

**E-POLICING AS A SERVICE: THE WAY FORWARD  
IN ZAMBIA**

BY  
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## DECLARATION

I, **Joel Njase** hereby declare that this dissertation represents my own work and that it has not been previously submitted for a degree at this or any other university.

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## ABSTRACT

E-policing as a service is a newly extended research concept of e-policing. It strikes a balance on cloud computing or mobile cloud computing concepts and applied policing strategies in matters of public security. The recent past has witnessed extensive expansion in broadband networks and mobile technology, resulting in an unmatched degree of connectivity for ordinary citizens across the world. However, the electronic collection, storage and sharing of complaints and information between public and the Police is still a major challenge in Zambia. A qualitative research study was conducted through analysis of data obtained from unstructured interviews, observations and focus group guided by initial conceptual literature review. The research revealed that, there was no effective inter-operable communication channel between the Police and the citizens for sharing information, no specific policing strategy to optimize use of technology to enhance cooperation, and lack of institutional capacity to deal with matters of change management in digitalization process of the Zambia police systems and procedures. Therefore; to provide a cost effective communication channel for enhanced information collection, storage and information sharing from paper based system to electronic system , a generic text e-messaging application was designed using unified modeling language (UML) and then developed using object oriented language namely Java. To optimize use of existing public ICT and Telecommunication infrastructure, concepts on cloud computing, Open Service Architecture (OSA) and Intelligent Network (IN) were utilized through key technological features of divorced or independent business service logic from Network Control in respect to telecommunication infrastructure. Lastly, recommendations on factors that confront e-Policing adoption and implementation are discussed. Therefore, accessibility to police service and other factors such as building services around citizen choices, provision for social inclusion, and making better use of information from a centralized database system the way forward in Zambia.

**KEY WORDS:** Electronic policing, Policing strategies, Information sharing, Cloud computing, OSA, Generic application.

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Last but not least, I owe my greatest thanks to the Almighty God.

## **DEDICATION**

This research is dedicated to my late father Dennis Syazemba Njase; who passed on at the age of 65 years on 14/05/2013 at Victoria Hospital in Lusaka, for teaching me to work hard and realizing my Engineering dream profession. Further as a child he taught me to love other people regardless of tribe, color, religion and above all being honesty. I remember how I struggled to make it to grade eight (8) after a third attempt. I didn't believe in myself but he encouraged me to continue my education and warned at the same time that, he would not allow me to secondary school until I got correct pass marks. This is what motivated me to realize that, what man has done, man can do. I am that man, with a new belief and hope to bring change to the poor and encourage Africa that we need to get things right for our children as well as grandchildren. Today, am humbled that after a long journey his vision for my life is coming true and I will continue to next level. His wisdom in analyzing things and skillful balancing of choice of words; was yet another character that today echo's in my mind, and has immensely assisted me in my research conducted in a law enforcement institution. May his soul rest in peace and I shall forever be grateful. To God be the Glory and honor for his life till we meet again.

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## **LIST OF ABBREVIATIONS**

**AFIS** – Automated Fingerprint Information System

**ABIS** – Automated Ballistic Information System

**API**- Application Programming Interface

**CADB** – Criminal Attribute Database

**DNA** – Deoxyribonucleic Acid

**GSM** – Global System for Mobile Communications

**I24/7** – International police information system (Interpol)

**ICT**-Information and communication Technology

**IP** – Internet protocol

**ISDN** – Integrated service digital Network

**OASIS**– Organisation for Advancement of Structured Information Standards

**OO** – Object Oriented

**OSA** – Open Service Architecture

**OS** – Operating system.

**PCIP**- Pacific council on International Policy

**PSTN** – Public Switching Telephone Network

**SMS** – Short Message System

**SOA** – Service Oriented Architecture.

**SOAP**– Simple Object Access Protocol

**SOBA** – Service Oriented Business Application.

**TCP** – Transmission Control Protocol

**UDDI** – Universal Description Discovery and Integration

**UML** – Unified Modeling Language

**WSDL** – Web Service Description Language

**XAAS** – Everything as a Service

**XML** – Extensible Mark-up Language

**ZICTA** – Zambia Information Communication and Technology Authority

**ZP** – Zambia Police

# **1 CHAPTER 1 INTRODUCTION**

Current e-policing research focuses on use and adoption of information and communication technology (ICT's) in police operations. Mostly, the research is underpinned by two previous research theories namely Technology Acceptance Model (TAM) and the Theory of Reasoned Action (TRA). However, in order to improve police /public cooperation we extend the aforementioned concept to e-policing as a service and the way forward need further research.

## **1.1 Background**

According, to the 2015 Zambia Police annual report the fast increasing population of approximately 15,000,000 people and recent infrastructure development in Zambia, has brought numerous operational challenges to the Zambia Police Service. The internationally recognised police to client ratio are 1:500 however, in Zambia the police to client ratio stand at 1:859 and in this regard e-policing as a service play an important role in establishing virtual policing to bridge the gap of insufficient manpower. For the purpose of this research, focus will relate to the migration from paper based to electronic collection, storage and sharing of information between police and the public. Therefore, choice of technology, cost and infrastructure needed for information sharing requires e-policing as a Service by integrating middleware technologies in a customized application especially under Intelligent Networks (IN). E-Policing as a service (e-PaaS) is specialized electronic service application for virtual policing. It strikes a balance on mobile cloud computing or cloud computing concept for everything as a service (XaaS), infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS), through integrated policing strategies in matters of public security. To appreciate this concept, understanding what e- Policing means is very important.

## **1.2 Electronic policing**

According to (LeBeuf, 2006) e-policing is electronic collection, storage and sharing of complaints and information from citizens. Further, electronic policing is the use of Information and Communication Technology (ICTs) in police work to improve effectiveness and efficiency, supporting front-line officers and assisting in local problem-solving initiative to reduce crime and reassure public (Boondao and Tripathi, 2007). In our understanding from this research, e-policing is the electronic means of accessing, storing and sharing of information between police and the public in matters of security. The accelerated development in Information and Communication Technology (ICTs) and Telecommunication services has brought numerous benefits in e-Health, e-Commerce, e-Education

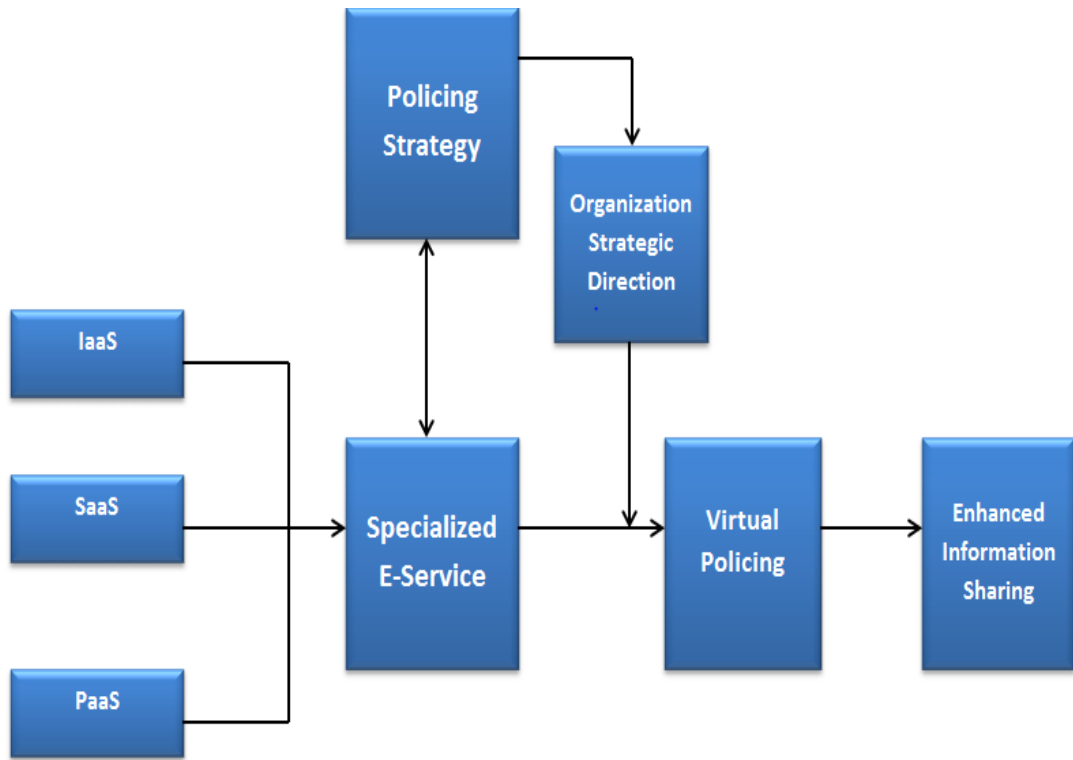
and e-Government. Accordingly, three specific areas of e-government can be identified (Marchionini et al., 2003): access to information, transaction service and citizen participation. Notwithstanding; how can citizens access information, conduct transaction service and participate, with low internet penetration of 15.4 percent in Zambia especially in matters of public safety. In contrast; mobile technology penetration is now 77 percent according to Zambia Information Communication and Technology Authority (ZICTA), but has equally not witnessed increased information sharing and inter-networking between Police and the Public. Further, the different existing communication platforms and infrastructure between the public service providers and the Zambia police service communication infrastructure has equally resulted in lack of inter-operable communication channel.

This is where electronic Policing as a Service plays a pivotal role in providing communication platform for the public to engage Zambia police service in matters of public security. According to (Ashby and Longley, 2005) technology is currently used to support policing in several ways, such as database systems to record crime details and geographic information systems to profile the characteristics of local policing environment, crime profiles and police performance to provide increased intelligence, especially when it comes to public security through virtual policing.

The conceptual model in figure 1 illustrates realization of e-Policing as a Service through integration of cloud computing service concepts such as Infrastructure as a Service (IaaS), Software as a Service, Platform as a Service and applied policing strategies. Without the cooperation of the Public, policing becomes very difficult to implement and at the core of this cooperation demands information and the sharing of information for effective law enforcement (Le Beuf 2003). In their research (Liu and Hu, 2005) stated that in order to have improved accessibility to police service and other factors critical for e-policing must include:

1. Building services around citizen choices,
2. Proving for social inclusion, and
3. Making better use of information

The aforementioned critical factors provide necessary requirements specification for e-Policing as a Service in our research.



**Figure 1:** Proposed Conceptual e-PaaS Model

### 1.3 Current Situation in the Zambia Police Service

The Zambia Police Service has been in existence since 1964 and was established under Article 193 of the constitution of Zambia. The mandate and functions of the Zambia Police Service are provided for in the constitution under Article 104 and the Zambia Police Act Chapter 107. The Zambia police service is mandated by law to:

1. Protect life and property,
2. Preserve law and order,
3. Detect and prevent crime,
4. Cooperate with the civilian and security organs established under the constitution,
5. Apprehend offenders against peace, and
6. Preserve peace.

Zambia police service has fairly managed issues of public security since the country's independence in 1964; however public perception on their effectiveness and efficiency has not been good. This can be attributed largely due to mistrust and unprofessional conduct by some members of the police towards victims of crime and the Public in general. Further, lack of clear policing strategies and poor information management as a result of intensive paper-based system used for information collection, storage and lack of efficient means to share information with stakeholders especially the Public. Therefore substantial amounts of time (Chan et al., 2001) are spent on completing reports, and huge resources are expended on administering paper flows, storing and maintaining records. This leads to delayed processing of criminal cases, traffic offences and its common knowledge that justice delayed is justice denied.

In order to improve its operations and services, the Zambia Police has since started modernizing work flow systems and procedures, through use of Information and Communication Technology (ICTs). It is important to note that the Zambia Police (Strategic Plan, 2013-2016) three indicative core functional structures include:

1. Human Resource and Administration,
2. Crime prevention and Law Enforcement, and
3. Research, Planning & Information Management.

Under the third indicative core functional structure a number of high impact technologies (koper et al., 2009) have been implemented and they have since created effective and efficient case analysis. However cost benefit analysis in respect to investment, impact on operations and expected benefits to the community has not yet been evaluated. Suffice to mention that, while advancement are being made to improve internal Police information systems, little has been done to provide external communication channels, to enhance efficiency and cooperation between Zambia Police and the public.

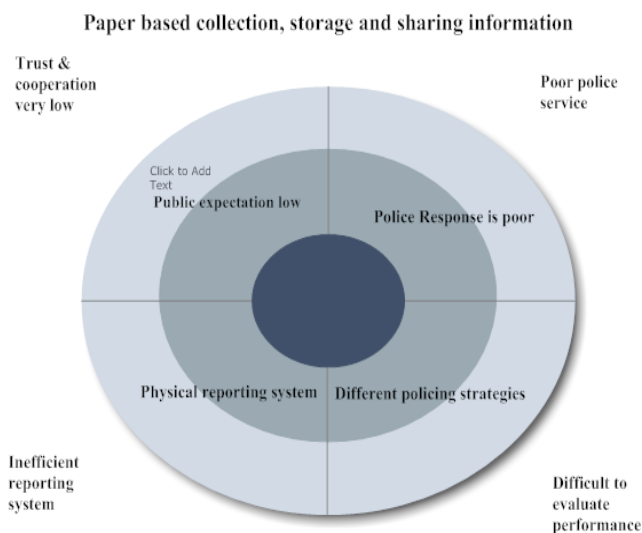
### **1.3.1 Existing policing conceptual model**

Figure 2 illustrates, the current situation related to information collection, storage and information sharing between Zambia police and the Public, and includes the following:

1. Physical presence of the members of the public to give reports or find out on information relating to subject of interest,
2. Delayed reporting due period taken to reach the station and if it is late in the night the report will be made the following day,

3. The adopted Policing strategies have no specific technological optimization tools to access, store and sharing of information with the community,
4. No centralized administrative reporting system hence difficult in providing timely reports on crime and other information ,
5. Use of paper to collect, store information hence require huge storage space,
6. Information sharing between the police and the public is poor.
7. Due to lack of consultation and community participation in issues of public safety a lot of mistrust exists.
8. Current strategies are good for physical law enforcement.

As a result of the aforementioned critical information is not shared and delayed response is the end product.

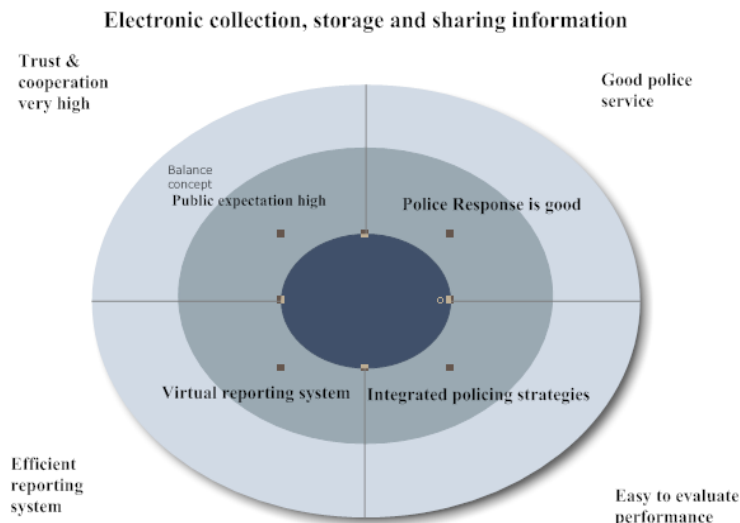


**Figure 2:** Current Conceptual policing model – ZP

### 1.3.2 Our proposed Model: Balanced Wheel Model

We propose a conceptual model as shown in Figure 3. Adopting an integrated strategic approach on policing matters and an inter-operable choice of ICT, which is cost effective provides shared concept on balanced wheel model. Advantages include:

1. No physical presence is required at police station or post to get any service,
2. Virtual policing to enforce law and order through effective command and control center,
3. The Public and the police have improved cooperation,
4. Information sharing between the police and the public is effective,
5. Consultation and Public participation in issues of public security is encouraged, hence improved trust and corporation, and
6. Provision of effective and efficient multi-channel communication media is established for electronic collection, storage and information sharing.



**Figure 3: Balanced Wheel Model**

#### **1.4 Statement of Problem**

The recent past (Perlman, 2012) has witnessed extensive expansion in broadband networks and mobile technology, affording ordinary citizens an unmatched level of connectivity. However, the electronic collection, storage and sharing of complaints and information between citizens and the Police is still a major challenge in Zambia.

## **1.5 Objective**

The main objective is to enhance electronic collection, storage and information sharing between Zambia Police and the Public, in order to improve efficiency and cooperation. Specific objectives include:

1. To develop a generic e-messaging application using object oriented language (Java),
2. To identify issues that confront adoption and implementation of e-policing as a service, and
3. To optimize use of existing ICT's/telecommunication infrastructure in e-policing as a service.

## **1.6 Research Questions**

1. What functional specifications are necessary for electronic collection, storage and information sharing between police and the public?
2. What issues confront adoption and implementation of e-policing as service, and
3. How can ICT's/telecommunication infrastructure be optimized to enhance e-policing as a service?

## **1.7 Justification**

The research has resulted in a generic e-messaging application to bridge the gap between the Zambia police and the public in information sharing. Additionally, a choice of multi-channel on e-Policing service, using mobile technology especially for those who cannot afford internet services will be realized.

## **1.8 Outline of the report**

The study report is divided into five chapters and includes the following:

**Chapter 1-** This deals with the introduction and includes background on what is e-policing as a service and related value definition of e-policing concept .The chapter also provides the current situation in Zambia Police vis- a- vis information collection, storage and information sharing . It further explains the efforts being made by the Zambia Police to enhance the use of Information and Communication Technology in police work and existing Policing conceptual model and the proposed policing conceptual model (Balanced Wheel Model).The problem statement and objectives are also included and ends with the scope or focus of this research.

**Chapter 2-** The literature review firstly deals with conceptual frame work on e-government and then the Zambian government position on the subject matter. Further, how e-government programs relate to e-policing in general. Secondly, it deals with the issue on policing strategies in respect to information collection and information sharing. The literature also deals with a number of arguments on e-policing adoption issues, the way forward on adoption and implementation of e-policing as a service. Lastly the required technology and understanding in the use of existing ICT/telecommunication infrastructure to connect private Organisations to the public.

**Chapter 3** - describes the materials and methodology through qualitative research, where the end result is a generic e-Policing application. Components of generic e-policing application, other things to consider for effective running of the application that is taking advantage of existing technologies. Designing of the system using star UML (Unified Modeling Language) and lastly is the development of the application using Java and MySQL tools. The first phase of testing uses white-box testing approach on the developer side and uses black box testing on the user side. Design stages include use of diagram provided in star UML, such as Context Diagram, Class Diagram, Use Case Diagram, and Sequence Diagram. Lastly, it deals with the methodology and then chapter summary.

**Chapter 4** - deals with the results and analysis of a generic e-policing application for electronic collection, storage and information sharing between the police the community.

**Chapter 5** - This is the last chapter and deals with conclusion of the research and recommendations on adoption and implementation of electronic Policing as a service. This was achieved, through applying a balanced analytical view in respect to strategic approach on policing matters.

## **1.9 Summary**

This chapter dealt with the introduction, background, the main objective, specific objectives, research questions, and provides the general outline of the dissertation. The recent past (Perlman, 2012) has witnessed extensive expansion in broadband networks and mobile technology, affording ordinary citizens an unmatched level of connectivity. However, the electronic collection, storage and sharing of complaints and information between citizens and the Police is still a major challenge in Zambia. Substantial amounts of time (Chan et al., 2001) are spent on completing reports, huge resources are expended on administering paper flows, storing and maintaining records, but the electronic collection and storage

improves efficiency. The main objective for this research is to enhance electronic collection, storage and information sharing between Zambia police and the public, in order to improve efficiency and cooperation. According to (LeBeuf, 2006) e-policing is electronic collection, storage and sharing of complaints and information from citizens. Electronic policing is the use of Information and Communication Technology (ICTs) in police work to improve effectiveness and efficiency, supporting front-line officers and assisting in local problem-solving initiative to reduce crime and reassure public (Boondao and Tripathi, 2007).

The research dealt with e-Policing as a service (e-PaaS), which is a specialized electronic service application for virtual policing. It strikes a balance on cloud computing concept for everything as a Service (XaaS) and applied policing strategies in matters of public security. It has resulted in a generic e-messaging application (e-ZP messaging system) to bridge the gap between the Zambia police and the public in information sharing. Additionally, a choice of multi-channel on e-Policing service, using mobile technology especially for those who cannot afford internet services will be realized.

## **2 CHAPTER 2 LITERATURE REVIEW**

### **2.1 Introduction**

The literature deals with conceptual frame on e-government and how it relates to e-policing. Further, it includes number of arguments on e-policing, adoption, implementation and the way forward in respect to new coined concept of e-policing as a service. To peruse this, a number of policing strategies are discussed and all find place in implementation of e-policing as a service. Lastly the required technology and understanding cloud computing in the use of existing ICT/telecommunication infrastructure to connect private Organisations to the public.

### **2.2 E-Government Conceptual framework**

Accordingly, three specific areas of e-government can be identified (Marchionini et al., 2003): access to information, transaction services and citizen participation, each plays a vital role in determination of e-policing and not forgetting e-policing as a service adoption and implementation.

The United Nation's guiding principles for crime prevention and Criminal Justice in the context of Development and a New International Economic order urge that "Community participation in all phases of crime prevention and criminal justice should be promoted and strengthened" (Viena. United Nations Office on Drugs and Crime, 2006). Further, the United Nation's Code of conduct for law Enforcement official states "every law enforcement agency should be representative of, and responsive and accountable to, the community as a whole". The latter demonstrates extent to which the Public influence matters of policing activities.

According to (Liu and Hu, 2005) the working group on E-Government in the developing world, under auspice of the Pacific Council on International Policy, listed the following as broad categories of the goals for e-government (PCIP, 2002) :

1. Improving services to citizens,
2. Improving the productivity (and efficiency) of government agencies,
3. Strengthening the legal system and law enforcement,
4. promoting priority economic sectors,
5. Improving the quality of life for disadvantaged communities, and
6. Strengthening good governance and broadening public participation.

Therefore a number of these goals can be effectively applied to e-policing as a service in Zambia and applying numerous features of local e-government as building block for service delivery, access and share information electronically 24 hours a day, 7 days a week (Liu and Hu, 2005) can be provided. The changing paradigm of law enforcement as well as new challenges, demands a parallel development in applied policing strategies in combating crime. Notwithstanding, “Policing is most obvious and apparent aspect of criminal justice system and a well-regarded police service is a prerequisite for the positive perception of justice” (Viena. United Nations Office on Drugs and Crime, 2006). In addition, the way in which policing is delivered will depend on a host of variables including the prevailing political and cultural doctrines as well as social, infrastructure and local tradition.

### **2.3 Policing strategies**

Owing to the growth of cities and increase in population in Zambia, a new strategic approach to national safety and protection of public property is important for both socio and economic development (Um, 2011). According to (United Nations Office for Drug and Crime, 2011) they categorized policing strategies into two broad areas which included:

#### **2.3.1 Traditional incident- based policing strategy**

This is face to face law enforcement strategy; where investigations and enforcing order, is done after a crime has been committed and it is not effective in controlling crime in most instances (Perlman, M., 2012). The mistrust between police and the public in complex urban space and remote rural areas can worsen the problem of combating crime in a country.

#### **2.3.2 Proactive strategies to control crime**

1. **Community-oriented policing strategy**-This is focused on developing ties between police and citizens in particular areas to gather intelligence and develop collaborative strategies to address crime concerns (Perlman, M., 2012). However, with poor access to information and lack of multi-channel connectivity between police and the public, building ties becomes a challenge. The purpose of the aforementioned strategy is to build public confidence in the authorities and the rule of law, as well as enhance public co-operation and participation.

2. **Problem-oriented policing strategy**- employs analysis techniques to help police understand crime problems and develop solutions to help prevent crime (Perlman, 2012; Jones and de Guzman, 2012). The main technique, underlying the

strategy uses scanning, analysis, response and assessment (SARA). At the heart, the strategy seeks to develop a deep understanding of a specific crime problem through empirical study of the problem.

**3. Intelligence-led policing strategy-** focuses on gathering information in efforts to deploy police resources to control crime (Perlman, 2012).

**4. Electronic Policing strategy-** focuses on the use of ICT's in combating crime through virtual policing in local communities. ICT has proved to increase efficiency and effectiveness of community policing in a number of countries (Perlman, 2012; Jones and de Guzman, 2011). The e-policing strategy uses community policing concept where the community members are involved in policing activities with the goal of fighting crime incidents (Busagala and Lilian, 2013).

## **2.4 Integrated Policing Strategy**

Since there are different policing strategies which if added result in a major challenge for police command; and once pursued simultaneously and aggressively, the different strategies would require significant changes in the mission, objectives, technologies and basic administrative arrangement of the police (Mark Moore and Robert Trojanowicz, 1988). Therefore, for application of strategies the Zambia Police must be open to discussions with the public about priorities, its operating procedure and its past performances. More importantly is the need to define cooperate strategy clearly and provide purpose that results in finding support from the public with respect to organizations efforts. This is where e-policing as a service finds its vital role as part of an integrated strategic approach with adoption and implementation of the aforementioned issues. In their research (Liu and Hu, 2005 ) stated that in order to have improved accessibility to police service and other factors critical for e-policing must include:

1. Building services around citizen choices,
2. Proving for social inclusion, and
3. Making better use of information

Notwithstanding, these factors affecting e-policing also applies to e-policing as a service, through optimization of technology for enhanced access to information between police and the public.

## **2.5 The way forward for e-policing in Zambia**

Conceptualizing E-Policing as a service (e-PaaS) in respect to specialized e-messaging application for virtual Policing coins a new approach to previous

research in e- Policing concept. It strikes a balance on cloud computing concept for everything as a Service (XaaS) and applied policing strategies in matters of public security. Moving data into the cloud (Rashid Husain, 2016) offers great convenience to users since they don't have to care about the complexities of direct hardware management. Consequently, cloud computing characteristic such as on-demand self-service, Broad Network Access, Resource Pooling, Rapid Elasticity and measured service cannot be over-emphasised (Abhishek and Maurer, 2014). Recent past research in this field of cloud computing has identified three service areas namely Software as a Service (SaaS), Infrastructure as a Service (IaaS) and Platform as a Service (PaaS). Further, research in cloud computing with respect to establishing; whether agile methodologies are beneficial or not in developing software that will be deployed in the cloud confirms that, they go well together but further investigations is required. It is obvious that cloud computing is emerging as a model that works on the principle of everything –as-a-service (XaaS) (Banerjee et al., 2011).

Cloud computing is a relatively new term with computer science from networking over distributed computing to web and software service (Sharma et al., 2014). The distributed nature of providing public security and need to improve efficiency in information collection, storage and sharing information between police and the public coins well with the cloud computing concept. Exploring e-policing as a service from the public view point takes concept of cloud computing as everything as a service (XaaS). However, for the purpose of this research a police view point is taken in regard to Infrastructure as a Service (IaaS). Therefore, the need to win public cooperation through improved service delivery, quick system deployment based largely on On-demand scalability in e-policing as a service cannot be over-emphasised. In this regard, (Manodaya et al., 2014) stated that, the foundation for platform as a service (PaaS) and software as a service (SaaS) is actually infrastructure as a service (IaaS). This is true for e-policing as a service as it depends on resource pooling were virtual and physical resources to provide connectivity capabilities are delivered as a service for a usage-based cost in matters of public security.

In recent years, (451research, 2016) the rise of cloud computing has had immerse impact on various industry sectors – most notably server and storage infrastructure as enterprises explore and enjoy the potential cost and agility benefits that come with using virtual infrastructure that is available on demand and as required. Therefore, e-policing as a service (e-PaaS) is an important tool for law enforcement environment in matters of public security. The cost of implementing a public security network that would provide a direct interaction between police and the public can be very costly. However, e-policing as a service offers multiple

potential benefits, including lowering cost of database licensing and infrastructure costs, faster time to application deployment, and reduced administrative as well as operational overheads.

The advent of global security threats coupled with increasing cyber-attack on technical infrastructure, issues of network security and control cannot be overemphasized. Notwithstanding, cloud computing has had a significant role in driving cost of storing and processing data, along with other additional benefits such as developer and business agility.

According to recent research (Hatem et al., 2014) defined and illustrated the concepts on cloud computing as indicated in figures 4, 5 and 6.

### 2.5.1 Infrastructure as a Service (IaaS)

Figure 4 illustrates offering web-based access to storage and computing power. The consumer does not need to manage or control the underlying cloud infrastructure but has control over the operating systems, storage, and deployed applications.

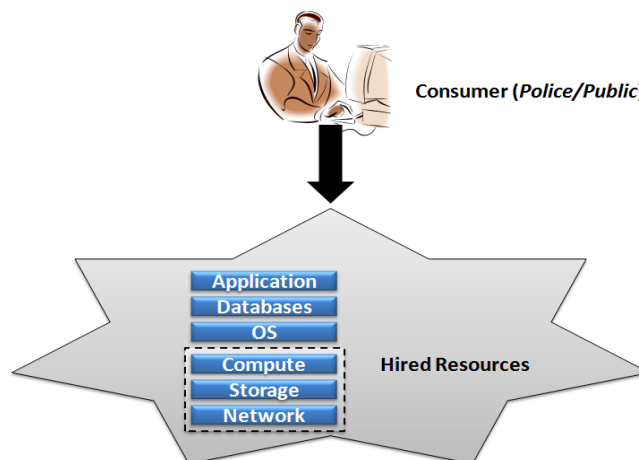
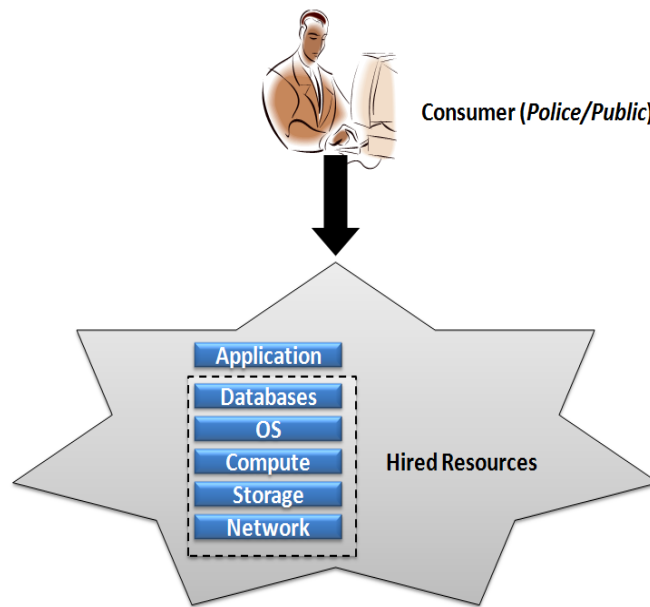


Figure.2 a: Infrastructure as a Service (IaaS)

### Figure 4: Infrastructure as a Service

### 2.5.2 Platform as a Service (PaaS)

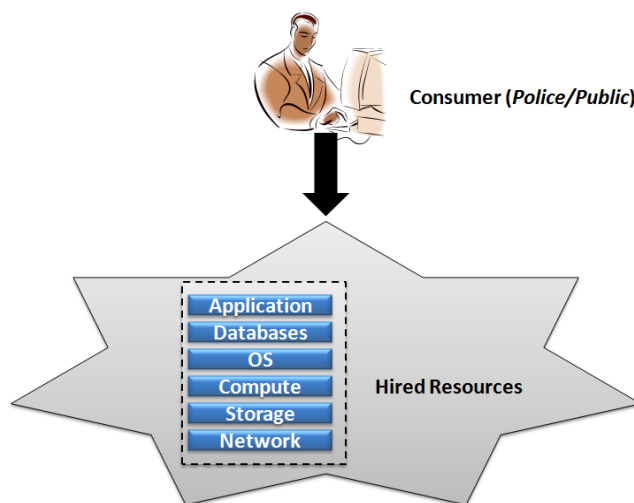
Figure 5 illustrates giving developers the tools to build and host web applications. The users host an environment for their applications. The users control the applications, but do not control the operating system, hardware or network infrastructure, which they are using.



**Figure 5:** Platform as a Service

### 2.5.3 Software as a Service (SaaS)

Figure 6 illustrates where the consumer uses an application, but does not control the operating system, hardware or network infrastructure. In this situation, the user steers applications over the network. Applications that are accessible from various client devices through a thin client interface such as a web browser.



**Figure 6:** Software as a Service

#### **2.5.4 E-Policing as a service (e-PaaS)**

It is important to note that, e-policing as a service is directly related to the e-policing concept. However, e-policing as a service extends the theory and scope of e-policing through use of cloud computing concepts. Since this is a new concept which requires further research, in establishing the dynamic implication in respect to its acceptance in law enforcement environment. Therefore; the process involved in the adoption and implementation of e-policing as a service just like innovative electronic government service confronts challenges at different levels, such as organization, individual, and technological (Ester and Tino, 2014). Further, these challenges have been separately analyzed by several disciplines such as management, psychology, sociology and information systems. However, they argued that, in order to understand the whole picture of challenges involved in this innovation process an integrated multi-disciplinary perspective is required. They noted that previous research and theoretical models such as the widely applied model of *technology acceptance* which focused on technological aspect emphasizing problems of individual use patterns. Theoretical and empirical works leave aside the analysis of the whole innovation process, including social and organizational factors influencing *resistance* or support for the new technologies. Both acceptance and resistance of implementing and transforming electronic tools in a day to day work practices are influenced by different issues, social as well as functional technological factors along a whole innovative process. The optimization of ICT systems in adoption and implementation through cloud computing concepts must ensure that issues of change management as well as business re-engineering are addressed in Zambia for effective e-policing as a service. While information technology may have enabled police to improve efficiency on information management (Chan et al., 2001), physical aspect of law enforcement in dealing with crime and public disorder is still a challenge. Notwithstanding, the above provides more effective means of proactive policing hence creating virtual police presence.

#### **2.5.5 Issues that confront e-policing as a service adoption and implementation**

The accelerated development in Information and Communication Technology (ICTs) and Telecommunication services in developing countries such as Zambia, has brought numerous benefits in e-Health, e-Commerce, e-Education and many more but to mention a few. This has resulted in social and economic development, which demands a safer and secure environment to attract foreign direct investment

(FDI). However due to lack of sufficient financial resources in area of public security, cost effective policing strategies and methods which promote community participation cannot be over-emphasized. According, to (Nanyombi and Ejiri, 2016) in their research regarding factors influencing the adoption of mobile health in Uganda; they noted challenges such as perceived usefulness, perceived ease of use of technological tool, perceived expectancy, effort expectancy, social influence and facilitating conditions. These factors are equally the same in Zambia especially in the adoption and implementation of e-policing as a service. Additionally, perceived high cost of technology use, and perceived security threats in the use of technology are other factors noted to affect e-policing as a service. According to (College of Policing, 2013) there must be robust mechanism and protocols for information sharing between police and the public to enhance timely, effective response and intervention to vulnerability within communities. However; with the aforementioned factors influencing adoption of e-policing as a service, these robust mechanism and protocols for information sharing, needs a balanced strategic approach in addressing them at technological and social level. Notably, information sharing is complex (LeBeuf, 2005) and involves many human and technological issues that are sometimes linked to each other and other times independent. Further, it was observed from our research that the methods for sharing information are different depending on whether police share information within or outside the organization. In cloud computing (Reddy et al., 2015) the client's data is distributed across different networks and stored client's data in data centres and the data reside in the physical network of service providers. This is where information security becomes a critical element, and must embrace stringent measures to secure the stock piling of information and guaranteed access at distinct levels (Kumar and Rahman, 2015). Further, applying powerful cryptographic security solution bargains both access and storage rights, which are critical in e-policing as a service. However to understand potential of ICTs in policing matters, issues that confront their effectiveness and efficiency must be analyzed.

In their research findings (Busagala and Lilian, 2013) revealed that, adoption of e-policing faced a number of challenges which included inadequacy of police staff with computer skills, inadequate budget for training in ICTs, financial constraints, low internet access and reliability, underdeveloped ICT infrastructure and lack of technology use acceptance among police officers. Addressing these factors and the need to win public cooperation as well as trust is a pre-requisite for effective electronic collection, storage and information sharing for e-Policing in Zambia. Further, (Min and sheng, 2014) in their research observed that internet consumer behavior attitude as established by Zhang qiong who showed that attitude-

behavior theory and technology innovation diffusion theory was still valid in e-commerce environment through hypothesis testing of his model. This aspect demonstrate that electronic services adoption and implementation such as electronic policing, require a careful balance on choice of technology diffusion, acceptance of such a process by users and a shared understanding on benefits that come with cooperation among stakeholders.

Implementing and rolling out e-Policing as a service programme demands an extension of the traditional police service with the more efficient, transparent, and more citizen-centered business process and underlying technical infrastructure (Liu and Hu, 2005). The success of e-Policing as a service will depend on multiple factors such as appropriate telecommunication infrastructure, business process re-engineering, and integration of ICT, citizen participation, and readiness for change. Additionally, (Liu and Hu, 2005) argue that amongst all these, human and organisational factors are more critical than technological aspect. This implies that, the human and organisational factors can seriously impede information sharing between police and the public even with proper technological choice in any business case. These issues are critical in Zambia were a serious postmortem on the Police service in respect of human resource placement, professionalism and discipline must be addressed for effective public security implementation through ICTs. Therefore, accessibility to police service and other factors such a building services around citizen choices, provision for social inclusion, and making better use of information from a centralized database system the way forward in Zambia.

#### **2.5.6 Adoption pre-requisite for e-policing as a service**

1. Ease of access to information or forms developed for the police services,
2. Types of reportable crimes and incidents ,
3. Penalties for false reports,
4. Security of the reporting system
5. Response or feedback to indicate report received, and
6. What information can be searched from the police database?

#### **2.5.7 Expected Problems in adoption and implementation of e-policing application**

1. Crimes reported are not from the jurisdiction,
2. Police may have to rewrite reports coming from the public
3. False reporting, and
4. Lack of follow-up on cases by the police.

## 2.6 Proposed electronic Messaging system (generic e-Policing application)

The proposed e-Policing as service network architecture for e-ZP messaging system is illustrated in Figure 7, where an application is developed to quickly share information between the Police and the public in matters of public security. It takes advantage of existing ICT/Telecommunication infrastructure, and is made easy by utilizing three underlying technologies namely mobile technology, Web technology and repository technology.



**Figure 7:** e-Policing network architecture

## 2.7 Mobile Technology

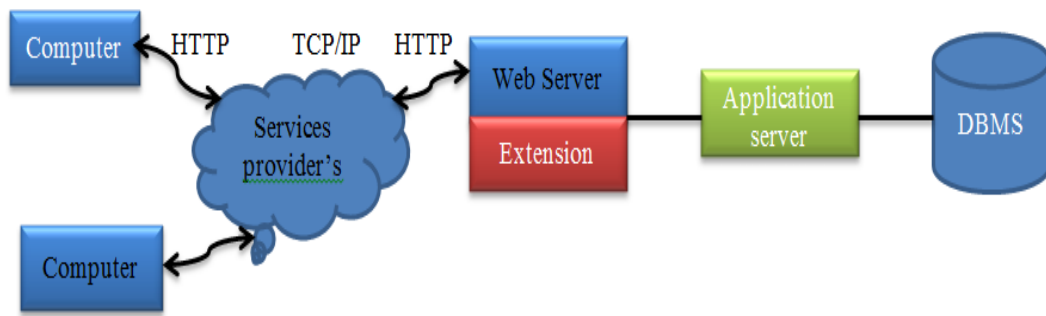
According to (Hyman, 2015) modern conventional definition for technology is “the application of scientific knowledge for practical purposes.” Notwithstanding, mobile technology is exactly what the name indicates – technology that is portable. It refers to any device that you can carry to perform wide variety of “tasks”. It is technology that allows those tasks to be performed through cloud computing concepts to realise a shared cost benefit among stakeholders such as police and the public via cellular phone, PDA, vehicles, laptops but to mention a few. The relevance of mobile technology to police tasks relate to timely access to accurate information, reduced administrative work for the police officers, improved communication and quick retrieval and transmission of relevant information (Singh and Hackney, 2011). Mobile technology plays a critical role in e-policing as a service with respect to enhanced institutional efficiency; through

migration from paper based to electronic collection, storage and sharing of information. Therefore, it is used as a vehicle to virtual reporting, searching and sending bulk messages to registered clients on the e-policing application anywhere and anytime. In order to implement e-policing as a service, mobile technologies through cloud computing concepts are among the numerous tech innovations aimed at enhancing efficiency and effectiveness in doing business hence reducing the cost of police operations. Further; access to information between police and the public through mobile and wireless devices enables organization to conduct their operations more efficiently and effectively (Nah et al., 2005). These technologies are enabled through collective use of various communication infrastructure and portal battery powered devices (Rao and Troshani, 2007). Factors which influence successful adoption of mobile technologies include prior knowledge and experience with the technology, perceived usefulness (Lu et al., 2003), perceived ease of use (Knirtsen et al., 2005), social influence (Bhattacharjee, 2000) and demographic variables such as age and gender (Nysveen et al., 2005). Additionally, technological characteristics such as interface and network capabilities, compatibility with existing network infrastructure, data transmission speed, availability and reliability of wireless network and information capabilities (Rao and Troshani, 2007; Sarker and wells 2003) are equally important. This is where cloud computing concept based on infrastructure as a service (IaaS) and e-policing as a service, finds a place in speedy adoption as well as implementation of an efficient electronic collection, storage and sharing of information between police and the public.

### **2.7.1 Web Technology**

In order to enhance information collection, storage and sharing of information between police and the public through e-policing as a service, various police monitoring centers across the country are connected to the central command Centre and database. It allows police officers in the command Centre to access information and prepares reports quickly and further allows the public to search for required information without physically going to a police station.

Typical web application involves four tiers (Lixin .T, 2010) as depicted in Figure 8.



**Figure 8:** Typical web application tiers

Tier 1	Tier 2	Tier 3	Tier 4
Web browser	Web Server	Application Server	Database

### 2.7.2 Web browser (Tier 1)

Web browser on the client side for rendering data presentation is usually coded in HTML. Web browser can run on most operating system with limited hardware or software requirement. It is a graphic user interface for the clients to interact with the web applications. The basic function of the Web browsers is to communicate with client server computer programs for distributing documents and information, generally called web data, over the internet. It uses HTML to communicate with client server.

HTML is a markup language. An HTML document is basically a text document marked up with instructions as to document logical structure and document presentation as shown below.

```
<html>
<head>
<body>
```

The form element is the most important mechanism for interaction between people and web applications.

### 2.7.3 Web Server (Tier 2)

A web server program generates data presentation and is mainly for receiving document requests and data submission from web browsers through the HTTP

protocol on top of the internet's TCP/IP layer. The main function of the web server is to feed HTML files to the web browsers. If the client is requesting a static existing file, it will be retrieved on a server hard disk and sent back to the web browser right away. If the client needs customized HTML pages like the client's bank statement, a software component like a JSP page or a servlet class (the "Extension" box in the web architecture figure), needs to retrieve the client's data from the database and compose a response HTML file on the fly.

#### **2.7.4 Application Server (Tier3)**

The application server is responsible for computing the business logics of the web application.

The form element has two attributes: Method and action.

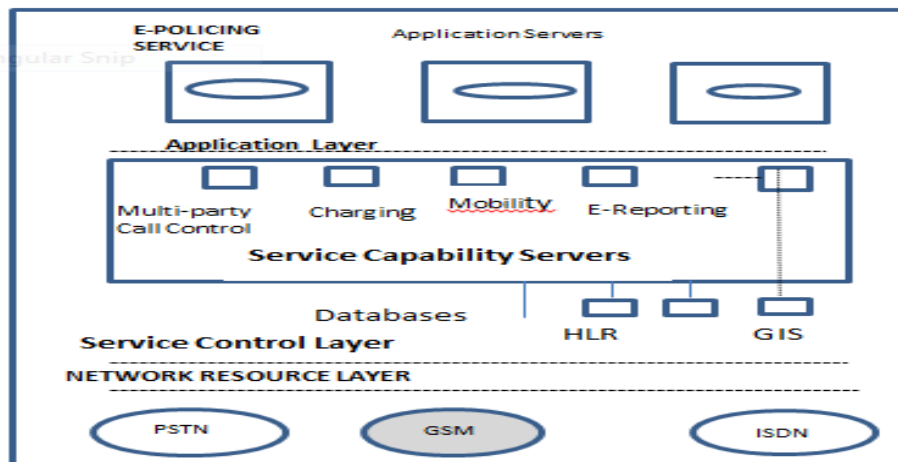
#### **2.7.5 Repository Technology (Tier 4)**

The repository technology ensures that whenever the message is received by the system a copy of that is made by storing it in the database. The system is using secure MySQL database system. This provides a central database for e-policing as a service and can be in a private cloud or public cloud.

#### **2.7.6 Open service architecture for e-policing as a service**

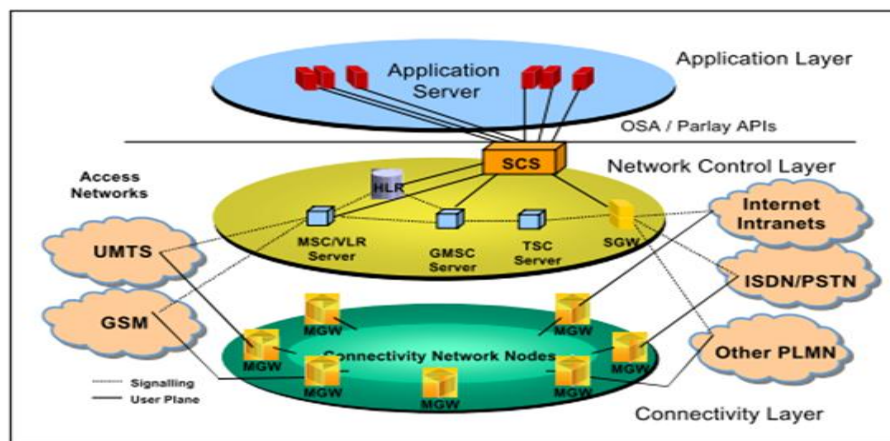
The distributed nature of providing public security demands technological solutions which are distributed and independent in matters of control. Therefore, the discovery of open distributed service networks; have resulted in open topology platforms and evolutions (Khayltash and Hanrahan, 2006) which work well in the implementation of e-policing as service. In light of this; they stated that applications and network control are now independent, making it possible for different parties to provide different services. This open architecture enables third party providers through cloud computing concepts such as infrastructure as a service (IaaS) to provide services that will be able to access core network functionality through standard Application Programming Interfaces (APIs), and will work inspite of core technologies being implemented on a specific network. Figure 9 illustrates open service architecture with three layers namely, application layer, service control layer and network resource layer. In this regard, e-Policing as a service (e-ZP messaging system) will be at the application layer and through API's can access service capability servers on the service control layer and ultimately to the network resource layer for connectivity. This provides a platform for integration of telecommunications and information services into one Reference Model for Open Distributed Processing (RM-ODP), which is a tool for design of

services using open distributed architecture (Khayltash and Hanrahan,2006). The proposed e-Policing as a service through open service architecture for e-ZP messaging system is were an application is developed to quickly share information between the Police and the public in matters of public security.



**Figure 9:** Detailed overview of open service architecture

Figure 10 illustrates the integration of telecommunications and information services into one distributed through Reference Model for Open Distributed Processing (RM-ODP), which is a tool for design of services using open distributed architecture (Khayltash and Hanrahan,2006).



**Figure 10:** Reference model for open distributed processing (RM-ODP)

## 2.8 Intelligent Networks (IN)

The intelligence network concept: intelligence is taken out of exchanges and placed in computer nodes that are distributed throughout the network. This concept reinforces the earlier RM-ODP to gain insight on how services creation is realised through the IN conceptual model. In this regard, choice of programming language which provides platform independent option, to develop an application for e-policing as a service becomes important.

**Intelligence=> access to databases**

To realise these concepts, recent development in intelligent networks has made it possible through capability of separating call control and transport from service control. According to (Ahamed, 2008) intelligent solution has revolutionized wireline networks and has resulted in rapid creation and deployment of services based on IN concepts. Various service capabilities are provided under capability sets such as CS-1 and CS-2. In light of our research data capability through Short Message Service (SMS) are realised as packets of data between service users. The IN conceptual model (INCM) provides a frame work for the design and description of each capability set and the target IN architecture. The INCM is structured into four planes as follows:

- 1) **Service plane (SP)** – describes services and service features such as access to information service (e-policing as a service),
- 2) **Global function plane (GFP)** – describes units of functionality known as service independent building blocks (SIBs), which includes messaging and billing of e-policing,
- 3) **Distributed function plane (DFP)** – provides network functionality known as function entities (FEs). SIBs in the GFP are realised this plane by a sequence of functional entity actions and their resulting information flow, and
- 4) **Physical plane (PP)** – describes physical architecture for IN- structured network in terms of physical entities the interfaces between them hence realizing functional entities from DFP.

## **2.9 Chapter summary**

The literature review firstly deals with conceptual frame work on e-government and then the Zambian government position on the subject matter. It further deliberates on how e-government programs relate to e-Policing in general. Secondly, it deals with the issue on policing strategies in respect to information collection and information sharing. To peruse this number of policing strategies are discussed and all find place in e-policing as a service. Thirdly, literature also deals with a number of arguments on e-Policing adoption issues, the way forward on adoption and implementation of e-Policing. Fourthly, it deals with the required technologies in actualization of e- messaging system (e- ZP Messaging System) for narrowing the digital divide between Zambia Police and the public, in order to enhance electronic collection, storage and information sharing. Further, the required technology and understanding in the use of existing ICT/telecommunication infrastructure to connect Zambia police to the public. The concept takes advantage of high mobile penetration rate, cloud computing concept and need to lower cost of engaging the public on matters of public security.

### 3 CHAPTER 3 METHODOLOGY

#### 3.1 Materials and Methods

This is a qualitative research study, where migration from manual paper based system to electronic collection, storage and information sharing is proposed for the Zambia Police. The end result is a generic e-Policing application (e-ZP Messaging System) with a centralized database for information sharing between Police and the public. Suffice to mention that, the focus area in this study was Lusaka province which included both urban and rural areas.

#### 3.2 Materials and Computer Languages Used

In this study, materials used included software and hardware.

##### 3.2.1 Software Environment

**Table 1:** Software environment

◀Programming environment is NetBeans -7.4,Java Development Kit(jdk-7u51),
◀WampServer64- version 2.5,
◀SMS enabler
◀MySQL server

##### 3.2.2 Messaging System Code Structure

The system has only one html file called index.html, (entry) and it has six (6) servlets. The purpose of the index is to provide the start point of the system and is used to organize navigation of the system (it gives direct access to various resources/pages).

## 1. **MyRelay Class**

It is used as a listener to all incoming messages from the SMS Enabler and it implements the appropriate responses to a request.

## 2. **Message Format for Public to Search or Report Information to Police**

To search for information or report crime with the Zambia Police, Public users can use their mobile terminals such as phones, Tablets, IPad from any Private or Public Telecommunication service providers using the format below:

S – TOPIC – Detail } Searching

R – TOPIC – Detail } Register (Reporting)

“S-stolen property – I’m looking for a vehicle Reg. No. ABC122”.

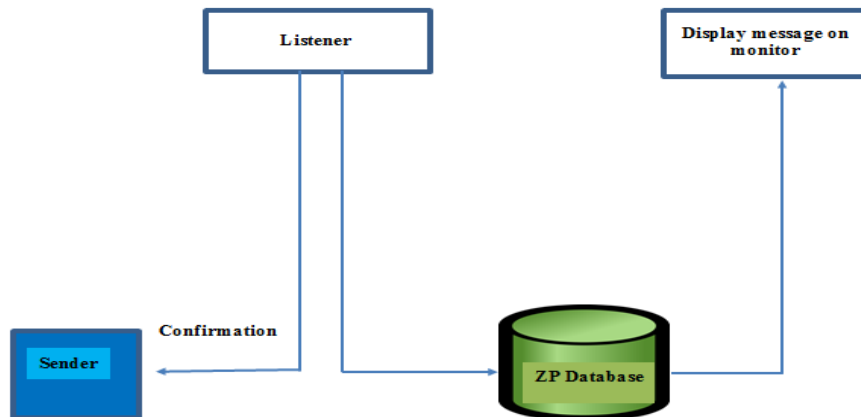
## 3. **Message Routing**

Figure 11 illustrates how the message from a mobile terminal will be received by the SMS Enabler. The Enabler will forward this message to the MyRelay. MyRelay will process the message, construct a response and forwards it to the enabler. The interaction between the SMS Enabler and MyRelay is specified in the URL of SMS Enabler in the tab called “sms to webserver”. This structure is necessary to splint function where the SMS Enabler listens to the message part for incoming messages whenever there is a message, the Enabler will read it and forwards it to the MyRelay. The purpose of the MyRelay is to process message received and construct a response which is then handed over to the Enabler, for transmission back to the sender through the public phone network.

## 4. **Display message Servlets**

The purpose of the display messages is to display information recorded in the database by the MyRelay.

## PROGRAM STRUCTURE



**Figure 11:** System structure

From literature on e-policing study and methodology, a business case for e-messaging system analysis, design (UML) and development is perused.

### 3.3 Context Diagram

The context diagram in Figure 12 illustrates systems that will interact with the e-Policing application (e-ZP messaging system).

#### 3.3.1 Public User

The public user will send text messages to report or search for information in the Zambia Police Public data base, through public network cloud. The Police public data base will store information on reported information which is yet to be verified before storing in the crime data base. The public data base will also store information on reported missing but found property and any other information required for public communication. The public user will receive a response to indicate status of the requested information.

#### 3.3.2 Specialized Departments

The public user can send emergency messages through the e-ZP messaging system and depending on the nature, the command control Centre will send to the relevant specialized department. If its fire, the fire Brigade will be informed accordingly.

#### 3.3.3 Police Command Control Centre

This Centre receives reports from the public user through e-ZP messaging system display and depending on the report activates the officers in the field through

Police digital dispatch radio system and other communication channels within police internal operations. The dispatch system shows location of officers and other resources such as patrol vehicles in the field. The Centre will also ensure that useful information required by the public user is sent through the e-ZP messaging system to advise or warn the public on crime related development in local areas.

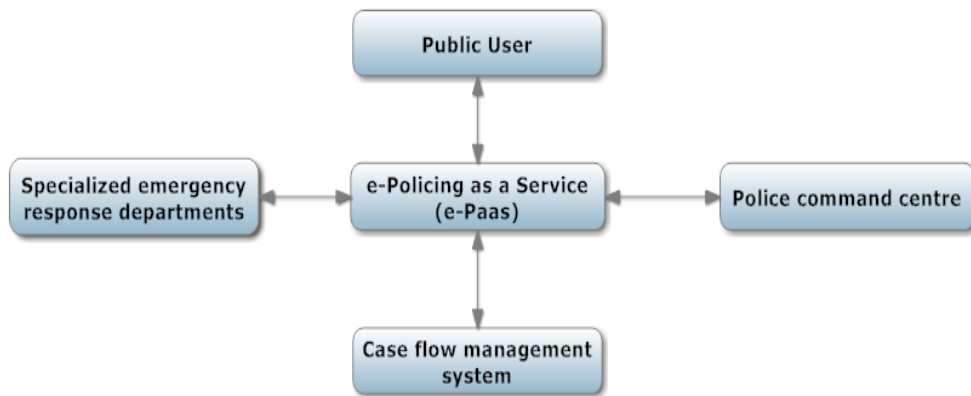
### **3.3.4 Case Flow Management System**

This is a new system being piloted in Lusaka where the work flow system from receiving and recording of the reports, dockets generation and report generation is being automated at the enquires or front desk. The system will link the police to other security wings and the judiciary. The manual system using Occurrence books where reports are recorded is now automated. Therefore, the electronic storage of reported information provides useful information for the Police in respect to both the crime data base and public data base. With this automation the public still need to physically report the cases at the front desk. This means one needs more time to walk to the nearest police station to make a report or share information with the Police.

### **3.3.5 E-Policing (e-ZP messaging system)**

The e-Policing application enhances reporting of crime or searching of useful information through a centralized police data base system via text messaging. This promotes personal security and public security through virtual policing. The centralized data base system improves report generation for police planning and operations. This method further strengthens cooperation, trust and information sharing between the police and the community.

1. Emergency departments such as the Hospital, fire brigade and Drug enforcement commission.
2. Forwarding and response information in crime reporting and information searching by the public users through existing ICT/Telecommunication infrastructure using text messaging system.
3. Viewing of information at police command and control center.
4. Information validation before entering it in police electronic capturing system for reports and docket generation.

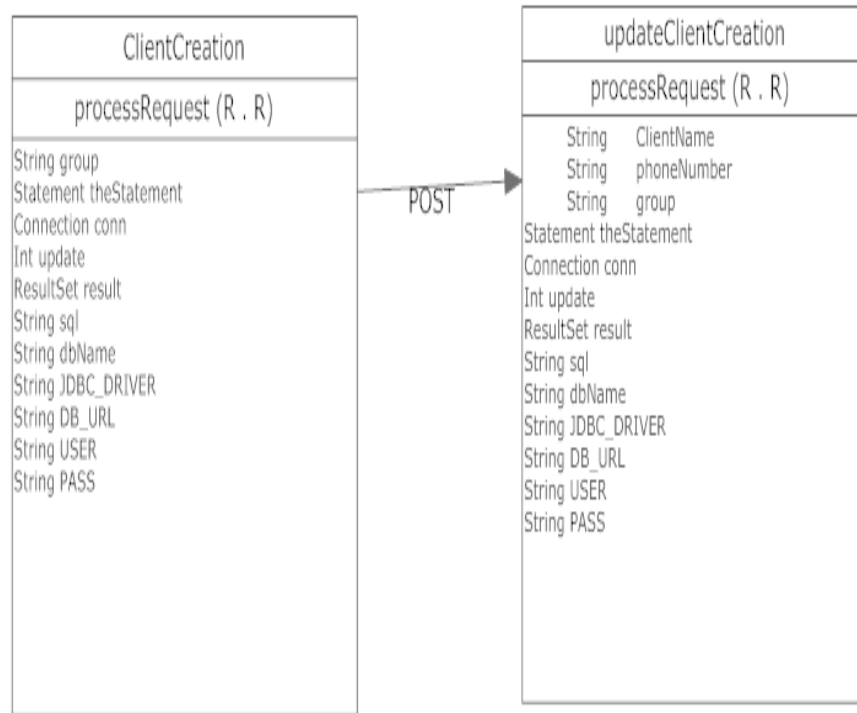


**Figure 12:** e-Policing Context diagram

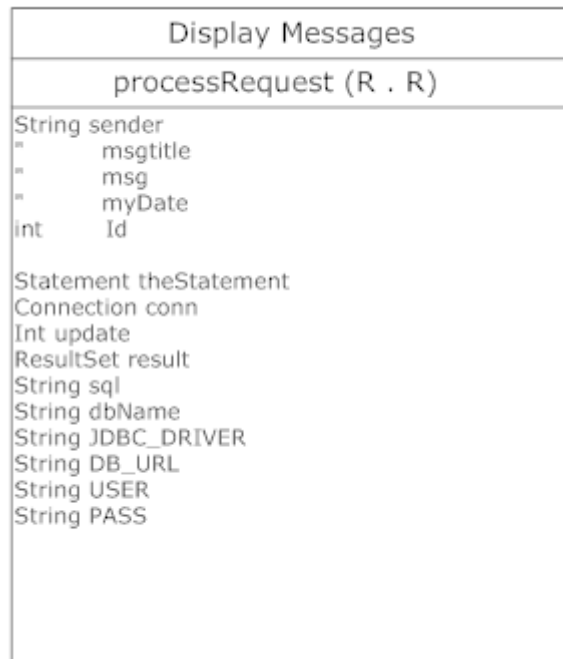
### 3.4 Class diagrams

This application is an object-oriented information system. Class diagrams in this regard shows relationship between objects in the system and each class has attributes and behavior .These classes include:

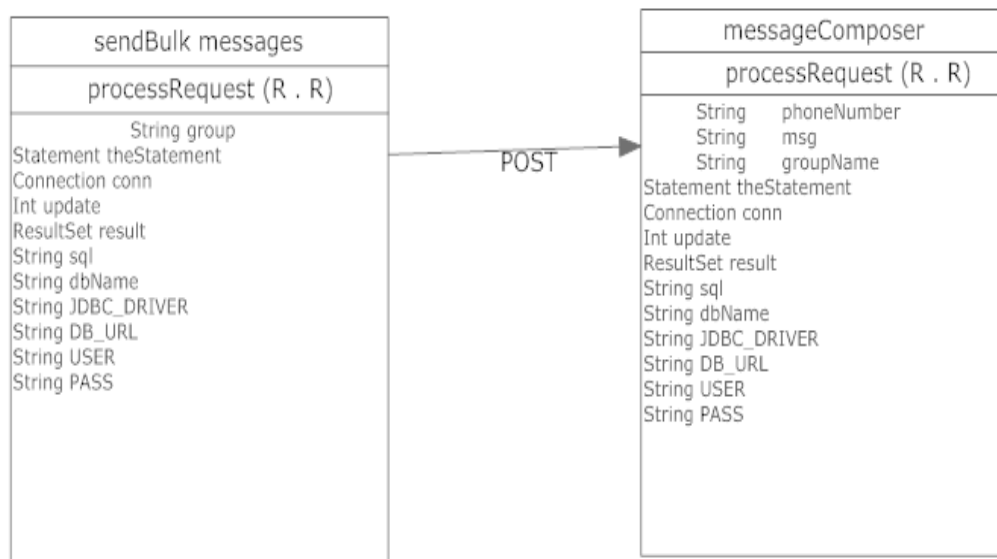
1. Client creation
2. Display messages
3. Message composer
4. My relay
5. Send bulk message
6. Update client creation



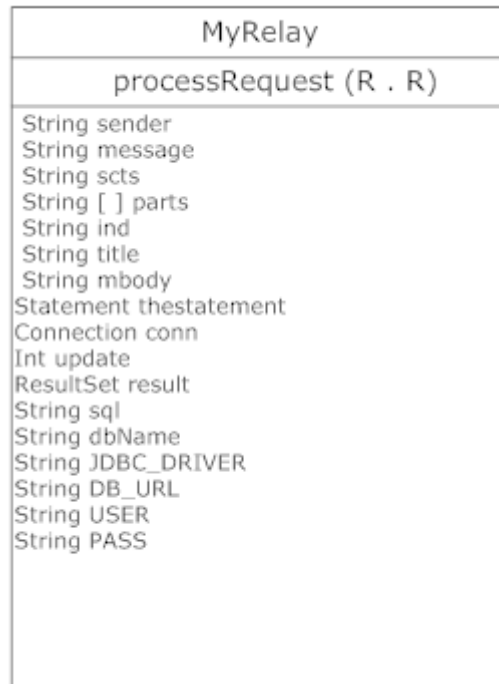
**Figure 13:** ClientCreation class diagram



**Figure 14:** Display messages class diagram



**Figure 15:** Send bulk messages class diagram



**Figure 16:** MyRelay class diagram

### 3.5 Use Case diagram

Use case diagram as in Figure 17, describes the relationship of the functionality applied in the application. Actors within the system are Administrator and public user.

#### 3.5.1 Function that can be performed by administrator

1. Send Bulk SMS message – An administrator can send a single SMS to a lot of people belonging to a particular group as specified in the system.
2. View received Messages – An administrator can view SMS messages reported to the police by members of the public
3. Create Users – An administrator can create users and group them according to similarities, e.g. location, ranks, work affiliation.

### 3.5.2 Functions that can be performed by public user

1. Report Crime through SMS – Any person can report a crime via SMS to the police messaging system
2. Search for information with the police via SMS – Any user can search for information of varying subject as the police offload them to the public database. This information may be missing persons, missing property like motor vehicles and national identity cards.



**Figure 17:** e- policing as a service Use Case Diagram

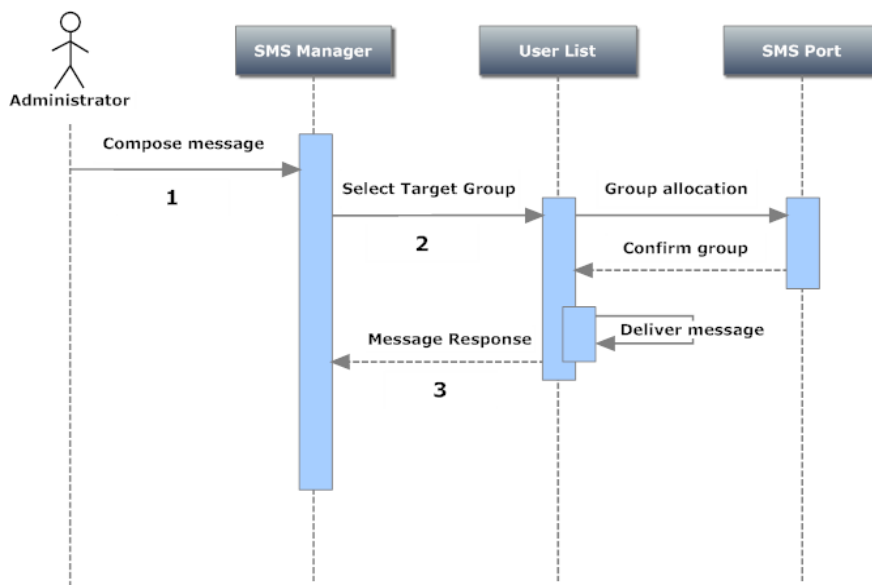
### 3.6 Sequence diagrams

Sequence diagrams illustrates decomposition of the generic e-policing application in respect of each use case sequence of event and interfaces.

#### 3.6.1 Send Bulk SMS message

This is a process of sending one message to several receivers and figure 18 illustrates the sequence diagram.

1. The administrator activates the SMS Manager (SendBulkMessage Class), writes a message required and the system displays the message composed
2. The administrator will select a target group from a list which is presented by the SMS Manager. The SMS Manager will then attach the selected group to the message container
3. The administrator will invoke message sending method which will present the message container to the message port. The port will give a message deliver response to the administrator.



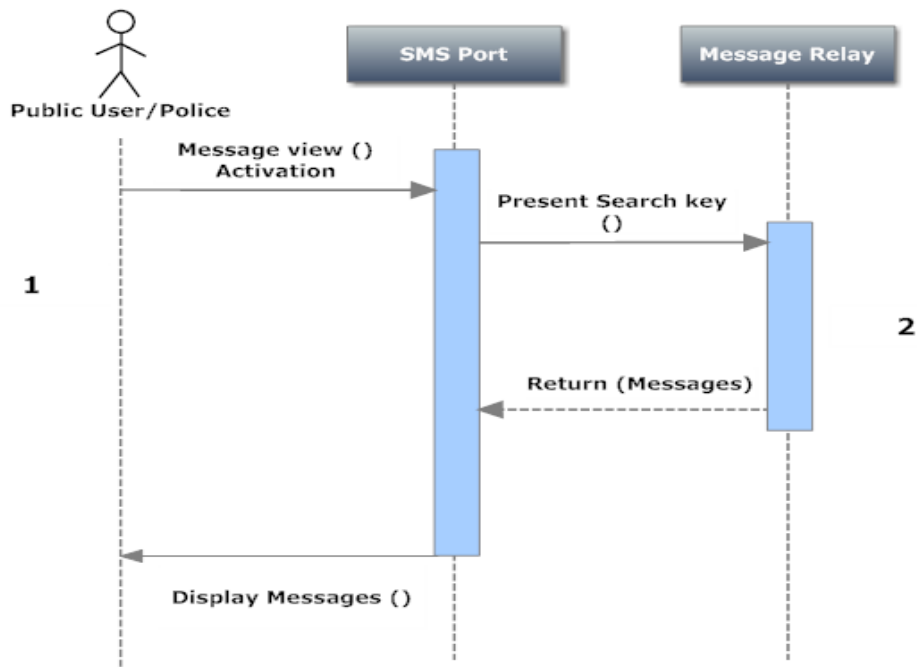
**Figure 18:** Send Bulk SMS sequence diagram

### 3.6.2 View received Messages

This is a process used to view messages received by the system and Figure 19 illustrates sequence diagram.

1. The administrator activates the Message Manager.
2. Message Manager searches the Messages Table and returns the result to itself

When this process is complete the system manager displays the message.

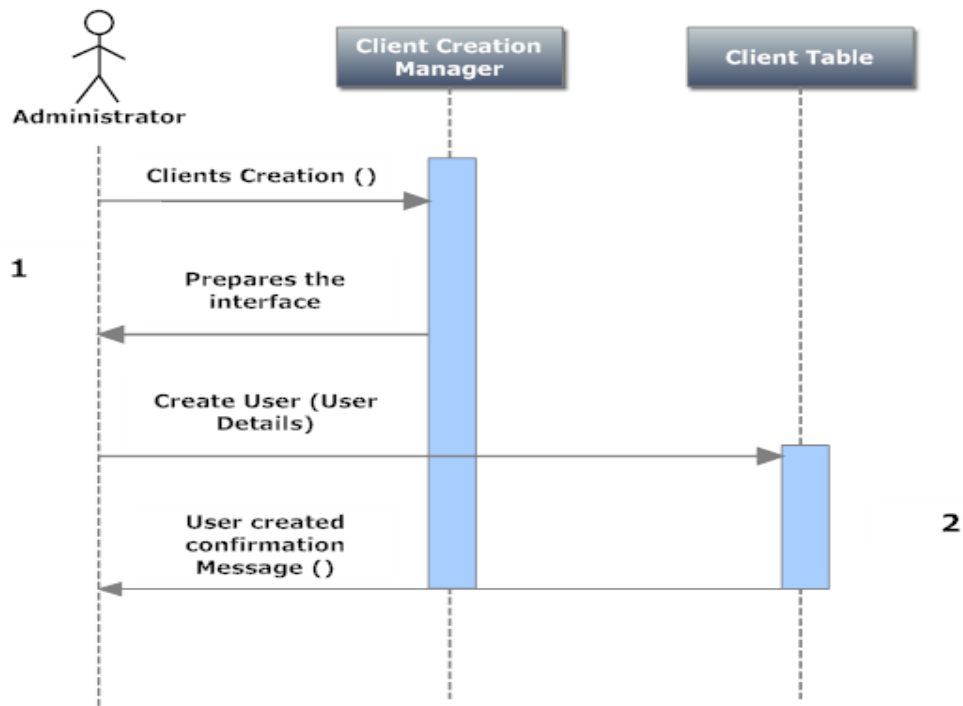


**Figure 19:** View Received messages sequence diagram

### 3.6.3 Create Clients

This is the process used to create client accounts on the system. These clients are grouped according to client category and Figure 20 illustrates the sequence diagram.

1. The administrator activates the client creation manager which prepares the detail capturing window (interface)
2. The administrator enters appropriate details and invokes the commit for the details to be saved. The repository confirms saving.

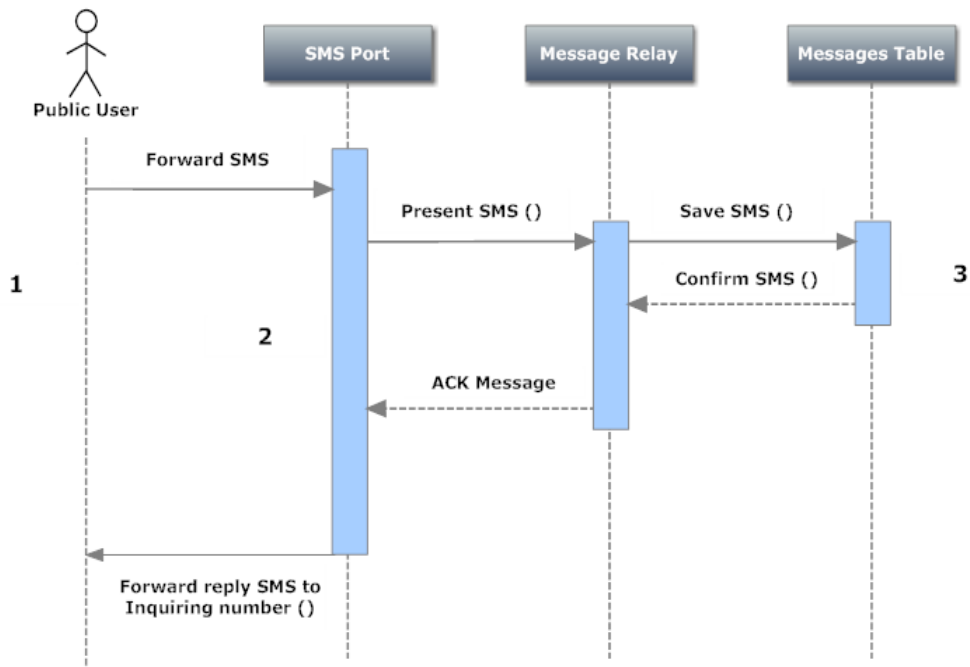


**Figure 20:** Create Clients sequence diagram

### 3.6.4 Report Crime through SMS

This module listens to the message port for incoming messages, interprets the message and responds to the message as appropriate and Figure 21 illustrates the sequence diagram.

1. A member of the public sends an SMS Message to report any crime and it is received by the computer message port
2. The port presents such a message to the system' message relay.
3. The relay records the message in the messages table. The message table confirms saving the SMS to the Message Relay. The Message Relay sends an acknowledgement message to the message port. The message port forwards the acknowledgement to the sender

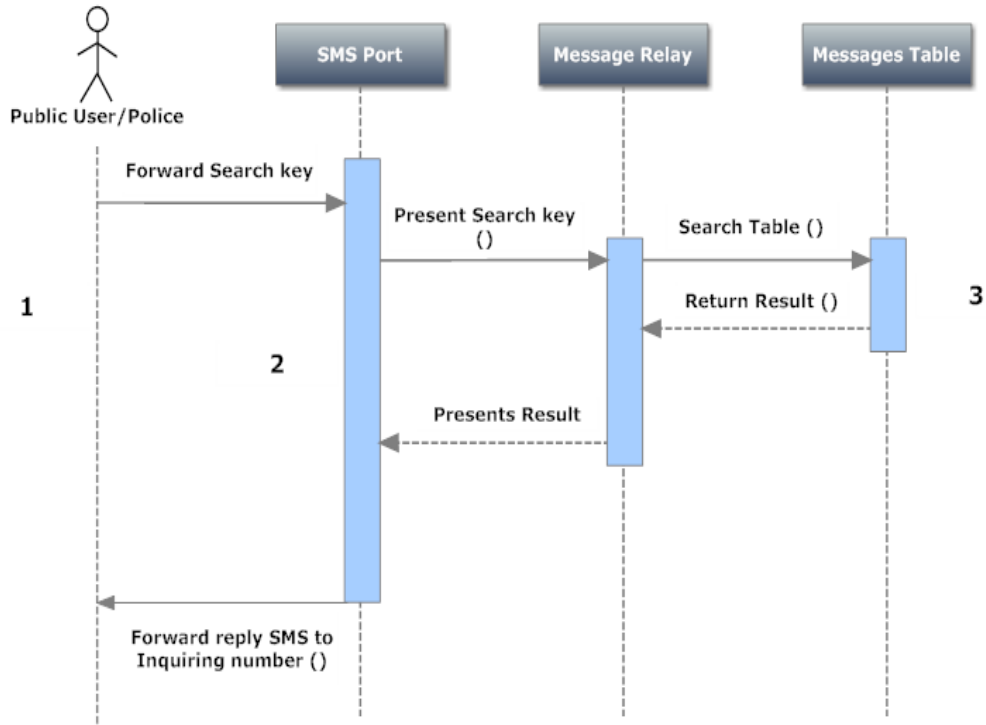


**Figure 21:** Report Crimes through SMS sequence diagram

### 3.7 Search for information with the police via SMS

Figure 22 illustrates the sequence diagram for searching information from Police Public database.

1. A member of the public sends a search key Message.
2. The port receives the search key and presents it to the message relay.
3. The relay searches the database using the received key. The message table gives up the search results to the message relay. The Message Relay sends the search result to the message port. The message port forwards the result to the inquiring number



**Figure 22:** Search for information via SMS sequence diagram

**a) Hardware**

Hardware tool and their specification

**Table 2:** Hardware specification

Hardware name	Specification
Laptop	- Hard disk 80GB Minimum - Processor 3.2 MHz Minimum. Preferable i3 and above - RAM 4.0 GB - 64-bit Operating System

**3.8 Methodology**

The methodology for the research included a qualitative analysis of data gathered from unstructured interviews (Fontana and Frey, 2005), observations (Kawalich,

2005) and focus group (Barbour, 2005) guided by initial conceptual observation from the literature. In that regard, the research method used is based on study of recent e-policing research, extensive document review, record inspection, Sending of police message to stations and posts in Lusaka and the phases of Software Development Life Cycle (SDLC).

### **3.8.1 Study of recent e-policing research**

Through literature on recent e-policing study and looking at various case studies especially in developed world where ICT infrastructure is advanced and well developed, focusing on issues to consider in e-policing adoption and implementation. Further, and more close to our situation was the case of Dodoma constraint of e-policing adoption and implementation where recommendation to develop a text messaging system using mobile phone was seen to be one of the best solutions in low internet penetrated areas or countries. This case study provided secondary data which gave good results and provided motivation to peruse the aspect of developing a generic e-policing application which is text based.

### **3.8.2 Extensive Document Review**

A large amount of written materials such as the strategic plans, implementation plans, annual reports, daily incident reports, and crime statistical reports, crime reports, and stakeholder's views on Police performance were analyzed though permission was not granted to include in this report but rather used to gain insight into current policing strategies in Zambia police, Public perception on Police performance and challenges that confront issues on information collection, storage and information sharing.

### **3.8.3 Observation**

Although observation provided a better understanding of challenges that confront effective information collection, storage and information sharing, focus group study with Police information rooms (Command Centers), front desk officers and patrol officers from Police stations within Lusaka, were completed to understand the necessity of ICT's in police work especially in respect to providing communication media with the Public. A set of policing strategies, e-policing issues, performance outcomes and problems were prepared from a review of literature and presented to the group for comments. Further Police messages were sent to nineteen Police stations in Lusaka to provide information on records of lost but found property in their custody, how many were collected, and if collected when and how the owners come to know about the location of the said found

property. The purpose was to test the record management system, time of response to the message from stations to Police service headquarters, to gain insight to challenges of identifying owners of such property and lastly to help identify probable solution to information sharing between police and the public. The message was sent on 27/03/2015 from Police Force Headquarters and a response was received on 08/04/2015. Out of the total number of stations only two responded representing 10.5 percent.

#### 4.7.4 Lost but found property at Zambia Police stations (Lusaka)

**Table 3: Sample data**

Station Name	Number of NRC	Number of ATM CARDS	Number of Driver's license
Chilenje	15	0	1
Kabwata	33	7	4
Total	48	7	5

These lost but found properties are at the named Police stations and still many exist at stations which did not respond to police message during the study period. This is due to lack of necessary tools and systems for information sharing between Zambia Police and the Public. Further lack of a centralized database renders report generation difficult on such issues.

#### 3.8.4 Phased Software Development Life Cycle (SDLC)

E-Policing service is potentially complex and needs to be specified from top-down perspective (Chan et al., 2001). An object-oriented approach is better to this approach, in which the fundamental objects are first defined, and the other objects inherent from them to add more detail. This object oriented approach, decreases the overall complexity of creating the service. For the purpose of this research the scope will be limited to e-messaging for crime reporting, searching and information sharing. Designing of the system using star UML (Unified Modeling Language) and lastly is the development of the application using Java and MySQL tools. Modeling using Star UML (The Object Management, Unified Modeling Language) finds its place in RM-ODP and provides OO paradigm in helping to identify the various players and interactions involved in e-Policing and how the information will be handled by the system. The first phase of testing uses white-box testing approach on the developer side and uses black box testing (Johan J.C and R. Latuperissa, 2014) on the user side. Design stages include use

of diagram provided in star UML, such as Context Diagram, Class Diagram, Use Case Diagram, and Sequence Diagram.

### **3.9 Chapter summary**

This chapter discussed research methodologies used in this research study and included means of data collection for analysis, application design and development. The methodology for the research included a qualitative analysis of data gathered from unstructured interviews (Fontana and Frey, 2005), observations (Kawalich, 2005) and focus group (Barbour, 2005) guided by initial conceptual observation from the literature. From existing policing conceptual model another model was proposed taking into account factors that can enhance or affect electronic information collection, storage and information sharing. Although observation provided a better understanding of challenges that confront effective information collection, storage and information sharing, focus group study with Police information rooms (Command Centers), front desk officers and patrol officers from Police stations within Lusaka, were completed to understand necessity of ICT's in police work especially in respect to providing communication media with the Public. Designing of the system using star UML (Unified Modeling Language) and lastly is the development of the application using Java and MySQL tools. The first phase of testing uses white-box testing approach on the developer side and uses black box testing on the user side. Design stages include use of diagram provided in star UML, such as Context Diagram, Class Diagram, Use Case Diagram, and Sequence Diagram.

## 4 CHAPTER 4 RESULTS AND DISCUSSION

### 4.1 Introduction

In the real time (Mani .P and M. Prasanna, 2016) digital world, software has played an important role in our society. As a result, e-policing as a service has taken advantage of that demonstrated fact to develop a text based messaging system for electronic collection, storage and sharing of information between police and the public. The system is used to provide a platform to optimize existing ICT's/telecommunication infrastructure at a shared cost between police and the public. Further, the system provides a multi-functional communication channel to support virtual policing and allows fast deployment of the system through cloud computing or mobile cloud computing.

From this study on e-policing, a business case for e-messaging system analysis, design using unified modeling language (UML) and development is perused in addressing a newly coined concept of e-policing as a service. Therefore, this chapter presents results of e-policing application and messaging format. The e-ZP portal (e-policing application) for receiving, sending information is illustrated from the test results of the developed system.

### 4.2 Message Format for Public to search or report information to Police

To search for information or report crime with the Zambia Police, Public users can use their mobile terminals such as phones, Tablets, IPad from any Private or Public Telecommunication service providers using the format below:

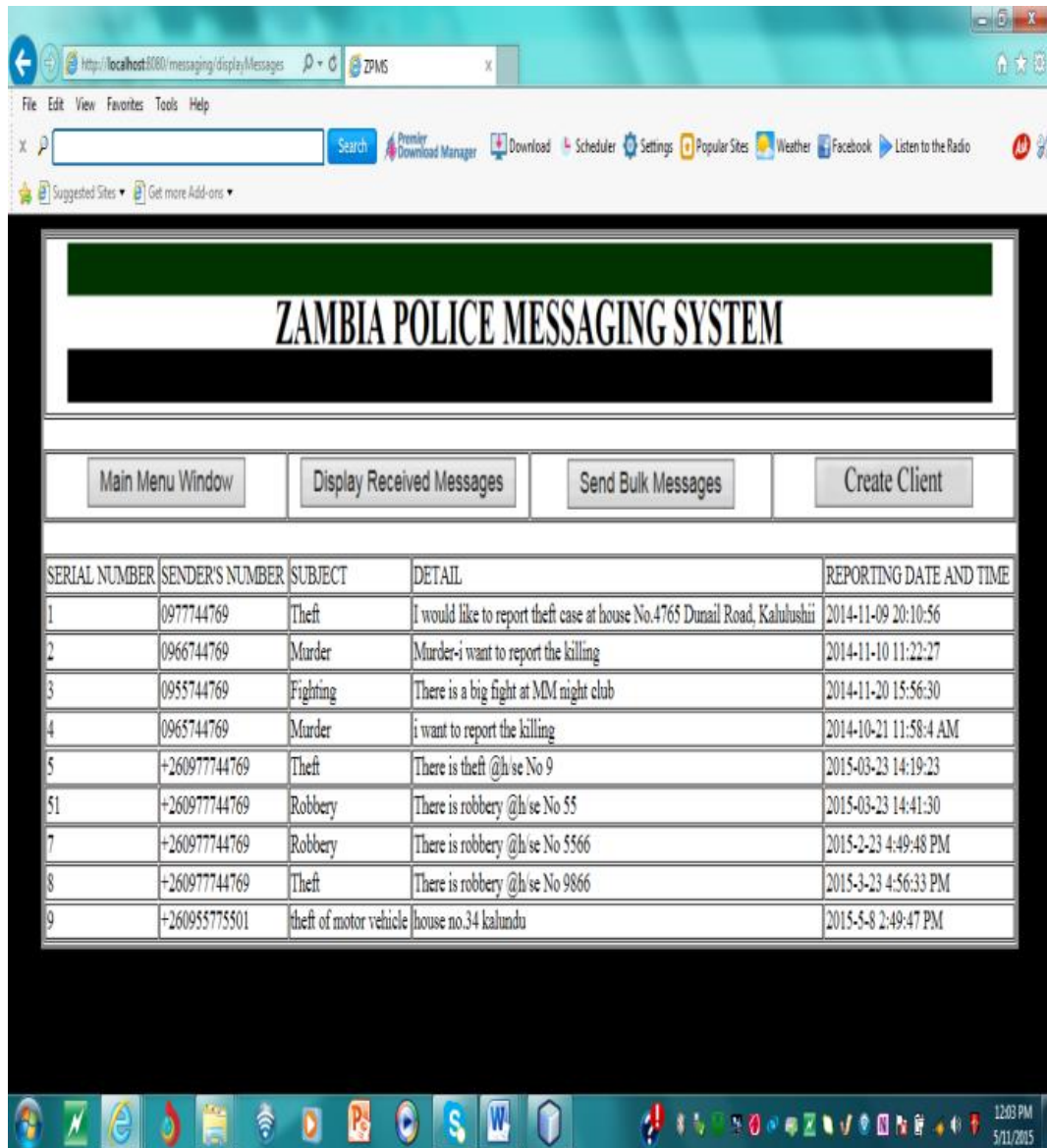
**S – TOPIC – Detail} Searching**

**R – TOPIC – Detail} Register (Reporting)**

### 4.3 Sample for e-ZP messaging system

Figure 23 illustrates sample page of displayed messages as received during testing stage from mobile devices (Reporting) at police command center. The first column represents the report number (Case number or OB number) which is vital in occurrence book. The second column provides the mobile number for the reporter and the third provides the subject of the report. Further the fourth column gives details of the report and the last column provides the date and time report is received at the command center (*From Public to Police*).The portal provides an interface for police to receive and send alerts as well as other security information at a shared cost with the public. More importantly, the design concept takes into account the front desk or inquiries office existing manual occurrence book detail

requirements. It has the occurrence number, date of incident and column for report details. For the developed system it provides an automated method and includes additional information such cell number of a client.



**Figure 23:** Sample for e-ZP messaging system

Therefore, this portal will enable police officers operating from the command centre to receive crime reports and then make appropriate action to respond. Since this system is independent from the police internal communication channel, any verified report is then sent to the nearest police station or police officer for action.

Since the system provides a central data base for all electronically collected information, the public can make remote search for information of interest such as missing persons, lost but found property and general crime situation. Further, the e-messaging system makes it easier to generate crime reports for analysis.

#### 4.4 Procedure to send bulk message from police to the Public

If you click “Send Bulk Message” button as shown below in Figure 24, the program will load the message compose area and will allow the user to select the target message recipient group (*From Police to Public*). This allows police to send alerts to the public and categorize information sharing especially in serious police operation requiring only officers assigned to a particular task to receive such information.



**Figure 24:** Step 1 for sending bulk message

Figure 25 shows the message compose area. The user is expected to type the message in the box provided, select the target group name and click the “Send” button.

This action will call the message Composer class which is responsible for retrieving phone number from the target group and forward them to the SendSMS utility.

Ideally java uses Javax / JavaCOMM or RXTX independent compiled classes (not part of java / JDK) to communicate with any attached computer device like the modem or any other accessory.

In implementing this there was a challenge as these classes have not been updated from the time Oracle took over java / JDK. For this reason a device communicator called SendSMS utility was developed.

**Figure 25:** Step 2 for sending bulk messages

After the Send SMS utility has finished executing its functions, the messaging system will display a list of recipients and their phone numbers as shown below in Figure 26.

MESSAGE	RECIPIENT	SESSION ID
Test message	Mr. Njase / +260955102282	

**Figure 26:** Final stage for sending SMS

## 4.5 Discussion

ICT's are important tools for enhancement of Police operation through effective electronic collection, storage and information sharing with the public. Generally, electronic services such as electronic policing require a careful balance of choice on technology diffusion, acceptance of such a process by users and a shared understanding on benefits that come with cooperation among stakeholders. Without cooperation of the Public, policing becomes very difficult to implement and at the core of this cooperation demands information and the sharing of information for effective law enforcement (Le Beuf 2003). Therefore, the tools for collecting, storing or sharing information can be manual and paper intensive or automated by electronic tools. The later provide enhanced means of information collection, storage and sharing of information, but that also come with other challenges which are underpinned by two previous research theories namely Technology Acceptance Model (TAM) and the Theory of Reasoned Action (TRA). The two theories consider behavioral intention as the central concept (Carter, L. & Belanger F. 2005). Arguably, it can be noted that, whether e-commerce, e-Health, e-Government or indeed e-Policing as a service, the issues that affect adoption and implementation of the aforementioned are related and to a large extent same. Since there are different policing strategies which if added result in a major challenge for Police command; and once pursued simultaneously and aggressively, the different strategies would require significant changes in the mission, objectives, technologies and basic administrative arrangement of the Police. This is where e-policing as a service finds its vital role as part of an integrated strategic approach in electronic collection, storage and information sharing. The optimization of ICT systems to enhance information collection, storage and sharing must ensure that issues of change management as well as business re-engineering are addressed in Zambia for effective e-policing system. E-policing plays (Liu and Hu, 2005) a critical role information sharing, management and the expected benefit with implementing this concept includes:

1. Improved Police to community relationship,
2. Increased prevention and reduction of crime incidents,
3. Enhanced Emergency service 991 applications which allow community to reduce their own risk, and enhance response from the Police or other authorities mandated to respond, and
4. Allows authorities to send instant alerts to the community in matters of public safety.

#### **4.6 Chapter summary**

This chapter dealt with the results and discussion of e-policing application for electronic collection, storage and information sharing between the police the community. Therefore, this chapter presented results of e-policing application and messaging format. The e-ZP portal (e-policing application) for receiving, sending information is illustrated from the test results of the developed system. Further, procedure to send bulk message from police to the Public and vice versa is discussed. It was, important to discuss issues on electronic services requirement especially e-policing as a service that, a careful balance of choice on technology diffusion, acceptance of such a process by users and a shared understanding on benefits that come with cooperation among stakeholders. Electronic means compared to paper based or manual provide enhanced means of information collection, storage and sharing of information, but that also come with other challenges, which are underpinned by two previous research theories namely Technology Acceptance Model (TAM) and the Theory of Reasoned Action (TRA). The two theories consider behavioral intention as the central concept (Carter, L. & Belanger F. 2005).

## **5 CHAPTER 5 CONCLUSION AND RECOMMENDATIONS**

### **5.1 Introduction**

Recent past e-policing research focuses on use and adoption of information and communication technology (ICT's) in police operations. Mostly, the research is underpinned by two previous research theories namely Technology Acceptance Model (TAM) and the Theory of Reasoned Action (TRA). However, in order to improve police /public cooperation we extend the aforementioned concept to e-policing as a service and the way forward.

### **5.2 Background**

The Zambia Police service annual report for 2015 indicates that, Zambia's population is increasing very fast and currently estimated at 15,000,000 people. Further, the accelerated infrastructure development in Zambia demands parallel human resource increase and development. The two issues have brought security operational challenge in regard to internationally recognised police to client ratio which is 1:500. However, in Zambia the police to client ratio stand at 1:859 which means on average each police officer must police the aforementioned figure of 859 persons beyond the stipulated number. This is where e-policing as a service plays an important role in establishing virtual policing to bridge the gap of insufficient manpower. For the purpose of this research, focus will relate to the migration from paper based to electronic collection, storage and sharing of information between police and the public. However, the issue of how policing strategies affect choice of technology in e- policing as a service and the need to maintain state security require further research. Therefore, choice of technology, cost and infrastructure needed for information sharing requires e-policing as a Service by integrating middleware technologies in a customized application especially under Intelligent Networks (IN).

E-Policing as a service (e-PaaS) is specialized electronic service application for virtual policing. It strikes a balance on mobile cloud computing or cloud computing concept for everything as a service (XaaS), infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS), through integrated policing strategies in matters of public security. It is obvious that cloud computing is emerging as a model that works on the principle of everything –as-a-service (XaaS) (Banerjee et al., 2011). Consequently, cloud computing characteristic such as on-demand self-service, Broad Network Access, Resource Pooling, Rapid Elasticity and measured service cannot be over-emphasised (Abhishek and Maurer, 2014). Further, research in cloud computing with respect to establishing; whether agile methodologies are beneficial or not in developing

software that will be deployed in the cloud confirms that, they go well together but further investigations is required. Therefore, the need to win public cooperation through improved service delivery, quick system deployment based largely on On-demand scalability in e-policing as a service cannot be over-emphasised. In this regard, (Manodaya et al., 2014) stated that, the foundation for platform as a service (PaaS) and software as a service (SaaS) is actually infrastructure as a service (IaaS). This is true for e-policing as a service as it depends on resource pooling where virtual and physical resources to provide connectivity capabilities are delivered as a service for a usage-based cost in matters of public security.

Since there are different policing strategies which if added result in a major challenge for police command; and once pursued simultaneously and aggressively, the different strategies would require significant changes in the mission, objectives, technologies and basic administrative arrangement of the police (Mark Moore and Robert Trojanowicz, 1988). These policing strategies include traditional policing and proactive policing categories. The proactive method include community policing, problem oriented - policing, intelligence – led and election policing strategies. Therefore, for application of strategies the Zambia Police must be open to discussions with the public about priorities, its operating procedure and its past performances. More importantly is the need to define cooperate strategy clearly and provide purpose that results in finding support from the public with respect to organizations effort.

The cost of implementing a public security network that would provide a direct interaction between police and the public can be very costly. However, e-policing as a service offers multiple potential benefits, including lowering cost of database licensing and infrastructure costs, faster time to application deployment, and reduced administrative as well as operational overheads. The advent of global security threats coupled with increasing cyber-attack on technical infrastructure, issues of network security and control cannot be overemphasized. Notwithstanding, cloud computing has had a significant role in driving cost of storing and processing data, along with other additional benefits such as developer and business agility.

### **5.3 Conclusion**

In this study a Police view point for e-Policing as a service is presented and factors affecting adoption and implementation are discussed. Generally, most police services around the world have implemented e-Policing system. However, in most under developed countries like Zambia strategic adoption of this concept

has been very slow with concentration on internal police modernization for improved case analysis. The key stakeholders such as the public still face challenges to contact the police through mobile technology despite having phones and other mobile terminals. Even, the widely used emergency lines are not localized and difficult to access due to congestion. Needless to mention that, e-Policing as a service is an extended research concept from e-Policing concept. Ideally, this is the first attempt in research to extend the theory of e-Policing. The concept reveals that specific models within XaaS can be realized for various organisations depending on the strategic direction of an institution. However, this notion still requires further research to underpin this concept within validated model in previous research as mentioned above.

This study presents a qualitative research through analysis of data obtained from unstructured interviews, observations and focus group guided by initial conceptual literature review. Therefore, to enhance electronic collection and management of information, this research has developed a generic e-messaging system, where mobile users can report crime or search for information through short text messages by accessing the Police Public database (Centralized database). The Police can also send alerts and any important information to the Public via the same system. Hence, first and second specific objectives on information collection and management are realized and through application of cost effective technology, which optimizes the utilization of existing ICT's /Telecommunication infrastructure addresses the third specific objective. Basically the system takes advantage of the increasing penetration rate of mobile technology. Accessibility to police service and other factors such a building services around citizen choices, provision for social inclusion, and making better use of information from a centralized database system the way forward in Zambia. This research has resulted into a balanced analytical view of e- policing as a service and provided recommendation for the way forward in Zambia. Furthermore, the research has established that electronic collection, storage and sharing of information can be realized through integration of platform independent application and utilization of existing ICT's/ telecommunication infrastructure.

#### **5.4 Recommendations**

From this research study it is recommended to adopt and implement the following:

1. A balance and integrated Policing strategy in policing matters,
2. Deploy E-policing systems which build services around citizen choices, social inclusion and promote information sharing,

3. Provides sufficient funds for training and ICT infrastructure development in the Zambia Police and other related agencies to enhance information sharing between the Police as well as the public,
4. A national strategic position on Global threats must be taken into account in the adoption and implementation of e-policing as a service,
5. Implement technology which allows scalability and inter-operability with other system,
6. Ensure that issues of change management and business re-engineering are looked into vis-à-vis acceptance and resistance of technology by users,
7. Identify challenges that confront electronic policing service and carefully devise mitigating strategies,
8. E-policing services must provide multichannel functionality in view of accessing and sharing information between the police and community, and
9. Implement system with technological solution that brings efficiency and provides affordable cost to larger population.

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## APPENDIX A - Time Line

From 20<sup>th</sup> November 2014 to 30<sup>th</sup>September 2015

**Table 4:** Gantt chart

Task	Nov-20	Dec-20	Jan-20	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sept-31
Literature review	■	■	■								
Writing Chartper1			■	■							
Submission for review to the supervisor				■							
Information gathering and case study comparison				■	■						
Writing chapter 2					■						
Submission of second chapter for review					■	■					
Application development and Testing						■	■				
Writing remaining chapters							■				
Submission for review								■			
Editing and compilation of final report								■	■		
Printing, binding and submission of final report										■	■

## APPENDIX B - Estimated Budget

**Table 5:** Estimate Budget

Research Objective	Targets	.Stat us	Schedule of Sub-Activitie s	Depts./Org s Contrib. to progress	Person nel to be involv ed	Estimates of materials, supplies, equipment & services		Time Frame (From....T o
						Item	Total Cost (K)	
Develop an e-Policing application	i) Case study analysis of e-Policing challenges.	New	Transport & Lodging fees	MoFNP, MoHA, DMMU, Fire Brigade	Dir., Assist Dir. & Tech. Personnel	Fees	5,000	monthly
	ii) Technology issues in e-Policing	New	Internet Bills	MoFNP, MoHA and community	Dir., Assist Dir. & Tech. Personnel	Internet Charges	10,000	monthly
	iii) Information reach and Range	New	Consultancy services	MoFNP, MoHA	Dir., Assist Dir. & Tech. Personnel	Fees	20,000	monthly
	iv) Security and mobility	New	Survey (Transport or fuel)	Community	Self	Charges	3,000	monthly
	iv) Recommendations	New	Stationary	MoFNP, MoHA	Dir., Assist Dir. & Tech. Personnel	Papers, pens, and tonners	2,000	monthly

## APPENDIX C-Source Code

```
packagemyClasses;

importjava.io.IOException;
importjava.io.PrintWriter;
importjava.sql.Connection;
importjava.sql.DriverManager;
importjava.sql.ResultSet;
importjava.sql.SQLException;
importjava.sql.Statement;
importjavax.servlet.ServletConfig;
importjavax.servlet.ServletException;
importjavax.servlet.annotation.WebServlet;
importjavax.servlet.http.HttpServlet;
importjavax.servlet.http.HttpServletRequest;
importjavax.servlet.http.HttpServletResponse;

/**
 *
 * @author Njase Joel
 */
@WebServlet(name = "clientCreation", urlPatterns = {"/clientCreation"})
public class clientCreation extends HttpServlet {

    String group;
```

```

// Variables to use to connect to database

Statement theStatement;

Connection conn;

int update;

ServletConfig config;

ResultSet result;

String userName = "root";

String password = "";

String sql = "";

String dbName = "zpdb";

static final String JDBC_DRIVER = "com.mysql.jdbc.Driver";

static final String DB_URL = "jdbc:mysql://localhost:3306/zpdb";

static final String USER = "root";

static final String PASS = "";

protected void processRequest(HttpServletRequest request, HttpServletResponse
response)

throws ServletException, IOException {

response.setContentType("text/html;charset=UTF-8");

try (PrintWriter out = response.getWriter()) {

    /* TODO output your page here. You may use following sample code. */

    out.println("<!DOCTYPE html>");

    out.println("<html>");

```

```

out.println("<head>");
out.println("<title>ZPMS</title>");
out.println("</head>");
out.println("<body>");
out.println("<table width=95% bgcolor=#FFFFFF align=center border=1
cellpadding=1 cellspacing=1>");
out.println("<tr>");
out.println("<td>");

out.println("<table width=100% bgcolor=#FFFFFF align=center border=1
cellpadding=1 cellspacing=1>");
out.println("<tr>");
out.println("<td align=center valign=top><img height=100 width=1100
src=\"Images/zp3.gif\" /></td>");
out.println("</tr>");
out.println("</table>");

out.println("<br>");

out.println("<table border=1 cellpadding=1 cellspacing=1 width=100% >");
out.println("<tr>");
out.println("<td width=25% align=center>");
out.println("<form name=form method=Post action=index.html>");
out.println("<input type=image value=Main Menu Window
name=btnHomesrc=\"Images/btnMMW.jpg\" />");
out.println("</form>");

```

```

out.println("</td>");

out.println("<td width=25% align=center>");

out.println("<form name=form method=Post action=displayMessages>");

out.println("<input type=image value=Display Received Messages
name=btnDRMsrc=\"Images/btnDRM.gif\" />");

out.println("</form>");

out.println("</td>");

out.println("<td width=25% align=center>");

out.println("<form name=form method=Post action=sendBulkMessages>");

out.println("<input type=image value=Send Bulk Messages
name=btnSBMsrc=\"Images/btnSBM.gif\" />");

out.println("</form>");

out.println("</td>");

out.println("<td width=25% align=center>");

out.println("<form name=form method=Post action=clientCreation>");

out.println("<input type=image value=Send Bulk Messages
name=btnSBMsrc=\"Images/btnCC.jpg\" />");

out.println("</form>");

out.println("</td>");

out.println("</tr>");

out.println("</table>");

out.println("<br>");

```

```
out.println("<form name=form method=Post action=updateClientCreation>");
out.println("<table bgcolor=#FFFFFF align=center border=1 cellpadding=2
cellspacing=2>");
out.println("<tr>");
out.println("<td>");
out.println("Name");
out.println("</td>");
out.println("<td>");
out.println("<input type=text name=cName");
out.println("</td>");
out.println("</tr>");
out.println("<tr>");
out.println("<td>");
out.println("Phone Number");
out.println("</td>");
out.println("<td>");
out.println("<input type=text name=pNumber");
out.println("</td>");
out.println("</tr>");
out.println("<tr>");
out.println("<td>");
out.println("Group Name");
out.println("</td>");
out.println("<td>");
out.println("<select name=gName>");
try
```

```

{

Class.forName("com.mysql.jdbc.Driver");

conn = DriverManager.getConnection(DB_URL,USER,PASS);

theStatement = conn.createStatement();

sql = "SELECT groupname FROM groups";
result = theStatement.executeQuery(sql);

while(result.next()){

group =result.getString(1);

out.println("<option name=" + group + ">" + group + "</option>");

}

result.close();

theStatement.close();

conn.close();

}

catch(ClassNotFoundException | SQLException e)

{

out.println(e);

}

out.println("</select>");

```

```

out.println("</td>");
out.println("</tr>");
out.println("<tr>");
out.println("<td>");

out.println("</td>");
out.println("<td>");
out.println("<input name=btn type=submit value=Save />");
out.println("</td>");
out.println("</tr>");
out.println("</table>");
out.println("</form>");

out.println("</td>");
out.println("</tr>");
out.println("</table>");
out.println("</body>");
out.println("</html>");
    }
}

// <editor-fold defaultstate="collapsed" desc="HttpServlet methods. Click on
the + sign on the left to edit the code.">

/**
 * Handles the HTTP <code>GET</code> method.

```

```

*
* @param request servlet request
* @param response servlet response
* @throws ServletException if a servlet-specific error occurs
* @throws IOException if an I/O error occurs
*/

@Override
protected void doGet(HttpServletRequest request, HttpServletResponse response)
throws ServletException, IOException {
    processRequest(request, response);
}

/**
 * Handles the HTTP <code>POST</code> method.
 *
 * @param request servlet request
 * @param response servlet response
 * @throws ServletException if a servlet-specific error occurs
 * @throws IOException if an I/O error occurs
 */

@Override
protected void doPost(HttpServletRequest request, HttpServletResponse response)
throws ServletException, IOException {
    processRequest(request, response);
}

```

```

/**
 * Returns a short description of the servlet.
 *
 * @return a String containing servlet description
 */

@Override

public String getServletInfo() {
return "Short description";
    }// </editor-fold>

}

packagemyClasses;

importjava.sql.*;
importjava.io.IOException;
importjava.io.PrintWriter;
importjava.sql.DriverManager;
importjava.util.Calendar;
importjava.util.GregorianCalendar;
importjavax.servlet.annotation.WebServlet;
importjavax.servlet.http.HttpServlet;
importjavax.servlet.http.HttpServletRequest;
importjavax.servlet.http.HttpServletResponse;
importjavax.servlet.ServletConfig;
importjavax.servlet.ServletException;

```

```

/**
 *
 * @author Njase Joel
 * Create
 *
 */
@WebServlet(name = "myRelay", urlPatterns = {"/myRelay"})
public class myRelay extends HttpServlet {

    String sender = "";
    String title = "";
    String mbody = "";
    String message = "";
    String myMessage = "";
    String scts;
    String myRegister = "R";
    String mySearch = "S";
    String ind;

    int id = 0;
    intserialnumber =0;
    intcountResult = 0;
    String mydate;
    String msgtitle = "";

```

```

String msg = "";

// Variables to use to connect to database

Statement theStatement;

Connection conn;

int update;

ServletConfig config;

ResultSet result;

String userName = "root";

String password = "";

String sql = "";

String dbName = "zpdb";

String CT;

static final String JDBC_DRIVER = "com.mysql.jdbc.Driver";

static final String DB_URL = "jdbc:mysql://localhost:3306/zpdb";

static final String USER = "root";

static final String PASS = "";

protected void processRequest(HttpServletRequest request, HttpServletResponse
response)

throws ServletException, IOException {

response.setContentType("text/html;charset=UTF-8");

try (PrintWriter out = response.getWriter()) {

```

```

sender= request.getParameter("sender");
message=request.getParameter("text");
scts = request.getParameter("scts");
String[] parts = message.split("-");

ind = parts[0];
title = parts[1];
mbody = parts[2];

Calendar calendar = new GregorianCalendar();
    String am_pm;
int hour = calendar.get(Calendar.HOUR);
int minute = calendar.get(Calendar.MINUTE);
int second = calendar.get(Calendar.SECOND);

int d = calendar.get(Calendar.DAY_OF_MONTH);
int m = calendar.get(Calendar.MONTH)+1;
int y = calendar.get(Calendar.YEAR);

if(calendar.get(Calendar.AM_PM) == 0)
am_pm = "AM";
else
am_pm = "PM";

    CT = hour+":"+ minute +":"+ second + " " + am_pm;

```

```

    String day = y+"-"+m+"-"+d;
mydate = day +" "+CT;

try
{

Class.forName("com.mysql.jdbc.Driver");
conn = DriverManager.getConnection(DB_URL,USER,PASS);
theStatement = conn.createStatement();

if(ind.equalsIgnoreCase(myRegister))
{
sql = "SELECT msgid FROM messages";
result = theStatement.executeQuery(sql);

while(result.next()){
id =result.getInt(1);

serialnumber = serialnumber + 1;
    }
serialnumber = serialnumber + 1;

sql="INSERT                INTO                messages
VALUES("+serialnumber+", "+title+", "+mbody+", "+mydate+", "+sender+"");

```

```

update = theStatement.executeUpdate(sql);

myMessage = "Message received at " + mydate + ", about " + title + ", the police
will quickly take appropriate action" ;

}

else if(ind.equalsIgnoreCase(mySearch))

{

sql = "SELECT msg,msgtitle FROM messages WHERE msg LIKE '%" + mbody+
"%";

result = theStatement.executeQuery(sql);

while(result.next()){

msg = result.getString(1);

msgtitle = result.getString(2);

countResult = countResult +1;

}

myMessage = "Search 4 " + title + " " + mbody + " gives "+countResult+ " result(s)
the details are that: "+msgtitle+ " "+msg;

}

else

{

myMessage = "ZPMS can't understand the format: To inquire send S-'topic'-
'Search Key'";

}

out.println(myMessage);

result.close();

theStatement.close();

```

```
conn.close();
```

```
}
```

```
catch(ClassNotFoundException | SQLException e)
```

```
{
```

```
out.println(e);
```

```
}
```

```
}
```

```
}
```

```
// <editor-fold defaultstate="collapsed" desc="HttpServlet methods. Click on  
the + sign on the left to edit the code.">
```

```
@Override
```

```
protected void doGet(HttpServletRequest request, HttpServletResponse response)
```

```
throws ServletException, IOException {
```

```
processRequest(request, response);
```

```
}
```

```
@Override
```

```
protected void doPost(HttpServletRequest request, HttpServletResponse response)
```

```
throws ServletException, IOException {  
    processRequest(request, response);  
}
```

```
    @Override
```

```
    public String getServletInfo() {  
        return "Short description";  
        }// </editor-fold>  
    }
```

```
package myClasses;
```

```
import java.io.FileOutputStream;  
import java.io.IOException;  
import java.io.PrintWriter;  
import java.sql.Connection;  
import java.sql.DriverManager;  
import java.sql.ResultSet;  
import java.sql.SQLException;  
import java.sql.Statement;  
import javax.servlet.ServletConfig;  
import javax.servlet.ServletException;  
import javax.servlet.annotation.WebServlet;
```

```

import javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import org.apache.poi.hssf.usermodel.HSSFWorkbook;
import org.apache.poi.ss.usermodel.Cell;
import org.apache.poi.ss.usermodel.Row;
import org.apache.poi.ss.usermodel.Sheet;
import org.apache.poi.ss.usermodel.Workbook;
import org.apache.poi.ss.usermodel.CellStyle;
import org.apache.poi.ss.usermodel.DataFormat;
import org.apache.poi.ss.usermodel.Font;

/**
 *
 * @author Njase Joel
 */
@WebServlet(name = "messageComposer", urlPatterns =
{"/messageComposer"})

public class messageComposer extends HttpServlet {

public String phonenumber;

public String msg;

public String groupname;

public String clientname;

private static final String FILE_PATH =
"C:/Users/police/Documents/NetBeansProjects/messaging/docs/myworks.xls";

```

```

// Variables to use to connect to database

Statement theStatement;

Connection conn;

int update;

ServletConfig config;

ResultSet result;

String userName = "root";

String password = "";

String sql = "";

String dbName = "zpdb";

static final String JDBC_DRIVER = "com.mysql.jdbc.Driver";

static final String DB_URL = "jdbc:mysql://localhost:3306/zpdb";

static final String USER = "root";

static final String PASS = "";

@SuppressWarnings("ConvertToTryWithResources")

protected void processRequest(HttpServletRequest request, HttpServletResponse
response)

throws ServletException, IOException {

response.setContentType("text/html;charset=UTF-8");

try (PrintWriter out = response.getWriter()) {

msg = request.getParameter("msg");

groupname = request.getParameter("gName");

```

```

out.println("<!DOCTYPE html>");
out.println("<html>");
out.println("<head>");
out.println("<title>ZPMS</title>");
out.println("</head>");
out.println("<body>");

out.println("<table width=95% bgcolor=#FFFFFF align=center border=1
cellpadding=1 cellspacing=1>");
out.println("<tr>");
out.println("<td align=center>");

out.println("<table width=100% bgcolor=#FFFFFF align=center border=1
cellpadding=1 cellspacing=1>");
out.println("<tr>");
out.println("<td align=center valign=top><img height=100 width=1100
src=\"Images/zp3.gif\" /></td>");
out.println("</tr>");
out.println("</table>");

out.println("<br>");

out.println("<table border=1 cellpadding=1 cellspacing=1 width=100% >");
out.println("<tr>");
out.println("<td width=25% align=center>");
out.println("<form name=form method=Post action=index.html>");

```

```

out.println("<input      type=image      value=Main      Menu      Window
name=btnHomesrc=\"Images/btnMMW.jpg\" />");

out.println("</form>");

out.println("</td>");

out.println("<td width=25% align=center>");

out.println("<form name=form method=Post action=displayMessages>");

out.println("<input      type=image      value=Display      Received      Messages
name=btnDRMsrc=\"Images/btnDRM.gif\" />");

out.println("</form>");

out.println("</td>");

out.println("<td width=25% align=center>");

out.println("<form name=form method=Post action=sendBulkMessages>");

out.println("<input      type=image      value=Send      Bulk      Messages
name=btnSBMsrc=\"Images/btnSBM.gif\" />");

out.println("</form>");

out.println("</td>");

out.println("<td width=25% align=center>");

out.println("<form name=form method=Post action=clientCreation>");

out.println("<input      type=image      value=Send      Bulk      Messages
name=btnSBMsrc=\"Images/btnCC.jpg\" />");

out.println("</form>");

out.println("</td>");

out.println("</tr>");

out.println("</table>");

```

```

Workbook wb = new HSSFWorkbook();

FileOutputStreamfileOut = new FileOutputStream(FILE_PATH);

    Sheet s = wb.createSheet();

    @SuppressWarnings("UnusedAssignment")

        Row r = null;

    @SuppressWarnings("UnusedAssignment")

        Cell c = null;

    @SuppressWarnings("UnusedAssignment")

        Cell c2 = null;

    @SuppressWarnings("UnusedAssignment")

        Cell c3 = null;

CellStylecs = wb.createCellStyle();

CellStyle cs2 = wb.createCellStyle();

CellStyle cs3 = wb.createCellStyle();

DataFormatdf = wb.createDataFormat();

    Font f = wb.createFont();

    Font f2 = wb.createFont();

f.setFontHeightInPoints((short) 12);

f.setColor( (short)0xc );

f2.setFontHeightInPoints((short) 10);

f2.setColor( (short)Font.COLOR_RED );

wb.setSheetName(0, "Sheet1" );

```

```

cs.setFont(f);

cs2.setBorderBottom(CellStyle.BORDER_THIN);

cs2.setFillPattern((short) CellStyle.SOLID_FOREGROUND);

cs2.setFont(f2);

intrownum=0;

try
{

Class.forName("com.mysql.jdbc.Driver");

conn = DriverManager.getConnection(DB_URL,USER,PASS);

theStatement = conn.createStatement();

sql = "SELECT clientname, phonenumber FROM clients";

result = theStatement.executeQuery(sql);

while(result.next()){

clientname = result.getString(1);

phonenumber = result.getString(2);

    r = s.createRow(rownum);

    c = r.createCell((short) (0));

c.setCellValue(phonenumber);

    c = r.createCell((short) (1));

c.setCellValue(clientname);

    c2 = r.createCell((short) (2));

```

```

c2.setCellValue(msg);
    c3=r.createCell((short) (3));
c3.setCellValue(groupname);

rownum=rownum+1;
    }
result.close();
theStatement.close();
conn.close();

}

catch(ClassNotFoundException | SQLException e)
{
out.println(e);
}
wb.write(fileOut);
fileOut.close();

out.println("<br>");
out.println("<table align=center border=1>");
out.println("<tr>");
out.println("<td align=center valign=top>");

```

```

out.println("MESSAGE COMPOSITION ");
out.println("</td>");
out.println("</tr>");
out.println("<tr>");
out.println("<td align=center valign=top>");
out.println("Composed Message: " + msg);
out.println("</td>");
out.println("</tr>");

out.println("<tr>");
out.println("<td align=center valign=top>");
out.println("Target Group: " + groupname);
out.println("</td>");
out.println("</tr>");
out.println("</table>");

out.println("<br>");
out.println("The excel file created is under path
C:/Users/police/Documents/NetBeansProjects/messaging/docs/myworks.xls.
Attach this file to the bulk messaging utility to distribute the message. ");

out.println("</td>");
out.println("</tr>");
out.println("</table>");
out.println("</body>");
out.println("</html>");
}

```

```

}

// <editor-fold defaultstate="collapsed" desc="HttpServlet methods. Click on
the + sign on the left to edit the code.">

/**
 * Handles the HTTP <code>GET</code> method.
 *
 * @param request servlet request
 * @param response servlet response
 * @throws ServletException if a servlet-specific error occurs
 * @throws IOException if an I/O error occurs
 */
@Override
protected void doGet(HttpServletRequest request, HttpServletResponse response)
throws ServletException, IOException {
    processRequest(request, response);
}

/**
 * Handles the HTTP <code>POST</code> method.
 *
 * @param request servlet request
 * @param response servlet response
 * @throws ServletException if a servlet-specific error occurs
 * @throws IOException if an I/O error occurs
 */

```

```
@Override
protected void doPost(HttpServletRequest request, HttpServletResponse response)
throws ServletException, IOException {
    processRequest(request, response);
}
```

```
/**
 * Returns a short description of the servlet.
 *
 * @return a String containing servlet description
 */
```

```
@Override
public String getServletInfo() {
    return "Short description";
} // </editor-fold>
}
```

```
packagemyClasses;
```

```
import java.io.*;
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.ResultSet;
import java.sql.SQLException;
```

```

import java.sql.Statement;

import javax.servlet.ServletConfig;

import javax.servlet.ServletException;

import javax.servlet.annotation.WebServlet;

import javax.servlet.http.HttpServlet;

import javax.servlet.http.HttpServletRequest;

import javax.servlet.http.HttpServletResponse;

import java.io.IOException;

/**
 *
 * @author Njase Joel
 */
@WebServlet(name = "sendBulkMessages", urlPatterns =
{"/sendBulkMessages"})

public class sendBulkMessages extends HttpServlet {

String group;

// Variables to use to connect to database

Statement theStatement;

Connection conn;

int update;

```

```

ServletConfig config;

    ResultSet result;

    String userName = "root";

    String password = "";

    String sql = "";

    String dbName = "zpdb";

static final String JDBC_DRIVER = "com.mysql.jdbc.Driver";
static final String DB_URL = "jdbc:mysql://localhost:3306/zpdb";
static final String USER = "root";
static final String PASS = "";

protected void processRequest(HttpServletRequest request, HttpServletResponse
response)
throws ServletException, IOException {
response.setContentType("text/html;charset=UTF-8");
try (PrintWriter out = response.getWriter()) {

        /* TODO output your page here. You may use following sample code. */
out.println("<!DOCTYPE html>");
out.println("<html>");
out.println("<head>");
out.println("<title>ZPMS</title>");
out.println("</head>");

```

```

out.println("<body>");

out.println("<table width=95% bgcolor=#FFFFFF align=center border=1
cellpadding=1 cellspacing=1>");

out.println("<tr>");

out.println("<td>");

out.println("<table width=100% bgcolor=#FFFFFF align=center border=1
cellpadding=1 cellspacing=1>");

out.println("<tr>");

out.println("<td align=center valign=top><img height=100 width=1100
src=\"Images/zp3.gif\" /></td>");

out.println("</tr>");

out.println("</table>");

out.println("<br>");

out.println("<table border=1 cellpadding=1 cellspacing=1 width=100% >");

out.println("<tr>");

out.println("<td width=25% align=center>");

out.println("<form name=form method=Post action=index.html>");

out.println("<input type=image value=Main Menu Window
name=btnHomesrc=\"Images/btnMMW.jpg\" />");

out.println("</form>");

out.println("</td>");

```

```

out.println("<td width=25% align=center>");
out.println("<form name=form method=Post action=displayMessages>");
out.println("<input type=image value=Display Received Messages
name=btnDRMsrc=\"Images/btnDRM.gif\" />");
out.println("</form>");
out.println("</td>");

out.println("<td width=25% align=center>");
out.println("<form name=form method=Post action=sendBulkMessages>");
out.println("<input type=image value=Send Bulk Messages
name=btnSBMsrc=\"Images/btnSBM.gif\" />");
out.println("</form>");
out.println("</td>");

out.println("<td width=25% align=center>");
out.println("<form name=form method=Post action=clientCreation>");
out.println("<input type=image value=Send Bulk Messages
name=btnSBMsrc=\"Images/btnCC.jpg\" />");
out.println("</form>");
out.println("</td>");
out.println("</tr>");
out.println("</table>");

out.println("<br>");
out.println("<form name=form method=Post action=messageComposer>");
out.println("<table align=center border=1 cellpadding=1 cellspacing=1 >");
out.println("<tr>");

```

```

out.println("<td>Message</td>");
out.println("<td>");
out.println("<textarea name=msg cols=40 rows=10></textarea>");
out.println("</td>");
out.println("</tr>");

out.println("<tr>");
out.println("<td>Target Group</td>");
out.println("<td>");
out.println("<select name=gName>");
try
{

Class.forName("com.mysql.jdbc.Driver");
conn = DriverManager.getConnection(DB_URL,USER,PASS);
theStatement = conn.createStatement();

sql = "SELECT groupname FROM groups";
result = theStatement.executeQuery(sql);

while(result.next()){

group =result.getString(1);
out.println("<option name=" + group + ">" + group + "</option>");
}
result.close();

```

```

theStatement.close();
conn.close();

}

catch(ClassNotFoundException | SQLException e)
{
out.println(e);
}

out.println("</select>");

out.println("</td>");
out.println("</tr>");

out.println("<tr>");
out.println("<td></td>");
out.println("<td>");
out.println("<input type=submit name=btn value=Generate>");
out.println("</td>");
out.println("</tr>");
out.println("</table>");
out.println("</form>");

out.println("</td>");
out.println("</tr>");

```

```
out.println("</table>");
```

```
out.println("</body>");
```

```
out.println("</html>");
```

```
    }
```

```
  }
```

```
// <editor-fold defaultstate="collapsed" desc="HttpServlet methods. Click on  
the + sign on the left to edit the code.">
```

```
/**
```

```
 * Handles the HTTP <code>GET</code> method.
```

```
 *
```

```
 * @param request servlet request
```

```
 * @param response servlet response
```

```
 * @throws ServletException if a servlet-specific error occurs
```

```
 * @throws IOException if an I/O error occurs
```

```
 */
```

```
@Override
```

```
protected void doGet(HttpServletRequest request, HttpServletResponse response)
```

```
throws ServletException, IOException {
```

```
    processRequest(request, response);
```

```
 }
```

```
/**
```

```
 * Handles the HTTP <code>POST</code> method.
```

```
 *
```

```

    * @param request servlet request
    * @param response servlet response
    * @throws ServletException if a servlet-specific error occurs
    * @throws IOException if an I/O error occurs
    */

    @Override

    protected void doPost(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {
        processRequest(request, response);
    }

    /**
     * Returns a short description of the servlet.
     *
     * @return a String containing servlet description
     */

    @Override

    public String getServletInfo() {
        return "Short description";

        }// </editor-fold>

    }

    packagemyClasses;

```

```

import java.io.IOException;
import java.io.PrintWriter;
import java.sql.Connection;
import java.sql.DriverManager;
import java.sql.ResultSet;
import java.sql.SQLException;
import java.sql.Statement;
import javax.servlet.ServletConfig;
import javax.servlet.ServletException;
import javax.servlet.annotation.WebServlet;
import javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;

/**
 *
 * @author Njase Joel
 */
@WebServlet(name = "updateClientCreation", urlPatterns =
{"/updateClientCreation"})
public class updateClientCreation extends HttpServlet {

public String ClieName;

public String PhoneNumber;

public String Group;

```

```

publicintserialnumber = 0;

publicint id = 0;

int update;

// Variables to use to connect to database

Statement theStatement;

Connection conn;

ServletConfigconfig;

ResultSet result;

String userName = "root";

String password = "";

String sql = "";

String dbName ="zpdb";

String [] cNames;

static final String JDBC_DRIVER = "com.mysql.jdbc.Driver";

static final String DB_URL = "jdbc:mysql://localhost:3306/zpdb";

static final String USER = "root";

static final String PASS = "";

protected void processRequest(HttpServletRequest request, HttpServletResponse
response)

throwsServletException, IOException {

response.setContentType("text/html;charset=UTF-8");

```

```

try (PrintWriter out = response.getWriter()) {
    /* TODO output your page here. You may use following sample code. */

    ClieName =request.getParameter("cName");
    PhoneNumber = request.getParameter("pNumber");
    Group = request.getParameter("gName");

    try
    {

        Class.forName("com.mysql.jdbc.Driver");
        conn = DriverManager.getConnection(DB_URL,USER,PASS);
        theStatement = conn.createStatement();
        sql = "SELECT clientid FROM clients";
        result = theStatement.executeQuery(sql);

        while(result.next()){

            id =result.getInt(1);

            serialnumber = id;
            }
            serialnumber = serialnumber + 1;

            sql="INSERT
                INTO
                clients
            VALUES("+serialnumber+", "+ClieName+", "+PhoneNumber+", "+Group+" )";
            ";

```

```

update = theStatement.executeUpdate(sql);

result.close();

theStatement.close();

conn.close();

}

catch(ClassNotFoundException | SQLException e)
{
out.println(e);
}

out.println("<!DOCTYPE html>");
out.println("<html>");
out.println("<head>");
out.println("<title>ZPMS</title>");
out.println("</head>");
out.println("<body>");

out.println("<table width=95% bgcolor=#FFFFFF align=center border=1
cellpadding=1 cellspacing=1>");

out.println("<tr>");

out.println("<td>");

```

```

out.println("<table width=100% bgcolor=#FFFFFF align=center border=1
cellpadding=1 cellspacing=1>");

out.println("<tr>");

out.println("<td align=center valign=top><img height=100 width=1100
src=\"Images/zp3.gif\" /></td>");

out.println("</tr>");

out.println("</table>");

out.println("<br>");

out.println("<table border=1 cellpadding=1 cellspacing=1 width=100% >");
out.println("<tr>");
out.println("<td width=25% align=center>");
out.println("<form name=form method=Post action=index.html>");
out.println("<input type=image value=Main Menu Window
name=btnHomesrc=\"Images/btnMMW.jpg\" />");
out.println("</form>");
out.println("</td>");

out.println("<td width=25% align=center>");
out.println("<form name=form method=Post action=displayMessages>");
out.println("<input type=image value=Display Received Messages
name=btnDRMsrc=\"Images/btnDRM.gif\" />");
out.println("</form>");
out.println("</td>");

```

```

out.println("<td width=25% align=center>");

out.println("<form name=form method=Post action=sendBulkMessages>");

out.println("<input      type=image      value=Send      Bulk      Messages
name=btnSBMsrc=\"Images/btnSBM.gif\" />");

out.println("</form>");

out.println("</td>");

out.println("<td width=25% align=center>");

out.println("<form name=form method=Post action=clientCreation>");

out.println("<input      type=image      value=Send      Bulk      Messages
name=btnSBMsrc=\"Images/btnCC.jpg\" />");

out.println("</form>");

out.println("</td>");

out.println("</tr>");

out.println("</table>");

out.println("<br>");

out.println("<table align=center border=1>");

out.println("<tr>");

out.println("<td align=center valign=top>");

out.println("RECORD UPDATED ");

out.println("</td>");

out.println("</tr>");

out.println("<tr>");

out.println("<td align=center valign=top>");

out.println("Client Name: " + ClieName);

```

```
out.println("</td>");
out.println("</tr>");

out.println("<tr>");
out.println("<td align=center valign=top>");
out.println("Phone Number: " + PhoneNumber);
out.println("</td>");
out.println("</tr>");

out.println("<tr>");
out.println("<td align=center valign=top>");
out.println("Group Name: " + Group);
out.println("</td>");
out.println("</tr>");
out.println("</table>");

out.println("</td>");
out.println("</tr>");
out.println("</table>");
out.println("</body>");
out.println("</html>");
    }
}
```

```
// <editor-fold defaultstate="collapsed" desc="HttpServlet methods. Click on  
the + sign on the left to edit the code.">
```

```
/**
```

```
 * Handles the HTTP <code>GET</code> method.
```

```
 *
```

```
 * @param request servlet request
```

```
 * @param response servlet response
```

```
 * @throws ServletException if a servlet-specific error occurs
```

```
 * @throws IOException if an I/O error occurs
```

```
 */
```

```
@Override
```

```
protected void doGet(HttpServletRequest request, HttpServletResponse response)
```

```
throws ServletException, IOException {
```

```
    processRequest(request, response);
```

```
}
```

```
/**
```

```
 * Handles the HTTP <code>POST</code> method.
```

```
 *
```

```
 * @param request servlet request
```

```
 * @param response servlet response
```

```
 * @throws ServletException if a servlet-specific error occurs
```

```
 * @throws IOException if an I/O error occurs
```

```
 */
```

```
@Override
```

```
protected void doPost(HttpServletRequest request, HttpServletResponse response)
```

```
throws ServletException, IOException {
    processRequest(request, response);
}

/**
 * Returns a short description of the servlet.
 *
 * @return a String containing servlet description
 */
@Override
1. public String getServletInfo() {
return "Short description";
    }// </editor-fold>
}
```