UNDERSTANDING THE MARKET AND ACCESS GAPS PRESENT IN SOUTH AFRICA'S BROADBAND INTERNET SECTOR

by Alan Cameron

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"Extreme poverty is almost synonymous with extreme isolation, especially rural isolation. But mobile phones and wireless Internet end isolation, and will therefore prove to be the most transformative technology of economic development of our time." -- Jeffrey Sachs, The Guardian newspaper, 2008

Declaration

I know the meaning of plagiarism and declare that all the work in the document, save for that which is properly acknowledged, is my own.

Signed by candidate

Alan Cameron
15 February 2016

Acknowledgements and dedication

This dissertation has been a family effort and is dedicated to several people whose support gave me the opportunity and ability to complete it:

To my wife, Nicole Cameron, for her constant support, motivating pep talks and for creating the environment for me to complete this work.

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Abstract

Internet access is a prerequisite for meaningful individual and national participation in the knowledge economy and removing barriers to such access serves broader national socio-economic policy imperatives.

This critical review of the literature posed the questions: What is South Africa's current telecommunications context from a Universal Access and Universal Service point of view and does a market gap and / or access gap remain despite efforts to address such gaps since 1994? If so, how do either or both the market gap and access gap appear in the South African context and what are key hurdles that need to be overcome in order to close these gaps?

The review provides a plain language explanation of how broadband Internet access can benefit South Africa's economy, and describes the negligible impact of existing policy in an anti-competitive market environment. A brief overview of South Africa's telecommunications history since 1994 until 2016 helps to contextualise the sector.

In the early 1990s, 2% of South Africans had access to voice telephony. A few years later Universal Service and Access regulation was overtaken by the rapid adoption of mobile phones. With more than 40% voice telephony domestic penetration the network effect of quicker communication stimulated the domestic economy. Having achieved Universal Access objectives relating to voice communications, today nations seek the compounded advantages from the network effect of broadband Internet access.

South Africa's GDP is predicted to grow by 1.34% for every 10% increase in broadband penetration, through increased productivity, job creation and greater access to cheaper services. However almost two thirds of South Africans cannot afford Internet access; and neither action by the free market nor the state is effectively increasing levels of cheap, accessible Internet.

Incumbent service providers dominate the South African telecommunications sector and have little incentive to accelerate Internet access and adoption to low-income households and areas outside of the major metropolitan areas. It is therefore necessary that policy facilitates: competition in the ICT product and services sector, effective spectrum management, productive Internet use by low-income households and user demand for online content.

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Acronyms, Abbreviations and Definitions

- **1GB of data:** One gigabyte of data allows an average of 1000 emails and about 20 hours of browsing online.
- **Access gap:** Seen at the limit of market impact, what Nava-Sabater et al. term the "affordability frontier" (2002), where the private sector cannot service groups without intervention, despite ideal market conditions (Navas-Sabater, Dymond, & Juntunen, 2002)
- **Asymmetric and symmetric interconnection rates:** These rates are those that telecommunications network operators charge one another to allow their subscriber to receive calls from outside their own subscriber network. The connection between one network to another incurs a cost, known as the interconnection rate. This is paid by the operator whose subscriber *receives* the call. The symmetric interconnection rates sees all operators pay one another the same rate for the connection, handover and termination of the call no matter how many calls are terminated on any one network. The asymmetric approach sees the larger operators, with the greatest subscriber base and thus generating the most calls, pay a higher rate than their competition with less market share (thus receiving fewer calls). This model can potentially be utilised by larger operators, who can subsidise – through revenue from higher interconnection rates in denser, urban areas – rural and remote places in the country.
- **Broadband Internet:** Broadband can be defined through its functionality in creating an "ecosystem of high capacity, speed and quality electronic networks, services, applications and content which enhance the variety, uses and value of information and communications for different types of users" (RSA 2013). Its second definition is related to its speed. The speed definition needs continual revision due to growing demands placed on the network; in 2006 the OECD defined it as download speeds "equal to or faster than 256 kilobits per second (kbps)" (2006) and in 2015 the United States Federal Communications Commission increased their definition to download speeds of at least 25 megabits per second (mbps) (Ellison 2015).
- **Consumer surplus:** The difference between the total amount the consumers who are willing and able to pay for a good or service and the total amount that they actually pay for it (the market price) (Riley 2014).

- **Gross Domestic Product (GDP):** A term to denote measurement of the size of a national economy. Defined as "an aggregate measure of production equal to the sum of the gross values added of all resident, institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs)" (OECD 2002).
- **ICT:** Information and communication technology
- **Internet economy:** Consists of the section of the economy stimulated through access and use of the Internet, and includes the required infrastructure investment and maintenance spend. Besides infrastructure this includes money spent on online retail, advertising and private and public use of the Internet (Goldstuck 2012).
- **Kilobits per second (kbps):** A unit of transmission speed, equal to 1000 bits passing a point per second (bytes are usually used to express storage capacity, while bits are used to express data signalling rates) (Weik 1997).
- **Knowledge workers:** Those performing knowledge-rich jobs. Such workers are typically but not universally well-educated. Some knowledge workers have high levels of literacy and lower levels of education, implying that basic skills obtained beyond education are recognised in the knowledge economy (OECD 2001).
- **Last mile:** Also known as the Access Network, it is the initial network users connect to in order to access the Internet.
- **Market gap:** The difference between how current market conditions limit the private sector's ability to fully meet residents' ICT needs and what optimal market conditions would allow.
- **Megabites per second (mbps):** A unit of data signalling rate (DSR) equal to one million bits per second (Weik 1997).
- **Teledensity:** Proportion of fixed telephone lines per person.
- **Telephony:** Transmitting speech at a distance.

Preamble part 1: A brief overview of the South African ICT sector

What is happening in ICT in South Africa authored by Alison Gillwald, Mpho Moyo and Christoph Stork (Gillwald et al. 2012) gives a helpful overview of the domestic ICT sector and part of this report is paraphrased below to introduce the sector to those unfamiliar with it:

The South African ICT sector is growing, encouraged by the consumer demand of mobile phones where 86% of adults own one. This high ownership rate can distract from the low levels of smartphone ownership and use – important as Internet access provides significant economic opportunity to individuals and the country. Only about a third of South Africans can afford to own a smartphone and use it to access the Internet. Levels of affordability of these devices and the communication services they offer are very low compared to countries similar to South Africa. This is mainly a result of sector policies which invite neither investment nor institutional arrangements encouraging competition.

This is particularly noticeable in the fixed-line segment, to the extent that the high price of wired broadband acts as a barrier to national economic growth. Prepaid mobile products, such as voice or data bundles also reflect this high affordability threshold and the cheapest prepaid mobile product was found to be almost 7.5 times more expensive than elsewhere in Africa.

Telkom's dominance of the fixed-line market continues unchallenged while the first and second mobile network operators, Vodacom and MTN respectively, hold an entrenched position together of about 80% of market share. Practices by dominant players have been characterised by price matching, poor quality of service and anti-competitive behaviour. Regulation, the introduction of a further two mobile network operators and a single fixed-line operator, and other measures have done little to markedly make participation in the ICT sector more affordable for the majority of South Africans. This minor dissertation further examines the context of the South African ICT sector and focuses on how the state and the market can move to make Internet access more accessible.

Preamble part 2: How does Internet infrastructure work?

Emmanuelle Auriol and Alexia Lee González Fanfalone provide a useful explanation that is paraphrased here (2014): Internet infrastructure, also known as a broadband network, is made up of three distinct networks connected together to deliver the online experience.

The access, core and backhaul networks each have a distinct role. The user interacts with the access network either through a wireless (i.e. 3G or Wi-Fi) or wired (i.e. copper or fibre) connection.

The access network connects over the last mile to a backhaul network. In the case of a wireless connection, the user would first connect to an Access Point (AP) using spectrum specific to Wi-Fi, or that of a cellular tower; this AP or cellular tower is connected to a backhaul network.

The backhaul network is the intermediate link (also known as the metropolitan network) made up of fibre or microwave links, between the access network and the core network.

The core network (also called the 'backbone') is encompassed in the national backbone network and is often created of fibre. It is useful to think of this backbone network as a national highway of Internet data traffic which connects to international submarine cables or Internet Exchange Points. Different types of technology are used for each network.

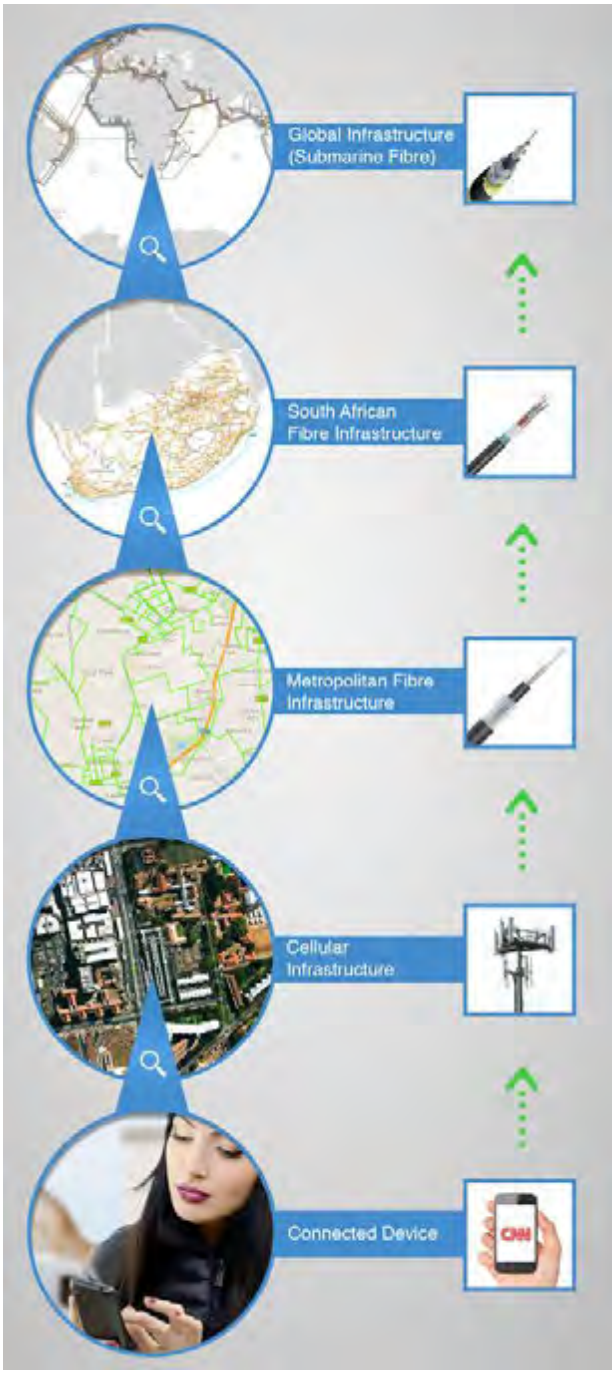


Figure 1. How separate networks connect to create Internet-enabling infrastructure (Delport 2014).

Figure 1 above illustrates the different elements of a broadband network and the types of technology used for each of these network elements (Delport 2014).

Chapter 1: Introduction

Two-thirds of South Africans are offline, unable to access the Internet. This is despite a vibrant domestic telecommunications sector with two fixed-line telephony companies, four mobile network operators, a proliferation of virtual mobile network operators, multiple Internet service providers and five high-capacity fibre submarine cables connecting the country to international Internet infrastructure.

In line with Moore's Law[1], civilisation's advancements in technology have pushed down the price of hardware in each stage of the physical infrastructure requirements of Internet access – from the undersea fibre cables to the smartphone in your pocket. Cooper's law, a related but separate law, has proven true regarding increased efficiencies in the use of radio spectrum (which transmits bandwidth) – its capacity for voice and data doubles every 30 months.

Despite these constant, rapidly-increasing efficiencies, the price of bandwidth remains too expensive for two-thirds of South Africa's population (Calandro, Gillwald, et al. 2012; Stork et al. 2013), as well as the globe's (Deloitte 2014), which is mostly made up of low-income households in developing nations.

This is, firstly, because the market is not willing to invest in a business model that would probably yield a low return (if any) and, secondly, because many state authorities cannot afford to do so, do not regard it as a priority, or do not have the skills to roll out the projects and programmes necessary to ensure an idea like this would run effectively.

Where conditions exist that encourage market-led investment, such as in many of South Africa's urban areas, the private sector not only meets the demand for area-specific ICT services through infrastructure investment but, compelled by the competitive market environment, players innovate and upgrade infrastructure regularly. This empowers those *already* online through increasingly cheaper access to better goods and services, thus fuelling the virtuous cycle of the ICT sector's growth and its increased impact. But only for those who can afford it. Those who cannot are found

[1] Moore's Law is a statement that is taken as fact referring to advancement in the field of microprocessors. It expresses that the processing power doubles about every two years, especially relative to cost and size (Merriam-Webster.com 2015).

on the wrong side of a 'digital divide', highlighting the stark opportunity disparities between those offline and those online.

As much of the ICT sector has its roots in telecommunications I therefore begin this minor dissertation reviewing literature to explain the origins and evolution of voice telephony towards reasonable access levels (Universal Access) and commonplace household access levels (Universal Service). I also examine how national economies benefit from universal telephony, as well as universal broadband Internet access and service. Moreover, I look at how the post-1994 South African national government responded to this perspective. Lastly, I review the current South African telecommunications context to discover if there is Universal Access to broadband Internet or if either or both a market[2] or access gap[3] is present.

With the literature highlighting the existence of these gaps, I then investigate the key hurdles in closing these gaps, so that domestic officials and policy makers can use the recommendations to close the digital divide and bring the communication advantages made possible by modern ICT to the South African public.

1.1 Research questions

- What is South Africa's current telecommunications context from a Universal Access and Universal Service point of view and does a market gap and / or access gap remain despite efforts to address such gaps since 1994?
- If so, how do either or both the market gap and access gap appear in the South African context and what are key hurdles that need to be overcome in order to close these gaps?

1.2 An explanation of the methodology

The technique used to show the gap in knowledge central to the research questions is that of a critical literature review. The influence of this non-empirical method is visible throughout the minor dissertation, in the type of information available, as well as its analysis and recommendations formulated.

[2] A market gap is the difference between how current market conditions limit the private sector's ability to fully meet residents' ICT needs to what optimal market conditions would allow.

[3] An access gap is seen at the limit of market impact, where the private sector cannot service groups without intervention despite ideal market conditions.

1.3 A map of the minor dissertation and nature of the conclusions

Eight chapters provide the structure of this minor dissertation:

Chapters 1, 2 and 3 introduce the initial concepts of Universal Access, Universal Service, Market Gap and Access Gap to familiarise the reader with the sector-specific concepts referenced in the research questions.

Chapter 4 finds similar benefits between the network effect of Universal Access in telephony and broadband Internet, setting out why and how telecommunications infrastructure stimulates economic growth and wealth redistribution through decreased costs and increased productivity in both the private and public sectors.

Chapter 5 explains how the post-1994 South African national government responded to this perspective through the industrious growth of Telkom's wired network, however many gains were nullified as the parastatal's mandate changed, and it disconnected of defaulting account holders.

Chapter 6 gives an overview of the South African telecommunications environment, examining how residents access and use the Internet, the role affordability plays in determining access, and the relevance of online information to low-income households.

Chapter 7 presents the conclusion that there is both a market and access gap present in South Africa, mostly due to the mishandling by the state of the ICT environment which inhibits the regular efficiencies of the private sector to meet the market demand. Besides unstable state oversight, a stagnant policy environment and Telkom's muddled priorities are also held up as key barriers to addressing the market and access gap.

Chapter 8 features recommendations to bridge the digital divide, highlighting the critical barriers around data and device costs, policy and the lack of demand stimulation and user skills. Open access, infrastructure sharing and the dismantling of USSAASA into an effective, focused organisation are identified as practices which would increase levels of Internet access.

Chapter 2: Universal Access and Universal Service

2.1 Defining and contextualising Universal Access and Universal Service

Universal Access (UA) allows people "the right to spend a proportion of their income on communicating, saving them costs elsewhere and improving their productivity," explains Andrew Dymond (2002).

At the level of national government, UA refers to a state objective to provide broad public access to information and communication technologies (ICT) and so through the immediacy of modern communication technology increase the rate of economic opportunities, productivity, learning and exchange within the economy.

The actualisation of these opportunities by individuals and organisations across the breadth of the economy makes it, in turn, more resilient, culminating in greater productivity and, therefore, economic growth.

Public payphones and library-based Internet workstations are often state-enabled expressions of a programme promoting UA, where these facilities are intended to be available in proportion to the population of the area or within walkable proximity of households (Dymond & Oestmann 2004). Adding to this general definition of UA, Sooful (2015) notes that the use of the ICT infrastructure needs to be affordable in order for the public to find it truly accessible and so use it in their daily lives to enhance the rate of local economic growth.

Universal Access is distinct from Universal Service (US). US indicates a context that contains a high level of saturation of ICT services. This can be seen in the proportion of homes and individuals in developed economies who have immediate access to the Internet through home use, as well as personal use through their Internet-enabled mobile phone (Blackman & Srivastava 2011). Developing economies usually pursue a UA policy in the short-to-medium term to ensure general convenient ICT access and so facilitate US to take effect over the long term (Dymond & Oestmann 2004).

2.2. Pursuing broadband Internet and telephony simultaneously

The rapid spread of mobile communications extends ICT's reach further and quicker than fixed-line infrastructure. This occurs as a result of having fewer physical barriers and now allows nations to

pursue UA for broadband Internet and US for voice telephony simultaneously (Blackman & Srivastava 2011). This leads to the use of universal access and service (UAS) “as a portmanteau policy term” (Lewis 2013).

Developed economies mostly had policies facilitating US for fixed-line telephone access, and with the definition of UA including “broadband availability and affordability” (Blackman & Srivastava 2011), these nations began adopting a UAS approach. According to Blackman & Srivastava, expensive broadband Internet may restrict it from ever becoming a universal service found within each household, even in the developed world (2011).

Modern definitions for UA and US of information and communication technologies include (Blackman & Srivastava 2011):

- Availability (meaning that it is available through public, community, shared or personal devices);
- Accessibility (everyone can use the service irrespective of location, “gender, disabilities and other personal characteristics”);
- Affordability (all citizens can afford the service).

This understanding of UA, US as well as UAS is incorporated into Chapter 3 which defines and contextualises the market gap and access gap.

Chapter 3: Market gap and access gap

3.1 Defining and contextualising the market gap and access gap

This degree of availability, accessibility and affordability of information and communication technologies directly promotes or prohibits the degree of penetration it experiences within the local, regional and national economic environment.

The process of enabling each of a country's residents to access voice telephony or the Internet looks to overcome two similar but distinct challenges. They are known as the market gap and access gap (Dymond & Oestmann 2004).

3.1.1 The market gap

Firstly, the market gap is seen as sections of the population that experience neither UA nor US. It is called a 'gap' as the market is unable to reach those sections of the population in the specific market economy of the region.

The market economy refers to a type of economy where decisions by the private sector around investment, production and distribution are based on the supply and demand of goods and services. In evaluating the factors which govern the market economy, the dynamics of supply and demand compel the market to create the conditions in which information and communication technologies are found to be available, accessible or affordable.

The market gap is the degree to which the market does not meet the UA or US needs of the population. Typically the market gap is closed through the creation of a pure free market economy where the prices for goods and services are set transparently through the influence of supply and demand. That is, as Dymond (2002) states, "the gap between what an imperfect market achieves in terms of reach and what a perfectly liberalised market would achieve."

3.1.2 The access gap

Secondly, the access gap is seen at the limit of market impact, what Navas-Sabater et al. term the "affordability frontier" (2002), where the private sector cannot service groups without intervention despite ideal market conditions (Navas-Sabater et al. 2002; Dymond & Oestmann 2004).

Typically, governing authorities attempt to implement policies and regulations within these market economies that, while allowing the private sector to lead through investments into the network and other services, ensure that this gap is closed (Navas-Sabater et al. 2002; Dymond & Oestmann 2004).

Therefore, governments seek to create an environment in which UA and US can become realities. They attempt this by creating a balance between the dynamics of a market economy and the contextual realities of the region in question; this should ensure information and communication technologies are available, accessible and affordable.

The concept of these two gaps is illustrated below, showing existing customers in the bottom left. Applicable to most low-income nations, the benefits of the telecommunications network only reach the minority of people who can afford the service (Dymond & Oestmann 2004).

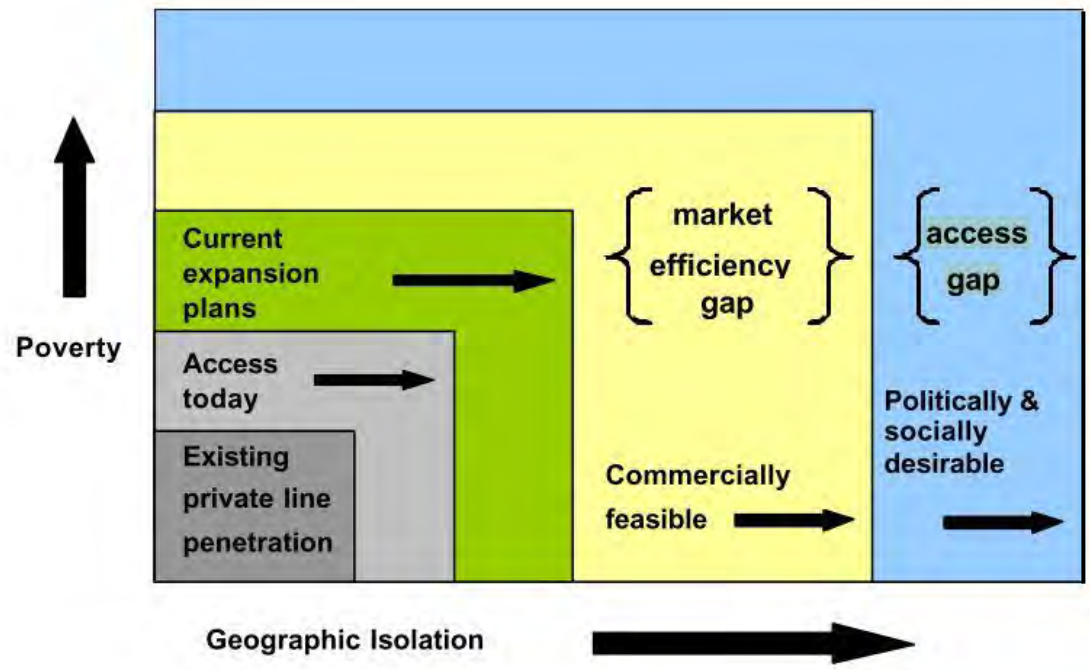


Figure 2.2 Illustration of market gap and access gap (Dymond & Oestmann 2004)

In the event that poor households or rural, isolated communities are not serviced by the market, additional stimulation is required, through state support or incentives, to motivate the market to reach further and so extend access. This is often what a universal access policy aims to achieve: that is, "extending the market into marginal areas" (Dymond & Oestmann 2004).

Dymond and Oestmann caution that although the steps appear sequential, the most favourable results are achieved in parallel where policies aimed at the access gap do not interfere with the market's solutions (2004).

In looking to understand South Africa's current levels of UA and US, and if either or both a market gap or access gap exists, it is also important to understand the economic advantages gained by a nation whose economic and policy environment encourages UA and US. This is the specific focus of Chapter 4.

Chapter 4: How does Universal Access for telephony and broadband Internet benefit national economies?

4.1 Benefits of Universal Access: Telephony

Part of the benefit of increasingly efficient communications technologies is the costs that are saved by these efficiencies, as well as by increased productivity (Dymond 2002); this was noticed with the increased household adoption of the telephone, enabling universal telephony (Röller & Waverman 1996).

Röller and Waverman's landmark study states that focused investment in telecommunications infrastructure does stimulate economic growth as, with other industry specific infrastructure investments, the uptake of the hardware increases sector-wide demand on each element of the production value chain (1996).

However, unlike regular infrastructure, the returns in telecommunication infrastructure exceed market stimulation of the sector, noticed primarily in decreased business costs. Where communication between companies is limited, the environment typically contains high costs of services pertaining to ordering, research and discovery. Nevertheless, the introduction of an effective telephone network not only decreases these business costs, but increases productivity. Hardy's statement, as cited in the Röller and Waverman study, has proved true: "If the telephone does have an impact on a nation's economy, it will be through the improvement of the capabilities of managers to communicate with each other rapidly over increased distances" (Röller & Waverman, 1996, cite Hardy, 1980).

The opportunity to communicate instantly increases the capacity of companies to take part in new productive activities. The important nature of this effect strengthens "as the information intensity of the production process increases". This results in the telecommunication investments directly benefitting a wide variety of sectors and so aiding economic growth (Röller & Waverman 1996).

Röller and Waverman establish a link between their observation about improved communication and the national investments in telecommunications – the investment spills over and creates externalities to those observations of other regular infrastructure pertaining to sanitation, water, transport and electricity (1996).

The influential study by Aschauer (1989) suggests that, “the stock of public infrastructure capital is indeed a significant determinant of total factor productivity growth,” and points out huge returns to public infrastructure investment. However, Röller and Waverman say, “a growing number of papers” point out “severe simultaneity bias and spurious correlation” in Aschauer’s findings. They contend that after these results are econometrically controlled, the returns are “much reduced”. The risk is similar reverse causation and false connections existing in telecommunications infrastructure (1996).

Reverse causality is seen when the increase in economic development is ascribed firstly to the increase in infrastructure and associated services, and secondly that the increased economic growth goes on to fuel demand for the very same sector, in this instance telecommunication services (1996).

Röller and Waverman go on to specify a structural model that accounts for this, as well as country-specific effects of spurious correlation that come about when other growth-promoting measures, such as taxes or investments in education, are falsely ascribed to the telecommunications sector (1996).

Unlike regular infrastructure, telecommunication enables network externalities: the more users, the more value is derived by those users. And, as this effect is not present in a similar manner in regular public infrastructure, investments in telecommunications infrastructure lead to higher growth effects (Röller & Waverman 1996). The authors then pose the question: *What if this impact is not linear and a growth impact increases once a significant network size is realised?* In doing so they verifiably discovered that once the critical mass of 40% penetration rate is achieved, the return on investment sharply increases (Röller & Waverman 1996).

In 2002 Navas-Sabater et al. cite figures from the International Telecommunications Union showing a straight-line correlation between a nation’s fixed-line telephone penetration rate and its GDP (Figure 3 on next page), illustrating that the more households with direct access to a telephone, the more residents contributed to the nation’s economy (Navas-Sabater et al. 2002).

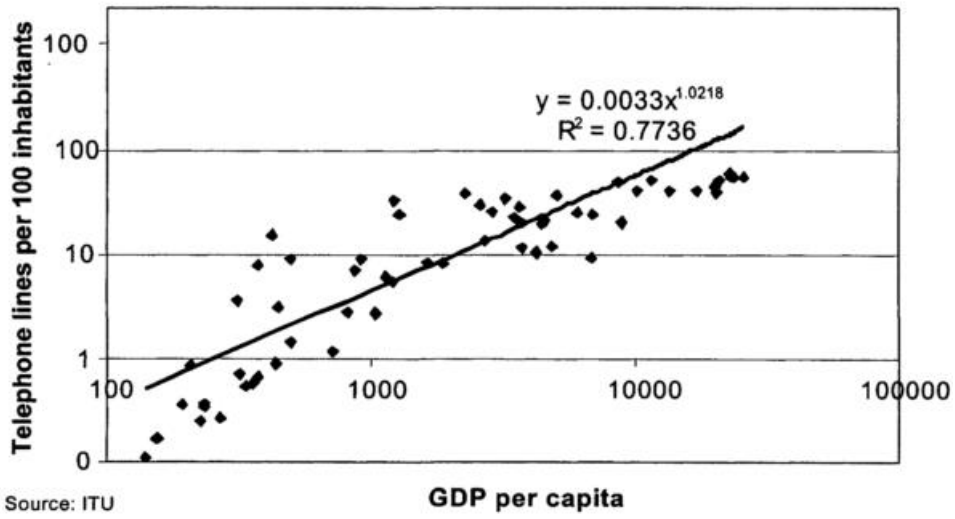


Figure 3. Telephone penetration as a function of GDP per capita (Navas-Sabater et al. 2002)

4.1.1 Telephony penetration rates in Africa

In the 1990s many African countries started a telecoms-reform process with universal access to voice communication services at the centre of policy concerns. They were faced with a fixed-line penetration base of 2%, a legacy of the previous fifty years of state delivery. Even around 2004, with the arrival of mobile voice penetration, many nations were struggling to achieve a penetration rate of 40% (Gillwald 2014), understood to be the tipping point at which network effects catalyse economic growth, employment and innovation (Röller & Waverman 1996).

The proliferation of mobile phones has made these opportunities increasingly available in many developing economies where fixed-line infrastructure is not common enough to achieve UA. Even where fixed-line services are available, mobile services provide a more affordable choice when looking to make a low number of outgoing calls and for incoming calls to be received at no cost (Oestmann 2003; Gillwald 2014). In most instances the price of mobile calls is generally more expensive than fixed-line calls, especially as often a single price is set for calls across the network – even for local calls. This price, in many cases, is unaffordable as seen by the high use of free messaging mechanisms such as the 'Please Call Me' messages Vodacom subscribers can send (Esselaar et al. 2010). The service, also referred to as "beeping" or "flashing", is exceedingly popular and in 2014 the network registered that fourteen billion 'Please Call Me' messages were sent (Shapshak 2015a).

As local calling using fixed-line telephony is far cheaper than using mobile, the technology becomes increasingly affordable as the number of outgoing calls increases.

A further advantage of fixed-line telephony is the variety of its uses such as transmitting documents via fax, scanners converting hard copies into digital copies, as well as facilitating Internet access. These factors initiated the formation of telecentres (Oestmann 2003; Hodge 2003).

According to Dymond & Oestmann (2004) prevalent socio-economic benefits of telephony are as follows:

- **Businesses** save several times the amount spent on telephone services in efficiency gains in travel time, stock control, logistics, sales calls and other business functions.
- **Farmers and micro-business owners** gain accurate, geographically-relevant information on market prices and so are able to earn more for their product.
- **Rural farmers, women micro-business owners, and students** find at least a third of their phone calls require them to "deliver a message, secure an answer or respond to problems." The more isolated the community, the larger the increase in opportunity cost through saved time and travel.
- **Individuals** benefit when not having to incur travel and other costs during family emergencies. Other benefits include lower health risk, better family relationships and more opportunities.
- **Institutions and government agencies** are able to deliver services more efficiently.
- **Students and others**, having learned how, they can access courses, business information, teaching material and more, are benefitted in their future business endeavours.

4.1.2 Remarks

With a local South African mobile phone penetration rate of just under 75% (GSMA Intelligence 2014) and a 96% national coverage claim by mobile service providers (Vodacom 2015) enabling a Universal Service-level of access to voice telephony, South Africa has joined the worldwide shift in focus towards broadband Internet access as the next Universal Access milestone.

This massive progression from the 2% telephony penetration rate seen in the 1990s shows the leapfrog effect mobile ICT technology had in South Africa to create the current Universal Service-level of access to voice telephony.

4.2 Benefits of Universal Access: Broadband Internet

Like road, rail and electricity, the fiscal-enabling environment that broadband facilitates will enable the surrounding nation – or neighbourhood – wide environment to evolve through new economic activities and gain "competitive and comparative advantages" (Crandall & Jackson 2001; Whisler & Saksen 2003; Qiang et al. 2009). The unpredictable new benefits of each utility were easily and

fundamentally adopted into daily life. Broadband Internet is being viewed as on par with these game-changing technological advancements which redefine human civilisation.

Broadband is either defined through its functionality to create an "ecosystem of high capacity, high speed and high quality electronic networks, services, applications and content that enhances the variety, uses and value of information and communications for different types of users" (RSA 2013), or through speed. This speed definition needs continual revision due to growing demands placed on the network; in 2006 the OECD defined it as "download speeds equal to or faster than 256 kilobits per second (kbps)" (OECD 2006) and in 2015 the United States' FCC increased their definition to download speeds of at least 25 megabits per second (mbps) (Ellison 2015).

This movement of, and access to, information that then matures into knowledge is a key step to improving living conditions. As such, tools for the gathering and processing of information are key to lifting households out of poverty in both developed and developing economies through effective wealth generation and redistribution (Navas-Sabater et al. 2002).

The rate of adoption of broadband within a country is often a key factor for international investors exploring opportunities in a particular territory. Developing economies featuring better ICT infrastructure attract more direct foreign investment, particularly in offshoring, outsourcing, and foreign investment sectors (Abramovsky & Griffith 2005) and, as a result, trade more (Qiang et al. 2009).

Catalysing productivity and GDP growth, creating jobs and increasing the availability of cheaper products, services and applications are some benefits of broadband Internet (Greenstein & McDevitt 2009; Katz 2012; Qiang et al. 2009). Research findings, including key contributions from Raul Katz and Christine Zhen-Wei Qiang have included the following benefits:

- **Increased productivity** and the resultant growth in GDP by 1.34% in low-to-medium income economies, like South Africa's, for every 10% increase in broadband penetration was found in a study by Qiang el al. (2009).
- **Job creation** and sustained employment benefits found by Katz et al. (2010), as part of a report on the German National Broadband Strategy.
- **Increased access to cheaper services** saved consumers around $7.5-billion between 1999 and 2006, reported Greenstein and McDevitt (2009).

4.2.1 General contribution to economic growth

Average impact on GDP growth, how various industrial sectors benefit differently and increasing national exports are some examples of the impact of broadband on economic growth. The overall "significant" positive impact of broadband on economic growth is corroborated by each author cited (Crandall et al. 2007; Czernich & Falck 2009; Thompson & Garbacz 2008; Koutroumpis 2009; Qiang et al. 2009), despite varying results (Katz 2012).

Katz explains that the limited amount of data available has forced the analysis to focus principally on Western Europe and North America (2012).

Table 1. Research results of broadband impact on GDP growth (Katz 2012)

Country	Authors – Institution	Data	Effect
United States	Crandall et al. (2007) Brookings Institution	48 States of the US for the period 2003-2005	Not statistically significant results
	Thompson & Garbacz (2008) Ohio University	46 US States during the period 2001-2005	A 10% increase in broadband penetration is associated with 3.6% increase in efficiency
Organisation for Economic Cooperation and Development countries (OECD)	Czernich & Falk (2009) University of Munich	25 OECD countries between 1996 and 2007	A 10% increase in broadband penetration raises per-capita GDP growth to 0.9-1.5%
	Koutroumpis (2009) Imperial College	2002-2007 for 22 OECD countries	An increase in broadband penetration in 10% yields an increase of 0.25% in GDP growth
High income economies	Qiang et al. (2009) World Bank	1980-2002 for high income economies	10% increase in broadband penetration yielded an additional 1.21% of GDP growth
Low and Middle income economies	Qiang et al. (2009) World Bank	1980-2002 for the remaining 120 low and middle income countries	10% increase in broadband penetration yielded an additional 1.38% in GDP growth

Katz points out the inconsistency in results is probably caused by:

1. Different sets of data,
2. Differences in the way the datasets were structured,
3. Grouping all data for a nation in one set (this ignores differing results from regions affected by local issues),
4. Different results in regions caused by local data at a country-wide level, as seen in Qiang et al. (2009) where dummy variables were used for Africa and Latin America. Katz suggests this over-estimates the impact of broadband on GDP growth (2012).

4.2.2 Rate of economic contribution

Findings suggest that after 20% of the population – a "critical mass" (Koutroumpis 2009) – is connected and able to benefit from broadband's functionality, economic growth accelerates in many different ways (Katz 2012). This facilitates a virtuous cycle of increasingly convenient economic behaviours, each incrementally affecting their individual economic impact (Katz 2012), also described as the "accumulation of intangible capital" (Katz 2012; Lehr et al. 2005; Basu & Fernald 2006).

But the rate of economic growth is not linear: broadband will be adopted early by those with the most to benefit; those who adopt it later will benefit less, comments Lehr (2005), and the peak benefit occurs after achieving critical mass and before market saturation point (Katz 2012).

This is shown in the following illustration:

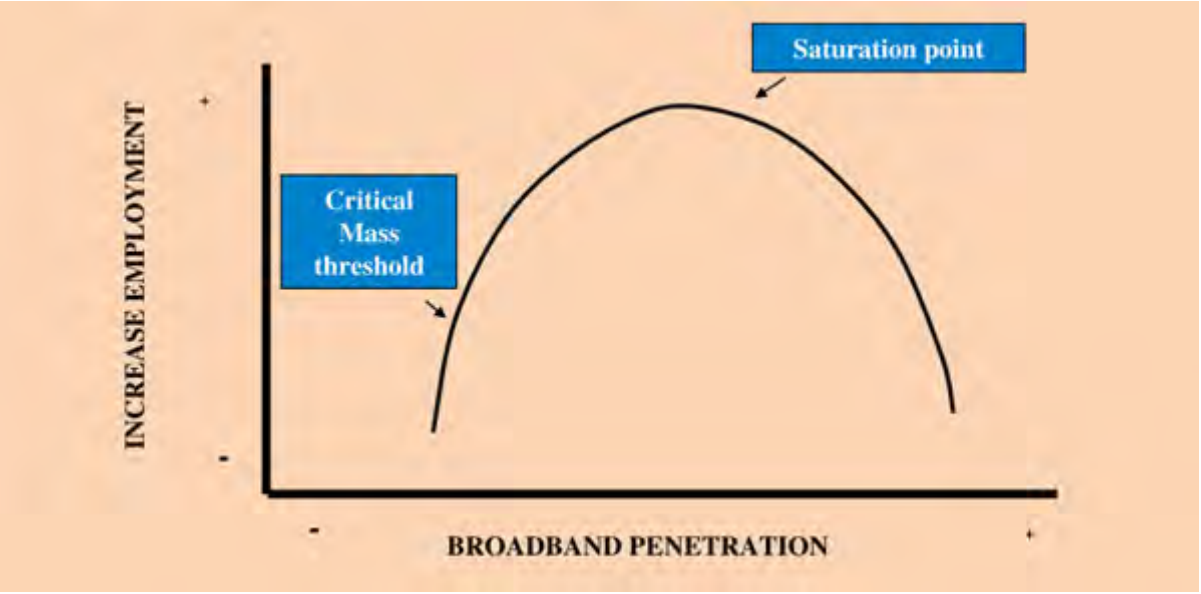


Figure 4. Impact of broadband on employment (Katz 2012)

Developing countries must therefore *first* reach high levels of penetration before sizeable economic impact would be felt, points out Katz (2012) who refers to Koutroupis' diagram illustrating OECD nations' benefit from widespread broadband adoption (2009).

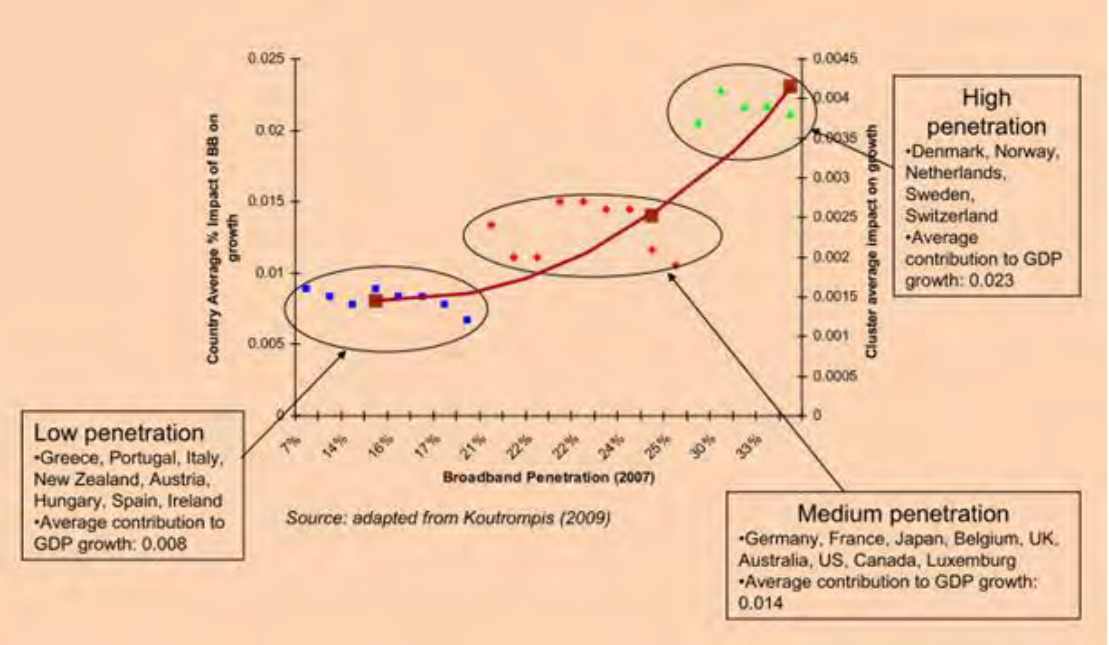


Figure 5. OECD: Percentage of impact of broadband on GDP growth (Katz 2012; Koutroumpis 2009)

Fundamental to this is the impact that institutional contexts, like labour market regulation, have on models that connect broadband to productivity. Broadband deployment needs to be supported by state policy encouraging training and consultation programmes to firms and SMEs to help maximise the return on investment, says Katz (2012), agreeing with Van Ark et al. (2002).

4.2.3 Effective wealth redistribution

These findings corroborate those of Navas-Sabater et al. when in 2002 the authors showed that the incomes of the poor grew more quickly in telecommunications-intensive economies: "In the last few years, a faster growth in the income of the poorest 20% of the population has been experienced by countries where the telecommunications sector is delivering its full potential to the economy, that is, where sector revenues account for 2 to 3 percent of GDP."

This economic growth is broadly attributed to the three economic areas shown in Figure 6 on the next page: increased productivity, job creation and increased access to cheaper services.

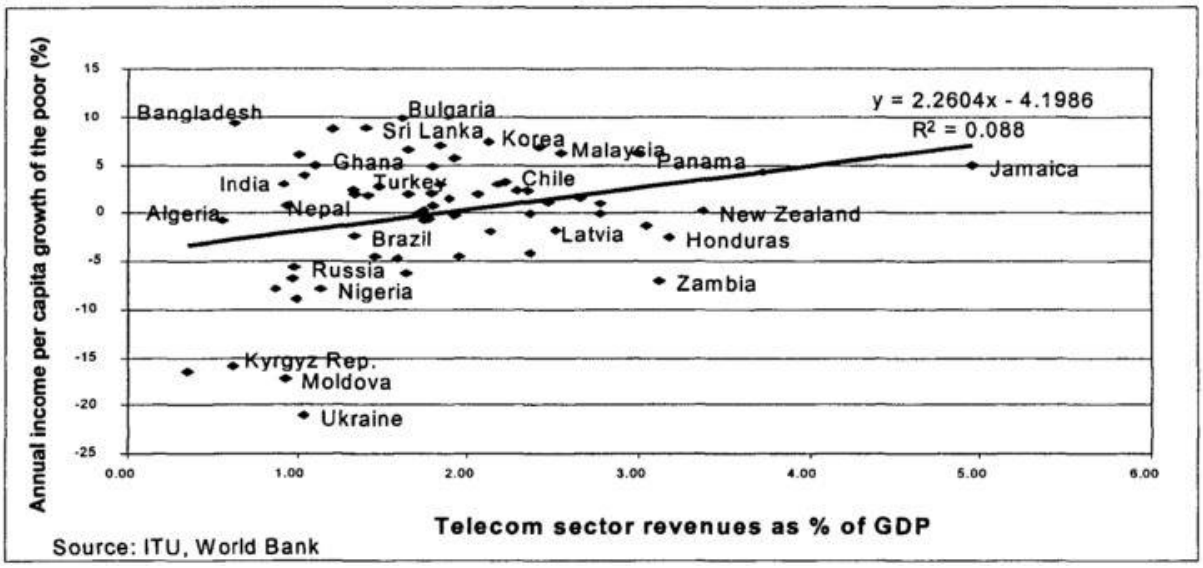


Figure 6. Income of the poor grows faster in telecom-intensive economies (Navas-Sabater et al. 2002)

4.2.4 Increased productivity

Economically-active residents who process information across all economic sectors rely heavily on the capital used to upgrade ICT processes (Navas-Sabater et al. 2002) and especially broadband (Katz 2012). This understanding is based on a 2009 study showing "the larger the percent of the workforce dedicated to information generation and processing is, the higher the proportion of capital stocks invested in the acquisition of ICT infrastructure", according to Katz (2012). Seen below, the greater the proportion of information workers (here after referred to as 'knowledge workers') in a country, the more capital is invested in information technology.

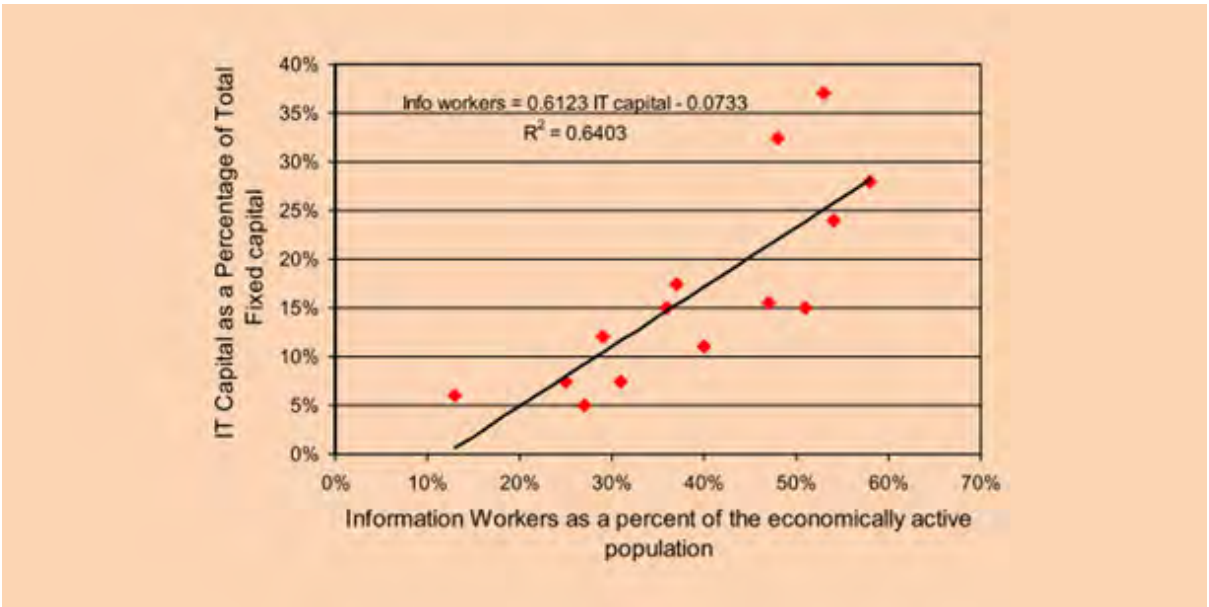


Figure 7. Knowledge workers and ICT investment (Katz 2012)

4.2.5 Theoretical explanation of ICT and productivity

Katz cites Charles Jonscher's 1982 dissertation, illustrating it below, suggesting a direct link between growth in knowledge workers and the adoption of technology to improve their productivity on a broader scale; this can be discovered by measuring a firm's micro-economic impact of ICT (2012).

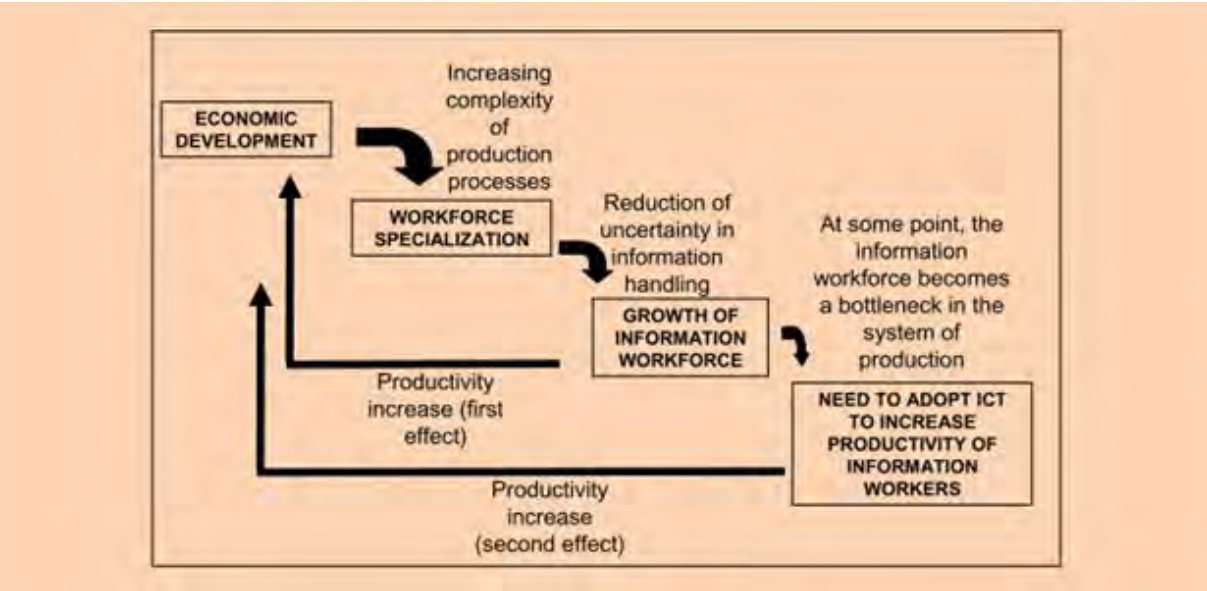


Figure 8. Causality model: ICT innovation and diffusion is driven by the growth of knowledge workforce (Katz 2012)

Katz explains the interdependent links in Figure 8 as follows:

As economic growth leads to more multifaceted-production processes, likewise the dynamics required to govern this become more intricate.

Knowledge workers are hired to process information to better organise the production of goods and services. As even more workers are hired to cope with – and increase – the complexity of information processes, they themselves become a bottleneck. Advances in information and communication technologies are then increasingly employed to maintain an efficient level of information processing and manipulation: extracting the required data, analysing it to create useable information and so allowing for it to be put into practice as knowledge.

While not having an economic impact in itself, broadband is an *enabler* in this virtuous cycle of productivity (Katz 2012).

4.2.6 Direct link between ICT and productivity

This enabling factor can be applied to broadband through a study done by Waverman (2009) in order to understand the economic contribution that broadband made to fourteen European nations and the United States between 1980 to 2007. Productivity increases by 0.13 percent for each

percentage increase in broadband penetration in high and medium income nations, while those with low broadband access (Greece, Italy, Portugal, Spain and Belgium) saw no productivity increase. The study deduced that, before improving productivity, widespread ICT and broadband adoption was needed. Once achieved, the average productivity of the nation increased.

The focus areas of private firms, public service and wealth redistribution are addressed below:

A. Private firms

The productivity gains of modern ICT technology are facilitated mainly through the adoption of new contextually-relevant business practices, including training and creating an environment that encourages entrepreneurialism and an adaptable organisation. This too applies to broadband, Katz states: "Both management and economics literature have shown that it is necessary to modify business practices in order for information technology to impact firm efficiency" (2012). This accumulation of intangible capital drives the impact on efficiency and productivity (Basu & Fernald 2006; Katz 2012).

Access to telecommunications, information services, and ICT in general, allows the user to contribute their knowledge and in doing so increases productive activities, according to Navas-Sabater et al., mainly referring to the universal service of fixed-line voice communication (2002).

This past finding is completely relevant to more modern findings related to the network effect of broadband connectivity:

1. Firms are quicker to adopt more efficient business practices (marketing and communications, inventory optimisation and rationalisation of supply chains).
2. A critical mass of 20% of broadband deployment catalyses innovation as applications and services applicable to the new environment are created (telemedicine, online education, and financial intermediation tools such as PayPal or e-Banking, as well as affordable and easily customisable products such as enterprise-level software) (Koutroumpis 2009).
3. Through the Internet, firms are no longer limited to using the skills of individuals within a geographic proximity and can also now reach labour pools, raw materials and consumers through business process outsourcing, such as call centres or manufacturing.
4. This "accumulation of intangible capital" enables small and medium enterprise-size firms to be more resilient to market forces (Auriol & González Fanfalone 2014; Katz 2012).
5. SMEs, cooperatives and farmers based in rural areas benefit from accurate information on fair prices for their products and the opportunity to access regional and national markets (Kenny et al. 2002)

6. On an individual level, the acquisition of knowledge and skills, the advantages of social network membership (such as the recruitment platform, LinkedIn) and an understanding of the career market place in the knowledge economy (by being familiar with decentralised and flexible ways to capture and circulate knowledge) are benefits acquired through the common use of broadband Internet (Johnson et al. 2005).
7. Qiang et al. (2009) cites Dutta and Mia's (2008) proposal that in the global-village type environment, broadband facilitates the ability to attract and retain talented knowledge workers which boosts the local, regional and national economies' competitive edge.

B. Public services

A study by the World Bank (Kenny et al. 2002) found that use of ICT improves the delivery of public services through efficiencies experienced at various government levels and departments. Seen in particular through:

1. An increased effectiveness of services like health and education (students with access to the Internet achieve better results than those without),
2. A threefold return on the capital investment within the public sector through improved productivity, and
3. The extension of public services to underserviced areas, facilitating an exchange of information and so empowering rural communities to feed back to governing authorities.

C. Job creation

Fornefeld et al. (2008) explain that broadband Internet is understood to affect employment simultaneously through:

1. New applications and services that increase the pace of innovation,
2. Increased business productivity through broadband-enabled efficiencies, and
3. Remote processing of information as well as service provision enables outsourcing (which can produce both an ebb and flow effect in employment opportunities)

Any job losses due to the effect of broadband productivity or outsourcing of jobs are outweighed by the innovative environment and the rise of services that create new jobs, suggests Fornefeld et al. (2008).

Katz, drawing on Fornefeld et al. (2008), illustrates in Figure 9 that broadband, in developing regions, would enable increased efficiencies and so initially lead to a loss of jobs, but all the while increasing production (2012).

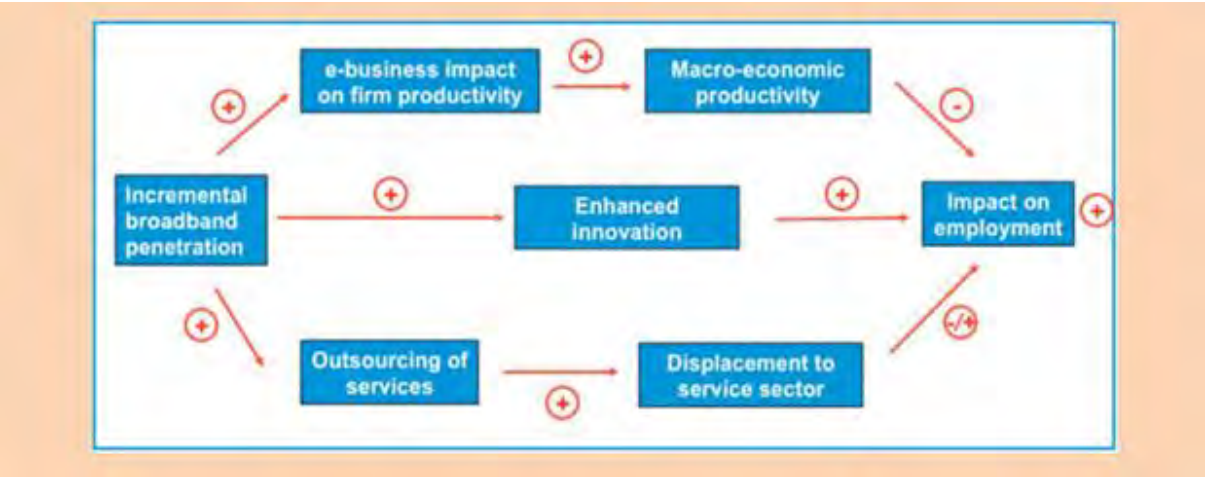


Figure 9. Network effects of broadband on employment (Fornefeld et al. 2008; Katz 2012)

Just as ICT helps developing economies plug into the global economy, the international domination of ICT relegates those nations, regions and municipalities who cannot – to the point of exclusion. They lose out on the trade and foreign direct investment it facilitates. ICT-enabled access to global markets is key to multinational corporations of every size when establishing a new local and national presence (Katz 2012).

An example is seen in India which has utilised ICT to become one of the fastest-growing Internet economies and, by the end of 2016, is expected to add 5.6% to its GDP, on par with Japan as the fourth largest Internet economy by GDP contribution. Software exports and online retail constitute most of its online economy (Dean et al. 2012). In 2007 India's software-export sector employed 1.6 million people and earned $32 billion (Qiang et al. 2009)

C.1. Broadband network construction

When a broadband network is created, employment is impacted through the creation of direct jobs, indirect employment and induced employment. Katz (2012) gives these examples:

1. **Direct jobs:** Telecommunications technicians, electrical engineers, construction workers, manufacturers creating the equipment.
2. **Indirect employment:** Buying and selling metal and electrical equipment in manufacturing sectors.
3. **Induced employment:** Created through increased household spending enabled through income from direct and indirect jobs.

The connection between broadband and employment by sector, as well as on entrepreneurship and small and medium-sized businesses is also established. It is found that as broadband and GDP growth are linked through several effects, so is broadband and employment.

Broadband's impact on employment according to industry sector

The effect across sectors is not uniform, and job creation is found to be focused on service and manufacturing industries (Crandall et al. 2007).

Another 2007 study discovered employment in the US state of Kentucky was stimulated as broadband access increased in a wide variety of sectors. These excluded accommodation and food services where it was thought capital investment into broadband adoption reduced employment (Shideler et al. 2007). Thompson and Garbacz suggest that in certain industries there may well "be a substitution effect between broadband and employment." While an increase in GDP occurs through greater productivity enabled by broadband adoption, this "can cause capital-labour substitution and may result in a net reduction in employment" (2008).

Interestingly, in rural economies in the United States broadband penetration created jobs in financial services, wholesale trade, and health sectors – caused mainly by firm relocation. The communities that benefitted were mostly in peri-urban areas on the outskirts of cities (Katz et al. 2010).

Broadband's impact on entrepreneurship and small and medium-sized enterprises

Individuals use broadband to produce content, goods and services – even while outside traditional employment structures and hierarchies. They do this through acquiring skills, developing social networks and facilitating peer-to-peer communities. This user-led innovation, also known as the "democratisation of innovation" (Von Hippel 2005) facilitates an environment whereby new decentralised and adaptive approaches capture and disseminate knowledge. These are most obviously seen in the enormous number of blogs, wikis (open websites where users can edit and contribute content, such as Wikipedia) and open-source software, outlined by Johnson et al. (2005). These online resources, which enable user-led innovation, further prepare other users to contribute to the knowledge economy (Qiang et al. 2009). It can be deduced that users often have an increasing societal impact as they generate or build on ideas, cooperating to develop new products.

A 2011 Mckinsey study across twelve nations found that small and medium-sized enterprises (SMEs) familiar with the Internet grew at *double* the rate "than those that used the Internet sparingly". These 'web-savvy' SMEs boasted twice the revenue through exports than those less connected, as well as creating twice the number of jobs (Manyika & Roxburgh 2011).

This facilitation of broadband Internet access and use by SMEs is especially important in South Africa as these enterprises contribute between 52 - 57% to the GDP, providing approximately 61% of the nation's employment (Goldstuck 2012).

In 2014 Deloitte estimated that through reduced transaction costs and distance constraints, SMEs in developing economies could improve their productivity by 25% through quicker innovation and access to international markets (Deloitte 2014).

C.2. Remarks

While broadband may reduce jobs through productivity gains in labour-intensive industries in the short-term and increase jobs through innovation in services in the medium-to-long term, there is no firm explanation of all effects. The unique characteristics of regional economies show that broadband does not have the same impact throughout a country (Katz 2012).

D. Consumer saving

Broadband brings increased access to goods and services at an even lower price than what consumers are prepared to pay. Katz (2012) identifies this saving as consumer surplus and explains it as follows:

Identifying consumer surplus requires a study before and after the investment of adopting broadband; in most instances the surplus is liable to change due to decreasing demand and / or a reduction of price. Broadband could affect both through:

- Increased business productivity,
- Reducing the demand of the product, and
- Increased market competition in both source materials and the final product (Katz 2012).

Greenstein and McDevitt's 2012 study of Brazil and Mexico conservatively estimated a consumer surplus caused by broadband in Brazil to be $7.03-billion and in Mexico to be $2.3-billion (Katz 2012).

4.2.7 Remarks

Just as the utility of broadband Internet benefits each person and sector making use of it, so increased national penetration and use would increase access to this opportunity. With 60% of South Africans owning a mobile phone and half of these being smartphones (Parle 2015), it seems to suggest strongly that domestic Internet access is limited to 30% of the population (Calandro, Stork, et al. 2012) or roughly 16 million of South Africa's 54 million citizens.

How this current context has come about, especially through the policies and actions of the South African government, is examined in Chapter 5: A brief history of access in South Africa since 1994.

Chapter 5: Good Intentions: A brief history of access in South Africa since 1994

During South Africa's adoption of democracy in 1994, the aim to achieve Universal Access and Service (UAS) became a key focus. Charley Lewis (2013) and James Hodge (2003) provide seminal contributions in this regard.

The telecommunications sector had emerged from, as Lewis contextualises, a "discriminatory history of systematic denial of access to telecommunications services for the majority of the population" (2013). As a result the 1994 Reconstruction and Development Programme (RDP) policy framework emphasises radically differing racially-determined levels of access: then an average approximation of one fixed telephone line was available to 100 people designated 'black', while by the same count 60 were available to people designated 'white' – all within an urban environment. In rural areas the differences were greater (ANC, 1994 as cited in Lewis, 2013).

Universal Access is recognised in the RDP as an "indispensable backbone for the development of all other socio-economic sectors" (ANC 1994) and, says Lewis, the policy made commitments to "provide universal affordable access for all as rapidly as possible within a sustainable and viable telecommunications system" (ANC, 1994 as cited in Lewis, 2013).

The White Paper on Telecommunications of 1996 accounted for this, stating: "Our particular goal is to balance the provision of basic universal service in telecommunications to disadvantaged rural and urban communities with the delivery of advanced information services capable of meeting the needs of a growing South African economy" (RSA 1996b). In the 1996 Telecommunications Act the sentiment was echoed, hoping to: "promote the universal and affordable provision of telecommunication services" (RSA 1996a) as the first of seventeen objectives. By the writing of the Electronic Communications Act 2005, the goal of affordable UA is seen in the commitment to "promote the universal provision of electronic communications networks and electronic communications services and connectivity for all" (RSA, 2014 as cited by Lewis, 2013)[4].

[4] The Electronic Communications Act 36 of 2005 as amended by the Electronic Communications Amendment Act 1 of 2014

5.1 South Africa introduces UAS interventions through licence obligations

South Africa looked to realise Universal Access and Service interventions through several universal service obligations. Described by Lewis as "an enforced internal cross-subsidy from more lucrative market segments to non-profitable services and areas" (2013), these mandatory service obligations are prescribed by industry regulations and licencing conditions (Intven 2011). Examples include: In Kenya, a phone within walking distance; in Ethiopia, a phone booth in every town; in Zambia, telephone booths in public places such as schools and clinics (Intven 2011). Free emergency calls or coverage to certain areas by mobile network operators can also be included (Lewis 2013).

Several types of state Universal Access and service interventions were decided on, which are described and reviewed below.

The first phase of democratic telecommunications reform in South Africa was from 1997 to 2002. The licences given to the incumbent fixed-line operator Telkom and the two mobile operators Vodacom and MTN all included universal service obligations (Hodge 2003; Lewis 2013).

At the time Telkom was extremely indebted, and so unable to make the infrastructure investment necessary to implement universal service coverage, and the state's own debt obligations and annual budget deficits obligations had limited its ability to fund it. The result was, as Hodge records, "a pragmatic compromise whereby Telkom was partially privatised (30%) and granted a five-year exclusivity period within which it was required to roll out infrastructure to meet the social objectives" (Hodge 2003).

Intven adds that the company was to use its monopoly revenues to cross-subsidise its network rollout and rebalance its rates by 2002, the end of the exclusivity period (Intven 2011).

5.1.1 Coverage obligations

Telkom's obligations included 2.96 million new lines brought into service; two thirds of these were in underserviced areas and for priority customers. Fines were agreed on if these weren't met. The roll-out was expected to double South Africa's teledensity to 20% of the population (Hodge 2003; Lewis 2013). No specific roll-out targets were given to the two existing mobile operators, Vodacom and MTN, as they received licences before the consultative policy process was started and their service was considered a luxury service (Hodge 2003).

Later, extra obligations of the distribution of free SIM-cards and handsets, as well as connecting public schools and institutions for people with disabilities to Internet infrastructure were set out. These obligations were extended to Cell C, see Table 2 (Lewis 2013).

Table 2. Licence obligations for operators (Hodge, 2003; Lewis, 2013)

	Rollout obligations	Community service obligations
Telkom	2,96 million new lines - 1.676 million in underserviced areas - 20 246 to priority customers - 3024 villages	120 000 payphones
Vodacom	- 60% of population coverage in 2 years - 70% of population coverage in 4 years	- 7 500 community service telephones in underserviced areas in 5 years - Low community service tariff - 1 250 000 S M-card connection packages - 125 000 handsets - 140 institutions for people with dis-abilities provided with Internet access (10 terminals each) over three years - 5 000 public schools provided with Internet access over eight years (subject to approval of implementation plan)
MTN	- 60% of population coverage in 2 years - 70% of population coverage in 4 years	- 22 000 community service telephones in underserviced areas in 5 years - Low community service tariff - 1 250 000 S M-card connection packages - 125 000 handsets - 140 institutions for people with dis-abilities provided with Internet access (10 terminals each) over three years - 5 000 public schools provided with Internet access over eight years (subject to approval of implementation plan)
Cell C	- 8% geographic coverage in 5 years, 40% with roaming agreements - 60% of population in 5 years, 80% through roaming agreements in 1 year	- 52 000 community service telephones in underserviced areas - Low community service tariff - 1 250 000 SIM-card connection packages - 125 000 handsets - 140 institutions for people with dis-

		abilities provided with Internet access (10 terminals each) over three years - 5 000 public schools provided with Internet access over eight years (subject to approval of implementation plan)
Neotel	- 60% of population in defined metropolitan areas within 5 years - 80% of population within 10 years	Establish and maintain "high speed Internet connectivity" to: - 2 500 public schools / education institutions - 2 500 public rural clinics

5.1.2 Universal Service Agency

Set up in 1996 to focus on universal service issues raised in the 1996 White Paper on Telecommunications Policy, Lewis notes it was the first time such a body was created. A 2009 Intelecon report found it international best practice to place the vast majority of the funds under the control of the regulator and not a state enterprise (Intelecon 2009).

5.1.3 Universal Service Fund

The Universal Service Agency was set up to administer the contributions totalling R20 million per year, solely using the funds to pay subsidies helping low-income households to afford access or towards the operators to assist them with their roll-out. R10 million was paid by Telkom, R5 million each by Vodacom and MTN (Hodge 2003).

5.1.4 Underserviced area licences

Underserviced area licences were introduced in 2001 with the amendments of the Telecommunications Act. These underserviced areas were defined as areas with fewer than five fixed telephone lines per 100 people and are plotted on the following page in Figure 10. It was intended that small businesses made up of historically disadvantaged groups and women benefit from being awarded licences (Lewis 2013; RSA 1996a). Several licences were awarded in 2004/ 2005 and seven more in 2007. In support of these small businesses a contribution of R5 million each year for three years was allocated from the Universal Service Fund. Discussions were held on business development support and the introduction of asymmetrical interconnections regulatory measures, where rural network operators receiving incoming calls from other more established operators, would receive a subsidy via the interconnection rate to strengthen the small companies' businesses cases… but no action was taken (Gillwald 2007).

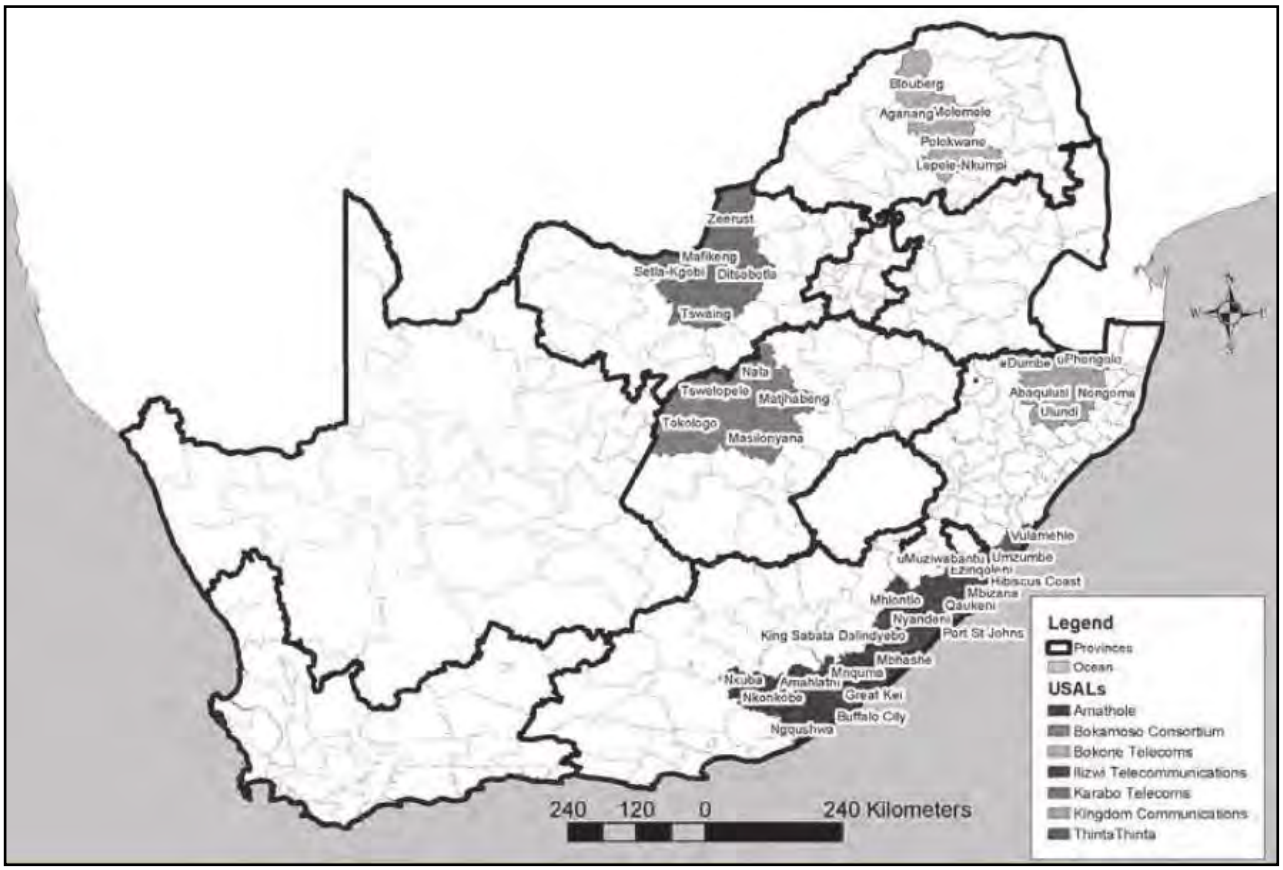


Figure 10. First seven under-serviced licences areas (Human Science Research Council, no date(Lewis 2013)

5.2 Examining the impact of the Universal Access and Service interventions

5.2.1 Coverage obligations

Telkom installed 2,67 million lines in the period of 1998 and 2002, narrowly missing its target of 2,96 million (Lewis 2013). The incumbent was on track until 2000 when it made a business decision not to tolerate bad debt and enforce timely payment of accounts. In 2001 there were 1,16 million lines disconnected and 606 000 in 2002 (Hodge 2003).

This rate of disconnection critically undermined the policy providing rollout targets for exclusivity, and indicates a policy failure as 2,003 million lines installed under the obligatory roll-out were not financially sustainable and resulted in a R17 billion cost to Telkom (Hodge 2003).

Hodge (2005) goes on to suggest several reasons for Telkom's decline, being:

- The targets were set in an uncertain environment with limited information,
- The targets were "inflexible instruments" unable to react to the market, and
- The displacement of fixed-line by prepaid mobile packages, which were altogether more affordable and convenient.

This trend continued and from a peak customer base of 5,5 million in 2000, Telkom's customer base declined to 3,8 million by 2013, with residential post-paid subscribers decreasing from 40,1% in 2002 to 30,8% in 2009 (Lewis 2013). The reverse is true for mobile subscriber numbers which by 2013 reached 51,4-million units (Lewis 2013).

The result of the community access obligations were similar: by 2002 Telkom met its target of 195 000 but this decreased to 132 000 by 2009. The mobile operators were also able to meet their very low target, based on an estimated market of fewer than a million users (Lewis 2013).

5.2.2 Universal Service Agency

While the Universal Service and Access Agency of South Africa (USAASA) plays a key role to advocate for Universal Access and Service in telecommunications policy, it has had marginal effect. Lewis attributes this to blurred reporting lines to the Minister of Communication, who directs appointments and expenditure, and the Independent Communication Authority of South Africa (ICASA), which regulates the sector (2013). This places the USAASA in "a very awkward position and it is not surprising that its track record of meeting its aims is extremely poor" (Limpitlaw, 2012 as cited by Lewis, 2013).

The agency was unsuccessful in both developing South Africa's universal access and service targets and using the Universal Service Fund to enhance access. After deciding to focus on one form of delivery (telecentres) and setting targets for hundreds to be built and equipped, the result was that by 2000, only 65 had been established. In 2001 it was found that a third were no longer operational, with working computers and phones in fewer than half of the remaining centres (Benjamin 2003). By 2005 the programme was downscaled with only 111 of the intended 4000 built and the focus of the programme shifted from telecentres to 'Cyberlabs' and 'Community Digital Hubs' (Lewis 2013). Despite the failure rate the agency's 2008/2009 annual report shows little innovation with plans to "rehabilitate and equip Community Access Centres, Cyberlabs in schools and Digital Hubs" (USAASA 2009). Sadly, many of these failed. It is argued that South African-styled telecentres are not an effective vehicle to deliver broad access to telephony services as they provided more centres than were necessary. They typically consist of between five and ten phone lines, five Internet-enabled computers, fax machines, scanners and copiers, at a start-up fee of around $40 000 (R320 000 at the time). In South Africa there are no more than a few telecentres and these are not a reproducible model at a national scale (Benjamin 2001).

Hodge compares the agency to the licence conditions, saying both "had misunderstood demand and miscalculated costs of delivery" (2003).

5.2.3 Universal Service Fund

The R20 million cap to the annual contributions was removed in 2001, requiring operators to pay 0.2% of total revenue (Msimang, 2006; Intelecon, 2009; as cited by Lewis, 2013). Initially managed by the Universal Service Agency, payments are now received by ICASA and handed directly to National Treasury. Lewis suggests Perry's 2010 estimate of R1 billion is too conservative as by 2008 contributions to the fund amounted to R636 million and during 2010 a further R437 million was collected[5].

Of the amount available, by 2009 only 35% (R227 million) had been spent, illustrated below (USAASA 2009) and this confirms Lewis' estimation (2013).

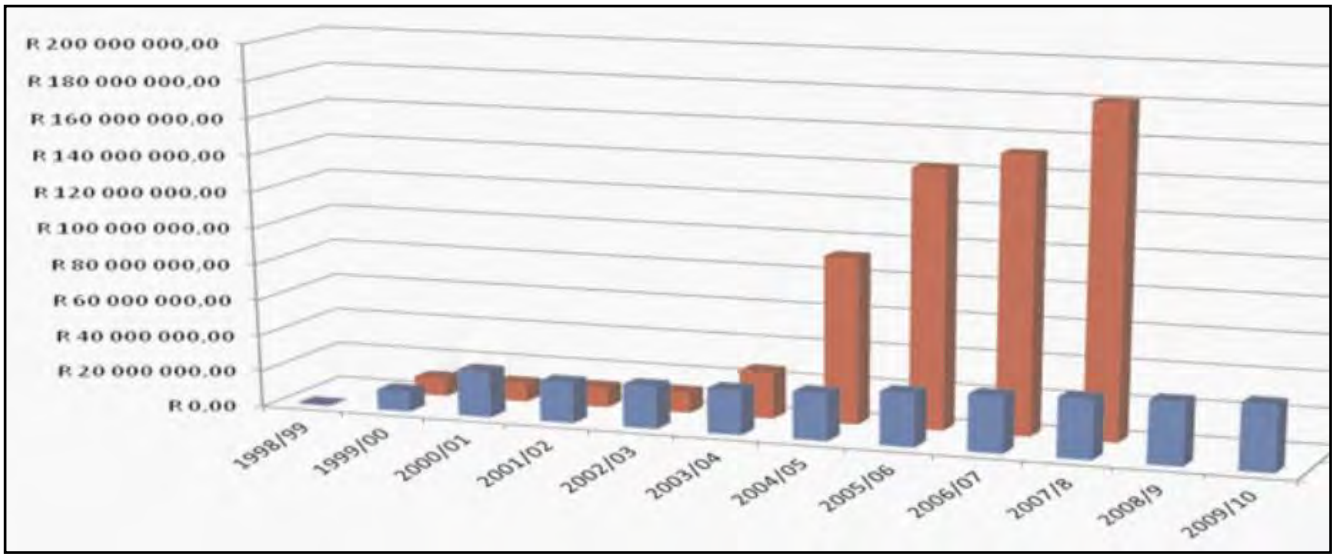


Figure 11.3 Universal Access Fund income in red and expenditure in blue (Lewis cites USAASA 2009 and USAASA 2010)

5.2.4 Underserviced area licensees

Intended to create an enticing licensing regime that encouraged the private sector to close the market efficiency gap in outlying areas through a rural operator model, the underserviced area licensees were to meet the standards set out by Dymond and Oestman (2003) of asymmetrical pricing, market orientation and technology neutrality. Gillwald (2005) notes the twenty-seven designated areas covered almost half of South Africa's population, providing the opportunity for a significant intervention.

Licensees need the support of policy and regulation, including a realistic funding structure, an asymmetrical interconnection regime, a flexible regulatory context and a simple licensing process (Gillwald 2002).

[5] Lewis cites 2009 and 2010 licensee compliance reports submitted to ICASA

The three-year cycle of R5 million funding support, subject to performance, was unsustainably low, says Lewis (Lewis 2013), pointing to Thornton (2006) and Gillwald's (2005) recommendations that the seven licensees should be reviewed and the amount be "increased substantially" and raised to between $5 million and $20 million, which is the funding necessary to start a similar business.

Gillwald found that the "cost-based asymmetrical termination charges that recognise the asymmetrical cost of terminating calls in high cost low-density rural areas" are key to a feasible business plan (2005). Network coverage in rural areas is more expensive than in urban areas as the network operator often has to make large investments in the telecommunications infrastructure in order to give signal coverage to a wide area. In the absence of a municipal fibre network, this would include the fibre-optic connections required to connect to the national fibre, a reliable supply of adequate electricity and regular maintenance. Lewis found that "no such interconnection regime was ever implemented for these areas" (2013).

The conditions of successful licence applications included several business structure requirements, such as, firstly, participation and ownership of historically-disadvantaged groups – a condition which undermined the requirements of "technical expertise and managerial skills" (Lewis 2013) and secondly, limiting foreign ownership to 25%, a condition which made them unattractive to investors (Gillwald 2005). A well-funded capacity building programme to strengthen these weaknesses never materialised (Lewis 2013).

By the time the first under-serviced area licence (USAL) was issued, the market structure in the areas had changed as mobile operators were already establishing themselves, forcing the fixed-line licensees to compete unexpectedly for market share against a fully-mobile services (Gillwald 2005). The 2004 liberalisation of the Voice Over Internet Protocol (VoIP) market allowed resale and enabled self-provisioning, so further eroding an already unsteady business model (RSA 2014). By allowing value-added network service (VANS) licensees to self-provide their own infrastructure, the state's action effectively removed the regulatory advantage handed to the holders of USALs.

Lewis records that no effective intervention was instituted and by 2008, despite clear warning from analysts, none of the licensees were yet sustainable (Thornton 2006; Senne 2008) with several becoming mobile resellers (Lowman 2005).

The lack of fixed-line telephony in rural areas has limited the spread of fixed-line broadband and so made the rural populations dependent on mobile service operators for access to the Internet.

5.3 Remarks

The decision by Telkom to disconnect lines of indebted account holders resulted in the most accessible and affordable way to make a phone call being through a mobile phone. This has remained true for Internet access in both urban and rural areas where a fixed line is often unaffordable.

The change in legislation allowing VANS to self-provide their own infrastructure upset the market dynamic in rural areas, taking away the incentive for those obligated to provide Universal Service in rural areas.

When considered alongside the chronic lack of investment by the Universal Service Agency from funds contributed to the Universal Service Fund to create community Internet hubs, a market gap is presented.

Chapter 6 will discuss how mobile network operators saw this gap as an opportunity to allow basic mobile phones to provide Universal Access levels for voice telephony in many rural areas. However, mobile Internet access is not as easily resolved and therefore a large proportion of South Africa's population remains offline.

Chapter 6: Mind the gaps: South Africa's telecommunication environment

6.1 Do figures suggest a market or access gap for Internet provision?

Mobile network operators have introduced universal access to voice telephony to South Africa and other countries across the globe.

Mobile telecommunications is the most rapidly adopted technology to date. In the ten-year period between 1999 and 2009 global mobile phone subscriptions grew from about 500 million to 4.6 billion, taking mobile penetration from 8% to 68% (Blackman & Srivastava 2011).

The uptake of mobile phones is reflected in the General Household Survey of 2014, where it was found that 95.7% of South African households have either a functional landline or mobile phone, or both. See Figures 12 and 13 respectively (page 41).

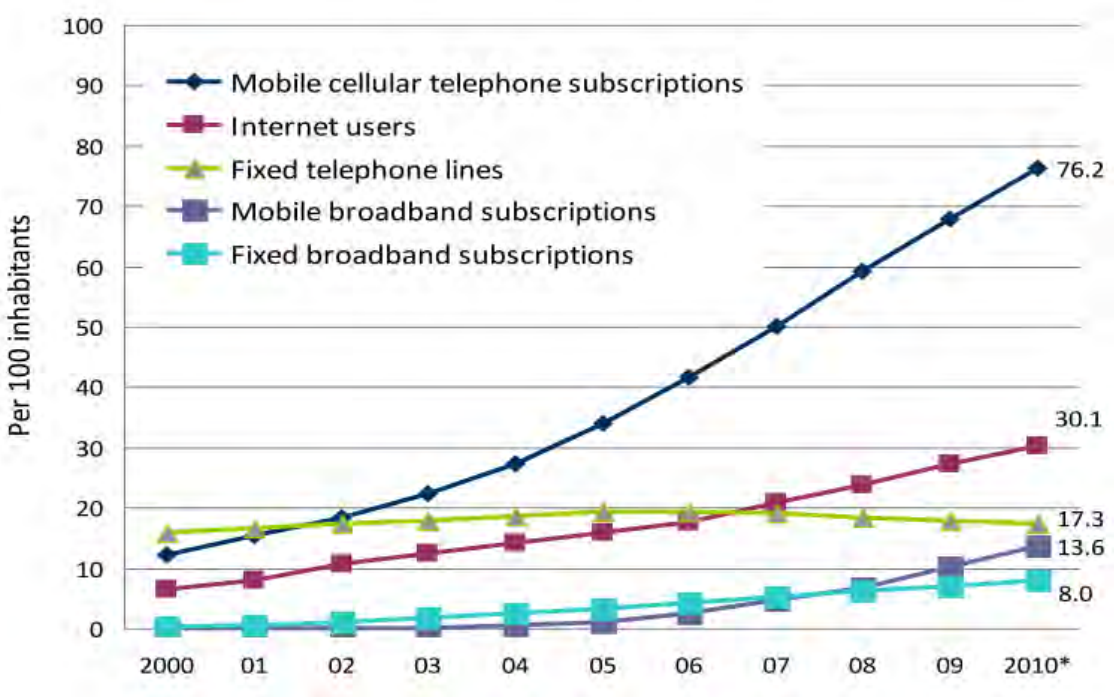
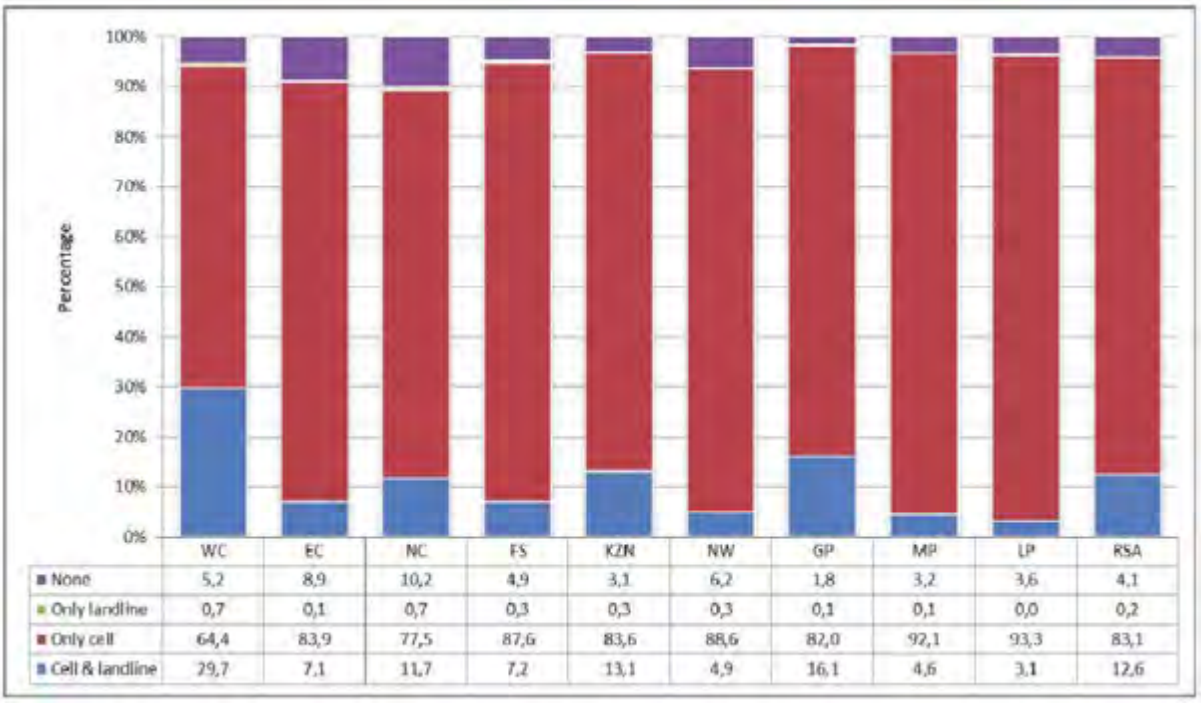


Figure 12. Global averages of types of telecommunications penetration. Source data from ITU World Telecommunication and ICT Indicators database (Blackman & Srivastava 2011)



	WC	EC	NC	FS	KZN	NW	GP	MP	LP	RSA
None	5,2	8,9	10,2	4,9	3,1	6,2	1,8	3,2	3,6	4,1
Only landline	0,7	0,1	0,7	0,3	0,3	0,3	0,1	0,1	0,0	0,2
Only cell	64,4	83,9	77,5	87,6	83,6	88,6	82,0	92,1	93,3	83,1
Cell & landline	29,7	7,1	11,7	7,2	13,1	4,9	16,1	4,6	3,1	12,6

Figure 4. Percentage of households who have a functional landline and mobile phone in their dwelling by province (Statistics South Africa 2014)

6.2 How South Africans access and use the Internet

Research ICT Africa helpfully contextualise South Africa in their empirical study, *Internet going mobile: Internet access and use in 11 African countries* by Christoph Stork, Enrico Calandro and Alison Gillwald (2013). The findings of which contextualise South African households and their relationship with the Internet:

Electricity, radio and Internet access: Almost 90% have access to the electricity grid, TV is slowly substituting radio as the most popular medium. There is also a decline in fixed-line telephone connections while computer and Internet access are both up – the Internet by almost 400% between 2008 and 2012 (Stork et al. 2013).

Social media preferred platform: South Africans access social media on their mobile phones more often than their email accounts, which was previously the communication tool of choice. This is primarily enabled by better user experience design which lowers possible language barriers and ICT skills requirements.

Mobile phones easier to use: The cheaper hardware of a mobile device, its user-friendly design and easy use, the advantages of being battery operated and therefore not reliant on a home electricity

connection, and that it allows the user to strictly control the cost incurred through prepaid vouchers, makes them more accessible and easier to use than computers (Stork et al. 2013).

Younger Internet users: The proliferation of mobile phones and ease of social media use, encourages a younger audience to access the Internet, and of the countries under Stork et al's investigation in 2012, South Africa had the largest proportion of 15 years or older active online at 33.7%.

Importance of Internet café wanes: Of South Africa's Internet users, 70% used either solely a mobile phone or both a phone and a computer. Stork el al found this was double the number of Internet café users, previously the most popular method of getting online.

Internet via mobile eclipsing PC: Of all South Africans using the Internet between 2011 and 2012, 70% of Internet users in South Africa used a mobile phone. The average age of those who first used the Internet on a mobile phone was 26.6 years and, of female Internet users, 56% first went online via a mobile phone (Stork et al. 2013).

Alison Gillwald's *Broadband 4 Africa* report adds one more:

Youth understand ICT better: Gillwald reflects that the youth are "referred to as 'digital natives' because once exposed they appear to be far more adept at utilising ICT than older generations, whether better educated or wealthier, [the] youth appear to be ideal candidates for the application of ICT to alleviate problems of unemployment and social disaffection" (Gillwald 2014).

The abovementioned all demonstrate that in South Africa, people are increasingly accessing the Internet via their mobile phone.

6.3 ICT access and affordability by average South African individual

Tim Parle of BMI-T cites Statistics South Africa's General Household Survey of 2014 and 2015 to show that of South Africa's 54 million people, children included, 60% own mobile phones and of these, 50% were smartphones (2015).

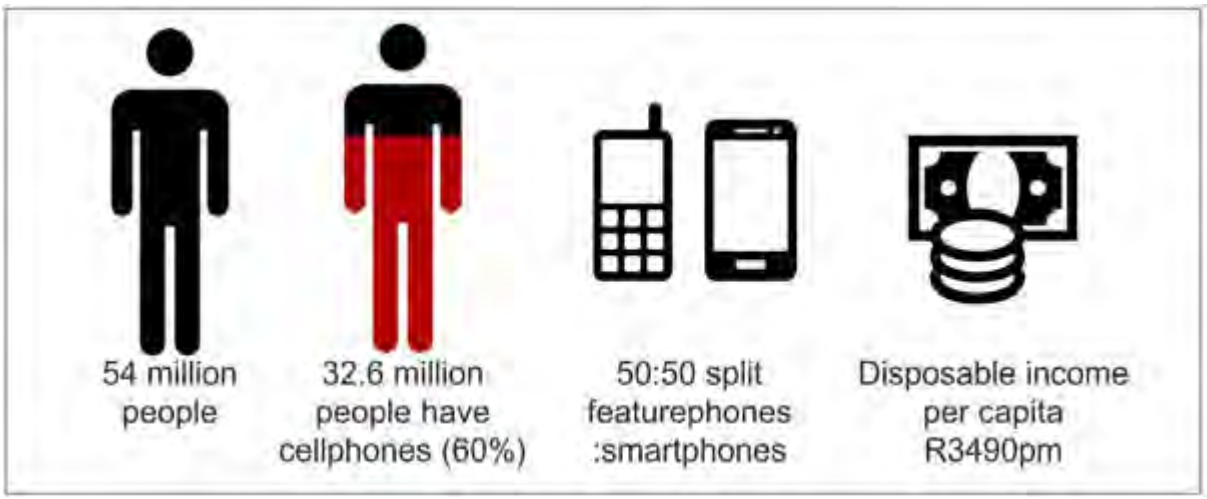


Figure 14. Metrics of individual access to broadband Internet access. Source data: Stats SA, General Household Survey - 2014, 2015; AMPS 2014B, 2015; Disposable income per capita of households, SARB Quarterly Bulletin, June 2015 (Parle, 2015).

According to Parle (2015), the average disposable income per capita is R3490. However, when discussing affordability, the spending power of the bottom of the pyramid is more relevant and not the median achieved by averaging out all domestic income levels.

6.4 Internet access and affordability by South African household

Of the 15,6 million South African households, 96% have access to mobile phones and 41% access the Internet on them. In contrast, only 11% have fixed-line Internet access at home and 20% of households possess a computer (Statistics South Africa 2014). This is in line with Parle's finding that only about 30% of South Africans own an Internet-enabled mobile phone (2015).

The *General Household Survey 2014* published by Statistics South Africa does not differentiate between households with fixed-line Internet access and those without. However, it does compare those with Internet access at home and via mobile phone directly. It is therefore assumed that the 11% of households with Internet access receives this access via a fixed line (Parle 2015).

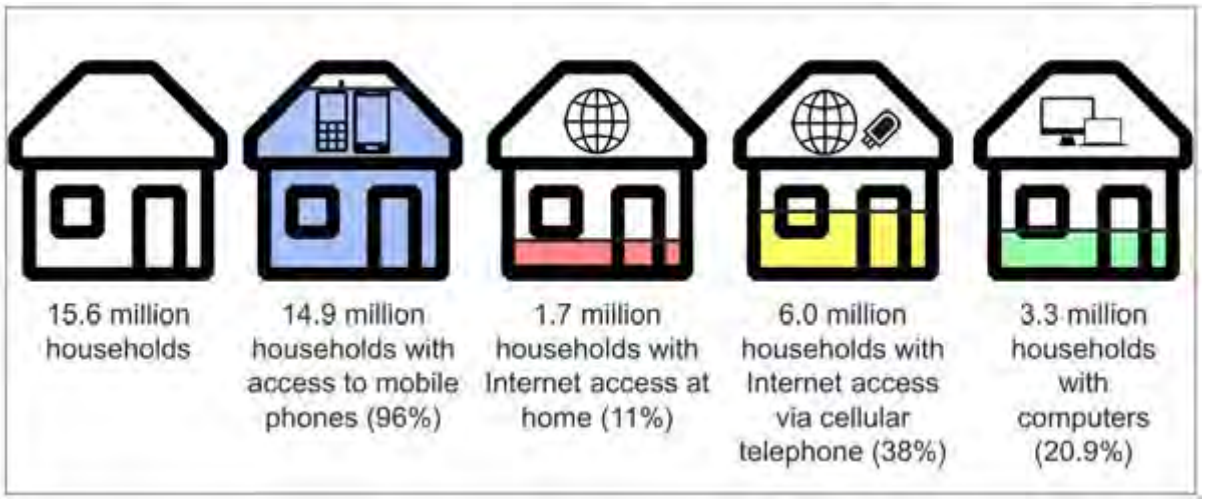
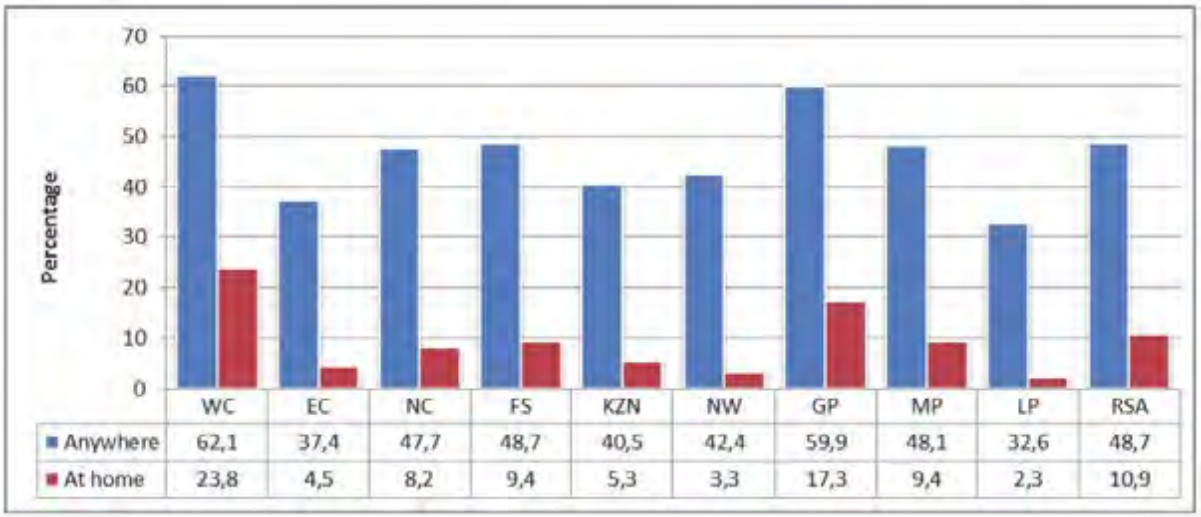


Figure 5. How South African households access the Internet. Source data: Stats SA, General Household Survey - 2014, 2015 (Parle 2015)

Statistics South Africa found that households with the least Internet access were those in rural areas while the best access was found in metro areas. The most likely provinces in which households were likely to access the Internet at home were the Western Cape (23.8%) and Gauteng (17.2%); Limpopo households were least likely with 2.3% connection rates (Statistics South Africa 2014).



	WC	EC	NC	FS	KZN	NW	GP	MP	LP	RSA
Anywhere	62,1	37,4	47,7	48,7	40,5	42,4	59,9	48,1	32,6	48,7
At home	23,8	4,5	8,2	9,4	5,3	3,3	17,3	9,4	2,3	10,9

Figure **6.** Percentage of households with access to the Internet at home, or for which at least one member has access to or used the Internet by province, 2014. **(Statistics South Africa 2014)**

While 17.8% of metropolitan households accessed the Internet, only 1.1% of those in the rural areas of the Eastern Cape, KwaZulu-Natal and Limpopo had the same access. Overall households are more likely to access the Internet at work, Internet cafes or educational institutions than at home, except those in the Western Cape or Gauteng (Statistics South Africa 2014).

By far the most popular method to access the Internet throughout the country is via a mobile device. On average more than 41% of households have at least limited access to the Internet via a mobile device (Statistics South Africa 2014).

Place Internets accessed	Geotype	Province (per cent)									
		WC	EC	NC	FS	KZN	NW	GP	MP	LP	RSA
At home	Metro	27,5	7,9	NA	NA	9,4	NA	18,0	NA	NA	17,8
	Urban	17,1	8,3	9,7	9,8	5,5	5,7	12,5	11,7	8,2	9,7
	Rural	12,9	0,8	2,9	6,7	1,1	1,1	7,6	7,6	1,1	2,4
	Total	**23,8**	**4,5**	**8,2**	**9,3**	**5,3**	**3,3**	**17,2**	**9,4**	**2,3**	**10,8**
At work	Metro	26,7	18,5	NA	NA	19,3	NA	27,4	NA	NA	25,5
	Urban	17,7	15,7	12,0	11,6	17,9	13,2	14,6	13,8	19,0	14,8
	Rural	5,9	1,7	3,2	3,0	3,2	2,6	9,0	3,8	2,4	2,8
	Total	**23,0**	**9,2**	**10,0**	**10,2**	**12,8**	**7,6**	**25,7**	**8,2**	**5,2**	**15,6**
Using mobile devices	Metro	59,6	49,5	NA	NA	38,9	NA	47,0	NA	NA	48,1
	Urban	32,5	44,8	49,0	47,1	43,1	48,6	52,9	54,2	53,4	46,8
	Rural	17,6	21,6	29,4	33,2	24,3	31,2	28,5	36,8	24,9	26,8
	Total	**49,8**	**34,0**	**44,6**	**44,9**	**34,3**	**39,4**	**47,5**	**44,4**	**29,6**	**41,3**
At Internet Cafes or educational facilities	Metro	16,2	13,3	NA	NA	9,5	NA	17,9	NA	NA	16,0
	Urban	11,0	6,0	2,9	11,2	9,2	6,3	7,8	7,4	5,5	8,1
	Rural	5,2	1,0	0,3	3,2	3,7	4,9	4,9	5,3	1,0	2,9
	Total	**14,1**	**4,8**	**2,3**	**10,0**	**7,2**	**5,6**	**16,6**	**6,2**	**1,7**	**9,7**

Figure 7. How and where South African households access the Internet (Statistics South Africa 2014)

6.5 Broadband Internet access in South Africa

6.5.1 Reach (Do South Africans receive 3G coverage?)

A 2015 Vodacom report claims that 96% of South African's population does receive 3G signal coverage from the operator (Vodacom 2015). A 3G signal, which peaks at 2Mbps, is currently the minimum requirement for mobile broadband (Christensson 2012).

Similarly, other coverage maps supplied by South African's remaining mobile service providers MTN, Cell C and Telkom Mobile all claim that the vast majority of residents do receive 3G signal. This makes it possible for residents to access the Internet through a variety of providers.

6.5.2 Affordability (Are South Africans able to afford data costs?)

With an average of 2.4 mobile phones per household, 97% of South African adults (older than 15 years) can access a mobile phone (GSMA Intelligence 2014), 86% of adults own a mobile phone (Gillwald et al. 2012), and 3G signal suitable for mobile Internet access covers 96% of the population (Dovey 2014; Vodacom 2015).

Why then are two-thirds of South Africans (Stork et al. 2013) still offline?

In short, Internet access is not affordable to the majority of South Africa's residents (Gillwald 2014).

There is no best practice from developed economies in facilitating an environment of affordable mobile broadband. Gillwald points out that, previously, many providers in developed economies simply upgraded their existing widespread copper and cable networks to quickly enable "almost universal" broadband. Now, however, they face the enormous investments required to create the fibre network and next generation broadband facilities (2014).

The South African context currently witnesses quicker, cheaper, more ubiquitous broadband via mobile networks than from fibre. A smaller, more fragile economy, with fewer tax payers – and more expenses incurred to establish and extend networks – present policy-makers a series of challenging decisions in looking to enable affordable broadband Internet access (Gillwald 2014).

South Africa's incumbent telecoms operator, Telkom, in 2014 provided telephone lines to only eight of a hundred inhabitants (Dovey 2014) and held monopoly of the country's only undersea fibre cable SAT-3 until 2008 (Esselaar et al. 2010). This not only kept prices for international bandwidth high but facilitated a large *unmet* demand for broadband Internet access. This monopoly was broken in 2009 by the connection of the SEACOM cable and by 2011 four submarine cables were connected to South Africa, alleviating this bottle neck (Esselaar et al. 2010) and resulting in a steep drop in the price of international bandwidth.

Currently the demand for broadband Internet is partly met through mobile data. However, the steep rise in data traffic across mobile operator networks has obliged continued infrastructure investment. The increasing data transfer demands of mobile broadband exceed those of voice traffic, for which the network was initially designed (Gillwald 2014).

The decreasing cost of mobile broadband-enabled devices, the simple prepaid fee structure and accessibility of 3G network signal facilitate increasingly convenient mobile Internet access – for those who can afford it.

In understanding the level of disposable income that the majority of South Africans, especially those at the 'bottom of the pyramid', have available to spend on accessing the Internet is explained by Justin Visagie (2013) in the following:

- The overall average household income of four people (at a median monthly income of R760 per person) is R3083 per month.

- 75% of households have an income of less than R4560 per month.
- The vast majority of households have an income of less than R2000 per month.

The 2012 South African National Planning Commission's National Development Plan defined households to be in poverty if members' individual income was less than R432 ($27) per month, or just under $1 per day (Calandro, Gillwald, et al. 2012). Internationally, the daily income level of $1.90 and below is used to define individuals in poverty, or at the 'bottom of the pyramid' (World Bank 2015).

Calandro, Gillwald, et al. found the following characteristics consistent with individuals at the base of the pyramid (2012).

- 76.7% of households have an electricity connection to the electricity grid.
- 75% percent of South Africans have at least one mobile phone.
- 59% of South African adults (those older than 15 years of age) have a bank account.

A. How much do South Africans pay for ICT services?

In the comprehensive *Western Cape Digital Readiness Assessment*, authored by Research ICT Africa, it is stated that the ICT basket of products considered useful contains 40 calls, 60 SMS's and 1GB of data. The mobile rate for 1GB is R149, a set package offered by Telkom Mobile, Cell C, MTN as well as Vodacom. An ADSL line at 4 megabytes per second is R338 per month. The national average to purchase these products amounted to 3.1% of gross national income by individuals, while in the Western Cape the basket would cost 7.6% of monthly earnings (2015).

Both ICT Africa and Richard Thanki (2012) point out South Africa's society is extremely unequal and has one of the highest Gini coefficients. Research ICT Africa calculates the affordability of ICT services as the total spent on mobile services as a percentage of individual income. For this they use ICT access and survey data (2015).

In the Western Cape, households are increasing spending on ICT access and on average 20.1% of individual income is used to purchase voice and data services (Research ICT Africa 2015).

Research ICT Africa state that, while not affordable – and likely to eat into amounts available for groceries, travel and clothing – the proportion spent shows the value that individuals place on communication services (2015).

ITU, the United Nations specialised agency for ICT, advises that ICT access is only affordable if 5% or below average monthly earnings. No developing nation is able to meet this affordability threshold for those surviving on less than $2 a day (Jorge 2014).

B. The global issue of affordability

Internationally broadband pricing is also found to be prohibitive.

In 2012 Thanki undertook an exercise using global ITU data of broadband prices, which found mobile broadband to be 81% of the cost of fixed phone lines. Using the approximation that mobile was between 50 – 80% the cost of fixed broadband and including the Gini coefficient of each nation, he found that mobile broadband was unaffordable (greater than 5% of the income) for between 2,6 and 3,5 billion people: “By continent this ranges from 8% of the population of Europe, to 90% of the population of Africa” (Thanki 2012).

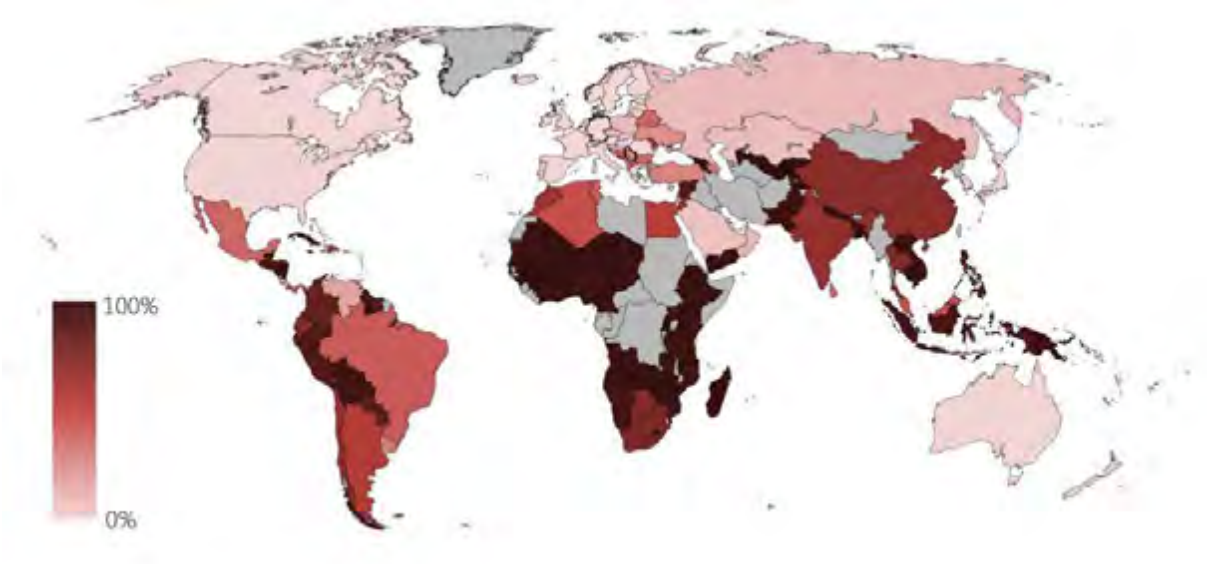


Figure 8. The proportion of people who find broadband unaffordable by country (Thanki 2012)

In 2013 it was found Kenyans sometimes spent 27% of their income on communications (Elder et al. 2013).

Calculations published by the World Economic Forum agree with the range of these disparities. The percentage of low-income people groups using the Internet is 7.6 percent (Dutta et al. 2015).

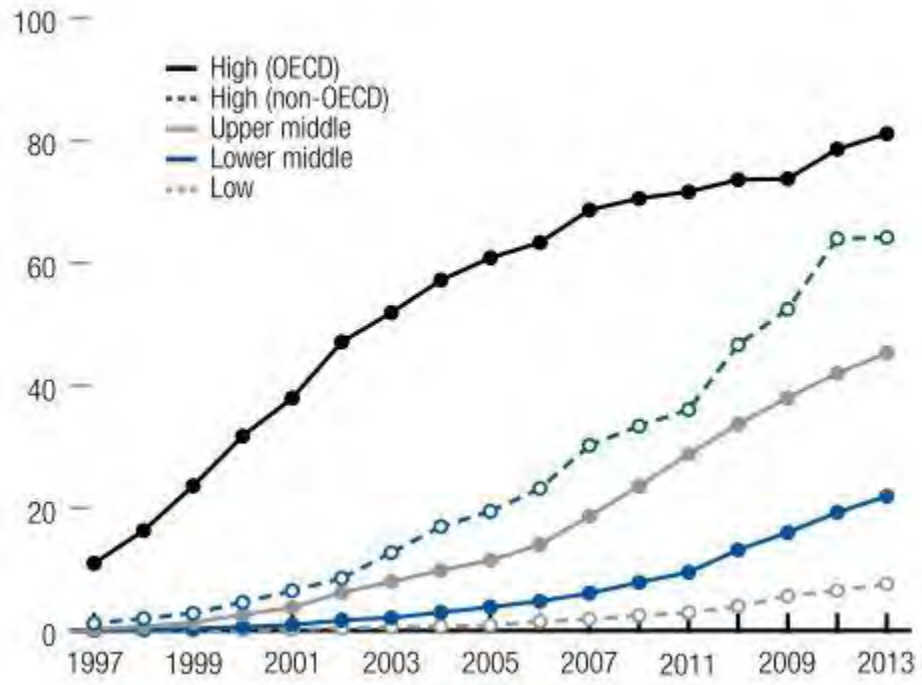


Figure 9. Global Internet penetration by income group percentage and by year (Dutta et al. 2015)

In Figure 19, the World Economic Forum plot the Internet penetration rate by income group and by year, and authors note the present rate of penetration is 10 times less than that of high-income individuals in OECD countries and still lower than the penetration rate among OECD countries in 1997 (Dutta et al. 2015).

And Internet penetration rates in low-income economies is slowing considerably. Initial quick growth off a low base at the onset of the mobile revolution has slowed to the point where a revised forecast of twelve years is predicted before the Internet reaches 75% of the world's population by mobile, wireless or wired technologies (Dutta et al. 2015).

C. Domestic household spending on ICT access

In an in-depth study of five focus groups spaced across three South African provinces (Gauteng, KwaZulu-Natal and the Western Cape), it was found that individuals and households pay between R120 (for about forty calls) and up to R300 for more as needed (Abrahams & Pillay 2014).

Research ICT Africa's web resource, a table reporting the 'cheapest prepaid product for OECD basket by operator in South Africa in local currency (ZAR)', records that Telkom Mobile's SIM-SONKE pre-

paid product will give users forty phone calls for R54 per month. The deal includes R0.29 per minute to mobile numbers on the same Telkom network and R0.29 per SMS, MMS or MB of data.

The disparity of R180 may be explained in the market share where the dominant operators, Vodacom and MTN, share 80% of the market between them and yet have been far less progressive in lowering their prices (Research ICT Africa 2015). Rather than reducing fees, Vodacom is trying to increase affordability through lower-priced devices.

The Lived Costs of Communications by Abrahams and Pillay (2014) reports that these typical low- and very low-income households' experience of phone calls is restricted by a focus on the best use of the limited available airtime.

At 3 – 6% of a household income ceiling of R3500, this proportionally high cost[6] limited uptake of mobile Internet use. Abrahams and Pillay found the cheapest data bundle available was R38 for 250MB from Telkom Mobile, six times greater than the cheapest airtime voucher of R6. These and other cost barriers resulted in little overall experience with mobile Internet or apps and participants to find limited value in owning a smartphone and not access the Internet (2014).

D. Remarks

While mobile network operators claim 96% of residents receive 3G signal coverage, and so are able to access the Internet, only 30% of residents own an Internet-enabled mobile phone. This ownership benefits the household members as through this 41% of households have Internet access. Mobile phones have proven to be by far the most popular way to access the Internet.

While it is clear that the cost of an Internet-enabled mobile phone is a significant barrier to Internet access, so is accessing the Internet once use of the mobile device is secured.

As the vast majority of households survive on R14.40 per day, which is less than $1 per day (R16.47) and markedly below the $1.90 international poverty line, the ICT basket of products considered useful is unaffordable at R149 per month. This amounts to 7.45% of the typical South African household's monthly income of up to R2000, and above the 5% threshold prescribed by the International Telecommunications Union. This reveals a clear access gap.

Notably, the long-term implications of reliance upon a wireless or mobile network is considered a less reliable and more data-intensive connection than wired networks. This is seen as the average cost of communication in a wired network decreases more effectively at scale than a wireless

[6] This R120 – R300 amount is for purely voice calls, excluding an SMS or data bundle.

connection of via a mobile network. This has an impact for economies with less fixed-line penetration that attempt to compete within the same market as those whose fixed-line penetration is extremely high – as is found when comparing developing economies to those already developed.

6.5.3 Relevance (Do those offline see the value of being online?)

The relevance of Internet access is the other side of the coin to gaining access. Once access is possible through reach and affordability, then demand becomes the next step towards the Internet contributing significantly to the economy. Therefore this demand determines the successful effect of access measures (Research ICT Africa 2015).

A. Little to stimulate demand

Current studies show that the most effective method to stimulate public demand is by reducing ICT costs to affordable levels (Research ICT Africa 2015), while macro-economic and society-wide indicators such as basic education levels and proportion of tertiary graduates either stimulate or depress demand or readiness (McKinsey & Company 2014; Research ICT Africa 2015).

More than basic accessibility is required for beneficial levels of adoption; namely “affordability, human development, high-level skills, production of content, local language government services and relevant applications” (Research ICT Africa 2015). McKinsey researchers suggest that the costs required to create relevant local content services and portals are often unjustified by the associated business model constraints (McKinsey & Company 2014).

Strengthening these areas will stimulate demand as private, public and civic actors are able to easily communicate inside and outside of their familiar networks. A more transparent network enables quicker interaction between parties so that governments find it easier to be more responsive and citizens are able to collectively solve problems. As business-to-business communications increase so do production efficiencies. As this network takes effect, so connected citizens, government and business sectors benefit from the convenience, driving increased adoption and fewer degrees of separation between those who create opportunities which others benefit from (Research ICT Africa 2015).

The low levels of ICT use in the informal trade sector allows users to benefit from even slight increased efficiencies through the use of a mobile device. While identified as a key technology used for business activities, most informal traders do not often use the Internet to receive or place orders, or advertise and are altogether more familiar with traditional methods of doing business through word-of-mouth (Research ICT Africa 2015).

Of those interviewed as part of the *Western Cape Digital Readiness Assessment* study group, 10.5% said that they had Internet access. They spent about R23 per month on data services, mainly used to gain information about goods and services. The remaining 89.5% of respondents said they did not see the need for Internet access (Research ICT Africa 2015).

High costs are a key inhibitor of basic ICT use by SMEs and people involved in informal trade. This also reveals "a very low e-literacy base in the country as soon as one moved beyond basic voice and data services" (Research ICT Africa 2015). Authors of the report state that even if users have affordable access to services, "they may not have the skills to use advanced Internet and value-added services optimally". This is a key factor inhibiting demand-stimulation in the informal trader sector (Research ICT Africa 2015).

In a separate study, Chair interviewed five female informal traders who use mobile phones to help market their business, finding WhatsApp[7] and Facebook to be inexpensive and effective platforms (2014). Over the top service, WhatsApp, has become South Africa's most popular instant messaging platform (Shapshak 2015b) and its uptake reveals that even low-income users see the value of purchasing data in return for the communication benefits it offers. WhatsApp's low data requirements has made the functionality of instant messaging affordable to low-income users, who previously found SMS services too expensive (Shapshak 2015a; Shapshak 2015b). The popularity of applications like WhatsApp increases the use, hence the demand, of data by users who previously saw little value in Internet-enabled mobile functionality.

B. Lack of basic and specialised skills

Basic adult literacy levels across South Africa are not adequate to give more residents a meaningful role in a digital economy. Key to this is the general proficiency of secondary school-level Mathematics and Science. Residents benefit most from, as well as meet the demands of, an ICT enabled environment by bringing to bear advanced knowledge and skills – many of which are gained at tertiary institutions. By 2014 only 13.4% of South Africans had completed a level of higher education (Statistics South Africa 2014)

McKinsey link the barriers Internet users face to complex, deeply-rooted systemic problems which societies, including South Africa, face. Barriers to the market in many developing economies include high content and service provider costs, as well as a lack of business cases which support the production of significant and enticing content, such as an advertiser-based model for content

[7] WhatsApp is an instant messaging application for smartphones and uses data to send messages, images, video or audio.

generation. This can result in a lack of awareness of Internet as there are limited cases proving its usefulness and little relevant content, while a lack of digital and language literacy points to an under-developed schooling system (McKinsey & Company 2014).

C. Remarks

While the access gap is known as the 'affordability frontier', the state needs to intervene to stimulate demand (Navas-Sabater et al. 2002), as such functional literacy and numeracy levels are seen as important user characteristics for the value of Internet access to be recognised. However, a lack of contextually-relevant information, in the home language of the user, discourages users from changing their behaviour and spending choices and so increase their access to the Internet.

The concluding Chapter 7 groups the salient points of the minor dissertation and brings them to bear on the research question.

Chapter 7: Conclusion

This critical literature review was undertaken to better understand broadband Internet access in South Africa and so examined the origins and evolution of universal access and service, as well as why and how universal access and service was encouraged through state action (specifically since 1994); it also aimed to give an overview of the current broadband Internet sector.

This review examined the concepts of a market gap and access gap and if this was applicable to South Africa's context, as such a high proportion of South Africans do not use the Internet. This precludes their gain from, and contribution to, the knowledge economy. The study sought to answer these two questions:

1. What is South Africa's current telecommunications context from a Universal Access and Universal Service point of view and does a market gap and / or access gap remain despite efforts to address such gaps since 1994?
2. If so, how do either or both the market gap and access gap appear in the South African context and what are key hurdles that need to be overcome in order to close these gaps?

The review did this through the discussion of these key areas:

- **Universal Access and Universal Service:** Communication methods that save costs and increase convenience through being available, accessible and affordable, first via telephony and then, after the proliferation of mobile phones, the Internet. Developing nations often adopt combined Universal Access and Service approaches to appropriately supervise differing levels of household ICT penetration. In South Africa, the scale of mobile phone adoption surprised domestic state authorities and regulators whose requirements imposed on mobile network operators to encourage universal telephony were quickly overtaken by market demand.
- **The economic benefits of Universal Access for telephony and broadband Internet:** Both telephony and broadband Internet enable conveniently quick information exchange and analysis over distance and so significantly contribute to economic growth, primarily through wealth redistribution, increased productivity, job creation and consumer savings. A critical mass of 40% penetration for telephony (Röller & Waverman 1996) and 20% for broadband Internet is required before serious national economic gains are felt; however, these benefits

quickly scale as the proportion of Internet/ penetration and knowledge workers rise as seen by the Internet's economic contribution in developed countries (Koutroumpis 2009).

- **South Africa's plan to make Internet access universal:** Partial or complete failure characterised each element of state intervention; universal access and service interventions saw inappropriate licensing conditions set on fixed-line and mobile network coverage, enforced industry contributions towards an ineffective universal service fund and hamstrung under-serviced area licensees.
- **South Africa's current telecommunications environment:** The most popular way for South Africans to browse the Internet is by using a mobile phone. Nonetheless, despite comprehensive 3G coverage and the proliferation of mobile phones, two-thirds of South Africans are offline, mostly because of unaffordable device and data costs. A basket of ICT products such as 60 SMS messages, 40 minutes of talk time and 1GB of Internet access amounts to 7.45% of the average household monthly income. Other barriers that hinder demand to Internet access include limited literacy rates, little local content immediately relevant to users, and a lack of general skills to make economically-productive use of the Internet.

In answer to the first research question: Yes, there is both a market gap, as well as an access gap, present in South Africa's broadband Internet sector.

There is a market gap because the manner in which the free market environment and practices are handled by the state does not enable the private sector to be efficient, thus creating a gap. This mishandling by the state includes:

- **Unstable government oversight.** The instability experienced at the Department of Communications, responsible for the regulatory, and policy environment in which the ICT sector functions. There have been five Ministers of Communications since 2009 with differing priorities.

- **Stagnant policy environment.** The slow rate of necessary policy adoption and poor implementation has created an anti-competitive market environment biased towards established actors and against new entrants.

- **Telkom's muddled priorities.** Telkom is neither very profitable nor working for the public good. Telkom's national fixed-line network is acknowledged to be the most important domestic backbone. Between 2006 and 2012 five Telkom CEOs resigned and these executive-level changes compromised its long-term strategic focus and ability. Telkom's

market value is far less than it was, and since 2006 the share price has declined by two thirds.

Moreover, there is an access gap. While we've seen that no truly competitive free market environment exists within the domestic ICT sector, South Africa does exhibit economically-active urban contexts which mimic such a market environment through higher levels of competition. However - within these - the price of ICT products and services remains beyond the reach of low income South African households. The income levels of a *significant* proportion of these South Africans are far too low to afford their inclusion in a meaningful and participatory way.

The exclusion of two-thirds of South Africa's population from the digital economy keeps them offline, disconnected from the communication, education and productivity benefits quick information transfer facilitates. As a result the economy of South Africa falls increasingly off the pace of developed nations and developing economies such as India.

This exclusion occurs despite rapid advancement of technological efficiencies which reduce the price of Internet infrastructure and increase the throughput of bandwidth. Key reasons for the exclusion are: poor policies, weak implementation and state interference. This has resulted in an ICT product and service environment which offers broadband Internet access almost exclusively to middle- and high-income households. Bandwidth is too expensive for two-thirds of domestic (Calandro, Stork, et al. 2012), as well as the globe's (Deloitte 2014), residents.

In the course of this minor dissertation, relevant literature was consulted to explain the origins and evolution of universal access and service, how national economies benefit from universal telephony, as well as universal broadband Internet access and service, and how the post-1994 South African national government responded to this perspective. The existing South African telecommunications context reveals that there are clear market and access gaps to broadband Internet access and use.

I suggest that the casual attitude of national government towards ICT products and services is highly unfortunate, due to the lost opportunities that access to broadband Internet holds for the economic, educational and health care environment.

Many provinces and cities across South Africa have separate programmes focused on making broadband Internet more accessible to benefit their regional or local economies, such as the Western Cape Broadband Initiative and the Tshwane Wi-Fi programme. However these efforts are fragmented, isolated and too few to catalyse the national economy.

What more can be done in the South Africa context to service the market and access gap among everyday South Africans? The recommendations for researchers and policy makers in Chapter 8 focus on data and device costs, policy, demand stimulation and user skills as well as the benfits of open access and infrastructure sharing.

Chapter 8: Recommendations for Researchers and Policy Makers

The market and access gap in broadband Internet access and use in South Africa has implications for future research and policy. Through the use of plain language I intend for this complex field to be more easily understood by state officials, and so encourage the implementation of these recommendations.

8.1 Data and device costs

There are multiple price barriers which prevent low-income households from adopting prepaid mobile broadband use. A variety of factors can increase access, including cheaper devices, as well as the reduction or removal of taxation on imported mobile phones or their components.

The price of an Internet-enabled mobile phone is still too expensive and this cost is the initial and most prohibitive barrier preventing more South Africans from accessing the Internet. Research shows MNOs pay up to 40% in taxes and fees and that 25% of the total price paid by phone owners is a result of taxes (Jorge 2014). Further research to reveal how taxes within the ICT products and services value chain increase costs would bring much-needed transparency to the sector and be useful to government officials in weighing up how best to increase the affordability of Internet-enabled mobile devices and thereby Internet access. The removal of taxes on services and mobile phones, how upcoming tax increases will take effect and tax relief for programmes encouraging Internet access should be encouraged. While just under two-thirds of South Africans have access to a mobile phone, only *half* are Internet-enabled. Just one third of South Africans own an Internet-enabled mobile phone, and the same third are the only South Africans who are able to access the Internet. In order for a fruitful increase in this number to take place, the cost of Internet-enabled smart phones *must* be made affordable.

The cost of data is also too high for effective use, whereby users can upload and download the required material to use the Internet in a productive way – be it for educational or commercial reasons. Instead of data caps for post-paid mobile phone subscribers, packages should include unlimited data. The price of occasional pre-paid data, whereby the small quantity of data is more expensive per unit than when buying in bulk, discourages nascent smartphone owners from using the Internet access capabilities of their device. This price scale should encourage Internet access to low-income households and not treat their lack of purchasing power in a punitive manner.

Competition in the mobile broadband Internet market forced data prices to drop from Vodacom's R600 per gigabyte in 2004 to Telkom Mobile's R20 per gigabyte in 2014 (when purchasing a ten-gigabyte bundle) (Muller 2014). The price of international bandwidth also saw a dramatic decline after Telkom's undersea cable monopoly was broken in 2008. Competition in the ICT sector increases Internet access in low-income households and should be actively encouraged. For this to succeed the market environment which protects the monopoly of fixed-line access by Telkom and the duopoly of mobile access by Vodacom MTN should be changed.

It is imperative that the state create a competitive environment which enables market forces to provide broadband Internet access to low-income households.

8.2 Policy

Policy needs to deliver affordable data and an acceptable good quality of service (to ensure that the speed of Internet access is quick and convenient). This will ensure that Internet use for educational, corporate and residential contexts is productive in that it enables actors in each setting to access, extract and contribute information in an affordable manner back in to the broader community (Stork et al. 2013).

This would be aided by efforts of policy-makers, who should urgently assign spectrum for high-speed wireless access through 4G (or LTE) so that it becomes available to the most people in the shortest time period. Any unused spectrum already assigned for use should be withdrawn and provided to those able to use it.

The roll-out of digital terrestrial television migration would create availability for spectrum reallocation elsewhere and, as such, the hurdles preventing this roll-out should be removed. This would allow for the formation of a transparent framework showing how the resulting broadcasting spectrum should be used (Goldstuck 2012).

These policy efforts would benefit the state through efficiencies in increased electronic communication to and from residents and, as mobile phones are increasingly the most prevalent device to access the Internet, e-government services should be transformed to be m-government services.

As the Internet becomes ingrained in citizens' everyday lives, the increased adoption of mobile money and banking services will benefit the state by encouraging individuals, households and small businesses to transact in a more transparent and efficient manner.

8.3 Shift focus to demand stimulation and user skills

Infrastructure is no longer as great a barrier to access as before, and the attention of the state should shift to stimulating demand by providing relevant content in local languages. Just as Stork et al. (2013) find that social media is easier to use, and therefore more popular than other Internet communication such as email, so the state should encourage opportunities for these users to increase their level of familiarity with the Internet. Regular Internet use will increase users' digital literacy and facilitate their productive use of it. This widespread productive use of the Internet is necessary for the network effect of Internet access to benefit the national economy.

Further, the state should encourage human development efforts such as age-appropriate educational strategies and relevant local language content. They should also create avenues for convenient access to digital resources. Safe, regular access to facilities such as desktop computers or a Wi-Fi zone would be invaluable.

8.4 Open access and infrastructure sharing

The use of open access networks reduces the duplication of infrastructure by Internet Service Providers and telecommunications providers. Sharing electronic communications infrastructure may require a closer monitoring of its use, but it does reduce the level of cost in providing the service to the customer. It is in the public interest to increase competition as this encourages competitive pricing by the suppliers and thereby stimulates demand. This stimulation boosts Internet adoption as well as the critical mass needed for the domestic economy to benefit from the network effects of quick and easy information transfer.

Calandro and Moyo (2012) suggest that incentives should be provided to the private sector to invest in national fibre backbones, perhaps using the collected universal access funds or tax breaks (Calandro & Moyo 2012). The legislation governing USAASA needs to be reworked. Shutting down the ineffective agency and creating a new agency with clear reporting lines, independent funding and public accountability to deliver Universal Access and Service responsibilities would be an effective way to do this. The income provided by the annual fee of 0.2% of all licensed telecommunications providers' annual turnover from the provision of licensed services must be ring-fenced for the Universal Access and Service purposes for which they were intended.

8.5 Concluding recommendations

In summary, research into the ICT services and product value chain on the effect of taxation and the added cost burden to the public needs to be undertaken. The practice of providing unlimited data use with post-paid mobile subscriber contracts should be encouraged and punitive pricing of low-

amount prepaid data bundles should be actively discouraged. The market itself would remove many existing cost barriers through healthy competition, and action by the state should be undertaken to remove the fixed-line monopoly and mobile network duopoly currently entrenched in the domestic telecommunications sector.

Policy should take a more active role to ensure the quality of mobile broadband Internet is suitable for productive use. This can be done through roll-out of digital terrestrial television, the mapping out of how spectrum is used, a process to assign available spectrum and giving MNOs increased flexibility to manage their spectrum use.

Stimulating increased use and demand for data can be done through age-appropriate educational strategies, relevant local language content and increased access to environments which encourage Internet use, such as safe outdoor Wi-Fi zones. State awareness campaigns should be employed to increase public Internet use, stimulate debate and create lobby groups to promote affordable access.

The stabilisation of the national fibre backbone through private investment can be encouraged by universal access funds and tax incentives. Infrastructure sharing should be encouraged to decrease operator costs, and so pass these savings on to the consumer. USSAASA, responsible for state Universal Access and Service plans, should be dissolved and policy updated to facilitate the creation of an effective, well-funded agency whose sole focus is Universal Access and Service provision.

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EBE Faculty: Assessment of Ethics in Research Projects (Rev2)

Any person planning to undertake research in the Faculty of Engineering and the Built Environment at the University of Cape Town is required to complete this form before collecting or analysing data. When completed it should be submitted to the supervisor (where applicable) and from there to the Head of Department. If any of the questions below have been answered YES, and the applicant is NOT a fourth year student, the Head should forward this form for approval by the Faculty EIR committee: submit to Ms Zulpha Geyer (Zulpha.Geyer@uct.ac.za; Chem Eng Building, Ph 021 650 4791)
NB: A copy of this signed form must be included with the thesis/dissertation/report when it is submitted for examination

This form must only be completed once the most recent revision EBE EIR Handbook has been read.

Name of Principal Researcher/Student: Alan Cameron Department: Civil engineering

Preferred email address of the applicant: cameron.an@gmail.com

If a Student: Degree: MPhil Urban Infrastructure Supervisor: Professor Mark van Ryneveld

If a Research Contract indicate source of funding/sponsorship:

Research Project Title: A case for state facilitation of free public broadband Internet access

Overview of ethics issues in your research project:

Question 1: Is there a possibility that your research could cause harm to a third party (i.e. a person not involved in your project)?	YES	~~NO~~
Question 2: Is your research making use of human subjects as sources of data? If your answer is YES, please complete Addendum 2.	YES	~~NO~~
Question 3: Does your research involve the participation of or provision of services to communities? If your answer is YES, please complete Addendum 3.	YES	~~NO~~
Question 4: If your research is sponsored, is there any potential for conflicts of interest? If your answer is YES, please complete Addendum 4.	YES	~~NO~~

If you have answered YES to any of the above questions, please append a copy of your research proposal, as well as any interview schedules or questionnaires (Addendum 1) and please complete further addenda as appropriate. Ensure that you refer to the EIR Handbook to assist you in completing the documentation requirements for this form.

I hereby undertake to carry out my research in such a way that

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

Signed by:

	Full name and signature	Date
Principal Researcher/Student:	[redacted] Alan Cameron	27 July 2015
This application is approved by:		
Supervisor (if applicable):	[redacted]	02 Dec 2015
HOD (or delegated nominee): *Final authority for all assessments with NO to all questions and for all undergraduate research.*		03 Dec 2015
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.		

ADDENDUM 1:
Please append a copy of the research proposal here, as well as any interview schedules or questionnaires:

Research proposal: The case for state facilitation of free broadband Internet access.

Today, by an order of magnitude, many more smart phones are carried around in Africa than the number of them which are used to access the Internet. What are the reasons that so many people can have access to the sum of humanity's knowledge within their grasp but are still unable to reach out and access it?

In step with Moore's Law, civilisation's advancements in technology has pushed down the price of hardware in each stage of the physical infrastructure requirements of Internet access – from the undersea fibre cables to the smartphone in your pocket. Cooper's law has proven true regarding increased efficiencies in the use of radio spectrum (which transmits bandwidth) – its capacity for voice and data doubles every 30 months.

Despite these constant rapidly increasing efficiencies, the price of bandwidth remains too expensive for two-thirds of the world's population – mostly made up by low-income households in developing nations.

In part this is because the market isn't willing to invest in a business model which would give so a low return – if any; and in part because many state authorities cannot afford to do so, don't regard it as a priority, or don't have the skills to roll out the projects and programmes necessary to effectively go where the market fears to tread.

Where conditions exist that encourage market-led investment, such as in many of South Africa's urban areas, the private sector not only meets the demand for area-specific ICT services through infrastructure investment but, compelled by the competitive market environment, players innovate and upgrade infrastructure regularly. This enables those online increasingly cheaper access to better goods and services, fuelling the virtuous cycle of the ICT sector's growth and its increased impact – for those who can afford it.
Those who can't are found on the wrong side of the 'digital divide' (a phrase describing the difference in opportunity between those offline and online).

In the course of this minor dissertation I review the literature of universal access; evaluate how accessible the Internet is for Cape Town residents from a pricing perspective; describe the level of built infrastructure available to private companies and municipal authorities; how bandwidth pricing is influenced by the policy and regulatory environment that affects local access; as well as the price and conditions surrounding broadband access to the local public.

ADDENDUM 2: To be completed if you answered YES to Question 2:

It is assumed that you have read the UCT Code for Research involving Human Subjects (available at http://web.uct.ac.za/depts/educate/download/uctcodeforresearchinvolvinghumansubjects.pdf) in order to be able to answer the questions in this addendum.

2.1 Does the research discriminate against participation by individuals, or differentiate between participants, on the grounds of gender, race or ethnic group, age range, religion, income, handicap, illness or any similar classification?	YES	NO
2.2 Does the research require the participation of socially or physically vulnerable people (children, aged, disabled, etc) or legally restricted groups?	YES	NO
2.3 Will you not be able to secure the informed consent of all participants in the research? (In the case of children, will you not be able to obtain the consent of their guardians or parents?)	YES	NO
2.4 Will any confidential data be collected or will identifiable records of individuals be kept?	YES	NO
2.5 In reporting on this research is there any possibility that you will not be able to keep the identities of the individuals involved anonymous?	YES	NO
2.6 Are there any foreseeable risks of physical, psychological or social harm to participants that might occur in the course of the research?	YES	NO
2.7 Does the research include making payments or giving gifts to any participants?	YES	NO

If you have answered YES to any of these questions, please describe below how you plan to address these issues:

ADDENDUM 3: To be completed if you answered YES to Question 3:

3.1 Is the community expected to make decisions for, during or based on the research?	YES	NO
3.2 At the end of the research will any economic or social process be terminated or left unsupported, or equipment or facilities used in the research be recovered from the participants or community?	YES	NO
3.3 Will any service be provided at a level below the generally accepted standards?	YES	NO

If you have answered YES to any of these questions, please describe below how you plan to address these issues:

ADDENDUM 4: To be completed if you answered YES to Question 4

4.1 Is there any existing or potential conflict of interest between a research sponsor, academic supervisor, other researchers or participants?	YES	NO
4.2 Will information that reveals the identity of participants be supplied to a research sponsor, other than with the permission of the individuals?	YES	NO
4.3 Does the proposed research potentially conflict with the research of any other individual or group within the University?	YES	NO

If you have answered YES to any of these questions, please describe below how you plan to address these issues: