# CHAPTER 1 - INTRODUCTION

The internet which is a ‘global communication of networks consisting of thousands of other networks that are interconnected by fiber optic cables’, has become part of the daily life of our society. The use of the internet has become very popular and eLearning is reshaping the way education is being acquired. In essence, the purpose of the internet is making lives easier by connecting to one another and sharing important documents, files and other resources. The internet has its origins in the 1960s and have gone through transformation and somewhat revolution. People have been adding to the Internet ever since it was invented. However, no single individual, group or company owns or control all the hardware that connects to the internet. Anyone can use the internet provided they have a compactible device and connection. While this technology is made a free and neutral resource for individuals globally, it has fallen short in providing an efficient accessibility where data can be transferred, and where connectivity is required in some regions of the world.

To use the internet, an individual or institution must have a connection that is provided by the ISP – Internet Service Providers. The ISP company connects their customers to these global networks of networks known as the internet using a data transmission technology appropriate for delivering Internet Protocol datagrams such as dial-up, DSL, cable modem or dedicated high-speed interconnects. Often, the ISP companies charge their customers and are responsible for the speed and the efficiency of the internet. Since these costs can sometimes get too expensive, some schools are not able to fully integrate and serve their students with the internet access. They are boycotted resulting in the unavailability of connectivity in schools through the internet. And because of this problem of limited or no internet access for communication and transfer, the course documents are not sufficiently disseminated among students, eLearning is lagging in their institutions and the benefits internet has to offer is not accessible in these educational institutions.

The Internet connectivity in an educational institution plays a critical role in education and learning. Huge amount of information is passed through for learning enhancement and other educational practices, which demands more sophisticated and efficient medium of communication and connectivity. If we look at a university setup in the developed countries, we can see that an efficient internet connection is inevitable in their activities. In the developing and underdeveloped countries, it is often a typical problem of little or no internet connectivity for educational enhancement. This typical problem of inefficient internet access leads to a lack of help for students and teachers to perform the necessary activities that can be done online.

## Problem Statement

All institutions aim to provide the best and efficient way of schooling within the constraint of their available finances. This is also the case for schools mostly in the developing and under-developed nations. However, circumstances and resources vary markedly between countries and all these usually impacts the implementation of the efficient way of learning in schools. Because of the pivotal role that the ISP companies play on internet connectivity, the charges for this service often gets too unbearable for institutions and hereby causes the lack of internet connectivity between students and their teachers in many schools of the developing and under-developed countries. Although, sharing course document handouts among students and verbal method of communicating announcements is what is mostly used in these institutions. However, several problems can be itemized because of using this traditional method of schooling:

* The concept of Blackboard for educational purposes to view course materials, submit an assignment, create a forum between teachers and students and other benefits that the blackboard offers is not made available in the institution.
* Information is not sufficiently disseminated among students and most importantly, the students that are not available at the time the information was passed across gets little or no content of the information that was passed.
* Schools that can afford the internet services run them at higher costs.
* According to personal experience, when this internet service is available, they often run so slow.
* Distributing handouts is not an effective way of passing course documents because it is susceptible to misplacement.
* All these problems lead to ineffective communication in an institution.

## 1.2 The Purpose of the Research

For this project, the main purpose is to provide a solution that enhances education activities and solves the problem of inadequate internet efficiency for educational development in places that offer little or no internet access for connectivity and for communication. This solution can be considered a short term, but it depends on how fast and rapid the schools in developing and under-developed countries can catch up in terms of resources, development and technicality. Here, I propose a way to solve this problem by creating a network in a local area that every device can connect to, using a software application – mobile, desktop, web and these devices that are connected on the LAN can communicate and share resources of any file type without the need for internet. The medium of communication would be through a Wireless Networking Protocol using an access point router. Devices that are connected on the LAN would be able to drop resources on a file system and can retrieve these resources on the file system with proper authorizations. This solution for a no-internet network creation would solve most of the problems faced with connectivity and communication in educational institutions and thus, will transform the sharing of course documents manually into a computer based as a digital transformation hereby enhancing an effective way of efficiency, distribution, connectivity and communication.

The benefit of this project is to achieve the following objectives:

* Digital Transformation in educational institutions – Making all course documents in one central repository instead of having to distribute papers and handouts.
* Creation of a mobile application software as a client for Content Management System (CMS) – This CMS models a typical blackboard.
* Server creation for request and response purposes – This server fetches resources from the file system into the client devices.
* Local Area Network that models a peer-to-peer connectivity – Since the internet is not in the scenario of what the solution proposes, its only right to be creating a local area network having no doubt that internet is the most effective medium of communication in a wide area network.
* Reduced cost of internet bandwidth that will be purchased in an institution – Since most internal communication would be done on this local network, file transfer through the internet which may take a certain amount of bandwidth will be restricted to the network that is created.
* All these goals lead to a solution to the problem in most ramification and these forms the objective of the project.

# CHAPTER 2 – LITERATURE REVIEW

For this project, the literature review of the scientific references founded by many studies and research to be considered are in Networking, Application software and Database as described below:

## 2.1 Networking

Networks are a collection of computers that are connected with wires and wireless signals. It can also be defined as a:

* Group of interconnected things.
* Number of interconnected computers.

Networking allows computer users to share data and interact with each other, even though they are using two different computers. “When network first came into being, computers could only communicate with computers that were produced from the same manufacturer. For instance, a company can run an IBM solution or a DECnet solution but not run both together. In the late 1970, the Open System Interconnection reference model was created to break this barrier.” (Lammle, 2007)

Networking is useful because it allows a group of people to access a pool of resources. One of the most useful resources a network makes available is people. Collaboration has become expected in a workplace, schools and other institutions because of networks. People are now able to talk, chat or send an electronic mail with someone else who is literally miles away. But networking does have some disadvantages, there is an initial cost to set up a new network – such as cost of purchasing networking equipment, labor cost for trained network personnel. Other disadvantage can occur because of the cost of maintenance and threats like viruses and hacking. However, with proper maintenance and security measures, these disadvantages can be mitigated

Networks and internetworking have grown exponentially over the last 20 years with constant evolution throughout the years. Networks are made up of different protocols and standards. It is helpful to know that Networking Protocols are the guidelines that define the communication between two or more devices while the Networking Standards make sure that different networking products from different manufacturers are interoperable using some set of rules. The evolution of Networks and internetworking can be described below:

### 2.1.1 Time Sharing – the first online communities - 1960

According to a Wikipedia page, “In computing, time-sharing is the sharing of a computer resource among many users by means of multiprogramming and multi-tasking at the same time” (Wikipedia, 2017). By the early 1960s, many people can share a single computer, using terminals to log in over phone lines. Even though the computers were unable to connect to each other at the time, these idea is described as the first common multi-user systems, with many people online at the same time. It then gradually develops into many features of later networks, from file sharing to e-mail and chat.



Figure 2.1 A User on the Dartmouth Time-Sharing System. (Timeline of Computer History, 2018)

### 2.1.2 Multiplexers: Getting more users into the same line – 1968

The telegraph is typically a system for transmitting messages from a distance along a wire in the early years. People have had the utmost urge to have many more connections on a single wire. Then the concept of Frequency Division Multiplexing came up which allows 15 terminals share the same line. Along that same line of thought in 1968, comes a new generation of time-division multiplexers that radically expand the computer terminals that can share the same line from the initial 15 now until 45. This innovation advances helped more people go online.

**2.1.3 Networks come online – 1969**

In the late 1969, at this time created by the United States Defense Advanced Research Projects Agency (ARPA), the ARPAnet makes a debut as a large-scale, general-purpose computer network that connects multiple computers together. ARPAnet was a ground for experimental networks and satellite radios and the need to connect diverse systems led ARPA to begin its internet programs, which developed techniques for interconnecting networks, using this technique to connect other research networks forming the basis for today’s internet, a worldwide network of networks. (Abbate, 1996--1988)

### 2.1.4 Inventing the Internet – 1973

Before 1957, Computers only worked on one task at a time and this is called Batch Processing. The concept of batch processing was ineffective as Engineers and Programmers started developing a need to work remotely. Then the idea of Time sharing came up – The concept of sharing the processing power of one computer with multiple users. So, the next challenge must be creating the ‘networks of networks’, a process called internetworking or internetting. The foundation of the internet begins with the Defense Advanced Research Project’s ARPAnet for the concept of a military network, the National Physical Laboratory for a commercial network, and Cyclades for the scientific network. (Picolsigns, 2009).

In 1973, France’s Cyclades and the Britain’s NPL network were experimenting on a protocol that influenced the United States’ development of ARPAnet TCP/IP internetworking protocol, which was first designed by Vint Cerf and Bob Kahn. Given that, the Cyclades had fewer nodes and the focus was laid on the communication with other networks. In this way, the term Internet was born. The collaboration of this led to the development of NCP – Network Control Protocol and later, it was replaced by a much efficient Transmission Control Protocol (TCP). The specific feature of the TCP is the verification of file transfer. To avoid congestion of these files that are transferred, the files that are sent are divided into smaller packets and this technology was termed, Packet Switching. During communication and transfer, the computers serve as a transfer node, starting with electronic mail and adding file sharing, remote access and eventually the World Wide Web capabilities.

### 2.1.5 Linking the Ethernet and Local Networks

The IEEE is an institute of Electrical and Electronics Engineer that develops global standards for a range of technologies. The year 1973 marks the start of the standard that will eventually prevail: Ethernet (Timeline of Computer History, 2018). While the internet is comprised of multiple layers, among these layers is the Link layer where Ethernet is categorized. Ethernet uses both Data Link and Physical layer specifications. All network connected in a local area had to be connected to some type of cable. When these cables are connected in a network, they act as a medium that transfer resources from one computer to another. The Ethernet becomes a contention media access method that allows all hosts on a network to share the same bandwidth of a link.

Fast forward to the year 1999, the IEEE 802.11b is a Wireless LAN for short range radio networking standard that came into place as “Wi-Fi”. The IEEE 802 family of standards made publicly available the 802.11 as a standard format for the Wireless Networking. “The wireless networking uses radio frequency to send information between devices that are able to pick up the frequency and translate the radio signals back into information that the device user can understand and use”. (edx, 2018). Radio frequencies come around in different types. The 5 GHz frequency has a less interference with a higher speed, but it has a shorter range than the 2.4 GHz is the common and popular frequency because it has a bigger range that is not mostly affected by obstacles. Wireless networking is measured in Mbps.

## 2.2 Application Software

An application software and a software application can be used interchangeably. A software application is a written set of software codes that serves as instructions for the computer to carry out the purpose of the written codes. This purpose is typically to solve problems. A way to solve problem is to begin analysis and break down of such problems into smaller pieces we can handle. A key note is to first understand the nature and concept of the problem as not all human problems require computational solution. However, if need be, we can go ahead to use software technology for our solution. For this project, the analysis has shown that software application is desirable to solve this problem at hand.

According to Shari, the figures below describe the process of analyzing a problem and synthesizing a solution.

PROBLEM

Figure 2.2 The Problem Analysis. (Pfleeger, 1991)

SOLUTION

Figure 2.3 The Solution Synthesis. (Pfleeger, 1991)

Software application spans across multiple sections of modern technology in mobile phones, laptops and many more. Here, I categorize software application into two major types:

* System device application – Desktop, Mobile.
* Web design application – Website.

Software applications require a certain level of proficiency in a software programmer. Software programmers take designing and implementing a solution to a problem computationally and are responsible for quality software services. Just as product manufacturers aspire ways to make sure their products are of quality produce; software programmers too find ways to ensure their software is acceptable. The quality and acceptability of a software depends on how easy it is to use, learn and if in fact, it provides solution to the proposed problems. There are different types of programming languages for software creation. Examples of this languages are Hypertext Markup language (HTML), JavaScript, ASP.net, C#, Java and so on.

Literature review is a systematic summary of studies addressing a clear question, with an unbiased and valid method to identify, study and analyze data or other relevant topics (GET-IT, 2015). In the review of the relevant references founded many actual implementations of solution that solve problems of connectivity and digital transformation. The following is a summary of each research reference in terms of their goals and the solutions they provide.

### 2.2.1 Blackboard, 1997

Blackboard is a technology developed by the Blackboard Inc. This tool delivers a content management system allowing faculty to add resources for students to access online. The blackboard technology is mostly used to support effective learning process by providing an area to place information about courses in multiple learning styles and content formats – texts, images, pdf, audio, etc. Blackboard provides a software application that is web-based and may be installed on local servers. Its main purposes are to add online elements to courses that would have been traditionally delivered face-to-face hereby serving a digital transformation.

### Conclusion

* According to Forbes.com, blackboard is used by more than 70 percent of the colleges and universities in the U.S.A. (Peter Bradford, 2007, pp. 35:301-314).
* Blackboard has proved ultimately useful in distance learning.
* A course content feature allows professors to post course documents on the platform.
* Students can chat in real time with other students in the classroom section.
* Students are also able to send emails.

### 2.2.2 Skype, 2003

Skype is a telecommunication software application that specializes in connecting many people through video calls, voice calls and chat. With Skype, individuals can hold a meeting, learn languages and do just about anything that needs to be done together on their phones, tablets, computers or TV with skype on it. (Skype, 2003). Skype was created by Swede Niklas Zennstrom and Janus Friis, and it was originally a feature of hybrid peer-to-peer and client-server system (Tallinn, 2014), before it was acquired by Microsoft which transitioned the technology into a centralized Azure service. (Goodin, 2012)

### Conclusion

* The use of peer-to-peer and client-server formed the basis and beginning of Skype.
* According to a Wikipedia entry in 2012, about 35 million number of concurrent users are on Skype (Caukin, 2012). The implication of this is that more and more people are connected to each other on daily basis because of this software application.
* According to reports, Skype has been improved to make Voice over IP (VoIP) a real-time communication option for schools. (Branzburg, 2007, p. 36)

### 2.2.3 Facebook, 2004

Facebook is a social media and social networking company based in California, United states of America. It was co-founded by Mark Zuckerberg in Harvard University. While in Harvard, Mark and his friend, Adam D’Angelo identified the need for students to upload lists of their friends and compare these friend lists with others. To them, it was a problem of connectivity that they were seeing to provide solutions to. In 2003, Mark’s goal would be to create a software application that he named Facemash with a PHP programming language. To create Facemash, Mark broke into Harvard’s web systems and copied student ID images. In 2004, Mark finally created a website that is called Facebook that lets users create profile for themselves and connect with their friends. (Telegraph, 2017)

### Conclusion

* Facebook grew out to become a widely accepted solution to the problem of social connectivity.
* It has further become a marketing solution outreach to connect multiple people in business environments.
* A comprehensive database for individuals are stored that matches people from everywhere else.
* The Facebook system is able to store data that is necessary for people to keep in touch and connect with each other.

### 2.2.4 Gmail, 2004

Gmail is an email service that was developed by Google. A software application was the solution to this particular problem of transferring electronic mail from one individual or corporation to another. This solution typically mitigates the long time it takes to traditionally post a letter through the post office services. Even though Gmail is not the only email service available, it is a technology whose research is worthy of my study and whose innovation is worthy of emulation. Whenever possible, Gmail uses a transport layer security (TLS) to automatically encrypt emails that are sent and received on the web and on the devices. (Gmail, 2016).

### Conclusion

* Gmail stands out as a wide service for digital transformation.
* Gmail becomes the first software application to reach 1 billion downloads on android device.
* According to the verge reports in 2016, Gmail has 1 billion monthly active users, and this shows the rate at which this software providing digital transformation is widely accepted. (Miller, 2016)

### 2.2.5 GroupMe, 2010

GroupMe is just another mobile group messaging app that is owned and controlled by Microsoft. It works similarly like a regular text message app on a mobile phone and even with a real-time communication. GroupMe solves the typical problem of people trying to connect to each other in groups. It even offers group calling as a conference call which does not push a time limit on you. Some of the features on the app includes ability to share photos, videos, location, create events and so on.

### Conclusion

* By June 2012, GroupMe has also been widely accepted and over 550 million messages were delivered on GroupMe each month. (Shontell, 2011)
* GroupMe becomes a software that radically competes with top leading technology experts like Google with the launch of Google+.

### 2.2.6 GitHub, 2008

Started by Linus Trovalds, GitHub is a web-based version-control and a collaboration platform for software developers. Many people have alleged that GitHub is a social networking site for programmers. Here software codes and other programming materials are uploaded in a central repository and can be retrieved at anywhere on any platform. GitHub also allow multiple developers to collaborate on a project, update and track progress on the project. Three main terminologies serve as distinct features on GitHub – fork, pull request and merge. Forking is when a project is created based on another project that already exists. Pull Requests are the changes you’ve pushed to a GitHub repository. Merging is joining a project you modify to an existing project for purpose of update and changes.

### Conclusion

* A software application written in Ruby on Rails.
* GitHub provides a light-weight workflow for developers.
* It allows developers to share their codes for others to view, modify and update
* GitHub can be used for any type of files.

## 2.3 Database

The collection of factual data can be described as a database. The database can further be described as a repository for a collection of computerized data files (Date, 2000, p. 2). Today, most universities and colleges have a centralized place they store student information. The departments that store these data are a very important section in colleges and it is in fact, a level of management of the college. Many routines and burdensome works need accuracy and little or no errors such as the student information, courses undertaken by each student in the school, degree level of the students and so on. A database server typically contains all the tables and data that are required to be saved.

A Database Management System is required to connect to the database server. In a typical development environment, the database can be installed on one centralized machine and usually developers can connect to that using a database management system that is installed on the respective machines. The figure below shows the relationship between a database and a database management system.

DBMS

DBMS

DATABASE

SERVER

DBMS

DBMS

Figure 2.4 How a database management system and a database server relate.

## 2.4 Discussion

After critically looking at these technologies, one thing they all have in common is the internet connectivity. For these technologies to become optimal in a learning environment, they all require the internet to work. This is what has made a difference in my proposition. For this project, the main medium of communication would be done over a wireless networking protocol connected from a router and to the other devices. No internet is required, and no Ethernet is required for this technology.

For the Networking review, the Timesharing system formed the basis of sharing a computer resource among many users. This technology that has developed into modern features of file sharing, to email and chat can be agreed as what came on to the design and implementation of networking connectivity. However, with the Multiplexers, it can be agreed that transmitting messages from a distance along a wire is a head start for modern telecommunication, but it can be criticized in the limited range this technology is able to cover. The Internet remains the largest community of online connections as the connections of different networks with little to no limitations. The only shortcoming of the internet is its efficient availability in certain areas of underdeveloped and developing countries which has formed the scope of this research as to how connecting individuals can be made possible until the Internet finally arrive in these places.

In the Application Software review, it can be completely agreed upon that this software applications are a tool for efficient connectivity and a tool that can further make education much smoother for individuals. While the Blackboard is held in high regards for its innovation, the Blackboard has its limitations and according to a survey of 730 faculty staffs and students in Wisconsin who uses this blackboard found that course management systems are harder to learn to use than expected. (Carnevale, 2003, p. 49). Another limitation of the blackboard is that its options may be restricted to some operating systems. Even though the GitHub is regarded as the leading version control service and a social platform for developers, its technology requires more technical know-how and certain expertise to work on a master level.

Database File System is another common tool that these software applications have in common as they require a centralized place to store their information. Database utilizes authentication for administrators and the implication of this is to provide integrity to the information that is saved by ensuring the data is not manipulated by unauthorized individuals.

These reviews can be summarized as follows:

* The technology for connecting individuals in an institution require internet connectivity.
* Each application software allows students to communicate either individually or in groups.
* File sharing are made possible with this networking and software tools.
* There is a centralized file system for storage of data.
* Communication is mostly done in a wide area network.

From the above, it is considered ideal the need for communicating and sharing information among individuals. The above systems solve a mutual problem of accessibility and connections, not only in educational institutions but in all ramifications of life. The system I am researching goes in a similar route and it provide a solution to this imminent problem of inefficient connectivity in educational institutions too but using a different innovative strategy of communicating and sharing files without need for the internet access. The education system in developed and developing countries is in the process of development and with this solution, it raises a high level of education enhancement in their institutions.

# CHAPTER 3 - METHODOLOGY

Connecting to sql Server

To connect to the sql server, certain considerations must be taken into place. These are configuration settings and according to Marko Zivkovic (Zivkovic, 2016), the settings have to be in place and they are so important that, without them, the connection to the remote SQL server would not be successful. These are:

* Allowing the sql server instance the protocol that is being requested
* Allowing the access through the firewall

To get the node.js server work to connect to the database file server, a javascript packet manager – npm’s module called mssql was installed. With this, connection was made easy to the database.

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