UNIVERSITY OF KWAZULU-NATAL

Factors affecting the roll-out of penetrative broadband delivery in KwaZulu-Natal

by

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Abstract

The roll-out of broadband infrastructure in countries across the globe is crucial to their economic, scientific goals, and social requirements. It has the ability to uplift lives by providing Information Communication Technology (ICT) skills for employment and it can also help improve access to online education, e-learning. Investments in broadband are increasing as policymakers believe that broadband may lead to job creation and economic competitiveness. The broadband divide in South Africa and other developing countries is of concern as broadband service is inhibited by numerous factors. Broadband macro-level access can be assessed according to penetration rates, broadband coverage, connection types, user demographics, and lastly high-level broadband policy development. The purpose of this study was to establish the factors affecting the roll-out of penetrative broadband delivery in KwaZulu-Natal (KZN), particularly with regard to fixed lines. The research employed a qualitative methodology. Purposive sampling was used to select six people from a total population of 250 and interviews were used to gather primary data for this study. Research findings revealed that Government needs to take the lead role if broadband penetration is to be rolled out in non-lucrative areas, for example rural KZN and non-affluent residential areas. The formation of partnerships amongst key role players such as other telecommunications companies, communities, and Government could assist with addressing the challenges and constraints associated with rolling out penetrative broadband services. Despite the progress that appears to be possible and is shown by other African countries such as Kenya, Uganda and Burundi, KZN appears not to be serious about rolling out penetrative fixed line broadband. A coordinated inter-governmental collaborative approach amongst key stakeholders on broadband penetration initiatives is required to develop a high speed communications infrastructure for all the country's citizens. Similar studies of this nature could be conducted in other provinces of South Africa for a more balanced and general view of the state of penetrative broadband in the country.

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ACRONYMS

3G	Third generation mobile telecommunications system
4G	Fourth generation mobile telecommunications system
ADSL	Asymmetric Digital Subscriber Line
DSL	Digital Subscriber Line
DBSA	Development Bank of Southern Africa
DPTS	Department of Post and Telecommunication Services
ECA	Electronic Communications ACT
ECTA	Electronic Communications Transactions Act
FTTN	Fibre to the note
FTTC	Fibre to cabinet or curb
FTTH	Fibre to home
GDP	Gross Domestic Product
GHz	Gigahertz
ICASA	Independent Communications Regulator for South Africa
ICT	Information Communication Technology
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
IT	Information Technology
ITU	International Telecommunications Union
Kbit/s	Kilobits per second
KHz	Kilohertz
KZN	KwaZulu-Natal
LTE	Long-Term Evolution (mobile communications standard)
Mbps	Megabits per second
Mbit/s	Megabit per second
MHz	Megahertz
NBP	National Broadband Policy
NGN	New Generation Networks
OECD	Organisation for Economic Co-operation and Development
PSTN	Public Switched Telecommunications Network
ROI	Return on Investment
SA	South Africa
VDSL	Very High Speed Digital Subscriber Line
Wi-Fi	Wireless Fidelity, a wireless local area network

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

The broadband divide in South Africa (SA) and other developing countries is still of concern: broadband roll-out is inhibited through numerous factors. These include high costs associated with roll-out and inconsistent distribution of broadband networks. There is a growing need for the roll-out of broadband in both developed and developing countries to support economic growth. The South African Government's long term aim is for all South Africans to be connected to broadband services and for 100% broadband penetration rate by 2030. President Jacob Zuma announced during his eighth State of the Nation Address (2015) that Telkom SA had been chosen as the 'lead agency to assist with broadband roll-out' in South Africa.

This study focuses on factors affecting the roll-out of penetrative broadband delivery in KwaZulu-Natal. This first chapter presents a background to the study, the problem statement, objectives, research questions, aims, significance and the overall organisation of the study.

1.2 PROBLEM STATEMENT

South Africa is presented with various challenges within the ICT sector, in particular the broadband market. The two key areas identified are the high cost associated in providing this service and the lack of existing ICT infrastructure required to provide this service (Chetty, Sundaresan, Feamster and Calandro, 2013). Government's long term plans are focused on growing SA's existing broadband footprint and making this service more accessible and affordable throughout the country by 2020. The broadband plan aims at improving the South African economy by combating unemployment, poverty, and inequality (Chetty et al., 2013). The ICT fixed line service is in continuous competition with the mobile providers with customers tending to prefer mobile connectivity as opposed to a fixed line connection. The fixed line market needs to establish ways to combat this decline and grow its broadband footprint within the South African ICT market. The research problem aims to establish the challenges of providing broadband in South Africa, particularly in the province of KwaZulu-Natal. Therefore, the overall purpose of the study is to investigate the factors affecting the roll-out of penetrative broadband delivery in KwaZulu-Natal.

1.3 BACKGROUND TO THE STUDY

South Africa has the characteristics of both an advanced and a developing economy. It has access to technology and sophisticated institutions that include research bodies and universities. In addition, SA has a private sector that is strong and has good fiscal resources (Gillwald, Moyo, Stork and Christoph, 2012). The Minister of Telecommunications and Postal Service, Mr. Siyabonga Cwele, indicated in 2015 that there is a critical need for reliable and cost effective Internet connection to ensure growth in the South African economy which is aimed at combating unemployment, poverty, and inequality. South Africa's fixed line access connections have continued to decline over recent years. Not every fixed line connection has broadband capabilities, meaning customers with a fixed line service are not guaranteed broadband. This could be seen as a contributing factor for the decline in the fixed line subscribers.

South Africa has the characteristics of both an advanced and a developing economy, yet it is not yet leveraging the potential benefits associated with the Information Communication Technology (ICT) sector in spite of its solid political and regulatory environment (Gillwald et al., 2012). Increasing hyper-connectivity is facilitated by the Internet together with its associated services which is redefining the existing relationships, firstly between enterprises and consumers and secondly, between the Government and the citizens. There are many challenges facing South Africans and the Government within the ICT sector, in particular the broadband market. Two key areas are the high cost and the lack of ICT infrastructure required to provide broadband. Armstrong (2013) identified three key challenges in providing broadband services in South Africa. These are speed and performance, coverage, and affordability. Government intends growing the broadband footprint in SA to ensure that broadband is accessible and affordable throughout the country (Armstrong, 2013). The fixed line market in South Africa has shown a continued decline in its subscribers over the past few years which doesn't bode well for organisations within this market, for example Telkom SA. The fixed line market is in continuous competition with the mobile providers. Customers tend to have greater preference for mobile connectivity as opposed to a fixed line connection. The fixed line market needs to establish ways to combat this decline and grow its broadband footprint in the South African market. This dissertation aims to establish the challenges of providing broadband in South Africa, particularly the province of KwaZulu-Natal.

National broadband penetration is around 2% (Gillwald et al., 2012). This study will focus on the fixed line broadband penetration in the province of KwaZulu-Natal. This study aims to

establish the role that Long Term Evolution (LTE) or the mobile communications standards play in the broadband market. The fixed line access connections have continued to decline over recent years: in 2012 fixed lines declined to 18% of households, where only 24% of households in urban areas were connected to a fixed line and 5.8% of households in the rural areas (Gillwald et al., 2012). According to respondents to the Regulatory Impact Assessment South Africa Household and Individual ICT Access and Use Survey (2012) more than 42% had no basic fixed line connection at their place of residence with 51% of this percentage indicating that they could not afford a fixed line service (Gillwald et al., 2012). Comparisons can be made between the mobile and the fixed line ICT sector, however this research focuses on the fixed line broadband market. Factors affecting broadband roll-out may vary from the fixed line sector when compared to that of the non-fixed line sector, which is the mobile sector; however, some of these factors may be universal to both the fixed line and the non-fixed line sector.

1.4 OBJECTIVES

The study was guided by the following objectives:

- To establish the challenges in providing broadband services, specifically in the province of KwaZulu-Natal;
- To explore the preferred broadband options, Long Term Evolution (LTE) or fixed line, or both;
- To assess the impacts of broadband to the economy; and
- To recommend a strategic plan to deliver high quality penetrative broadband service in KwaZulu-Natal.

1.5 RESEARCH QUESTIONS

The research questions were as follows:

- What are the challenges in providing broadband services in KwaZulu-Natal?
- What are the preferred broadband options, Long Term Evolution (LTE), fixed line, or both?
- What are the impacts of broadband to the economy?
- What strategies or plans are in place to deliver quality penetrative broadband service in KZN?

1.6 AIM OF THE STUDY

The aim of this study it to establish the factors affecting the roll-out of penetrative broadband in KZN. The study will conclude with recommendations on roll-out of broadband strategies for KZN.

Results from this research are aimed at establishing the key factors affecting penetrative broadband roll-out within the province of KZN, with the objective of establishing possible solutions. The research is aimed at understanding KZN`s intended broadband penetration strategy and establishing appropriate strategies for speeding up broadband penetration within the province. This investigation should benefit broadband users within KZN by providing insight and understanding into the reasons for the slow and inconsistent broadband speeds, and the reasons for the lack of uniform broadband presence throughout the province.

1.7 SIGNIFICANCE OF THE STUDY

This study is based on Information Communication Technology (ICT) fixed line organisation that provides various communication options and solutions throughout SA. The ICT market has undergone many significant changes during the past 25 years, particularly with the introduction of mobile services. Previous research studies have focused on understanding transformation within the ICT sector, but there has been little research on the factors that affect the roll-out of penetrative broadband, in particular KZN. The findings of this research will contribute towards understanding the effects of penetrative broadband, and how this affects both the economy and the public in general.

1.8 LIMITATIONS OF THIS STUDY

The scope of this research is limited to the province of KwaZulu-Natal. This study focuses on the factors affecting the roll-out of penetrative broadband in the ICT fixed line sector which could vary to some degree when compared to the mobile broadband ICT sector.

1.9 ORGANISATION OF THE STUDY

The study is presented in five chapters which are briefly described below:

Chapter One: Introduction

This chapter provides an introductory framework for the study. In particular, this chapter covers background, the problem statement, objectives, questions, aims and organisation of the study.

Chapter Two: Literature review

This chapter presents the literature related to the study in line with the study objectives. The literature describes challenges in providing penetrative broadband in KZN, broadband options and the impact of broadband.

Chapter Three: Research Design and Methodology

This chapter presents the methodology for the study. The study takes a qualitative approach and this chapter describes the qualitative methodologies used. The chapter discusses the research instruments, population, sampling and sampling strategy, reliability and validity as well as ethical considerations.

Chapter Four: Results, Interpretation and Discussion of Findings

This chapter provides the findings and results of the research. The findings include biographical data, challenges in providing penetrative broadband in KZN, broadband options for SA, and impact of broadband on the economy. The chapter also analyses and interprets the results linking them to findings in the literature.

Chapter Five: Conclusions and Recommendations

This chapter provides conclusions and recommendations of the study. The recommendations and scope for further research are also conveyed.

1.10 CONCLUSION

Chapter One has presented an overview of the study which included the problem statement, background, the objectives and aims, as well as the significance of the study which forms an introductory framework to this dissertation. Chapter Two presents the literature review relevant to the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Chapter Two reviews the literature related to the study and focuses on key discussion points which include the understanding of broadband and its definition, the South African broadband market and options, Long Term Evolution (LTE) as an alternative to fixed line, the state of broadband in South Africa (SA) and KwaZulu-Natal (KZN), the key challenges in rolling out penetrative broadband, measuring broadband service quality and the importance thereof and lastly, the impact of broadband on economic growth. The literature review has assisted with establishing the current state of broadband in South Africa when compared to the rest of the world and has helped to answer the question, does penetrative broadband matter?

2.2. UNDERSTANDING AND DEFINING BROADBAND

The speed at which information is received from the Internet to a person's computer is called broadband speed. Upload speed refers to the speed at which a person can send information from their computer to the Internet. Broadband Internet service is the newest dimension of the Digital Divide for access to this service (Argaez, 2014). The common term used to describe a very fast Internet connection is 'broadband', which enables Internet users to download online entertainment, for example, video clips and music, and also to listen to digital radio (Argaez, 2014). In the past, users were required to dial up when they needed to connect to the Internet. Today, via broadband connection, the Internet can remain online at any given time and emails can be sent faster, thus speeding up all online data exchange. Traditionally if people were busy on the Internet they were unable to make a voice call; broadband Asymetric Digital Subscriber Line (ADSL) allows people to surf the Internet and make use of their telephone simultaneously, which makes this service more costly than dial-up connection.

According to Kelly and Rossotto (2012), broadband does not have a single, standardised definition despite its global growth and promotion by content providers, network operators, and policy makers. They added that the term 'broadband' refers to multiple aspects of both the services and network. It includes:

- the infrastructure that is used to deliver services to the customers or end users;
- the high speed which connects to the Internet;
- the applications and services that are made available through broadband networks which includes the Internet, protocol television (IPTV) and voice services that may be bundled in a 'triple-play' which comes as a broadband package to access the Internet.

Many countries have established definitions of broadband that are based on the connection speed, which is typically in megabits per second (Mbit/s) or kilobits per second (Kbits/s). However, broadband has often been defined traditionally as data transmission speed, which is the quantity that can be transmitted in a pre-determined time, typically one second which is also referred to as the data transfer rate (Kelly and Rossotto, 2012). This definition helps determine whether the users are accessing the Internet in a basic or more advanced way in terms of content, applications, and services.

Kelly and Rossotto (2012) indicated that defining broadband with respect to speed presents some limitations. Firstly, the speed of broadband definition varies amongst international organisations and countries; it ranges from the download data speed of a least 256 Kbits/s on the low end in countries such as South Africa and India to speeds that are faster than 1.5 Mbit/s on the high end in countries such as Canada. Secondly, broadband speed may not keep pace with technological improvements, meaning that what is regarded as broadband today may be considered too slow in the future as improvements in applications technologies are developed. Thus, a speed-based definition of broadband will require updating over time. Lastly, there could be instances whereby speeds are not being realised by the end user as per Government's ruling; the end user speed could be much higher, or vice versa. For example, Colombia's broadband speed definition is 1 Mbit/s; however, the country's average broadband connection speed is currently 1.8 Mbit/s, which is much higher than the government regulation of that country.

Providing a clear definition for broadband is complicated. True broadband starts with Asymmetrical Digital Subscriber Line (ADSL) which can typically range from 1 Mbit/s to 10 Mbit/s. According to Umino (2002), broadband can be defined as the amount of capacity and the speed of data transfer depends on the telecommunications network.

2.3 THE BROADBAND MARKET IN SOUTH AFRICA

The Electronic Communications Act (ECA) provides the legal framework for the communication technologies. The Inter-Government Relations Framework Act sets the relationship and interaction between Government's three spheres. The Independent Communications Authority of South Africa (ICASA) is responsible for ensuring effective and independent regulation of the ICT sector. The Electronic Communication Transaction Act (ECTA) sets the framework for electronic verifications and transactions. Thus South Africa`s broadband development is governed by the ECA, ICASA, ECTA and the Inter-Government Relations Framework Act.

The key players in the ICT market in SA include the fixed line market, the mobile market and the Internet service providers (ISP). Fixed-line telephony in SA has a relatively low rate with around 4.2 million fixed line connections (International Telecommunications Union [ITU], 2010). Service providers on the fixed-line market are primarily made up of Telkom and Neotel, with Telkom the dominant player. In 2006, Neotel became South Africa's second fixed-line operator thus ending Telkom's monopoly in controlling the fixed-line services. There are four licensed mobile operators in South Africa; these are MTN, Vodacom, Cell C and Telkom Mobile. According to the research firm Nielsen Southern Africa, there has been a drastic increase in the numbers of mobile phone users in South Africa from 17 percent of adults in 2000 to 76 percent in 2010.

2.4 BROADBAND OPTIONS AVAILABLE

According to Barua, Whinston and Yin (2000), extensive usage of ICT which includes the Internet, broadband networks and cellular phones, has redefined the interaction frontier whereby the application of Internet technologies has evolved into a business process with consumers. This evolution has afforded users various options to connect to the Internet and for the way in which communication takes place. According to Argaez (2014), broadband has the capability of transmitting information that is 40 times faster than the speed of a dial-up modem connection. Furthermore, this is a permanent connection, thus users need not dial up every time they need to connect onto the Internet. Various broadband options noted by Argaez (2014) are listed below:

- **Integrated services digital network (ISDN)**. This is a dial-up symmetrical service from 64 kilobits per second (Kbit/s) to 128Kdps, with a maximum speed of 256 Kbit/s with a dedicated ISDN line. The down side to this type of service is the high cost

when compared to the current broadband pricing; secondly is it not as quick as cable or digital subscriber line (DSL). (Argaez, 2014)

- **Digital subscriber line (DSL)**. Telephone networks were not engineered to carry high speeds of data. DSL gets around the problem by utilising the phone line to carry digital signals directly. The distinct advantages of DSL are that it allows larger data rates than a regular modem, an always-on connection, and lastly the land line can be used at the same time as the Internet. There are various types of DSL, for example, Fibre to the home (FTTH), Fibre to the curb (FTTC), Very High data rate (VDSL), High bit-rate DSL; however, the most readily available to consumers and small businesses is ADSL. ADSL speeds can reach a maximum of up to 10 megabits per second (Mbps) over short copper lengths; however, most carriers cap the service at 1.5Mbps, due to the fact that only a few customers are within the parameters that are able to access higher data rates. (Argaez, 2014)
- **Cable/Fibre Optic**. This is a fibre optic network used to connect television (TV) and provide fast Internet access. Hybrid fibre-coaxial (HFC) networks that makes use of cable TV pictures also have the capability of carrying data at very high rates. The downside to this type of connection is that people living in a block of flats or gated complexes may face difficulties obtaining this service if the cable is not already installed, requiring then to obtain permission from the body corporate or building manager. Secondly, building where this service is available may be affected by the type of equipment located within this building or complex which may not afford the option to connect to the Internet. Fixed line ICT companies are currently on a fibre deployment strategy call Fibre to the home (FTTH) that provides high broadband services of up to 100 Mbps. (Argaez, 2014)
- **Satellite**. This is often touted as an alternative to the fixed line access to broadband connection, however satellite has yet to provide DSL data speeds similar to fixed line. However, satellite has been instrumental to and successful in providing a much faster and often more reliable Internet service, in particular in rural and regional areas, when compared to the standard public system telephone network (PSTN). In recent times satellite technology developments have launched a broadband satellite service that connects users to the Internet via a two-way satellite connection, which provides download speeds of up to 512Kbps and 64Kbps or 128Kbps upload speeds. (Argaez, 2014)

- **Wireless**. Broadband wireless services are centred on the Electrical and Electronics Engineers 802.11 (IEEE 802.11) standard. This standard was a consolidated effort between the IEEE, Lucent Technologies, Nortel Networks, and Symbol Technologies to create the specification for IEEE 802.11 used with wireless area networks, which also includes the 802.11, 802.11a, 802.11b, and 802.11g, all part of the IEEE family. The most widely deployed of the IEEE family is the 802.11b which is often called Wi-Fi that runs on the public 2.4 Gigahertz (GHz) spectrum which has the capability of providing data speeds of up to 11Mbps over a range of up to 150 meters. (Argaez, 2014)

2.5 LONG TERM EVOLUTION (LTE) AS AN ALTERNATIVE TO FIXED BROADBAND

A recent survey by the Global System for Mobile Communications Association (2014) suggested that mobile-enabled services for entrepreneurial and educational are the fastest growing services. According to Vermeulen (2015), Telkom recently announced the expansion of its LTE network to some 22 or more suburbs in KZN, Western Cape and Gauteng. In addition to this Telkom made various claims regarding its LTE-Advanced (LTE-A) network as a competitive alternative to its fixed-line broadband. According to Vermeulen (2015), the following comments were made by Telkom SA regarding a recent investigation into its LTE-A broadband:

1. Telkom claimed to be one of the earliest adopters of LTE-A technology in the world.
2. Telkom's LTE-A network size is unrivalled in Africa.
3. The LTE-A speeds that Telkom provides are comparable to speeds available over a fibre network.
4. LTE-A service speeds offered by Telkom are debatably a compelling alternative to fixed-line broadband for high-speed connectivity. Speeds on fibre broadband connections are available from 4Mbps to 1Gbps. Here you pay for what you get. Telkom's LTE-A speed variations are significant that is up to 150Mbps; however, you don't pay less if you get slower speeds.

Is Telkom LTE-A an alternative to fixed-line broadband? This will depend on the context. A wireless alternative for areas that do not have 100Mbps Fibre to the Home (FTTH) is LTE-A.

If access to FTTH or even VDSL is available, this is a more compelling choice than LTE-A (Vermeulen, 2015).

2.6 THE STATE OF BROADBAND IN SOUTH AFRICA

South Africa is part of Brazil, Russia, India, China and South Africa (BRICS), a group of emerging economies and is considered one of the world's leading emerging economies (BRICS, 2012). The top broadband players in the SA market are semi-privatised and the state- owned Telkom for fixed-lines and iBust for fixed wireless. Vodacom is the largest mobile operator followed by MTN and Cell C with Telkom Mobile being the newest player in the mobile market. The majority of South Africa's broadband users make use of wireless networks to hand-held devices to the base stations which in most cases have optical fibre backhaul to these stations.

The most recent survey by the Institute of Race Relations (IRR) has shown that South Africa`s average cost per month of a broadband service is ten times more costly than in the United Kingdom (UK) that has Internet speeds that are five times faster than that of South Africa (Alfreds, 2015). In 2012, Dina Pule, the South African Communication minister at the time, announced in her budget speech: "The Department of Communications remains committed to delivering 100 percent broadband penetration by 2020 and delivering a million jobs by 2020". Similar promises have been made since 2006 by Government which analysts have criticised for non-delivery and too much consultation (Muller, 2012). In more recent times, the Minister of Telecommunications and Postal Service, Mr Siyabonga Cwele, re-emphasised the critical need for reliable and cost effective Internet connection across South Africa in order to ensure growth within the South African economy aimed at combating the unemployment, poverty, and inequality (Cwele, 2015). He mentioned further that the long term aim is to achieve 100 percent penetration rate by 2030 whereby all South Africans are connected to a broadband service, adding that Wi-Fi technology could play an instrumental role in achieving the 100 percent target penetration rate.

The Broadband Commission is an international body that is set up by the International Telecommunication Union (ITU) and United Nations Educational, Scientific and Cultural Organization (UNESCO) (Voster, 2013). According to Voster (2013), the State of Broadband 2013 report shows that SA broadband performance is poor. This report revealed the following information:

- Out of 183 countries, SA is ranked 111 in fixed broadband penetration (2.2%)

- Out of 170 countries, SA is ranked 62 in mobile broadband penetration (26%)
- Out of 128 countries, SA is ranked 44 in percentage of households with Internet (25.5%)
- Out of 192 countries, SA is ranked 92 in percentage of individuals using internet (41%)

The report also revealed that the top countries globally for Internet users are all located in Europe, with only two exceptions, which is New Zealand (8th) and Qatar (10th). South Africa is behind in its broadband penetration with fixed lines which is around 2.2 percent. According to the ITU, the future of mobile broadband is projected to reach seven billion subscribers in 2018 globally with Long Term Evolution (LTE) alone accounting for about 500 million subscribers by 2018. Globally, 4G (fourth generation mobile network) subscribers are expected to grow from 88 million in 2012 to 864 million by 2017 (Voster, 2013).

South Africa has a National Broadband Policy (NBP) in place, the key objective of which is to ensure universal service and access to reliable, secure and affordable broadband services focusing on rural and under-serviced areas. Secondly, the aim is to provide appropriate support for digital inclusion; thirdly there must be continued expansion and availability of broadband capacity to support social and economic goals of SA (National Broadband Policy for South Africa, 2013). South Africa has seen steady broadband uptake since 2003 (Lewis, 2005).

Dongles which plug into a personal computer via the universal serial bus (USB) port allow connectivity to the wireless network either from the home, office or public place, thus enabling mobile Internet connectivity with low access costs. The use of prepaid billing is appealing particularly for the irregular or lower income users (Stork et al., 2013). The use of a 3G dongle is relatively straightforward as the user simply plugs it into a computer to gain instant connectivity to the Internet. This kind of access has a relatively lower set-up cost when compared to the fixed lines, especially in areas where there is no fixed line connection or broadband infrastructure. Therefore, it is no surprise that mobile broadband access in SA is growing rapidly when compared to the fixed broadband sector. The number of users going online via their cell phones is also growing significantly due to the relatively low equipment costs which provide many popular services such as Mixit, Facebook and WhatsApp, substitutes for traditional voice and SMS services (Research ICT Africa and Intelecon, 2012).

According to Gillwald et al. (2012), mobile broadband is both cheaper and faster than fixed broadband; however, mobile is unlikely to replace fixed-line connectivity because of its variability, especially for consumers that prefer and require a stable and reliable Internet connection. Therefore, South Africa must invest in next-generation fixed-line infrastructure to encourage widespread broadband adoption (VDSL and fibre-to-home) and also ensure that fixed broadband prices are reduced.

The SA National Broadband Policy is a significant step in the right direction aimed at addressing accessibility and affordability of broadband, building a society of information, and promoting the usage and uptake of broadband (Burrows, 2013). Burrows (2013) described how that Telkom has highlighted the fact that achieving universal broadband access will mean more than merely rolling out broadband networks, stating that Internet access forms only a part of what is required to achieve Government's broadband penetration goals. He states that the other challenges lie in people who are digitally disempowered, who are above the age of 24, who have not completed secondary schooling and/or have no access to the Internet. He estimated this figure to be approximately 15 million people. As the global digitisation pace increases, SA is effectively falling behind the developed world with respect to innovation and broadband readiness (Burrows, 2013).

Broadband plays an instrumental role in developing businesses which impacts on the economy as a whole; small and medium sized businesses have a significant contribution to make to SA's Gross Domestic Product (GDP) and job creation and stand to significantly benefit from Internet access (Burrows, 2013). It is, in fact, vital for SA's economic growth that both small and medium enterprises and individuals are empowered to access and make full use of the Internet. According to the ITU, the future of mobile broadband is projected to reach seven billion subscribers in 2018 globally with Long Term Evolution (LTE) alone accounting for about 500 million subscribers by 2018; 4G subscribers are expected to grow from 88 million in 2012 to 864 million by 2017, globally (Voster, 2013).

2.6.1. The state of broadband in KwaZulu-Natal (KZN)

The State Owned Enterprise (SOE) and State Owned Companies (SOC) have rolled out approximately 12 000 kilometres of fibre optic cable in KZN which connects eight main districts Point of Presence (POP) and there are 27 municipality POPs (Department of Economic Development and Tourism, 2014). According to the KwaZulu-Natal Investment Monitor (2014), investment in ICT equipment in KZN has continued its strong performance

and increased to 16.4 percent year-on-year and a 5.2 percent quarter-on-quarter (see Table 2.1). KZN is also a major consumer of information technology, most especially in the so called L-shaped area in KZN that extends from Pietermaritzburg to Richards Bay.

Main and sub-indices of the KwaZulu- Natal Investment Monitor	**% change a year ago**	**% change a quarter ago**
Transport Equipment	-2.90%	0.50%
Buildings	-4.70%	-4.60%
Civil Construction	1.50%	-4.90%
Machinery	-12.45%	1.10%
ICT Equipment	16.40%	5.20%
Transfers	15.80%	13.00%
Total Investment Index	**-4.30%**	**-0.80%**

Table 2.1: KZN Investments - results March 2014
Source: Kwazulu-Natal Investment Monitor (2014)

With the use of cellphone towers being a preferred option in the rural areas, most of the ICT equipment investment will be in the bigger cities. Despite the slowdown, as shown elsewhere in Table 2.1, the ICT industry is constantly growing due to the growing shift in general technology. KwaZulu-Natal is benefiting from certain developments such as the Dube trade port and also the undersea cables which come to shore near Durban (Kwazulu-Natal Investment Monitor, 2014).

According to Rasool (2012), Vodacom, together with the KZN Department of Education, launched an ICT resource centre which is based in Pinetown. In addition, the Department of Basic Education, in partnership with Vodacom SA, has identified the need to build ICT resource centres throughout SA aimed at fast tracking effective teaching and learning. Senzo Mchunu (KZN MEC for Education, 2012) indicated that education can no longer continue without ICT in the classroom. He added that the centres will empower users, thus effectively improving teaching and learning (Rasool, 2012). Information and Communication Technology is changing the landscape in education not only in KZN but throughout SA. The roll-out of penetrative broadband has to gain aggressive momentum if Government aims to achieve its strategic target of 100 percent broadband penetration by 2020.

Table 2.2 shows that the number of adults in KZN with a qualification is 3.7 percent which is extremely low. The lack of broadband connectivity could be a contributing factor to inhibiting people from obtaining suitable passes in order to gain university entrance, thus

preventing them from pursuing higher education. Broadband availability could contribute positively to increasing the number of adults pursuing higher education in the form of distance learning through web based online learning (Association for Rural Advancement, 2015).

Size	92 100km^2
Share of country	7.6%
Total farming land	6.5 mill ha
Livestock farming suitability	82%
Arable farming suitability	18%
Total Population	
Share of national population	20.7%
Population growth rate	12%
Population in rural areas	54%
Black people	84.9%
Coloured people	1.5%
Indian people	8.5%
White people	5.1%
Working age population economically active	51.3%
Unemployment rate	45%
Average annual household income	R64 359
Adults with no education	12%
Adults with degree or higher	3.7%
Pupil to teacher ratio	36:1
Matric pass rate	77%
Proportion population HIV+	18.4%
Women at ante-natal clinics HIV+	36.5%
Residents per public sector doctor	5 107:1
Residents per public sector nurse	1 050:1

Table 2.2: KwaZulu-Natal facts and figures

Source: Association for Rural Advancement (2015).

According to Premier Senzo Mchunu in the KwaZulu-Natal State of the Province Address (2015), without solid ICT support, it is virtually impossible to manage business or to run a government. He went on to say that ICT has become an instrumental enabler and is the virtual backbone for economic growth (Mchunu, 2015). He added that although KZN has made progress in rolling out broadband, the process is slow with broadband still not accessible to a large portion of both rural and concentrated urbanised areas within KZN. Over the past four years the Provincial Broadband Strategy and Implementation, in partnership with the national government, has led to the installation of 14 459 kilometres of fibre optic (Mchunu, 2015). This equates to about 80 percent of the fibre optic backhaul efforts which has seen about 1583 schools in KZN connected. KwaZulu-Natal's E-Health and telemedicine has seen all 85 public hospitals connected, and over the past year there have been 119 clinics connected (Mchunu, 2015).

The premier claimed, however, that Government still has to strengthen the role of Districts as centres of coordination in order to achieve the goal of radically transforming the economy. While ICT availability in the medical and education sectors of Government has improved, KZN's broadband roll-out plan is not moving at the pace required to achieve Government's 2020 broadband penetration target plan.

2.7 GLOBAL APPROACHES TO BROADBAND INFRASTRUCTURE ROLL-OUT

The telecommunication and ICT industry is undergoing profound transformation with far-reaching consequences, with the development of new and emerging technologies and the spread of Internet Protocol (IP) which is based on next-generation network (NGNs). Operators within the telecommunication industry, policy makers, service providers, civil society, consumers and other stakeholders have the responsibility to work on this transformation and are adapting to the economic and social changes that are driven by accelerating technological change.

Most governments are now focusing on growing and developing the ICT sector. Several countries around the world, such as Finland, France, Republic of Korea, Japan, Sweden, the United Kingdom and the United States, took the approach of viewing broadband development as an ecosystem (Kim, Kelly and Raja, 2010). Apart from these countries being successful in the deployment of broadband, they have also been successful in mobilising policies and regulations. Making use of the ecosystem approach has helped governments to understand and establish their roles in using broadband as a tool in the development of ICT (ICT4D).

According to Kelly and Rossotto (2012), ICT development in low and middle income countries indicates that private led ICT companies are extremely effective at growing new networks and services throughout the population. They went on to say that mobile phones provide a platform for a wide range of information and communication services and applications, which covers an estimated 80 percent of the world's population. The number of wireline telephones per capita took over 30 years to multiply tenfold; this is now on the decline worldwide. In relation to fixed lines, mobile phones took about 12 years to multiply tenfold number, and Internet users took approximately eight years (Kelly and Rossotto, 2012).

It has been noted that there is a lack of interest in the private sector when it comes to investing in broadband in rural and remote areas, where government incentives are in place; thus public sector support is deemed necessary for the deployment, ownership and operation of a broadband network (Kelly and Rossotto, 2012). It is of critical importance for the policy makers of each country to determine whether the private sector led broadband development reform can achieve economic and social goals and if more direct intervention is necessary by Government (Kelly and Rossotto, 2012). This type of approach is reflected in the European Commission's 2010 Communication on Broadband which recognises that broadband' s overall benefits to society are considerably more than that of the private incentives to invest in high-speed networks (European Commission, 2010). Broadband goals have thus been achieved through stimulating investment that are beyond the current market driven level. Where intervention is deemed necessary, Government roles are limited and do not distort market mechanisms that are functioning well or discourage private investment.

Figure 2.1 that follows provides information on Africa's fixed broadband take-up compared with the rest of the world. It can be seen that Africa is lagging behind the rest of the world therefore more effort is required from key strategic partners to move the fixed broadband subscriptions closer to the global count. This is possible through penetrative access and core infrastructure growth and improvements.

Mobile broadband take-up (17.4%) is much higher when compared to the fixed broadband take-up which is at 0.5 percent. Figure 2.2 provides information on the mobile broadband take-up when compared to the rest of the world. However, like fixed broadband, the mobile broadband percentage in Africa is relatively low (17.4%) when compared to the rest of the world which is at 47.2 percent. Information released in the State of Broadband report (2013)

shows that SA broadband performance is poor whereby fixed broadband penetration was at 2.2 percent while the mobile penetration was at 26 percent, higher in 2013 when compared to the latest broadband statistics in Africa.

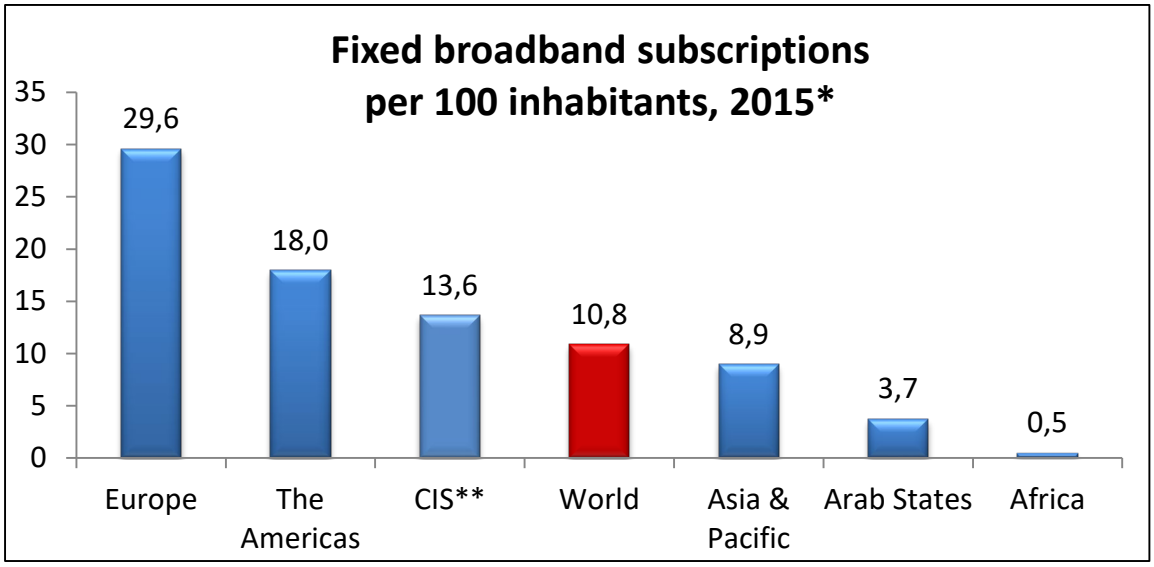

Figure 2.1: Global fixed broadband statistics
Source: ITU World Telecommunication (2015)

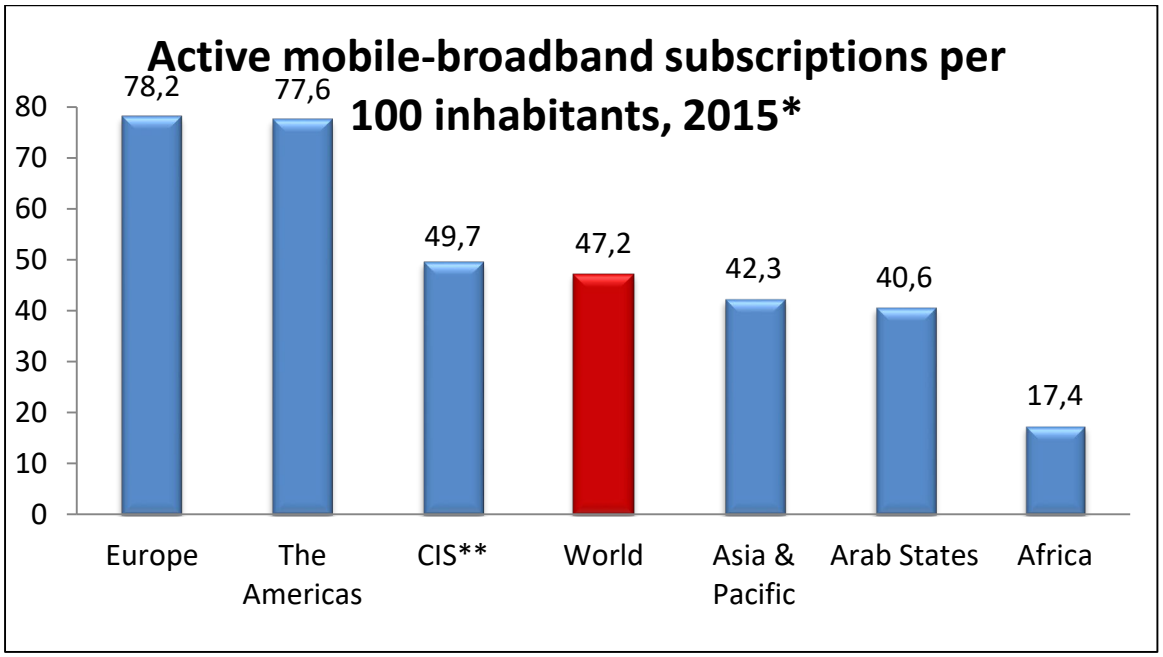

Figure 2.2: Global active mobile broadband subscriptions
Source: ITU World Telecommunication (2015)

2.8 CHALLENGES OF BROADBAND ROLL-OUT

Armstrong (2013) identified three key aspects to providing broadband services in South Africa being speed and performance, coverage, and affordability. A person firstly needs to establish what type of broadband connection they require which is determined by the individual's speed requirements, their budget, and lastly the location (that is city or regional) of his/her office or home. There also needs to be an understanding of the key elements that go into broadband design, such as international bandwidth, platform costs, backhaul and head-end, as well as access costs (Austin and Bradley, 2005).

According to Armstrong (2013), from an economical versus geographical point of view, less than 2 percent of South Africa's area concentrates 50 percent of the population and about 77 percent of the national income; in addition, the mid to high income areas are highly concentrated in a few suburban and urban areas, thus about 59 percent of households represent 83 percent of the total income which makes infrastructure roll-out very challenging. The author went on to say the data explosion and the falling cost per megabit poses a challenge to meet this demand. The growth of bandwidth usage in South Africa is exponential, that is people are paying less for more. However, there is a drive from Government in both developing and developed nations to create and execute strategies best suited for generating the benefits of widespread and also affordable broadband access (Frieden, 2013). The changing consumption needs of broadband users are becoming more demanding, and the demand for backhaul and core bandwidth is proportional to the growing demand.

2.8.1 Geography and demographics

According to the US Government Accountability Office (GAO) (2010), in 27 of 30 Convention on the Organisation for Economic Co-operation and Development (OECD) countries, broadband has been deployed to 90 percent or more of the households despite differences in geographic and demographic factors. The adoption rates of broadband are affected by factors such as cost, population, and computer ownership. To increase the adoption rate, GAO selected seven countries and developed an action plan with five categories. These included:

- instituting plans and polices;
- the provision of funds through public and private partnerships;
- increasing competition;

- expanding online services; and
- providing digital literacy training and consumer subsidies.

All seven countries have instituted some type of broadband plan (GAO, 2010). Furthermore, in countries where the private enterprise is viewed as unprofitable, regional or national governments in all of the seven countries have used public and private partnerships. Therefore, high rates of broadband deployment have been achieved, overcoming the geographic and financial differences. However, this was not the case in all OECD countries. For example, Denmark, the most populated OECD country with an average of 128 people per square kilometre was able to deploy broadband to 99 percent of households which is much higher that than OECD average of 90 percent.

Figure 2.3 shows South Africa's mid and high income areas are highly concentrated in relatively few suburban and urban areas (highlighted in red); 59 percent of the households represent 83 percent of total income. Income value and population concentration makes the case for broadband infrastructure roll-out in South Africa extremely challenging.

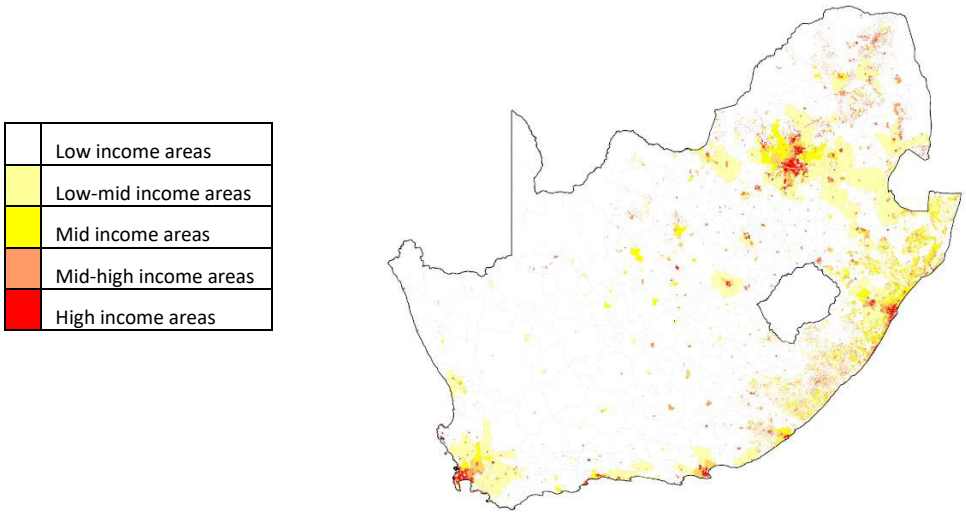

Figure 2.3: Income areas in South Africa
Source: Armstrong, 2013

2.8.2 Data explosion

According to Armstrong (2013), traffic projections for North America in both fixed line and mobile show six times growth that is from 2013 to 2018. Mobile usage remains substantially lower than that of the fixed line usage. Armstrong added that bandwidth for broadband is dominated by intensive applications such as gaming, file sharing and storage, while mobile

broadband usage is driven mainly by ad hoc browsing, video content and social media such as BBM and Mixit. Broadband usage in South Africa is also growing exponentially (see Figure 2.4).

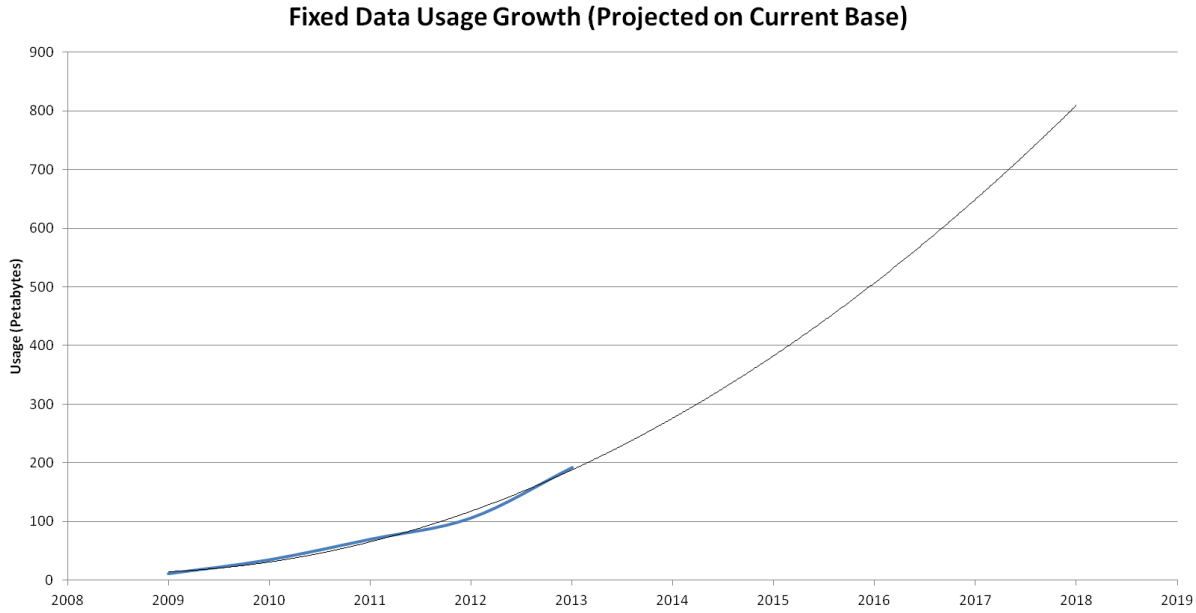

Figure 2.4: South African usages in gigabytes
Source: Armstrong, 2013

According to Bottomley (2012), Cisco's network index shows that the amount of mobile data using the Internet on the cellphones, tablet computers, and laptops will increase forty-nine fold over the next five years, that is the volume of data consumed on mobile devices will be more than double each year, and by 2016, about 102 000 terabytes of information will be sent every month, which is equivalent to about 26 million DVDs or 283 million SMSs per second. According to Kevin Bloch, Cisco's Head of technology in Australia, the substantial annual growth in Africa's mobile sector is greater than in any other global region, and has been driven by factors such as more devices (like tablets, cellphones, and laptops), faster connection speed, and most importantly, more video material. Cisco predicts that all that 84 percent of all mobile data will involve video by 2016, and that mobile data is expected to grow three times faster than fixed-line data. By 2016, the amount of mobile data will be more than one Exabyte per year (Bottomley, 2012).

2.8.3 Changing consumption

The number of Internet-connected devices is rapidly growing in the home and changing the way broadband services are consumed. The amount of households with four or more devices

accessing the web has increased from 32 percent to 43 percent; as a result, the amount of bandwidth consumed per home is constantly growing and is expected to grow to four times the current amount by 2015 (Bandwidth Consumption and Broadband Reliability, 2012). This growth is represented in the mobile smartphones and tablets, the fastest growing sector of connected devices. According to Huovinen (2014), the manner in which people are watching television is changing and evolving into an activity which doesn't necessarily takes place in a person's living room, but rather anywhere and also on multiple devices. In addition, Huovinen (2014) highlighted that consumers are moving away from watching traditional cable television and are moving towards video streaming the Internet on their smart devices, thus increasing the demand for broadband Internet services as smart devices require Internet access. According to Huovinen (2014), the drastic rise in demand and traffic means that Internet Service Providers (ISP) have to rethink their access aggregation structures in order to meet the end users' demands and the growing requirements for broadband. Internet Service Providers need to establish new ways to address the demand for access to broadband making them rethink their aggregation network structure to enable them to keep up with the changing consumer preferences and control costs. This goes beyond raising the consumer's line rate; ISPs need to revamp their entire infrastructure (Huovinen, 2014).

2.8.4 Regulation and policy challenges

According to Barrett and Slavova (2012), significant regulatory issues within the ICT sector include liberalisation, competition policies, licensing, and taxes. Taxes on communication services are influenced strongly by ICT affordability in Africa, for example the low average income, import duties on ICT equipment and value-added tax (VAT) ranging from 5 to 23 percent on services and goods.

Another contributing factor is excessive licencing which can stifle the delivery of numerous content-based ICT services. Pure data transmission regulation should, however, be synchronised with content broadcasting (Barrett and Slavova, 2012). According to Gasmi and Virto (2005), telecommunication policy access can be understood in terms of two broad concepts. The first is universal service which is primarily used in developed countries, for example, England, USA, etc. where the focus is on upgrading and extending communication networks thereby ensuring that a minimum level of service is provided to individual households, which includes the least accessible areas. The second concept mentioned by Gasmi and Virto (2005), universal access, is this policy objective is typically for developing

countries, for example SA, India, Brazil, etc. which seek to grow the geographic access to ICT of the population at large and in most instances, for the first time. Without universal access, providing penetrative broadband in SA will clearly pose a massive challenge within the South African ICT sector, especially from a fixed-line perspective (Gasmi and Virto, 2005).

Table 2.3 outlines the characteristics of universal access and universal service in terms of affordability, availability and lastly, accessibility. When designing ICT policy, intervention must be aimed at promoting equitable access to ICTs. Both the users and the technology must be considered as forming a socio-technical system through which improvements to ICT access translates into improved rural livelihoods that are sustainable (Dymond, Oestmann, Whiting, Smithers, Milne and Milne, 2010).

ASPECT	UNIVERSAL ACCESS	UNIVERSAL SERVICE
Availability	Focused coverage	Blanket coverage
	Public access (e.g., at a pay phone or telecentre)	Private service on demand
	Free emergency calls	Free emergency calls
Accessibility	Walking distance, convenient locations and hours	Simple and speedy subscription
	Inclusively designed premises (e.g., for wheelchair users); inclusively designed terminals or available assistance (e.g., for the blind or deaf)	Inclusively designed terminals and services (e.g., for blind or deaf people)
	Assistance from an attendant	Assistance through the terminal (e.g., by making calls or viewing help pages for the web)
	Adequate quality of service (e.g., having few failed call attempts)	Reasonable quality of service (e.g., having few dropped calls)
Affordability	Options of cash and card payment	Cost of average monthly usage is a small percentage of monthly GNI per capita
	Options of cash and card payment	Options of cash, card, and electronic payment
	Payment per use (e.g., for a single call or message or an hour of Internet access)	Flat rate, bundles of services or low monthly subscription fee

Table 2.3: Characteristics of Universal Access and Universal Service
Source: Dymond et al. (2010).

2.9 MEASURING OF BROADBAND PERFORMANCE

In policy terms, measuring broadband performance is also known as quality of service. According to Gillwald et al. (2012), it has been argued by operators that it is flawed to compare pricing in different countries without also comparing broadband quality and coverage. With the developed world receiving broadband connectivity that is fast and reliable together with reliable broadband infrastructure in place, studies have shown that broadband in developing countries can improve the lives of their citizens by facilitating access to economic opportunities and social welfare that were inaccessible to the economically disadvantaged previously (International Telecommunication Union, 2012).

The common metrics used for measuring the performances of broadband include upload and download speeds, which could also be called upstream and downstream throughput. Upload speed is usually reported in Megabits per seconds (Mbps) indicating how fast a user can send data to the Internet, whereas download speed which is also reported as Megabits per seconds (Mbps) is the measure of the speed at which the user receives data from an international or local server (Chetty et al., 2013).

Broadband penetration in South Africa is increasing, in particular on mobile phones, but there is little known of the fixed or mobile broadband performance in South Africa (Chetty et al., 2013). This can affect the progress of the Internet from a developmental aspect; therefore, from this perspective, it is necessary to monitor broadband performance (Bilbao-Osorio et al., 2013). Measuring broadband performance can assist regulatory measures and ensure that consumers are provided the level of service they are being charged for by their service provider with a reliable connection. In addition, policies for broadband can be developed by informed decisions (Chetty et al., 2013).

Regardless of the chosen measurement technique, there are many other factors both with fixed lines and mobiles that could affect broadband performance. Key factors linked to fixed lines include the time of day, the distance to the closest measurement server and customer equipment, while mobile factors include the user presence that is indoor or outdoor, the type of handset, the strength of the signal, whether the user is in a crowed area, for example, at a rugby match (Chetty et al., 2013). Therefore, measuring service quality goes beyond the boundaries of simply measuring the quality of service received from an internet service provider. A person could be causing poor broadband speed for him- or herself. Such a person

could become extremely frustrated and believe the poor service is due to the ISP which may not be the case.

2.9.1 Why measure broadband performance?

Broadband penetration in SA is increasing, in particular on mobiles, however very little is known empirically about the broadband performance in the mobile or fixed line sector, which is significant since monitoring broadband performance is key to ensuring the country's national broadband goals are being achieved as in the draft National Broadband policy (Chetty et al., 2013). Measuring broadband can be beneficial to regulators:

- for ensuring that the end users are receiving broadband speed for which they have paid for;
- for assessing connection reliability; and
- for creating broadband policies which are based on informed findings. (Federal Communications Commission, 2012)

According to Chetty et al. (2013), no systematic study of mobile and fixed line broadband performance has been conducted in SA. In addition to this, data findings revealed, broadband speeds for the end users appears to be far lower than what has been promised by their ISPs unlike in more developed countries. Secondly, download speeds of mobile providers are faster than that of fixed-line ISPs, and more variable. Lastly, ISP broadband speeds are not the only limiting factor for broadband performance. Other factors include latency to websites and services visited by users which can drastically affect broadband performance. For example, the physical distance between a user and specific servers for popular sites such as Facebook creates a latency of typically several hundred milliseconds; this is extremely high if the end user wants consistent good performance. Broadband performances and measurements can help safeguard both the ISP (when slow broadband speeds are not their fault but rather due to latency) and the end user (by ensuring their ISP provides them with the speed for which they are paying.

2.9.2 Measuring broadband performance

Measuring broadband performance is vital to ensuring proper and appropriate data collection. This is done by using certain metrics. The most common metrics for broadband performance include download and upload speeds (which can be referred to interchangeably as downstream and upstream throughput) packet loss, latency and lastly, jitter (Ofcom, 2012).

According to Chetty et al. (2013), to measure a user's upload or download speed from the user machine, a file needs to be transferred from the user's machine to or from a local server. The user's upload or download speed is measured by the time that it takes to transfer the file, and to measure latency a tool called 'ping' is used. A packet of information is sent to the relevant server, the time it takes to get a response is then measured and this is then used to calculate the speed. The variance of and packet loss is called jitter and this measures how many packets are lost along the way to a particular destination (Sundaresan et al., 2012). According to Sundaresan et al. (2012), these methods are generally accepted to perform broadband performance tests with relatively minor variations in detail such as the size of the file that is transferred, the amount of tests initiated, etc.

According to Chetty et al. (2013), the collection of fixed broadband measurements is done in two key ways. In both cases, these techniques are basically measuring the connection speed from the consumer to the nearest Internet gateway or their ISP network server. However, other factors that could have an effect on performance, from a user linked to a certain website or the use of a particular application or service, are excluded from this measurement. This approach of measuring the access network provides good insight into key areas of focus for both the regulators and policymakers in areas of improvement of quality of service for the consumer (Chetty et al., 2013). However, the network paths beyond the ISP's network can't be ignored because this could also affect the user's experience.

2.9.3 Factors influencing performance on fixed and mobile connections

According to Chetty et al. (2013), there are many factors affecting mobile and fixed line broadband performance regardless of the type of measurement technique as shown in Table 2.4 that follows. Factors influencing broadband speed on the fixed lines include time of day (network congestion is at its peak when most users are online). Speed measurements may differ depending on the time at which the speed test is taken. Secondly, distance from the server results in speed variations. Thirdly, consumers' equipment, either the customer's modem or the host device could affect speed test performance. Another factor is shared connections: the greater the number sharing the same connections, the slower the speeds, in particular for the host based measurements. According to Bennett (2010), mobile connections as opposed to fixed line are subjected to many more confounding factors, including the user's geographical position, whether the user is in a crowed area or not, the type of handset used to access the Internet, the strength of the signal. Therefore, the broadband performance

measurements may not be repeatable on mobile networks which are dependent on where and when the measurements are taken.

It is clear then that quality of broadband service can be affected by various factors which could stem from either the ISP or consumers, or from both. Appropriate data collection and testing methods can help to identify and localise the problem.

Factors	Mobile	Fixed
Time of day: Networks get more congested during peak times of usage when more users are online.	x	x
Multiple users: The more users that share a connection, the more performance will be negatively affected.	x	x
Distance to exchange: The further away the user is from the exchange, the worse the performance.	x	x
Users' equipment: Modems, outdated operating systems, viruses and software, as well as handsets can all affect performance.	x	x
Website capacity: The servers on which websites are hosted and their capacity can affect performance.	x	x
Geographic location: Network coverage and backbone networks may be better in certain areas.	x	x
Number of users in vicinity: Users at crowded events experience poorer performance than users in less crowded places.	x	
Signal strength: The signal strength to the handset can affect performance.	x	
Indoors/outdoors: Users who are indoors can experience poorer performance.	x	

Table 2.4: Summary of factors affecting mobile and fixed broadband performance
Source: Chetty et al. (2013)

2.10 THE EFFECTS OF BROADBAND ON ECONOMIC GROWTH

Romer (1990) and Czernich et al. (2011) argued that, according to endogenous growth theory, broadband networks have the ability to stimulate economic growth in various ways such as promoting knowledge sharing and distribution, enhancing the coordination of various work activity and lastly, facilitating product innovation. According to Lio and Lui (2006), ICT availability in rural areas can raise incomes through the increase of agricultural productivity and through the introduction of income channels other than the traditional farm jobs. Investments in broadband are increasing as policymakers believe that broadband may lead to job creation and economic competitiveness (Kolko, 2012).

There is a concerted effort by governments in Emerging Market Economies (EMEs) to follow suit with broadband diffusion, with a significant growth of the number of broadband subscribers, from 37.20 percent in 2005 to 69.40 percent in 2010 (Euromonitor, 2010). According to Seymour and Naidoo (2013), countries' broadband infrastructure is crucial to their economic and scientific goals, and to the social requirements of the knowledge economy which has the ability to uplift the lives of the people by providing ICT skills for employment and also help improve access to online education, known as e-learning. According to Hill, Troshani and Burgan (2014), broadband macro-level access can be measured by penetration rates, broadband coverage, connection types, user demographics, and lastly high-level broadband policy development. Broadband research statistics at a country level show that various factors that can impact on broadband adoption:

- demographic (education, population density, ethnicity),
- marketing (policies, pricing),
- economic (government policy, GDP, completion), and
- infrastructural (broadband infrastructure, interest access and user skills).

South Africa has realised the need of high-speed broadband technology to improve the ICT infrastructure in the country; however, even with the high demand of broadband in the country, the adoption of the technology is relatively low, particularly by household consumers (Seymour and Naidoo, 2013). Minister Siyabonga Cwele has indicated that the Department of DTPS has agreed with the United Nations' specialised ICT agency (ITU), to make broadband an economic enabler (Broadband Stats, 2014).

South Africa has an estimated population of 54 million with about 19.8 percent in KZN, making it the second highest of the nine provinces in terms of population. The current unemployment rate in South Africa is approximately 25 percent which is the worst of the BRICS nations, currently between four and eight percent (State of Broadband, 2013). Table 2.3 shows that the unemployment in KZN was around 37.9 percent in July 2014. This is a high percentage considering that KZN accounts for about 20 percent of South Africa's total population. Broadband is considered one of the key tools to ensure growth in economies around the world (State of Broadband, 2013) and reliable and cost effective Internet connections are vital for economic growth in South Africa.

Oct-Dec 2013	Jul-Sep 2014	Oct-Dec 2014	Qtr-to-qtr change	Year-on-year change	Oct-Dec 2013	Jul-Sep 2014	Oct-Dec 2014	Qtr-to-qtr change	Year-on-year change
Per cent			Percentage points		Per cent			Percentage points	
South Africa	**24,1**	**25,4**	**24,3**	**-1,1**	**0,2**	**34,0**	**35,8**	**34,6**	**-1,2**	**0,6**
Western Cape	21,0	23,6	22,9	-0,7	1,9	22,1	25,5	24,5	-1,0	2,4
Eastern Cape	27,8	29,5	29,1	-0,4	1,3	43,3	43,0	41,9	-1,1	-1,4
Northern Cape	24,9	29,7	28,7	-1,0	3,8	34,8	39,5	38,4	-1,1	3,6
Free State	33,0	34,6	32,2	-2,4	-0,8	40,9	40,9	39,5	-1,4	-1,4
KwaZulu-Natal	19,9	24,1	20,8	-3,3	0,9	36,2	40,8	37,9	-2,9	1,7
North West	27,3	26,8	25,2	-1,6	-2,1	42,2	41,8	40,0	-1,8	-2,2
Gauteng	25,2	24,6	24,6	0,0	-0,6	28,9	29,6	29,6	0,0	0,7
Mpumalanga	27,2	29,3	26,6	-2,7	-0,6	40,2	42,0	40,5	-1,5	0,3
Limpopo	16,9	15,9	15,9	0,0	-1,0	36,1	38,4	37,2	-1,2	1,1

Table 2.5: Unemployment rate by province
Source: Quarterly Labour Force Survey (2016)

2.11 CONCLUSION

Chapter Two has reviewed the literature related to this study and focused on defining and understanding the broadband concept, the broadband markets in South Africa, broadband options measuring broadband performance, the state of the broadband market in South Africa (more specifically, KwaZulu-Natal), the global broadband approaches, measuring broadband performance, and finally, on the effects of broadband to the economy. The next chapter presents the research methodology used in this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter presents the methodology used for this study and includes detailed discussion on the research design aimed at establishing key factors affecting the roll-out of penetrative fixed-line broadband in KZN. Other key aspects discussed in this chapter include research philosophy, research design and research strategy, population target, sampling, reliability and validity as well as ethical considerations. The chapter concludes by discussing data analysis techniques and the limitations of the study.

3.2 RESEARCH PHILOSOPHY

Business research makes use of two general approaches for collecting and reporting on information: one is positivist (quantitative approach) and the other, phenomenological (qualitative approach).

3.2.1 Positivism (Quantitative) Approach

This approach supports the use of the natural science methods in the study of social reality (Bryman and Bell, 2007). According to Gill and Johnson (2010), this approach relies on collecting data on reality which is observable and which can be measured and analysed so that relationships are discovered with the data collected which can be generalised to the population. Through the data analysis process, hypotheses are developed and tested to enable conclusions to be drawn on observable social reality, as opposed to perceptions (Saunders, Lewis and Thornhill, 2012).

3.2.2 Phenomenological (Qualitative) Approach

This research used qualitative techniques to collect both primary data and secondary data. These techniques are concerned with a world view with an in-depth understanding of a certain subject from people's experiences which could also be subjective (Du Plooy-Cilliers, Davis and Bezuidenhout, 2014). Qualitative methods involve the researcher making use of data that is qualitatively obtained to answer questions. In this study to gain insight into the knowledge and experiences from respondents regarding factors affecting the roll-out of penetrative broadband in KZN. According to Neuman (2011), research data collected

qualitatively is regarded as meaningful and relevant by the researcher. A qualitative methodology takes an interpretative approach which provides more of an understanding compared with measuring for results (Babbie and Mouton, 2009).

A purposive sampling method enabled this researcher to choose who to interview (that is who to include in the sample) based on a set of characteristics (Du Plooy-Cilliers et al., 2014). The intention was to make use of snowball sampling, whereby the researcher is open to referrals of the people who are involved and responsible for the fixed broadband roll-out in KZN. Data was collected from various sources identified by the researcher to acquire a broader understanding of the topic. Interviews with selected staff from an ICT fixed line service organisation who are involved in the broadband roll-out were conducted. A list of open ended questions afforded respondents the opportunity to provide their insights about broadband services in general. Interviews were conducted on a one-on-one face to face basis to enable the researcher to acquire different perspectives. The reviewing of documents was an additional method of data collection.

3.3 RESEARCH DESIGN

Research design can be defined as the science and the art of planning procedures used when undertaking research studies in order to acquire the most valid data (Collis and Hussey, 2003). There are various types of research designs, such as ethnography, grounded theory, case study, and content analysis. It is essential to select the correct research design that answers the research questions (Leedy and Ormrod, 2001). According to Cooper and Schindler (2003), the types of data collected and choice of data sources provides the context for identifying the relationships amongst variables, all of which are influenced by the research design. The four types of design are as follows:

1. **Descriptive studies** provide descriptive data such as "the what, when, who, where and how" of the population being investigated (Cooper and Schindler, 2003). At times, this type of study is performed as a precursor to exploratory or explanatory research (Saunders et al., 2012).
2. **Exploratory studies** are suited to research where the area that is being investigated is ambiguous or new where the variables may not be sufficiently clear to develop hypotheses (Cooper and Schindler, 2003).
3. **Causal studies** investigate the dependency between two variables by analysing and understanding how the change in one variable affects change in the other variable.

Similarly, business research is more focused on rationalising, identifying and calculating the relationships between variables as opposed to determining their cause (Cooper and Schindler, 2003).

4. **Explanatory studies** concern research investigating a problem with the objective of identifying the relationships between variables (Saunders et al., 2012). According to Cooper and Schindler (2003), when conducting this type of study, the researcher makes use of theories together with hypotheses to explain the factors which have resulted in particular occurrences.

This study is exploratory and qualitative in nature. The area being investigated is ambiguous and the variables were not clear enough to develop definite hypotheses. The key objective of this research design is to acquire a clearer understanding of the problem. This is usually undertaken through a literature search and interviews with specialists on the topic.

3.4 THE TARGET POPULATION

The aggregation of study elements such as events, artefacts, and individuals is defined as a research population and data is collected from this population to provide the basis of analysis (Burns and Grove, 2004; Babbie and Mouton, 2009). The population size of the fixed-line company selected for this research has a specific division directly responsible for the broadband roll-out plan and strategy for KZN. This division has 250 employees who are responsible for the planning, engineering and executing of the fixed line broadband roll-out strategy. The regional leadership structure comprises of one regional head and five regional managers who report directly to him. These six people are the final decision-makers responsible and accountable for the roll-out plan and service delivery of the fixed line broadband services for KZN.

This researcher used purposive sampling whereby specific people within the population were identified for this study, thus concentrating on people with particular characteristics and knowledge. Of the 250 employees, six were identified as the key decisions makers and strategists with regard to the KZN fixed-line broadband roll-out plans. Interviews were conducted with all these individuals based on their positions with regard to making key strategic decisions related to broadband roll-out in KZN, as shown in Table 3.1 below. These interviews provided the researcher with a deeper understanding on technical issues associated with the roll-out of fixed line broadband services.

Title	Broadband Responsibilities
Regional Executive – Network Engineering and Build (NEB-KZN Head)	Responsible, accountable and the final decision maker for the KZN fixed line broadband roll-out strategy
Regional Manager Regional Integrated Network Planning (RINP)	Responsible for planning and providing KZN broadband plan, that is the one- to five-year plan which is in line with the company's strategic objectives
Regional Manager Technology Engineering	Engineering the KZN broadband technology deployment plans, both on the access and core ICT network
Regional Manager Access Engineering (Fibre Copper)	Engineering the KZN broadband access network (optic and copper) as per the regional plans
Capital Budget Manager and Programme Manager	Responsible for managing the regions expenditure and requesting capital and operational funding for broadband program plan, also responsible for executing the broadband roll-out plan
Regional Manager Service Order Management (SOM)	Responsible for managing new broadband order requests

Table 3.1: Interviewees and their broadband responsibilities

3.5 SAMPLING STRATEGY AND SAMPLE SIZE

Probability and non-probability sampling methods are the two sampling techniques used in research studies. When making use of the probability sampling technique, the prospect or likelihood of each sample unit that will be selected is known and would most likely be uniform for all items (Saunders et al., 2012). A probability sampling technique involves using a sample to construe statistical inferences on the population; this technique can be classified further into systematic, stratified, simple or cluster random sampling (Saunders et al., 2012).

Purposeful sampling was used for this study and involves selecting a relevant target sample. The researcher selected specific people from the 250 people directly responsible for planning, engineering and executing the fixed line broadband strategy and service delivery in KwaZulu-Natal. Of the 250 employees, six are key decisions makers and strategists working with a fixed broadband strategic plan. All six were selected based on their level of business acumen, decision making and knowledge. Thus a sample related to fixed broadband rollout in KZN was selected which was relevant to this research.

3.6 DATA COLLECTION

Research data collection techniques used for qualitative and exploratory study include interviews, focus groups and participant observation. According to Kolb (2008), qualitative data collection by interviewing involves using personal communication between the researcher and the research subjects. Qualitative research in particular is about acquiring an in-depth understanding of a certain subject based on people's experience which can be subjective (Du Plooy-Cilliers et al., 2014).

The researcher collected both primary and secondary data for this study. Secondary data collection involved extensive analysis of existing documents which included ICT reports, policies, and regulations. The technique used to collect primary data in this study was in-depth expert interviews; this involves social interaction between the respondent and interviewer, offering both the respondent and interviewer opportunities to clarify responses and questions (Chambliss & Schutt, 2012). This study made use of in-depth interviews with all key decision makers responsible for the formulation and implementation of the broadband plan for the KZN region in order to obtain insights and opinions of factors affecting the roll-out of penetrative broadband. Of the various data collection techniques, in-depth interviews were the most practical; focus groups were not practical in this situation.

In interviews, the researcher was able to be flexible and ask both closed and open-ended questions. The researcher was also able to decide the order in which the questions were asked and answered. Finally, participants were provided the opportunity to obtain clarity concerning the questions. The interviewer was well positioned and acquired a good understanding of what participants were actually saying. All interviews were conducted face-to-face at lasted between 20 to 30 minutes.

Figure 3.1 is adapted from Kusek and Rist (2004) and shows both formal and informal structured methods of data collection. Using semi-structured methods tends to provide in-depth qualitative data, for example reviewing official records and interviews. The structured methods provide data such as census, surveys and experiments. This study used qualitative semi-structured data collection methods.

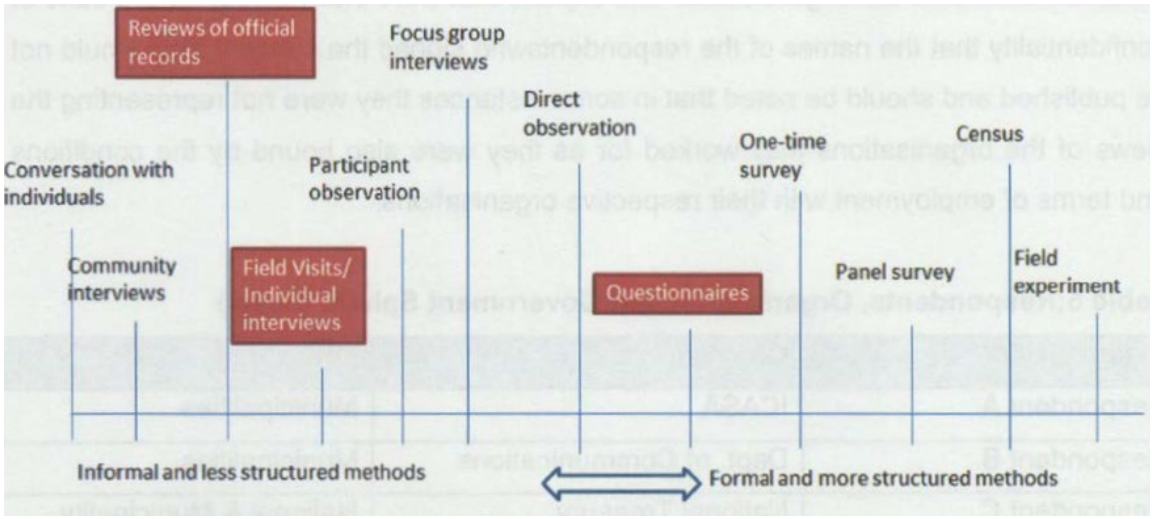

Figure 3.1: Data collection methods
Source: Adapted from Kusek and Rist (2004).

3.7 PILOT STUDY

A questionnaire is refined through a pilot study aimed at ensuring respondents don't encounter problems when answering questions and also to ensure no problems are encountered when analysing the data (Saunders et al., 2012). The importance of this phase is to test the appropriateness of the questions wording (Sekaran and Bougie, 2013).

The pilot study undertaken was aimed at ensuring the interview questions asked in this research were easy to understand and not too technical in nature. This study was conducted with four participants, all of whom felt the questions were neither too difficult nor too technical. The pilot study revealed there was no need for the researcher to change or amend any of the interview questions, however the sequence of the questions was reconsidered to ensure better flow. The interview questions can be found in Appendix A.

3.8 DATA ANALYSIS

Qualitative analysis does not make use of formal well-established knowledge from statistics and mathematics. The data is context-based, can be considered vague and may also be interpreted in more than one way. For this study, descriptive qualitative data was sourced from interviews. Thematic analysis was used to analyse the data that was collected from interviews with the aim of discovering patterns and developing themes (Harvard, 2008).

This study used purposive sampling, a phenomenological approach, and qualitative interviews which enabled the data review and analysis to be undertaken in conjunction with

data collection (Collis and Hussey, 2003; Babbie and Mouton, 2009). Data analysis involved ongoing iterations of note compilations based on the reflections and thoughts of the researcher, categorising the interview data and linking it to various other data sources and data reduction of notes from the interview. On completion of data categorisation and identifications of themes, the themes were then organised in an orderly manner, which reflected a meaning or pattern that emerged from the research data set, which responded to the research questions (Braun and Clarke, 2006).

Henning, Van Rensburg and Smit (2004) proposed various data analysis steps (see Figure 3.2) According to Leedy and Ormrod (2001), a few steps needs to be taken into account when analysing research data which include: organising facts which could be arranged in a sequence of events; secondly, information categorisation into meaningful themes; thirdly, interpreting relevant information sourced from documents related to the study; fourthly, the combination of themes into a single view to help identify the patterns which may lead to other ideas; lastly, generalising and syndissertationing the complete outcome of the study with the objective of drawing conclusions, thus setting the tone for future studies.

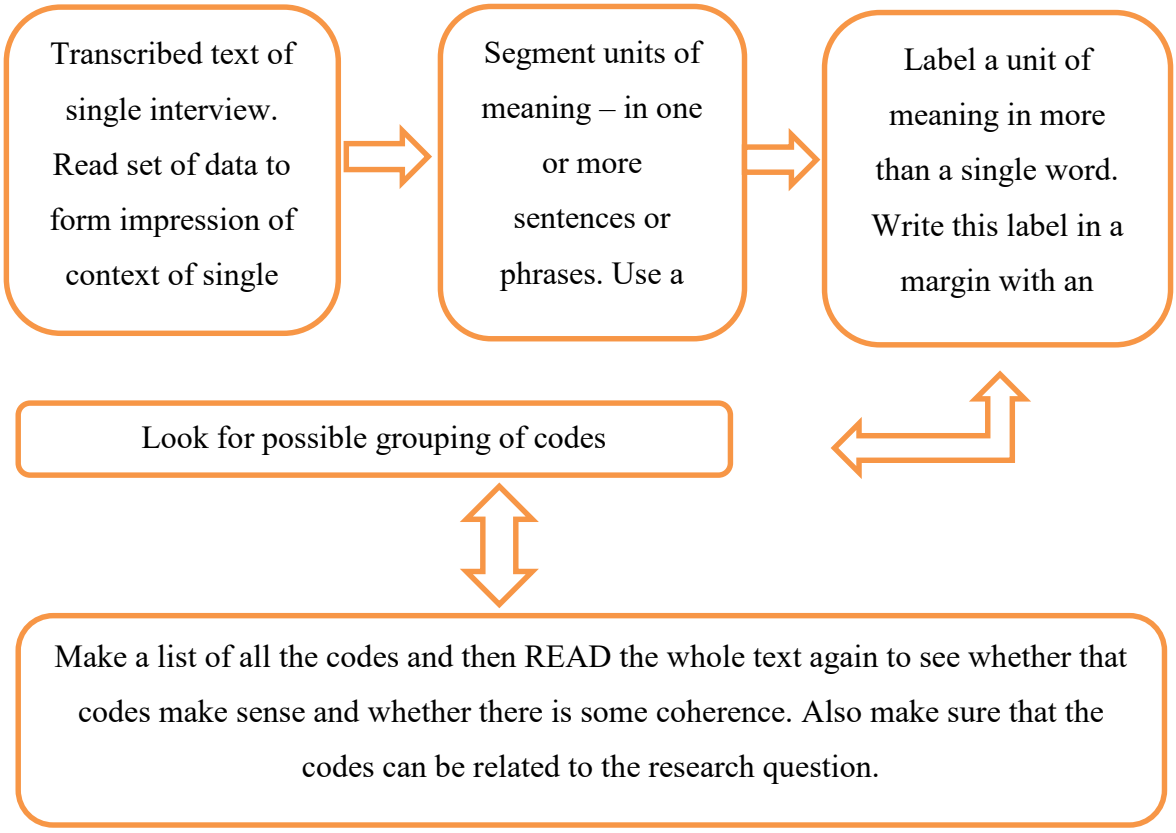

Figure 3.2: Data analysis steps
Source: Adapted from Henning, Van Rensburg, and Smit, 2004.

According to Thomas (2006), qualitative evaluation data analysis using the inductive approach involves, firstly, condensing raw textual into a summary format that is brief. Secondly, establishing well understood links between the research objectives and the derived findings of the summary from the raw data; and lastly, developing a framework which is made up of the underlying structures of processes or experiences that are evident in the raw data. Making use of this approach provides an easily used set of procedures that is systematic for analysing qualitative data aimed at producing reliable and valid findings.

3.9 VALIDITY AND RELIABILITY

According to Wagner, Kawulich and Garner (2012), validity and reliability is necessary to ensure the quality of the research and its conclusion. According to Greener (2011), internal validity refers to the consistency between the models being investigated with the recognised procedures for the research techniques it advances. When the research proves a causal relationship between two or more variables, then internal validity is verified (Saunders et al., 2012). According to Greener (2011), external validity is concerned with whether the model examined by the researchers and developed is applicable to the phenomenon that it is meant to be investigating. According to Cooper and Schindler (2003), the extent to which the research instruments provides adequate coverage of the research questions forming the basis of a study is referred to as content validity. According to Wagner et al. (2012), the degree to which the research measures, measure the occurrence of the concepts which the researcher intended to measure, is referred to as construct validity.

The degree to which a study findings are representative of the meaning of the research participants is referred to as credibility (Lincoln and Guba, 1985 as cited in Lietz and Zayas, 2010). The credibility of this study was acquired through ensuring data collected and findings were firmly linked back to participants' own insight and experiences on broadband roll-out challenges, with particular emphasis on key factors supporting and inhibiting the roll-out of penetrative broadband networks. To ascertain this, key decision makers involved with rolling out broadband networks where identified and qualified as participants in this study. The researcher persistently pursued deeper explanations on various aspects of broadband roll-out challenges, particularly on broadband penetration. For example, participants were asked to provide typical core network challenges associated with broadband penetration.

Dependability is about obtaining similar results if the same study was repeated using a similar method, context, and participants (Shenton, 2004). The researcher provides a comprehensive

description of all participants in terms of title, position and division. According to Saunders et al. (2012), reliability implies that analytical procedures and data collection methods would produce findings that are consistent if repeated by another researcher on another occasion. According to Bryman and Bell (2007), the stability of the measure which can be established through re-testing is concerned with the reliability of the data which also includes internal reliability and inter-observer consistency. Feedback from the respondents was linked to the literature review.

Confirmability refers to the extent to which the findings of a study are the results of the insight, ideas, and experience as opposed to the characteristics and preferences of the researcher (Shenton, 2004). The researcher ensured confirmability in this study through linking the various data on the findings and through retaining records on raw material, interviews, compilation of themes, various notes, and data reduction.

In order for the researcher to establish the reliability of primary data, he interviewed different respondents from different departments, thereby testing the reliability of the primary data gathered from each respondent. The primary data collected was then compared to the secondary data, thus primary data was checked against the secondary data. This approach was used to evaluate the reliability of the primary data collected; little deviation from the primary data collected would mean the data collected was reliable.

3.10 LIMITATIONS

The primary limitation was the lack of research undertaken in the study of broadband penetration roll-out particularly in KZN. Primary data collected was from respondents involved only with fixed line broadband service delivery in KZN; the questions asked were answered based only their point of view. The scope of this research was limited to the province of KZN and focused on the factors affecting the roll-out of penetrative broadband in the fixed line sector, which could vary when compared to other provinces in SA and in other parts of the ICT sector, in particular the mobile market.

3.11 ETHICAL CONSIDERATIONS

Prior to the start of this research an ethical clearance certificate was received from the UKZN Graduate School of Business (see Appendix B).

The ethical approach to this study included consent, privacy, the right to withdraw from the study, confidentiality and anonymity. An invitation and consent letter (see Appendix C) was sent out to each of the potential participants, which clearly indicated the reasons, objectives and outcome to this study. The participants were encouraged to contact the researcher with any questions they might have had concerning this study. The consent letter clearly indicated that the participant would not be prejudiced in any way. This approach ensured informed consent was obtained from each of the eligible participants thus maintaining ethical standards. The participants were given the opportunity to decline participation at any point with full confidentiality.

As part of the interview process, participants were encouraged to ask questions and given the opportunity to reflect, without any intimidation, and also the right to decline or withdraw from participating. All participants who were interviewed did so willingly, without requesting additional information from the researcher.

The storage of data ensured access to this information was not accessible to anyone except the researcher. All data collected during interviews was recorded and saved onto a compact disc. This disc was locked away in a safe; the researcher is the only individual with a key. After five years have passed this disc will be disposed of appropriately by either burning it or breaking thus maintaining confidentiality of the research participants.

3.12 CONCLUSION

This chapter has described the methodology and research design that was used in this study. The study used a qualitative approach and this chapter has explained this choice. This chapter also included discussions on the sampling strategy, research design and administration. The limitations of the study and ethical considerations concluded Chapter Three. The chapter that follows provides a detailed analysis and discussion of the findings.

CHAPTER FOUR

STATEMENT OF RESULTS, ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents the results of this study, analyses these, discusses and links them to the literature that was reviewed in Chapter Two. This study is qualitative in nature, thus the presentation takes a thematic approach: the results are presented in themes according to the research objectives.

4.2 RESEARCH OBJECTIVES

These were stated in Chapter One, and are presented again below for ease of reference:

- To establish the factors taken into account and challenges encountered when providing broadband in South Africa, KwaZulu-Natal;
- To explore the preferred broadband options, Long Term Evolution (LTE) or fixed line, or both;
- To assess the impacts of broadband to the economy; and
- To recommend a strategic plan to deliver high quality penetrative broadband service in South Africa, in particular KZN.

4.3 PARTICIPANTS

Six respondents were identified within a leading fixed line ICT organisation. They are key decision makers responsible and accountable for the overall broadband strategy and roll-out plan within the province of KZN. The table below provides details of the role players within the fixed line ICT organisation. All six identified individuals were interviewed, therefore 100 percent of the sample actively participated in the study.

RESPONDENT	TITLE	DIVISION
1	Regional Executive	Network Engineering
2	Regional Network Planning	Network Engineering
3	Regional Network Engineering	Network Engineering
4	Regional Access Engineering	Network Engineering
5	Regional Budget Control Execution	Network Engineering
6	Regional Network Execution	Network Engineering

Table 4.1: List of respondents

4.4 ANALYSIS OF QUALITATIVE DATA BASED ON RESEARCH OBJECTIVES

According to Fereday and Muir-Cocrane (2006), the identification of themes or major ideas in a document or a set of documents is referred to as thematic analysis of qualitative data, which is a form of pattern recognition in the data, where the categories for analysis are based on emerging themes. In addition, a qualitative approach to research usually develops themes from text; this is a process that is often referred to as 'open coding'. Themes for this study in particular emanated mainly from the literature review, thus resulting in deductive theoretical thematic analysis. The results are now discussed in relation to the research objectives.

4.5 RESULTS BASED ON OBJECTIVE 1: Key roll-out factors considered and challenges associated in providing broadband services in KwaZulu-Natal

Feedback from each of the respondent's views was recorded. Research objective 1 is important because in 2012, fixed lines declined to 18 percent of households where only 24 percent of households in urban areas were connected to a fixed line and 5.8 percent of households in the rural areas. According to a survey, resulted revealed more than 42 percent had no basic fixed line connection at their place of residence, while another 51 percent of respondents indicated they were unable to afford a fixed line service (Gillwald et al., 2012). Important to note was that not all fixed line services have the capability of providing a broadband service. The question that follows is aimed at understanding factors taken into consideration when rolling out or upgrading the broadband network and secondly, the challenges associated with rolling out broadband services in KZN.

4.5.1 Question 1: What are some of the key factors taken into consideration when rolling out or upgrading the fixed line broadband network?

Respondent One

"Two keys aspects are taken into account: firstly, priority and secondly, funding. The priorities are determined by the company's strategy and funding availability. The criteria are not specified. Return on investment is another factor taken into consideration when rolling out broadband."

Respondent Two

"Factors taken into account when planning the company's broadband network are: congestion problems associated both with the core and access network, in particular uplink

congestions; secondly, port availability to connect up customers to the network; thirdly, customer demands and needs (this equates to return on capital investments). The company's broadband strategy is guided by some of these factors."

Respondent Three

"Geographical areas, particularly on the access network, are taken into account. Key role players identify access sites where remote units are strategically positioned, aimed at maximising customer connectivity to these units, which equates to higher financial returns. Other factors include safety and the availability power."

Respondent Four

"We closely follow the company's strategy, bringing together the various technologies used to enable broadband service connectivity and functionality." The company's strategy focuses on high return of investments which is then used to determine a broadband roll-out plan and funds are then allocated accordingly. Strategy changes during the course of the financial year pose major challenges during the engineering phase; these changes affect the roll-out continuity, efficiency, and effectiveness which adversely affect roll-out timelines.

Respondent Five

According to this respondent, the focus is on the high end user market with the objective of maximising returns on investments. The company has not included outlying and rural areas as part of their broadband strategic plans. Marketing, together with the strategy division's main focus, was on the high end user market, or elite suburbs and gated communities, for example, Durban North, Gateway, Umhlanga areas.

Respondent Six

The cost to roll out broadband is taken into account. The choice is either underground or aerial. Safety is another factor which is taken into account. Thirdly, permission needs to be acquired from the necessary authority to deploy access infrastructure; if permission is not acquired, this could result in a change of roll-out plan or strategy, for example, the use of wireless technology. Safety of staff, service providers and equipment needs to be considered. The Internal Rate of Return will also affect whether a project can go ahead. The region is further guided by the company's broadband strategic plans.

4.5.2 Question 2: What are some of the most challenging aspects associated in rolling out broadband services in a fixed line ICT organisation? How different are these challenges when compared to KZN?

This is in line with the first objective of the study which sought to establish the challenges in providing broadband services in South Africa. This question sought to establish the views of the respondents on what they consider to be some of the key broadband challenges in SA. Feedback from all the respondents is summarised below.

Respondent One

The fixed line ICT sector forms a critical component of Government's broadband long term strategic plan in SA. Some of the key challenges encountered in the fixed line ICT sector in South Africa are the high level of copper theft, sabotage, vandalism, lack of capital funds and lastly, the topology. When considering KZN in particular, its large rural land mass and its mountainous geography present a unique challenge that requires a specific approach to planning, engineering and deploying ICT infrastructure. There are, however, common challenges such as funding, theft, vandalism, and sabotage, etc.

Follow up question: What part of your ICT network poses more of a challenge when rolling out broadband, the access or core network?

"All the challenges mentioned in the previous question form part of the access network, therefore the access network. We encounter challenges in the core network, however the access network clearly presents more of a challenge."

Respondent Two

Theft is one of the most challenging aspects associated in rolling out fixed line broadband infrastructure. The second challenge would be vandalism which adversely affects the quality of broadband services. The cost associated with replacing vandalised and stolen infrastructure (which at times results in the disconnection of service due to the high replacement costs) can make the service non-viable. Therefore, outside influences present a major challenge when it comes to providing reliable cost effective broadband service. *"I would say that the challenges mentioned are not isolated to KZN in particular but are rather of national concern. In KZN I would think that large land size together with the terrain presents a major challenge when rolling out penetrative broadband, in particular providing power to the remote sites, the lack of return on investment, and theft."*

Follow up question: What part of your ICT network poses more of a challenge when rolling out broadband, the access or core network?

"Certainly the access network, with key areas such as theft, ROI, geography all within the access network. So there are certainly greater roll-out challenges in our access network when compared to our core network."

Respondent Three

"Challenges that are considered universal in the SA ICT fixed line market include theft, funding constraints, vandalism and customer growth; however, access distribution to our customers poses the greatest challenge, this is known as the last mile." There are however unique challenges within each province; KZN in particular has to deal with its mountainous terrain. This equates to higher costs associated with rolling out ICT infrastructure which requires a unique approach. Therefore, providing a penetrative fixed line broadband service in KZN will require massive capital outlay, which presents major challenges.

Follow up question: What would you consider more of a challenge when rolling out broadband, the access or core network?

The access network is much more unstable when compared to the core network. Therefore, when rolling out broadband, more effort and time is required, especially at new remote sites. A second challenge is having to deal with external factors which the company has little or no control over such as theft, replacement, vandalism, etc.

Respondent Four

"There are numerous challenges when it comes to rolling out broadband within a fixed line ICT company. Theft and geography are the major challenges when it comes to providing penetrative broadband in KZN. Theft presents major challenges when it comes to rolling out broadband in rural areas. Currently the company has to deal with ongoing theft of its poles and copper within certain rural areas. KZN is more suited for wireless network topology as opposed to a fixed line connectivity. The reason for this is that the cost per line will increase if the distance from point A to point B increases, however wireless to a certain degree mitigates the increase in cost due to distance. Added to geography is tele density which determines the viability of providing broadband. There are however exceptions where viability is not the deciding factor, for example providing broadband for essential services that is hospital, police stations, etc. Therefore, theft, geography, vandalism and tele density which determines the viability of the broadband roll-out plan are some of the major

challenges associated with rolling out penetrative broadband in KZN". It is clear that all of these challenges primarily lie in the access network.

Respondent Five

From a roll-out perspective, dealing with the respective municipalities is one of the greatest challenges, particularly acquiring permission and being issued with wayleaves timeously. Apart from the municipalities, working within gated communities also proves challenging in terms of being allowed permission to roll out ICT infrastructure. Dealing with Sanrail for access to the road reserves presents a further challenge for the laying of the backbone fibres. *"These challenges are primarily due to our stringent business approach (ensuring all documents are filled out properly) which leads to roll-out delays and at times even to the cancellation of projects."* Challenges associated with broadband roll-out, in particular in rural KZN, will vary nationally and regionally in particular with regard to the Central Business Districts and built-up or developed areas. One of the biggest challenges is the terrain where there are areas which have previously not had any form of fixed line ICT infrastructure; these areas will require larger capital investment which presents another challenge and proves to be a stumbling block. Secondly, acquiring permission from tribal leaders to build ICT infrastructure in these areas and dealing with theft and vandalism also pose major challenges for the broadband network, particularly on the access side.

Respondent Six

This respondent also highlighted the cost to roll out broadband service as a major challenge. Other challenges are vandalism and theft; the more exposed the infrastructure, the more prone it becomes to vandalism and theft. Acquiring wayleaves from the municipalities also presents challenges which result in delays, sometimes cancellation of the roll-out plans. Limited skills within the ICT sector is a major challenge. Generally, contractors within the ICT sector are 'cherry picking', in other words, concentrating on areas where there are lucrative contracts. In the rural areas there are state institutions where ICT contractor presences are very thin. In rural KZN, theft of the poles and copper present a major challenge. Also acquiring permission from tribal leaders can be challenging. The safety of both the company's employees and their contractors is also an issue. The return on investment is a major deterrent when considering penetrative broadband in rural KZN; high capital investment does not make business sense. However, company imperatives are at times overriding. The other challenge is whether customers in rural areas are able to afford the service and monthly expense over an

extended period. Therefore, the Internal Rate of Return (IRR) and funding constraints are major hindrances in terms of rolling out penetrative broadband in KZN.

Follow up question: What would you consider more of a challenge when rolling out broadband the access or core network?

"The access network without a doubt."

4.5.3 Discussion of Objective 1 results

The findings revealed that certain key factors need to be taken into consideration when rolling out broadband network. Responses to the first research question revealed that the majority of respondents agreed that financial constraints and return on investment were the key factors taken into consideration when planning the company's broadband network. Other aspects mentioned included remote positioning of access nodes, core and access congestion, port availability and safety. It is clear the company's broadband strategy is determined primarily by the return on investment which in turn establishes the capital allocation; therefore, the company's strategy and capital network investments are determined by their return on investment, in particular for broadband services. To grow the broadband footprint in KZN aimed at providing penetrative broadband, the return on investment needs to be re-considered due to the low returns from investing in broadband infrastructure to remote and rural areas in KZN.

The second question in this research objective focused on the challenges encountered when rolling out broadband. Findings revealed there are numerous challenges, the most common of which include theft and vandalism resulting in high replacement costs which could also result in the total loss of service due to the non-viability to reinstall. Secondly, geography and topology in KZN (large rural land mass which is mountainous) present a unique challenge which requires a specific and specialised approach when planning, engineering and deploying ICT infrastructure here. Thirdly, financial constraints present major limitations to providing this service to a larger geographical area, with very little or no fixed line broadband service, particularly in the rural and remote parts of KZN.

All the respondents claimed the top priority was high returns for broadband. Geography and theft were other key challenges encountered when rolling out broadband. All these challenges lie on the access side of the broadband network which has also been referred to as 'the last mile'. According to the GAO (2010), geography and finances do pose challenges when it comes to broadband roll-out. Where these broadband challenges are evident and make private

enterprise unprofitable in the OECD countries, regional or national governments in all seven countries have used public and private partnerships. High rates of broadband deployment have been achieved, overcoming the geographic and financial differences among the OECD countries, with some countries, for example Denmark (the most populated OECD country with an average of 128 people per square kilometer and with 99 percent of households with broadband) even higher than the OECD average of 90 percent. According to Kelly and Rossotto (2012), it took over 30 years for the wireline telephones to multiply tenfold per capita; however, this is now on the decline worldwide. Mobile phones took about 12 years to multiply tenfold, and Internet users took approximately eight years. Penetrative broadband roll-out in KZN needs to look at adopting a similar approach to that of the OECD to address challenges such as geography and finances using mobile networks, which will also address issues of theft and vandalism to a certain degree.

4.6 RESULTS BASED ON OBJECTIVE 2: To explore the preferred broadband options, Long Term Evolution (LTE) or fixed line, or both

The question for research objective 2 sought to establish the preferred broadband options used by the fixed line ICT Company: either LTE (mobile communication), fixed or both. In our fast paced world people prefer to be mobile, therefore LTE resonates with the world's mobility approach. All six of the respondents were interviewed and asked the question below and their responses follow.

4.6.1 Question 3: What would be considered the preferred broadband option used to provide your customers with broadband, Long Term Evolution (LTE), fixed line, or both?

Respondent One

"From a technical perspective, fixed line is the best option. People are generally looking for fixed line broadband. I believe that fixed line is the best option, in term of reliability and availability. From a cost perspective and depending on the application, if you have areas with mass requirements, then fixed line is more feasible. Therefore, fixed line is the main broadband option which the company is currently driving with LTE considered secondary."

Respondent Two

"Fibre to the home (FTTH) is important because we can provide our customers with a very high level of broadband service." LTE is good and both have their applications which depend

on the customer's requirements. Some customers do business from home; for this application FTTH is perfect and provides excellent stability. For stability, fixed line is preferred. People who run more mobile businesses and use mobile phones will prefer LTE. LTE should also help address some of the theft problems, particularly in the rural areas.

Respondent Three

According to the third respondent, both options are preferable. LTE is a quick solution for a person who is mobile; however, the increasing number of customers using the LTE network will result in congestion of the network and slower broadband speeds. FTTH provides a more stable network. Therefore, for the rural areas LTE is a quick solution which can be used to provide penetrative broadband to these areas; for a more stable network, fibre will have to be rolled out. By monitoring the LTE network high usage areas can be identified and these areas can be converted from LTE to fixed line which is more reliable. LTE is a good option for providing penetrative broadband in KZN.

Respondent Four

According to respondent Four, it has to a combination of both, which is market related. The geography in KZN lends itself to wireless in rural areas. According to recent global trends, first world countries seem to be going fixed line and developing countries are choosing wireless. The reasons for choosing fixed lines include higher capacity, reliability and they are not susceptible to atmospheric conditions. Therefore, we need a balance between LTE and fixed line which is based on the geography and other dynamics of where the service is required.

Respondent Five

"LTE is the future so if the company can deploy LTE this will be advantageous. The company has a lot of fixed line legacy services in the network and its current focus is on upgrading the existing network, particularly the metros and core areas with high revenue generation that is for return on investments." Unfortunately, the same cannot be said about the outlying areas, which include the rural areas and a large part of urban areas. The company's main focus is on upgrading their existing network and deploying fibre optic technologies because fixed line numbers are shrinking. *"We to go with what our customers want which is optic fibre or FTTH."*

Respondent Six

According to this respondent, LTE is probably going to be the way to go because it will be the easier option for the company to deploy due to the terrain and the remoteness in KZN: *"LTE in my opinion will be the preferred option which can provide services to a wider audience as opposed to fixed lines".* The roll-out time for LTE is also much quicker. Fixed lines will gradually diminish in the future. However, the company will want to keep fixed lines in Metro areas due to fibres producing the best service and bandwidth; however, in remote areas this is clearly not a good option from a viability and feasibility perspective. Therefore, the best option for the Metro areas will be fibre and for the rural areas, LTE will be the preferred option.

4.6.2 Discussion of Objective 2 results

According to feedback, taking into account reliability and speed for broadband, fixed line in the preferred option. However, LTE can play a key role in providing broadband, particularly in rural and remote parts of KZN. There is evidence that fixed line companies are appreciating the value of using LTE. Vermeulen (2015) indicated that Telkom recently announced the expansion of its LTE network to approximately 22 suburbs in Western Cape, KZN and Gauteng. Further to this, Telkom has made various claims regarding its LTE-Advanced (LTE-A) network as a competitive alternative to its fixed-line broadband. According to feedback from all individuals interviewed and the literature, LTE is a preferred option for broadband, particularly in the case of KZN where the terrain and geography present unique challenges.

4.7 RESULTS BASED ON OBJECTIVE 3: To assess the impacts of broadband to the economy

Broadband has far reaching benefits in terms of the World Wide Web:

- It enables people to communicate with their loved ones far away,
- It enables distance learning,
- It helps with training people in remote areas, etc., all of which help to stimulate and grow the economy.

Romer (1990) and Czernich et al. (2011) argued in line with endogenous growth theory that broadband networks have the ability to stimulate economic growth in various ways such as promoting knowledge sharing and distribution, enhancing the coordination of various work

activity and lastly, facilitating product innovation. Providing good quality and affordable broadband is therefore of paramount importance to the economy in general. The aim of research objective 3 was to establish if the entities that are primarily involved with rolling out broadband have an understanding of the impact of broadband from an economic perspective.

4.7.1 Question 4: What understanding do you have of the impact that broadband has to the economy?

Respondent One

Broadband plays an instrumental role in both developing and developed countries and helps to stimulate and grow the economy. Many people live in remote areas within KZN; the use of broadband at schools can lead to providing better education. In terms of tertiary education, with good broadband, people can study from home (e-learning) and this can be cost-effective. Remote clinics are able to train and educate people on aspects such as Human Immune Viruses (HIV), Tuberculous (TB), etc. These are some of the benefits from an economic perspective. Rolling out broadband will certainly have a positive impact on the economy and on the lives of all South Africans and this could be achieved through a collaborative effort amongst various stakeholders such as Government, NGOs, private sector, etc.

Respondent Two

This respondent had read that broadband improves the Gross Domestic Product (GDP). On visiting some schools in rural areas, this respondent noted that some of the teachers' knowledge was insufficient. The intention is to have the broadband backbone in place and ultimately a Wi-Fi network where students and teachers are able to access the Internet which will benefit them tremendously with their learning abilities and access to knowledge. Some of these places have no electricity and no books so having the tablets could be a huge benefit to learning. Therefore, partnerships need to happen with Eskom. The KZN schooling system will have to provide the schooling curriculum and will have to be the hub. Similarly, with the hospitals – one major hospital has all the doctors and a large number of clinics that are linked to that particular hospital in the rural areas. Doctors from that hospital visit all these clinics, but the clinics also need to have access to the doctors; broadband would assist with this.

Respondent Three

For the rural areas, particularly the schools in these areas, children making use of the library can now also make use of broadband if available at the library to source and acquire information from the Internet. This can be much easier and quicker than using books.

Broadband will also help businesses in rural areas to search for stock and product prices. *"Therefore I see it as a platform to empower the nation."*

Respondent Four

For economic reasons, the focus is on affluent areas and for political reasons, there is a focus on the rural areas which presents a gap in the middle. The economic drive appears to be rooted in financial and political benefits. However, from a broader economic perspective, broadband plays a much more instrumental role in terms of education, training, and empowering the nation in general. Ensuring that broadband benefits the entire nation requires the formation of partnerships with various telco, Government and other stakeholders to provide broadband.

Respondent Five

Like any infrastructure, broadband will have an enormous impact in terms of our country and economy going forward. It has been proven that countries where broadband has high penetration are more advanced in terms of their economy. In Africa, countries like Uganda, although one of the poorest countries on the continent, have a telecom and broadband infrastructure far better than SA, even though SA is considered to be one of the developed countries in Africa. This has a positive impact in terms of GDP. Kenya is similar to Uganda and has concentrated on its telecom infrastructure and finally, Burundi, a country ravaged by wars and violence, has an infrastructure ten times better than SA in terms of concentration into their local community. Obviously it is an advantage to the country if all villages ae connected and this will have an enormous impact on the economy of the country.

Respondent Six

"With broadband presence, from an education point of view, it is unbelievable what children learn." From a medical point of view, a doctor can sit in one location and perform an operation through a fibre in another facility. So the effects of broadband in terms of education, health, and from an economic point of view, are phenomenal. There is so much that can be done via the Internet from a business perspective. Simple things like purchasing a cell phone can easily be done on the Internet which can save a rural customer from coming into the CBD. Simple things like this can make a huge difference, particularly considering the functions that you can get on a smart phone. *"So if you start enabling people with a simple*

thing like a torch or a compass that you would require in a rural area this can make a huge difference in their lives."

4.7.2 Discussion of Objective 3 results

According to all respondents, broadband clearly has a positive impact on the economy of a country. Areas of the economy identified which could benefit from broadband were education, medical, and training and development. According to Seymour and Naidoo (2013), broadband has the ability to have a positive impact on a country's economy particularly with uplifting the lives of the people by providing ICT skills for employment and helping improve access to online education, known as e-learning. Therefore, broadband can be considered an important enabler to ensure positive economic growth globally; hence the need for a cost effective and reliable broadband service.

It is estimated that only approximately 3.7 percent of adults in KZN have a degree or higher. Penetrative broadband could help improve this percentage by making tertiary education more affordable and accessible through e-learning. The high unemployment rate in KZN is also an area of concern, particularly in the rural communities. According to Lio and Lui (2006), ICT availability in rural areas can increase incomes through the increase of agricultural productivity and through the introduction of income channels other than the traditional farm jobs. This could be seen as one of the ways to reduce the unemployment rate, particularly in the rural areas of KZN. Clearly there is correlation with what the literature states when compared to the feedback received on this research question. Therefore, broadband should form a vital part of SA's economic growth plan, particularly from an unemployment, poverty, and equality dimension which is in line with the endogenous growth theory.

4.8 RESULTS BASED ON RESEARCH OBJECTIVE 4: To recommend a strategic plan to deliver high quality penetrative broadband service in South Africa, in particular KZN

Objective 4 primarily sought to establish strategic plans for the fixed line ICT sector aimed at providing a high quality penetrative broadband service in KZN. The research question aimed to explore the fixed line strategic plans in place to provide penetrative broadband in KZN.

4.8.1 Question 5: What strategies are in place, particularly to deliver quality penetrative broadband in KZN?

Respondent One

"Currently there are no specific or clear strategies in place, we are just rolling out the company's master plan. I don't have a clear understanding how the company's broadband strategy is aligned to Government's 2020 broadband plan. The KZN region is being told as it happens, thus I don`t have an insight in terms of where the company intends going strategically, particularly in terms of providing penetrative broadband for KZN."

Respondent Two

According to the second respondent, the current strategy is based on the National Broadband Plan (NBP) where a few key areas have been identified: a portion of the Eastern Cape which forms part of the KZN roll-out plan and three municipalities within the province.

Follow up question: When looking at these municipalities would you consider this strategy as being penetrative broadband roll-out going deep into rural areas or specific focus areas?

The respondent explained that there is a list of schools, hospitals, clinics and government buildings in the rural areas of municipalities which are approximately 40 kilometres away from an exchange. In terms of priority, schools are considered first, followed by other government buildings such as clinics, hospital, and police stations. Therefore, the current strategy with regard to penetrative broadband focuses primarily on government buildings only. There is no clear strategy in terms of proving penetrative broadband for the general public or rural communities.

Respondent Three

The National Broadband Plan targets certain rural areas, particularly schools, hospitals and most recently, the voting stations. Therefore, the primary focus at present is on schools, hospitals, clinics, and courts, that is government organisations only. The company's long term strategic plans in rolling out broadband into the rural areas of KZN is still unknown.

Respondent Four

There are plans in place which needs to be finalised and approved: *"I don't want to mention things which have not be finalised and have some degree of uncertainty".*

Follow up question: When are these plans expected to take place or materialise?

When the plans have been approved, the company intends moving forward to the next phase which could be during the course of this financial year.

Respondent Five

From this respondent's understanding, the company doesn't have a plan but is working with Government at high levels to formalise the manner in which broadband will be established in remote rural areas of KZN. It is not clear whether budget has been made available for this financial year to kick start the project; it is hoped that this project will gain momentum in the next financial year and the years to follow. From a company strategy perspective there does not appear to be a firm plan in place to go into the rural areas. The partnership with Government is the only thing that will help ensure that this project gains momentum, therefore Government is key to ensuring broadband penetration.

Respondent Six

Except for the National Broadband Plan, there are no plans in place mainly because it doesn't make sense for the company to spend so much to provide penetrative broadband service. This respondent did not know of any strategic partnerships formed within KZN to roll out penetrative broadband in the province. It will be certainly much easier to roll out wireless technology than fixed line. The ICT mobile sector has made good progress in terms of having broadband presence in deeper rural areas of KZN, although perhaps not fast enough.

4.8.2 Question 6: What are your recommendations, if any, for improving penetrative broadband in KZN?

Respondent One

"... getting community buy-in in terms of securing infrastructure"

Follow up question: Are you suggesting forming partnerships?

This respondent felt that partnerships with the community would help protect and safeguard the ICT infrastructure and Government from a funding perspective.

Respondent Two

"I believe it has to be done via the Department of Post and Telecommunication Services (DPTS), they have to engage with the various role players and ensure that funds are distributed purely for that, preventing people from buying themselves out of contracts by not meeting targets."

Follow up question: Are you suggesting the formation of strategic partnerships with key role players?

"Yes."

Respondent Three

This respondent felt that LTE would be the easiest and quickest in terms of deployment. Providing access to customers based on revenue and demand within a particular geographic location, one can then decide to "go fibre" if the demand warrants it, thus providing a better service.

Follow up question: Are you suggesting that wireless is therefore a better option for providing broadband in rural parts of KZN?

Due to the terrain and the geographic set-up of the province this respondent felt that LTE was the more feasible and appropriate technology.

Follow up question: What are your feelings towards partnerships in terms of rolling out penetrative broadband in KZN?

From the government side this would be the correct choice, especially if the decision is to use radio as an option to provide broadband. MTN and Vodacom might have a larger coverage area than Telkom Mobile at present, therefore forming partnerships with these mobile companies will be a step in the right direction especially if wireless is the preferred broadband service. Government needs to take the lead and decide on suitable partners for this type of roll-out.

Respondent Four

This respondent felt that proper market research was essential. Secondly, collaboration with the architects and key decision makers in Government and municipalities. *"I believe we are very poor when it comes to collaboration."*

Follow up question: Do you believe forging collaborative partnerships amongst key role players will help improve collaboration?

Forging partnerships with Government, communities, and possibly other telecommunication companies is one of the ways of going forward.

Respondent Five

Respondent Five felt partnerships were vital. The company has formed strategic partnerships which enabled it to upgrade and deploy various infrastructures in remote rural sites within the

province; this was due to the cash injection made possible through the formation of these partnerships. *"I believe that Government needs to play a leading role here, particularly if you take into consideration the fact that the president mentioned that they want to enable each and every village with broadband connectivity, thus providing connectivity to all. Together with the Government I also believe that the communities have to play and equally important role in terms of educating the people letting them know that the infrastructure is for there to benefit them and the larger communities."*

Respondent Six

According to Respondent Six, there needs to be adequate cable/fibre size feeding the various areas; the existing fibres need to be supplemented with larger ones. Secondly, a combination of both fibre and wireless technologies will ensure wider audience coverage. Finally, the marketing of products is important.

4.8.3 Discussion of Objective 4 results

There were two key questions related to this objective. Feedback from the first revealed that the roll-out plans for penetrative broadband in KZN are sketchy, slow, and unclear. To date, very little has been done particularly by the fixed line ICT sector to provide broadband penetration in KZN. This could be attributed to the lack of return on their investments, theft, geographical challenges and the high costs related to the roll-out of broadband in rural and remote parts of KZN. According to Kelly and Rossotto (2012), there is a lack of interest in the private sector with regard to capital investment in broadband in the rural and remote areas even though Government incentives are in place. Therefore, public sector support is of vital importance to for the support, deployment, operations and lastly, ownership of a broadband network. It is of paramount importance that Government takes the lead and drives the broadband plan not only for KZN but for the entire country if the 2020 broadband vision is to be achieved. Feedback received from the individuals interviewed indicated that the fixed line ICT company is waiting for Government to provide the broadband strategic plan and leadership, particularly in the rural and remote areas of KZN.

Feedback and suggestions received from the second question for this theme pointed in the direction of partnerships, which are taking place at a slow pace, thus hampering the efficient and effective broadband roll-out in KZN. Respondents to this question suggested Government needs to take the lead in forming an efficient and effective collaborative partnership with various key role players, such as other telecommunication companies, the

private sector, and the communities. Government is making some attempt to drive this partnership, for example, the Department of Basic Education in partnership with Vodacom, identified the importance of building ICT resources centres across the country with the objective of fast tracking effective teaching and learning. According to Kelly and Rossotto (2012), privately led ICT companies are extremely effective at growing new services and networks in low and middle income countries. Hence the partnership formed between Government and Vodacom seems to be a step in the right direction. However, Government's current penetrative broadband strategy and objective is primarily focused on schools, hospitals, government building and clinics with little or no focus on the general community in the rural and remote parts of KZN. If this strategy is maintained, this will adversely affect people's right to access information and the right to e-learning due to the lack of ICT infrastructure, particularly in the rural areas of KZN. If Government intends achieving its 2020 broadband vision, then much more needs to be done.

4.9 CONCLUSION

Chapter Four has presented the results from the interviews which were conducted with the key role players responsible for planning, engineering and executing the broadband plan for the fixed line ICT service provider in KZN. The data results were analysed, crossed examined, summarised and linked to the literature reviewed in Chapter Two. The next and final chapter presents the conclusions and recommendations of this study.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The final chapter of this study presents the conclusion and recommendations. It starts with the presentation of the findings from the secondary research which is followed by the findings from the primary research. Conclusions are drawn from the findings and lead to recommendations.

5.2 SUMMARY OF RESEARCH OBJECTIVES

The conclusions drawn from this study are in line with the study objectives as outlined in Chapter One which are:

- To establish the challenges in providing broadband services in South Africa, KwaZulu-Natal;
- To explore the preferred broadband options, Long Term Evolution (LTE) or fixed line, or both;
- To assess the impacts of broadband to the economy; and
- To recommend a strategic plan to deliver high quality penetrative broadband service in South Africa, in particular KZN.

5.3 CONCLUSIONS FROM THIS STUDY

The following conclusions can be drawn from the study:

- KwaZulu-Natal appears not to be taking the rolling out of penetrative broadband seriously, particularly the fixed line ICT provider, despite the progress shown by other African countries such as Kenya, Uganda and Burundi;
- Rolling out broadband requires large capital funding and support from Government;
- Besides a rather vague national Broadband Policy, there are no clear broadband roll-out plans in place for the fixed line provider in KZN;
- Rolling out penetrative broadband requires top management commitment from the fixed line service provider, due to low returns of investment; and

- Rolling of broadband in KZN is hindered by increasing vandalism and theft which is of major concern to the fixed line service provider.

5.4 RECOMMENDATIONS

The following recommendations are based on the above conclusions can be made:

- Ensuring effective and efficient roll-out of penetrative broadband within KZN, requires engagement with key stakeholders such as Government, various telcos, banks, communities, NGOs, aimed at establishing an appropriate and achievable strategic plan to map the way forward for penetrative broadband roll-out. The key stakeholders must meet periodically to ensure the strategic plan is on track and take corrective action when the need arises.
- Government needs to provide financial support to ICT service providers to incorporate penetrative broadband service delivery as part of their business strategy. Financial support from Government takes the form of tax rebates, government grants, and government support for businesses.
- Support from the local communities and traditional leaders may be considered one of the instrumental ways in dealing with and addressing the problem of theft and vandalism of ICT infrastructure. Communities need to be educated and informed of the value and benefits of broadband presence within their communities.
- Government needs to acquire foreign investment and ensure that this investment is being used wisely.
- Private organisations can support the country's broadband drive by either investing or donating funds. In return, Government could make these organisations 'broadband champions' who can form part of Government's broadband steering committee. Alternatively, Government can provide support to these organisations through tax relief or through business transactions.
- Government could consider the option of licensing municipalities to provide ICT services to communities.
- Broadband needs to be made more affordable to all South Africans which will increase the attractiveness of broadband. Government, together with Independent Communication Association of South Africa (ICASA), needs to map a way forward to reduce broadband costs.

5.5 SCOPE FOR FURTHER RESEARCH

This study has focused on the challenges associated with the roll-out of penetrative broadband in KZN by South Africa's national fixed line ICT company. Apart from the lack of penetrative broadband presence in rural areas, there are also concerns over the lack of fixed line broadband in built-up urban areas throughout South Africa. Therefore, a study on factors hindering the presence of high quality fixed line broadband availably in these areas should provide insightful findings regarding the lack of a fixed line broadband presence. Similar studies of this nature could be conducted in other provinces of SA in order to develop a broader view of the state of penetrative broadband in SA.

5.6 CONCLUSION

The final chapter of this study has presented the conclusions and recommendations based on the study objectives in Chapter One. The strategies and decision making processes on factors inhibiting the roll-out of broadband may result in delays if not addressed effectively and timeously. Improved economic growth and development in rural communities in KZN is dependent on broadband infrastructure deployment. The Minister of Communication needs to ensure that appropriate broadband policies are in place to ensure broadband growth and penetration. There are a number of factors that have been identified and examined in this study posing challenges for providing penetrative broadband. One of the apparent reasons why penetrative broadband initiatives are not successful is the lack of coordination and continuity by Government. The South African Government could consider engaging with other countries in similar broadband predicaments.

This study may have developed insights into the challenges affecting the roll-out of penetrative broadband in KZN which have formed the basis of its conclusions and recommendations.

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APPENDICES

Appendix A: Interview questions

Appendix B: Ethical clearance certificate from the UKZN Graduate School of Business

Appendix C: Invitation and consent letter

Appendix A: Interview questions

1. What are your key functions within this company with regards to broadband service delivery and rollout?

2. What are some of the key factors taken into consideration when rolling out or upgrading the broadband network?

3. What are some of the most challenging aspects associated in rolling out broadband service in fixed line ICT Company?

4. How different are these challenges in KZN, if at all?

5. Which areas of the broadband network pose the greatest challenge, the access network that is the last mile or the core network?

6. What is the preferred broadband service offering to customers, Long Term Evolution (LTE) or fixed line, or both?

7. Do you believe that the current broadband growth strategies are considered penetrative? Kindly elaborate.

8. Does the broadband strategy vary from one area to another in KZN region? Kindly elaborate.

9. What understanding do have of the impact that broadband has to the economy?

10. What broadband strategies does your company have in place for rural areas within KZN, if any?

11. What are your recommendations if any, in improving penetrative broadband services in Kwa-Zulu Natal?

Appendix B: Ethical clearance certificate from the UKZN Graduate School of Business

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

15 October 2015

Mr Santosh Manilall (214582945)
Graduate School of Business & Leadership
Westville Campus

Dear Mr Manilall,

Protocol reference number: HSS/1291/015M
Project title: Factors affecting the rollout of penetrative broadband delivery in KwaZulu-Natal

Full Approval – Expedited Application

In response to your application received on 08 September 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]

Dr Shenuka Singh (Chair)

/ms

Cc Supervisor: Dr Emmanuel Mutambara
Cc Academic Leader Research: Dr Muhammad Hoque
Cc School Administrator: Ms Zarina Bullyraj

Humanities & Social Sciences Research Ethics Committee
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Appendix C: Invitation and consent letter

UNIVERSITY OF KWAZULU-NATAL

School of Graduate School of Business and Leadership

Master of Commerce Research Project

Researcher: Santosh Manilall (+27 82 8855 049)

Supervisor: DR E. Mutambara (031-260819)

Research Office: Ms. P Ximba (031-2603587)

Dear Respondent,

I, Santosh Manilall am a Master in Commerce student in the Graduate School of Business and Leadership, at the University of KwaZulu-Natal (UKZN). You are hereby invited to participate in a research project entitled, ***Factors affecting the rollout of penetrative broadband delivery in KwaZulu-Natal.***

The aim of this study is to: Establish the challenges of providing penetrative broadband in South Africa, particularly in the province of KwaZulu-Natal.

Through your participation I hope to understand: What are the some of the major challenges in providing broadband services in South Africa, KwaZulu-Natal? What are the preferred broadband options when it comes to providing broadband services, Long Term Evolution (LTE) or fixed line, or both?

The results of this interview is intended to contribute to the general public in providing them with in-depth understanding as to the reasons why broadband services varies in terms of availability/unavailability and speed.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this research project. Confidentiality and anonymity of records identifying you as a participant will be maintained by the Graduate School of Business and Leadership, UKZN. If you have any questions or concerns about participating in this study, please contact me or my supervisor at the numbers listed above.

It should take you about 45 minutes to complete the interview.

Sincerely

Investigator's signature_____ Date_____

UNIVERSITY OF KWAZULU-NATAL

School of Graduate School of Business and Leadership

Master of Commerce Research Project

Researcher: Santosh Manilall (+27 82 8855 049)

Supervisor: DR Emmanuel Mutambara (031-260819)

Research Office: Ms P Ximba (031-2603587)

CONSENT,

I (Full Name) _____hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

I hereby consent/ do not consent to record the interview.

_____ _____

Signature of Participant Date