AN INTEGRATED WEB BASED UNIFIED TELECOMMUNICATION SOLUTION ON AN N-TIER SERVER ARCHITECTURE.

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DECLARATION.

I declare that this Research project is my original work and has not been previously published or submitted elsewhere for award of a degree. I also declare that this Research project contains no material written or published by other people except where due reference is made and author duly acknowledged.

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I do hereby confirm that I have examined the master's Research Project of

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ABSTRACT.

Telecommunications technology is ever evolving to meet the rapid changing needs for services in organizations. Private Automated Branch Exchange/Private Branch Exchange (PABX/PBX) is a telephony platform that is privately based and links between a subscriber and a telephone network which is switched in nature. The functional technology applied is a Public Switched Telephone Network that allows the shared application of connectivity between departments in an organization. Consequently, the technology incorporated other components, e.g. ADSL lines to establish an extension which was not linked to the numbering plan of the central point and the number block associated to the PABX/PBX. Although it was a renowned state-of the art technology for handling communications within organizations, it developed challenges which led to its inability to meet organizational telecommunication needs, for example, technological challenges, limited monetary resource and loss of communication connectivity due to scalability and vandalism.

In this research project, an implementation of an integrated web based unified telecommunication solution on N-Tier Server architecture was adopted. There are other solutions which have been applied to address the issues, but there are a number of areas that have not been tackled e.g. security because in the event that the platform is managed by a third party, its level of security standard is not guaranteed. Also loss of communication connectivity and cost of implementation have not been adequately addressed.

The solution uses existing infrastructure equipment like servers which will be virtualized to form a front end and back end server linked together to achieve its function.

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ABBREVIATIONS.

PBX-Private Branch Exchange.

PABX- Private Automated Branch Exchange.

ACD-Automated Call Distributor.

IVR: Interactive Voice Response.

PSTN: Public Switched Telephone Network.

UCaaS: Unified Communications As A Service.

VOIP: Voice over Internetworking Protocol.

DS: Domain Service.

CS: Certificate Service.

CHAPTER 1: INTRODUCTION.

1.1 BACKGROUND OF STUDY.

Telecommunication technology is a very vital component in day to day operations in an organization. The first PBX was discovered in the year 1900 where the early private branch exchange switchboards were established in which operators functioned private company switch boards initially by hand. (Green, 2001). Thereafter, in the year 1970, volumes of calls increased, thus utilizing receptionists to transfer calls which became impractical and difficult. (Bender, 2000). Despite the introduction of Automated Call Distributor which was an improved version of PBX, most organizations adopted, but as more staff increased, it became outstretched thus becoming a challenge adding more lines or extensions. (Edwin, 2006). During the evolution of telecommunication technologies, there was a standard measure for determining in-depth reliability of electronic components in telecommunication systems. It was based on the findings on average time in hours for telecommunication systems to develop problems like a mean period between problem [MPBP] and mean period between service loss [MTBSL]. The standard analysis discovered was usually mistaken and misapplications of the assessment lead to the inappropriate use of PABX solution as a dependable tool of communication. (Teotech, 2003). A study conducted on Real time communication concepts and Business applications, many organizations are adopting real time application solutions and real time dashboards.

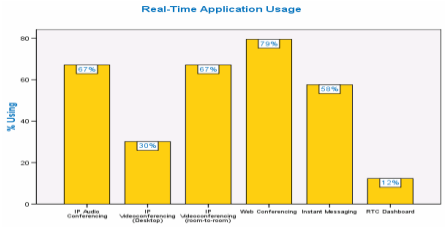


FIGURE 1: STATISTICS OF REAL TIME APPLICATION USAGE [Source: Real Time Communication Journal 2009]

From the chart above, communication platform numbers have risen at a faster rate. The more the communication platform rising, the complexity, it becomes for the interactive end user. An organization must apply a series of steps to determine the appropriate communication platform to adopt depending on a given scenario like location and period. A typical scenario is that organizations attempt to reach staff to undertake a given assignment but are unreachable. This often leads to numerous voicemail or messaging requests hanging across many services. As a result, the rising number of related solutions led to communications becoming more complex, thus leading to increased frustration in offering technical support in the event of a problem and inefficiency.

1.2 THE SOURCES OF PROBLEM IN TELECOMMUNICATION TECHNOLOGIES.

The Use of PABX telecommunication platform has caused many challenges in organizations as indicated in the background of the study. The sources of the problems are as a result of the following:

1. **Hardware Problems:** This is as a result of the PABX components, stopping to function as desired and there is no redundancy to complement links and duplication of functions. This leads to the frequent loss of signal which makes the organization struggle in communicating with staff. Also vandalism of telecommunication cables has led to massive loss of communication signal which in the long run lead to hardware problems.
2. **Operator Error:** This is caused by direct human interventions. They can be classified as intentional where someone makes an error knowingly or unintentional where someone makes an error unknowingly. In the end, will cause consequential damage to the

equipment, thus blocking organization from reaching out to other stakeholders through telephone and communicating with other colleagues across departments.

3. **Software Problems and Overloads:** This is as a result of irrecoverable drivers, small interchange in telecommunication protocol, implementation and handling. They can be also as a result of the inappropriate capacity, massive delays during onset hours due to many staff accessing telecommunication platforms at the same time. This problem is mainly attributed to PABX not being able to handle large staff.
4. **Denial of Service Attack:** This is a very major cause of telecommunication problems. A case in point is where a certain virus unleashes system change on the PABX and as a result, massive unwanted communication can reach many unauthorized staff, which in the end organization information which is highly confidential are leaked out thus putting the organization at stake. This problem has created a negative impact on the telecommunication thus need of a solution to address denial of service attack.

1.3 DEFINITION OF TERMS.

1. UNIFIED TELECOMMUNICATIONS: is a modern technology where staff interacts with each other through a platform hosted on a computer system. (Green, 2001).

2. PRIVATE BRANCH EXCHANGE: a telephone network, private in the nature set up to be used within an organization setting. (Bender, 2000).

3. AUTOMATED CALL DISTRIBUTOR: is a telecommunication system that channels incoming calls to a target node of terminals that an agent uses (Green, 2001).

4. INTERACTIVE VOICE RESPONSE: is a telecommunication infrastructure that enables a computer system to engage with staff through voice recording sound and a keypad. (Edwin, 2006)

5. PUBLIC SWITCH TELEPHONE NETWORK: is the mapping of the telecommunication network that is operated by national, regional, or local operators, offering an infrastructure platform and services for public telecommunication. (Bender, 2000).

6. N-TIER SERVER ARCHITECTURE: is an architecture consisting of client and server where which presentation, application, and management of data operations are separated in a logical form. (Teotech, 2003).

7. UNIFIED COMMUNICATION AS A SERVICE: is a service delivery model in which a variety of telecommunication and collerated systems and services are channeled to a third-party provider and managed over an IP network. (Edwin, 2006)

8. IM PRESENCE: is a collaborative telecommunication enabler for continuous instant Messaging and Presence. (Atea, 2011).

9. SINGLE-TENANCY PLATFORM: is a mode where the end user receives a highly customized software platform that can be mapped with on-premises systems. (Atea, 2011).

10. MULTI-TENANCY PLATFORM: is a mode where systems share a single software platform for operator functions. (Teotech, 2003).

1.4 PROBLEM STATEMENT.

1. **Technological challenges in telecommunication**: PABX system being used by organizations is complex in nature. With components connected together, key operational dependencies and support become a challenge. It impacts the following two areas:

    a) **Routing Challenges:** Because the PABX executes singularly based on extensions, a user cannot be managed across all establishments. ACD and IVRs have their own functional policies which require that each time there is a change in a call guard, each routing table need to be updated in the individual application. Maintaining the same communication

policies across the PBX system is troublesome with millions of changes to the routing table and staff properties like groups, job status on a daily base can be impracticable.

b) **Administration Challenges:** The architectural design for PBX requires persistent translation between systems to execute fundamental telecommunication policies. It also requires that call agent would need to be configured severally, which will be difficult to grow and scale whenever user numbers go up thus administering the PABX technology proves a challenge.

2. Limited Monetary resource: Majority of organizations function under limited funds because of high operating costs that has pushed up the recurrent expenditure and lowered development expenditure to the point of no available funds for organizational growth. As a result, buying IP headsets to operate through modernized PABX is difficult, thus leads to the challenge of modernizing telecommunication infrastructure to the latest technology so that the organization does not grapple with communication.

3. Loss of Communication: This is based on scalability and vandalism. On the issues of scalability, whenever one wants to add new staff to the PABX platform, new lines of connectivity are required and the technology is restricted to a number of staff. By the end of it all, the organization ends up purchasing an addition PABX license, which becomes very expensive because is computed based on the number of staff. Also by adding more members of staff to the PABX platform slows down connectivity thus lack of clarity when communicating. On the issue of vandalism, theft of copper cables is on the rise, which meant that once disconnected, you cannot communicate, thus making it difficult to reach the staff.

1.5 AIM OF THE RESEARCH PROJECT.

The aim of undertaking the research project is to improve efficiency in inter-organizational communication and ensure access to telecommunication infrastructure for ease of operations.

1.6. SPECIFIC OBJECTIVES.

a) To identify Unified telecommunication solutions and other technologies used in telecommunications.

b) To design the unified telecommunication solution on N-Tier server architecture.

c) To implement the unified telecommunication solution on N-Tier server architecture.

d) To test and validate the unified telecommunication solution on N-Tier server architecture.

1.7 SIGNIFICANCE OF THE RESEARCH PROJECT.

Unified telecommunication is developing rapidly, thus the need for being ease of management so that organizations can operate effectively. Most communications applications are increasing and determining the appropriate solution would prove a challenge. (Boettener, 2009). This study addresses the best solution to communication in an organization because PABX/PBX is not sustainable in this day and age of technology. The solution also reduces the complexity of functionality and in the long run, both staff and support teams have ample time to benefit from the solution.

The key application areas of this solution are organizations that cannot manage PABX/PBX and they have servers that are on a local area network and also serve as active directory where staff are authenticated to access the resources on a network.

In the body of knowledge, the study will open an opportunity to learn and apply new skills in technology like application of server virtualization on an existing infrastructure which improves efficiency, implementation of unified telecommunication on a virtualized server infrastructure

and access the unified telecommunication system in an organization easily by making it web based. In the end, the project can be used for further research in the field of web based voice hosted, on-premise server that can be accessed through a virtual local area network and mobile platform.

1.8 SCOPE OF THE RESEARCH

This research project focuses on inter-organization unified telecommunication solution. This means that it tackles the challenges of telecommunication within an organizational setting and the solution is limited to telecommunication within the organization.

1.9 CONCLUSION

The research project proposes an integrated web based unified telecommunication on N-Tier server architecture. It is the interrelationship of the computing and communication tools that staff apply in their daily operations at work place. It is basically a platform accessible through a computer that combines modules like Instant Messaging, Telepresence, unified messaging and interactive voice. It has the ability to enhance function and improve communications and business environment. Organizations stand to gain a lot from the solution thus facilitate ease of doing business.

CHAPTER 2: LITERATURE REVIEW.

2.1 STATE OF THE ART.

Unified telecommunication relates to organization systems that integrate a broad range of technologies and applications that have been developed and tested as a single communication mode. It basically refers to integrating real time responsive and interactive systems.

A given user can access a variety of communication platform such as SMS, chat, fax and voice, but with unified telecommunication, has scaled up broader technologies to incorporate scheduling, workflow and interactive sound response. (Atea, 2011).

Unified telecommunication is a key element in virtually any organization. As the enterprise foundation base continues to grow, telecommunication strategies must evolve at the same time, to ensure operations remain efficient and productive. It has grown as one of the most effective ways for an organization to enhance its business operations.

According to IDG Enterprise report on unified telecommunication, 80 percent of surveyed IT decision makers arrange to invest in unified telecommunications in the next 10 months. The average return of investment through unified telecommunications is between 5 and 9 months. Most organizations will actualize these benefits - not only through reduced expenses, but also through improving collaboration and general organizational operations.

2.1.1. UNIFIED TELECOMMUNICATION ON PRIVATE NETWORK THROUGH MOBILE TELEPHONY.

This is a telecommunications solution running on a mobile platform. The services available with this solution come with two separate user interfaces that are well linked to the functional environment in which they are established. Mobile contacts access unified telecommunications services through a designed standard portal which offers an optimized view for smart phones.

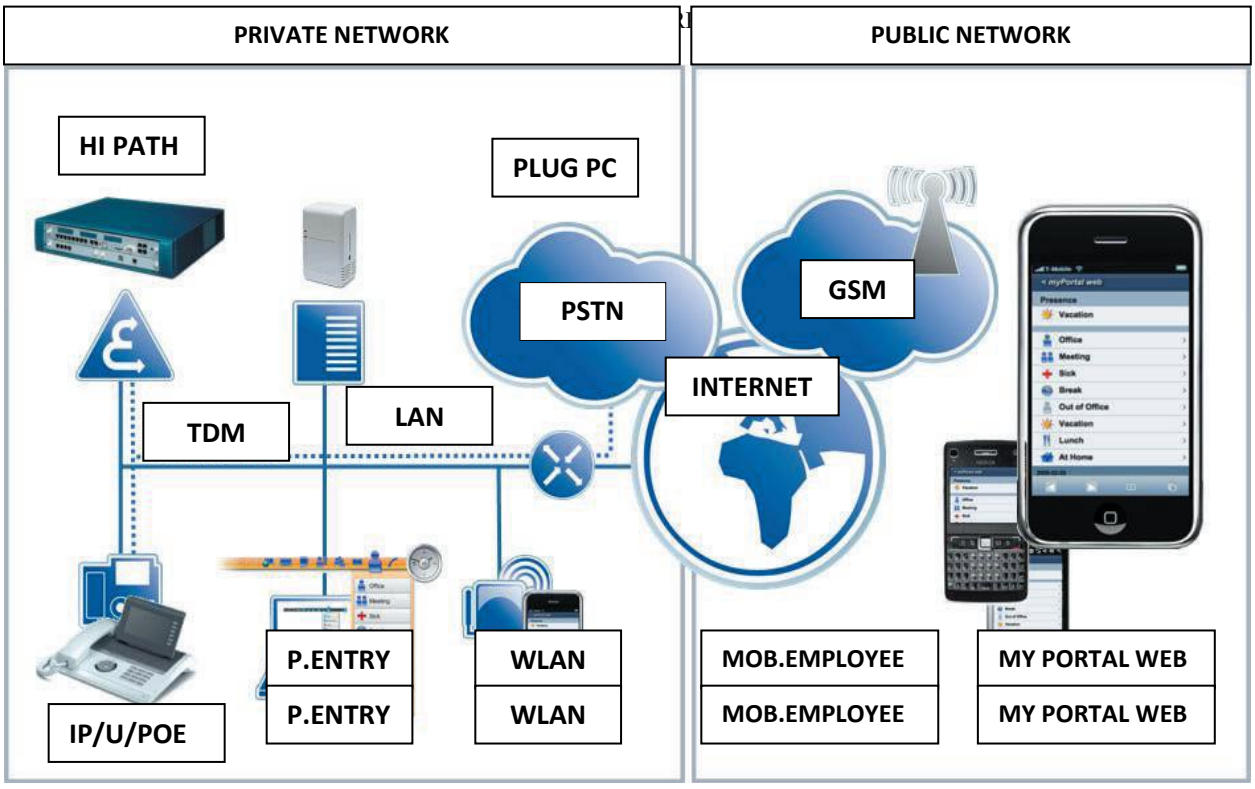


FIGURE 2: UNIFIED TELECOMMUNICATION ON PRIVATE NETWORK THROUGH MOBILE TELEPHONY.

From the above diagram, the integration of the mobile phone and the unified telecommunication is public and private network. On the public network, the GSM network from the mobile phone is interlinked to the internet which is mapped to the PSTN on the private network. However, from the illustration, staff is fetched from the PSTN server through TDM, which proves a

challenge in that when it comes to scalability, the PSTN server becomes outstretched and not able to accommodate more staff. (Brent and Neville, 2011).

2.1.2 UNIFIED TELECOMMUNICATION AS A SERVICE.

Unified telecommunication as a service is a lead adaptable model in which a selection of telecommunication and collaboration platforms and services are managed by a third-party provider and mounted over an Internet Protocol network. The technology consists of organization messaging and availability technology, web meetings and teleconferencing. Unified telecommunication as a service is renowned for giving high levels of availability as well as flexibility and scalability for core organization tasks. (Chelmsford, 2009).

There are two ways to look at Unified Telecommunication as a Service: single-tenancy and multi-tenancy. With a single-tenancy approach, the end user gets a customized system platform that can be incorporated with on-premises applications. Multi-tenancy staff shares a single system platform. Organizations can also apply a hybrid approach, keeping a section of their unified telecommunications, on-premises and other applications in the cloud. In regards to (Tsutsui, 2008), security and technological advances still a challenge with this approach due to its complexity in nature and it's being handled by third party.

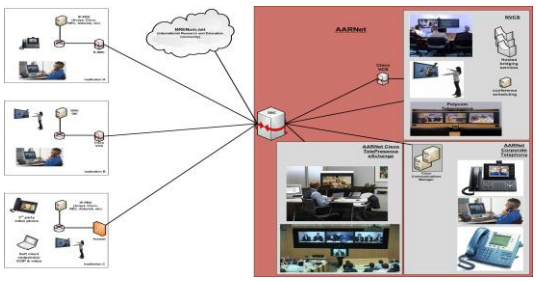


FIGURE 3: UNIFIED TELECOMMUNICATION AS A SERVICE.

2.2. STATE OF PRACTICE: UNIFIED TELECOMMUNICATION CASE STUDIES.

The key areas where unified telecommunication will be of great benefit are as follows:

- Call Centers in Financial Sector.

According to a survey conducted by (Cisco, 2009), financial institutions have placed its market position to become the largest investment in the region. They have always shown leading financial performance and a careful approach to risk taking, guided by its mandate of delivering strong and sustainable returns of investments to stakeholders.

The majority of the financial institutions is up to the task of continually harnessing their market status and nothing is allowed to stand in the way of that direction. However, in the recently, most of them have been undertaking merger and acquisition, which led to a scenario where separate call centers from multiple providers existed for different business functions. Not only the arrangement was highly inefficient, but also the financial institutions were unable to guarantee equal customer service excellence or undertake a single point of individual customers view. As a result, a proper unified telecommunications solution will be needed to address this.

An integrated connection based network for LAN and WAN with a unified telecommunications Manager platform hosted for IP telephony will be desirable thus make a good sense to adopt a unified telecommunications call center solution.

In the long run, financial institutions used existing infrastructure to deploy a more efficient, unified telecommunication solution and they ended up spending less resources for efficiency in telecommunication and serve customers through call centers.

- Office Operations in Church Setting.

According to a research undertaken by (Cisco, 2012) many churches have established office operations to deal with the congregation. Due to the increased number seeking the services of the church, an appropriate telecommunication solution needed to be established in order for communication to be effective. They adopted and implemented unified telecommunication using highly customized unified telecommunication manager that managed to address the issues of communication. The benefits that come along way after implementing the solution has been increased collaboration amongst the congregation, reduced costs that come along with telecommunication, reduced workload for IT staff supporting the solution and improvement of church safety.

2.3 TECHNOLOGICAL ADVANCES IN UNIFIED TELECOMMUNICATION.

2.3.1 INTEGRATION OF SIP TRUNK INTERFACE WITH IP UC VOIP.

This is the current technological advances in unified telecommunication whereby the SIP trunk interface is programmed and mapped with IP UC VOIP so that user experience is achieved. The solution is accessed remotely using a customized web interface. This technology has been tried and has proven to be effective and able to meet organizational needs.

2.4 CRITIQUE OF LITERATURE.

Ranganathan (2004), proposes Unified telecommunication as a service as the best platform to address the challenges facing telecommunication in organizations. It has been acknowledged as the most successful implementation in many regions of the world and is most recent technological research being undertaken. However, as the cloud has the capability to enhance a number of operations, the end result is not always as intended. A major problem with cloud

computing is that the virtual environment cannot guarantee the safety of mission-critical solutions in the sense that it is managed by third parties, especially multi-tenancy which exposes sensitive and critical information to unauthorized staff. If decision-makers don't implement the proper security appliances, hosted unified telecommunications systems integrated with video and audio conferencing applications can be corrupted, turning them into practically useless tools. According to (Teotech, 2003) on instant cash flow improvement and return on investment with unified telecommunication, the up-and-down surge of the economy in the past many years has led to the need to function more efficiently and cut costs where applicable. As a result, they proposed unified telecommunication on the private network through mobile telephony as one of the significant developments that have a direct impact on the technological advancements. However, based on the interlinking of public and private network, the PSTN Server where staff will be vetted and have access to the system with their mobile phones will have a challenge as more and more staff increase because it is supposed to handle enterprise functionality but it does not do so since is limited to few staff thus scalability is not addressed. On the inter-connectivity, public and private networks connect through clouds which also brings in the aspect of security because it is being managed by third parties which does not guarantee safety of what is happening while interacting with the system. In this research project, I propose an integrated web based unified telecommunication solution on N-Tier server architecture to address challenges in telecommunication. This is because it will use the existing infrastructure like servers being used as active directory to authenticate and activate staff to access the unified telecommunication system.

CHAPTER 3: METHODOLOGY APPROACH.

3.1 INTRODUCTION

Research methodology refers to the platforms at which research studies are planned and the steps by which is analyzed. In this chapter, will be looking at the various methodologies applied in the unified telecommunication, evaluate them and propose an appropriate methodology for addressing telecommunication challenges in organizations.

3.2 CURRENT METHODOLOGIES APPLIED IN UNIFIED TELECOMMUNICATIONS.

3.2.1. INTERVIEW METHOD

A research undertaken by (Welde, 2011) on Implementing Unified Communication from the perspective of end staff at the University of Adeger, Quantitative method was the best choice when finding out a relatively unknown concept where relevant quantitative instruments would be difficult to establish. As the purpose of this project was primarily looking at how employees use and feel about unified telecommunications, it was appropriate to use quantitative methods, as it allows informants to explain in-depth focus about the issues they feel are the most fundamental. Under the quantitative method of research, interview method was applied, where end user data were collected in relation to the impact of unified telecommunications in their operations and analyzed. Thereafter, based on the findings, the standalone unified telecommunication system was developed and configured for staff with an objective of testing the solution to prove the findings got from the interview. However the solution did not have a centralized management store which at the end, did not map the findings from the interview undertaken.

3.2.2. SURVEY METHOD

A research project undertaken by (Edwin, 2006) on a framework for establishing unified telecommunications applying an appropriate process for optimizing technology, survey method was used where they interacted with stakeholders to come up with a framework on a unified telecommunications solution suitable to the given staff based on the needs assessment. The framework developed was a solution is linked to IP PBX such that for connectivity purposes, IP PBX creates sessions for staff, thus are in a position to use the system. It can also be channeled through an IP Phone system where through IP PBX connectivity over the IP Phone system, unified telecommunication solution will be enhanced for staff to function effectively. At the end of it all, the main problem of scalability was not addressed since it did not have the element of testability to meet user requirements.

3.2.3 CASE STUDY METHOD

A research project undertaken by (Bradley and Shah, 2010) on driving efficiency in unified communications, they applied Case Study research where they mapped information collected from different organizations totaling to 100 which in the end, the study of unified communication was realized. From the given literature, Interviews, Survey and case study research methodologies have been used.

3.3 EVALUATION OF CURRENT METHODOLOGIES AND RELATED ATTRIBUTES.

Unified telecommunications have given set of attributes and the table below denotes the evaluation of the attributes in relation to the methodologies applied. The table has methodologies that have been sampled to be applied in earlier unified telecommunication research and whether it will support the current attributes of a unified telecommunication solution to be implemented in N-Tier Server architecture as per the problem statement and literature review.

ATTRIBUTE/METHODOLOGY	INTERVIEWS	CASE STUDY	SURVEY	EXPERIMENTAL
NETWORK TRACING.	N	N	Y	Y
KNOWING AVAILABILITY OF THE OTHER STAFF.	N	N	N	Y
UNIFIED MESSAGING.	N	N	N	Y
INTEGRATED AUDIO CONFRENCING.	N	N	Y	Y
INSTANT MESSAGING.	N	N	N	Y
CALL ROUTING.	N	N	N	Y
EXTENSION DIALING ACROSS ALL DEPARTMENTS.	N	N	Y	Y
ABILITY TO SIMULATE UNIFIED TELECOMMUNICATIONS.	N	N	N	Y

TABLE 1: EVALUATION OF ATTRIBUTES OF UNIFIED TELECOMMUNICATION AND RELATED METHODOLOGY.

KEY: N – METHODOLOGY NOT SUPPORTED RELATED TO THE ATTRIBUTE.

Y - METHODOLOGY SUPPORTED RELATED TO THE ATTRIBUTE.

From the above analysis, interview methodology is not suitable because of the accuracy of output from the end staff since they can be intimidated easily and thus proving the efficiency of the solution will prove difficult especially on the voice data element which is key in the research project. Case study is not suitable because it doesn't have the element of proving facts since is based on past activity which cannot be ascertained on the spot. The survey method could have been most preferred but is limited to checking the effectiveness of configurations, especially on unified messaging, instant messaging and simulation effectiveness. It only applies to the front end output and back end output not effective thus methodology not applicable.

3.3 PROPOSED METHODOLOGY.

3.3.1 EXPERIMENTAL RESEARCH

The methodology to be adopted in the implementation of the unified telecommunication solution on N-Tier Server architecture is Experimental Research methods. Lab Experimental Research is

an organized procedure or steps carried out with the ultimate goal of verifying or establishing the validity of a solution. In this case, the solution will be configured on the server then end staff will interact with the system by making voice calls which in the long run prove that by having a unified telecommunications solution on an N-Tier server architecture, efficiency will be achieved and costs will be at manageable levels since there will be no need of having PBX.

The gains that come along with the proposed methodology are:

- It contributes to cumulative knowledge
- The researcher has exclusive control over variables.
- Improvements to new ideas and insights.

3.4 EVALUATION OF TOOLS

There are various tools that can be used to implement the unified telecommunication solution on N-Tier Server Architecture. The table below shows evaluation of tools to be used in the implementation of the unified telecommunication solution for N-Tier server architecture.

ATTRIBUTE/TOOLS	SHORE TEL 8	LENK CS	AURA-AVAYA	LOTUS SAMETIME	OPENSPACE UC
CAN FUNCTION UNDER WINDOWS PLAFORM.	Y	Y	Y	Y	N
HAS THE ABILITY TO SIMULATE/DEVELOP TOPOLOGY BEFORE IMPLEMENTATION.	N	Y	N	N	N
CAN FUNCTION WITH DESKTOP COMPUTER.	N	Y	N	N	N
CAN INTEROPERATE WITH OTHER SYSTEMS.	N	Y	N	N	Y
HAS VOIP CAPABILITY.	Y	Y	N	Y	Y

CAPABILITY TO SHIFT LIVECALLS.	N	Y	Y	N	Y
CAN WORK UNDER WEB BASED PLATFORM.	N	Y	N	N	N
CAN FUNCTION UNDER N-TIER SERVER ARCHITECTURE	N	Y	Y	N	N

TABLE 2: EVALUATION OF ATTRIBUTES OF UNIFIED TELECOMMUNICATION AND RELATED TOOLS.

3.5 PROPOSED TOOL.

3.5.1 LENK CS TOOL

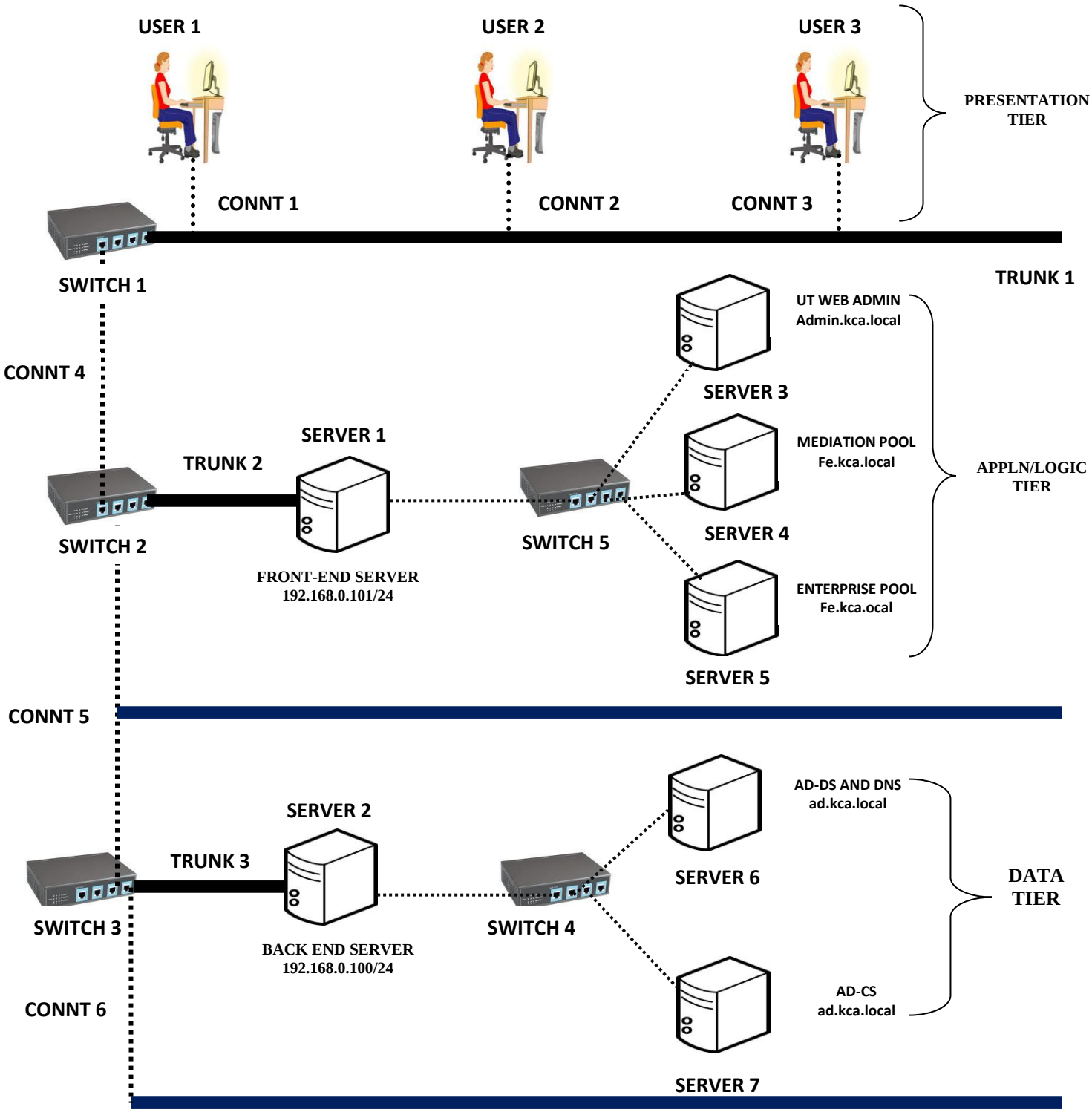
From the analysis above, the Lenk CS tool is most preferred because it will function on computers where they will function as client server technology. The tool has room for simulation where one defines the topology and thereafter transferred to the implementation tool which will address the telecommunications challenges facing organizations.

The benefits of the Lenk CS tool to be used are:

- It can integrate with other existing tools without the need to further modify.
- It can work on client computers and Servers effectively.
- It is highly scalable.
- It is affordable.
- It is flexible and in the event of any change, is accommodative.

CHAPTER 4: CONCEPTUAL DESIGN.

4.1 CONCEPTUAL DESIGN



4.2 INTRODUCTION OF THE CONCEPTUAL DESIGN.

The conceptual diagram above depicts the implementation of unified telecommunication on N-Tier server architecture. The N-Tier server architecture is clustered down into three layers which have mapped the core components of the unified telecommunication infrastructure that will in the end tackle the challenges of telecommunication in the organization.

4.3 N-TIER SERVER ARCHITECTURE.

4.3.1 DATA TIER.

The role of this tier is to handle data management. It comprises of data rollout mechanisms that encompass moderate realism, which allow access to data. In the implementation of unified telecommunication, the back end server resides in this layer. The back end server comprises of two sub servers, DS and CS. The DS host staff and computers, For staff, they are created under user segment by specifying preferred username and valid password. Once they have been created, they are activated so that they can be able to login to a computer on a local area network. For computers, are mapped to the server through domain name which enables the server to recognize the computer as a child computer. Based on this perspective, the two components go hand in hand because a user will login to a computer registered by the server and his or her credentials validated and verified as per the information registered upon creation of an account. The same back end server hosts CS that issues secured certificate, digital in nature for browsers to access the web based unified telecommunication web admin platform for system administrator to administer the functionality of the unified telecommunication system.

Based on the above illustration, this layer is a prerequisite for the successful implementation of the unified telecommunication solution on N-Tier Server Architecture.

4.3.2 APPLICATION/LOGIC TIER.

This tier acts as an intermediary between the presentation tier and data tier. They relate to each other through communication and usually consist of applications that perform verification and personalization. Under the unified telecommunications, the tier hosts the front end server that will host the unified telecommunication infrastructure. The component under the application/logic tier consists of the following:

- **UT WEB ADMIN**: This is the heart of the unified telecommunication because system administrators administer usage of the solution to staff. From the platform, staff is pulled from the back end server and activated to access unified telecommunication solutions through the unified telecommunication client interface. Once the user has been pulled, he or she is mapped to the components accessible at her disposal and validated to communicate with other end staff. The platform also integrates components from the enterprise pool and the mediation pool so that the overall functionality of the solution is achieved.
- **MEDIATION POOL:** This is a component under unified telecommunication that mediates the unified telecommunication infrastructure and the entire components of the back end server. The mediation pool configures the schema modal to the back end server and set attributes that will be used to map domain name to the front end server so that in the end there will be negotiation link between the two servers. Once negotiation link has been established, a global view log is formed to activate the interoperability.
- **ENTERPRISE POOL:** This is the focal point of the management and utilization of unified telecommunication infrastructure. It is from here where various components are

specified and programmed to meet the purpose of unified telecommunication like voice, enterprise dialing plan and conference. It is from here where a logical database is created to map staff from back-end server to be accessed through unified telecommunication web admin portal. The enterprise pool also allows for mapping of simulated unified telecommunication components to real time functionality, thus reducing time to develop the platform from scratch.

- **4.3.3: PRESENTATION TIER.**

This tier is where staff access the unified telecommunication solution to aid their operations. It comprises of unified telecommunication client interface which has voice, messaging and screen sharing.

4.4 SECURITY OF THE UNIFIED TELECOMMUNCATION SOLUTION.

The unified telecommunication solution has been designed to meet the following goals of security on the N-Tier server architecture platform:

Confidentiality: This is meant to ensure that communication between staff in the organization is protected from unauthorized access. In the unified telecommunication solution, staff will be validated from the back-end server through unified telecommunication web admin portal.

Integrity: These are strategies put in place to protect the solution from unauthorized modifications or deletion of messaging. In the unified telecommunication solution, archiving of messaging will be undertaken in the back end server where no user can access without approval by the system administrator.

Availability: They will access through the unified telecommunication client interface and ensuring that the server services are not stopped so that staff are denied access to the solution to aide them communicate effectively. The system administrator can also access the unified

telecommunication web admin platform on any computer on the network, thus can be in a position to support staff anywhere within the organization thus no need to be at his/her desk to offer support.

4.5 NETWORK SETUP

From the conceptual diagram, the unified telecommunication solution will purely function on a local area network because the main focus is the issue of inter-organization communication that is key and best principle in any success of an organization. The switches are intelligent in nature such that they are able to filter communication traffic thus minimize collisions.

4.6 WEB BASED PLATFORM

The unified telecommunication web admin platform will be web based running on hyper text transfer protocol secure. This will be mapped on the enterprise pool that is linked to the back end server's domain service. The system administrator will be in a position to support users at the comfort of their desk.

4.7 SUMMARY OF CONCEPTUAL DESIGN.

The conceptual design has fully illustrated the implementation of the unified telecommunication solution on N-Tier Server architecture. The front end and back end server will be virtualized to ensure that there will be no need to two physical servers to aid their operations, but one server will serve the two. On the back end server, the DS and CS are applications based thus all of them will reside on the server. The same theory applies to the front end server components. The entire components are connected to a local area network through switches and staff interact the unified telecommunication solution through a client interface. In the event of a segmented network, a router is configured to allow communication from separate network segments.

4.8 REQUIREMENTS FOR UNIFIED TELECOMMUNICATION SOLUTION ON N-TIER SERVER ARCHITECTURE.

	ITEM DESCRIPTION	SPECIFICATIONS
1	HARDWARE	Desktop Computer: Dual Core 2.8 GHZ CPU SPEED, 4GB RAM, 500GB HDD. Laptop: Intel ® Core i3, 2GB RAM, 500GB HDD. Network Switch-8 Port. CAT 5E Network Cables.
2	OPERATING SYSTEM	Windows Server 2012, Windows 8.
3	APPLICATION TOOL	Lenk CS Tool.
4	OTHER TOOLS	HYPER VIRTUALIZATION TOOL. PACKET TRACER 5.1.

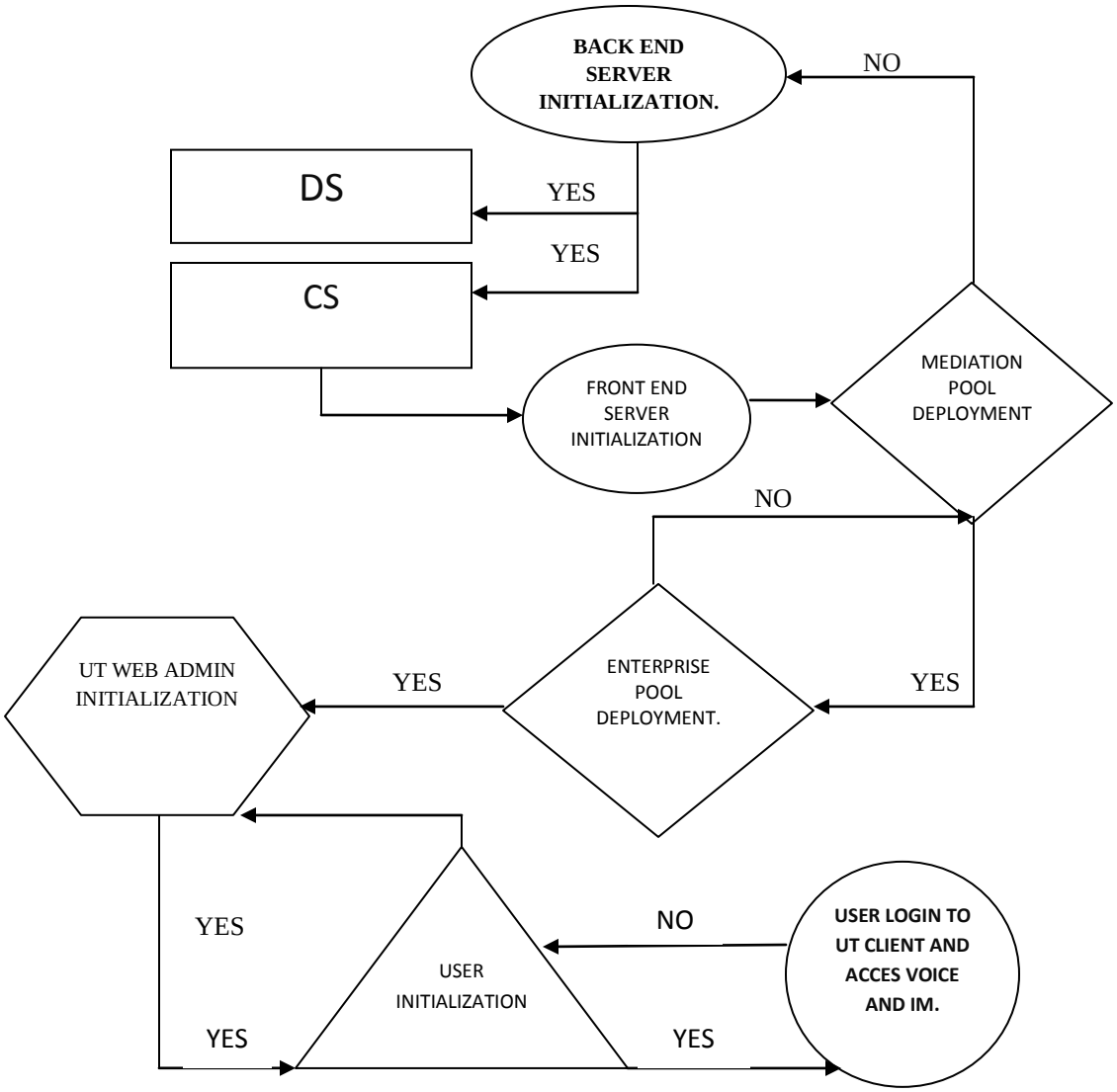
TABLE 3: HARDWARE AND SOFTWARE SPECIFICATIONS.

CHAPTER 5 IMPLEMENTATION

5.1 INTRODUCTION

The unified telecommunication solution will be implemented on a server based network running on a local area network. This type of implementation was selected because it cuts costs of infrastructure in the sense that one server is used to host two servers running virtually. The other reason is that it allows room for ease of administration because the servers will run on one platform that will be interoperable and in the end the system administrator will be in a position to monitor and administer the system with a lot of ease.

FIGURE 4: IMPLEMENTATION MODEL.



From the above implementation model, the back end server hosts the DS and CS.

The DS is configured to host the domain name and the staff who in the long run, must be in a position to access the unified telecommunication client interface. The active directory certificate service will authenticate and issue digital certificate to browsers that will access the unified telecommunication web administration platform. Once they have been configured, the front end server is configured where the mediation pool is programmed.

Once the components have been configured, the enterprise pool is set up where the unified telecommunication topology is defined to consist of audio, video, application sharing, enterprise voice and traffic control management. After the setup, the components are collocated together with the mediation pool to form a unified telecommunication web administrator tool, which will be used to initialize staff from active directory so that they are in a position to use voice communication. By the end of it all, the authenticated user should be in a position to access unified telecommunication client interface.

5.2 INPUT FROM THE SYSTEM

- Joining the computer to a domain.
- Creation of Staff in the back end server.
- User Logging in to the unified telecommunication solution.

5.3 OUTPUT FROM THE SYSTEM

- The user is able to send instant messages.
- The user is able to call back.
- The solution being able to allow verified user to log in.

CHAPTER 6 TESTING AND RESULTS.

6.1: TESTING PROCEDURE

The diagram flow chart below shows the testing procedure for the unified telecommunication solution on N-Tier server architecture.

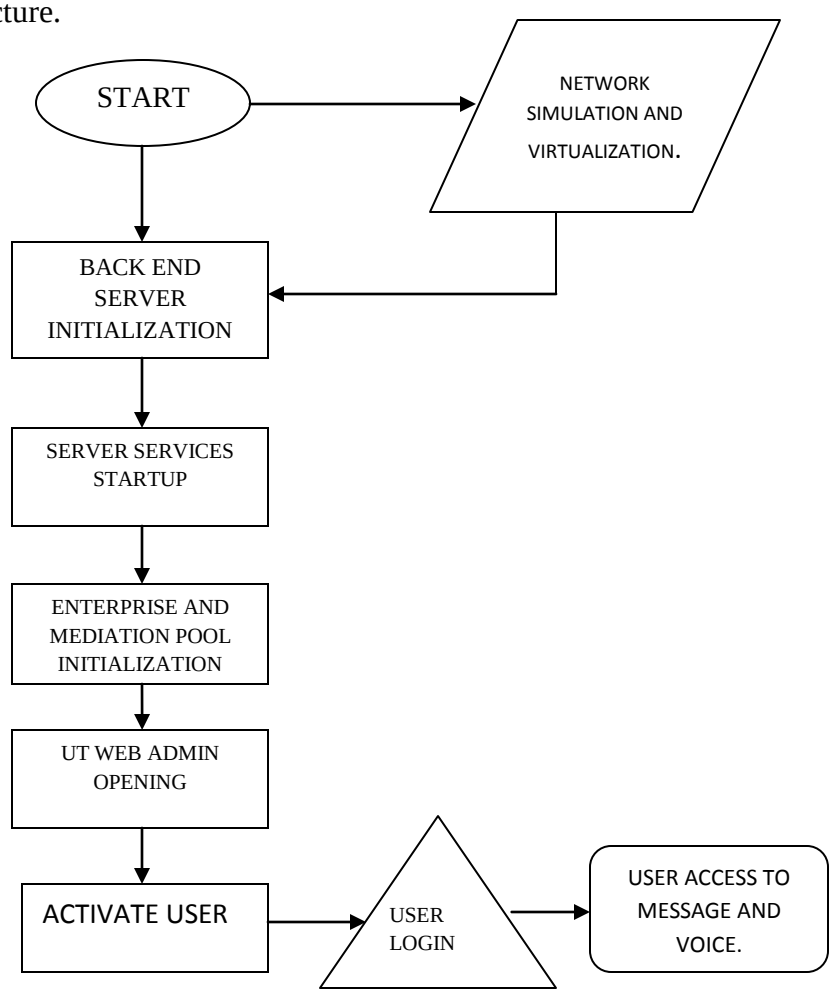


FIGURE 5: TEST PROCEDURE.

FIGURE 5: TEST PROCEDURE

From the above procedure, the network is tested through initialization where the nodes on the network are powered on and the connectivity commands are run to ascertain that they are communicating. Once they have been run, and functioning, the back end server is initialized by loading a program and system files. Thereafter the services are started after which in the event

there is a delayed service like the front end service, is then force start because without it, then the solution cannot function effectively. On the enterprise and mediation pool initialization, they are tested by opening the unified telecommunication web admin portal since they facilitate the running of the solution and if it does not function, then they need to be re-programmed for it to function. However, if the unified telecommunication web admin portal is functioning as required, then the portal should be accessible through a web browser. By the end of the test, the end user should be in a position to send messages and communicate with other staff on the network.

6.2 RESULTS AFTER APPLYING TEST PROCEDURE

In the first instance, we set up the network so that clients can access the unified telecommunication system through the server as shown on the diagram below:

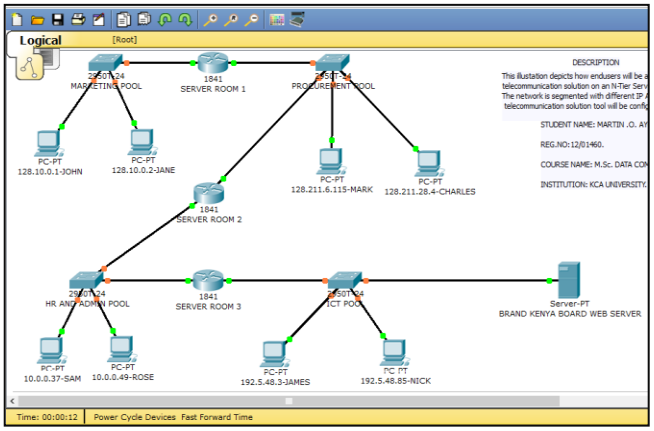


FIGURE 6: SIMULATED NETWORK

The simulation above applies to organizations having various departments and operating on different network segments. The router was used to allow room for different network segments to communicate since they operate on a private network. When testing the network, ping command is used and the expected outcome is to return it responds by returning time to live with

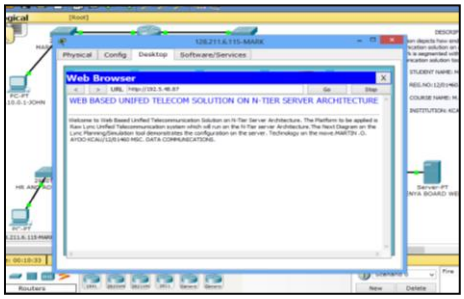
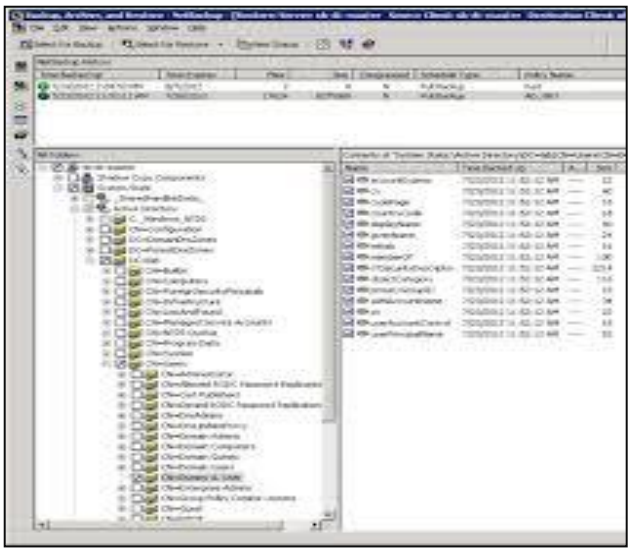
distance mileage of communication, meaning that the client computer can access the front end and back end server and other client computers. The protocol used to define the connectivity between client and server through the router is Enhanced Interior Gateway Routing Protocol. This protocol analyses and auto respond routing decisions against advanced distance vector routing. The output from the client computer accessing simulated back-end server denoting connectivity is shown  below:

FIGURE 7: OUTPUT FROM SIMULATED NETWORK.

From the above once the network is fine, we virtualize the server to run two systems, i.e. domain service, certificate service and front edge server. The tool to use is a hyper virtualization tool that divides the physical server into two or more logical servers. Once it has been virtualized, the directory service is created and populated with staff. The certificate services will also be configured and tested that will allow browsers to access unified telecommunication web admin platform through the server. From the output shown below, staff from the domain service will be able to access the unified telecommunication client system from the network.

FIGURE 8: OUTCOME OF BACK END SERVER INITIALIZATION.



Once the domain service is up and running, the Lenk CS TOOL is configured to link up the domain service and certificate services server to enable staff access the unified telecommunication tool for voice and messaging.

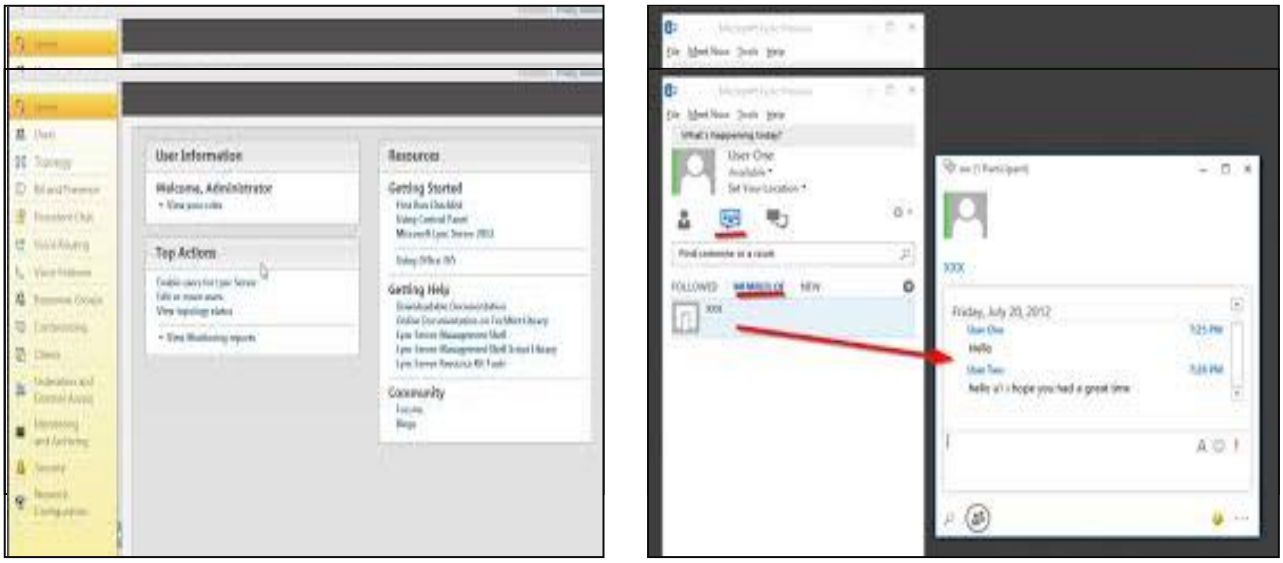


FIGURE 9: OUTCOME AFTER ENTERPRISE POOL AND UT WEB ADMIN POOL STARTUP.

From the above results we see that the infrastructure has been utilized effectively since the server has been virtualized and clients' access unified telecommunication solution on N-Tier Server Architecture. By this implementation, PABX/PBX has been replaced with the unified telecommunication system through active directory and unified telecommunication

administration tool which will improve ease of administration and overall security of information system.

CHAPTER 7: DISCUSSIONS, CONCLUSIONS, RECOMMENDATIONS AND FURTHER WORK.

7.1 DISCUSSIONS

The integration of web based unified telecommunication solution on N-Tier server architecture led to the achievement of the objectives highlighted in the project as follows:

Objective 1: To identify Unified telecommunication solutions and other technologies used in telecommunications. In this objective, there exist solutions and technologies touching unified telecommunications but one major component that was lacking is how to tackle technological challenges which was fundamental. In the research project, the technologies and solutions were critiqued and in the end, web based unified telecommunication solution on N-Tier server architecture was most preferred. This was achieved under research methodology chapter.

Objectives 2: To design the unified telecommunication solution on N-Tier server architecture. In this objective, I was able to come up with a conceptual design model, which was designed to ensure that the telecommunication challenges are addressed. It involved linking web based unified telecommunication solution and the N-Tier server architecture. This was done and achieved under conceptual design chapter.

Objective 3: To implement the unified telecommunication solution on N-Tier server architecture. With this objective, I implemented the unified telecommunication solution on N-Tier server architecture where the data layer was running the ADDS and ADCS, Application layer was configured the Enterprise pool and mediation pool servers and UT web admin tool. The presentation layer was configured the web client interface for end users to access the telecommunication platform.This was achieved under Implementation chapter.

Objective 4: To test and validate the unified telecommunication solution on N-Tier server architecture. This was achieved after implementation where the solution was pilot run at the institution and yielded results. This meant that the solution indeed addressed the telecommunication challenges facing many organizations. This was achieved under testing and results chapter.

7.2 CONCLUSIONS.

From the research project, we see that the infrastructure has been utilized effectively since the server has been virtualized and clients' access unified telecommunication solution on N-Tier Server Architecture. By this implementation, PABX/PBX has been replaced with the unified telecommunication system through active directory and unified telecommunication administration tool which will improve ease of administration and overall security of information system.

The research project has achieved the objective of efficient utilization of available resources in a given organization and improving security of telecommunication thus enhancing efficiency.

7.2 ACCOMPLISHMENTS.

- Skills of virtualizing one physical server to two logical servers were acquired.
- Simulation of virtual networking segmentation and unified telecommunications on N-Tier server architecture was done.
- Transferring the simulation to real environment and testing was successful.
- Command language for web based unified telecommunication and integration of back-end and front-end server setup was successful.

7.3 CHALLENGES.

i. The installation and configuration of the unified telecommunication solution took a long time.

ii. Learning a new programming concept for integration in unified telecommunication solution took time.

iii. Integration of Active directory and unified telecommunication topology was highly complex.

7.4 RECOMMENDATIONS.

Since the solution has been successfully implemented, I recommend organizations to embrace the technology and as a result, they will gain return for their money. The research proposes that PBX/PABX system be phased out gradually as the unified telecommunication solution is being adopted for the challenge with new technology is a gradual acceptance to change.

7.5 FURTHER WORK.

The area of unified telecommunications is still new and the majority of organizations is yet to embrace this technology. The research proposes implementation of mobile web based unified telecommunication solution that will be mapped to a server running on a local area network such that staff members can as well use their mobile phones to interact and communicate for the well being of the organization.

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