

Developing Smart Free Public Wi-Fi in South Africa

Can public Wi-Fi help redress digital inequality, and if so, how? Emerging lessons from South Africa's diverse implementations

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Abstract

Free Public Wi-Fi (FPW) has been deployed in many countries for over a decade for a range of economic and municipal governance reasons. However a literature review found that although previous research on Free Public Wi-Fi (FPW) did exist, it pertained largely to projects initiated in the early 2000's, the pre-smartphone era and related to wealthier countries, with minimal consideration of socially-inclusive access. At that time Wi-Fi was early in its 'hype cycle' and no evaluations of current projects were done, meaning that there is no foundation of evaluative methodology on which to build.

The recent increase in smartphone penetration into lower income groups has led to FPW gaining greater traction as a socially inclusive solution to broadband access. Many municipalities in South Africa (SA) have embarked on FPW projects. The main challenge, as with all infrastructure initiatives, is that projects require upfront and ongoing financial investment and management commitment in the face of stark alternative demands and therefore policy decisions must be well-informed to maximise return on investment and ensure project success.

SA's two major metros, Johannesburg and Cape Town, used different funding approaches to their FPW, providing a natural experiment from which there are significant learnings which, although context specific, will provide insights for the extension of FPW into smaller towns and less developed towns. It should also have wider application for other developing countries. There is no clear winner and loser arising from the experiment, with the different approaches and funding models producing various positive and negative outcomes across the two projects. The paper does however distill some factors for success relating to cost, funding, deployment, the user experience and project replicability and sustainability for policy makers in developing countries.

Wi-Fi is never 'free' and a basic taxonomy is suggested based on who pays for the service (typically the end-customer, government, advertisers or owners of the site being covered) and what parties stand to gain. Only one of the projects studied aimed at full government sponsorship, a situation which the municipality is reviewing. This paper suggests what has worked about each approach, although emphasising that different contexts call for different solutions.

The well-funded, government sponsored FPW was able to evolve more quickly and have more people on line with better services than the mixed commercial and government funded model. However the first is highly dependent on political will and leadership, making its long terms sustainability and potentially its scalability more susceptible to risk than project that result from innovative public private interplays that are self-funding.

The study found that projects are best imbedded in a wider broadband strategy (rather than stand-alone), including government fibre connectivity projects, content and applications. Government buildings are an ideal starting point, as connectivity, power and security are already budgeted for. Educational institutions should be prioritised, as they are numerous, well positioned within populations, provide broadband for learning, and target age groups most likely to adopt broadband. Libraries, health facilities, museums and public open spaces have also been targeted. Open access Wi-Fi networks have the advantage of allowing competition by internet service providers but require more costly equipment to facilitate than projects involving one exclusive service provider.

The findings inform the concluding set of recommendations to policy makers and municipal decision makers.

Introduction

Broadband digital inequality is reflected as much in usage as connectivity. The high costs of data in many African countries, including South Africa (SA), means that although people may have coverage and the devices to connect, they can often not afford to be on-line or use data intensive applications or platforms to exploit the benefits of being connected fully. The shift from PC based Internet access to mobile broadband, with increased smartphone penetration into lower income groups, has enabled shared access strategies that can spread the costs and opportunities amongst funders, suppliers and users. Free Public Wi-Fi (FPW) projects have been deployed for over a decade in major cities around world for a range of economic and governance reasons and are now relatively widespread, although uneven in their take up and with mixed outcomes.

The overpromise and under-delivery of public Wi-Fi¹ in the first decade of the millennium in the northern hemisphere however, limited its traction outside of some of the major cities in the North. Failure has been attributed variously to technical, regulatory and commercial factors most of which are not inherent to Wi-Fi but to the timing and context into which it was introduced (See Fraser 2009)². In cities, where most people had affordable broadband access, the value of low quality or limited bandwidth access was not going to be a major driver of publicly or privately provided Wi-Fi. Where this was not the case, Wi-Fi was likely to be congested and not able to meet the requirements of individuals' private use.

In addition, the advent of Wi-Fi in more mature economies preceded the shift from computer to smart phone as the primary device to connect to the Internet. In mature, yet heavy mobile user markets, such as Hong Kong, cities could use public Wi-Fi networks to better inform citizens on public services, and encourage commercial activity as an extension of the widespread fibre connectivity in the city. This better reflects the conditions that are reigniting the deployment of Wi-Fi globally, but in Africa particularly as an access strategy. Although Africa has lagged behind many other parts of the world in providing FPW, initiatives now exist in many primary cities – notably Nairobi, Kigali and Lagos, and including those in SA, which are the subject of this paper.

In the mobile broadband era global Wi-Fi hotspot numbers are expected to grow to more than 340 million by 2018; that is one hotspot per 20 people (iPass 2015)³. Wi-Fi traffic has been shown to exceed mobile traffic in South Africa (SA) and other countries where comparative studies have been undertaken. Of course, these figures hide that most private hotspots contributing to this figure are concentrated in more affluent areas of cities or in cities with the political will and resources to connect citizens and tourists to public information, like timetables, traffic congestion, public events, or in support of local commercial activities.

Peter Torrens (2008) argued nearly a decade ago that nascent public Wi-Fi was being used to encapsulate and reinforce civic space. Wi-Fi appears to offer a solution to last-mile problems that may reduce the unevenness of broadband take up and particularly use, at least for those with access to Wi-Fi-enabled hardware. Wi-Fi was found to strengthen existing urban geography.

Wi-Fi can provide access to innovative voice and data services to individuals and businesses. (Gunasekaran V, Harmantzis F. 2008) present a convincing case for why regulators and policy makers should seek suitable strategies to promote Wi-Fi as an alternative broadband access

¹ Wi-Fi is an inherently disruptive technology that allows a new generation of telecommunications operators to compete with established incumbents in both the fixed and wireless markets. It is a family of radio communications standards designed to use predominantly licence-exempt radio spectrum.

² See Fraser, Eric. 2009. 'The Failure of Public WiFi' *Journal of Technology Law & Policy*, 14(2): 161–78.

³ *The global public Wi-Fi network grows to 50 million worldwide Wi-Fi hotspots*. 2015. Available at <https://www.ipass.com/press-releases/the-global-public-wi-fi-network-grows-to-50-million-worldwide-wi-fi-hotspots/> and the Growth Map can be found at <https://www.ipass.com/wifi-growth-map/>

technology. They also highlight the importance of Wi-Fi for cellular operators to offload traffic from increasingly data-congested networks.

The work of Hanjin Park, Youngmi Jin, Jooho Yoon, Yung Yi (2016) extends this complementary role of public Wi-Fi with “delayed Wi-Fi offloading” as a low-cost solution, which alleviates the impact of the mobile data explosion by persuading users to delaying their delay-tolerant traffic until in Wi-Fi coverage, obtaining useful insights into the actual economic benefits of user-oriented delayed Wi-Fi offloading and how to incentivize users to deploy such a service.⁴

Problem statement and research question

Conditions in Africa are very different to those in OECD countries where FPW research has been undertaken. Primarily, large numbers of people have no or limited access to broadband and, for those who are able to access it regularly, the use of it is inhibited to various degrees by the relatively high price of data.

Advances in mobile technology, together with cheaper entry-level smart devices have combine to increase mobile data uptake across the continent. However, outlying areas still suffer from limited coverage and slow data speeds. Relatively high data prices further exclude the poor and inhibit the optimal use by most users even in urban areas or where competitive services are available (Ray-Moreno 2016)⁵ Large numbers of users in Africa are from countries with some of the lowest gross national incomes per capita in the world, but paying high costs, due to inadequate competition, ineffective regulation of operators or the high underlying dollar costs of rolling out networks (especially where operators have to develop complementary power and roads infrastructure). Prices remain relatively high across the African continent, and SA is not in the top third of African performers on the 1GB RIA African Mobile Pricing (RAMP) Index. Many customers therefore cannot afford to utilise enough data to gain the key benefits of broadband access.

This is arguably the primary policy challenge for African countries. Universal service strategies initially focused on the extension of fixed networks through dedicated universal service levies, generally proved unsuccessful. Efforts to aggregate demand through the creation of telecentres, initially for voice and subsequent to the Internet through computers had mixed results, but generally subsidised supply-side driven initiatives had short lived success or failed. A few of the community initiated centres, driven on some form of entrepreneurial or commercially sustainable model, worked. But, with the advent of mobile broadband and smart devices, the price and skills barriers that computer-based Internet access created were increasingly removed, undermining the logic of access and device aggregation. Mobile devices can now offer adequate user experiences with web-browsing, e-mail access, messaging and an increasing variety of over-the-top (OTT) platforms and applications, such as Facebook and Whatsapp⁶ (Stork, Calandro and Gillwald 2013). Wi-Fi offers lower-priced Internet at higher data speeds, and can thus target marginalised communities.

⁴. Joohyun Lee, Yung Yi, Song Chong and Youngmi Jin model interactions between a single provider and users, to show that Wi-Fi offloading is economically beneficial for both parties, and quantify the practical gain, boosting provider revenue from 21% to 152%, and user savings from 73% to 319%. “Economics of Wi-Fi offloading: Trading delay for cellular capacity”. 31 December 2012. (Available at <https://arxiv.org/pdf/1207.6607.pdf>)

⁵ See Rey-Moreno, C contribution in (2016). “Alternatives for Affordable Communications in rural South Africa. Innovative regulatory responses to increase affordable rural access” (a combined submission to SA Parliament on 21 Sept 2016), available at http://www.r2k.org.za/wp-content/uploads/Policy-brief-Cost-to-Communicate_13092016_FOR-SUBMISSION.pdf

⁶ See Stork C, Calandro E and Gillwald, A (2013). Understanding internet going mobile. Internet access and use in 11 African Countries, Policy Paper 14, Research ICT Africa, Cape Town.

www.researchictafrica.net/publications/Evidence_for_ICT_Policy_Action/Policy_Paper_14_Understanding_Internet_Going_Mobile.pdf

Beyond connectivity there is also growing evidence that a critical mass of people needs to be connected for the network effects that enhance the information flows and reduction transactional costs that are associated with enhanced efficiencies associated with economic growth (Katz 2013). It appears that the real gains are associated not only with connectivity but the intensity of use, which reflects not only the extent of time online, though this appears to be a good indicator too, but the range of services used and the activities undertaken with them.

Governments can maximise the unique opportunity that Wi-Fi now presents, to increase broadband penetration, while also promoting digital inclusivity. They can consider how best to promote Wi-Fi within the context of their overall strategy. However, as with most infrastructure-dependent approaches, there are multiple combinations of different investment and policy options to consider. Governments, find such decisions difficult as projects enter new territory, with little internal experience to draw on.

With smartphones increasingly available (including amongst lower income groups) and having the computing power, memory and screen size needed for meaningful Internet use, one promising solution is FPW. Provinces and cities in SA are starting to invest in coverage of underserved areas and in their central business districts. The traction with citizens has been overwhelming.

SA, although facing numerous challenges regarding broadband provisioning, is fortunate to be able to review the diverse range of Wi-Fi projects aimed at solving these challenges. FPW projects are aligned with the SA national broadband policy requirement that all public buildings be connected to broadband and should include a FPW hotspot (RSA 2013). This diversity provides a rich research opportunity for comparing models and contexts, to assess the effectiveness (or potential effectiveness), of government-sponsored FPW.

The arising research is *what can we learn from the 'natural experiments' of FPW projects in South Africa in relation to the success factors of their different models and if it is, what learnings can be drawn to influence future policy, particularly in terms of the interplay between the public and private sectors in resource constrained environments.*

Conceptual framework for revenue models and definitions

Wi-Fi, being licence exempt, allowed new competitors to enter and disrupt the wireless market, in which there were only four mobile networks operators, and to introduce new business models, which commonly include an element of free access to the customer. Free access always requires a financial sponsor, and hence a return of some description (financial, social or political). The combinations of who the funders are and what they are seeking leads to different sponsorship models, the common of which are listed in **Error! Reference source not found.**Table 1 (**Error! Reference source not found.**).

Sponsor	Value obtained
Operator	Gives away an initial free bundle (per venue) to entice the customer to buy additional access when this bundle runs out. The sponsor achieves a return if a target uptake ratio is achieved.
Venue owner	The owner of a venue such as a café or restaurant sponsors Wi-Fi to attract or retain clientele. The Wi-Fi is seen as part of the value offered to the customer (for example, in a hotel or at a conference centre). The venue may be large (a shopping mall, public beach or tourist precinct, and be co-sponsored by a group of commercial interests.
Advertiser	The advertiser pays the operator to interact with customers, as a targeted audience who obtain free access in return for viewing advertisements.
Analytics user	A company pays for (legitimate) access to customer information, derived from sponsored Wi-Fi access systems. These systems can build sophisticated customer

	information and aggregate trends, based on variables, such as customer Internet usage behaviour and usage location information. Analytics can be used to enhance advertising
Government	Local, provincial or national government can sponsor Wi-Fi to promote socio-political or economic objectives at the level of a venue, city, province or country.

Table 1: Common Wi-Fi Sponsorship Model Taxonomy

For the purpose of this report, the concept of Free Public Wi-Fi (FPW) refers to a government-sponsored, publicly accessible Wi-Fi broadband service.⁷

Methodology

The multiple Smart City initiatives and related fibre-optic projects by cities - as these initiatives appear to have determined the character of ensuing Wi-Fi projects - were explored in a study (Geerdts et al. 2016) which itemises and detail the background, objectives, description and initial review of these projects as at Dec. 2015. A review of this Study found that Gauteng and Western Cape in particular have implemented assessable initiatives. The 4 largest metropolitan areas: Tshwane, Johannesburg and Ekurhuleni (in Gauteng), and Cape Town (in Western Cape) have municipal and provincial projects. The different approaches to the municipal-funded Tshwane Free Wi-Fi project and the Western Cape FPW public-private and public-community initiatives started at similar times, and are advanced enough to provide a natural experiment. This Study compares the different approaches, business models and funding arrangements to understand what is common and what differs, and to assess their extent and sustainability as part of wider urban socio-economic inclusion strategies.

The cases are developed through desktop research of publicly available resources to better understand the rationale and status of the initiatives as provided by the organisations under review together with high-level interviews with key informants within the main two projects to better understand the models. As the projects had not engaged deeply in self-assessment at this early stage, this paper has also provided them with some evaluation of these public initiatives. User information (although difficult to obtain) was requested to supplement interviews and some mini-ethnographic research on users and random survey at hotspots undertaken by Research ICT Africa in 2016 are drawn on.

In addition to this supply side analysis, qualitative research was based on online surveys conducted by operators of the two main projects. This is supplemented more generally by focus group results which explored the use of FPW and other 'free' or low cost data in SA undertaken by RIA during 2017⁸.

This paper uses the understanding about funding models outlined in Table 1 (above), as well as capability to deploy projects) to test the underlying premise of government involvement in FPW, to suggest which models are most likely to achieve the best returns, and also be scalable, replicable and sustainable, and to suggest how these desired outcomes should translate into appropriate policy.

The South African Case

⁷ See (Geerdts 2016) for detailed descriptions of the South African projects.:

⁸ This will be supplemented with the findings of the RIA 2017 ICT access and use survey which includes several demand side issues relating to FPW and which will be available in August 2017.

A departure point for this report is the South African government's broadband policy, SA Connect⁹, which restates many socio-economic benefits as the rationale for the policy itself and also includes a Vision for 2020 and connectivity targets for 2016, 2020 and 2030.

Wi-Fi was gaining attention, globally, over a decade ago, at a time when South Africa's market was struggling to open up. In 2008 ICASA published regulations which allowed license exempt use (albeit with conditions) of the standard Wi-Fi frequencies, used both indoor and (extensively) to provide Wi-Fi services in rural areas¹⁰.

A number of early public Wi-Fi initiatives, bizarrely including one to connect orphanages and schools, were shut down and their equipment seized for not being type approved and for interfering with licensed operators whose rights supersede those of the unlicensed operator¹¹. As a result of these early test cases, the entry into the South African market was largely limited to the commercial application of Wi-Fi, with high-end coffee shops and conference venues making limited bandwidth available to patrons. As in more mature markets, this was a complementary service, with few people using it as their major or primary source of access¹². However global trends, improvements in Wi-Fi technology and a proliferation of devices and applications overcame policy and regulatory lethargy, driving Wi-Fi for device access, data analytics and Internet of Things¹³.

Increased smartphone penetration

The increasing affordability and penetration of connected mobile devices (smartphones, phablets and tablets) included lower income market segments. According to SAARF's (SA's Audience Research Foundation) last AMPS survey¹⁴ over 50% of SA adults aged 15 and older had used a smartphone (up from 41.3% in only 12 months, from June 2014). The data shows a particularly dramatic increase in smartphone penetration amongst the lowest income brackets (referred to as Living Standard Measure, LSM categories 1–4), from 14% in June 2014, to over 22% a year later.¹⁵ (SAARF 2015)¹⁶.

Smartphones offer an acceptable user experience of the Internet (including browsing, emailing, and watching videos). SAARF found that 36% of SA's access social networks (predominantly Facebook and Twitter) with 96% of that accessing being via smartphones¹⁷, with social networks a significant driver of new-user uptake being significant (Stork, Calandro and Gillwald, 2012). Compared with the high smartphone usage, only 23.5% were found to have Internet access at home via a computer (laptop or PC).

The Gauteng case

A full 24% of the country's population lives in this highly urbanised province, which drives about a third of national economic activity, mainly within 3 adjacent municipalities - Johannesburg, Tshwane

⁹ South Africa Connect: Creating Opportunities, Ensuring Inclusion. South Africa's Broadband Policy". 20 November, 2013 (Promulgated as Department of Communications Notice 953, on 6 December, 2013).

¹⁰ Independent Communications Authority of South Africa, ICASA published Notice 926 of 2008 on 29 July 2008 in *Government Gazette* 31290, Licence Exemptions.) ICASA has recently prescribed certain spectrum licence exemptions, including for the use of the 2.4 GHz band for wide-band wireless systems.

¹¹ Paul Vecchiato. 2009. "ICASA defends Wi-Fi confiscation". 20 February. (Available at http://www.itweb.co.za/index.php?option=com_content&view=article&id=20376)

¹² The Wi-Fi Forum reported to ICASA research undertaken by iPass, claiming that in 2014, there were 8 611 commercial hotspots in SA. This equates to one hotspot for every 6,155 people in the country. These hotspots are mainly located at retail outlets (3 211), hotels (3 099), and cafes (2 256). (See "South Africa's Wi-Fi versus the world", *My broadband*. 3 Dec 2014. (Available at <http://mybroadband.co.za/news/wireless/113349-south-africas-wi-fi-versus-the-world.html>)

¹³ (Wi-Forum 2018 presentation to ICASA as part of public hearings. See footnote 5).

¹⁴ SAARF. 2015. "AMPS 2015A" (survey results ending June 2015). Published October. Slide 65.

¹⁵ Ibid. Slides 67,68

¹⁶ This data will be supplemented with demand side data from RIA's Access and Use Survey, in August 2017

¹⁷ Ibid. Slides 69,70

and Ekurhuleni, each of which runs an independent FPW initiative as summarised below, with more detail available in a prior report (Geerds et al. 2016).

Tshwi-Fi is SA's best known project, based on the vision¹⁸ of an individual with an ICT management track record, Alan Knott-Craig. He considered free broadband access as a human right and sought to demonstrate that FPW was best positioned to provide universal access. He set up Project Isizwe¹⁹ as a non-profit organisation, together with a committed team, and persuaded the mayor of Tshwane, which is both the country's capital city and (physically) largest metropolitan authority, to fund Tshwi-Fi. Essentially, Project Isizwe was funded via city grant to replace a modest, 100-site, city-run Wi-Fi project (part of Tshwane's Vision 2055 programme)²⁰ with an ambitious, phased project of over 1000 sites (creating the largest FPW project in Africa) in a form of build, operate (for 3 years) and transfer arrangement. Tshwi-Fi offered higher data allocations and faster internet than the previous project, and introduced curated content, free on-net voice calls and access on key bus routes²¹.

Project Review

Phase 3 was completed, subsequent to the Geerds et al (2016) study on smart FPW. The actions of the mayor (especially as he re-sponsored the project in Phase 2 and 3) are a key part of the review. He originally authorised the project on the basis that the city would only pay for demonstrated success – an arrangement which required Isizwe's founders to find bridging finance²², at considerable personal risk²³. Rollout commenced in November 2013. The first mayor was sufficiently encouraged by the (pilot) Phase 1 in 2014, that he approved a larger Phase 2, and then a very-much expanded Phase 3, which he had by then decided by should have the target for every citizen to have access to free Wi-Fi within walking distance of their homes. In his May 2015 annual address, he indicated that 14.7% of residents were within walking distance of the service. His ultimate vision was "to eventually provide free Wi-Fi connectivity in every street, every corner and to every household in the Capital City"²⁴.

There is little doubt that the project has a positive impact on the lives of many people. Project Isizwe showcases many beneficiaries of the service, especially students, entrepreneurs and job seekers²⁵

However, a win at the municipal polls by the opposition ("DA") party, in August 2016, led to the new mayor reviewing the project. His response as a newcomer saddled with the financial commitment, gives insightful reviews of the project. Firstly, he affirmed the socio-economic (and by now very political) value of the project, mentioning in his maiden budget speech (in May 2017) that "Contributory to the creation of an inclusive Tshwane teaming with opportunity is our city's award-winning Wi-Fi. ... [which] has facilitated access for 3 million users. ... [and] taken on a momentum of its own, with active and engaged citizens making a difference in their communities with the power of technology. I have been vocal in my support of the free Wi-Fi project. The TshWi-Fi network is stable and operational and our job now is to make it better and sustainable... Recognising that cities can be urban hubs of creativity and innovation, the new administration has an ambitious vision of making

¹⁸ Knott-Craig Jr, A. and Silber, G. 2015. "The story of Tshwane Free WiFi". (Available at <http://www.projectisizwe.org/wp-content/uploads/2016/06/1-The-Story-of-Tshwane-Free-WiFi1.pdf>)

¹⁹ Project Isizwe should not be confused with the commercial enterprise, Sizwe IT Group.

²⁰ Alfreds, D. 2013. "Tshwane to roll out free Wi-Fi". News 24. 15 August 2015. (Available at <http://www.news24.com/Technology/News/Tshwane-to-roll-out-free-Wi-Fi-20130815>). [6 November, 2015]

²¹ Project Isizwe. 2014. "Tshwane hits the road with innovative 'Bus WiFi'". 1 December. (Available at <http://projectisizwe.org/tshwane-hits-the-road-with-innovative-bus-wifi/>) [23 December, 2015]

²² Knott-Craig Jr, A. and Silber, G. 2015. "The story of Tshwane Free WiFi". September. (Available at <http://www.projectisizwe.org/wp-content/uploads/2016/06/1-The-Story-of-Tshwane-Free-WiFi1.pdf>)

²³ Interview with Project Isizwe's CEO (Khan) and CTO (Devine), Herotel offices, 28 January, 2016.

²⁴ Mayor Ramokgopa. 2015. "City of Tshwane State of the City Address". 14 May. (Available at <http://www.gov.za/speeches/mayor-kgosientso-ramokgopa-city-tshwane-state-city-address-14-may-2015-0000>)

²⁵ Found directly on the Project Isizwe homepage, at <http://www.projectisizwe.org/>

Tshwane the most connected city on the African continent... Not only does free Wi-Fi allow users who previously only had limited access to get online, it also gave small businesses the chance to use information technology to thrive.”

The new mayor goes on to describe how “Entrepreneurs like Sizwe Ntloko, a photographer and graphic designer, use TshWi-Fi to grow and operate their business ventures. Sizwe accesses the internet at TshWi-Fi zones and communicates with his team and sends designs to clients. Free Wi-Fi has made a real impact on people’s lives: ‘TshWi-Fi gives the youth the opportunity to expand their minds,” says Lenah Mashiya, a local radio station presenter ... We’re constantly looking for ways to innovate, but it is important to take time to appreciate how far we’ve come and to acknowledge the incredible TshWi-Fi community of champions, innovators and ambassadors that we have become a part of...”

The DA administration took over as contracts with Isizwe were reaching term, noting that it was expensive, but “whilst it was born in sin, it was simply too far down the road to simply cancel the service and start anew”²⁶, noting that the national government’s auditor general had declared the expenditure “unlawful and irregular”. The DA did renew Isizwe’s lease in May 2017²⁷ (and there would have been considerable political backlash had they not done so), but committing to the following changes (which policy makers need to note carefully):

- Taking physical ownership of the network. (This is because one need to ensure future independence from a ‘sole supplier’ relationship, in procurement terms)
- Aligning expiry/renewal dates for Phases 1, 2 and 3 (to simplify the management agreement)
- Updating performance level metrics (to reflect new access speeds and daily bundles)
- Expanding the project into more areas (this being a sign of confidence in the project)
- Commercialising aspects of the network (advertising is specifically mentioned) and finding supplementary sources of funding (supporting the view that full government funding is simply not sustainable)

In terms of usage, Isizwe-supplied data²⁸ given in the project study (Geerdts et al 2016) has been updated with that from a recent interview²⁹ and the elements that are available given in Table 2 (below).

Date	Users	Age	Gender	Access by	Usage
April 2014	29 000 unique (mainly students)	54% between 20-29.	30% female		Good internet proficiency, using service multiple times daily. Mainly social media, research and email, but also news, work searches and instant message
July 2014	86 000 unique			Smartphone: 73%	84% had a Facebook account and 55% Twitter. 7mbps average download speed
May 2015	630 000 unique (equiv of 21% of Tshwane population)	52% were 24 or younger	48% female	Smartph: 81%; Computer: 11%	There were 5.8m views on the video portal
July 2015		80% were <35 years	48% female		81% of sites are educational institutions

²⁶ Rudolph Muller, “Tshwane Free Wi-Fi – the true story”. Mybroadband. 27 June 2017.

²⁷ Mzekandaba, S. “Hope for Tshwane’s free WiFi. 26 May 2017. (Available at http://www.itweb.co.za/index.php?option=com_content&view=article&id=162100) [26 May 2017].

²⁸ Interview with Tim Genders, COO of Project Isizwe, Cape Town, 11 May 2017

²⁹ These are sourced from periodic news updates provided at <http://projectisizwe.org> as at the dates specified in the table, available in their news archives.

August 2015	755 000 unique users, or 26% of the Tshwane population, now having accessed the service			
December 2015		47% female	Computer: 12%	72% of sites are educational institutions (rollout was now in under-served areas)
May 2017	100k users per day, over 700k unique users per month. >3m unique devices had logged on			7% of customers actually reach their daily usage limit 3.5m sessions conducted monthly.

Table 2: Isizwe-Supplied User Data

Content from a list of websites is given un-metered access (over and above the daily bandwidth allocation). This includes health, information (including Wikipedia), employment, education and government websites. A subset of this content is a curated portal, called Tobetsa³⁰. Tshwi-Fi trains ‘champions’ to assist users, collect stories and promote this content portal³¹. The portal is also an important tool to elicit general user feedback.

Project Isizwe has expanded business development capacity to increase private and public funding and impact policy. They are engaging with other municipalities within and outside SA³².

Other Gauteng Initiatives

The City of Johannesburg, the commercial capital, has a long-standing broadband and “smart city” initiative managed by its Department of Economic Development. The primary deliverable is fibre deployment (with the city as anchor tenant), with free public access to be deployed via the so-called Smart Wi-Fi Project, with 1000 sites... A new political party is running the city since August 2016 and there was a storm of tweets when it was thought the new Mayor was switching off the Wi-Fi. The project is being implemented slowly. The project has been described previously (Geerds et al. 2016) and will not be described further, except to illustrate aspects of policy proposals. Since that Study, little progress has been made

Ekurhuleni, adjacent to Johannesburg is funding its own fibre-and-Wi-Fi project. Deployment commenced in January 2015³³, with completion planned for January 2018. The budget is R120m to provide access at 695 public buildings. The city aims to spend under 0.05c per MB³⁴.

Province of Western Cape

The Western Cape is SA’s second wealthiest province, and fourth largest by population, with 5.8m inhabitants, about two-thirds of whom live in the metropolitan area of the capital, Cape Town.

Six FPW projects were identified in the Western Cape³⁵. The City of Cape Town (“CoCT”) provides free Wi-Fi in parts of the city centre and also ran a pilot, open access network in two suburbs with low

³⁰ Project Isizwe. 2014. “Tobetsa Content Portal Goes Live”. 31 July. (Available at <http://projectisizwe.org/tobetsa-content-portal-goes-live/>) [22 December, 2015]

³¹ Project Isizwe. 2015. “WiFi Champions program launched”. 4 December. (Available at <http://projectisizwe.org/tshwane-launches-free-wifi-champions-programme/>). [13 December, 2015]

³² Knott-Craig Jr. video interview on CNBC Africa Power Lunch. 4 June 2014. (Available at <http://www.biznews.com/interviews/2014/06/04/alan-knott-craig-2/>) [22 December 2015]

³³ Alfreds, D. 2015. “Ekurhuleni switches on free public Wi-Fi”. 19 November. (Available at <http://www.fin24.com/Tech/News/ekurhuleni-switches-on-free-public-wi-fi-20151119>) [20 November, 2015]

³⁴ Nthlophi, L. “Introducing Ekurhuleni Free Wi-Fi” (Presentation providing a status reporting update as at Nov 30, 2015).

broadband penetration. The provincial government runs a flagship fibre and Wi-Fi project (a key subject of this study) but also ran three pilot projects with different partners³⁶ (via grants of R1.2m each, over two years, with the expectation that the projects would find their own supplementary funds³⁷). These projects are all described in the previous Study (Geerdts et al. 2016).

Broadband within the metropole is the responsibility of the CoCT whereas broadband within smaller towns and rural areas is promoted by the provincial Department of Economic Development and Tourism (DEDAT).

The Western Cape put out a tender for a public-private partnership (PPP), resulting in the appointment of telco operator Neotel (now part of Liquid Telecom) to deploy a physical fibre network and maintain it for 10 years. This network saved money relative to existing ICT costs, and also allowed for inclusion of Wi-Fi hotspots at sites to be nominated by DEDAT, on the fibre route.

The Wi-Fi component is aimed at one AP for each ward, or 384 sites in total, which Neotel will fund, build, manage and maintain for three years, offering 250MB per device, per day, at 2Mbps minimum speed. Access to government websites (the gov.za domain) is not metered or limited. Neotel can sell Wi-Fi data bundles beyond the 250MB, if it so wishes, or provide its own commercial Wi-Fi services. DEDAT funds the daily free data allocation. Rollout is between March 2016 and February 2018.

The expected benefits listed were: provision of information and transaction capability (including for job seeking); educational; safety; service delivery; and decrease in digital divide.

Information from the projects that could be used to assess sustainability is currently limited. Top sites listed in November were Google, Tubidy (a music video and audio download site) and Avast (an antivirus site).

City of Cape Town (CoCT)

The municipal authority (CoCT)³⁸ has successfully deployed an open access fibre network to connect public buildings and sell wholesale access to ISPs and has also provided free Wi-Fi in selected certain public spaces since 2013. Its additional Digital Inclusion Project³⁹ aims to provide broadband access in under-served communities. An initial study, supported financially by the United States Trade and Development Agency, determined that Wi-Fi was suitably promising as an access technology for CoCT to proceed with a proof of concept (POC), in 2014, to provide Wi-Fi via public hotspots on an open access basis in two areas, Khayelitsha and Mitchells Plain. The scope of the project and research objectives⁴⁰ were described in the previous Study (Geerdts 2016). The project was deemed successful enough to move to tender. The tender closed in 2016, but had not yet been awarded (as at May 2017).

The project took advantage of the CoCT fibre project for backhaul, extending wireless backhaul spurs where necessary. Distinguishing features of the project appear to be:

³⁵ Most of the information for the Western Cape provincial projects results from a face-to-face interview with Marc Cloete, programme manager for Wi-Fi deployment, 8 December 2015.

³⁶ Interview with Jo-Anne Johnson, Chief Director, Western Cape Government, 2016.

³⁷ Western Cape Government's Department of Economic Development and Tourism (DEDAT). 2013. "Call for Applications for Funding of Free WiFi Projects (to NPO's). Terms of Reference". 11 November.

³⁸ Unless otherwise indicated, the information for this section derives from a meeting with the Cape Town Wi-Fi project team (chaired by Leon van Wyk), and follow-up information provided by Raven Naidoo, including the case study (Naidoo, R. et al. "Case study: Public Internet access using Wi-Fi. Results of a Proof of Concept project carried out in Khayelitsha and Mitchells Plain". City of Cape Town. Undated.

³⁹ Naidoo, R. et al. "Case study: Public Internet access using Wi-Fi. Results of a Proof of Concept project carried out in Khayelitsha and Mitchells Plain". City of Cape Town. Undated.

⁴⁰ Naidoo, R. et al. "Case study: Public Internet access using Wi-Fi. Results of a Proof of Concept project carried out in Khayelitsha and Mitchells Plain". City of Cape Town. Undated.

- Targeting specific areas known to have very low Internet uptake.
- Extending coverage outside of (rather than at) public buildings (or facilities). Public buildings were used where appropriate, but high masts were deployed to extend coverage, and additional masts were also deployed away from public buildings.
- Have Wi-Fi APs “open access” in that they allowed multiple ISPs to offer Internet services. A commercial tender process (request for quotes) was, therefore, based on providing the ISP portion of the service rather than provisioning infrastructure. ISPs were able to provide service via a simple cross-connect to CoCT’s main switching centre, and therefore did not have to pay infrastructure costs beyond Internet provision itself.

From Jan. 2015, multiple service providers were appointed by tender to offer service. CoCT did not filter content on this network, and could analyse preferred destinations. Key learnings from this project included:

- A maximum (as well as minimum) daily free allowance must be specified, otherwise service providers compete on free allocations, congesting the Wi-Fi services.
- When daily allocations were large, file torrents dominated traffic, followed by YouTube, and then Google Drive, with Facebook being the most popular social network application. X-rated videos were also popular. Google searches and software updates were prominent activities (in particular, Microsoft updates).
- When daily usage was reduced, torrents dropped and YouTube traffic dominated (27% of the total at the end of an initial study in 2015), Facebook and Google Search also remaining high on the list.

CoCT reported in November 2015⁴¹ that the POC was complete. Based on the evaluation, CoCT had decided not to offer Wi-Fi as a residential access technology, but to rather provide public Wi-Fi zones. One constraint to connecting houses (via high masts) was the prevalence of iron sheeting as roofing. The actual project costs, and certain research completed, were requested but not made available for this report.

Recommendations from the POC included: that the number of ISPs be limited to 3; that the daily allowance be limited; that file-sharing or X-rated content be restricted; that ISPs be allowed to draw income by advertising or micropayments. In addition, CoCT felt that if they had access to more detailed analytics from ISPs, including fields such as geography and location type (e.g. library or clinic), they could provide a more targeted service.

Policy Suggestions Based on FPW Business Model Comparison

This section aims to inform policy based on both *common findings* and a *comparative review* between projects.

Rationale for Projects

The argument for providing FPW from is supported by the following points:

- Penetration of smartphones is high, and growing in the low-LSM (life style measure) groups.
- Smartphones (as well as phablets and tablets) offer a convenient and worthwhile experience for general consumption, although not for complex tasks better suited to large screens.
- Most South Africans access the Internet primarily via cellphones, have limited access to a true “broadband experience”, due to the high costs of mobile data and limited rural coverage of 3G and LTE.

SA’s wealthiest two provinces (Gauteng and Western Cape) and wealthiest four cities (Johannesburg, Cape Town, Tshwane and Ekurhuleni) all have FPW programmes. Initiatives lag for the rest of the country. Government entities, and particularly the poorer local authorities, face stark resource,

⁴¹ Meeting with CoCT officials, 27 November 2015, Durbanville offices of the City of Cape Town.

capacity and infrastructure challenges. Wi-Fi can reduce the digital divide only if there is significant investment beyond the current initiatives.

Coverage via Government Buildings

Government buildings are suited as a starting point for FPW. All major projects targeted public buildings, as there is a relatively marginal operational cost to providing public Wi-Fi. These buildings already have power and security and are located in urban and rural areas.

Connectivity either already exists to these government buildings or can be supplied in the same project. SA's broadband policy, targets 50% of all public buildings to be connected by 2016, giving specific mention to schools and clinics.

- Wi-Fi provisioning often piggy-backed on the connectivity project itself (Ekurhuleni, Western Cape) or benefited from existing connectivity (cities of Cape Town, Tshwane).
- The benefit of the complementary approach was that Wi-Fi approval was expedited (in other words an authority approves a combined fibre/Wi-Fi project more readily than a Wi-Fi only project).
- Furthermore, Wi-Fi was (and should be) planned as part of a broader broadband initiative.
- The disadvantage of the complementary approach is that objectives and costs are not as easily disaggregated. Wi-Fi does ultimately need to have a stand-alone motivation in order to be sustainable.

Most public buildings selected were schools. This makes sense because schools outnumber other government building types, connectivity is essential for modern learning and school-age children are ready adopters. In July 2015 80% of Tshwi-Fi hotspots were at educational institutions, and the demographics of users show them to be typically under 24 years old. The Tshwane beneficiaries video-interviewed for the Tshwane Free Wi-Fi website almost all refer to research and assignments as the main benefits of free Wi-Fi. Most of Isizwe's projects, apart from Tshwane, are school based and they are planning to add specific focus on education⁴².

The Western Cape selected educational institutions for 41% of its sites.

Libraries are also popular, forming over half the connections in Johannesburg, topping Ekurhuleni's priority list, and constituting 35% of the Neotel Wi-Fi list. 100 libraries were connected in Tshwane prior to Tshwi-Fi.

The third most common target building types are health institutions (hospitals and clinics). In Johannesburg, clinics make up 16% of connected buildings, and in the Western Cape (Neotel project), 18% are clinics. These ratios are comparable. In Tshwane, 24% of non-educational buildings are health facilities.

Commuter sites are probably the most useful of all venues, providing connectivity for the wider public on a regular basis, while people continue with their normal social and economic activities. Many countries provide free Wi-Fi on public transport, including Australia, Korea, Israel and France. Bus stops and buses themselves were targeted in Tshwane. In Cape Town, bus stops were connected by CoCT and the large taxi ranks by Project Isizwe.

Museums and tourist or heritage venues, included in Tshwane's coverage list, are often the first to be covered in developed countries, to attract tourists. In the Introduction to this report, mention was made of the Australian experience, where public Wi-Fi was introduced to provide supportive information on tourist and heritage sites being visited. Open spaces (parks or open areas in city

⁴² Interview with Project Isizwe COO on May 11, 2017

centres) were included in the coverage list for Cape Town, Johannesburg, Ekurhuleni and Tshwane. An Australian study⁴³ that suggests that theoretically, FPW complements public spaces, allowing for broad communities to interact; provides a sense of identity and belonging for regular inhabitants; furthers culture (“through forms of commerce, individual expression, social interactions, public art, street performances and local events”); and can “lubricate urban flows by providing shelter, relaxation and places to socialise”⁴⁴. These abstract concepts are untested locally, but aspects are demonstrated by Tshwane’s video magazine content services, which were enjoying a million downloads per month.

Apart from the above, in order to make a significant difference to resident’s lives, coverage must be sufficiently available at locations that promote sustained, regular use, to the point where access can be integrated into the daily lives of all – be they residents, students, job seekers or business people. Tshwane has the most extensive coverage, with the mayor recognising that coverage is not completed until every resident can walk to a FPW spot (1km for urban areas, and 5km for rural areas around the city).

The SA Connect policy targets affordability as 2.5% of the population’s average income. This target may be achievable if citizens combine free Wi-Fi data use at selected, easily accessible sites with continuous mobile data coverage for lighter applications. In this respect, coverage along commuter routes is important, such as taxi ranks covered by Isizwe in Cape Town, and bus routes covered in Cape Town and Tshwane. Another positive development is free Wi-Fi provided in taxis by Wi-Taxi, a national joint venture project between Santaco and Telkom. Train stations should enjoy free Wi-Fi (as is the case in Paris) and so should public markets.

The projects studied all projected Wi-Fi from public buildings, approximately 100-200m radius, so that at least adjacent households can connect. CoCT tried to enhance coverage using high masts, but the iron roofing common in many areas does reduce signal penetration.

Wi-Fi coverage provided solely from public buildings has its limits. A growing broadband economy includes skilled individuals using full-feature PCs for applications, such as software coding, financial analysis and advanced multimedia creation. These desktop workers require a higher level of service than public Wi-Fi is providing. Much of the economic benefit of broadband penetration derives from the employment and income from the services of this high-end user group. However, any business that depends on continuous information or real-time applications will find the patchwork of coverage to be business-limiting. This is more the case since muggers find users clustered at Wi-Fi hotspots easy targets⁴⁵. For the average household to have no coverage at night is also clearly restrictive.

Costing

TshWi-Fi has the benefit of 3 years operation now to give credence to its costs. Although Isizwe posted its own pricing⁴⁶ and the previous report estimated detailed updates (Geerdts 2016), of more relevance to policy is this 3-years outcome (the point at which the initial contracts are being renewed). Isizwe’s COO estimates that ZAR218m (approx. US\$17m⁴⁷) was spent for capex and 3 years of

⁴³ Lambert, A et al. “Free Wi-Fi and Public Space The state of Australian public initiatives”. University of Melbourne / Institute for a Broadband-Enabled Society. August 2013.

⁴⁴ Ibid. Page 5

⁴⁵ See, for example: <http://mybroadband.co.za/news/wireless/152505-watch-out-for-criminals-at-public-wi-fi-spots-sa-police.html>

⁴⁶ <http://web.archive.org/web/2013111122631/http://projectisizwe.org/fiz-pricing> (Project Isizwe archived material as it was on 11 November 2013.)

⁴⁷ ZAR/US\$ in May was around R13/\$.

operations for all phases. Assuming 600 000 unique users, dividing over 36m, and given that ZAR75m was additional, for the VAS (Web, portal voice etc). – the costs are ZAR 6m per month (opex) or ZAR10m/month per user (including capex) (for a 500Mb allocation and speeds of up to 15mbps⁴⁸). This is under \$0.5/m/user for opex and under 1\$/m/user all told, which is exciting.

Isizwe's did realise a slight saving as Neotel initially donated a free 1Gbps⁴⁹ link and Tshwane offered its existing metro fibre network for the initial phases within the urban area. TshWi-Fi also has free peering to large content providers such as Google.

Cape Town does not disclose its costs. However, both the CoCT (and Isizwe) concurred that paying a premium for the Wi-Fi equipment was justified in terms of additional functionality and performance. Network management was an important feature. CoCT also valued the ability to analyse user behaviour.

The Western Cape is providing Wi-Fi on the back of a fibre-deployment PPP in which government only pays for free daily usage (by paying for dedicated bandwidth to each AP).

Ekurhuleni has set a target cost of ZAR R0.05 per MB consumed, which amounts to ZAR12.80 per user, per day (if the user uses full allocation), which is comparable to Isizwe's costing.

In summary, as time elapses, further research needs to be done to determine the actual costs of providing FPW, with Tshwi-Fi providing a useful benchmark for decision makers to work from.

Funding

All of the projects reviewed have built Wi-Fi projects on the back of fibre-based connectivity networks to public buildings; in most cases as integrated projects. For the sake of correctness, in isolated cases, and particularly for more remote sites, high-capacity wireless broadband connections have complemented the basic fibre network, but the principle is the same.

A fundamental policy issue is whether or not governments should subsidise the internet at all. When Tshwi-Fi commenced, Project Sizwe's founder campaigned for government to fully fund Wi-Fi to all, on the basis it was a human right and that authorities would recoup expenses due to ensuing economic growth⁵⁰. It is telling that Tshwane is continuing to fund its Wi-Fi, but seeking supplementary funding. Isizwe is also reviewing their approach. The COO is considering a model where funding is sought for initial capex and one year's operation.

Johannesburg and Ekurhuleni are fully funding Wi-Fi together with their fibre networks. In the short term the Johannesburg project is continuing, without confirmation yet of its longer term support. Ekurhuleni is still being deployed.

Cape Town is funding and deploying its infrastructure, over which ISPs can run commercial services, provided they offer residents the free daily allocation of 250Mb. The future of this project is not clear, since the city went to tender in 2016 but has not proceeded. The Western Cape's approach is for a private sector company to run commercial fibre and Wi-Fi services, on the basis that government is an anchor tenant, guaranteeing uptake for government buildings and to pay for the daily per-resident allocations for Wi-Fi. There is not yet evidence of which model (if any) will 'win out'.

Some revenue can be recouped by selling top-up vouchers when a customer reaches their daily limit, based on the "Operator Sponsored" category in Table 2. Isizwe strongly rejected this model on the

⁴⁸ According to Akamai, these speeds place Tshwi-Fi users in the top 5.8% of South Africa's users: Akamai. 2017. "State of the Internet Connectivity Report" page 15.

⁴⁹ Knott-Craig Jr, A. Presentation to Radwin customers, 7 November 2014.

⁵⁰ Ibid.

basis of very low potential uptake^{51 52}, but is now reconsidering⁵³, on the basis that the 7% or so Tshwi-Fi users who cap daily should be given an opportunity to pay. Previous research (Geerdts 2016) indicated that a small Wi-Fi community initiative was able to sell additional data vouchers, and recent results from the Western Cape Neotel project also indicated low, but significant voucher uptake.

Western Cape's approach is different. They planned to pilot 384 sites so as to research the impact before funding further, but both parties are sufficiently encouraged by early feedback to engage about expanding the project before the pilot ends⁵⁴. The agreement also encourages Neotel, as they gain experience on the need and costs from the pilot, to drive their own commercial expansion. In summary, Western Cape's priority is to catalyse commercial initiatives (providing a degree of de-risking, through funding and guaranteed uptake), but it appears it will fund future public projects if they are shown to support strategic outcomes. The disadvantage from a research perspective is that Neotel would keep its commercial results confidential.

Maintaining the correct public/private interplay is seen as important to sustainability. The University of Pennsylvania recently reviewed the finances of the 20 municipal fibre projects (of 88 in total) for which dedicated financial reports were available, and found that 11 had generated negative cash flow, and seven had break-even projections of over 60 years. Therefore only 2 projects were actually profitable⁵⁵. The Australian government has proactively worked to engineer a world-class national broadband network which is often regarded as an expensive failure⁵⁶.

In the longer term, input pricing could reduce to the point where free Wi-Fi is no longer considered a significant expense. Until then the model is entirely dependent on substantial public funding. There is a danger, as happened with the first generation public Wi-Fi in the smaller towns of Knysna, and later in Stellenbosch, of an innovative private company driving the project vigorously and enthusiastically but then departing, leaving the municipality to carry the project, without the internal capacity to do so (Geerdts 2016).

Private Sector Stimulation

The Western Cape broadband strategy includes stimulation on private sector investment in broadband and the partnership with Neotel can be seen as such an activity: by improving information on the market (via an assessment of supply and demand side digital readiness in 2015); by helping investors understand the costs; by creating demand (with government as an "anchor tenant"); and by reducing capital outlay requirements (by paying for part of the infrastructure). The City of Cape Town (CoCT) is encouraging private investment by reducing the upfront capital outlay required for the APs and the backhaul connectivity. This model is more expensive to implement than the Tshwane model, but such an 'open access' network includes the private sector and fosters innovation and open competition, whereas Tshwi-Fi may inadvertently have stifled potential private initiatives to offer service.

Deployment capability

⁵¹ <http://projectisizwe.org/faq/>

⁵² Alfreds, D. 2015. "Christmas bonus for Tshwane Wi-Fi users". 15 December. (Available at <http://www.fin24.com/Tech/News/christmas-bonus-for-tshwane-wi-fi-users-20151215>) [15 December, 2015]

⁵³ Interview with Tim Genders, COO of Isizwe, on 11 May 2017

⁵⁴ Follow-up interview with Marc Cloete, programme manager for Wi-Fi deployment, 2 June 2017.

⁵⁵ Yoo, C. "Municipal Fiber in the United States: An Empirical Assessment of Financial Performance". May 2017

⁵⁶ McMillen, A. "How Australia bungled its \$49 billion broadband internet rollout". May 12, 2017, found at <http://www.afr.com/technology/web/nbn/australias-internet-trails-thailand-kenya-20170511> [May 14, 2017]

Wi-Fi involves complex, new and fast-changing technologies which are not the traditional domain of expertise of local authorities, either to deploy directly or to manage contractually. Project Isizwe argues this as the reason for contracting specialist expertise such as theirs on a turnkey basis⁵⁷ and they have indeed shown the most visible results, building on zeal, passion and innovation.

Table 3(below) outlines how different authorities have managed deployment:

Authority (Project)	Mechanism	Wi-Fi Link to Fibre Project	Outcome
Tshwane	Outsourced to Isizwe	Uses existing fibre. 18km additional	Strong visible results but new administration acting to reduce dependency on a single supplier ⁵⁸
City of Cape Town	Managed its own (wholesale) implementation	Uses existing fibre, adding where needed	Stalled in pilot phase since 2014. Use of retail ISPs has delivered service at no cost to city.
Western Cape	Public Private Partnership (province pays for Wi-Fi usage bandwidth only). No transfer at end (to reduce risk of obsolescence)	Add-on	Maintained budget and timing. The main problems – power outages and theft ⁵⁹ - become that of the partner.
Ekurhuleni	Contracted via tender to build, maintaining ownership ⁶⁰	Add-on	Still in process, appears on track
Johannesburg	In house via a special purpose vehicle	Add-on	Fibre (hence Wi-Fi) suffered numerous legal disputes, delays and costs ⁶¹ .

Table 3: Deployment Models Used

DEDAT pointed out that CoCT's geographically dense customer base argues for ownership of infrastructure and provision of open-access service, whereas the Province has opted for a PPP to serving smaller towns and rural areas, with the FPW model determined by the fibre project.

In summary, deployment capability is more likely to exist within the wealthier provinces and larger municipalities, but even then results have been mixed. The quality of execution of fibre projects seems to be a good precursor to capability to deploy Wi-Fi. Project Isizwe is an excellent choice of execution partner for government entities who have funds but need rapid, assured, turnkey execution.

Service Performance Levels

⁵⁷ Personal interview between the author and Mr Knott-Craig, 22 April 2014.

⁵⁸ My Broadband journalists recently claimed actual tested download speeds were 0.050 to 0.36 Mbps in tests but their exceedingly low values did not seem plausible given the high average throughputs seen on Isizwe's live monitor. The low results were published in Vermeulen, J. "Project Isizwe might lose Tshwane's free Wi-Fi project". 1 June 2017. Available at <https://mybroadband.co.za/news/wireless/213630-project-isizwe-might-lose-tshwanes-free-wi-fi-project.html> [1 June 2017]

⁵⁹ Neotel monthly SLA adherence reports for January, February and March 2017

⁶⁰ Interview with Lydia Ntlhophi, City of Ekurhuleni ICT Business Relation Management Divisional Head. 23 December, 2015.

⁶¹ Cernowalow, M. 2015. "ITWeb investigates: Unravelling BWired's network shenanigans". ITWeb. 6 March. (Available at http://www.itweb.co.za/index.php?option=com_content&view=article&id=141717:ITWeb-investigates-Unravelling-BWired-s-network-shenanigans) [28 December, 2015]

Throughput speeds are best compared against the South African policy targets, which called for 50% of the population to have access at 5Mbps average, by 2016. By 2020, 90% should average 5Mbps access, and 50% 100Mbps. Table 4 (below) shows the relative speeds and allocated bundle sizes:

Authority (Project)	Nominal Speeds (Mbps download)	Data Bundles (MB/day)	Notes
Tshwane	15	500	Verified as accurate, early in the project ⁶² (when speeds were still 7.5 Mbps). Journ recently claimed in tests ⁶³ .
City of Cape Town		250	Not provided as wholesale, so ISP dependent. "Always On" has a 100Mbps wholesale link, so speeds slow down if this link saturates.
Western Cape	Nominal 2Mbps for now	250	Neotel must connect buildings at 10Mbps and 100Mbps as per SA Connect guidelines.
Ekurhuleni	Not specified, given as "fast".		Journalists achieved 125Mbps at launch function ⁶⁴ .
Johannesburg	10	300	

Table 4: Project Download Speeds and Data Allocations

The projects offer good theoretical speeds (better than many more affluent home owners might experience). A limitation of these projects is that they do not monitor user-side throughput speeds. One needs to be able to measure the end-user experience as a project feature and to conduct research. Western Cape does measure uptime of each AP (against service levels), but this information is confidential.

User experience

Very little end-user experience information is available from the projects reviewed, aside from nominal data speeds. One could argue that users of a free service complain less than for a paid service. Feedback from focus groups on user strategies for affordable access to the Internet conducted as part of an five African country comparison during 2016 and 2017 provides some insights. Explaining why subsidised or zero-rated data does not lock users into specific content avenues user, South African focus groups, divided along urban rural and gender lines, indicated that they had other means of accessing the Internet were reported during the focus groups. Most respondents in urban and peri-urban areas used private individual connections, and sought out free commercial or public Wi-Fi provided. This service is mainly available in urban areas, as noted from the peri-urban and rural respondents who still had to travel to access public Wi-Fi points (Chair 2017).⁶⁵ Free public Wi-Fi, whether it be provided by a public or commercial entity is very popular, as is free Wi-Fi at work, universities, schools, hotels, restaurants, pubs, shopping malls, Internet cafés, or private individual networks. Free Wi-Fi at schools is usually only available to students and staff, thus limiting those who make use of it. Commercial spots, such as restaurants and hotels are often the most popular spots for Wi-Fi access with crowds of young people often found outside the Wi-Fi area. However, the

⁶² <http://mybroadband.co.za/news/wireless/92581-free-wi-fi-in-tshwane-tested-impressive-results.html> [4 November 2015]

⁶³ Rudolph Muller, "Tshwane Free Wi-Fi – the true story". Mybroadband. 27 June 2017.

⁶⁴ Alfreds, D. 2015. "Ekurhuleni switches on free public Wi-Fi". 19 November. (Available at <http://www.fin24.com/Tech/News/ekurhuleni-switches-on-free-public-wi-fi-20151119>) [20 November, 2015]

⁶⁵ See Chair, C (2017) Internet use barriers and user strategies: South Africa Focus Group report, in Ed: Gillwald, A Broadband for Africa Series, Public Policy Paper no.3 at www.researchICTAfrica.net

commercial hotspots in some instances require one to purchase a service prior to accessing the internet or comes with a limited usage time:

'It can be accessed at the restaurant. They give you the password if you have bought something inside' (Male respondent, peri-urban).

Roll out has mainly been in urban centres and even there users face challenges. In Soweto Gauteng, the municipal Wi-Fi was no longer available. In Ashton, none of the respondents knew of any initiative in their areas. In rural areas, Wi-Fi was available at schools and shopping centers but still required travel time to make use of the services (Chair 2009: 3).

Locating public Wi-Fi spots is also a challenge for respondents. Free commercial Wi-Fi, such as that in food outlets, is the most popular. Rural respondents however, do not benefit from similar options. There is a need to extend the benefits of initiatives to increase connectivity to rural areas. Apart from specific internet initiatives, within the deep rural area sites, basic services such as electricity need to be deployed to ensure people are not limited to using their mobile devices at specific times of the day (Chair 2009:17)

Further, policy-related findings and recommendations

The projects reviewed were (and should be) positioned within a broader planning context aimed at promoting broadband, which includes a mix of fibre and Wi-Fi, content and applications. The Western Cape/Cape Town projects are also 'coordinated' to an extent, as should the Gauteng projects be.

No significant policy findings arose relating to demographics (particularly age and gender). Only Tshwi-Fi records user information (via self-reporting events).

Conclusion

Wi-Fi holds enormous promise to contribute to the vision of rapid promotion of broadband in an inclusive manner, provided that projects learn from what has been done thus far, and are well informed, well-conceived and well designed to make judicious use of scarce resources.

Sustainable models to promote inclusive broadband should be explored and replicated. Initiatives in SA share objectives with those in other countries, although with more focus on the development objectives of increasing overall broadband penetration, providing Internet access as a basic human right and addressing digital inclusivity. With commitments from government to ongoing investments in such initiatives, it is important to understand which models show the most promise for replication, and to learn how to improve projects in future. The models involve very different (often competing) points of departure and, therefore, fundamental project design and implementation choices must be made upfront, which will have impact for years to come. If wrong or uninformed implementation models are embraced, they can lead to expensive failures. Similarly, if learnings from projects are not shared with others, costly mistakes are often duplicated. Therefore, informed options about designing and implementing Wi-Fi are very important.

The fact that the larger projects are clustered in the wealthier provinces and cities suggests that expansion will be severely limited by organisational capacity and budget. Policymakers will, therefore, have to focus on increasing leverage of private investment (based on models already mentioned) and by fostering new innovations and business models that will draw the private sector into offering free and reduced-cost Wi-Fi on a significant scale. There is enough groundswell of existing *private* free-Wi-Fi initiatives to suggest that widespread replication is possible, provided new innovative models can be found (including appropriate PPP models) to provide low-cost, Wi-Fi-based broadband services at affordable rates.

The report uses research results to the extent they are provided by the projects under review and the scope of the report does not extend to independent user surveys or actually measuring the socio-economic impact of these projects. While this is an important undertaking, it is resource intensive and requires a rigorous baseline survey which could be followed by an 'end-line' study. The individual surveys being conducted currently by Research ICT Africa will provide some nationally representative information on FPW access and use (in Aug 2017).

One of the key policy questions is the extent to which government should be investing directly in a free service, and to what extent it should rather be stimulating investment and encouraging business models that provide low cost service. There are multiple sources of return for an investment in Wi-Fi services, whether the investment is by government or private sector sponsors. The options are complex, but at least the following should be included:

Economic growth. All projects (local and international) promote the view that the economic growth of an area will create more value than is spent on a project (an economic return). The benefits might be enhanced economic well-being, job creation, local competitiveness, attracting skills, bringing tourists and businesses to an area or creating an economic growth hub. For a local authority, an expected secondary benefit is an increase in taxable activity.

Digital inclusion. A demand-side value analysis of infrastructure development recognises the public and social value, not only economic value, generated by information infrastructure that generate positive externalities that benefit society. All projects promote the view of including a higher percentage of citizens in the benefits of the digital age and providing improved communication and access to information on, for example, health, education and job opportunities.

Advertising. Sponsored Wi-Fi has considerable growth potential, with the differentiator being that it is highly targeted – being more personal and allowing a higher level of customer interaction than traditional media, such as radio and TV. The Western Cape encouraged its FPW providers to explore such options, and Tshwane recently decided on this approach. It is too early to determine the results of this approach.

Analytics. Wi-Fi offers rich analytics capabilities, which can be used to enhance the targeting in advertising; to enhance government planning (for example, to understand routes used on public transport and at transport nodes); and by the private sector (such as detailed individual behaviour at shopping centres). The opportunity is not well developed in SA, but has been developed internationally by companies such as Google and definitely needs further consideration. Due attention should be given to the privacy rights of individuals, especially when analytics are used for individual customer interaction. Much of the analytic data is useful as aggregated information (without needing to know details of individuals).

Freemium service for subscribers. The conventional Public Wi-Fi model (common amongst commercial operators) is to offer a free bundle and charge for additional usage. This approach was supported in all the Western Cape models. Isizwe originally resisted, but is now open to this approach.

Government are therefore urged to consider the deployment of existing universal service funds often lying dormant in national treasuries, fruitlessly deployed for pet projects or patronage paybacks, or provided to profitable operators to service underserved areas to which user cannot affordably gain access, to divert these funds to the deployment and extension of FPW to urban and rural areas currently largely not serviced by public Wi-Fi networks, and to do so in such a way as to maximise leverage of private sector resources, where, as in the case of TshWi-Fi, "the ingenuity of the private sector becomes critical to securing the service in the long term"⁶⁶.

⁶⁶ Vermeulen, J. "Project Isizwe might lose Tshwane's free Wi-Fi project". 1 June 2017. Available at <https://mybroadband.co.za/news/wireless/213630-project-isizwe-might-lose-tshwanas-free-wi-fi-project.html> [1 June 2017]

Wider recommendations

These research findings should encourage FPW initiatives but also ensure they are sustainable because they are not easily switched off (as the newly elected Tshwane administration taking over from those who initiated the project found out), without incurring the wrath of the public!

Additional research and evaluation

Certainly at a policy level, there is more scope for research and develop business models which reduce access costs and yet are sustainable and maximise private sector investment.

It is therefore recommended to SA policy makers as they seek in terms of SA Connect to extend FPW to all public buildings that an evaluative methodology needs to be developed, including costing detail. Projects should also include analytical capability so that the beneficiary experience (transfer speeds, latencies and coverage) and behaviour (what they are doing) can be understood and improved (whilst protecting the privacy rights of users). Minimum technical specifications are needed to ensure FPW provides the expected user experience.

Surveys of beneficiaries also need to be undertaken (requiring a survey budget) so as to better understand beneficiary demographics and be able to measure user adoption, attitudes, preferences and benefits of the FPW intervention, dis-aggregated by demographic dimension.

Deploy USF funds

Funds from the Universal Service and Access Agency of South Africa (USSASA) should be used to extend FPW to municipalities beyond the major centres in line with SA Connect. This will require a clear roll plan and funding model that has yet to be devised. Treasury has allotted funds for the connection of 8000 clinics (and any other public buildings that are nearby) but the operational costs and capacity to run these have not been developed. The Fund has been ineffectively deployed in the past and funds are currently frozen while the case between the Minister of Communications and the free to air broadcaster over the standard of the boxes that the universal service funds have been redirected to for the subsidisation of set top boxes which provides a case in point. Putting these funds to use to enable access to public website, or data intensive applications and platforms not affordable to the poor, it would improve the intensity of use that is now understood to be a factor in addition to connectivity necessary for network effects associated with growth and development to prevail.

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Appendix 1 - Glossary of terms

Term	Definition or meaning
3G	Third generation mobile cellular
3GPP	Refers to the family of third generation mobile. The purpose of using the term in this report is to distinguish 3GPP, the mobile cellular ecosystem used by incumbent mobile operators (such as MTN, Vodacom) from that of Wi-Fi (which is not a 3GPP technology). 3GPP technologies include GSM, 3G and LTE.
access point or AP	The physical equipment, which is connected to a high site and provides Wi-Fi connectivity to customers. Another common term is a “hotspot”. An area offering Wi-Fi (sometimes called a Wi-Fi zone) may be served by one or more APs. Therefore, there are usually more APs in a network than there are Wi-Fi areas or Wi-Fi zones.
Cap	A colloquial term for a data allowance. In this report, the cap is specified in terms of free megabytes allocated per device per day, or (in some cases) per month.
CoCT	City of Cape Town (the metropolitan authority)
Hotspot	A service point from which Wi-Fi is offered, usually public Wi-Fi. Since the term can refer to a single access point, or a Wi-Fi zone (consisting of multiple APs) the term is used with caution in this report.
FIZ	A free Internet zone. A single area with FPW coverage, in the parlance of Project Isizwe.
FPW	Free public Wi-Fi
ISP	Internet service provider. An ISP typically provides Internet services, but may provide these over the access infrastructure of another operator.
KZN	KwaZulu-Natal
LAN	Local access network. This is a private network, normally consisting of Ethernet cables or Wi-Fi connections, connecting devices (for example) in a home or office.
LTE	Long Term Evolution is the latest 3GPP wireless technology, offering improved performance in a number of respects.
Mbps	Megabits per second – the data throughput rates in millions of bits per second. In this report, most references are to the download rates that a device can achieve, using Wi-Fi.
PC	Personal computer. The PC is referenced to highlight the distinction, albeit a narrowing one, between a PC (with keyboard and mouse entry, and full-feature Windows or similar multi-tasking operating system) and (say) a smartphone or digital tablet.
POC	Proof of Concept. A (small) project implemented to demonstrate that a concept works as envisaged, or to test a concept.
PPP	Public-private partnership. In the context of this report, the common model is for a private company to deploy (and optionally, to manage) infrastructure on behalf of government, on pre-arranged terms. Partnership terms can vary.
SA Connect	SA’s broadband policy, known as “South Africa Connect: Creating Opportunities, Ensuring Inclusion” which was adopted in 2013 and includes a section on vision and targets for broadband connectivity.
(Wi-Fi) site	See Wi-Fi zone.
Telco	Telecommunications company/telecommunications operator
WISP	Wireless ISP. An ISP that operates its own infrastructure, based largely on wireless connections (which usually make use of licence-exempt spectrum).
Wi-Fi®	A term licensed to the Wi-Fi Alliance®, referring to the body of standards for wireless data communication known collectively as the 802.11 family, agreed by the Institute of Electrical and Electronics Engineers (IEEE). What is of interest to this report is that standards are sufficiently advanced to allow generally seamless establishment of connections between devices (such as laptops, tablets and smartphones) and public APs. Of further interest is that the standards are evolving, allowing faster connections and reducing equipment prices. For primarily commercial information on Wi-Fi, visit www.Wi-Fi.org and for technical standards detail, see www.ieee.org .

(Wi-Fi) zone

In this context, a zone (or a site) is an area covered by public Wi-Fi. The distinction is that a zone can consist of one or multiple APs.