since that would avoid having to deal with the multitude of different operating systems, and continuing to use NCP. However NCP relied on the ARPANET to make sure the packets reached the destination. If there was any packet loss during transmission, the protocol along with its supporting applications would crash. 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 Transmission Control Protocol/Internet Protocol (TCP/IP).

## **The Transmission Control Protocol/Internet Protocol (TCP/IP)**

The TCP/IP was designed to be a communications protocol that replaced the NCP. The pioneering researcher, Bob Kahn, outlined some of his ideas in setting up this protocol

1. Each distinct network must be standalone and no internal changes to its design and topology could be required to any such network in order for it to connect to the internet.
2. Communications would be on a best effort basis. I.e. if a packet didn’t make it to the final destination, it would shortly be retransmitted from the source.
3. Intermediary nodes, which would later be called gateways and routers, would be used to connect the networks. There would be no information retained by the gateways about the individual flows of packets passing through them, thereby keeping them simple and avoiding complicated adaptation and recovery from various failure modes.
4. Algorithms must be designed in order to prevent data loss from disabling communications
5. Providing for host-to-host “pipelining” so that multiple packets could be enroute from source to destination at the discretion of the participating hosts, if the intermediate networks allowed it.
6. Gateway functions to allow it to forward packets appropriately. This included interpreting IP headers for routing, handling interfaces and breaking packets into smaller pieces if necessary.
7. Packets need to reassembled and checked for data integrity from fragments when they reach their destination

However Kahn realized the complicated logistics involved in implementing his ideas on multiple operating systems and enlisted the help of Vint Cerf, who worked intimately on the design on the NCP. Thus starting from spring of 1973 the two worked together in implementing this new communication protocol. Some basic approaches emerged from this collaboration including the use of a 32 bit IP address in which the first 8 bits signified the network and the remaining 24 designated the host on that network. The assumption that 256 networks would be sufficient for the foreseeable future was clearly in need of reconsideration when Local Area Networks (LANs) began to appear in the late 1970s.

## **Transatlantic connection and rise of multiple internet technologies**

A major initial motivation for both the ARPANET and the Internet was resource sharing – for example allowing users on the packet radio networks to access the time sharing systems. Connecting the two together was far more economical that duplicating these very expensive computers. However, while file transfer and remote login (Telnet) were very important applications, electronic mail has probably had the most significant impact of the innovations from that era, especially after the ARPANET made the first transatlantic connection in 1973 with the university college of London. It was estimated that in the same year email accounted for 75 percent of all ARPANET network activity.

Another massive impressive development of the 70s was the start of Project Gutenberg. Project Gutenberg is a global effort to make books and documents in the public domain available electronically. It began when Michael Hart gained access to a large block of computing time and came to the realization that the future of computers wasn’t in computing itself, but in the storage, retrieval and searching of information that, at the time, was only contained in libraries. He manually typed (because optical character recognition hadn’t been invented at the time) the “Declaration of Independence” and launched Project Gutenberg to make information contained in books widely available in electronic form. In effect, this was the birth of the eBook.

# **Evolution of popular Websites**

## **Imdb (URL:** [**http://imdb.com**](http://imdb.com)**)**

IMDB is an online database of information related to movies, television series, home videos, video games and streaming content. It is a popular website where people can get ratings and information about the latest movies and shows as well as a go to place to catch up on celebrity news. The website was created by Col Needham in October 1970. In its inception the site was no more than shell scripts that could be used to search lists that would one day become a mega database. It has since been acquired by Amazon in 1998.

By 2001 the site only had few moderate styling done on the homepage with the logo appearing on the top left of the navigation where there are links that go to information about movie show times, news, favorite movies(available for registered users), message boards and guidance to the site’s pages. Below the navigation there are also links to Imdb galleries, top movies and recommendations. These links looked like plain texts and had no styling done on them whatsoever. The remaining part of the website was divided into three. The left hand side with an eggshell yellow background has a searching entry and a filterer as well as links to information about top movies at the box office, opening movies and home videos. It also had options to translate the site into Italian and German. The middle part of the body was where the main content is located. At the top is mainly links to DVD discount sales that are updated hourly at amazon.com. Other content may include trailers, IMDB movie of the day picks, movie trivia, and movie or TV quotes of the day. The right hand side was dedicated to advertisement and an option to subscribe to IMDB’s newsletter so that the user can get updates about the latest news. The bottom of the page another navigation bar is located with links to different pages of the site. All in all the content was predominantly textual and limited visuals and colors were used. The information on the site looked a little overloaded and in disorganized.

By 2010 however massive overhauls could be seen on the site. The search bar was now placed at the very top of the site along with links to register or login. The navigation panel was replaced with drop down menus for the items Movies, TV, News, Videos, community…etcetera. The content part now split into two where the left part included main content like latest movie trailers, top news, movie trivia, recaps and quotes. It also had recommendations at the bottom based on the user’s history. On the right information about show times, the latest box-office and movie openings as well as TV guide is located. Compared to the earlier version the site was a lot easier to operation and surf. Since 2010 only small changes can be seen on the site but the major change is to the bottom navigation where the links have added more style and a black background color. Icons can also be seen where user can follow Imdb on social media platforms like Facebook, Twitter and Instagram.

## **BBC (URL:** [**http://www.bbc.co.uk**](http://www.bbc.co.uk)**)**

The BBC (British Broadcasting Corporation) is a news service in the United Kingdom. Their website was launched in April 1994. By the turn of the millennium it was one of the most popular news sites. At first glance the site has not utilized the available space correctly with most of window on the right hand side being empty. Because of that it appeared overloaded with content. Otherwise it had a search and navigation bar at the top of the homepage like most websites at the time, and the remaining part of the page had widgets of the lates news, categories, weather updates, localized content and TV listing. They had a disorgtylnianized feel about them and were difficult to navigate. By 2010 BBC had changed drastically in terms of organization and space utilization. The search and navigation panels were more or less the same with few changes to styling and the reddish pink backdrop but the content was now split into two parts. The left hand side contained widgets on top categorized news stories while the right hand side had space for advertising and contained information that is update much more regularly like the weather and stock market data. Since then has become much more simplistic

## **Instagram (URL:** [**http://www.instagram.com**](http://www.instagram.com) **)**

Instagram is a social networking service owned by Facebook.

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