A FRAMEWORK TO ADDRESS THE PROBLEM OF MOBILE PHONE THEFT: A CASE STUDY OF THE TELECOMMUNICATIONS SECTOR IN ZAMBIA

BY

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DECLARATION

I, **Benaiah Simui Akombwa**, do hereby declare that this dissertation is the result of my own findings and research except to the extent acknowledged by explicit references. This work has not been previously submitted in part or full for the award of a Master's degree at this, or any other university.

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CERTIFICATE OF APPROVAL

This dissertation by **Benaiah Simui Akombwa** is approved as fulfilling the requirements for the award of the degree of Master of Engineering in Information and Communication Technology (MEng ICT) by the University of Zambia.

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Examiner 3..Signature …………………… Date....................

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ABSTRACT

As in most nations in Africa, the problem of mobile or cell phone theft is something that local authorities in Zambia are desirous to address. With advances in technology, phones have gotten smaller and of high value. Motivated by this rising challenge, this study purposed to propose an appropriate framework that would help reduce phone thefts. A cross-sectional survey was carried out in which 420 structured questionnaires were distributed among Lusaka residents in four different districts using a multi-stage cluster sampling method. Interviews were also done with various stakeholders such as the Mobile Network Operators, ZICTA and the Police. Data was analysed descriptively using SPSS version 16. Results of the study revealed a 67% phone theft prevalence and confirmed that phone thefts in Zambia have been on the rise, without any seemingly workable remedy from the authorities to counter the issue. Further, Samsung mobile phones topped as the most frequently stolen followed by Nokia. Currently, victims of lost or stolen phones report the matter to the Police then the law enforcement wing tries to recover the phone through a manual process. This study proposed to develop a framework that would help enhance collaboration by interested parties and eventually reduce the prevalence of phone theft by ultimately blocking the handset and preventing its reuse in Zambia once reported stolen.

Keywords: *Mobile Phone theft, CEIR Zambia, Addressing Cell Phone Theft in Zambia, IMEI Blacklisting in Zambia*

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DEDICATION

I dedicate this work to my children, Limpo Abigail and Chabota Jason, as well as to my wife Annette Habweza. I also dedicate this work to my brothers Samuel, Moses, Peter, David; as well as to my parents Dr. Simui Harrington and Mrs. Given Monde Akombwa. I hope this work will inspire those in my sphere of influence to work hard and strive for excellence.

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ACRONYMS AND ABBREVIATIONS

CEIR – Central Identity Equipment Register

EIR – Equipment Identity Register

GSMA – GSM Association

ICT – Information and Communication Technology

IMEI – International Mobile Equipment Identity

ITU – International Telecommunications Union

MNO – Mobile Network Operator

SADC – Southern African Development Community

SI – Statutory Instrument

ZICTA – Zambia Information & Communications Authority

ZMK – Zambian Kwacha

ZNDC – Zambia National Data Centre

CHAPTER ONE

INTRODUCTION TO THE RESEARCH

1.1 Introduction

This chapter discusses the general problem of mobile phone theft and its impact on consumers globally. The statement of the problem, significance, scope, aims and objectives of this study are also discussed. Other key considerations such as research questions, definition of key terms and organization of the thesis are equally outlined in this chapter.

1.2 Background to Mobile Phone Communications

Over the past two decades, the lives of billions of people have been revolutionized by two technologies: mobile communications and the internet. The two technologies were initially developed in parallel but are now on a fully converged path [1]. This convergence portends a new era in which a considerable majority of the world's population not only makes phone calls using a mobile handset, but also now access the internet over mobile technology. The escalating use of technology to facilitate communication and enable information access is perhaps one of the most notable attributes of the world in which we live today. The phenomenal acceptance and growing use of mobile and Internet technology and applications perhaps exceed any other sphere of human activity. Information and Communication Technology (ICT) remains pivotal in economic growth - maintaining a lead as a service sector with the biggest growth rate [2]. In the 1980s, microprocessor technology and cheap memory transformed the communication industry. The Web was born in the 1990s and the price of international telephone calls cost only a fraction of what was charged fifteen (15) years before [3]. Till the early 1980s nearly all national communications were facilitated by parastatals or government-controlled monopolies characterized by slow innovation. International voice traffic was limited, with occasional satellite broadcasts and no commercially available email facilities. No competition existed in the provision of international voice calls, making international voice connections very few and extremely expensive to callers while significantly profitable to telephone companies [3].

The Britons introduced restricted competition and started privatizing British Telecom and Cable & Wireless. AT&T in the United States of America (USA) was also unbundled on 1 January 1984 and permitted to provide enhanced information services and value-adds [3]. More countries followed example to embrace competition, privatization and liberalization in the telecommunications sector. Convergence became the aim as boundaries and restrictions that initially confined data and voice, local and long-distance, wireless and cable/telephone services gradually fell off [3]. Universal mobile broadband connectivity deployments and the wide acceptance of increasingly powerful hand-held devices are at the centre of the rise of the sharing economy. This accounts for the change in the way many people consume goods and services. The role of regulators in the communications sector has become considerably central to the success of national social and economic policies — with consequences affecting trade and commerce, healthcare, education, access to financial and a variety of government services. A nation's government is responsible for creating and maintaining a business environment in which the mobile industry thrives and innovates with positive economic and social outcomes for the benefit of all citizens. The citizenry of a nation benefit the most when private-public partnerships are established on the foundation of trust and openness.

The mobile telecommunication services market has grown to represent more than 7.6 billion mobile connections, serving 4.7 billion unique mobile customers globally [4]. This growth is anticipated to continue and its impact is evident in both developed and developing markets. Individuals, corporate entities and governments alike have adopted the many innovations that characterize mobile telecommunication services that have enabled new business models supporting new forms of personal and business interaction [4].

As consumers steadily migrate from traditional services to increasingly adopt the use of broadband-enabled data communications now available on hand-held gadgets, the mobile telecommunications industry continues to be highly dynamic [5]. Flexible, light-touch regulation is extremely important as the market is best able to drive the sector's evolution, and highly prescriptive policy falls short of keeping up with the ever-advancing mobile technologies, services and consumer demands. As technology rapidly advances, the relevance of rules or regulations and guidelines only sustains if they are flexible enough to evolve along with the system [3]. Policymakers face new and rather exciting challenges and opportunities as the use of mobile phones and internet becomes a significant factor in the transformation of many other sectors. The GSM Association (GSMA) as a global trade association of mobile operators launched an initiative in 1996 to block cell phones based on a shared compilation of

globally unique identifiers of handsets reported stolen or lost [5]. By the use of the International Mobile Equipment Identifier (IMEI) of mobile phones, the GSMA maintains a compiled list or an IMEI Database of all phones reported stolen or lost by the mobile network operators' customers [1] [5].

The growing economic and social centrality of the internet and especially mobile telecommunication services creates a need to protect customers and beneficiaries to safely and securely continue to use these services [4]. Without such protection, a risk exists wherein the benefits of modern communications diminish. As more complex and advanced mobile telecommunication services emerge, the list of probable threats equally increases [4]. Their storage capacity has increased such that they are capable of storing considerably large amounts of information. This has made mobile phones an easy target of criminals [4]. Theft of mobile phones is a matter of global concern that has seen governments endeavouring to work with the police, manufacturers and mobile network operators (MNOs) to do all that is possible in helping reduce the prevalence [6]. Regrettably, there are criminals working to unwarrantedly reap benefits from trading in stolen cell phones. These criminals supply a black market in mobile phone handsets obtained through street crime and mugging [1] [5] [7].

1.3   Statement of the Problem

- Globally, theft of mobile phones has been a growing concern over the past decades. With advances in technology, cell phones have gotten smaller, portable and of high value. This has made mobile phones an easy target of criminals [4]. This is because criminals easily reap benefits from selling these phones without being traced.

- This problem is more prevalent in developing countries where there are no mechanisms to block stolen phones and prevent them from reconnecting to GSM networks. A baseline study undertaken confirmed that phone thefts have persistently increased over the past years. In the year 2011, 476 phone thefts were reported to the Zambia Police. By end of the year 2018, this number had increased to 1,275, representing a phone theft increase percentage of 267.9%. These statistics present an annual average of 778 phone thefts. Authorities such as Zambia Police and the Telecommunications Regulator, with mobile network operators (MNOs) on one end, do acknowledge that no framework of

engagement presently exists for cooperation among stakeholders to address this growing problem of cell phone theft. As can be seen from Figure 1.1 below, phone theft incidents are on the increase.

- The absence of deliberate and well-coordinated efforts by various players in the Telecommunications Industry in Zambia is not helping in finding possible methods for addressing this problem.
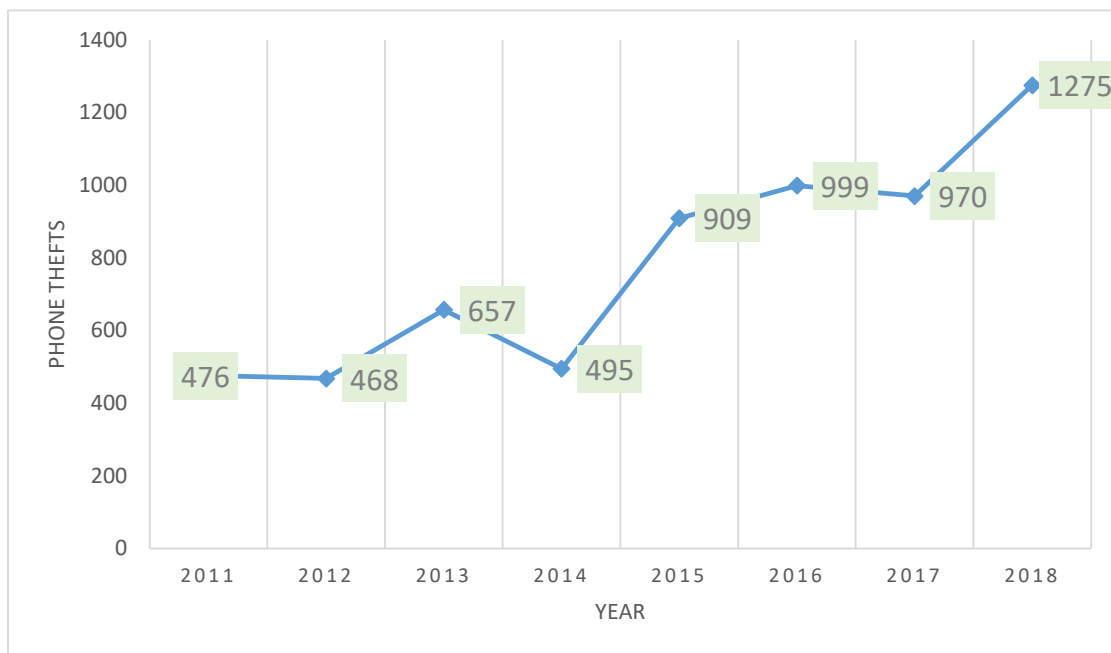
Figure 1.1 Reported Phone Thefts Countrywide

1.5 Significance of the Study

Despite the problem of mobile phone theft not being of the industry's design or making, the industry constitutes part of the solution. Mobile phone theft is increasingly becoming a challenge to law enforcement typically in territories where no deliberate action and policies have been invoked to exhaustively deal with the issue [1]. This study will discuss the options available for the Zambian Telecommunications industry to reduce or prevent mobile phone theft. The policy implications and steps previously taken to reduce mobile handset theft from a regulatory standpoint will be reviewed. As with other efforts and attempts aimed at combating the problem of mobile handset thefts and reducing crime, the framework discussed herein aims

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to make phone theft riskier and less rewarding. The framework proposed in this study will contribute significantly to long-term policy-related aims to combat mobile phone theft in Zambia and the Southern Africa region.

1.6   Scope of the Study

This study focusses only on the Telecommunications sector and industry in Zambia. Mobile Network Operators (MNOs) do no offer the facility for assisting law enforcement authorities, typically the police, with searching their databases in remote sites or locations. All phone-theft related queries are handled in Lusaka for the three mobile network operators, namely Airtel, MTN and ZAMTEL.

1.7   Aim of the Study

This study was aimed at formulating a framework for the interaction of various players in the problem of mobile phone theft to improve exchange of required information in the management of the problem of phone theft. The previous sequence of events in the fight against mobile phone theft and the limitations thereof were brought out to identify gaps for improved problem and incident management.

1.8   Objectives of the Study

General Objective

To propose a framework through which various players like Mobile Network Operators (MNOs), Law Enforcement Officers, the Regulator and Victims can interact for the mutual benefit and to disadvantage thieves of handsets.

Specific Objectives

The research will focus on the specific objectives below;

1. To profile the prevalence of phone thefts among the mobile phone users in Zambia.

2. To evaluate the existing security mechanism or framework available for reducing phone thefts among users in Zambia.

3. To propose a framework that could be used by authorities in the mobile phone industry to mitigate these phone thefts.

1.9   Research Contribution

This research was focused on examining mobile phone theft and its major contribution was the baseline study highlighting the prevalence of cell phone theft in Zambia. Prior to this study, no information was available to give the impact of phone theft. Part of the findings of this research were published in the Journal of Mobile Studies[1].

1.10   Research Questions

1. What is the prevalence of phone thefts among the mobile phone users in Zambia?
2. What efforts are being put in place by the Zambian authorities to help reduce phone thefts and how effective are these efforts in addressing the problem of phone thefts among the mobile phone users in the country?
3. What framework would be appropriate for use by authorities to mitigate the phone thefts in Zambia?

1.11   Organization of the Dissertation

There are five chapters in this dissertation. The introductory background of this research and an overview of mobile phone theft globally, at regional level and specifically in Zambia are given in Chapter 1. The research problem, objectives and focus of the research as well as its significance are substantiated in the first chapter.

Chapter 2 gives an introductory background to mobile telecommunications in Zambia. The chapter also reviews mobile cell phone architecture and technology and possibilities for

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[1] Benaiah Akombwa, Simon Tembo, Situation Analysis of Mobile Phone Theft in Zambia, Journal of Mobile Studies, Vol. 1 No. 1, 2019, pp. 1-7. doi: 10.5923/j.jms.20190101.01.

industry action to address mobile phone thefts by collaboration. This review of the literature is then employed to determine the adaptability and applicability of IMEI blacklists in addressing cell phone theft. The chapter also highlights the growth of the mobile telecommunications industry in Africa, Zambia in particular. Possible methods or options available to address the challenge of Mobile phone theft are also examined for possible application to the Zambian telecommunications sector.

Chapter 3 discusses the research methodology, detailing and describing the tools, procedures and methods that were employed to undertake this study.

Chapter 4 mainly presents the findings of the study, presenting them alongside discussion.

Chapter 5 contains conclusions and recommendations

1.12   Chapter Summary

This is the introductory chapter of this thesis. A review of the subject area was given. The background, the problem statement, the research objectives and the significance of the study are also highlighted. The chapter closed with an outline of the thesis.

CHAPTER TWO

LITERATURE REVIEW

2.1   Introduction

An introductory background to mobile telecommunications in Zambia is given in this chapter. The chapter also reviews mobile cell phone architecture and technology and possibilities for industry action to address mobile phone thefts by collaboration. This review of the literature is then employed to determine the adaptability and applicability of IMEI blacklists in addressing cell phone theft.

2.2   The Telecommunications Industry in Zambia

The era of Mobile Telecommunications in Zambia was preceded by the traditional fixed phone system commonly known as the public switched telephone network (PSTN), with the first phone exchange having been installed in Livingstone as far back as 1913 [8]. This network continued to grow mainly along the line of rail and the noble attempts by the authorities to extend connectivity to remote areas became a challenge because of ageing equipment (for which spares became a nightmare to find), coupled with undercapitalisation. Zambia's Post and Telecommunications Company (PTC) was the parastatal charged with the responsibility to maintain the conventional PSTN network [8]. Till the introduction of multiparty democracy in the early 1990s, telecommunications service provision was a monopoly of the Postal and Telecommunications Company (PTC) [8] [9]. In alignment with global telecommunications sector reforms, the government of the Republic of Zambia enacted the Telecommunications Act in 1994. This enactment provided a legal framework to open the market to new players in the provision of telecommunications services. The liberalisation made way for competition in nearly all telecommunications aspects save for the international gateway (IGW) and the PSTN [9]. Resultant from this policy change was the split of the postal and telecommunications functions by the creation of two separate legal entities; the Zambia Telecommunication Company (ZAMTEL) and the Zambia Postal Corporation (ZAMPOST) [9]. The creation of an autonomous regulator, the Communications Authority of Zambia (CAZ), relieved the Postal

and Telecommunications Company (PTC) of regulatory functions and mandated the newly created regulatory body (CAZ) to oversee and control frequency spectrum use. In 2006, the Zambian government officially launched the National Information and Communications Technology (ICT) policy after extensive consultative engagements with stakeholders in academia, the private sector, various professionals and practitioners within and outside government. Resultantly, new legislation was passed to safeguard the National ICT Policy objectives that established a new institutional, legal and regulatory framework. The ICT Act of 2009 mandated the Communications Authority of Zambia to change name to the Zambia Information and Communication Technology Authority (ZICTA) [9].

There are presently three mobile network operators in Zambia's Telecommunications sector. The first mobile telecommunications company was licenced in 1994 when ZAMTEL was permitted to offer mobile cellular services to the general public [10]. Then followed the first privately-owned mobile operator to enter the Zambian market in 1995, Telecel Zambia, which is now MTN after a buyout in 2006 [10] [11]. Zamcell, later taken over by Celtel, then Zain, now Airtel [11] entered the market in 1997 as the third mobile network operator [10]. To date, ZAMTEL is still holding privileged monopoly on fixed-line or Public Switched Telephone Network (PSTN) services [10] [11]. The Zambian government took action to sell off seventy percent (70%) of ZAMTEL equity to Libya's LAP Green in quarter one (Q1) of 2010. This move, alongside the reduction of licence fees from the previous USD18 million to USD350 thousand, practically took away ZAMTEL's monopoly over the international gateway and attracted new entrants. This resulted in significantly reduced international calling rates by as much as seventy percent (70%) [11]. The sale of ZAMTEL to LAP Green was later reversed after the Patriotic Front (PF) took over power from the Movement for Multiparty Democracy (MMD) in 2011. This was challenged and the London High Court passed judgement in 2017 for the Zambian government to compensate LAP Green [12] [13] [14] [15]. In a Press Statement issued on 19th March, 2018 [16], the Zambian ICT Regulator (ZICTA) gave notification of award of a licence to a fourth mobile network operator – UZI Zambia Limited. Thus to the three previously existing mobile network operators (MNOs) Airtel, MTN and ZAMTEL was to be added a company whose major shareholding entity is Unitel International Holding B.V registered in Netherlands [16] [17] [18]. Hopes were high that the coming on board of a fourth mobile operator would drive innovation in the telecommunications sector that will enhance service delivery and bring about benefits to end users. In a Press Release, the Competition and Consumer Protection Commission (CCPC) - the primary advocate and

regulator for Competition and Consumer welfare in Zambia - anticipated that the introduction of a fourth mobile network operator would offer alternatives to customers as well as drive innovation envisaged to trigger growth of the sector [19]. However, as at the time of this writing, UZI Zambia Limited had neither started operations nor officially launched for the on-boarding of customers or subscribers. In quarter three (Q3) of 2019, the Ministry of Transport and Communications was on record of having considered quashing UZI Zambia's mobile operating licence if operations would not have begun by November of 2019. On 3rd September 2019, Minister of Transport and Communications, Mutotwe Kafwaya, was quoted as having said UZI Zambia's operating licence would expire by November 30 of the same year [20]. The delay in UZI Zambia's launch is speculated to have been owing to mobilizing of funds and the general public still awaits an update from the Ministry of Transport and Communications as to what the next course of action shall be after the company is apparent failure to launch by November 2019 [20] [21] [22].

According to the Zambia Information and Communications Technology Authority (ZICTA), there were 4.4 million mobile phone subscribers as at end of December 2009 – representing a mobile penetration rate of thirty-two percent (32%) [10]. The mobile penetration rate has been on the increase, with the rate standing at 79.1% as at end of September 2017 [23]. A summary of the statistics from 2008 to quarter 4 of 2017 is given in **Table 2.1,** clearly showing that the usage and adoption of mobile phones is generally on an upward trend. As a collaboration with the Central Statistical Office and the Ministry of Transport and Communications, a National Survey on Access and Usage of ICTs by Households and Individuals was undertaken by the Zambia Information and Communications Technology Authority (ZICTA) in 2018. This survey was aimed at measuring progress in the uptake of ICT products and services across the country. According to the 2018 National Survey, an estimated that 53.5% of all the individuals across the country were active users of mobile cellular telephones. The uptake of smartphones increased from 13.5% to 29.6% between 2015 and 2018. The report estimates the level of knowledge of the existence digital financial services available in Zambia among all individuals aged 10 years and above to be at 67.2% [24]. From the 2018 National Survey, 56.9% of the males confirmed being active mobile telecommunications service users as compared to 50.9% for the females.

Table 2.1 Mobile Penetration rates in Zambia

Year	Zambian Population	Mobile Phone Subscribers	Penetration Rate of Mobile Phones
2008	11,900,000	3,207,000	27%
2009[2]	12,896,000	4,406,000	34.2%
2010	13,092,666	5,446,536	41.6%
2011	13,721,498	8,164,553	59.5%
2012	14,156,468	10,524,676	74.3%
2013	14,605,555	10,395,801	71.2%
2014	15,068,729	10,114,867	67.1%
2015	15,545,778	11,557,725	74.3%
2016	16,037,474	12,017,034	79.4%
2017	16,405,229	13,438,539	81.9%
2018	16,667,720	15,470,270	91.6%
2019[3]	17,381,168	16,889,138	97.2%

Lusaka Province has the highest concentration of mobile phone subscribers at 72.7%. This is followed by Copperbelt Province at 69.1% and then Southern Province at 60.6%. The lowest concentration of active cell phone users was recorded in Muchinga Province at 40.9%, North-Western Province at 36.4% and Northern Province at 34.4%. The proportion of active male mobile cell phone users across Zambia is relatively higher when compared to that of females.

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[2] 2008 & 2009 figures are obtained from ZICTA & ZDA Report [10]
[3] 2019 figures are up to Quarter 3 or end of September [23]
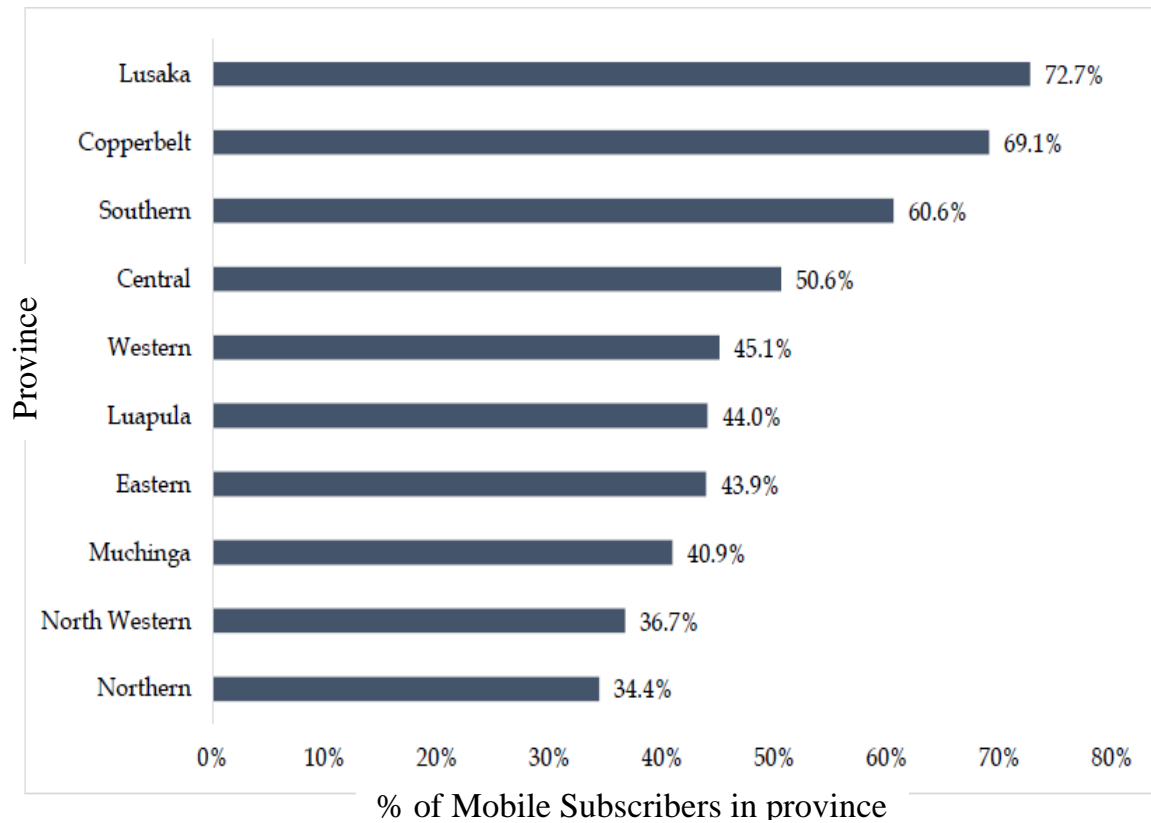
Figure 2.1 Mobile Penetration by Province [24]

Clearly, the adoption of cell phones is on the increase as can be seen from Figure 2.2 below;
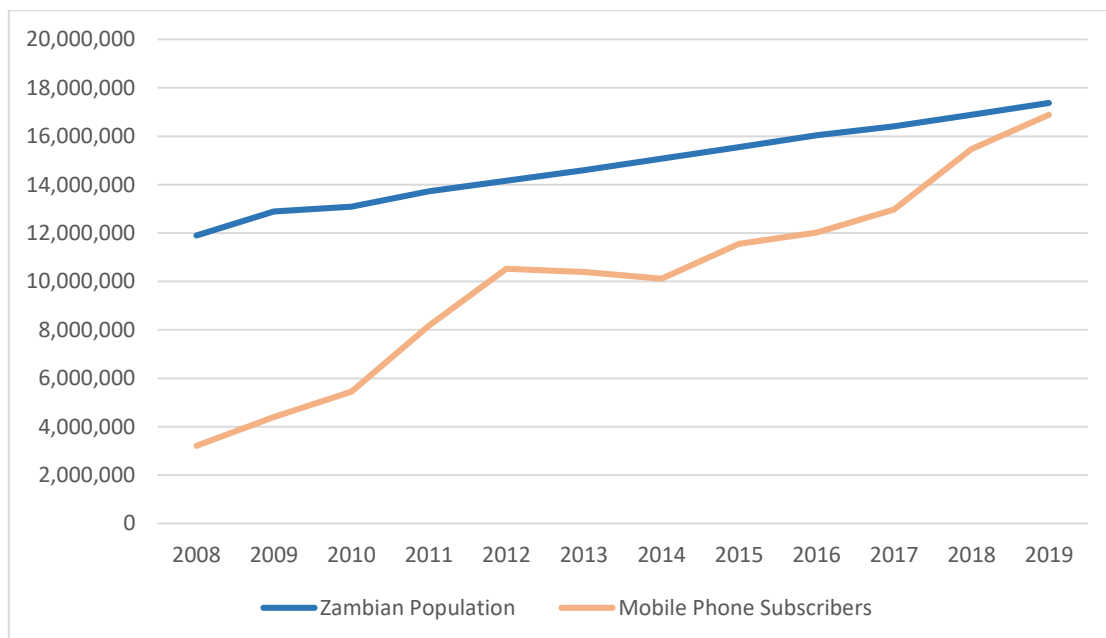
Figure 2.2 Mobile Subscriber Penetration Rate [23]

Airtel is currently Zambia's most preferred mobile network. Survey results from 2018 show that Airtel stands at 48%, followed by MTN at 45% and ZAMTEL at 7%.
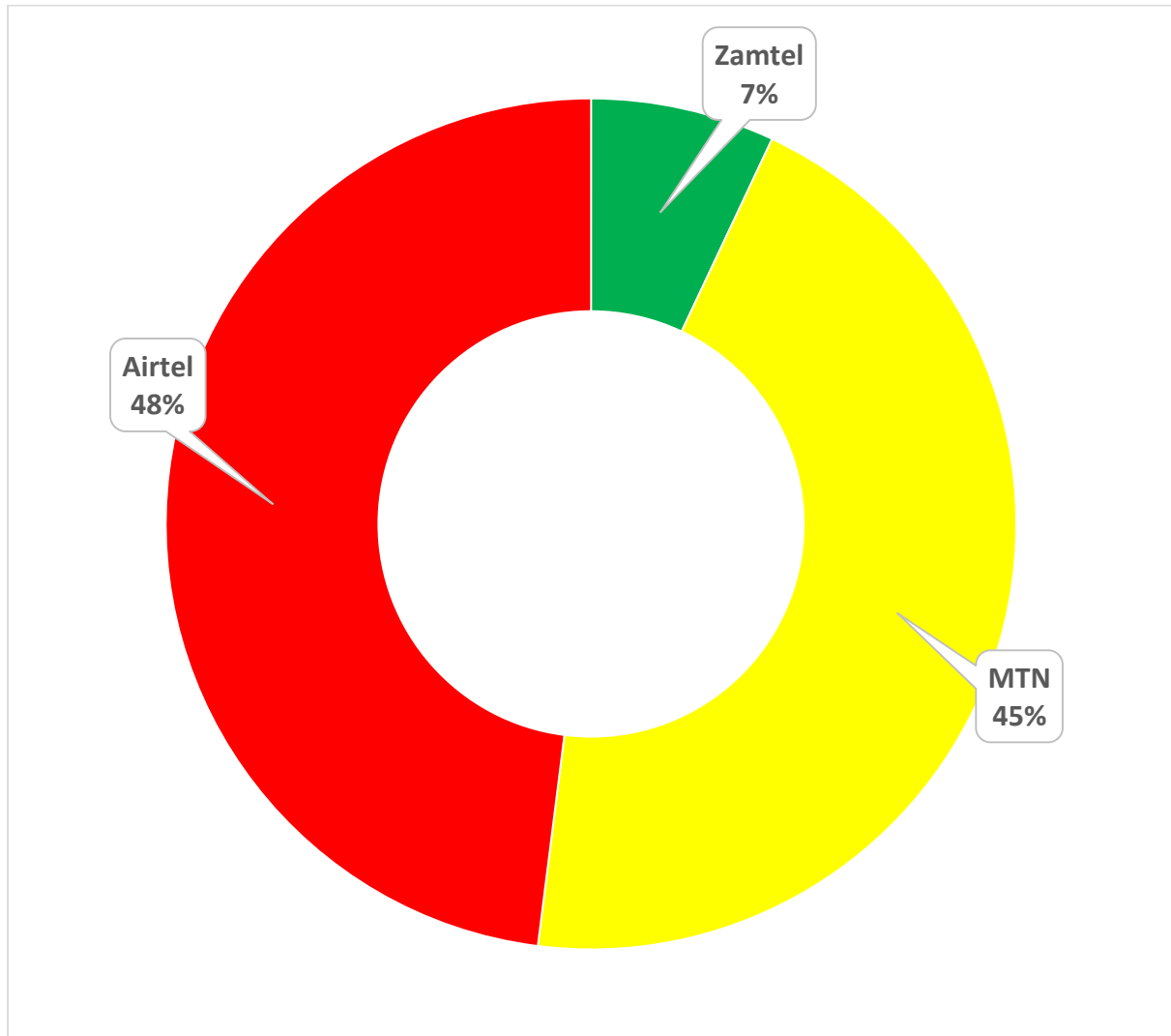
Figure 2.3 Mobile Cellular Network Market Share [24]

MTN's dominance is mainly on the Copperbelt and Central Provinces. Zamtel's dominance is mainly in Western and Eastern Provinces
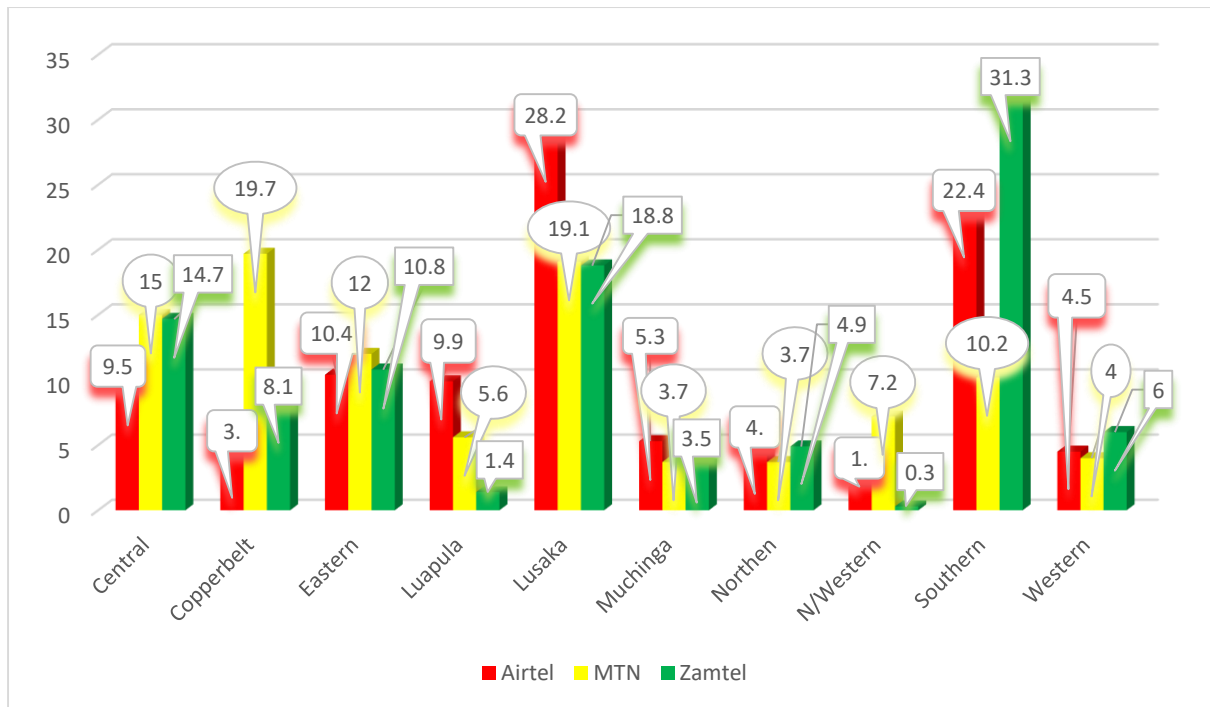
Figure 2.4 Mobile Network Operator Dominance by Province [24]

MTN was the market leader in 2014 and 2015. MTN at 48.8% beating Airtel in second position at 36.3% in 2014. MTN was still leading in 2015 at 45.7% against Airtel's 39.8% in 2015 [10].
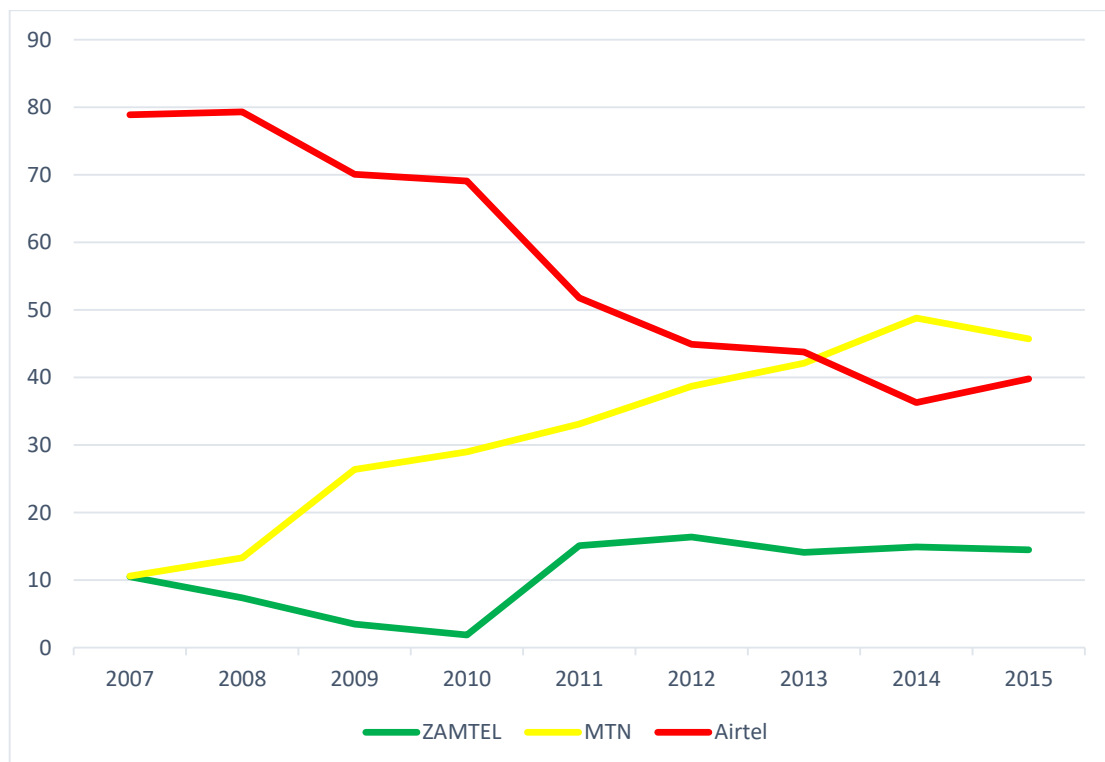
Figure 2.5 Market Leadership from 2007 to 2015 [10]

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Notably, 2G and 3G technology have the widest coverage in Zambia, accounting for 42.7% and 41.9%, respectively, of the population within reach of mobile cellular signal. Only 14.5% of the mobile subscriber population in Zambia is tapping into 4G cellular technology. [24].
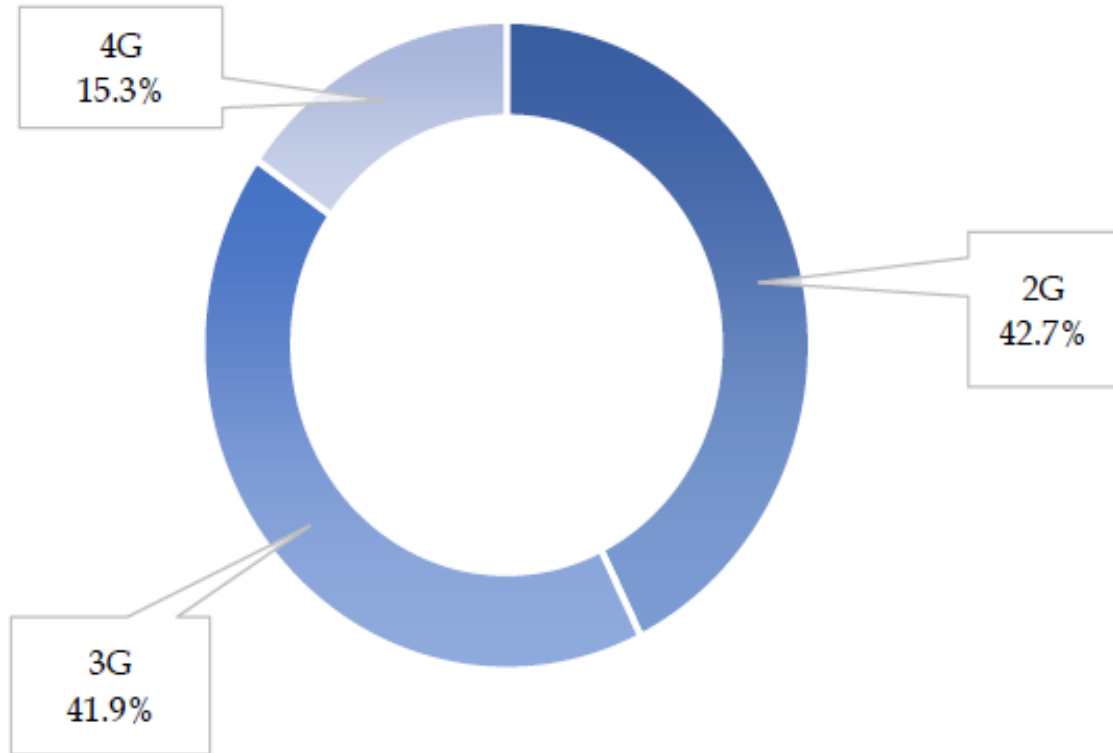
Figure 2.6 Countrywide Coverage of 4G, 3G, and 2G Technologies [24]

2.3 Overview of Cellular Network Communications

The emergence of cellular networks is possibly the most innovative of developments in data communication and telecommunications. Cellular technology is the fundamental building block on which is built mobile telephony that supports users in locations not easily serviced by wired networks [25]. Cellular telephone networks were originally analogue, and are now referred to as first-generation (1G) systems. Advanced Mobile Phone Service (AMPS) developed by AT&T was the most common first-generation system in North America. With the threat of exhausting available capacity in first-generation systems, second-generation (2G) systems providing support for digital services, high-quality signals, higher data rates and increased capacity were developed [25]. Finally came third-generation (3G) systems whose aim was to offer high-speed wireless communications to support – in addition to voice –

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multimedia, data and video. The International Telecommunications Union (ITU) in the initiative for the year 2000 for International Mobile Telecommunications (IMT-2000) defined capabilities of third-generation (3G) systems as follows;

- Efficiency in spectrum use and support for a wide variety of mobile equipment that supports roaming
- PSTN-quality voice and support for both circuit-switched and packet-switched data services
- Flexibility and interoperability aimed at supporting new technology and services

The early 1980s were characterized by rapid growth of analogue cellular telephony, particularly in European countries like Scandinavia and the United Kingdom (UK). Cellular communication networks began with each country developing its own system - an objectionable situation that threatened interoperability because mobile equipment would only operate within boarders of each country and thus market for mobile equipment would be limited [26]. To guarantee interoperability and facilitate international roaming, the Conference of European Posts and Telecommunications (CEPT) created a group to design a Pan-European mobile cellular radio system. This group was first named the **Groupe Spécial Mobile** (GSM) but GSM later became the abbreviation for Global System for Mobile communications [26]. Thus a digital cellular communications platform developed in Europe for standardization of mobile telephones speedily became accepted worldwide. Global System for Mobile communications (GSM) was designed for compatibility with Integrated Services Digital Network (ISDN) services and the Public Switched Telephone Network (PSTN) [26] [27]. Cellular networks use several low-power transmitters, on the order of a Wattage less than 100. The coverage circumference of low-power transmitters is generally small, so an area would be split into cells - with each cell served by its own antenna [25]. A cell is served by a base station and has an allotted range of frequencies. A base station is made up of a control unit, a transmitter and receiver. To avoid crosstalk or interference, neighbouring cells are assigned different frequencies [25, 26, 27].
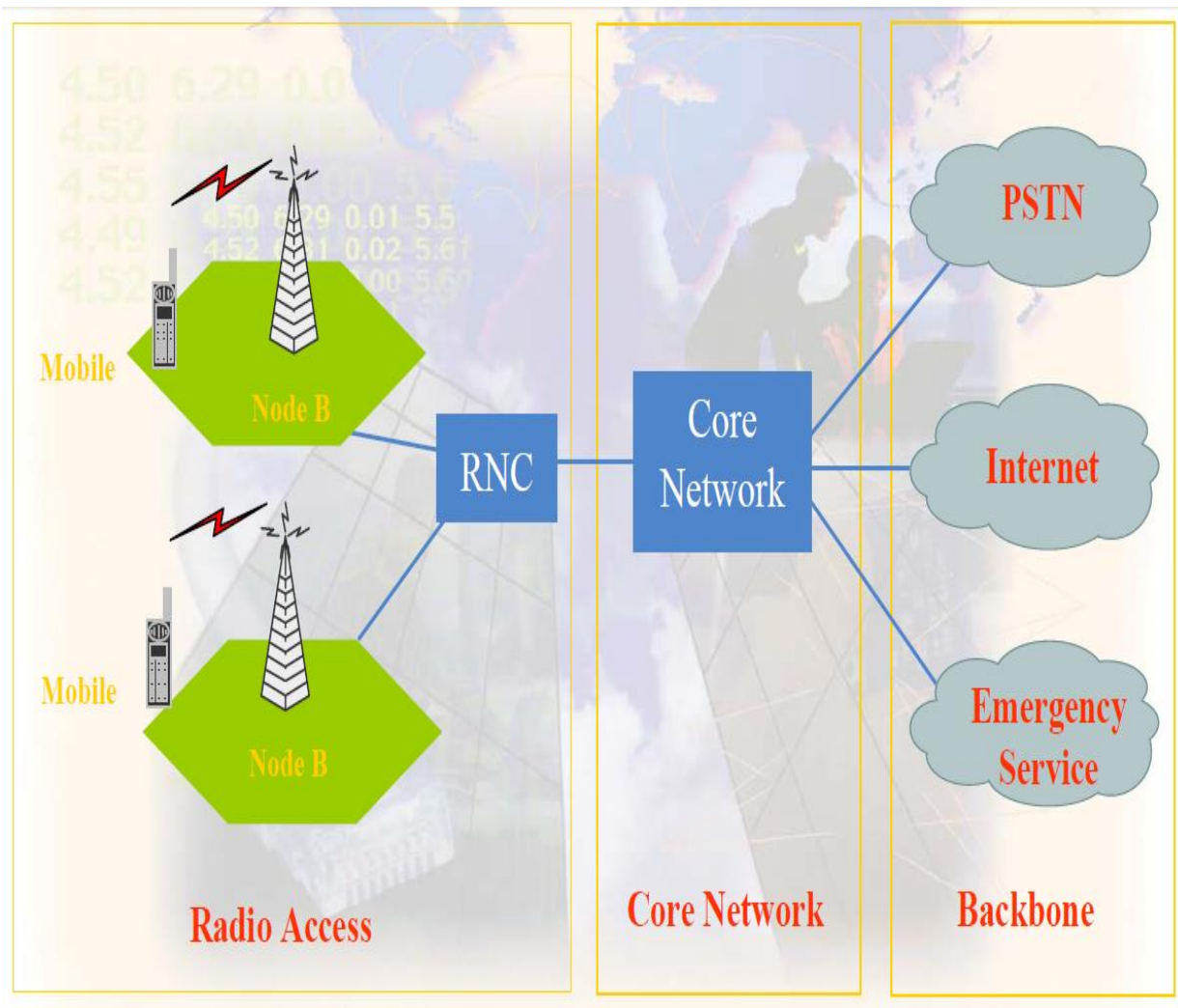
Figure 2.7 Cellular Systems Architecture [28]

Radio Access: processing of radio frequency and resource management

Core Network: major component is the mobile switching centre (MSC) which handles user authentication, admission control, traffic control, roaming, billing, network support and maintenance.

Backbone network: provides voice connection services between mobile units - it is also connected to the PSTN to facilitate linkage between fixed (landline) subscribers and mobile cellular customers.

2.3.1 GSM Network Architectural Overview

Technical specifications for the Global System for Mobile (GSM) communication outline the various elements that make up the GSM network and define interface requirements as well as functions of various elements [27] [29]. GSM symbolizes a tremendously successful mobile communication technology that has been adopted for both business application and personal day-to-day activities [30]. The GSM network could be segmented into four (4) parts; namely the mobile station (MS), the base station subsystem (BSS), the network and switching subsystem (NSS) and finally the operation and support subsystem (OSS) [27]. In GSM technology, subscribers are permitted to change service provider or carrier without having to change the handset or phone or terminal [30]. Figure 4 presents an architectural overview of the GSM network.
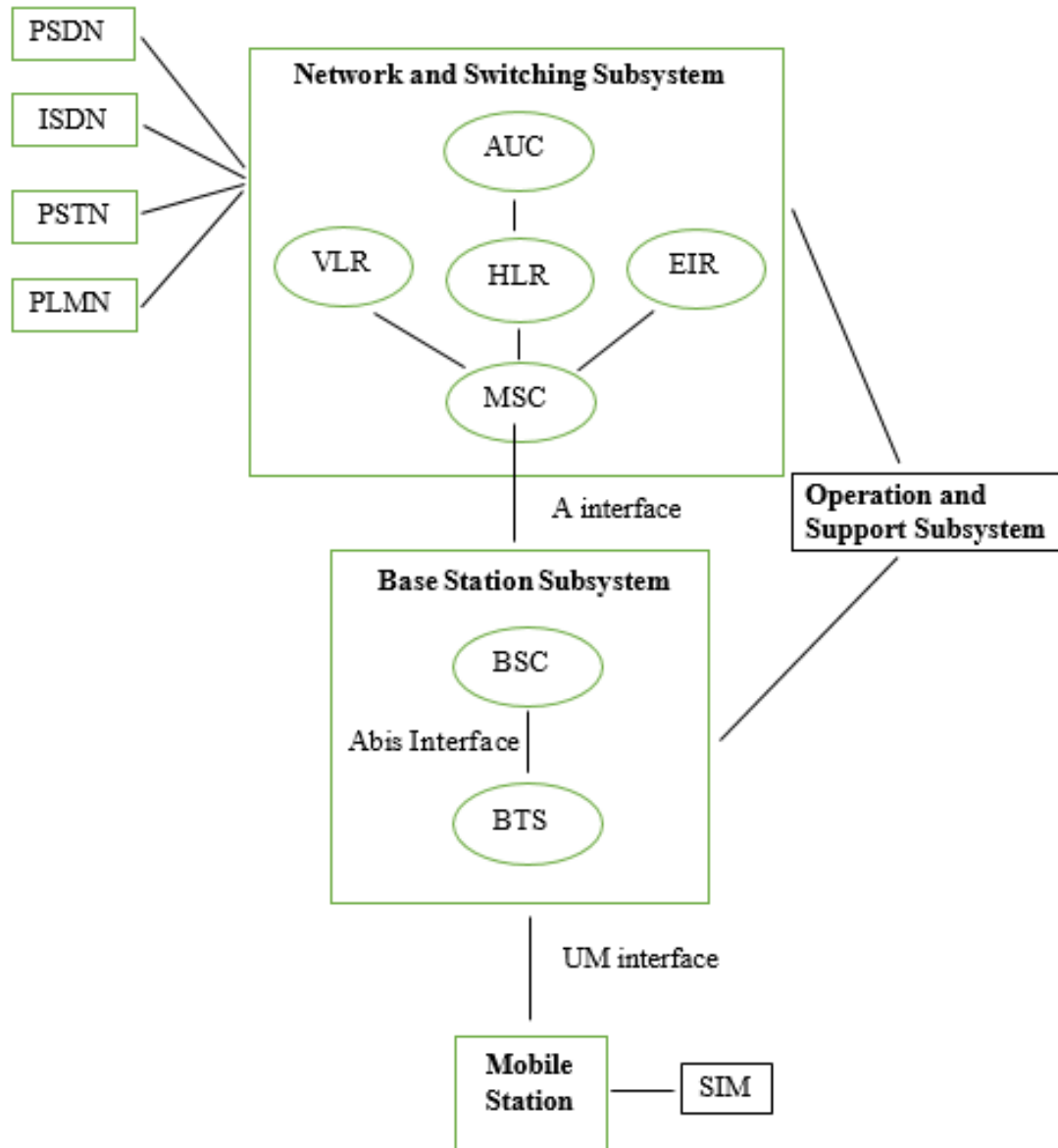
Figure 2.8 Components of GSM System [26]

2.3.1.1   Mobile Station

Mobile Stations are primarily made up of two main elements - the Subscriber Identity Module (SIM) and the mobile equipment or terminal [27, 29]. Terminals could either be fixed – typically such as the type installed in automobiles – or they could be portable, handheld devices. The continuous decrease in volume and weight of these handheld devices has been characterized by an increase in memory, capabilities and functions that has given big success to GSM [27] [31]. Each GSM mobile handset has a provision or slot for a subscriber identity module (SIM). The SIM offers unique identity through the use of the

International Mobile Subscriber Identity (IMSI). A mobile phone will not function and be able to attach to the GSM network without a SIM. Looking much like a small smart card, the SIM contains cryptographic keys and algorithms. The mobile network operator authenticates the SIM before a subscriber can use their phone to either call or access other GSM services [27] [29] [30]. Subscriber Identity Module (SIM) cards are removable and thus offer users the ability to travel abroad taking only the SIM card as need may arise. This means a traveller could simply arrange a rental handset while abroad and avoid having to invest in a new phone [27] [31]. The SIM card offers users mobility as a user can have access to their subscribed services on any terminal or handset by simply plugging their SIM into the device desired for use [27]. Mobile Station equipment or handsets are uniquely identified on the network using an International Mobile Equipment Identity (IMEI). While uniquely identifying a Mobile Station Equipment to the GSM network, the IMEI offers security features that can be used to prevent unauthorized network access and detect stolen equipment [32]. By specification of the GSM architecture, an IMEI is a fifteen (15)-digit number consisting of the of elements listed in the figure below;
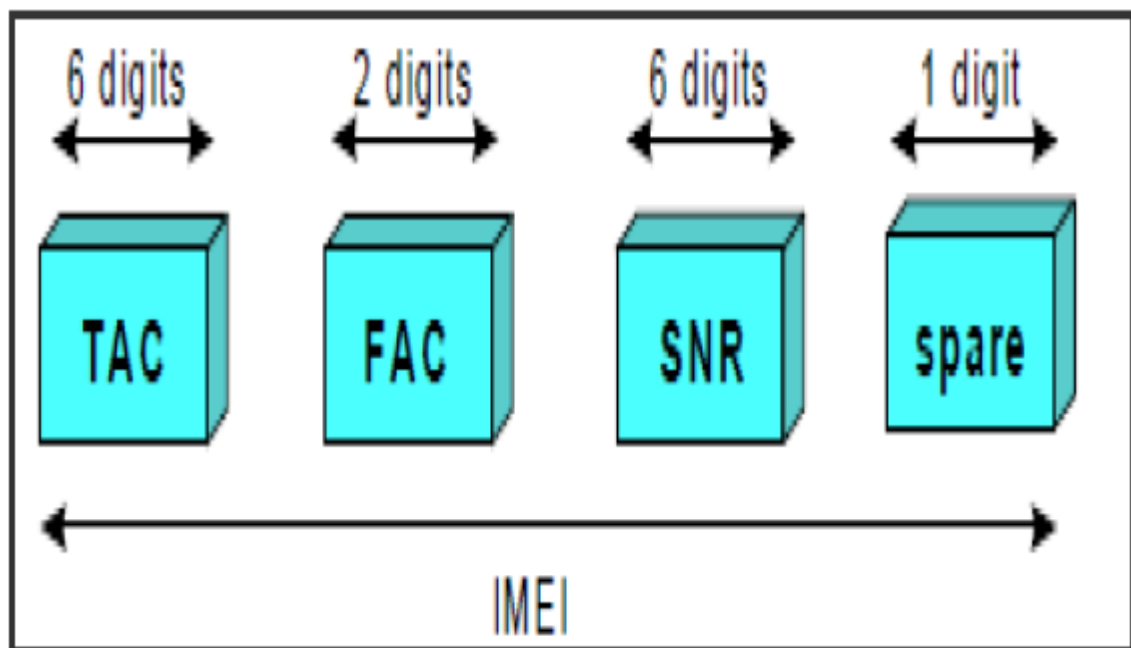
Figure 2.9 IMEI Elements [32]

TAC is Type Approval Code and is determined by the GSM Association. FAC is short for Final Assembly Code and it identifies the equipment manufacturer. SNR is short for Serial Number - it is an individual serial number of six digits that uniquely identifies all equipment within each Type Approval Code and Final Assembly Code. Spare represents a spare digit for future use [32].

2.3.1.2   The Base Station Subsystem

Comprising of two parts, the Base Station Subsystem (BSS) connects the Mobile Station (MS) and the Network Subsystem (NSS) [27] [29]. The two parts that make up the Base Station Subsystem are the Base Transceiver Station (BTS) and the Base Station Controller (BSC). Corresponding to antennas and transceivers that handle radio-link communication with the Mobile station, the Base Transceiver Station (BTS) serves a cell [27] [29]. The Base Station Controller (BSC) is primarily responsible for managing the radio resources for one or a group of BTSs. It facilitates radio channel setup, handovers, frequency hopping and regulation of BTS power levels. The BSC also offers a link between the Mobile services Switching Centre (MSC) and the Mobile Station [27] [29].

2.3.1.3   The Network and Switching Subsystem

Performing as does a normal switching node in ISDN or PSTN networks, the Mobile services Switching Centre (MSC) is the principal component of the Network Subsystem [27] [29]. The Mobile services Switching Centre (MSC) furthermore affords functionality required to manage mobile subscribers - such being registration, authentication, location updates, handover of a mobile station to base stations as a user moves, and the routing of calls to roaming subscribers. Various functional entities within the Network Subsystem interplay using the Signaling System 7 (SS7) to provide the aforementioned services to mobile subscribers. These functional entities include the Home Location Register (HLR), Visitor Location Register (VLR), Authentication Center (AuC) and the Equipment Identity Register (EIR) [27] [28] [29].

The Home Location Register (HLR) is a database holding all subscriber management and administrative information for each registered user on a given GSM Network along with current Mobile Station (MS) location. Each GSM network logically has one HLR, though the implementation could be a distributed database [26, 27, 28, 29, 33].

Information essential for offering a visiting user's subscribed services as per their HRL is contained in the Visitors Location Register (VLR). Upon mobile station's coming into the coverage area of a new Mobile services Switching Centre (MSC), the Visitor Location Register (VLR) sends a request for information to the subscriber's HLR [26, 27]. By this, the VLR gets sufficient information to offer subscribed services without having to inquire from the respective HLR each time the visiting subscriber establishes communication. The Authentication Centre (AuC) is a secured register containing security parameters required for encryption and authentication functions used to verify and manage user identity. Another important database in GSM is the Equipment Identity Register (EIR) which contains information about valid mobile stations. Each mobile station is uniquely identified by the International Mobile Equipment Identity (IMEI). An IMEI could be flagged as unacceptable and thereby render a device unusable on the network if it has been reported stolen or if the device defies recommended specifications [26] [27]. A black, gray or white list could be maintained by the Equipment Identity Register (EIR). Mobile stations or terminals or handsets on the black list are denied network access while those on the white list are expressly granted network access. The gray list typically holds faulty devices that may not satisfy specific prerequisites and thus pose a threat to the network.

2.3.1.4   The Operation and Support Subsystem

For control and monitoring of the GSM System, the operational and support subsystem is connected to the network and switching subsystem and the base station subsystem. The operation and support subsystem also controls the load of traffic load of the base station subsystem (BSS)

2.4   Global Mobile Economy Overview

The global mobile phone subscriber penetration was at 67% in 2018 and is projected to reach 71% by the year 2025. The global smartphone adoption rate stood at 60% in 2018 and is expected to hit 79% by 2025 [34]. Notably demand for mobile services is on the increase. The Technology mix for 2018 was such that 2G accounted for 29%, 3G stood at 28% and 4G at 43%. By 2025, it is expected that 2G will be nearly phased out or be at 5% of global cellular connection. 4G will be the predominant technology accounting for 59% of the connections with 3G connections also dwindling at 20%. As a maturing technology, 5G is expected to account for 15% of global connections by 2025.
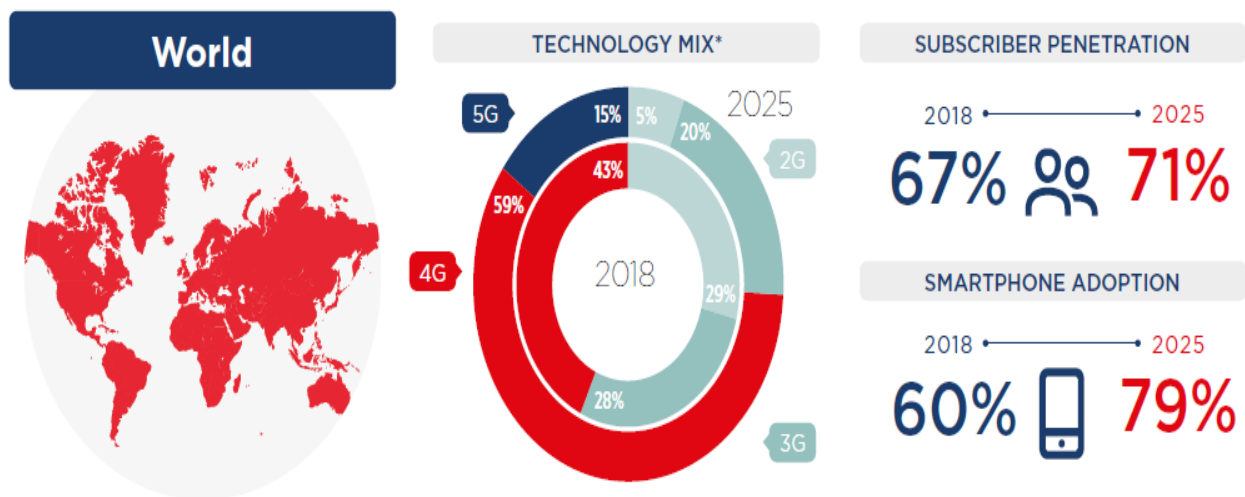
Figure 2.10 Global overview of Mobile Economy [34]

The Asia Pacific region recorded a mobile penetration rate of 66% in 2018. Smartphone adoption in this region was at 54%. Projections for 2025 are that mobile penetration and smartphone adoption will rise to 72% and 82% respectively. Mobile penetration rates for 2018 stood at 80% in the Commonwealth of Independent States (CIS) region. Only a growth by 2% is projected by end of 2025 to 82%. Clearly, this region seems to have reached a level of saturation. Smartphone adoption is expected to rise from 53% recorded in 2018 to 73% by 2025. Europe's smartphone adoption recorded for 2018 was 72%, against a mobile penetration rate of 85%. Smartphone adoption and mobile phone penetration are expected to grow to 82% and 88% respectively. In Latin America, 67% mobile subscriber penetration rate was recorded

for 2018 with an accompanying smartphone adoption rate of 65%. The projection is that mobile penetration will grow to 74%, while smartphone adoption is anticipated to reach 79% by end of 2025. The Middle East and Northern Africa (MENA) held a record of mobile subscription penetration that stood at 64%, which was far higher than Sub-Saharan Africa's penetration rate at 45%. Smartphone adoption rate in the MENA region is at 52% in 2018 and greater that Sub-Saharan Africa's smartphone adoption rate of 36% for the same year. The MENA region's mobile subscriber penetration and smartphone adoption are expected to grow to 69% and 74% respectively. North America recorded a subscriber penetration rate of 83% in 2018. Smartphone adoption is the highest at 80% in this region. Projections are that smartphone adoption will reach 90% whereas subscriber penetration is expected to reach 85% by 2025.

2.5   Overview of Sub-Saharan and Zambian Mobile Phone Market

A joint report published in 2012 by the African Development Bank, the African Union and the World Bank confirmed Africa's GDP has been growing by an annual average of five percent (5%). This growth is attributed to the uptake of information and communication technology (ICT) and the spike in the adoption of mobile phone technology [35]. Like in many parts of the world, Mobile phones in Sub-Saharan Africa have moved from being just communication gadgets. Mobile phones are now the chief method of access for life-improving services. Cell phones are now driving the agenda of financial inclusion for majority of the poor to access to financial services affordably. With the emergence of mobile telephony has come possibilities for innovation on the African Continent. Connecting individuals to either services, markets, organizations or indeed other persons around the globe, mobile phones are bridging the urban-rural divide [36] [37]. Sub-Saharan African (SSA) mobile money market was worth US$655.8 million in 2014 and was projected to reach US$1.3 billion by end of 2019. This signifies high chances for business development and financial inclusion for segments that previously had no access to banking services. Mobile phones, and the benefit they offer for accessing mobile banking, considerably promote financial inclusion among minorities and enhance business opportunities. By global standards, Somalia stands at 4th lowest mobile penetration, but ranks 3rd in sending/receiving money and 1st in payment of bills using mobile phones [38]. Mobile technology is by far the most common tool with which consumers access online services, and this might explain why the mobile internet subscriber base has quadrupled since 2010. By end of 2017, 135 mobile services in 39 countries were active with 122 million active accounts in

the region. Four hundred and forty-four (444) million unique mobile subscribers - representing a penetration rate of 44% - were registered for 2017 and a 4.6% growth rate to six hundred and thirty-four (634) million subscribers by the year 2025 is projected by GSMA Intelligence [39].

Smartphone uptake is on the increase in Sub-Saharan Africa, and 250 million smartphone connection were reported as at 2017. Smartphone adoption is expected to grow from the recently-recorded rate of 34% for 2018 to 67% by the year 2025 [40] [34]. In 2015, 13.5% of mobile cell phone users in Zambia owned smartphones. By end of 2018, the smartphone had more than doubled to 29.6%, with 76.6% of all the individuals owning smartphones being below 35 years of age. A significant increase is the use of smartphones was noted in the urban areas; growing from 18.4% to more than double at 42.1%. Rural areas saw an improvement in the use, acceptance and adoption of smartphones from 6.5% percent to 14.3%.
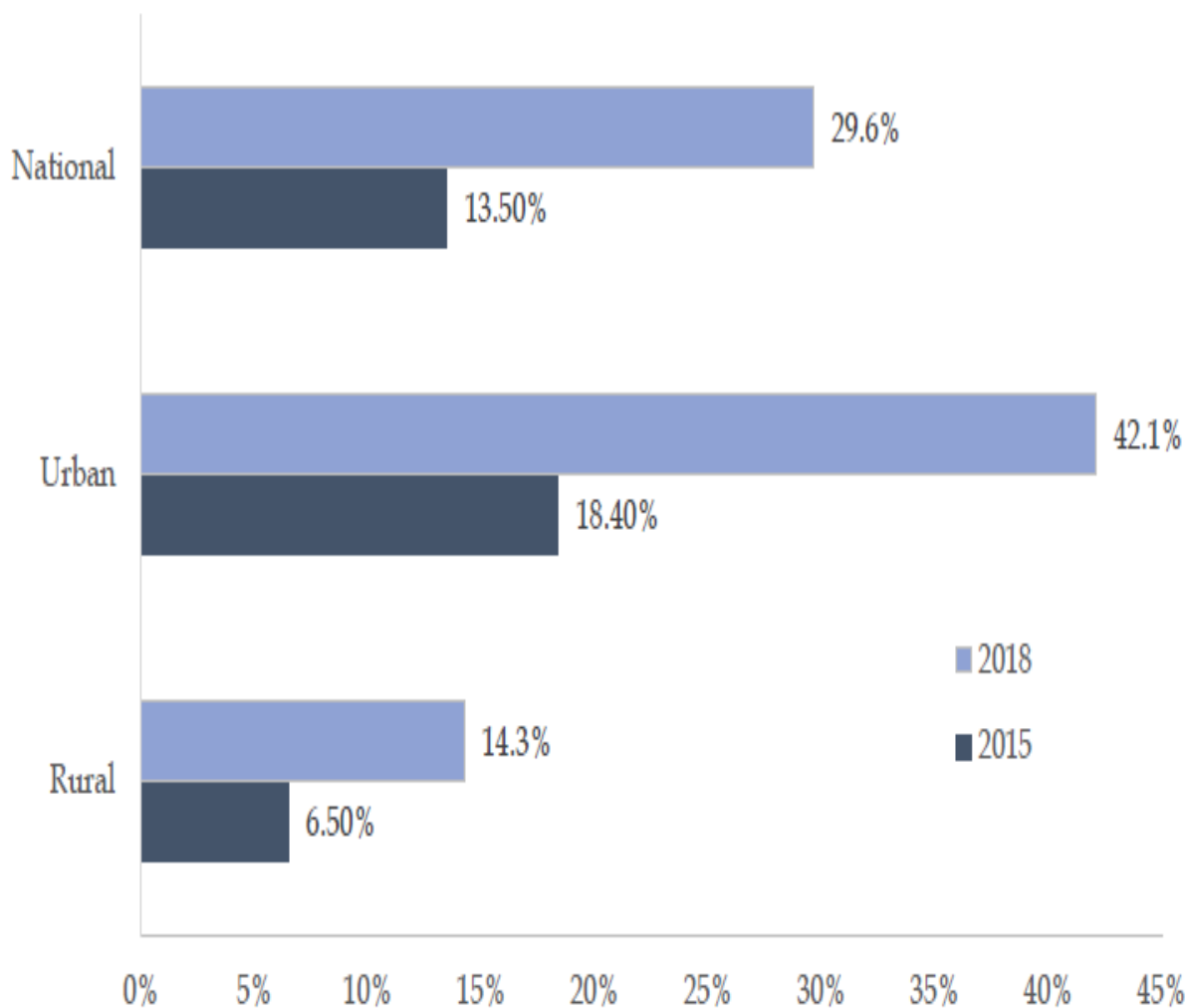
Figure 2.11 Smartphone adoption in Zambia [24]

Mobile phones offer access to digital financial services in Zambia. Sending money is the most frequently accessed service and accounts for 88.7%, followed by receiving money which accounts for 72.5% of accessed services.
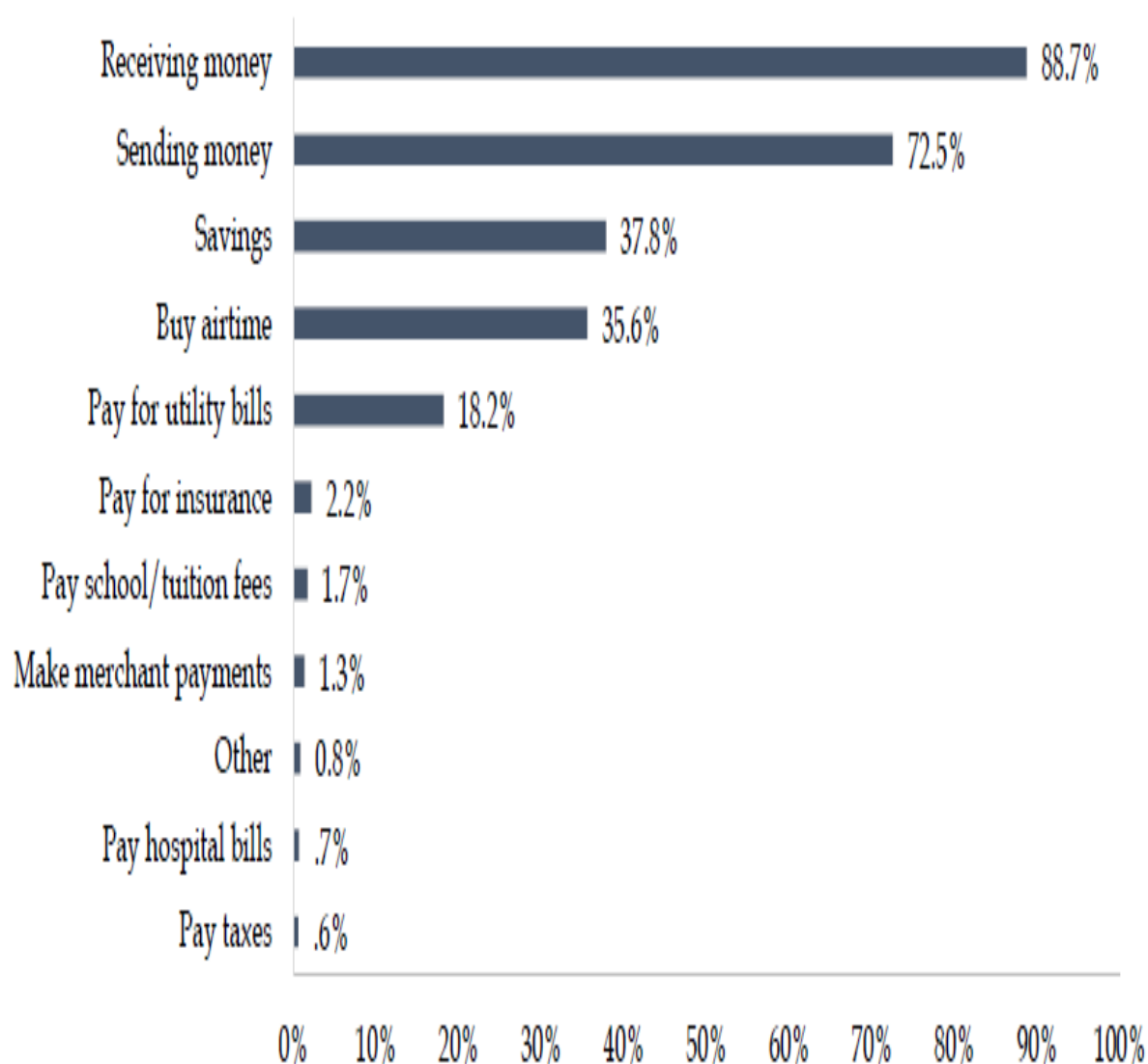
Figure 2.12 Types of Mobile Transactions [24]

All three service providers currently have a mobile money service or product. The most widely used digital financial service provider is MTN money at 56.9% then followed by Airtel at 44.7%.
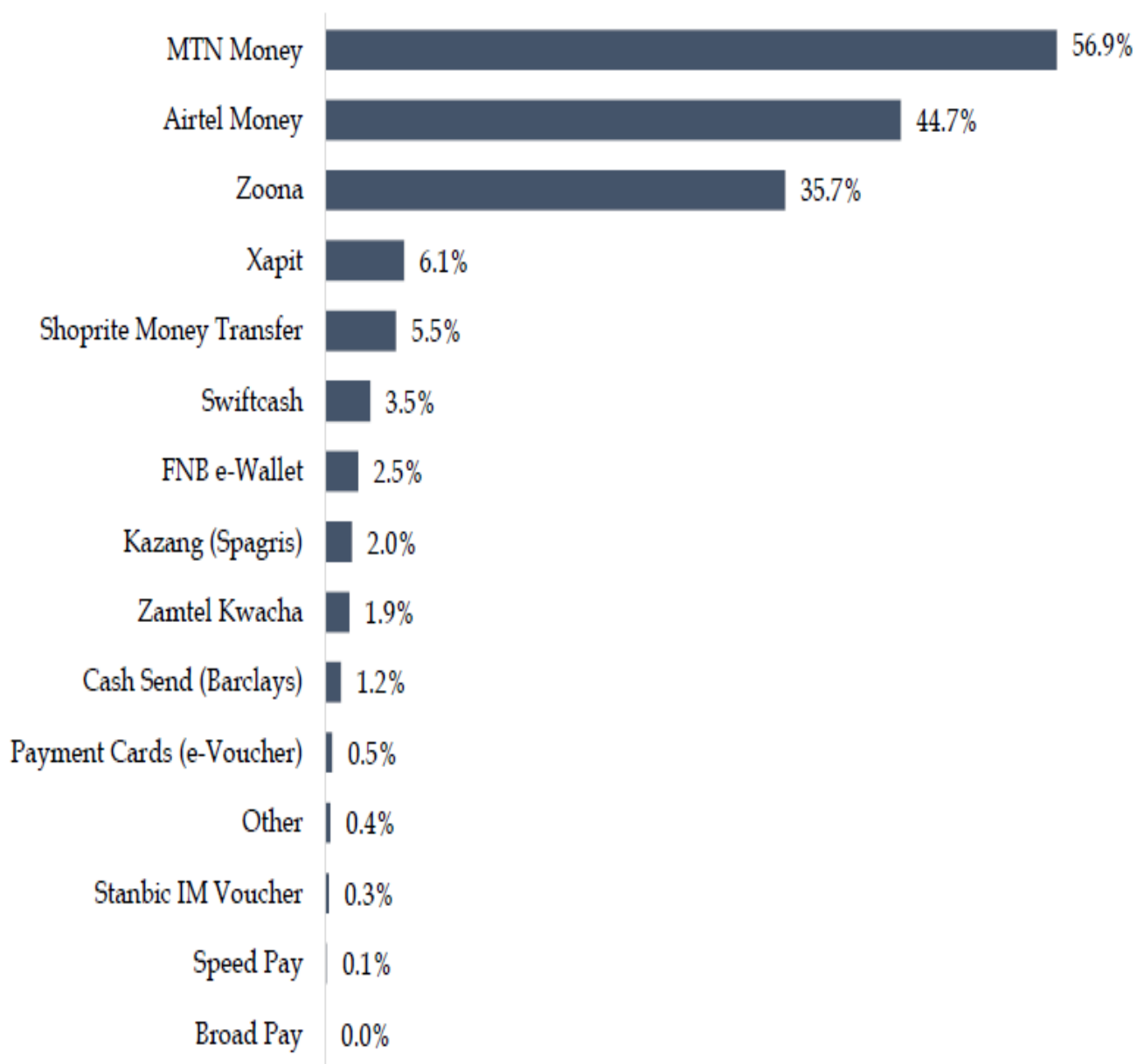
Figure 2.13 Most Common Mobile Money Platforms [24]

The number of mobile money agents in Zambia was 47,000 by the end of 2018, representing a growth by double when compared to 23,000 in 2017. The number of mobile money accounts equally increased from 2.3 million at the end of 2017 to 4.3 million in 2018 [41].

2.6   Related Works

Mobile phone thefts have been a growing concern globally. With advances in technology, cellular or mobile phones have gotten smaller, portable and of high value – capable of carrying substantive amounts of user information. This has resulted in phones being an easy target of criminals [4]. Mobile phones are now commonly deployed in work places for increased productivity of mobile workers. As such, a single mobile device could integrate with different technologies and carry enterprise information. If such a device were to be lost or stolen, confidentiality of the data stored on that device is highly compromised [42]. The GSM Association (GSMA) brings together nearly 800 operators and represents the interests of mobile operators worldwide with over 250 players in the mobile ecosystem, among which are included handset and equipment manufacturers and software companies. The GSM Association allots globally unique identifiers to device manufacturers. The unique identity is known as an International Mobile Equipment Identifier (IMEI). Every mobile phone has a 15-digit number, also known as an IMEI number that is globally unique. This number could either by found underneath the GSM mobile phone's battery or by dialling ***#06#** on a device's keypad [6]. GSMA also ensures that devices manufactured and sent to market are compliant with the requirements of the 3rd Generation Partnership Project (3GPP). In 1996, GSMA launched an initiative to have stolen mobile handsets blocked on the basis of the International Mobile Equipment Identifier (IMEI) [1] [4] [5]. The issue of mobile phone theft is certainly not of the industry's creation, yet industry forms part of the solution. Blocking or blacklisting the IMEIs of stolen or lost mobile phones would render them useless, and thereby reduce their value on the black market. The consideration to blacklist stolen mobile phones from networks has been around for 2 decades, but is hardly implemented regionally and more so internationally [43].

2.6.1   Regional Mobile Phone Theft Interventions – United Kingdom and Australia

Notably, the United Kingdom have been ahead with efforts to combat cell phone theft. A Crime Reduction Charter was signed in 2006 and it acknowledged the future commitment of the mobile phone industry towards collaboration with law enforcement agencies to ultimately address phone theft. This charter was spearheaded by the Mobile Industry Crime Action Forum (MICAF), which included mobile network operators, UK retailers, and some handset

manufacturers. The first country to have had all mobile network operators effect IMEI blocking or blacklisting was the UK, followed by Australia [44].

A campaign dubbed 'Mind Your Mobile' is championed by Australian authorities and the Police in a bid to reduce theft of mobile phones. IMEI blocking or blacklisting completed in March 2003 and prevents stolen handsets from being used on any network in Australia. Blocking the IMEI number renders a handset inoperable. In 2003, Australia's GSM network providers – Vodafone, Telstra and Optus – agreed on a response time of 36 hours for blocking or unblocking stolen and found handsets respectively. These three mobile operators exchange lists of lost or stolen mobile phones. The Australian Mobile Telecommunications Association (ATMA) offers an online portal at which those desiring to buy second-hand or preowned mobile phones could verify whether a mobile phone was reported lost or stolen and subsequently blocked from use by the network carriers. Roughly about 50, 000 phones per year are unblocked at owner's request on account of being returned.

2.6.2   Regional Mobile Phone Theft Interventions – United States & Latin America

A projected three million one hundred thousand (3.1 million) customers in America experienced theft of a mobile phone in 2013 [45]. Recognizing that mobile device theft is a key concern facing law enforcement agencies, customers and other stakeholders in the mobile device ecosystem, a Mobile Device Theft Prevention (MDTP) Working Group was created through the Technological Advisory Council (TAC) of the Federal Communications Commission (FCC) of the United States Government. The MDTP Working Group's mandate was to examine the prevalent problem of cell phone theft and formulate recommendations to the Federal Communications Commission by end of 2014. The Mobile Device Theft Prevention Working Group collected law enforcement from 21 police jurisdictions as well as FBI crime data - and estimated at least 10% of all thefts and robberies committed in the United States in 2013 were connected to theft of a mobile device [46]. With the chief aim of lessening or eliminating mobile device theft, the Mobile Device Theft Prevention (MDTP) Working Group assessed the device theft problem, examined available or possible solutions to combat device theft and identified the gaps between the problem and current solutions with a heavy emphasis privacy, cybersecurity, privacy and outreach requirements. With consumer protection as a key focus, the MDTP Working group affords a platform via which key parties with

different areas of expertise can engage to define a nation action plan for deterring mobile theft. According to this report, unverified data strongly suggests that at least a chunk of the stolen smartphones end up being shipped from the United States to remote regions [46]. This highlights and confirms the reality that theft of smartphones is an issue of global magnitude ultimately necessitating multi-national collaboration and coordination. A number of technology-based initiatives could be useful in addressing mobile device theft but it is also true that no single technology will eradicate phone theft without a complementary collection of operational techniques for mitigation. Effective and efficient user or consumer education is a key component of any solution. Consumers will need education on device-based solutions [46]. For American users, mobile devices don't just end at being used for text, voice and video communications. repositories for personal and business information. Phones now carry personal and business information and they interface users with essential gateways and give access to a lot of useful services and information. Phone theft, therefore, is a complex issue needing a solution both in America and on a global scale. Theft of mobile phones in the USA could happen as part of a larger criminal network or simply as "opportunistic crime" [46]. The Mobile Device Theft Prevention (MDTP) Working Group reported that a multidimensional solution would very likely address the problem. Effective solutions must inherently deter criminals. This effectively means that solutions to mobile device theft must be difficult to circumvent as well widely deployed. The useful life or period within which a stolen device is of value should be very limited. Mobile Device customers must also be educated and dissuaded from buying devices from untrusted and unknown suppliers on account of the very high chances that the devices will be blocked from use in a short space of time [46]. With theft prevention mechanisms active, such as IMEI blocking, criminals could either use the stolen device as a personal media device (e.g., camera, music player, Wi-Fi device) or end up just discarding it.

As the use of smartphones has grown in Latin America, so have incidences of mobile handset theft increased [47].
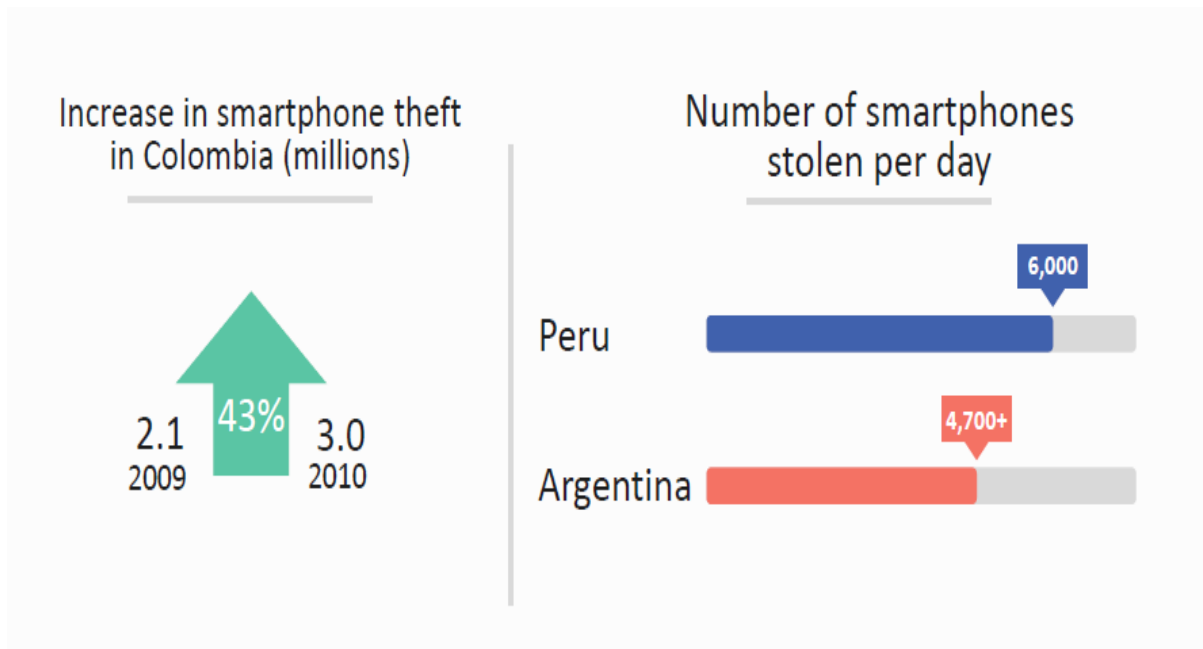
Figure 2.14 Latin America Phone theft statistics [7] [47]

In 2009, 2.1 million handsets were reported as stolen in Columbia. In the year that followed, a 43% increase in phone theft incidents was noted to 3 million cases. Countries in Latin America were among those that embraced policies aimed at identifying stolen or lost devices and denying them access to network connectivity - mainly through the use of whitelists and blacklists [47]. A whitelist contains devices or handsets authorized to connect to a GSM network. A blacklist is a centralized list of barred devices; it typically contains IMEIs of handsets either reported lost or stolen. Devices that are rendered unusable on a GSM network reduce in value, and this tends to lessen the motivation for phone theft. Latin America promotes tackling of mobile phone theft through whitelists and blacklists. The concept of a centralized database or list of excluded or barred devices is hosted in a national database that synchronizes with other countries within the region as well as GSMA's global database. Devaluing stolen devices is the ultimate goal of GSM IMEI blacklists.
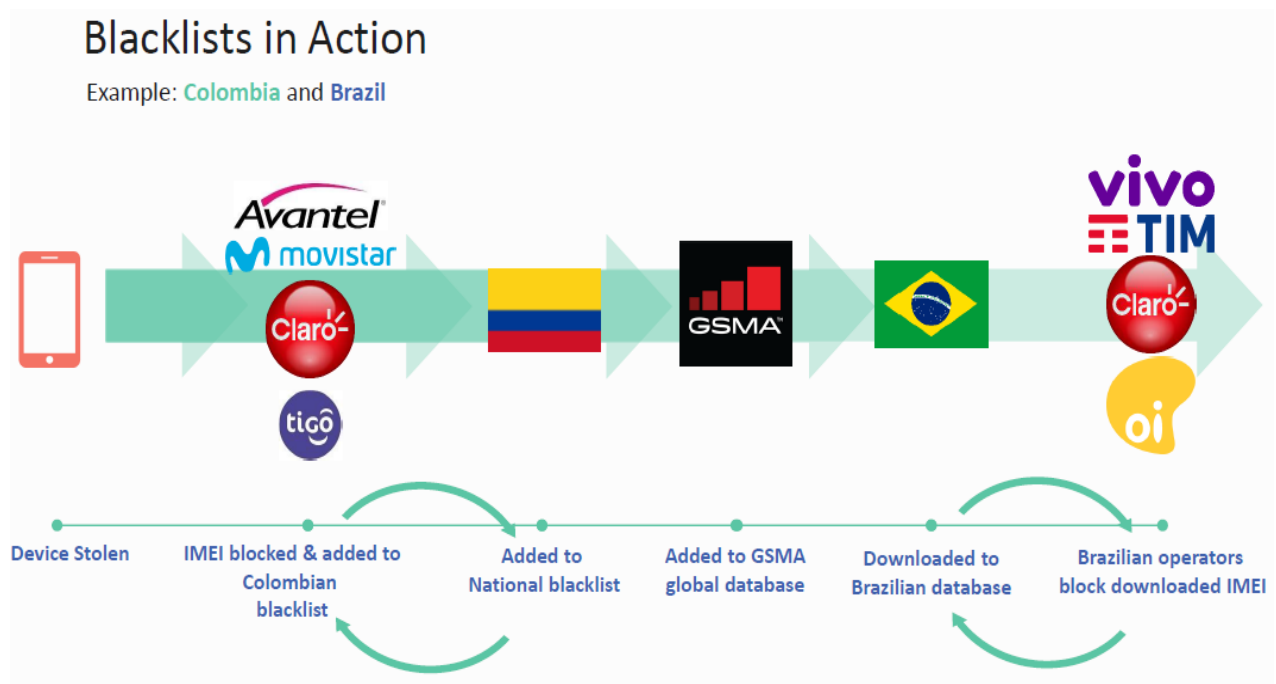
Figure 2.15 Blacklists in Brazil and Columbia [47]

IMEI whitelists mainly prevent stolen devices from connecting to a GSM network. Whitelist contain approved or allowed devices, with unlisted devices being denied connection to the network. This generally requires pre-registration of any devices sold within a particular country. A recent study in Brazil established that only 51% of phone theft victims reported to the Police. Notwithstanding the execution of blacklists and whitelists in Peru, an approximated average of 250 devices are stolen per hour - translating to 6,000 stolen devices per day. Phone theft incident reported to the Columbian police in the initial half of 2017 were as low as 4%. Thieves circumvent blacklist systems by either shipping stolen devices in neighbouring regions and countries or altering IMEIs. Latin America, the extent to which altering of IMEIs is done remains unknown [47].
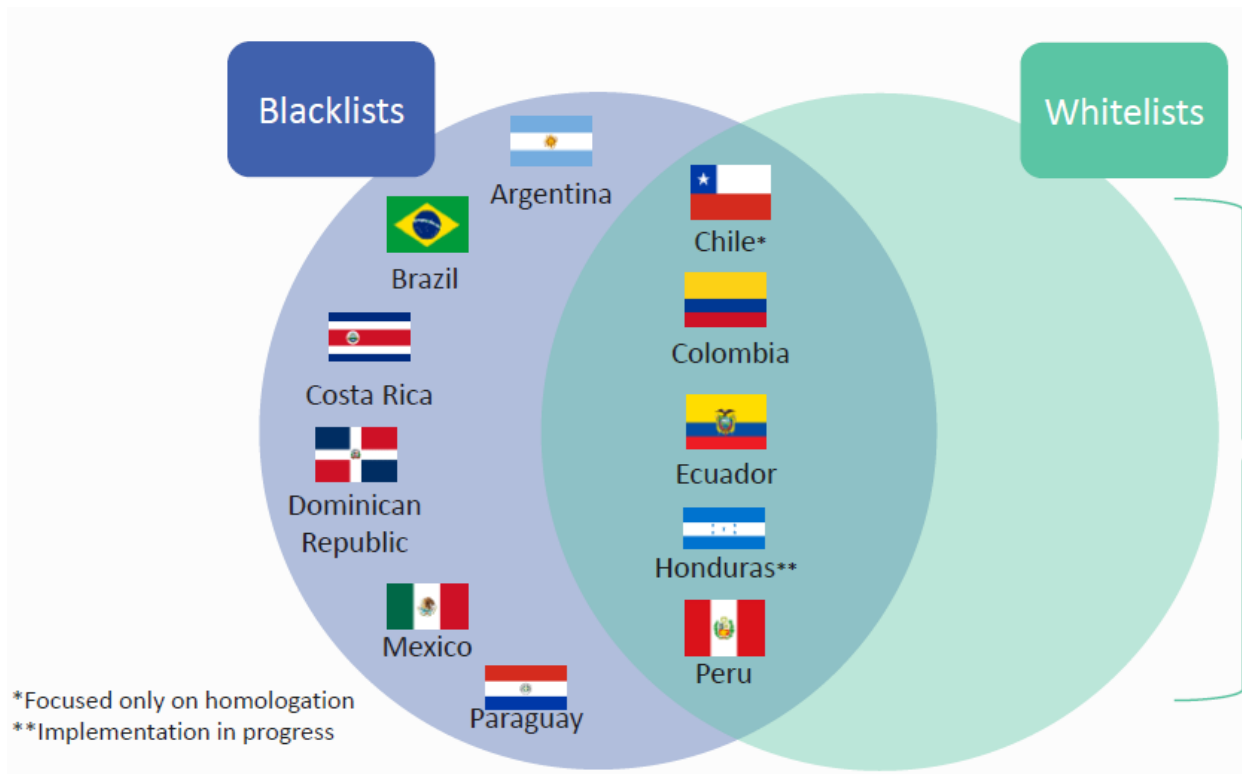
Figure 2.16 Blacklists and Whitelists in Latin America [47]

In Peru, devices are linked to a national civil registry entry of the device owner. Whitelist in Chile are used to confirm or ratify imported devices before they are sold to the local market. However, this whitelist is not designed to be updated as devices get stolen. In Chile, a user invokes the process of ultimately blocking a stolen device by reporting the theft to authorities [47].

2.6.3 Regional Mobile Phone Theft Interventions – India

The Telecom Regulatory Authority of India (TRAI) observed that the theft of handsets was a major problem affecting cities. To this effect, TRAI instituted measures to work out a framework by which theft of mobile phones could be dissuaded and Consultative Paper No.2/2004 was issued on 8th January 2004 to invoke engagement by various stakeholders [48]. Handset cost was identified as a chief inhibitor for low-end customers, with a gap in mobile phone prices clearly noted between the legitimate and grey markets. The grey market consists of smuggled, lost and or stolen handsets. In response to the Consultation Paper by TRAI, VODAFONE noted that the issue needing attention was to address reprogramming of handsets

or replication of IMEI numbers. Reprogramming of handsets was viewed as a bigger problem on account of it being used to bypass handset IMEI blacklists [49]. Citing infrastructure deployment and related cost, Vodafone wondered whether the benefits of setting up and CEIR are proportionate to the costs. They argued that the percentage of handsets thefts was insignificant to warrant the implementation and maintenance mobile phone blocking infrastructure. Service providers in India would, upon receipt of a complaint through the call centre, provide facility for speedy blocking of the SIM card. Such swift action is justifiable because a SIM card holds a customer's identity, their choice or type of services and sometimes a contact list or directory. SIM cards contain billing details and are non-transferable. Abuse of a customer's account and identity after theft is so high, hence the reason all services attached to a SIM are blocked urgently. Vodafone acknowledged that the CEIR would have to be a single database at national, as having regional databases would likely pose interconnection and synchronization challenges that would result in delayed response [49].

Actions taken to safeguard consumer interests by disincentivising or dissuading the purchase of handsets from the illegal grey market would be a step in the right direction. The blacklisting of handsets became a major consideration of the Telecommunication Regulation Authority of India (TRAI) and it was proposed to be done based on the International Mobile Equipment Identity (IMEI) [50]. The next phase would be to ensure sharing of IMEI numbers of stolen or lost handsets among all mobile network operators in the country and denial of service to blacklisted handsets by all operators in a bid to effectively address the theft problem. But as noted by Yatin Jog et al, operators in India implemented Equipment Identity Registers (EIRs) in isolation and thus stolen phones could still be usable if one simply changes SIM cards since operators were not sharing information.

2.6.4   Mobile Phone Theft in African and Zambia in Particular

Because of comparatively low pricing, buying and resale of pre-owned phones is quite popular in Nigeria [51]. These phones are alleged to have been refurbished and transported from London. An April 2018 report by The UK Sun brought to light the fact that most of these preowned phones were aggressively snatched from previous owners and shipped to be sold in Computer Village, Lagos, Nigeria. A survey undertaken by TechPoint confirmed that 60% of the respondents who had bought used phones admitted to knowing that the phones might have

been stolen. The UK Sun investigation claimed that Nigeria was not party to a global initiative aimed at blacklisting stolen phones through their IMEI numbers [51]. Association of Communication Device Technicians of Nigeria (AMCODET), since the year 2016, has been working with respective government departments to ensure security procedures were effected for blocking of stolen phones. This approach, while not being the ultimate remedy for addressing the flourishing national market for stolen phones, would be a step in the right direction towards contribution to finding a solution [51].

Whereas purchasing second-hand electronic gadgets affords users in Kenya the opportunity to save a few coins, the exposes users to two risks. Firstly, users could end up buying faulty gadgets. More dangerously, users could be implicated in criminal cases for having purchased stolen goods [52]. The Directorate of Criminal Investigations (DCI) of the Kenya Police cautioned citizens against buying stolen phones.

Theft of mobile phones is rampant in South Africa, with thousands of weekly cell phone stolen thefts recorded countrywide [53]. Stolen phones could end up being used in commercial and organized crime, so it is imperative to report an incident or a lost or stolen cell phone to the Police. In case a user's stolen mobile should be discovered to have been used in crimes such as car hijacks, bank robberies, or some other serious crime, an unreported theft could point to the user/owner as a possible suspect. Reporting a phone as stolen, therefore, results is a handset being blocked or blacklisted from use within South Africa. This serves as a deterrent [53]. Khanya Khondlo Mtshali observed that 70% of property thefts recorded in 2018 involved a mobile phone [54].

Creation of an Equipment Identity Register (EIR) in Sudan was considered in 2015 by Mustafa Ahmed E. M. and others [55]. With increased adoption of smartphones, users become exposed to risks of being targets of criminals. A method mobile service operators could adopt to reduce phone theft is implementing and EIR. An EIR is a database containing devices permitted to operate on a network, as well as those devices prohibited.

Plans by the Zambian ICT Regulator (ZICTA) to address mobile phone theft have the backing of the laws of the land. ZICTA head of Consumer Protection announce in 2014 that the ICT Regulatory Authority expected the registration of IMEI to help reduce phone theft [56]. In the Zambian context, **Statutory Instrument No. 65 of 2011** titled "Registration of Electronic Communication Apparatus" gives power to ZICTA to monitor registration of devices and SIM Cards [57]. This Statutory Instrument (SI) also mandates ZICTA to register electronic

communication apparatus and set up and maintain a Central Equipment Identification Register (CEIR). SI number 65 clearly defines the role of the regulatory authority in requiring that all Network Operators or Mobile Service Providers shall keep, maintain and make available in their networks an Equipment Identification Register (EIR). This EIR is to contain IMEIs for devices used on the provider's network and subscriber details of the person using the device. The subscriber details are to include the full names, address and tittle. By this SI, network service providers are required to maintain three lists known as the white list, grey list and black list, for the purposes of managing SIM and IMEI numbers.

a) A white list would contain SIM and IMEI numbers of all devices permitted for use in Zambia.

b) A grey list would contain the SIM and IMEI numbers of mobile devices likely to be cloned or to have changed electronic identity, or are used without approval.

c) A black list would contain SIM and IMEI numbers of devices barred from use on account of having been lost, stolen or cloned.

Statutory Instrument number 65 of 2011 made provision for ZICTA to have IMEI numbers blacklisted and disabled upon supplying proof of ownership and a police report. To this effect, an Information and De-activation Centre would have to be created.

ZICTA, as part of user education and awareness, has published some guides on mobile phone security on their website [58]. Over and above the fact that phones are assets of monetary value, they also carry significant amounts of sensitive personal or financial information. By use of a Personal Identification Number (PIN), users could protect data from access by unauthorized parties. Most cell phones generally offer the feature of locking a SIM to a specific handset so as to minimize or eliminate unauthorized use of a mobile handset. This is called SIM-locking, and it prompts for a PIN whenever another SIM is inserted into the device [58]. General phone security tips for protecting mobile phones are;

i) Desisting from carelessly leaving mobile phones.

ii) Contemplating a possible insurance scheme or policy to serve as a cushion if need for replacement should arise.

iii) Keeping or securing phones securely or safely when in public places. This generally includes make sure that the phone's tone does not draw attention.

iv) Phones should advisably be away from reach by very young children.

v)   Every handset has a unique serial number called the IMEI number, by which devices are identified by the mobile phone service provider's network. The IMEI is a 15-digit number usually found on the back of a phone or below. In instances where a phone is switched on, the keypad combination *#06# also reveals a handset's IMEI. Members are generally encouraged to take down or note their IMEI number in case of loss or theft of a phone. ZICTA categorically states that reprogramming of a mobile phone or modification of the IMEI is an offence as outlined in the ICT Act, and this offence attracts a penalty or imprisonment not exceeding one year, or both [58].

Table 2.2 Summary of Related work

Researcher/Author	Title	Summary of work	Research GAP
GSM Association [5]	Mobile Policy Handbook: An Insider's Guide to the Issues	Handset have a 15-digit unique identifier known as an International Mobile Equipment Identifier (IMEI) - is usually beneath phone battery or dialling *#06# on a device's keypad if phone is on	Acknowledges that each GSM Device has an IMEI but no model or framework is suggested
A. Bahuguna [32]	A Literature Survey on GSM Network Identities	GSM Networks support creation of blacklists, whitelists and gray-lists	No model by which GSM blacklists could be used to deny service to stolen or lost handsets.
Yatin Jog et al [50]	Analysing Central Equipment Identity Register (CEIR) Model for Mobile Handset Tracking in India	12 Mobile Network Operators in India implemented Equipment Identity Registers (EIRs) in isolation	No exchange of black-lists is suggested among all service providers.
A. Y. Korkusuz [33]	Security in the GSM Network	Setting up if Equipment Identity Registers enhances security	No model or framework is suggested for addressing issue of stolen handsets

2.7   Chapter Summary

This chapter has revealed relevant literature to the study of mobile phone theft. A comprehensive architectural review of the GSM was done to explore unique handset identity that could be used to blacklist lost or stolen handsets. A review of approaches and efforts to address this problem in developed countries was also reviewed.

CHAPTER THREE

METHODOLOGY

3.1   Introduction

This chapter endeavours to detail and describe the tools, procedures and methods that were employed to undertake this study. The methodology used to answer the research questions as set out in Chapter one of this report is discussed at length.

3.2   Research Approach

Two main approaches, in general terms, are identifiable when conducting research. These are quantitative and qualitative. Qualitative research focuses on the social constructivism paradigm and sanctions the socially constructed nature of reality. It targets the exposition and consideration of certain human actions and experiences as well as clashing views and customs. This method gives no emphasis on data in numerical form and thereby does not stress the analysis of data by use of statistical techniques [59].

Quantitative research is concerned with the gathering of data and translating it into numerical formats so that analyses and deductions can be drawn with ease. This type of research demands objectivity and thus the researcher ensures that their behaviour, attitude or presence are distanced from the study and or any experiments thereof. Realising that both the qualitative and quantitative methods have merits and demerits but could complement each other, this study adopted a mix of the two.

3.3   Research Design

Cooper and Schindler [60] define Research design as a plan or framework for conducting the study and collecting data. In research circles, they are basically three types of research designs namely exploratory, descriptive and explanatory research design. In any given study, the type

of design adopted is dependent on the nature of the problem one is intending to address. This particular study, adopted a descriptive research design. This kind of design is one that is designed to collect data that describes the characteristics of persons, events or situation [61].

This design method was preferred because this study focussed on describing experiences of the mobile phone users in relation to phone thefts, experiences of the main actors in the management of the problem of mobile phone thefts, as well as determining mechanisms that have been put in place by authorities in order to curb such losses.

Table 3.1 Research Design Matrix

OBJECTIVE	RESEARCH QUESTION	METHOD
1. To profile the prevalence of phone thefts among users in Zambia.	1.1 What is the prevalence of phone thefts among the mobile phone users in Zambia?	- Surveys - Interviews
2. To evaluate the existing security mechanism available for reducing phone thefts among users in Zambia.	2.1 What efforts are being put in place by the Zambian authorities to help reduce phone thefts among users in Zambia? How effective are these efforts in addressing the problem of phone thefts among the mobile phone users in the country?	- Surveys - Interviews
3. To develop a framework through which various players in the phone industry can interact for the mutual benefit of reducing phone theft.	3.1 What framework would be appropriate for adoption by authorities to mitigate the phone thefts in Zambia?	- Surveys - Interviews - Literature Review

3.4 Data Sources

Both primary and secondary data sources were utilised in this study. Primary data was in form of structured and semi structured questionnaires that were distributed to four categories of respondents. These respondents included the Zambia Police as the law enforcer, Mobile Network Operators (MNOs) as the service providers, ZICTA as the regulator as well as the general populace who are the users. Open-ended and closed-ended questions were included in these questionnaires in order to capture both the qualitative and quantitative responses. Further, online survey was conducted through Google Forms, which was used in a way used to aid in the reception of responses to the questionnaire designed for the general populace.

In terms secondary data, the study methodically evaluated data from previous studies that considered GSM theories and concepts for a possible solution to the challenge of mobile phone theft. The literature examined encompassed journal articles from reputable publishers, proceedings and publications, material from standards bodies like the International Telecommunications Union (ITU) and the GSM Association (GSMA).

Particularly, the Researcher conducted face-to-face interviews mainly with ZICTA, MTN and ZAMTEL. The course of these interviews was generally guided by the questionnaire designed for Mobile Network Operators (MNOs).

3.5 Population of the Study

Population is the total compilation of elements about which we wish to make inferences [62]. The population considered for this study was the Lusaka Population. The justification for focussing on Lusaka Province was that the province had the highest number of recorded incidents of phone theft. Further the Headquarters (HQs) for the Mobile Service Providers, ZICTA and Police are in Lusaka. Based on the statistics obtained from CSO, Lusaka has a population size of approximately 1.7 million.

3.6 Sampling Technique and Research Flow Chart

Taro Yamani [63] [64] gives a simplified formula to calculate sample sizes that was employed to determine the minimum respondents suitable for this study. The Statistical formula posits that the minimum acceptable sample size from any given population should be given by the equation;

$$n = \frac{N}{1 + N(e)^2} \qquad\qquad (1)$$

Where;

- n = sample size

- N = population of the study

- e = % level of significance

In this case a 5% level of significance or margin of tolerable or permissible error was adopted used while a total population is one million seven hundred thousand (1,700,000) for Lusaka province. Substituting numbers in the formula gives;

$$n = \frac{1,700,000}{1 + 1,700,000(0.05)^2}$$

$$= 399.9$$

Further, an Online Sample Size Calculator [65] Tool was also consulted.

Calculate your sample size

Population size ❓	Confidence level (%) ❓	Margin of error (%) ❓
1700000	95 ▾	5

Sample size

385

Figure 3.1 Online Sample Size Calculator, Source: Survey Monkey [65]

Based on this estimated Lusaka population, a sample of four hundred and twenty (420) respondents were selected and given questionnaires to fill in. This number of chosen respondents is above the minimum recommended by both Taro Yamani's formula and Survey Monkey's Online Sample Calculator. In determining the target respondents, a multi-stage cluster sampling method was used to select respondents from the four different zones of Lusaka namely Chilanga, Chongwe, Kafue and Lusaka. The sampling design was appropriate for a large sample such as for this study. In this design, the study proportionately clustered the respondents according to their zones. After clustering them, a systematic random sampling of households and individuals was then used to select the final respondents.

Further, in selecting the other stake holders from the Police, ZICTA, and service providers, purposive sampling was employed in which subjects were purposively selected based their expert knowledge on the subject. See fig below of an online sample size calculator indicating the sample size at 5% margin of error.
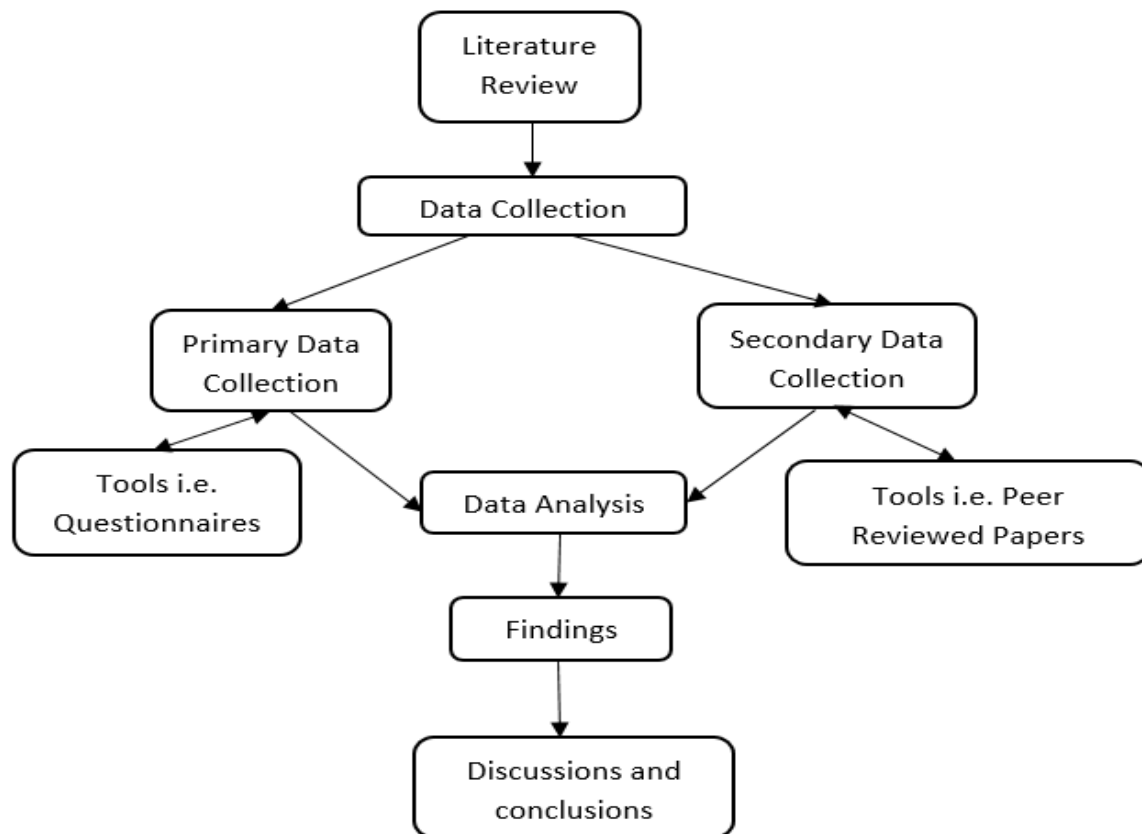
Figure 3.2 Research Methodology Flowchart [62]

3.7   Data Analysis and Presentation

Upon collection of the filled up questionnaires, they were coded, and data entered in to the Statistical Package for Social Scientists version 16 (SPSSv16). The data was then analysed using Univariate analysis only since the study was not doing any comparison of variable indicators. Additionally, Microsoft Office Excel 2016 also employed for translating some of the data into graphical representations like pie charts and bar charts.

3.8   Conception Framework

The concept of the study was motivated by the observed increased number of phone thefts in Zambia as established from the reported cases at the Zambia Police Service as validated during the baseline study.

Notably, the currently existing framework of engagement by stakeholders does not address the problem of mobile phone theft, given the rise in phone theft incidents. The study's ultimate goal of developing a framework suitable framework that would help reduce phone thefts in Zambia. To achieve this therefore, the study intended to determine and profile the extent of phone thefts in the country, particularly in Lusaka Province. Further, the study intended to examine the systems that are currently existing in the country that are aimed at controlling the scourge of phone thefts, so as to determine the strengths and weaknesses of these existing systems. Upon establishing the weaknesses in the existing systems, the study proposed a framework that would cover the gaps in the existing system and reduce the prevalence of phone thefts in the country.
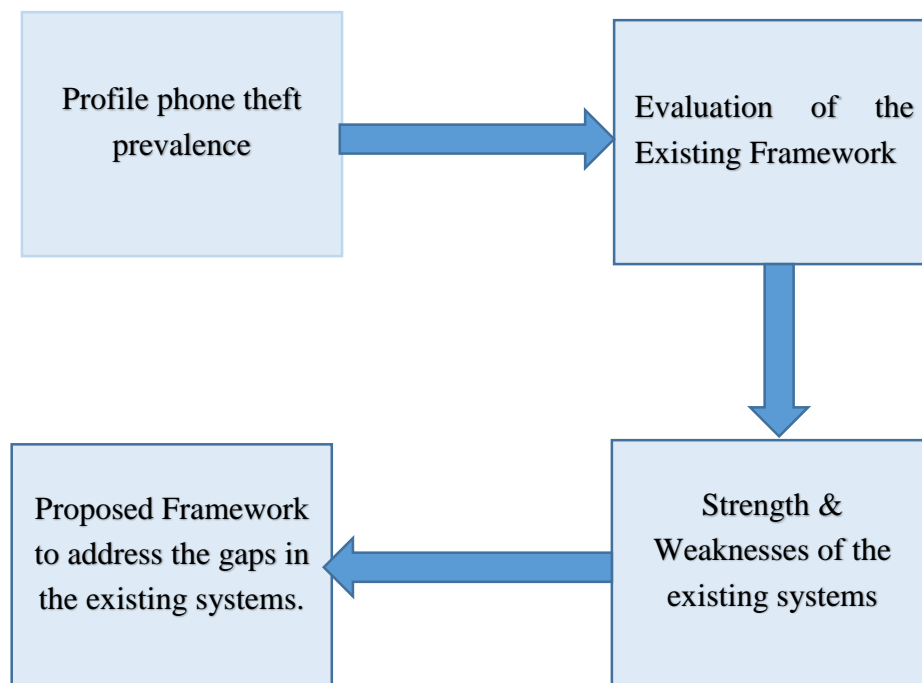
Figure 3.3 Conceptual Framework

3.9   Validity and Reliability

To ensure validity and reliability in the research findings, the study provided for quality checks of the research at each stage. To achieve this, the study ensured that research instruments used in the study such as questionnaires were perfectly designed in conformity of the original objectives of the study, and that a pre-testing was done before distributing the questionnaire to

the whole sample population. Further, the selection of the respondents to be included in the study was strictly guided by scientific sampling techniques to eliminate any form of biasness resulting from unbalanced responses. At the analysis and interpretation stage, the exercise was done using correct analytical tool called SPSS, with the appropriate features to carry out any scientific tests. The Researcher took a short course in Data Management and Analysis using SPSS. This in turn ensured that the research findings are accurate and consistent, and could be generalized and used to solve the practical problem at hand.

3.10   Ethical Considerations

As per research ethics, all respondents were introduced to the study at the point of giving them questionnaires. In this introduction, it was made clear that participation in the study was voluntary and that they would not be coerced into it if they were not willing to. Further, it was also explained to them that the findings of the study were purely for academic purposes and would not be used for any other. As such, names of the respondents or any form of identity was not required, so as to protect them from any other negative consequences arising from the findings. The researcher's personal preconceptions and prejudgments did not influence the research findings in any way.

3.11   Limitations of the Study

The study did not cover the whole country because of the allotted research time and the financial implications of a nationwide scope. Only mobile network subscribers in Lusaka Province were considered for the study.

3.12   Chapter Summary

This chapter discussed the manner through which the study was conducted. The procedure by which data was collected, inputted for processing and analysis is also explained. Also outlined was the study population, sample selection technique, ethical considerations and limitations of the study. The following chapter is a detailed analysis of the findings of this study.

CHAPTER FOUR

RESULTS AND ANALYSIS OF FINDINGS

4.1   Introduction

This chapter deals with descriptive analysis of data collected from primary sources. The analysis was conducted based on responses made in line with the research questions and objectives of the study. Based on this analysis, this research attempted to address the problem of phone thefts by developing a model Framework through which various players like Mobile Network Operators (MNOs), Law Enforcement Officers, the Regulator and Victims can interact for purposes of reducing the scourge among mobile phone users. The study hoped to achieve this this by;

(i)   Profiling the prevalence of phone thefts among the mobile phone users in Zambia.

(ii)   Evaluating the existing security mechanism available for addressing phone thefts among users in Zambia.

(iii)   Developing a framework that could be used by authorities in the mobile phone industry to mitigate these phone thefts.

Statistical package for Social Sciences (SPSS Version 16) was used for data entry as well as for analysis and interpretation of findings.

4.2   Descriptive Analysis

This section presents the description of socio-demographic characteristics of the sample respondents. It provides data on gender distribution, age structure and educational background. The survey questionnaire primarily targeted 450 individual mobile phone users within Lusaka Province. Ultimately, 420 respondents completed the questionnaires and handed them back to the researcher, representing 93.33S% response rate.

4.2.1 Gender and Age Distribution

As shown in the pie chart below, 55.8% of the phone users that responded were male while 44.2% were female. Thus, even though male respondents in this study were comparatively more than the female, the gender distribution was fairly balanced to ensure that there was no biasness on the final findings of the study.

GENDER DISTRIBUTION

44.2% 55.8%

■ Male
■ Female
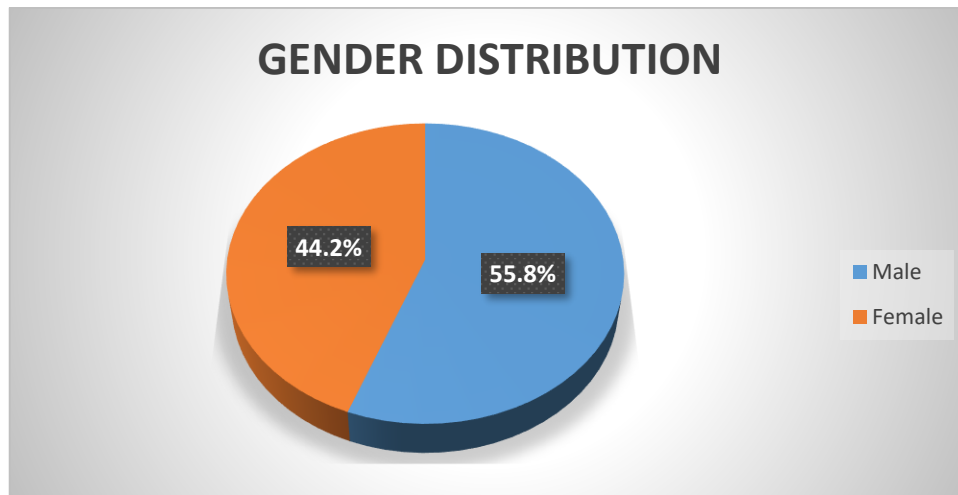
Figure 4.1 Gender Distribution

57.5% of the respondents were in the age range of 16-35 years, and these were in the majority, followed by those in the age range 36-45, comprised of 28.75% of the respondents. Only 10.25% were in the age group of 46-55 years while the remaining 3.5% fell in the 56-65 years age group.

57.5			
	28.75		
		10.25	3.5
16-35	36-45	46-55	56-65

AGE
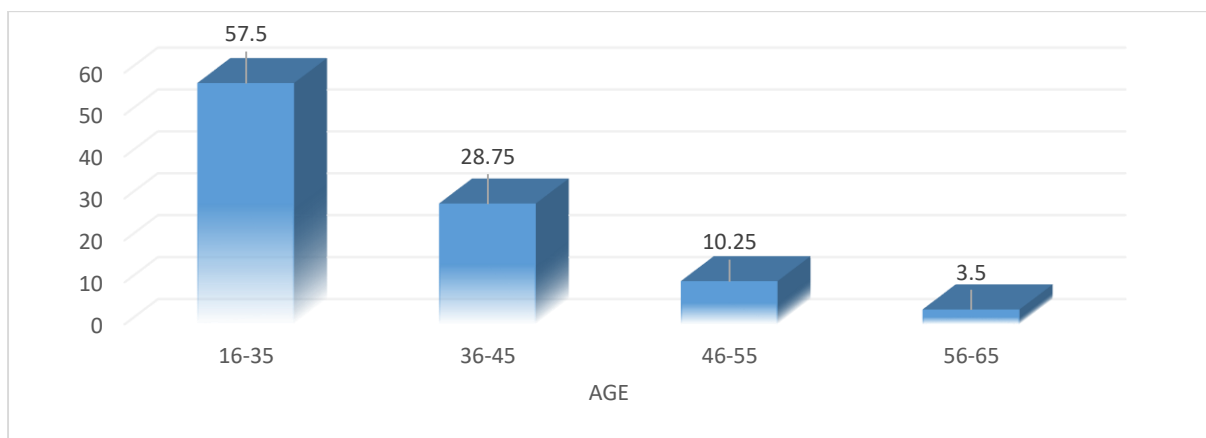
Figure 4.2 Age Distribution

4.2.2 Educational Background of Respondents

Education is one of the key variables that may influence an individual's susceptibility to phone theft or loss. It is also a key factor in uplifting an individual as well as the society, because it improves the skills, potential, creativity and innovation. This in turn determines their affluence in relation to the type of phones that they may own.

Figure 4.3 below reveals that 5.6% of respondents had a grade 12 Certificate and below, 7.8% of the respondents had a College Certificates, while 20.3% had College Diplomas. Further, 43.8% of the respondents indicated that they had University degrees, 21% were holders of a University Masters while the remaining 2% of the respondents had a qualification higher than a Masters' degree.
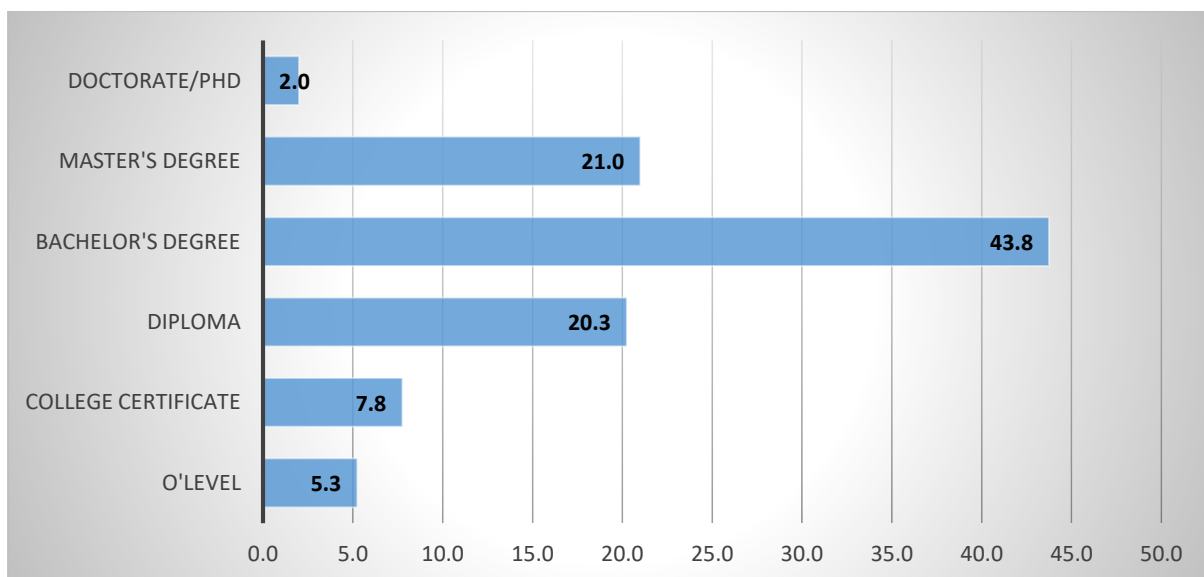
Figure 4.3 Educational Level of Respondents

The above demographics of respondents reflect balanced characteristics of respondents in notable areas of gender, age and education orientation. Such a balance was necessary to ensure that findings of this particular study were not biased or skewed as a result of unbalanced characteristics among respondents.

4.2.3 Phone Ownership

The purpose of this section was to profile the phone thefts by outlining the different type of phones owned by the various respondents in this study, the value of such phones, as well as the incidences of thefts and losses as experienced by these phone owners.

The study was more concerned with the analysis of phone thefts particularly in the last decade, as such it was important to ensure that most of the respondents had owned a phone long enough to have possibly experienced a loss or theft. Table 3 below reveals that 13.2% of the respondents had started owning phones in the last ten years. The rest of the respondents in excess of 85.5% had owned a phone for 16 years or more.

Table 4.1 Length of Ownership of phone

When was the first time you ever owned a cell phone?			
	Frequency	Percent	Cumulative Percent
0-5yrs Ago	2	.5	.5
6-10yrs Ago	53	13.2	13.8
11-15yrs Ago	148	37.0	50.8
16-20yrs Ago	144	36.0	86.8
More than 20yrs	53	13.2	100.0
Total	400	100.0	

The study established that people could got to own phones through varying options. Some purchased from shops, others bought from the streets or black-market, some purchased from abroad while others were given the phones as gifts.

The mere fact that 16% of the respondents confirmed having purchased phones from the street/black-market creates an incentive for why people would steal phones because a market at which they could be sold exists. 33% confirmed having received a phones as a gift. This shows how vulnerable users that choose to buy phones off the street could be exposed to dealers who might sell them phones that may have previously been stolen. User education would be paramount to discourage users from buying phones off the street.
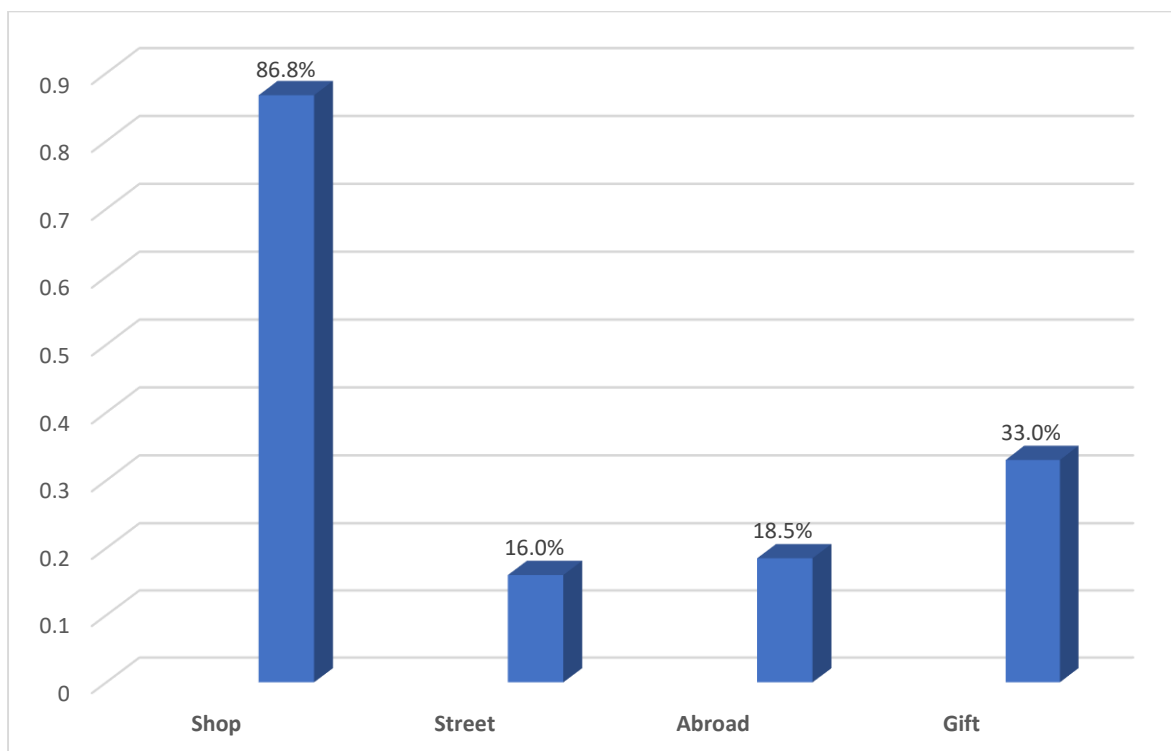
Figure 4.4 Source of Phone

Results suggest that Zambia is a Samsung-dominated market when it comes to the type of cell phones as 81% of the respondents indicated having owned such phone. Nokia cell phones came second at 80.5%.

4.2.4 Prevalence of Phone Thefts

The study revealed that 67% of the respondents had had their phones stolen.
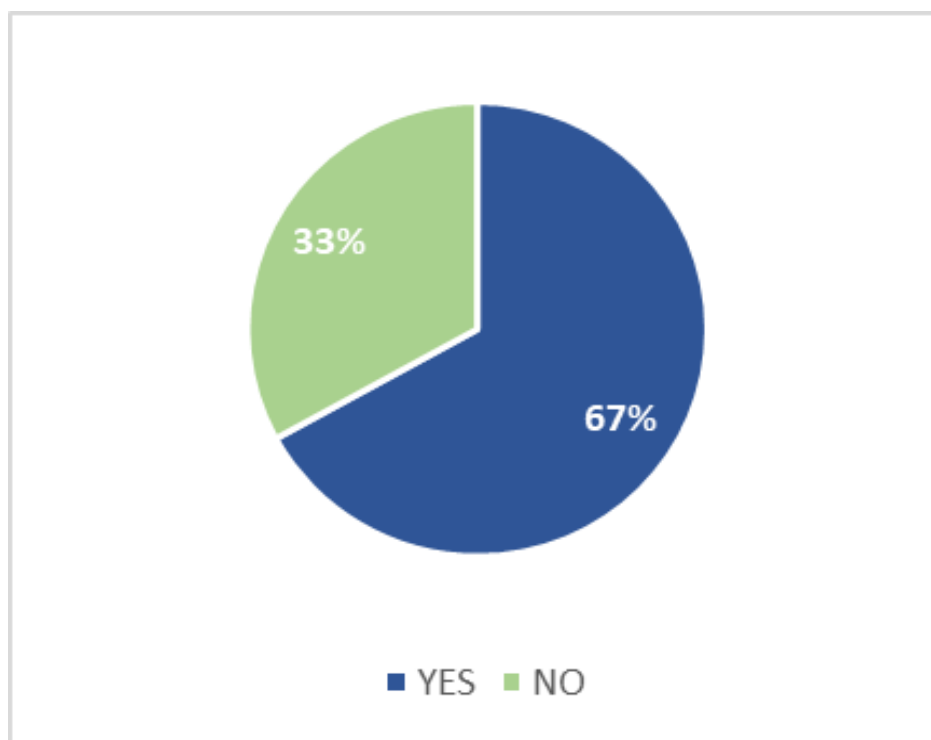
Figure 4.5 Phone Theft

4.2.5 Phone Thefts according to provinces

A baseline study undertaken confirmed that mobile phone theft is highest in Lusaka, with Copperbelt and Southern Provinces at second and third places respectively. The statistics for these 3 provinces accounted for 75% of recorded statistics from the period of 2010 to 2018.

Table 4.2 Theft of Phones according to Province

Province	Recorded thefts (2010 to 2018)
LUSAKA	2065
COPPERBELT	1615
SOUTHERN	1600
NORTHERN	681
CENTRAL	384
WESTERN	256
EASTERN	150
N/WESTERN	118
MUCHINGA	99
LUAPULA	37
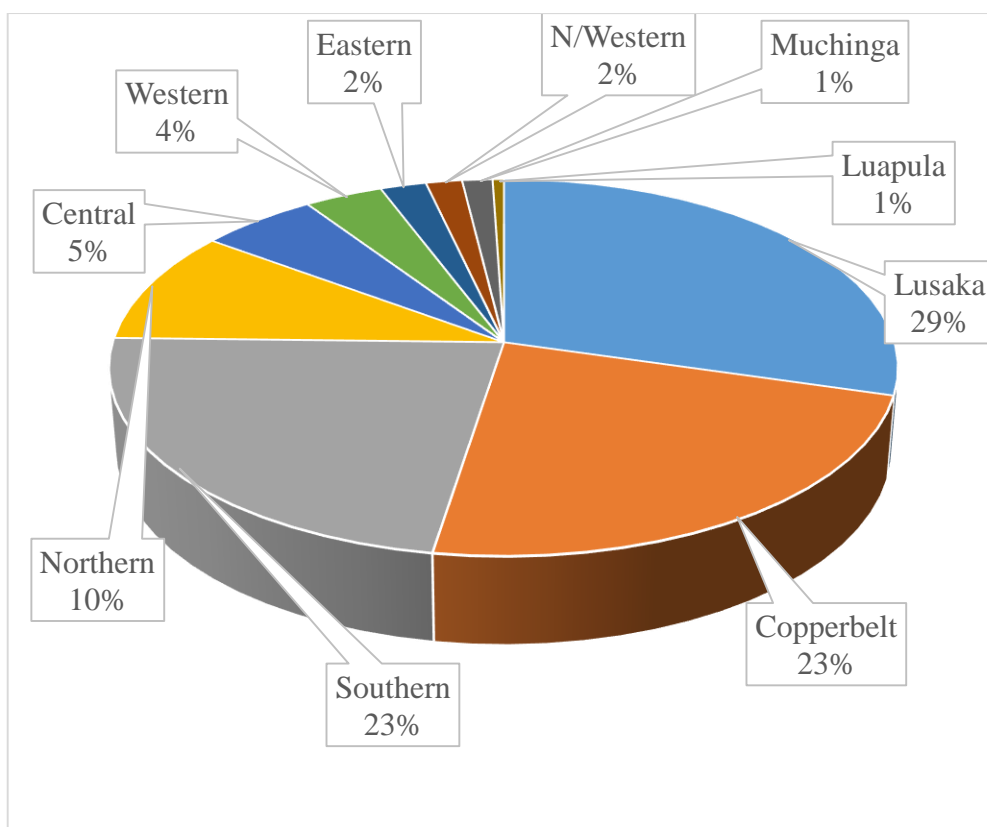
Figure 4.6 Phone theft according to Province

From the male population, 67.7% of them had lost a phone while 66.1% of the females had experienced a phone theft or loss.

Table 4.3 Phone Theft/Loss in Relation to Gender

Gender	Have you ever experienced a theft or loss of a cell phone?		Total
	YES	NO	
Male	151 67.7%	72 32.3%	223 100%
Female	117 66.1%	60 33.9%	177 100%
Total	268 67.0%	132 33.0%	400 100%

The study also established that majority of theft/losses was experienced by respondents within the 16 – 35 age group in excess of 55%. The prevalence of losses reduced with increased age. This could be explained by the fact that the young people are more active and outgoing in contrast to the aged who are less mobile.
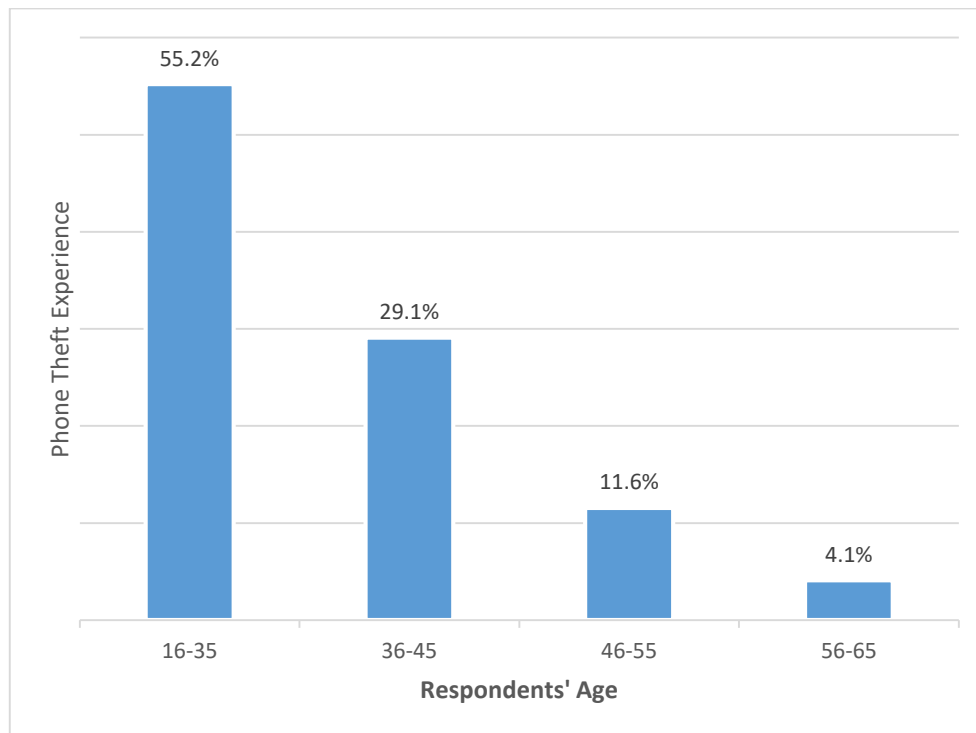
Figure 4.7 Phone Theft in relation to Age

When it comes to the types of phones or handsets stolen, Samsung took to lead. Samsung phones stolen stood at 45.1%, followed by the Nokia handsets at 28.6%.

Table 4.4 Stolen Phones by Make/Brand

TYPE OF PHONE STOLEN	
APPLE IPHONE	5.6%
NOKIA	28.6%
ITEL	5.6%
SAMSUNG	45.1%
HUAWEI	9.8%
SONNY ERICSON	5.3%
TOTAL	100%

All three GSM service providers currently operating in Zambia do have the capability to blacklist or deny service to a device or handset based on its IMEI. Further, 61.6% suffered a theft or loss while an Airtel SIM card was in the handset; 26.3% MTN and only 12.1% of thefts/losses occurred with ZAMTEL SIM cards inserted in the phones.
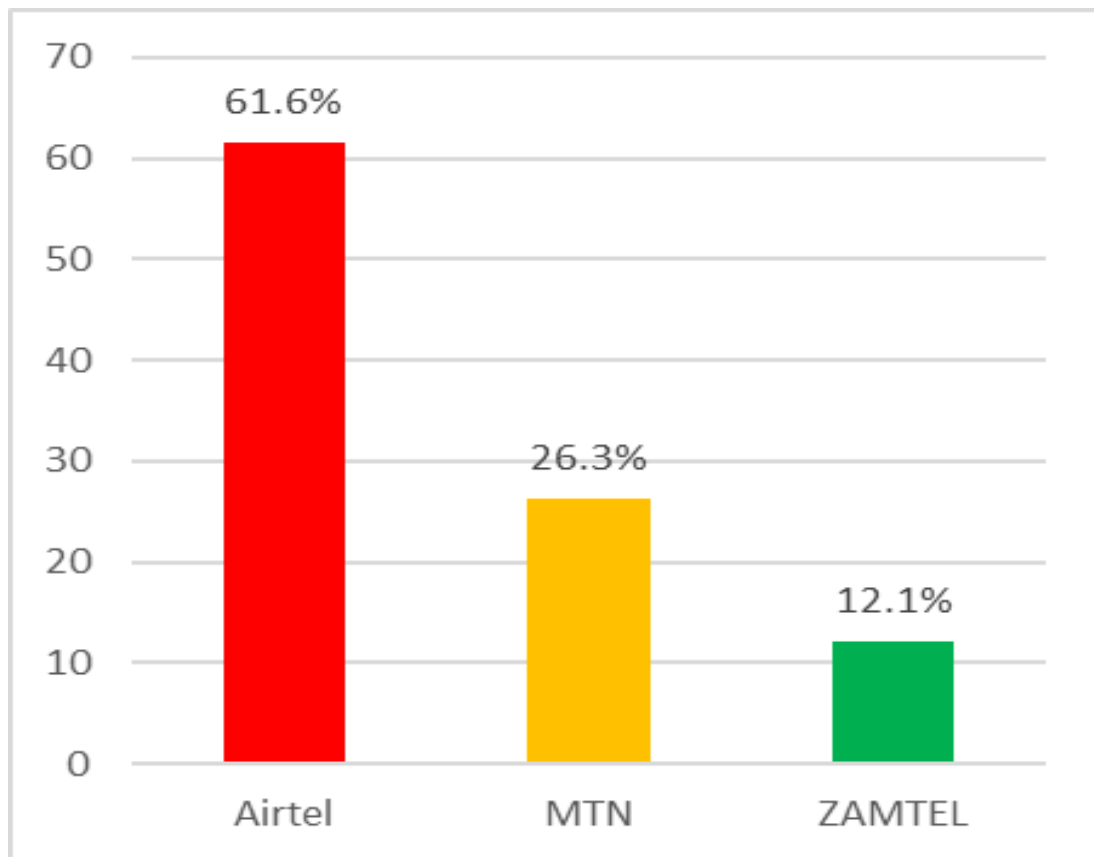
Figure 4.8 Theft Victims According to Service Provider

Based on the responses obtained from the three mobile operators, from ZICTA as the regulator, as well as from the Zambia Police service who are the Law enforcer, the following framework was developed, depicting the existing system or framework for dealing with the problem of lost or stolen phones.

Table 4.5 Phone Theft in Relation to Value of Handset

Have you ever experienced a theft or loss of a cell phone? * What is the estimated value (in Zambian Kwacha) of the handset lost or stolen?							
Have you ever experienced a theft or loss of a cell phone?	What is the estimated value (in Zambian Kwacha) of the handset lost or stolen?						
	Below K500	Between K500 & K1,750	Between K1,751 & K3,500	Between K3,501 & K5000	Between K5,001 & K10,000	Above K10,000	Total
YES	40	114	66	31	13	4	268
	14.9%	42.5%	24.6%	11.6%	4.9%	1.5%	100.0%

In terms of the value of phones stolen or lost, findings of the study revealed that majority of the phones stolen ranged in value between Zambian Kwacha K500 and K1,750. Phone thefts of handsets valued between K1,751 and K3,500 accounted for 24.6%. Phones value above K5,000 accounted for 6.4% of thefts, a possible indication that users of high-value devices are perhaps more alert.

Of those that experienced loss or theft of a phone, 58% confirmed having reported to the Police.
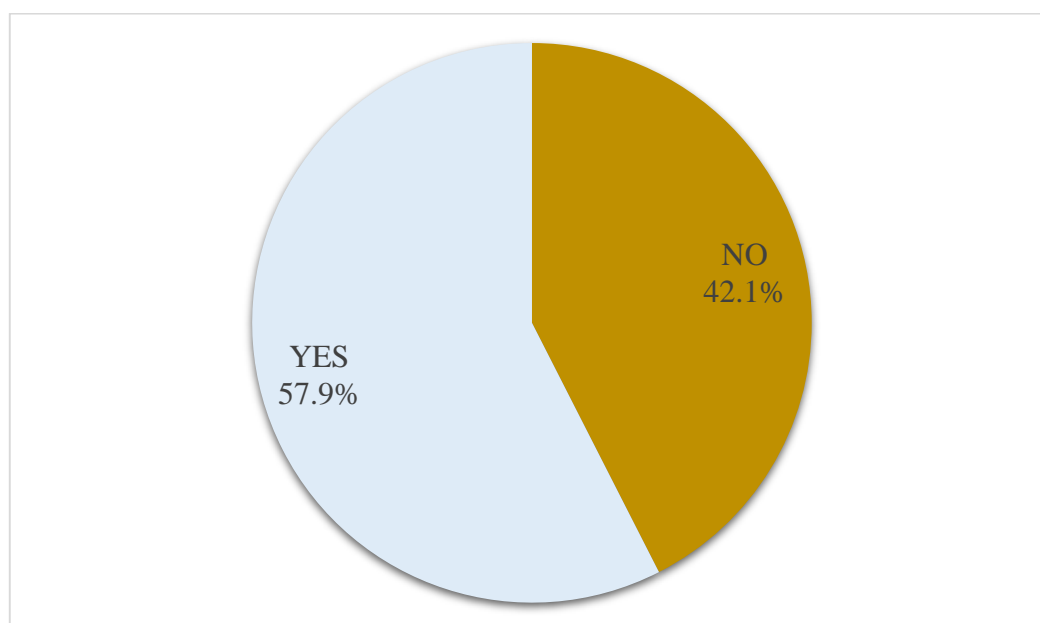
Figure 4.9 Report of Handset Theft/Loss Police

56

This reveals a rather low rate of reports made to the Police about theft of phones and shows the levels of confidence that the general public has for the Zambia Police service (Law Enforcement).

Table 4.6 Report of Phone Theft to Police

		When your cell phone/handset was lost or stolen, did you report the loss or theft to the Police?		
		Yes	No	Total
Have you ever experienced a theft or loss of a cell phone?	YES	154	112	266
		57.9%	42.1%	100.0%
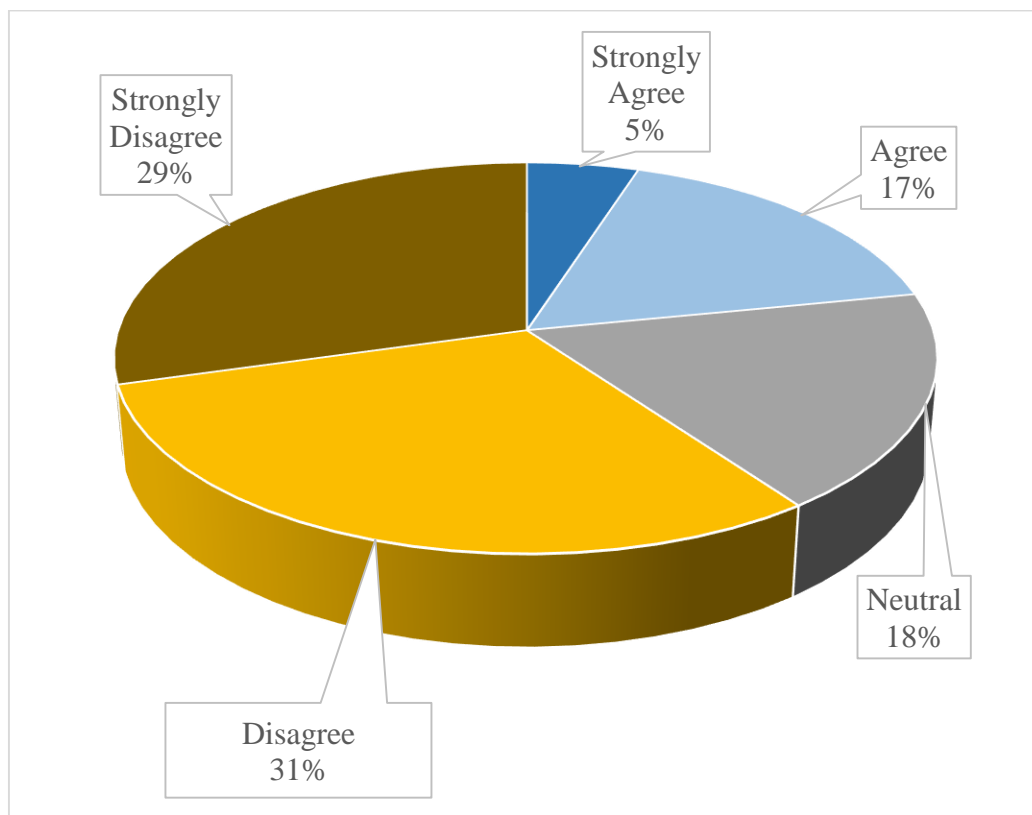
Figure 4.10 Rating Zambia Police's Responsiveness

By interpretation, the general view and opinion is that the Zambia Police Service could do better in the way the handle phone theft incidents. Of The number of respondents that were agreeable that the Zambia Police Service was helpful when theft or loss of mobile phones is 22.1% - which is made up of those that strongly agreed at 5.2% and those that agreed at 16.9%. Of the respondents, 18.2 percent were neutral. Results indicate that majority of the respondents, representing 60% are disgruntled with Zambia Police handles incidents of phone thefts.

Table 4.7 User Responses on Service Satisfaction

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5.00%	16.90%	18.10%	30.60%	29.40%

4.2.6   Recovery of Stolen or Lost Phones

From the 268 that lost phones, only 27 respondents, representing 10.1% confirmed having ultimately recovered their lost or stolen phones. The rest, in excess of 239 respondents, representing 89.9% never recovered back their phones.
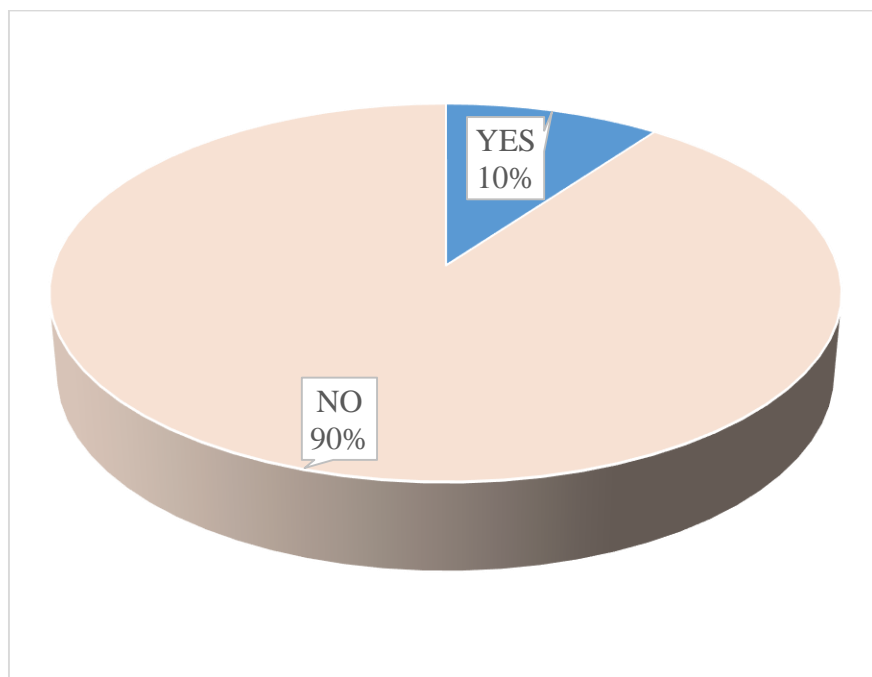
Figure 4.11 Rate of Recovery of Phones

58

Further, among those that indicated that they managed to recover their phones back after losing them, 77.8% of them indicated that the police recovered the phone while 22.2% indicated that the phone was simply returned to them out of good will by the persons who found them. Our Police's rate of recovery of stolen phones is very low, as seen from the findings.

4.2.7   Loss of Data or Information

46% of those that lost phones confirmed having lost data too. The nature of the data that was lost was mainly documents, pictures, video and audio clips. Some claimed having lost educational material that was in electronic format.
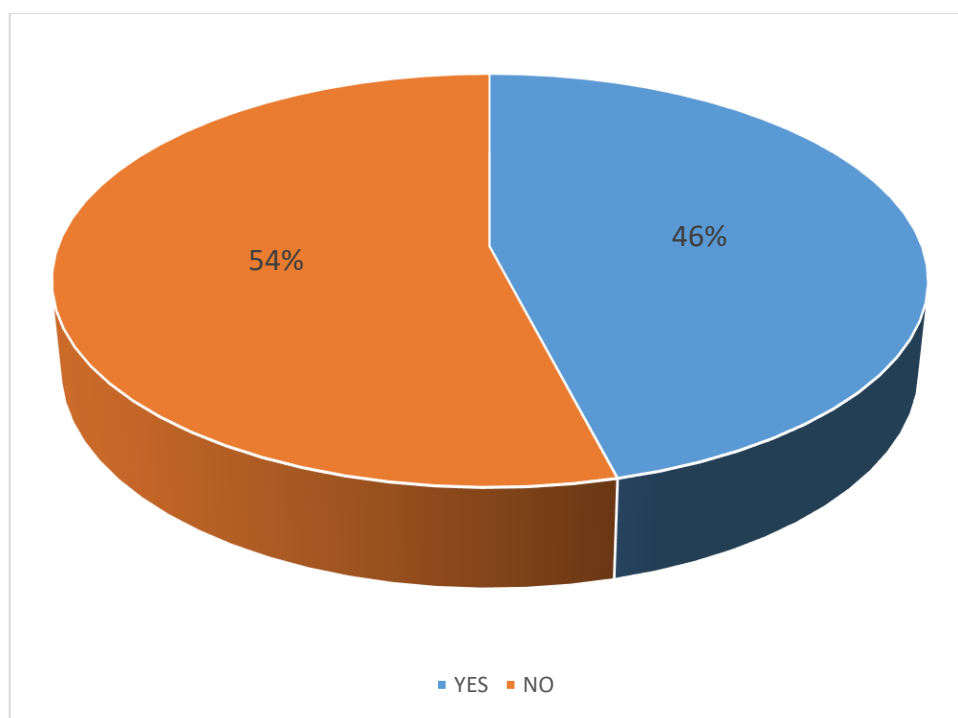
Figure 4.12 Loss of Information/Data

Of the respondents, 64% confirmed that they are aware of that every handset has a globally unique identifier called an IMEI. This is usually found on the box in which a handset is shipped, or could be found by dialling *#06# on the keypad if a handset is switched on.
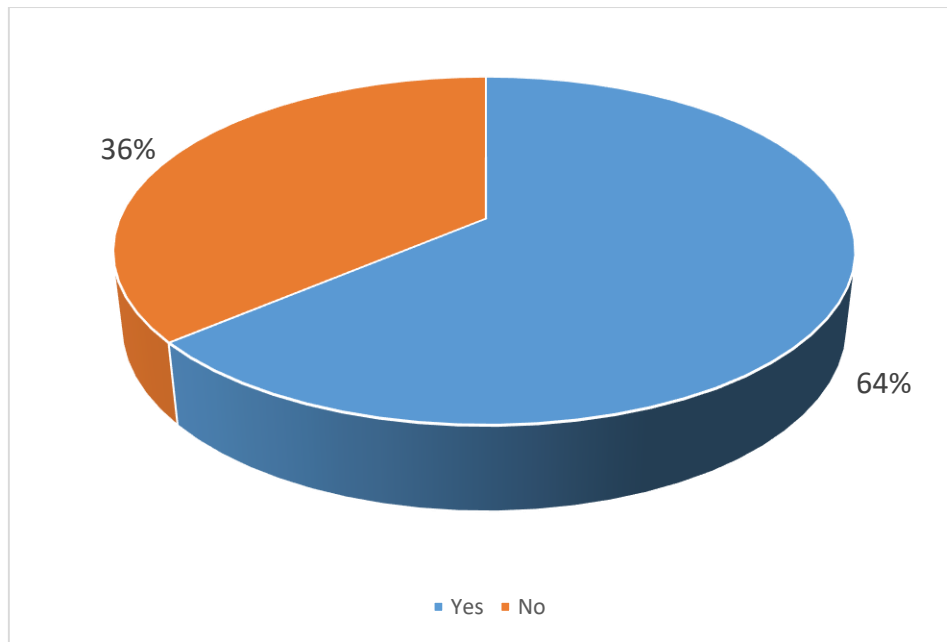
Figure 4.13 Knowledge of IMEI Feature

Respondents were asked as to whether they had at any point found the IMEI to be of any use. Only 26% percent of the respondents confirmed having found the IMEI useful. This suggests that Authorities need to increase awareness of the IMEI and how it could be used in instances where a phone is lost or stolen.
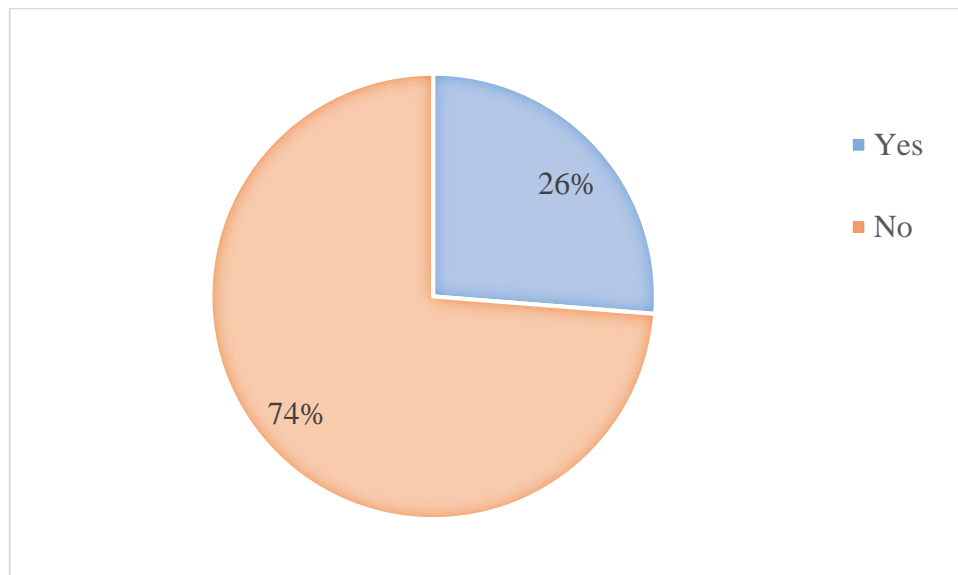
Figure 4.14 Usefulness of IMEI

Majority of respondents denied having seen, read or heard "Awareness Tips by Authorities" on ICT Security with a focus on mobile phone theft. Perhaps ZICTA needs to publicise the URL on their website that gives tips on what people could do in case their phone is lost or stolen.
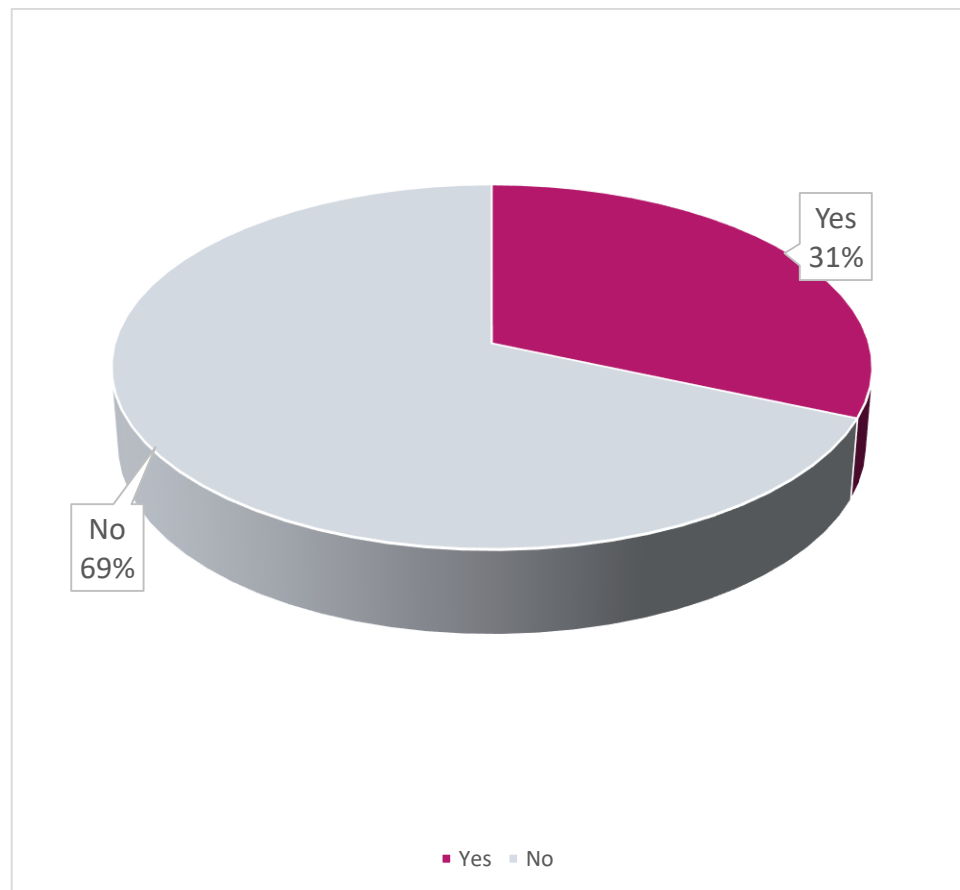
Figure 4.15 User Awareness Tips on Handling Phone Thefts

Handset manufacturers, in response to the problem of mobile phone theft, have incorporated security features into devices. Notably, Apple IOS 13 smartphone devices have the "Find My" app released as the successor of the "Find My iPhone" in earlier versions [66]. Android smartphones equally have the "Find my Device" feature [67].
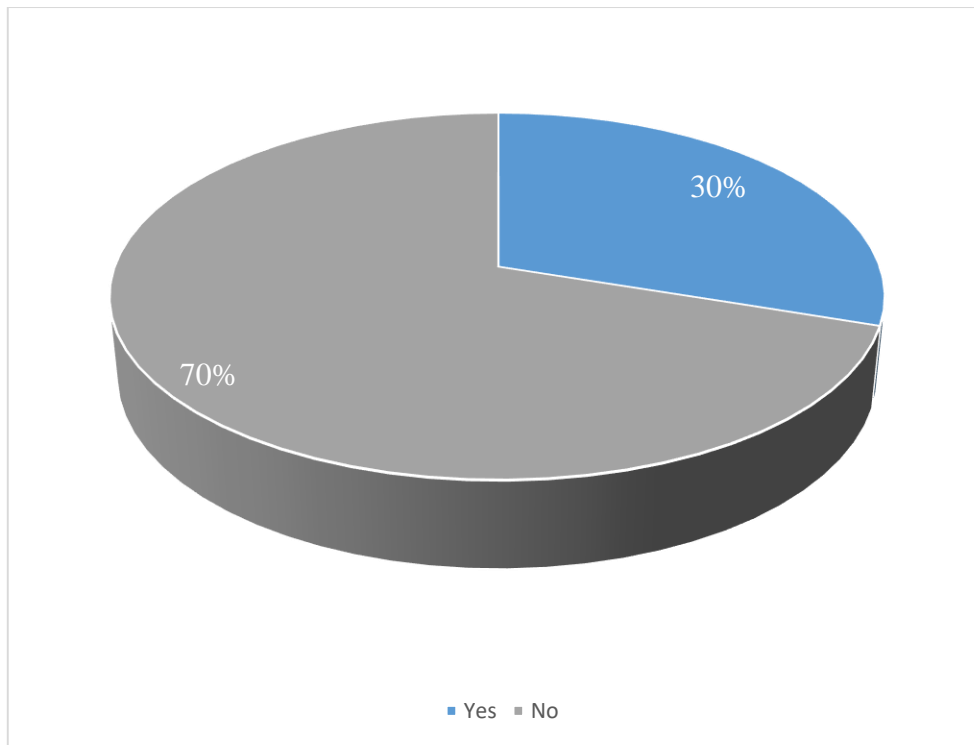
Figure 4.16 Knowledge of Device-based Tracking of Lost Handsets

4.2.8 Law Enforcement (ZAMBIA POLICE) Perspectives

- Prevalence of phone thefts is on the increase as confirmed by the findings of the baseline study. The generally observed trend was that a phone stolen from a particular place in the country would be traced (often time after being be re-sold) to be in other parts of the country. Three cases were given as examples, wherein in phones stolen in Lusaka were traced to have been connecting with one of the service providers in North-western province, Copperbelt and Western provinces.

- A Cybercrimes Unit does exist under the Criminal Investigations Department at the Zambia Police Force Headquarters. This is the unit that generally handles mobile phone theft incidents. The team is not adequately equipped, they have no computers, stationary or a vehicle for easy transportation to the magistrates' office and each of the mobile operators in following up closure of phone theft incidents. Sometimes high-profile cases and those of greater gravity according to the law tend to overshadow or overtake phone theft crimes. On average, training programs are arranged annually for this unit.

- The police indicated that there had been meetings, workshops and collaborative engagements with the Mobile Network Operators (MNOs) and the Telecommunications Regulator (ZICTA) aimed at discussing possible cooperation in addressing the problem of mobile theft. MNOs are generally helpful in executing search warrants presented to them by the Police, with an average response time of 3 to 5 days for a printout of activity logs on a certain mobile subscriber number or IMEI. However, nothing concrete has so far come out of these meetings with regard to an engagement model or framework aimed at reducing phone theft.

- The Zambia Police confirmed embarking on a sensitization programme to inform the general members of the public not to expose their phones in crowded places, and to desist from using phones in unsecured environments during the night. Further, the public was being implored to demand receipts on which is indicated serial numbers and or the IMEI each time they bought a phone from recognized outlets. However, only 31.5% of respondents indicated ever having heard of or seen any Mobile Phone Security Tips or Public Awareness Talks aimed at tackling the problem of mobile phone theft done by either the Police or ZICTA. This is quite a low rate that needs to be improved upon.

- In a case where a phone has been lost or stolen, the procedure was such that the police would ask the victim if he/she knows the serial number of the stolen handset. The Police then proceed to obtain a signed search warrant from the magistrates' This authorizes MNOs to obtain printout of activity on a said device. Besides these outlined steps, the police indicated that they had no definite strategy in place to help reduce the theft of phones drastically.

4.2.9 Regulatory (ZICTA) Perspectives

- Findings of the study revealed that ZICTA is currently not party to any regional or global initiatives or collaborative efforts aimed at combating or reducing mobile phone theft by the use of technology.

- As the regulator of the telecommunications sector in Zambia, ZICTA confirmed that all the three mobile network operators have the GSM System features that offer capability

to blacklist or block handsets based on IMEIs. ZICTA also confirmed that all 3 mobile network operators have EIRs implemented. ZICTA has convened meetings to consider collaboration among Mobile Network Operators, the Law Enforcement Wing (Zambia Police) and other stakeholders.

- ZICTA also confirmed that they do not request for incident statistics on lost or stolen handsets from mobile network operators or Zambia Police.

- Statutory Instrument Number 65 of 2011 [68] mandates ZICTA to register electronic communication apparatus and set up and maintain a Central Equipment Identification Register (CEIR). This study has confirmed that preparations so far done for the preparation of setting up a Central Equipment Identity Register are at less than 10%.

- Further, the authority conducts quarterly awareness sessions in order to give "Security Tips" on Cybersecurity, with a heavy focus on the challenge of Mobile Phone Thefts. However, on overall, regarding the current model of engagement or framework of interaction between owners of stolen phones, Zambia Police, mobile network operators (MNOs) and the Regulator (ZICTA), there was no Model in place. Any loss of a phone was currently treated like any loss whereby a loss report is lodged to the Police who will investigate to try to recover it. Information can be obtained from service providers upon production of a warrant.

4.2.10 Service Provider Perspectives

MTN and ZAMTEL did not expressly provide responses to this study by filling out the questionnaire that was distributed to them. The Researcher got responses from MTN and ZAMTEL by interviewing various sections or units that deal with Mobile phone thefts at different times.

- Service providers do not currently keep any records of phone thefts or losses. However, they all confirmed having teams of not more than 5 persons dedicated to respond to Law Enforcement Agencies and their requests as per ICT Act of 2009.
- The framework of engagement by which the Police, ZICTA and Mobile Network Operators interact in attempt to curb phone thefts was not defined in definite terms. There

are no specific or explicit outcomes wherein service providers are expected to block or blacklist stolen or lost handset. The focus is on fighting crime in general.

- Mobile Network Operators incur expenses in responding Law Enforcement Agencies in terms of stationary and court appearances.

- ICT Infrastructure on the end of the Zambia Police needs to be developed to make the collaboration more effective. This includes setting up of official or corporate email address for officers that handle mobile phone thefts.

- All three mobile service providers confirmed that their GSM networks support features wherein services could be denied to a subscriber based on their handset or cell phone's IMEI, though blacklisting of IMEIs is currently not being done for lost or stolen mobile phones.

4.2.11 Existing Framework for Addressing Mobile Phone Theft in Zambia

There is no existing requirement or mandate wherein Mobile Network Operators (MNOs) ultimately blacklist lost or stolen handsets to prevent them from being used. If at all blacklisting of handsets was done by a single Mobile Network Operator, users would simply circumvent this by switching mobile service providers because operators are not currently exchanging blacklists. The process is open-ended with no assurance that the Zambia Police (Law Enforcement Wing) would actually attempt to pursue the issue any further following the report of the theft.

This study has established that all 3 mobile network operators currently operating in Zambia do have GSM Systems Features that support blacklisting of handsets/phones based on the IMEI (International Mobile Equipment Identifier). ZICTA will come to the centre stage to facilitate the exchange of blacklists so that a handset/phone on this list would not be usable on any of the 3 providers' network.
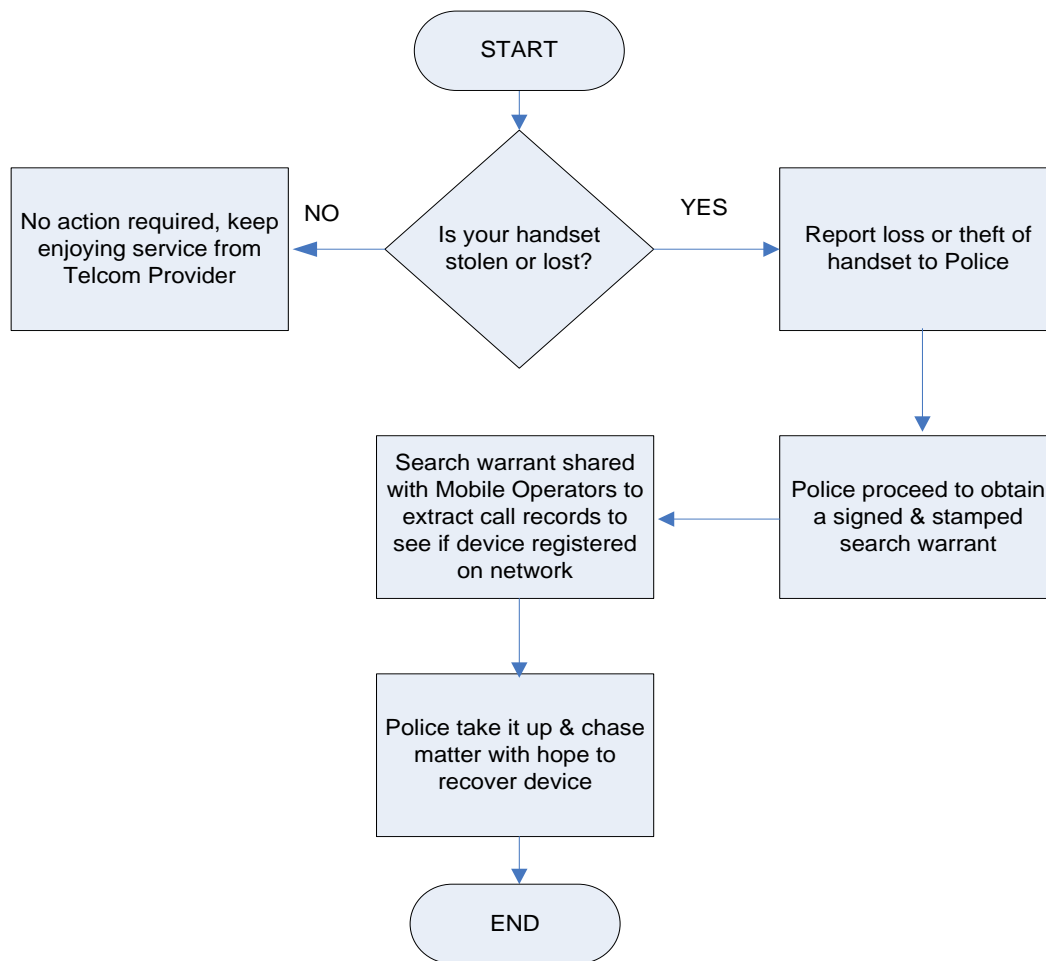
Figure 4.17 Existing Framework of Engagement on Mobile Phone Theft/Loss

4.2.12 Proposed Framework for Addressing Mobile Phone Theft in Zambia

The introduction of blacklists would ultimately render stolen phones unusable and, with user education, considerably reduce the motivation for which criminals steal phones. ZICTA would set up and Manage Central Identity Equipment Register wherein all providers exchange blacklists instantly. This could leverage on database migration tools readily available for the easy exchange of blacklists by mobile service providers [69]. This move would not only reduce in-country phone thefts, but also prepare our nation to participate in Regional (SADC) initiatives aimed at combating mobile phone theft.
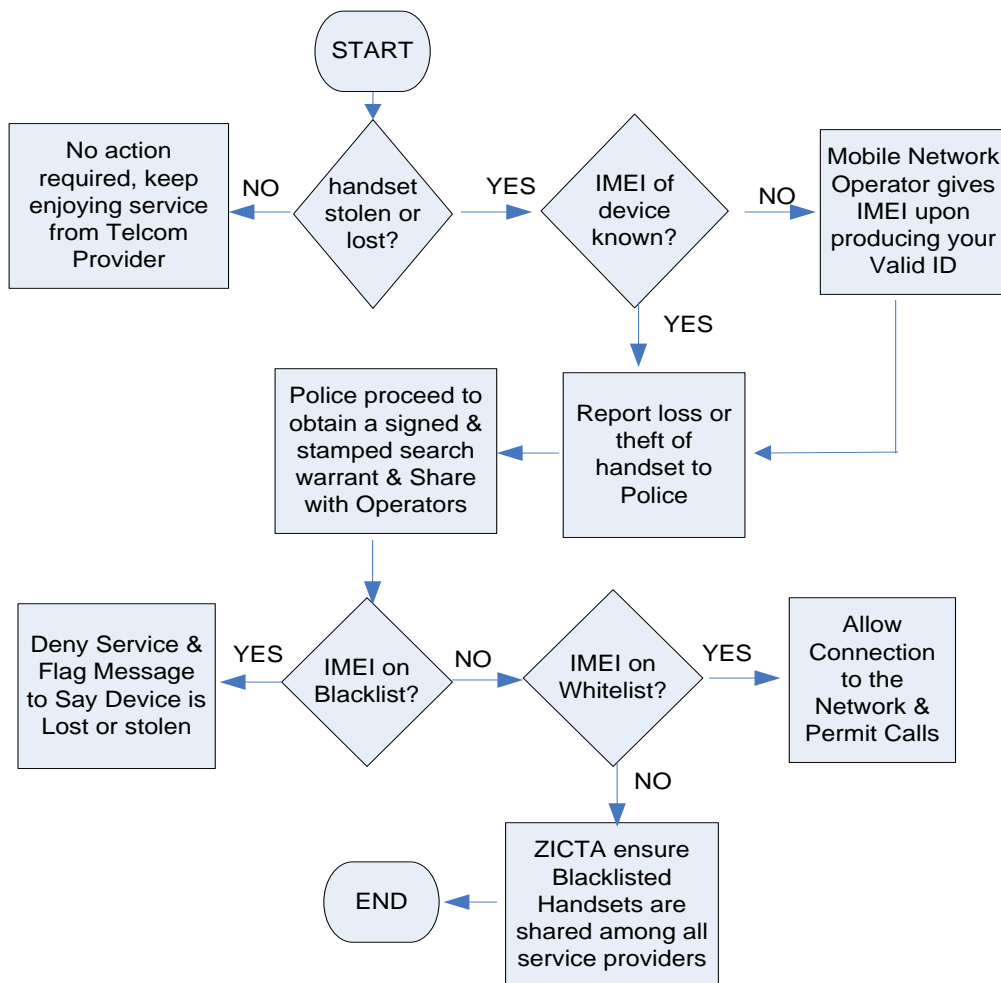
Figure 4.18 Proposed Framework to address Phone Theft in Zambia

4.3   Chapter Summary

This chapter presented the prevalence of phone thefts. These were presented in terms of the types of phone and the characteristics of people that lost them. Further the chapter showed a poor recovery rate of lost phones as well as efforts that are being made by the different stakeholders in the communication industry to ensure that phone thefts are reduced in the country. Responses given by various stakeholders do confirm that the existing framework of engagement over lost and stolen mobile phones does not provide sufficient security in curbing phone thefts. A new framework was presented with the expectation to reduce phone thefts by ultimately blacklisting stolen or lost handsets and ensuring that blacklists are shared among the three mobile service providers. The next chapter presents conclusions of the study as well as recommendations.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1   Introduction

This last chapter contains a summary of the findings of the study on a framework aimed at addressing mobile phone theft in Zambia in relation to research objectives and questions as outlined in chapter one. Secondly, the chapter offers recommendations for a way forward by the Telecommunications Regulator (ZICTA), the law enforcement wing (Zambia Police) on what could be prioritized in addressing phone theft based on the findings from the other key stakeholders engaged during the study.

5.2   Conclusion and Recommendation

Guided by the research objectives, the study made conclusions based on the following research questions:

a)   What is the prevalence of phone thefts among the mobile phone users in Zambia?

In terms of the prevalence of mobile phone theft in Zambia, the study established that a phone theft prevalence of 67% with Samsung mobile phones topping as the most frequently stolen followed by Nokia.

b)   What efforts are being put in place by the Zambian authorities to help reduce phone thefts and how effective are these efforts in addressing the problem of phone thefts among the mobile phone users in the country?

The existing framework for addressing mobile phone theft does not mandate the blacklisting of lost or stolen mobile phones. The rate of recovery for lost or stolen phones was at 10%.

c)   What framework would be appropriate for use by authorities to mitigate the phone thefts in Zambia?

This study proposes a framework that ensures the ultimate blacklisting of lost or stolen handsets.

With the establishment of the Zambia National Data Centre (ZNDC), ZICTA could facilitate the set up and management of a Central Identity Equipment Register wherein all providers exchange blacklists instantly. The introduction of blacklists would ultimately render stolen phones unusable. Database Migration Tools are readily available to aid in easy exchange of blacklists by mobile service providers in Zambia [69]. Coupled with user education, this move could considerably reduce the motivation for which criminals steal phones. Coupled with user education, this move would not only reduce in-country phone thefts, but also prepare Zambia for participation in Regional (SADC) initiatives aimed at combating mobile phone theft.
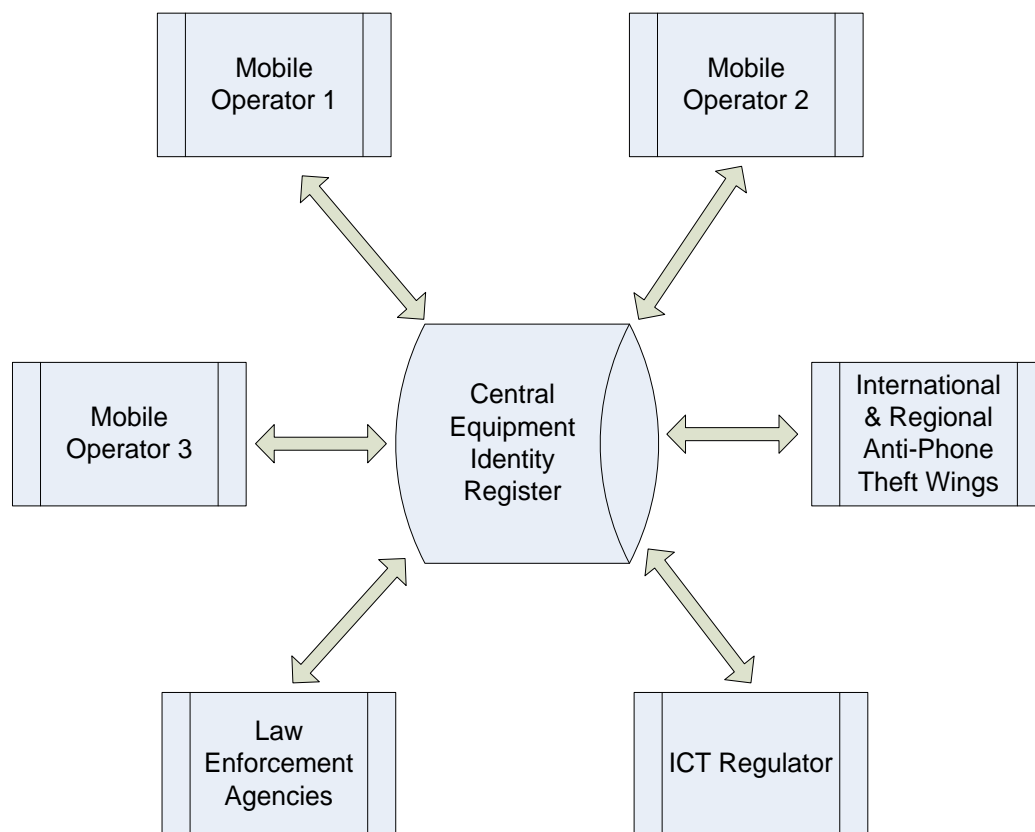
Figure 5.1 Enhanced Collaboration for Exchange of IMEI Blacklists

Here-below is a detailed model or framework of collaboration for the exchange of IMEI blacklists among mobile operators. The framework, in an ideal situation, now sees Zambia

collaborating not only at the regional level, but at global level with the GSM Association (GSMA).

National EIR IMEI Database Solution
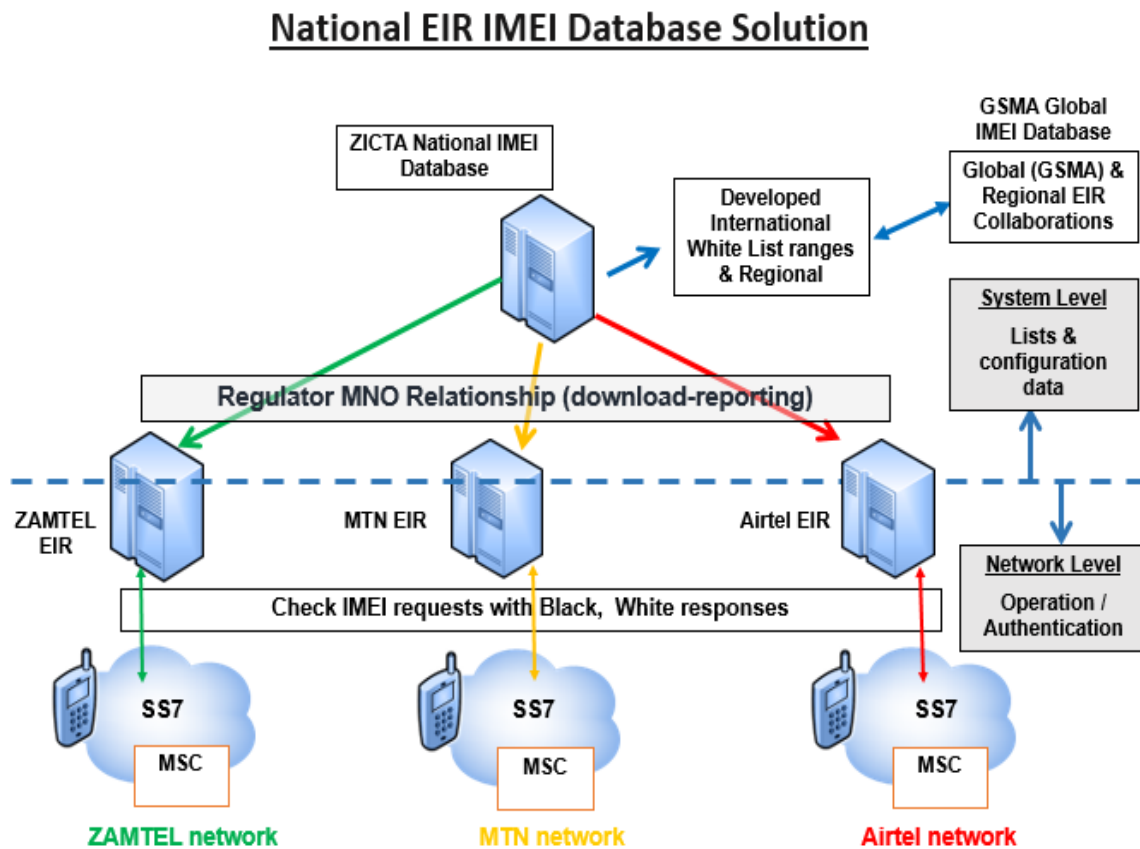
Figure 5.2 Detailed Collaborative Framework for Exchange of IMEI Blacklists

With this extensively detail collaborative framework implemented, mobile cell phone theft is bound to reduce because stolen phones would be devalued by ensuring that they are blacklisted.

5.3   Future Works

A regional model or framework of collaboration could be implemented for the Southern Africa Development Community (SADC) and a continental framework also implemented to ensure that Africa does not remain a dump site for phones stolen in other continents. This would see regions partnering together in the fight against mobile phone theft; thereby making the world a better and safer place for telecommunications users.

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APPENDICES

APPENDIX A: Questionnaire for ZICTA

UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

A Framework to Effectively address Mobile Phone Theft: A Case Study of the Telecommunications Sector in Zambia

Dear Respondent,

My name is **BENAIAH AKOMBWA (0979693519)** and I am a student at the University of Zambia pursuing a Master of Engineering degree in Information and Communication Technology (ICT). As part of fulfilling requirements for my program of study, I now need to do a baseline study examining the problem of mobile phone theft. This research is aimed at coming up with a framework of cooperation by stakeholders in a bid to address the problem of mobile phone theft.

Your organization has been purposively sampled to assist with information on the research subject, as the ICT and Telecommunications Regulator in Zambia and would therefore assist in providing information related to the mobile phone thefts.

Kindly help add quality to this research work by providing answers to the questions below and provide attachments where possible. Your responses will be treated with the highest level of confidentiality and will strictly be used for academic purposes.

Thank you in anticipation

For any information about this survey, you may wish to contact the following;

Research Supervisor: Dr. Simon Tembo - Email - Simon.Tembo@unza.zm

Assistant Dean-Postgraduate: Dr. E. Mwanaumo - Email Erastus.Mwanaumo@unza.zm

INSTRUCTIONS:

Please tick or cross on the applicable choices provided, or supply written answers where applicable.

1. Kindly indicate the total number of mobile subscribers for the years indicated below;

Year	Mobile Subscribers in Zambia
2010	
2011	
2012	
2013	
2014	
2015	
2016	
2017	
2018	

2. Kindly share information relating to market share (in %) for the three mobile network operators for the periods as requested per below;

Year	AIRTEL	MTN	ZAMTEL
2010			
2011			
2012			
2013			
2014			
2015			
2016			
2017			
2018			

3. Is ZICTA party to any regional, continental or global initiatives or collaborative efforts aimed at combating or reducing mobile phone theft by the use of technology?

Yes ☐   No ☐

If the answer to the question above is YES, please give more information or list any such regional or global programs in which ZICTA participates to fight the problem of mobile phone theft

i) _____

ii) _____

iii) _____

iv) _____

4. Do all the three mobile network operators (Airtel, MTN and ZAMTEL) have Equipment Identity Registers (EIRs) implemented in their GSM Networks?

Yes ☐   No ☐

5. Mobile Network Operators are generally required to maintain a whitelist, grey list and black list to facilitate the management of SIM and IMEI numbers to facilitate the disablement of electronic devices/phones/handsets that do not confirm with requirements.

A whitelist contains SIM and IMEI numbers of authorized electronic devices. A grey list contains SIM and IMEI numbers of electronic devices suspected to be cloned or to have changed electronic identity or are otherwise utilized without authorization. A blacklist contains SIM and IMEI numbers of apparatus or electronic devices that are disabled as a result of being stolen, cloned, used without authorization or for which electronic identity has changed. Please confirm whether/if all 3 operators do have these lists in place and share them with ZICTA as and when requested

	White List in place & is shared with ZICTA	Grey List in place & is shared with ZICTA	White list in place and is shared with ZICTA	Service Provider doesn't share list
Airtel				
MTN				
ZAMTEL				

6. Is the Authority (**ZICTA**) in a position to state and or confirm whether or not the 3 mobile Network operators have GSM System features capable of supporting the blacklisting or blocking of handsets based on IMEIs?

	YES, GSM Network Supports *blocking* or *blacklisting* of IME	**NO, GSM Network DOES NOT Support *blocking* or *blacklisting* of IME**	**UNSURE**
Airtel			
MTN			
ZAMTEL			

7. Does **ZICTA** receive or have any overview of statistics on lost or stolen handsets from either mobile network operators or the Zambia Police?

Yes ☐   No ☐

If the answer to the above is yes, kindly give figures handsets reported incidents for lost or stolen handsets/phones for the periods listed below;

Year	Recorded Phone Theft/Loss Cases
2014	
2015	
2016	
2017	
2018	

8. Have there been any past attempts wherein the ICT and Telecommunications Regulator (**ZICTA**) convened a meeting to consider collaboration among Mobile Network Operators, the Law Enforcement Wing (Zambia Police) and other stakeholders in view of addressing the challenge of mobile phone theft?

Yes ☐   No ☐

9. How often does ZICTA conduct "Awareness Sessions" or give "Security Tips" on Cybersecurity, with a heavy focus on the challenge of Mobile Phone Thefts?

Never	☐
Monthly	☐
Quarterly	☐
Biannually	☐
Annually	☐

10. What is the current model of engagement or framework (if any) of interaction between owners of stolen phones/victims of mobile phone loss/thefts, Zambia Police, mobile network operators (MNOs) and the Regulator (ZICTA)?

_____
_____
_____
_____
_____
_____
_____
_____

11. **Statutory Instrument No. 65 of 2011** titled "Registration of Electronic Communication Apparatus" gives power to ZICTA to monitor registration of devices and SIM Cards. Have all three (03) mobile network operators completed the registration of SIM cards to satisfaction?

Yes ☐   No ☐

12. **Statutory Instrument No. 65 of 2011** mandates ZICTA to register electronic communication apparatus and set up and maintain a Central Equipment Identification Register (CEIR). Has the process of setting up a Central Equipment Identification Register (CEIR) commenced?

Yes ☐   No ☐   Partially ☐

13. At what percentage are we standing in terms of completion of the set up and maintenance of a Central Equipment Identity Register (CEIR)?

Less than 10 percent	☐
Between 10% and 25%	☐
Between 26% and 50%	☐
Between 51% and 75%	☐
Between 76% and 80%	☐
Between 81% and 100%	☐

14. Has any incident ever been reported to ZICTA's about the likelihood or occurrence that persons, either working alone or with others, modify or tamper with a mobile cell

phone's unique identifier - the International Mobile Equipment Identity (IMEI) in Zambia?

Yes ☐   No ☐

15. Is there any legislation, policy or guideline that compels mobile network operators to limit or restrict the number of SIM cards and or handsets or mobile cell phones that an individual or subscriber can own at once or cumulatively in Zambia?

Yes ☐   No ☐

If the answer to question 14 above is YES, please state the number _____

END!! THANK YOU

APPENDIX B: Questionnaire for Zambia Police

UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

A Framework to Effectively address Mobile Phone Theft: A Case Study of the Telecommunications Sector in Zambia

Dear Respondent,

My name is **BENAIAH AKOMBWA (0979693519)** and I am a student at the University of Zambia pursuing a Master of Engineering degree in Information and Communication Technology (ICT). As part of fulfilling requirements for my program of study, I now need to do a baseline study examining the problem of mobile phone theft. This research is aimed at coming up with a framework of cooperation by stakeholders in a bid to address the problem of mobile phone theft.

Your organization has been purposively sampled to assist with information on the research subject, as the Law Enforcement wing of government in Zambia and would therefore assist in providing information related to the mobile phone thefts.

Kindly help add quality to this research work by providing answers to the questions below and provide attachments where possible. Your responses will be treated with the highest level of confidentiality and will strictly be used for academic purposes.

Thank you in anticipation

For any information about this survey, you may wish to contact the following;

Research Supervisor: Dr. Simon Tembo - Email - Simon.Tembo@unza.zm

Assistant Dean-Postgraduate: Dr. E. Mwanaumo - Email Erastus.Mwanaumo@unza.zm

INSTRUCTIONS:

Please tick, circle or cross on the applicable choices provided, or write where indicated.

1. **Briefly list the order of steps or sequence of events or procedure to be followed when/if someone has had their phone lost or stolen.**

   i) _____

   ii) _____

   iii) _____

   iv) _____

   v) _____

   vi) _____

2. **Is there a dedicated team or unit currently in place to address and fight the crime of mobile phone theft?**

   Yes   No

3. **Is the team/unit adequately empowered with the following;**

   a) Do they have enough resources?

   [ ] the unit/team has computers for its use

   [ ] a vehicle is allocated to the team for use

   [ ] team/unit has access to facilities for making follow-up calls with parties

   [ ] the team has enough stationary to perform their tasks as required

   b) Do they have the required skills and knowledge to police mobile phone theft?

   [ ] skills to use personal computer

   [ ] basic knowledge on handsets and IMEI function

   [ ] trends in telecommunications

   c) How often does the team receive training in cybersecurity?

Once in 2 years	Once a year (annually)	Quarterly (4 times a year)	Unsure	No cyber security training
5	4	3	2	1

4. **On a scale of 5 to 1, how prevalent are mobile phone thefts in Zambia? (circle the applicable answer)**

Very Prevalent	Prevalent	Unsure	Not Prevalent	There is no phone theft
5	4	3	2	1

5. **Is the Zambia Police Service currently tracking statistics of stolen mobile phones per quarter, per year? If so, kindly share recorded incidents of stolen phones for the years below;**

Year	Recorded Phone Theft Cases
2010	
2011	
2012	
2013	
2014	
2015	
2016	
2017	
2018	

6. **In efforts of the Zambia Police to fight crimes related, are the three Mobile Network Operators (MNOs), Airtel, MTN and ZAMTEL generally cooperating or helpful?**

Yes   NO

7. **Please rate the cooperation of the Mobile Service Providers**
   a) Is Airtel Zambia helpful to the Zambia Police in regard to queries related to mobile phone theft or handsets reported lost?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

b) **Is MTN Zambia helpful to the Zambia Police in regard to queries related to mobile phone theft or handsets reported lost?**

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

c) **Is ZAMTEL helpful to the Zambia Police in regard to queries related to mobile phone theft or handsets reported lost?**

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

8. **As a Law enforcement agency, what measures have you put in place to control, curb or prevent mobile phone thefts?**

_____
_____
_____
_____
_____
_____
_____
_____

9. **Are you aware of any regulatory requirement that limits the number handsets/mobile cell phones that an individual can own at once or cumulatively?**
   ☐ Yes
   ☐ No
   ☐ Unsure

10. **Have there been any previous meetings, workshops or collaborative engagements with the Mobile Operators and or the Telecommunications Regulator (ZICTA) to discuss possible cooperation in addressing the problem of mobile theft?**

   Yes   No

11. **Would the Zambia Police be willing to participate in cooperation with other stakeholders to fight the problem of mobile phone theft?**

Yes   No

12. Is there likelihood that persons, either working alone or with others, modify or tamper with a mobile cell phone's unique identifier - the International Mobile Equipment Identity (IMEI)

Yes   No

If incidents have been reported before wherein a mobile phones unique identifier has been changed, please indicate how many incidents/occurrences _____

13. Does the Zambia Police presently offer knowledge tips or public awareness talks aimed at tackling the problem of mobile phone theft?

Yes   No

14. What is the Zambia Police's strategy to prevent or reduce mobile phone theft?

_____

_____

_____

_____

END!

THANK YOU

APPENDIX C: Questionnaire for Mobile Operators

UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

A Framework to Effectively address Mobile Phone Theft: A Case Study of the Telecommunications Sector in Zambia

Dear Respondent,

My name is **BENAIAH AKOMBWA (0955693519)** and I am a student at the University of Zambia pursuing a Master of Engineering degree in Information and Communication Technology (ICT). As part of fulfilling requirements for my program of study, I now need to do a baseline study examining the problem of mobile phone theft. This research is aimed at coming up with a framework of cooperation by stakeholders in a bid to address the problem of mobile phone theft.

Your organization has been purposively sampled to assist with information on the research subject, as a Mobile Network Operator in Zambia and would therefore assist in providing information related to the mobile phone thefts.

Kindly help add quality to this research work by providing answers to the questions below and provide attachments where possible. Your responses will be treated with the highest level of confidentiality and will strictly be used for academic purposes.

Thank you in anticipation

For any information about this survey, you may wish to contact the following;

Research Supervisor: Dr. Simon Tembo - Email - Simon.Tembo@unza.zm

Assistant Dean-Postgraduate: Dr. E. Mwanaumo - Email Erastus.Mwanaumo@unza.zm

:

Please tick, circle or cross on the applicable choices provided, or write where indicated.

1.   Briefly list the order of steps or sequence of events or procedure to be followed when/if someone has had their phone lost or stolen

i) _____

ii) _____

iii) _____

iv) _____

v) _____

vi) _____

2.   Does your organization keep a log of incidents for handsets/phones reported lost or stolen?

Yes ☐   No ☐

3.   Is there a dedicated team or unit within your organization to handle queries or inquiries related to lost or stolen mobile handsets/cell phones?

Yes ☐   No ☐

4.   If the answer to question three (3) above was yes, how many persons are on that team?

Less than 5 persons ☐

5 to 10 persons ☐

10 to 15 persons ☐

Over 20 members ☐

5.   Do you think the team has sufficient manpower to respond to queries related to phone/handset theft?

Yes ☐   No ☐

6. **What costs does your organization incur in relation to the team/unit that attends to queries related to lost or stolen mobile phones/handsets?**

   d) Stationary

   e) Phone bills for calls made to various interested parties in following up

   f) Other

         i.   _____

        ii.   _____

      iii.   _____

      iv.   _____

7. **On a scale of 5 to 1, and based on records of queries that your organization attends to, how prevalent are mobile phone thefts? (circle the applicable answer)**

Very Prevalent	Prevalent	Unsure	Not Prevalent	There is no phone theft
5	4	3	2	1

8. **To the best possible extent, kindly share available logs or statistics of incidents where phones were reported as stolen or lost for the years below;**

Year	Recorded Phone Theft Cases
2010	
2011	
2012	
2013	
2014	
2015	
2016	
2017	
2018	

9. **The Zambia Police to is charged with responsibility to fight crime in Zambia. Is there a clearly defined framework of interaction and or cooperation between your organization and the Police as regards queries on mobile phone theft or lost phones?**

Yes ☐   No ☐

10. **Would your organization participate in meetings, workshops or collaborative engagements with other Mobile Operators, the Law Enforcement (Police) and or the Telecommunications Regulator (ZICTA) to discuss possible cooperation in addressing the problem of mobile theft?**

Yes ☐   No ☐

11. **Does your GSM network support features wherein services could be denied to a subscriber based on their handset or cell phone's IMEI?**

☐ Yes
☐ No
☐ Unsure
☐ Choose not to answer

12. **Does the regulator (ZICTA) request for statistics specifically regarding recorded lost or stolen mobile handsets?**

☐ Yes
☐ No
☐ Unsure
☐ Choose not to answer

13. **Kindly highlight or list any challenges that your organization faces as a result of the problem of mobile phone theft**

_____
_____
_____
_____

_____

14. **Do you have any proposals or suggestions as to how the current framework of interaction could be improved?**

_____
_____
_____
_____
_____
_____
_____
_____

15. **Is there any limit or restriction to the number handsets or mobile cell phones that an individual can own at once or cumulatively on your GSM network?**

☐ Yes
☐ No
☐ Unsure

16. **Would your organization be willing to participate in cooperation with other stakeholders to fight the problem of mobile phone theft?**

Yes ☐   No ☐

END!

THANK YOU

APPENDIX D: Questionnaire for Mobile Users

UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

A Framework to Effectively address Mobile Phone Theft: A Case Study of the Telecommunications Sector in Zambia

Dear Respondent,

My name is **BENAIAH AKOMBWA (0979693519)** and I am a student at the University of Zambia pursuing a Master of Engineering degree in Information and Communication Technology (ICT). As part of fulfilling requirements for my program of study, I now need to do a baseline study examining the problem of mobile phone theft. This research is aimed at coming up with a framework of cooperation by stakeholders in a bid to address the problem of mobile phone theft.

We need input from users of mobile/cell phones to assist with information on the research subject.

Kindly help add quality to this research work by providing answers to the questions below and provide attachments where possible. Your responses will be treated with the highest level of confidentiality and will strictly be used for academic purposes.

Thank you in anticipation

For any information about this survey, you may wish to contact the following;

Research Supervisor: Dr. Simon Tembo - Email - Simon.Tembo@unza.zm

Assistant Dean-Postgraduate: Dr. E. Mwanaumo - Email Erastus.Mwanaumo@unza.zm

INSTRUCTIONS:

Please tick, circle or cross out the applicable choices provided, or write where indicated.

1. Gender**:** ☐ **Male** ☐ **Female**

2. Age (number of years)

16 – 35	36 – 45	46 – 55	56 – 65	Above 65

3. Level of Education

[   ] O' Level/Grade 12   **[   ] Bachelor's Degree**

[   ] College Certificate   **[   ] Master's Degree**

[   ] Diploma   **[   ] Doctorate/PhD**

4. Which of the following best describes your occupation?

☐ **Student**   ☐ **Private Sector Employee**

☐ **Government Employee**   ☐ **Unemployed**

☐ **Self-employed**

Section 2: Mobile Service Provider Affiliation Information

5. How many handsets/cell phones do you currently possess/own? _____

6. Which Mobile Service Provider are you with?

AIRTEL ☐   **MTN** ☐   **ZAMTEL** ☐

7. When was the first time you ever owned a cell phone?

0 – 5yrs Ago	6 – 10yrs Ago	11 -15yrs Ago	16 – 20yrs Ago	More than 20yrs

8. What type of phones have you owned before?

☐ **Apple iPhone**   ☐ **Samsung**

☐ **Nokia**   ☐ **Huawei**

☐ **ITEL**   ☐ **Sonny**

☐ **LG**   ☐ **Other** (specify name) _____

9. Were all the handsets/cell phones purchased in a shop or on the street?

Shop ☐   **Street** ☐   **Ordered abroad** ☐   **Given Gift** ☐

Section 3: Phone Theft Experiences

10. Have you ever experienced any theft or loss of a phone?

Yes ☐   **No** ☐

11. If your answer to question 10 above is YES, briefly describe the experience

_____

_____

_____

12. What model/type/make was the stolen or lost handset?

☐ **Apple iPhone**   ☐ **Samsung**

☐ **Nokia**   ☐ **Huawei**

☐ **ITEL**   ☐ **Sonny**

☐ **LG**   ☐ **Other (specify name)** _____

☐ **Not applicable**

13. What SIM card(s) was in the stolen or lost phone(s)?

AIRTEL ☐   **MTN** ☐   **ZAMTEL** ☐

14. What was the estimated value (in Zambian Kwacha) of the handset lost or stolen?

		Tick applicable
1	**Below K500**	
2	**Between K500 – K1,750**	
3	**Between K1,751 – K3,500**	
4	**Between K3,501 – K5,000**	
5	**Between K5,001 – K9,999**	
6	**K10,000 and above**	

15. Apart from contacts, was there any valuable data or information on the phone?

Yes ☐   **No** ☐

If yes, kindly indicate what data or information_____

_____

16. When your cell phone/handset was lost or stolen, did you report the loss or theft to the Police?

Yes ☐   **No** ☐

17. Indicate the extent to which you agree with the statement below;

The Police were helpful when I reported the loss/theft of my cell phone/handset

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Give   reasons   for   your   answer   above

_____

_____

_____

_____

18. Was your handset/cell phone ultimately recovered or found?

Yes ☐   **No** ☐

If your answer to question 18 above was YES, how was it recovered?

☐ **Phone returned**

☐ **Phone traced by police and eventually recovered**

Other_____

_____

_____

Section 4: User Awareness of Phone Security Features/Measures

19. Have you ever heard of/seen any security tips or public awareness talks aimed at tackling the problem of mobile phone theft done by either the **Police** or **ZICTA**?

Yes ☐   **No** ☐

20. Are you aware of the mobile cell phone/handset globally unique identifier called an **International Mobile Equipment Identifier (IMEI)?**

        Yes ☐   **No** ☐

21. Have you ever found the IMEI useful to you at any point?

        Yes ☐   **No** ☐

22. At a personal level, what measures have you put in place to, as much as possible, prevent a reoccurrence of mobile phone thefts/loss?

    _____

    _____

    _____

    _____

23. Do you know about any device-based mechanisms for tracking handsets/mobile cell phones reported stolen or lost?

        Yes ☐   **No** ☐   **Unsure** ☐

    If your answer to above question is YES, please supply further detail(s)

    _____

    _____

24. What would you recommend as a way forward in preventing or reducing mobile phone theft?

    _____

    _____

    _____

    _____

    _____

<div align="center">

END!

THANK YOU

</div>