Development of a National Broadband Strategy Project

Phase 2 report

Prepared by

Setics SA

ICT Consultants (Pty) Ltd

Progressus Corporation

For

Botswana Telecommunications Authority

27 February 2012

PROGRESSUS CORPORATION
17 avenue Marcel Proust.
75016 Paris -.France
Tel: + 331 45 25 53 12
Fax: + 331 45 27 31 19
E-mail:
olivier.jacquinot@progressus-corp.com

SETICS
7, rue Biscornet
75012 Paris
France
Tel: +33 1 45 89 74 93
Fax: +33 1 44 68 93 63
E-mail: vrm@setics.com

ICT CONSULTANTS (PTY) LTD
Unit 1, Plot 20651, Sekotlo Rd,
Block 3 Industrial, Gaborone.P. O.
Box 1735, Mogoditshane,
Botswana.
Tel: +267 393 6298,
Fax: +267 3180581
E-mail: info@ict.co.bw,

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

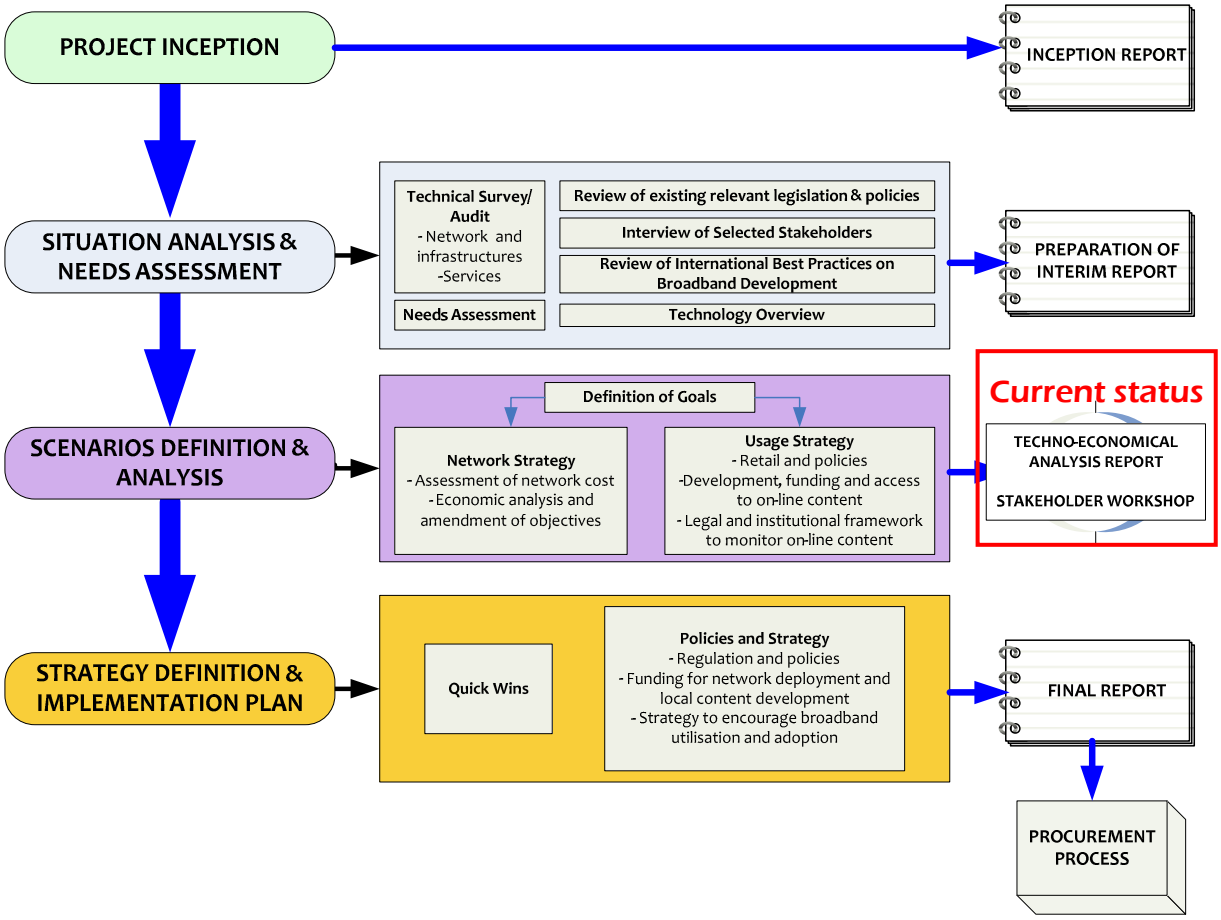
1 Introduction

This report corresponds to the third deliverable for the consultancy in respect of "the Development of a National Broadband Strategy for the Government of Botswana and the Botswana Telecommunications Authority". It is the final output for the second phase of this assignment dedicated to a techno-economic analysis and qualitative scenarios for the national broadband strategy.

The observations, findings, hypothesis presented in this report and feedback from stakeholders will serve as basic elements on which the final recommendations and the draft National Broadband Strategy will be based.

Figure 1-1 shows a flow chart of activities and deliverables associated with this assignment.

Figure 1-1: Methodology flowchart and current status of the study



During the Project Inception Phase, the Consultants, the Botswana Telecommunications Authority (BTA) and the Ministry of Transport and Communications (MTC) reviewed the terms of reference for the project and agreed

priority areas. The output of this phase was a Project Inception Report which outlined the agreed revisions.

Phase 1 of the assignment involved data collection, interviewing a number of stakeholders countrywide and undertaking an analysis of the existing infrastructure, market structure, regulatory and policy framework. The list of interviewed stakeholders is contained in the Interim Report which was delivered at the end of Phase 1. The Interim Report presented a situational analysis of the status of broadband services in Botswana. The Interim Report was arranged as follows.

- Chapter 1 provides an introduction of the project and presents agreed project activities and workflow as shown in figure 1-1 above.
- Chapter 2 presents an overview of the definition of broadband as defined by a number of international organisations such as the International Telecommunications Union (ITU), the World Bank and a number of countries. It also presents an overview of the development of policy and regulatory framework related to the Information and Communications Technology (ICT) sector in Botswana as articulated in the Telecommunications Policy of 1995, the National ICT Policy (Maitlamo) and related legislations such as the Telecommunications Act [CAP. 72:03].
- Chapter 3 reviews the supply-side of broadband market in Botswana and assesses the constraints and opportunities faced by key stakeholders such as the Public Telecommunications Operators (PTOs) being Botswana Telecommunications Corporation (BTC), Mascom Wireless and Orange Botswana, and Internet Service Providers (ISPs). It also reviews the broadband requirements for key users such as Government Institutions, ISPs as wholesale consumers, needs of potential heavy users such as educational and research institutions.
- Chapter 4 reviews and compares Botswana's market and regulatory structure to those of other countries in Africa and Europe. It compares Botswana's tariffs for various services with those of other countries and highlights potential impediments to the development of the sector in general and broadband services in particular.
- Chapter 5 presents international best practice in respect of the development of broadband policies, regulation and services. The analysis looks at the development of broadband policies in six countries (Australia, France, Morocco, Rwanda, Mauritius and Ghana) and provides an outline of lessons that could be beneficial to Botswana.
- Chapter 6 presents an overview of various technologies that can be deployed to deliver broadband services. These include cable technologies (fibre-to-the-x, xDSL), fixed wireless technologies (FWA/WiMAX, Wi-Fi), mobile technologies (3G, 4G networks), satellite technologies and power line communication.
- Chapter 7 provides a summary of the key findings from Phase 1. As shown in figure 1-1, this assignment included, amongst other things, the identification of

recommendations (called Quick Wins) which BTA and or MTC could implement fairly quickly to bring tangible benefits to the ICT Sector. As per the terms of reference, Quick Wins were supposed to be one of the deliverables at the end of the project. However, BTA and MTC requested the Consultants to identify any Quick Wins that could be identified at the end of Phase 1. The said Quick Wins are included in Chapter 8 of Phase 1 Report. Chapter 9 provides a list of stakeholders interviewed during data gathering exercise.

In the present report:

- Chapters 2 and 3 present the key findings and a summary of the Quick Wins from Phase 1, respectively.
- Chapter 4 presents the models used to analyse the network strategy, i.e. the elements that constitute the supply-side policies.
- Chapter 5 deals with the usage strategy (demand-side policies).
- Chapter 6 provides an outline of the essential recommendations for the National Broadband Strategy.

Stakeholders are requested to review this consultative document and to comment on the recommendations and respond to consultation questions in the various sections. Written inputs should be submitted to the Botswana Telecommunications Authority (BTA) no later than the 18th of April 2013.

In all cases where the stakeholders disagree with the Consultants' preliminary recommendations in this document, they should:

a) State and explain their reasons for disagreement

b) Propose alternatives to the recommendations with justifications for same.

BTA will arrange a public workshop in due course to discuss the issues dealt with in this report.

2 Summary of relevant findings from Phase 1

The challenge of developing broadband access for the majority of people and professionals in Botswana, and to fulfil the present and future needs of the society, requires consideration of various issues such as:

- Infrastructure footprint extension;
- Pricing structure and market competition dynamism and
- Availability of services and their usage.

2.1 Infrastructure footprint extension

As discussed in Phase 1 report, networks are broken down into distinct segments:

2.1.1 International Access

The results in Phase 1 report show that international bandwidth is a limitation for a smooth access to the Internet in Botswana. The reasons are technical and financial. Technical because most of the content to be accessed is hosted abroad (mainly USA and Europe) and no international global Internet exchange (GIX) is available in Botswana. Therefore, most of the traffic generated in Botswana has to transit through international connections and bandwidth availability can become a bottleneck. Most of all, the price of this international connectivity is an issue that has been mentioned by many stakeholders.

Even though the connection to two new submarine cables (EASSY and WACS) might improve the situation, the BTA should monitor international bandwidth prices to ensure that they do not deter the development of the telecommunications sector.

2.1.2 National backbone

As discussed in section 3.2.1 of the Interim Report, a fibre optic cable backbone spans Botswana. It constitutes a key asset for the country because such a backbone is required to support the development of access infrastructure throughout the country.

2.1.3 Backhauling

The backhaul network is the portion of the network that connects the backbone with the access network (e.g. copper local loop by collecting DSL traffic gathered in exchanges, wireless access by collecting traffic from base station or BSC/RNC).

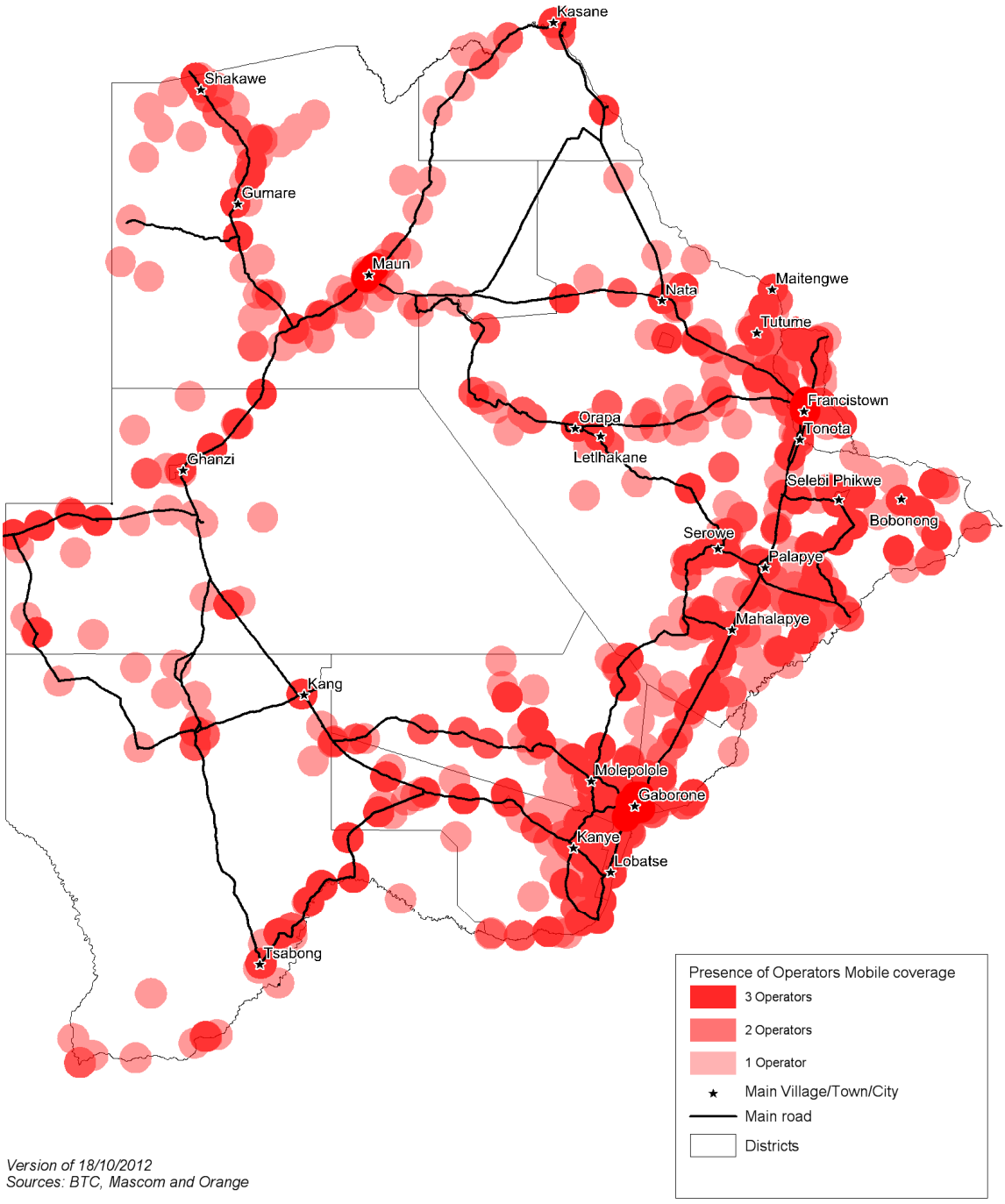
Currently, this portion of the network does not appear to be a major constraint. Operators rely on leased lines, their own microwave links or in the biggest cities on their own metropolitan area network (MAN) fibre optic cables.

Future evolution of networks and traffic demand will however lead to an increase in the demand for more capacity on backhaul links that can provide wholesale Ethernet/IP based services.

2.1.4 Mobile coverage

Currently mobile telephone coverage is relatively satisfactory for most large and medium sized villages. Main roads are also partially covered. 3G coverage however is limited to main cities and some major villages. Furthermore, outside densely populated areas, there is generally only one operator available. Hence users have to rely on SIM cards from various PTOs and cannot be certain that they can be reached on their main contact number wherever they are.

Figure 2-1: Mobile coverage over Botswana



Information collected during interviews shows that operators are currently improving the 3G reach of their networks.

2.1.5 Satellite

Satellite connections remain expensive in Botswana, even though new offers for cheaper satellite connection emerge.

Consequently this technical solution cannot be considered as a way to provide broadband services on a large scale in the country. However it should be considered for most remote areas. Besides, the cost of access to satellite connection should be used as a threshold when assessing the relevance of any terrestrial solution in low density areas.

2.2 Price structure

Like any country in the world, the incumbent operator owns an infrastructure that is used by other stakeholders.

The analysis carried out so far has identified two main issues:

- The lack of transparency in prices (how prices are calculated),
- There are generally no Service Level Agreements which define the offered services and what the incumbent operator commits to do in return for payment. Thus the incumbent operator dictates the terms and conditions of current service provision contracts.

In some cases the price structure becomes an obstacle for the development of innovative services. For example national bandwidth prices that are too sensitive to distance, or ADSL usage that implies payment to both BTC and the ISP and is not related to costs. We are aware that BTC has recently put forward proposals to review some of these issues.

The process of splitting the incumbent operator BTC into two entities, namely BoFiNet and BTC Ltd might be instrumental in the stimulation of the market and the establishment of open, non-discriminatory networks and wholesale offers. However, this process needs to be speeded up and the stakeholders should be briefed regularly as regards what is being done and what the times frames are for concluding the process. Our understanding is that the split is intended to benefit the industry. Yet during interviews, practically all private sector stakeholders said they had no clarity as regards the Government's intentions and objectives in relation to the split, save for what they read in the newspapers. Some argued, that the few times that they had been briefed by the Government, it was more of the Government telling them of what it intends to do but with little room for input from industry as regards the process. We see no harm in the Government providing regular briefings to key industry stakeholders on critical issues regarding the split and giving them the opportunity to provide input and suggestions. Naturally, Government does not have to agree with them but such briefings and feedback would also give Government the

much needed free advice and ensure that Government's approach is relevant to industry's requirements and expectations.

2.3 Services

Interviews conducted during the Phase 1 of the assignment revealed that many stakeholders count on the implementation of the e-Government programme to generate an uptake in the usage of broadband services.

Furthermore, the lack of local contents is often raised as a constraint in the demand for broadband services. Such local contents could be services dedicated to local users, addressing a specific local usage in both English and Setswana languages.

3 Quick Wins

As discussed in Chapter 1, Phase 1 identified some recommendations (called Quick Wins) which BTA and or MTC could implement fairly quickly to bring tangible benefits to the ICT Sector. The following is a none-exhaustive list of Quick Wins.

The on-going phases of the National Broadband Strategy study will focus on analysing scenarios and options for a longer term strategy to foster the development of broadband services.

3.1 ADSL offers

3.1.1 Increase available bandwidth on ADSL

There are currently 3 different packages proposed by BTC: bronze (512 kbps downlink / 128 kbps uplink), silver (1 Mbps downlink / 192 kbps uplink) and gold (2 Mbps downlink / 256 kbps uplink). However the technical information collected has not shown any constraint in the network that would hinder offering higher bit rates. On the contrary, equipment already installed is, according to BTC, configured with protocols that should allow BTC to make the best use of the copper network (ADSL2+ for more than 10 Mbps peak rates, Re-ADSL for long loops or copper lines in poor condition).

Furthermore, rolling-out technology for professional services offers with guaranteed quality of service and symmetry between uplink and downlink should be considered (SHDSL and/or SDSL).

Recommendation 1 BTC should reorganize its ADSL offers and propose packages that do not put a ceiling on available bandwidth.

As explained earlier, at local loop level costs for the operator are not related to the actual use of bandwidth as they are mainly fixed costs.

This effort, combined with a new structure of prices (according to various stakeholders, a separation between access sale and bandwidth sale is underway), would improve the user experience and give space to ISP for innovative services offering. We accept that this recommendation may require that BTC do some analysis (e.g. measurements of the state of its copper network) but we think that BTC could easily handle his issue.

3.1.2 Enable quality of service differentiation

The current structure of bandwidth services does not allow quality of service differentiation. This hinders in particular the provision of voice over IP.

We suggest that the structure of wholesale ADSL allows quality of service differentiation. This could be done in two ways:

- Authorize multi virtual circuits on the same line (to differentiate voice and data),

- Structure the bandwidth offer with guaranteed capacities (in the same way that bitstream offers are based in other countries).

3.2 Wholesale catalogue

A condition precedent to the establishment of a dynamic and competitive telecommunications market is the presence of transparency in the wholesale offers made available to third party telecommunications operators and Internet service providers.

Recommendation 2 We recommend that BTC publishes a catalogue (standard offers) detailing its wholesale offers, containing the key technical and contractual terms and conditions to be committed between BTC acting as a wholesaler and its PTO or ISP customers. Other licensed Public Telecommunications Operators should also publish such catalogues for their respective wholesale services (e.g. leased capacity, infrastructure sharing, etc.).

Such a catalogue would provide transparency as regards conditions of contract as well as on prices. It should be subject to comment by affected wholesale customers before being adopted. In the event of major disagreement, BTA should make a determination of matters under dispute.

We present hereafter some of the items that should be covered by such a catalogue.

3.2.1 Wholesale Leased Lines Offers

- Geographical availability of the offer i.e. list of relevant BTC Exchange Offices
- Leased Line interfaces on customer site
- BTC requirements for installation and maintenance at customer site
- Service supervision and maintenance process
- Definition of the relevant KPI (Key Performance indicators) for service quality such as:
  - Mean time to set up the service,
  - Mean time for intervention in the event of faults,
  - Guaranteed time to repair and restore the service
  - Max time of service interruption (e.g. 4 hours) over a specified period (e.g. 6 months).
- Contractual SLA (service level agreement) defined in terms of objectives for such KPIs (threshold values, measurement process).
- Penalties applicable in case of SLA violation.

Furthermore, service eligibility information should be available and updated online to enable interested parties to find out what services are available between any two points.

3.2.2 Wholesale Ethernet transport Offer

In addition to the current offers, the global telecom market in Botswana will also require Ethernet Transport services, due to the following factors:

- ISPs with WLAN / FWA / WIMAX / Access Nodes need to collect their traffic and transport it to their central network management centres.
- Telecom operators acting on the Corporate segment need to collect VLAN segmented Ethernet traffic ("level 2 VPN") and transport it to their Central network management centres.

The main advantage of Ethernet transport Wholesale Services and offers is that their pricing is normally much less sensitive to the transport bit rate than the legacy schemes based on PDH / SDH hierarchy.

This would mainly be requested in Metropolitan areas and main cities (Gaborone, Francistown) and be an opportunity:

- For BTC/BoFiNet to increase customer traffic on its Metro Ethernet network.
- For those ISPs / PTOs customers to save CAPEX on the building of microwave backhauls.

This remark can be extended to a national long haul Ethernet transport service.

As it deals with a layer 2 Ethernet transport service, it would typically provide prices for a given guaranteed bit rate (1 Mbps, 2 Mbps, 10 Mbps, 100 Mbps) with a distinction between Metropolitan, Intercity, National.

The same remarks apply on the necessity to have a formal wholesale service defined in terms of service specification for connection interfaces, delivery format, geographical availability, KPIs, SLAs, etc.

3.2.3 ADSL

Dealing with an ADSL Wholesale offer, the BTC's Catalogue should *inter alia* specify:

- The technical architecture of the offer, i.e. the protocol stacks supported at access, backhaul and traffic delivery interface levels, for both residential and corporate type of ISP markets
- The geographical availability of the offer, i.e. the identification of all "DSL access areas" eligible for that service
- The traffic delivery supported formats (ATM, IP) and delivery points
- BTC process of customer's purchases, i.e. list of actions, and processing delays
- BTC process in case a customer requests for a modification on an established wholesale service.

- End user installation process: list of supported customer premises equipment (CPE) to be published by BTC on its Web server, CPE to be provided and installed by the customer.
- Extranet access to BTC wholesale ADSL network management: BTC to provide an extranet web access providing to its customer the operational status of a given connection or set of connections.
- BTC process in case of customer notification of a failure, via extranet, via mail, via telephone, etc.; acceptance criteria; how to make follow-ups in case of a fault that has been reported to BTC.
- Guaranteed time to repair and restore the service.
- Max time of service interruption (e.g. the aggregate service interruption shall not exceed 4 hours) over a specified period subscription (e.g. over a period of 4 months).

3.2.4 Wholesale Infrastructure sharing

The list of available infrastructure (rights of way, antenna masts, towers, ducts, trenches, etc.) should be made public, providing information such as:

- Locations (should be available in a geographic system),
- Characteristics (diameter of duct, height of the high point, etc.),
- Engineering rules for usage (ducts occupancy ratio, maximum tower loading, available capacities, etc.).
- BTC process of customer's purchases, i.e. list of actions and processing delays.
- Radio frequency compatibility rules (interference management requirements and procedures, etc.).
- Maintenance conditions.

The "guidelines for sharing of passive communications infrastructure in Botswana" came into force with effect from 1st October 2012. Interviews of stakeholders and the analysis of the market have shown the necessity for operators to have access to such infrastructure. Hence, we welcome the publication of these guidelines and recommend that to ensure their successful implementation, BTA should scrutinize reference offers made by operators with regards to prices and method of calculation in order to ensure that they are cost oriented. BTA should consult operators (large ones but also smaller ones) within a few months to assess whether reference offers provide a satisfactory operational framework for the smooth application of the guidelines.

3.3 Pricing structure

3.3.1 National bandwidth prices

Our benchmarks show that in comparison to other countries, the cost of bandwidth in Botswana is much more sensitive to distance. This situation might impede the development of competition in large areas of the country since the cost of leasing capacity to backhaul traffic from locations that are far from the main urban areas may be uneconomical for potential alternative operators and service providers. Current (and future) technologies are much less sensitive to distance compared to legacy technologies.

Recommendation 3 We recommend that cost studies conducted by BTA in recent past be re-examined against the sensitivity of cost with respect to distance for various capacities. We propose that the structure of wholesale tariffs for national bandwidth should be adapted accordingly taking into account the results of these analyses.

3.3.2 Wholesale ADSL Price Structure

The current wholesale ADSL price structure is based on:

- An access charge, paid directly by the customer to BTC,
- A bandwidth charge, paid by the ISP to BTC.

The access charge covers the cost of the local loop line and ADSL equipment (DSLAM, modem), whereas the bandwidth charge covers the cost of backhaul and backbone. The following changes could be made to the current situation:

3.3.2.1 Pay the access charge to the ISP and not to BTC:

The current situation requires that the end customer keeps on paying a bill to BTC. Two drawbacks result from this situation:

- the first one is that it makes life more complex for the customer, who has to manage two different bills;
- the second one is that it does not provide a fair playground for competition, since BTC keeps a commercial link with the customer whereas the Internet service is provided by the ISP.

Recommendation 4 We recommend that the access charge and the bandwidth charge should both be paid by the ISP to BTC (as it is done in other countries), in order for the end customer to deal with a single bill for Internet access and service.

3.3.2.2 Have an access charge independent of the bandwidth:

Currently, tariffs of the access charge depend on the bandwidth, whereas the cost of the access line is not dependant on bandwidth (at least up to 20 Mbps). The only reason to maintain a difference in wholesale tariffs is that these tariffs are based on retail-minus pricing. However, it imposes constraints on ISPs (to align on current BTC's prices) and constitutes an entry barrier to competition and innovation.

Moreover, the copper local loop is an essential facility and should be priced on a cost-oriented basis.

Recommendation 5 We recommend that the access charge be based on BTC's actual costs and be independent of bandwidth.

3.4 The case for BPC as a telecommunications operator

The Botswana Power Corporation (BPC) owns 850 km of fibre optic cable which covers most of the major urban areas and large villages on the eastern side of the country.

BPC management undertook a feasibility study to assess the viability of establishing an entity that would use the excess fibre optic cable network to provide telecommunications services. The study reviewed various models and concluded that such an undertaking would be viable. Their preferred model is that of a Public Telecommunications Operator (PTO). BPC management said that they made submissions to their Board, the Government and BTA requesting for authorisation to use the excess capacity in their fibre optic network to provide telecommunications services.

3.4.1 Option 1: Grant BPC a Licence

We have no mandate to validate BPC's feasibility study and its recommendations. However, we do in principle support and recommend that BPC's infrastructure be made available to other telecommunications operators because:

a. This would make a major contribution to the available broadband infrastructure in Botswana. Many countries worldwide (e.g. South Korea, Japan, France, Morocco) made use of fibre optic cable infrastructure constructed by their power utilities or railway operators. Closer to Botswana, South Africa established the Broadband Infrastructure Company (Infraco) in 2007 through a structural separation of Eskom, whereby the fibre optic infrastructure and associated rights (e.g. rights of way) that had previously belonged to Eskom were transferred to Infraco. In addition, companies whose core activity is to provide fibre transport networks have been established in many countries (e.g. FINETIS in Morocco, or Dark Fibre Africa in South Africa).

b. During interviews with other PTOs and Internet Service Providers (ISPs), they complained about the high cost of backhauling traffic from remote areas in Botswana to their main switching centres and points of presence. In fact, ISPs argued that for as long as the cost of backhauling traffic remains high, there is no chance of any ISP not associated with BTC extending their services outside the two major cities. Thus granting BPC a licence would bring some competition (though limited to certain areas) in the backhaul wholesale market which would in turn benefit the retail market.

We note that there are other public utilities such as Water Utilities Corporation that have fibre optic cable network although not necessarily to the same extent as BPC. Our argument in favour of BPC applies with the same force to these entities. In our considered view, the current legal framework for the regulation of the

telecommunications market is capable of accommodating the public utilities without any need for amendment.

Recommendation 6 It is recommended that BPC's request for approval to use its extensive fibre optic cable network to provide telecommunications services be approved. BTA would determine the type and conditions of the licence that would be granted to BPC.

3.4.2 Option 2: Allow BPC lease its excess fibre to BoFiNet

There could be other Government policy consideration, to which we are not privy, that may preclude the granting of a telecommunications licence to BPC. However, that would still not detract from the fact that, at a national level, it is economically unwise to let a country's resources lie idle, while there is a great need for their use and such usage could improve the wellbeing of the country.

Thus in the event BTA and or the Government is not inclined to agree to the previous recommendation, we propose that they (BTA and the Government) consider and approve of an arrangement whereby BPC could lease its excess fibre optic cable capacity to Botswana Fibre Networks (BoFiNet).

As discussed elsewhere in this report, interviews with key stakeholders in the telecommunications market have revealed that BoFiNet's mandate is not clear. If BoFiNet is going to operate with the same mandate that BTC had, then:

a. The current problems of high cost of national and regional backhauling will persist.
b. The unresponsive or indifferent attitude towards the requirements of market will also persist.

Notwithstanding these concerns, if the BTA and the Government are not amenable to Option 1, then an alternative could be that BPC be allowed to lease its excess fibre cable capacity to BoFiNet with no requirement to licence BPC.

This would still be better than the current situation in the sense that it would make more fibre optic cable infrastructure available to the telecommunications market and if the above concerns are addressed, this option could lead to the delivery of broadband services to consumers in more places in the country at reasonable a price.

In the event BTA and the Government are not amenable to Recommendation 6, we recommend that they encourage BPC to lease its excess fibre optic cable capacity to BoFiNet.

3.5 Accelerate the implementation of e-Government

The Government has already identified the need for major changes in technology, business processes and organisational structures. Therefore an ambitious National e-Government strategy 2011-2016 has been drafted and officially launched by the Minister on the 26th of September 2012.

As of today, most Ministries now have their own websites, providing some information. Key milestones are defined as follows:

- Creation of a government portal -2011-12
- Download forms - 2013
- Transactions 2014.

Nevertheless, the implementation plan is not fully defined yet, and interviewed stakeholders have expressed their concerns as regards what they perceive to be slow implementation of e-Government services so far.

Recommendation 7 We recommend that the Government communicate what services will be made available and by what dates and accelerate the implementation of the plan so as to create the need as well as the demand for e-Government Services.

One can expect operators and service providers to adjust to this new demand by extending the reach of their broadband network.

3.6 Audit Nteletsa II and Kitsong centres and other access centres

Nteletsa II is generally acknowledged as being a successful experience. It has extended the reach of mobile coverage and increased the number of communication centres. However, some gaps have been identified: the tendering process (e.g. property regime of infrastructure), the implementation (e.g. duplication of Kitsong centres with other access centre in the same village, lack of trained personnel to manage the Kitsong centres and provide support to users, etc.).

Such access centres have proven to be an efficient way to provide access to broadband services, together with training and support when they are run and operated by trained people.

Recommendation 8 We recommend that an audit should be carried out of the Nteletsa II project, as well as other related projects such as Sesigo or the implementation of Kitsong centres by Botswana Post. The outcome of such a study should provide useful lessons that could be taken on board during the rollout of broadband services.

3.7 Develop a programme for training on use of ICTs

ICT capacity building among the population is a key requirement for a wider penetration of broadband usage. In particular, strengthening skills and knowledge of people living in remote and rural areas helps promote social and economic opportunities.

Recommendation 9 Alongside Recommendation 8 above, a user-centred training programme should be developed that would provide immediate results.

The training campaign could take various forms and target different categories of people and users:

- Learning the basic use of computers, mobile devices in rural areas (access to the Web, CV writing, etc.)

- Advanced ICT training (for example in schools ICT Clubs could be established to facilitate the teaching ICT services).
- The use of websites and e-services for small companies and associations.

Such training campaign would also provide an opportunity to identify local community champions. Such people's leadership and skills would make them valuable agents for the promotion of the uptake of broadband services. They would also provide support to other people in their communities. This would also be a way to revitalise some of the Kitsong centres while at the same time identifying potential sources of relevant local content that would ensure that trainees keep and maintain the usage of broadband services.

3.8 Coordination for coherent action

The lack of commercial power in villages or in specific centres to be equipped with ICT equipment (schools, libraries, border offices, etc.) has been identified as an obstacle for the development of broadband.

Recommendation 10 The setup of a common team composed of officers from the Ministry of Transport and Communication (MTC) and from the Ministry of Minerals, Energy and Water Resources (MMEWR) would allow a more efficient cooperation when deciding to roll-out broadband infrastructure in order to ascertain that targeted villages have been electrified or are planned to be by the time broadband infrastructure is rolled out to them.

Beyond the coordination between Ministries, a national coordination for the implementation of the National Broadband Strategy that will consider all aspects (supply-side and demand-side policies) is necessary.

Question 1: Coordinated implementation of the National Broadband Strategy

To ensure a coordinated rollout of broadband infrastructure and services across all public and private sectors of the economy, there is a need for a Committee that will coordinate the various activities.
How should this Committee be constituted?

3.9 Set-up the universal service fund

Extending infrastructure requires obviously large investments. Even though the present assignment has not yet investigated the funding issue that will help the implementation of the national broadband strategy, it appears certain that having a specific fund that could be mobilised for projects that will follow the adoption of the strategy will be instrumental.

Recommendation 11 We propose that the Government should set up the universal service fund following recommendations presented in the study about the "development of a Universal Access and Service Policy for the Communications Sector in Botswana" (2006). It has been suggested that this universal access and service fund could draw on various resources, one of which being the operator levy. This source is intended to be durable based on its capacity to accumulate over time. However, it should be put into practice rapidly in order to allow the fund to grow before broadband projects are effectively launched.

3.10 BTC splitting: Define the scope and roles of each entities

The decision of splitting the incumbent, the Botswana Telecommunications Corporation, has been taken by the Government. The scope for resulting entities has not been entirely defined yet (e.g. which infrastructure or equipment will remain with BTC and which one will go with BoFiNet). Stakeholders expressed concern about the uncertainty that this situation causes, and the lack of visibility in this process.

Recommendation 12 We urge the Government to finalize the definition of the scope of both BoFiNet and BTC Ltd, clarify how they would act on the market (e.g. would the new BoFiNet act on the market as a competitive profit oriented player or only as a break-even (cost-recovery) open access operator to facilitate competition in the retail service segment of the market).

While BoFiNet has a new Board of Directors, we were informed that the establishment of BoFiNet (e.g. organisational structure, etc.) will still be driven by the Public Enterprises Evaluation and Privatisation Agency (PEEPA). In our view, the sooner the Board takes over full responsibility for BoFiNet's operations and start executing its mandate, the better it will be for the effective development of more efficient competitive market for all stakeholders.

3.11 Content and Applications: Dedicate a budget and initiate discussions

The issue of local content has been raised many times. We think it may be positive to encourage the development of local content or web hosting with financial incentives. However, it may also create lots of inefficient developments or misuse of such financial incentive. Therefore, we propose to dedicate a specific budget for such actions. Specific use such as financing local web hosting or content development could be done in many ways: through the creation of a specific public/private investment fund, through a club including operators, ISPs, content developers, web hosting…, or through direct public financing or specific tax exemptions. Then, there may be various ways of finance projects: direct financing to dedicated companies, creation of incubators, creation of clubs, etc.

The approach for the development, funding and access to on-line content is investigated in section 5.1.

Recommendation 13 Allocate a specific budget for the development of relevant local content, applications and web hosting, and initiate discussions with interested third parties for the setting-up of a specific organization for the financing of such developments.

4 Network strategy

4.1 Objectives

4.1.1 Definition of goals

As explained in the previous section, Botswana enjoys quality infrastructure in terms of backbone. Furthermore, it appears that most of the issues identified with regards to international bandwidth and national backbone access are or will be addressed during the BTC separation process and the creation of the special purpose vehicle, BoFiNet.

The main challenge to improve the availability of broadband network countrywide appears to be the development of high quality access networks. These networks should provide a large footprint and a reliable quality of access, in order to fulfil the needs that will continue growing over time.

Past experiences from local programmes (e.g. Nteletsa programmes) and the international benchmark show that there will be a need for public investment to foster the deployment of broadband networks. The economic and social benefits that can be expected from a dynamic ICT sector and the largest availability of connection facilities make a case for State intervention, aimed at increasing the reach of the network and the available bandwidth.

The Consultants are of the view that extending the footprint of networks (making broadband as close as possible to a universal service) should be the first priority for the Government. Accordingly this chapter focuses on an analysis of the economic implication of the deployment of a network that would allow the provision of broadband to the largest number of inhabitants in Botswana. The second part of the chapter presents the implication of rolling out the necessary equipment to upgrade existing facilities to enable them to provide broadband services.

The simulations have been performed on the basis of technologies capable of addressing a large number of subscribers (deployment of a single technology at a large scale in the country), future-proof (standardised technology, with a wide number of suppliers, and deployed and accepted by Tier 1 operators). The interim report presented the available solutions to provide broadband. Two next generation access (NGA) technologies emerge as being most relevant for the National Broadband Strategy: 4G networks to provide a large footprint and make broadband available to everyone and fixed xDSL technologies for more specific needs, mainly professionals.

4.1.2 4G networks

As seen in the situational analysis performed in Phase 1 of this assignment, the country is relatively well covered with mobile phone services. The technical infrastructure for base stations (towers and high points equipped with energy supplies, backbone, backhauls, etc.) exists and can be reused for next generation networks.

Operators have already started to roll-out 3G solutions in Botswana that provide access to first class broadband services. Nevertheless, for the long term it is certain that Next Generation Access networks such as LTE, LTE+ will be necessary to cover the needs for fast broadband services. Furthermore, the fact that 4G-solutions can use frequencies that are made available by the digital dividend reduces the number of base stations necessary to ensure the coverage of large rural areas. Hence, even though 3G HSPA+ equipment could certainly on the short and middle term cater for most of the usage, the cost of deployment of 4G solutions would be comparable for a more future proof solution with best in class equipment.

4.1.3 xDSL networks

The analysis done in Phase 1 revealed that BTC telephone exchanges are all equipped with ADSL 2+/ Re-ADSL capability. Thus it appears that the issue of providing broadband on the copper local loop will be mainly addressed by the use of refined marketing and commercial policies, because the constraints are not technical. Furthermore, the cost of deploying copper network is high and the time needed can be quite long. It would not be necessary to focus the strategy on increasing the footprint of the existing local loop.

Nevertheless, the interviews carried out with various stakeholders during Phase 1 (the 'needs analysis' phase), have shown that the lack of quality and reliability guarantees on the xDSL connections were often seen as major concerns for professionals. Therefore in selected areas with higher needs and demand for better quality connection with guaranteed quality of service, the roll-out of SDSL (symmetric-DSL) together with service level agreements providing acceptable guaranteed return to service times when there is a service failure will be recommended.

4.1.4 Other technologies

Of course, there is and will be room for other technologies to be used in the country. Thus, it is clear that for the most remote locations satellite will remain cheaper than rolling out a terrestrial solution. Besides, fixed wireless access solutions are already an answer for enterprise access and some niche and local markets. Its development and the capacity for alternative operators to build reliable business models based on FWA largely depends on more general issues such as the capacity of sharing infrastructure (e.g. high points) and the cost of national and international bandwidth.

4.2 Network strategy

4.2.1 Methodology principles

4.2.1.1 Wireless network

As explained above, the modelling was based on the deployment of a LTE network. The costs calculation considers the incremental cost for the roll-out of a next generation access wireless network re-using as much as possible existing infrastructure (backbone, backhaul, towers and high points).

Taking into account the variability of geographical conditions (size of localities and population density) the model provides an estimate of the budget needed for a network deployment over various geotypes (see 4.2.1.3 hereafter). In addition, based on commercial hypothesis, the profitability of this service has been calculated over the 10 years of supposed deployment.

Hence the model illustrates the feasibility of deployment with or without public support.

4.2.1.2 DSL network

The model is based on the topography of the existing copper network and the location of telephone exchanges equipped with ADSL equipment. The incremental cost for upgrading these exchanges with Symmetric-DSL capable equipment has been determined. The model takes also into account the operational cost related to the necessary support (supervision, maintenance team, etc.).

Considering that a small percentage of the professional subscribers (based on the current number of ADSL activated lines) would wish, and have the financial capability to migrate to an improved service, the number of resulting SDSL lines has been calculated.

One should note that whatever the hypothesis taken in terms of penetration rate, the resulting budget is relatively low with regards to global network cost. Therefore, the issue of upgrading the DSL network with symmetric DSL is more related to the commercial strategy than to the budgetary challenge.

4.2.1.3 Geotypes

The kind of usages and the profitability for private operators to roll-out a network are both dependent of the urbanisation of the area and the population density.

Based on statistics provided by Statistics Botswana, the Consultants organised towns and villages according to their size and population density. Accordingly six clusters were defined representing the villages (the detailed list of localities is in Appendix – see 7.1):

Table 4-1: Geotypes clusters division

Cluster	Characteristics	Number of localities
1	Population of 500 to 1,000 inhabitants	162
2	Population of 1,001 to 5,000 inhabitants	106
3	Population of 5,001 to 10,000 inhabitants	28
4	Population > 10,000 inhabitants and population density < 1,500 inhab./km²	14
5	Population > 10,000 inhabitants and population density > 1,500 inhab./km²	9
6	Major cities (Gaborone and Francistown)	2

Taking into account the location of existing base stations and the coverage and traffic capability of Next Generation Access (NGA) equipment, a selection of sites has been used as input data for the model (some new sites have been proposed to cover localities which are not covered by existing networks). For largest localities (cluster 3 to 6), the number and position of sites needed has been calculated based on the actual topology of the 2G/3G networks and the geography of the area (boundaries of localities as per data obtained from Statistics Botswana, Department of Surveys and Mapping, and aerial photographs). A part of the data related to cluster 3 has been extrapolated from data coming from similar localities.

Likewise, the modelling of the backhaul network and the transport network uses the topology of existing microwave and fibre optics networks.

4.2.2 Usage statistics

4.2.2.1 Current usage

Analysis of various data for the market in Botswana led to some key figures for the mobile data market at the end of 2011:

Based on observed data, the current growth rate of data traffic is estimated at a compound annual growth rate (CAGR) of 210% for the period 2008-2012.

The number of mobile data users in 2011 is estimated to have been about 35,000 (2% of the population).

The average usage is estimated at a level of 432 MB per month per user in 2011

Table 4-2: Key figures 2011

Total Mobile Data users (mid-2011)	35,485
Usage 2011 (MB/month/User)	432
Total volume Data, CAGR 2008-2012	211%

Source: BTA and operators Data, Consultants' Analysis

4.2.2.2 Future usages and penetration

Many market studies show that mobile data volume is increasing at a high rate and that this will continue for the coming years.

Hereinafter we present a summary of some results that show the relevant trends for the data market, as obtained from studies done by Cisco, Ericsson, Alcatel Lucent, Idate, ComScore, etc. Details are provided in the appendix.

1) Observed data show **that mobile data traffic has been increasing exponentially** in many European countries and in the US, with a 2 to 3-fold increase each year, with a **level of 200 to 300 MB per inhabitant per month in 2010.**
2) **3G Penetration rate is currently at levels higher than 50% of mobile users in developed countries**, even though it remained at lower levels (below 5% in 2010) for Brazil, Russia, India and China (BRIC).
3) Growth of mobile data traffic comes from growth in the number of users and increase in individual usage, which has reached a level of **1.5GB per month per user for the most advanced countries,** with an average usage of 155 MB per month. Video usage has been a major contributor to the growth.
4) Smartphones represent 82% of Mobile data traffic, but only 12% of handsets.
5) **Mobile data traffic should continue to increase in the forthcoming years**, as a result of the increase in the number of smartphones and of the usage per smartphone, which is estimated to be in the range of **2 to 3 GB per month in the years 2016-2018.**
6) **Mobile Usage will be driven mainly by video**, which will represent 70% of the traffic in 2016.
7) As mobile traffic and usage grow, prices per MB are falling down, and mobile data average revenue per user (ARPU) should grow in a limited range: **current prices will fall from 5 cents per MB to 3 cents per MB in North America in 2014, with ARPUs remaining in the 30 USD range**.

On the basis of the observed data and international benchmarks, 3 scenarios of growth have been established as discussed below.

Based on the previous analysis, we propose some relevant scenarios for the development of the mobile data market, in terms of penetration of service and number of users, monthly usage and ARPU. These scenarios are used in the

network model to calculate networks costs, and then to assess the total level of profitability of new investment in broadband infrastructure.

The analysis of the scenarios is based on the settlement clusters. It has been assumed that the pace of development of broadband services will be different in rural areas compared to urban areas. The higher demand for broadband services in urban areas will necessarily lead to faster deployment of broadband infrastructure in urban areas. The scenarios are based on a 10 years forecast (2014 - 2023), and the basis is taken from 2011 data (as there is no data on broadband usage in Botswana prior to that year).

For the sake of simplicity, it has been assumed that no broadband data services were provided in 2011 in clusters 1 to 3 (most rural areas), and that the current usage (Mb/user/month) is the same in clusters 4 to 6. It has also been assumed that clusters 1 to 3 will have a 3 years shift from clusters 4 to 6, so that the 2014 figures for clusters 1 to 3 will be the 2011 figures of clusters 4 to 6.

Table 4-3: Clusters – initial situation

Clusters	C1	C2	C3	C4	C5	C6
Penetration rate 2011	0.0%	0.0%	0.0%	3.0%	3.5%	3.7%
Number of users 2011	0	0	0	15,743	8,024	12,232
Usage 2011	0	0	0	432	432	432
Penetration rate 2014	3.0%	3.5%	3.7%			
Number of users 2014	3,603	15,114	7,541			
Usage 2014	432	432	432			

The scenarios are based on 2 sets of forecasts:

- A short term set of forecasts (2016 for clusters 1 to 3 and 2013 for clusters 4 to 6), for penetration of services and usage;
- A long term set of forecasts for penetration of services and usage.

These 2 sets are built on 3 different scenarios in order to determine the relevant range of development factors and economic indicators.

The 3 scenarios reflect different situations:

- Scenario 2 is the medium scenario: it corresponds to an average of 53% for the traffic growth for the period 2013 to 2016, which may seem conservative compared to international benchmarks or observed data for Botswana, but seems reasonable in consideration of long term trends,
- Scenario 1 is the low end scenario, with a 47% CAGR for traffic. In this scenario, the penetration has a slower increase than in scenario 2, but with a higher usage (resulting from a more urban population with intense usage),
- Scenario 3 is the high end scenario, with a 60% CAGR for traffic. It corresponds to a situation where mobile data services encounter a faster penetration, but with lower usage than in the other scenarios.

Figure 4-1: Scenarios – Penetration rate forecast

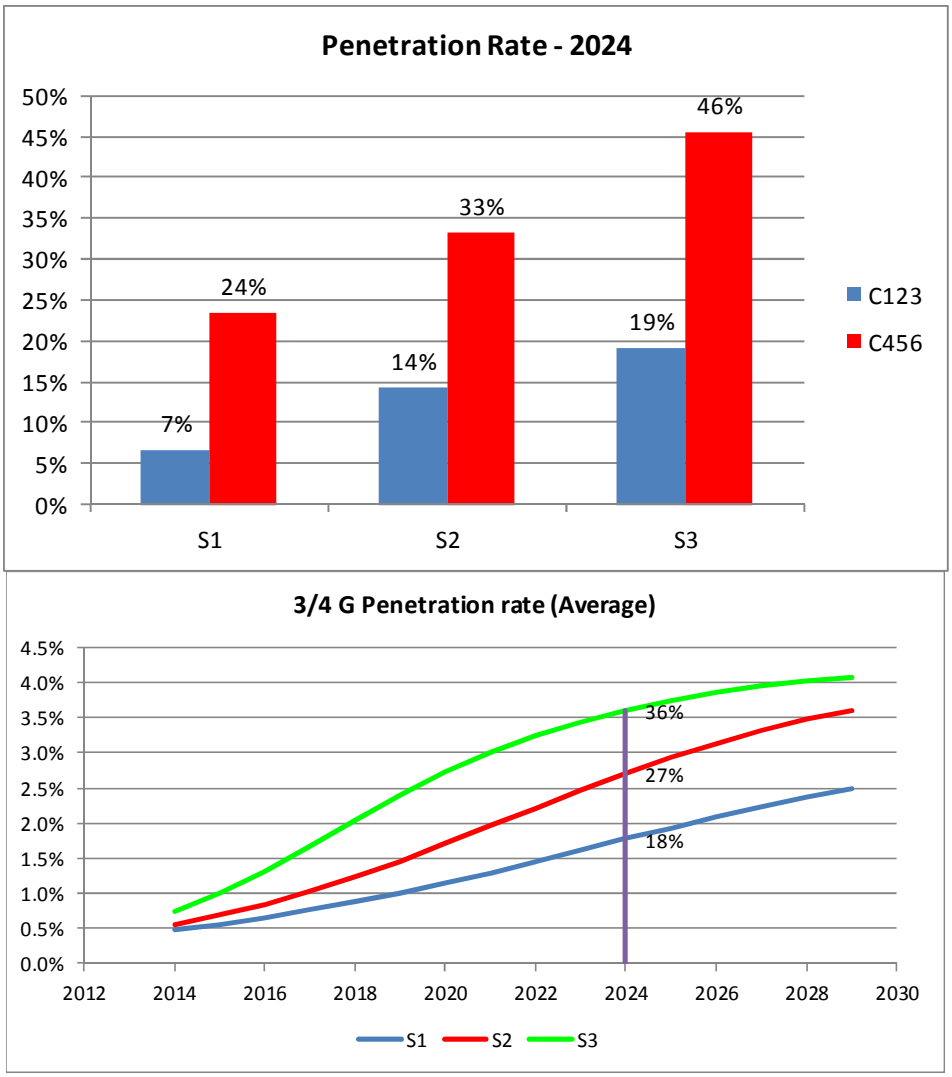
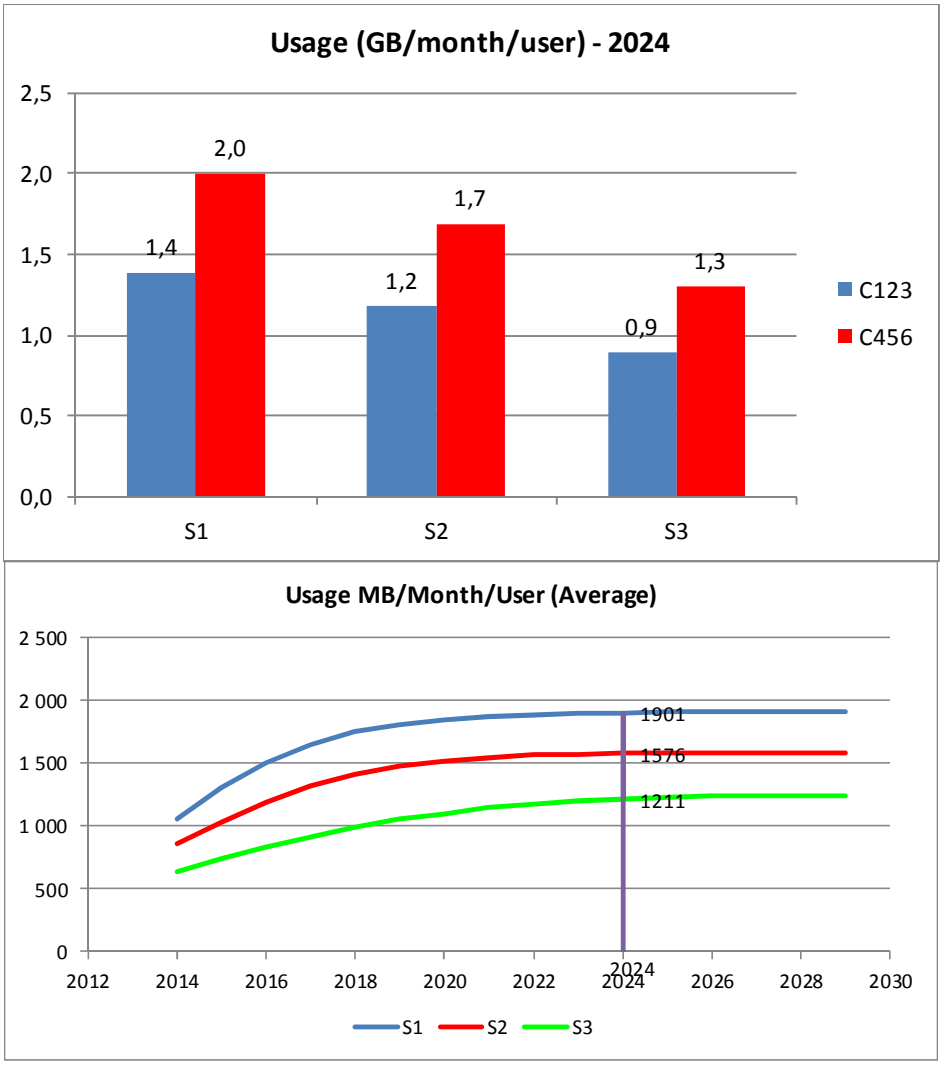
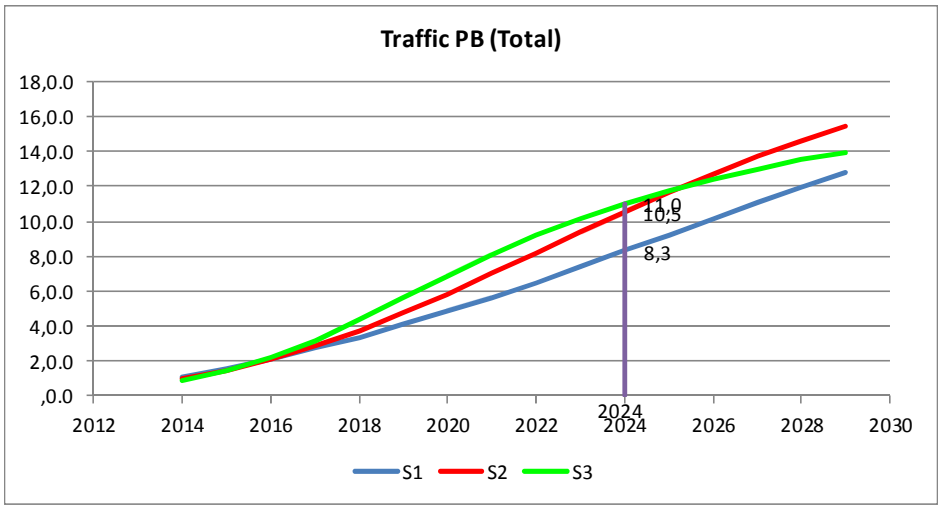


Figure 4-2: Scenarios – Usage forecast



The resulting total volume of traffic is given in the figure below.

Figure 4-3: Evolution of total traffic



Note: PB stands for Petabyte. 1 Petabyte = 1,000,000 GB.

These scenarios have been established with the objective of proposing the most reliable forecast for the future development of broadband. Although it is well known that reality has often been in contradiction with forecasts in the telecommunications industry, the proposed forecasts integrates in the best way possible the accumulated experience in Botswana and in other countries in the field of Internet and Mobile Broadband. Therefore it is a logical conclusion to say that the scenarios represent the most likely evolution, given the present knowledge in Mobile Internet.

The range of estimates included in the three scenarios corresponds to possible various stakeholders' strategies.

4.2.3 Wireless network modelling

4.2.3.1 Network structure

The modelled wireless network is based on the existing infrastructures of the mobile operators currently deployed in Botswana, i.e. 2G and/or 3G equipped sites, which will be upgraded with an additional LTE system.

This system is considered as operating both in 800 MHz and 2,600 MHz bands, the 800 MHz band being mainly suited for low density rural areas, while the 2,600 MHz band is suited for medium and high density urban areas.

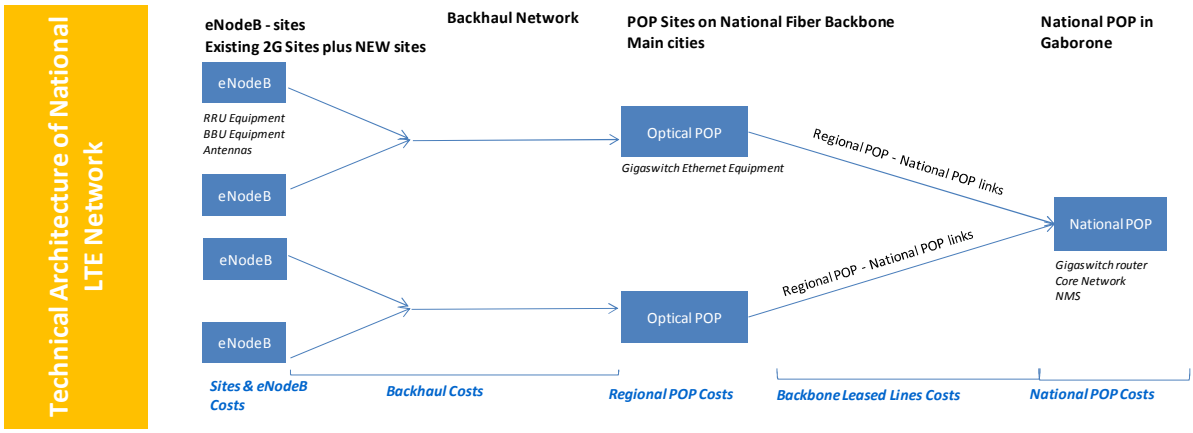
The target LTE coverage is nationwide, defined as 100% of all localities listed in each of Clusters 1 to 6, for a total population of 1,809,470 inhabitants representing about 90% of the total Botswana population.

The network structure is made of 5 parts:

1. Access network, based on existing 2G/3G equipped sites, plus a limited number of new sites to be built for some low population density rural areas not yet covered by any wireless technology.
2. Backhaul network, based on the existing tree & branch microwave network deployed for 2G/3G systems, which will be upgraded to a full packet technology suited for a pure data LTE access system.
3. Regional POP sites equipment, i.e. Gigaswitch routers in charge of aggregating the LTE data traffic of the backhaul network. This equipment will be implemented in existing operators' sites in Gaborone, Francistown, Gantsi, Kang, Maun, Mahalapye, all served by the national optical fibre backbone.
4. National backbone, transmitting the traffic from each regional POP to the central national POP located in Gaborone
5. National POP, providing traffic aggregation function, LTE Core Network function, central NMS (operation & supervision) function, and interfaces to external networks (data traffic to third party national and international networks).

This structure is shown hereunder, such as defined for the Cost model

Figure 4-4: LTE Network Cost model



The building of such a network cost model requires the following dimensioning parameters to be calculated, which are essential in terms of cost evaluation:

- Number of existing sites to be upgraded to LTE.
- Number of new sites to be built and equipped with LTE.
- Monthly data traffic in Gbytes per LTE equipped site.

- Number of LTE equipped sites that can be backhauled by a given packet microwave tree, with a capacity of 150 Mbps / 300 Mbps / 600 Mbps / 900 Mbps.
- Dimensioning parameters of the LTE Core Network, i.e. maximum number of connected UEs (smartphones) for a given data service package (e.g. 2 Gbytes per month)

These parameters have been calculated for different network deployment scenarios, namely:

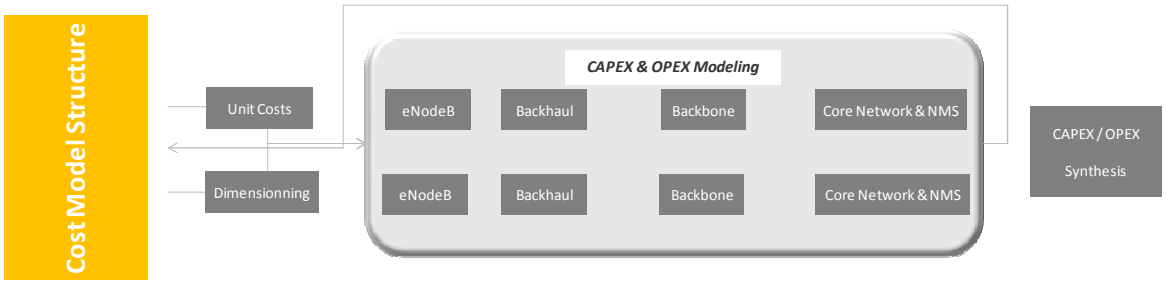
- A full national urban / suburban / rural scenario covering clusters 1 to 6.
- A suburban / urban scenario covering clusters 4 / 5 / 6.
- An intermediate suburban / urban scenario covering clusters 3 / 4 / 5 / 6.

The cost network model calculates for each scenario the CAPEX and OPEX of the corresponding deployment.

4.2.3.2 Assessment of network costs

The cost model is based on the following structure, in line with the network structure described in the previous chapter.

Figure 4-5: LTE Network CAPEX / OPEX Modelling



We hereunder provide the main assumptions which have been made to assess the network costs.

4.2.3.2.1 Unit Costs assessment

Infrastructure costs

- The costs of building new sites in rural areas, when required, have been assessed based on similar projects done in Botswana. For example, it has been assumed that 48 m high towers will be required in rural areas.

LTE Equipments costs

- For all active LTE related equipment, unit costs are based on responses for tenders from major telecom equipment suppliers for similar projects.

- This covers eNodeB equipment, packet microwave equipment, gigaswitch routers, Core Network equipment (MME, S/PGW, PCRF) and associated Network Management systems.
- The unit costs do not include Customs Duty (15%) and Value Added Tax (12%).

Transmission costs on the backbone

- The costs of transmitting the traffic aggregated by each regional POP to the national POP in Gaborone are based on BTA regulatory Directive n°1 of 2011.
- The costs are per STM1 OPEX per year, according to the actual distance in km between each regional POP and Gaborone.

4.2.3.2.2 Determination of the key cost factors

We describe hereunder the determination of the key cost factors previously listed in the network structure section.

- Number of sites for coverage purposes

  This number was calculated, taking into account the location of:

  - target localities to be covered.
  - existing 2G / 3G sites of Botswana's mobile operators.

  The coverage study has been adapted for rural areas, assuming that a village can be covered by an existing 2G station if its distance to the nearest station is less than 7.5 km, in line with a typical 800 MHz coverage radius for rural areas. If not, a new station will be built.

  For a national coverage, this method lead to the implementation of LTE equipment (e-NodeBs) in 383 existing sites, plus 65 new sites to be built to cover villages in clusters 1 & 2 rural areas. These values are consistent with the number of sites of the existing operators' deployments for 2G & 3G systems.

- Number of sites required for capacity purposes

  The cost model envisions a long term network life, i.e. until 2023, with the possibility of supporting high end service packages, namely close to 2 Gbytes /user/ month at a given date of the network life.

  In a dense area deployment scenario for example, i.e. limited to clusters 4, 5 and 6, after a deployment starting with 120 sites required for coverage purposes, more sites will be required to cater for increased capacity (densification) after the year 2019, leading to 185 sites for the highest S3 scenario. This number of sites is derived from the following parameter.

- Monthly Data traffic in Gbytes per LTE equipped site

  The network model assumes a rather conservative 1.8 bps/Hz spectral efficiency, applied to a 10 MHz bandwidth LTE system, deployed in 3 sectors sites.

  The system load is limited to 60%.

  The resulting amount of data throughput per LTE equipped site and per month is 2135 Gbytes.

  This figure provides directly the number of required densification sites, as soon as the required capacity exceeds the capacity offered by the sites deployed for coverage purposes.

- Capacity figures for 150 / 300 / 600 / 900 MBps microwave trees

  The existing microwave backhaul network is composed of tree & branches, each tree aggregating typically 4 to 30 BTS sites.

  The last mile microwave link (from the terminating BTS to the next hop) will transport 3*18 = 54 Mbps (3 sectors, 18 Mbps per sector on the busy hour), it will then be based on a 150 Mbps microwave link.

  The higher level links, at 150 Mbps / 300 Mbps / 600 Mbps / 900 Mbps will respectively aggregate up to 4 / 10 / 25 / 45 BTS with 3 sectors each.

  These parameters allow the cost model to calculate the number of required microwave links of each capacity, between the last mile level (BTS side) towards the trunk level (regional POP side), and therefore the backhaul costs.

- LTE Core Network and NMS cost factors

  We used a rather simple and straightforward determination for LTE Core Network and NMS cost factors, based on LTE deployments in other countries.

  For LTE Core Network, and for each component (MME, S/PGW, PCRF), the cost structure is composed of a fixed cost representing a fully redundant 1+1 HW platform, plus a variable cost according to the actual number of software licence fees to be purchased, as a function of the max number of connected subscribers.

  The same applies to the Network Management System, with a variable cost function of the actual number of network elements (eNodeBs, ePC i.e. Core Network Elements, microwave links) to be managed.

  The cost model then provides a flexible way to calculate the Core Network and NMS cost for a given deployment, described in terms of LTE equipped sites and attached subscribers.

4.2.3.2.3 Cost summary

As a final result, the cost model provides a Cost summary sheet, with the CAPEX & OPEX per year values of the required LTE deployment.

Table 4-4: Example of a Cost summary sheet

LTE National Network for clusters 1 to 6	CAPEX in kBWP	OPEX in kBWP per year
Sites	81 917	2 625
RAN Equipments	164 112	21 460
Backhaul MW Equipments	39 442	4 691
POP Equipments	3 188	363
Core Network for 100 k subs	25 014	1 876
Core Network for 500 k subs	45 639	3 423
NMS for 100 k subs	6 376	478
NMS for 500 k subs	8 713	653
Total for a 100k subs Network	320 047	31 493
Total for a 500k subs Network	343 010	33 216

4.2.3.3 Deployment plan

The calculation of the total cost for each scenario is based on a progressive deployment of the infrastructure.

The deployment plan is based on a total coverage of clusters 4 to 6 in a minimum number of years (e.g. 2 years), and of clusters 1 to 3 in a longer period (e.g. 5 years). The assumptions are:

Table 4-5: Deployment plan

Number of sites deployed per year for coverage		S1	S2	S3	Number of sites needed for coverage
C123		60	60	60	328
C456	Orange	60	60	60	120
	Mascom	60	60	60	120
	BTC	60	60	60	120

Additional sites are added when traffic increases, and costs are taken from the model.

The international bandwidth prices are taken from current Botsgate prices with a 5% decrease each year.

Similarly, 5% yearly decrease is also applied to national backbone costs.

4.2.3.4 Other costs

Commercial, Overheads and other Costs

It is assumed that 50% of the revenues are used to finance commercial (sales, marketing and customer relationship), overhead and other costs (such as IT, licence…). This percentage is taken from the Consultants' experience and database from various costs models of operators.

Acquisition costs

In addition to these costs, it is assumed that acquisition costs are needed to subsidise handsets, in particular for data access, where even simple feature phones with 3G or 4G access may cost at least 200 USD in the forthcoming years. In parallel, a churn assumption is taken into account, with the following values:

Table 4-6: Acquisition costs and churn rate

Acquisition cost (BWP)	1000
Churn rate	10%

4.2.4 DSL network modelling

4.2.4.1 Network structure

We considered the deployment of SDSL additional lines in the existing DSLAMs equipped by BTC, with a penetration rate (number of additional SDSL lines divided by the number of ADSL activated lines) equal to 10%.

Two SDSL technologies have been considered as stated in the Phase 1 report, i.e.

- The standard DSL technology based on ITU-T G991.2 which offers symmetric bandwidth upstream and downstream. It runs over a pair of copper wires, with a maximum range of 3 km.
- The new Ethernet transport variant (SDSL EFM, based on IEEE 802.3ah Ethernet First Mile standard) which allows the transport of 5 Mbps per copper pair below 3 km, with the ability to bundle 4 pairs and transport up to 20 Mbps in dense city environments

Central Office Equipment is composed of SDSL Line cards inserted in the existing DSLAMs.

When the existing DSLAM installed capacity (information provided by BTC) is not sufficient to host the required SDSL line cards, an additional DSLAM shelf is provided and taken into account in the SDSL cost model.

Customer Premises Equipment (CPEs) is composed of SDSL modems, to be installed and supported by the operator.

As far as Network Operation is concerned, SDSL is a technology for Business customers, with stringent SLAs for service availability, real time on line support, multiple KPIs, and penalties for the operator.

For these reasons, SDSL suppliers for both DSLAMs and CPEs are now providing efficient Network Management Systems with built in functionalities for end to end service supervision, performance monitoring and security management.

The cost model includes such state of the art dedicated NMS, in which the CPE Management layer is integrated to the Central Office Network Element management layer.

4.2.4.2 Assessment of network costs

We derived from main suppliers List Prices, the unit costs of

- SDSL Line cards and DSLAM shelves
- costs of the CPEs without EFM functionality (2 Mbps symmetrical throughput)
- costs of the CPEs with EFM functionality (5 Mbps symmetrical throughput)
- NMS platform and software fees.

The model calculates, for each BTC exchange to be equipped with SDSL:

- the number of SDSL line cards and DSLAM shelves to be provided,
- the traffic in Mbps aggregated at each regional POP, to be transmitted to the national POP of Gaborone, assuming 80% of SDSL lines without EFM and 20% of SDSL lines with EFM
- the associated CAPEX / OPEX per year for DSLAMs, CPEs, NMS
- the market value of transporting the required traffic on the national backbone, based on the BTA regulatory Directive n°1 of 2011.

					CAPEX in	OPEX in kBWP
SDSL Network at	**10%**	**penetration rate, i.e. for**	**1 541**	**customers**	**kBWP**	**per year**
		SDSL CO Equipments			6 900	340
		SDSL CPE Equipments			6 000	450
		Network Management			1 100	80
		Total SDSL Network Costs			**14 000**	**870**

4.2.5 Retail Pricing

The second characteristic of the scenarios is the level of revenue (for data services only; the total revenue would be the sum of the data ARPU and voice and SMS ARPUs). Its calculation is based on assumptions relative to:

- The current level of pricing, and
- Evolution of prices.

In the absence of observed data for ARPUs and prices per MB, the scenarios are built on values for ARPUs and prices per MB in 2014 based on current tariffs proposed by the operators. The ARPU calculated with this method is at a level of 230 BWP per month.

The evolution of prices are taken into account for the 3 scenarios, in accordance to international benchmarks, and with various factors (described in appendix). The model calculates the ARPU. There is of course an important issue concerning the sustainability of the assumptions of ARPU and penetration rate taken for the long run (2024). It is clear that when the penetration rate increases, the ARPU is supposed to decrease as a consequence of the inclusion of a larger population. The model relies on the following assumptions for 2024:

Table 4-7: 2024 ARPUs and Penetration rates

Assumptions for 2024	ARPU (BWP)	Penetration rate
S1	149	18%
S2	127	27%
S3	100	36%

Results from national statistics (Statistics Botswana, Labour statistics 2010) show that:

- the average salary was at a level of 4,600 BWP in December 2012,
- a fraction of the employees, which we estimated at 18%, earned at least 6,600 BWP in December 2010,
- a proportion of 45% earned at least 6,100 BWP at the same date.

It seems therefore that the assumptions may be considered as reasonable, since the ARPU represents respectively 2.2% and 1.6% of the salary in the 2 cases.

On another hand, the calculated levels for 2024 may be compared to international benchmarks (data for 2014), in USD (comparison made in Purchase Power Parity), which gives some reasonable basis:

Table 4-8: 2024 ARPUs and prices per MB, USD PPP

Scenario	ARPU (USD, PPP)	Price per MB (USD,
S1	35	0.018
S2	29	0.019
S3	23	0.019
Benchmark (2014)	30	0.030

4.2.6 Economic analysis

The above assumptions are used to calculate the economic indicators for operators developing 4G networks in addition to existing 2 or 3G networks.

The objective of the model is to assess the profitability of the investment in a broadband mobile data network covering a major part of the population of the country. Given the fact that certain areas are certainly not profitable, and in any case

do not allow economic space for more than one operator, the rationale of the model is the following:

1) The first objective of the regulation is to promote infrastructure competition, which is the only way to establish sustainable growth and competition for the benefit of customers in the long term. Therefore, it is assumed that in urban areas, there should be economic space for 3 operators. These areas cover at least clusters 4 to 6;
2) In the less populated areas, the benefit of infrastructure competition would be offset by the cost of inefficient duplication of network. Therefore, it is assumed that in the less dense areas, the optimal organization of the market implies the presence of only one infrastructure operator (through active RAN-sharing or roaming), the other operators sharing the cost and revenues in proportion of their respective market shares. The cost sharing mechanism is discussed further in section 6.1.2. The purpose of the modelling, at this stage, is only to estimate costs and revenues for operators in rural areas with infrastructure sharing;
3) The model analyses the first case, where there is one infrastructure operator in clusters 1 to 3, and then looks at the case where the area concerned to infrastructure competition would be extended to cluster 3, limiting the infrastructure operator to clusters 1 and 2.

The model is based on the case of 3 operators with the following assumed market shares:

Table 4-9: Operators' market shares

Operator 1	30%
Operator 2	55%
Operator 3	15%

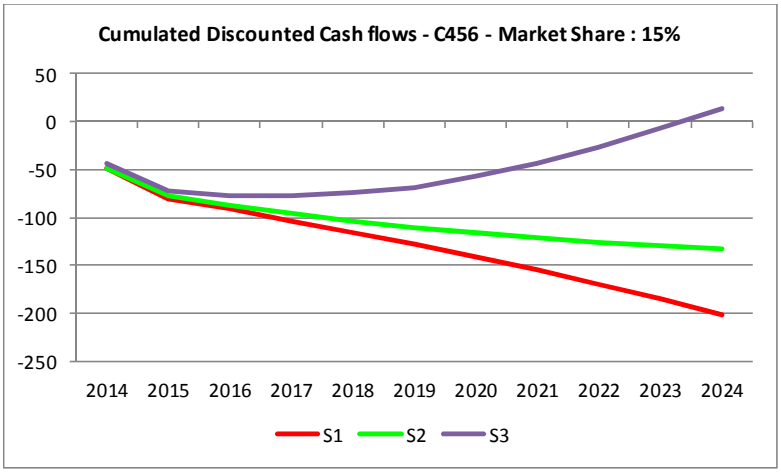
The business case for each operator is described below:

- For clusters 4 to 6, and for each scenario, each operator is supposed to invest in coverage in 2 years. Then, depending on the total data traffic generated, additional sites are eventually added for capacity.
- For clusters 1 to 3, the "infrastructure operator" is supposed to invest in coverage, no other investment for capacity would be necessary. Then, the costs are shared among the operators.
- Each operator is thus supposed to have CAPEX for the investment in the network (coverage + additional sites for capacity) in totality for clusters 4 to 6 and in relation to its market share for clusters 1 to 3. The same rationale applies for CAPEX linked to customer acquisition and to OPEX.

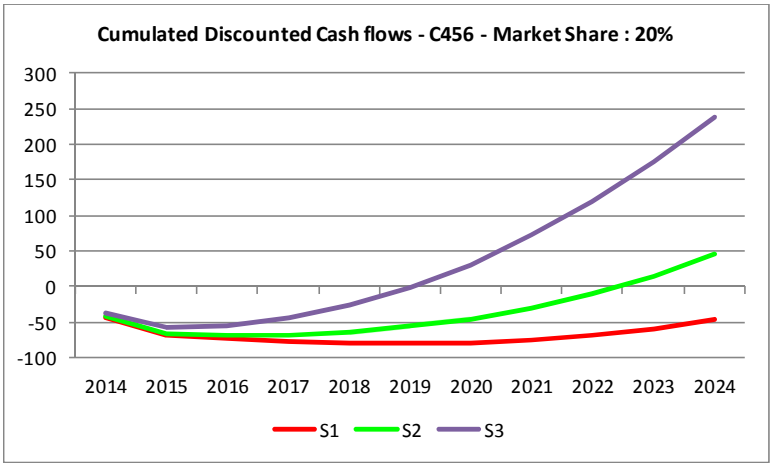
The detailed results of the model are presented in appendix. Hereafter we present the main summary conclusions.

1. For urban areas, **the profitability for broadband access is only possible for operators with a minimum market share of 20%.** This is a consequence of the initial cost of coverage which can be only offset by a minimum number of customers.

An operator with 15% market share will not be profitable on a 10 years period, except in the very high end scenario…

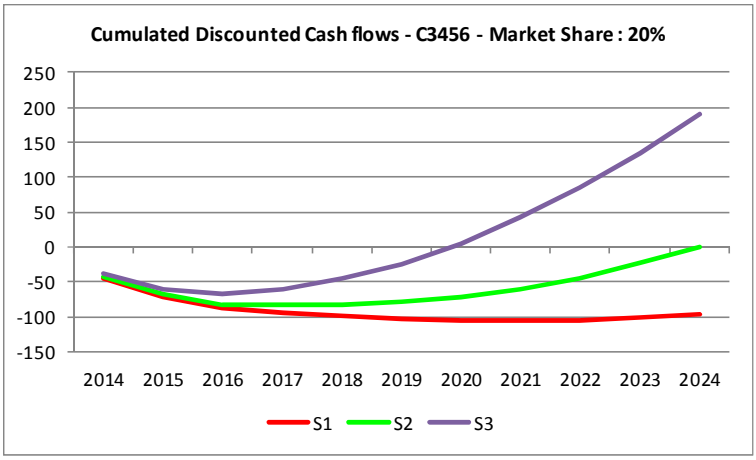


… whereas an operator with 20% market share will be profitable, except in the very low end scenario.



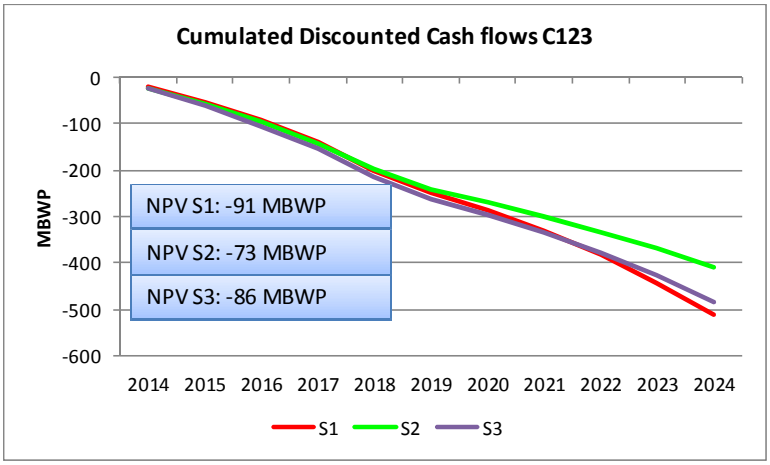
2. **Including cluster 3 in the business case of an operator with 20% market share leads to a very limited profitability**, and even the impossibility to recover its costs in the long run

Except in the very high end scenario, there is no positive profitability to invest in the totality of clusters 3 to 6 for an operator with 20% market share.



3. **For rural areas, even with a single operator investing in infrastructure, there is no economic business case**, as a consequence of the importance of coverage costs and low usage; however, depending on the growth rate of penetration and usage, the net cost of these areas remains limited.

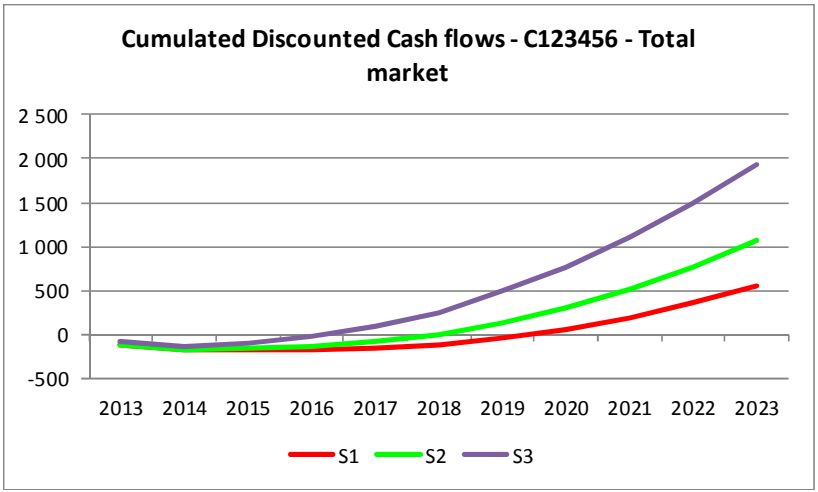
The Net Present Value (NPV) is calculated with a discount rate of 17%.



The model shows that the operational margin is positive (revenues minus operating costs), but the capital costs are never covered.

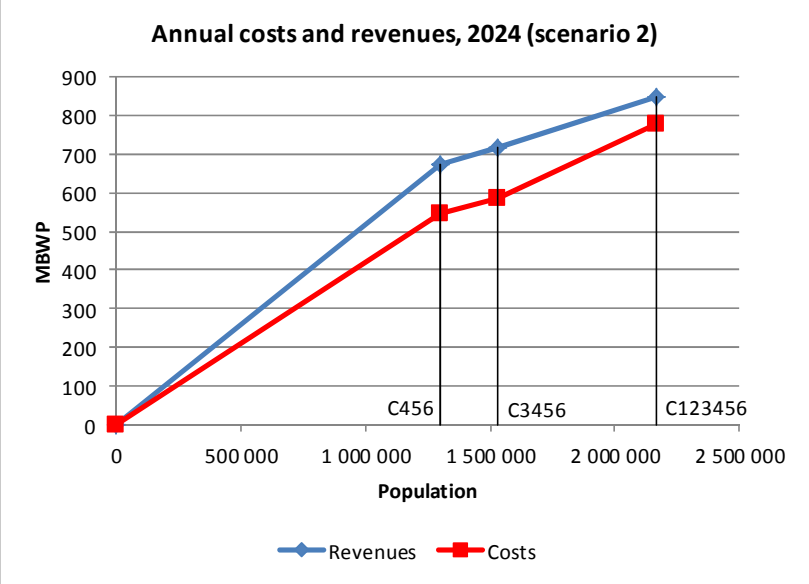
4. However, the total market (corresponding to the sum of the 3 operators for clusters 4 to 6 and the unique infrastructure for clusters 1 to 3) is profitable from a global point of view

Considering the totality of the market, it appears that covering the whole country is profitable



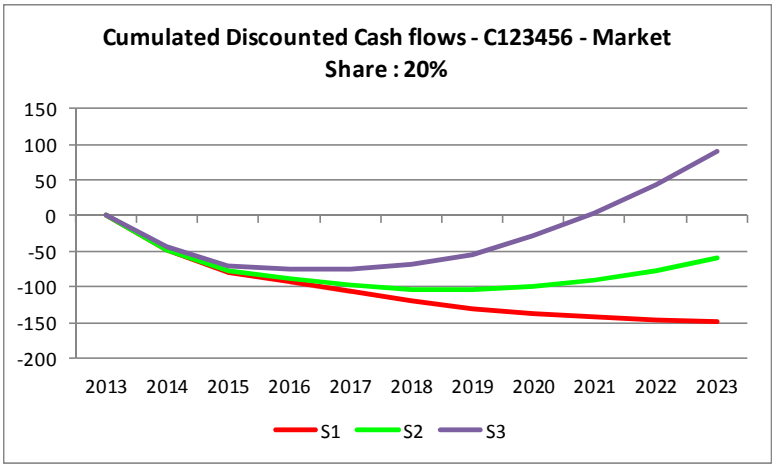
Annual costs and revenues, in 2024, show that the incremental deficit for clusters 1 to 3 is less than the profit made in clusters 4 to 6

The graph also shows that the impact of including or not cluster 3 in the unique infrastructure is limited. This is due in particular to the relatively small population of this cluster (around 200,000 inhabitants)

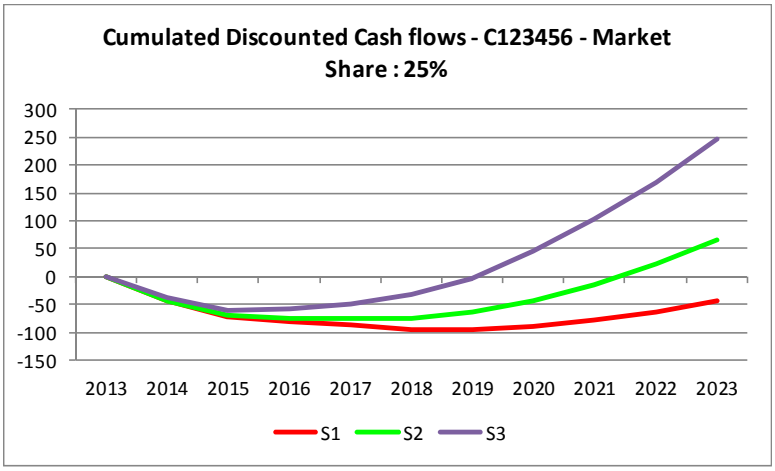


5. But the mechanism of cost sharing for clusters 1 to 3 is only profitable for operators with a significant market share, greater than 25%

The precedent case of an operator with 20% market share which was profitable in clusters 4 to 6 comes to no or very limited profitability for the total coverage of the country, even with shared infrastructure in clusters 1 to 3…



… whereas an operator with 25% market share will be profitable, except in the very low end scenario.



6. This analysis suggests that that even in the case of infrastructure sharing, there is no possibility to recover the costs for operators with less than 25% market share, so that a specific funding mechanism needs to be put in place.

Including coverage obligations in future 4G licences for all operators could actually be a disincentive for some operators and place the competition in an unbalanced situation, since only operators with a large market share would be profitable. Therefore there is the need for a funding mechanism such as a Universal Access Fund, used to finance the net cost of covering these specific areas, and financed with contributions from operators and/or direct subsidization from the State. The existence of a global positive margin indicates that an appropriate fund financed by the operator could be a viable solution.

5 Usage strategy

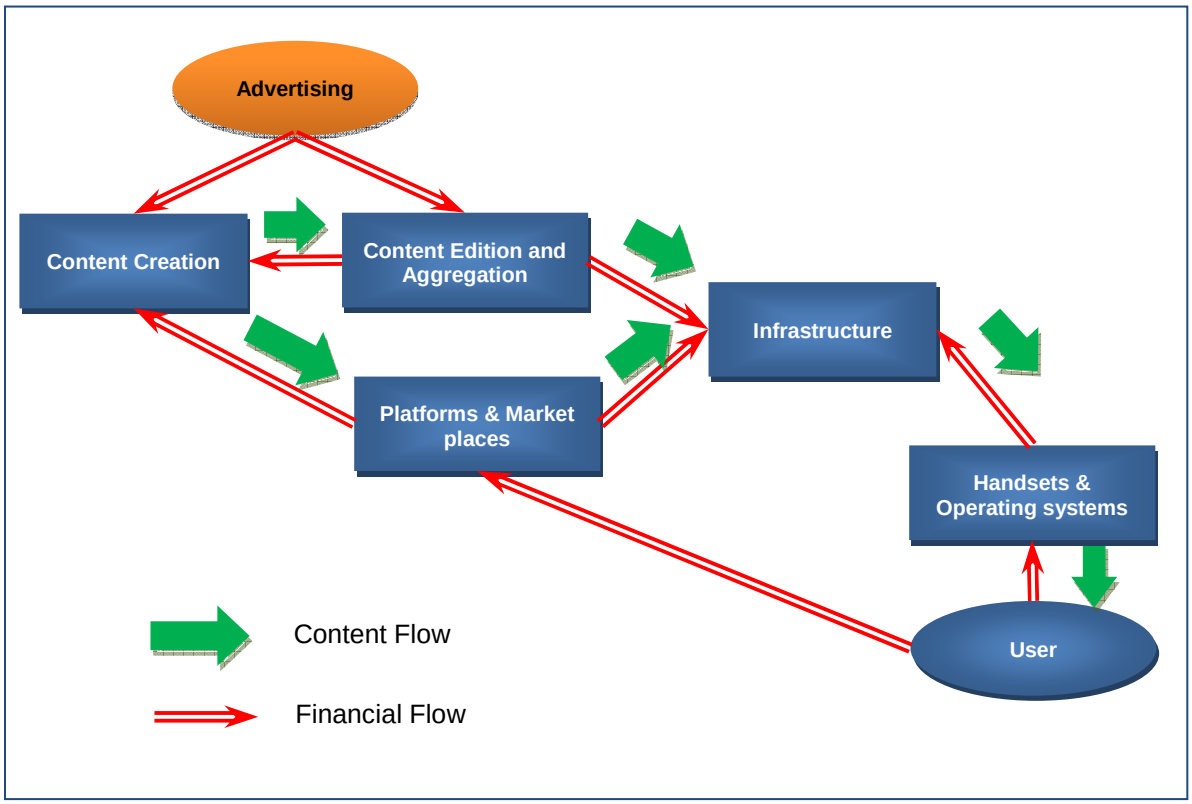
5.1 Development, funding and access to on-line content

5.1.1 The on-line content value chain

The availability of content is of prime importance to the development of broadband services in Botswana. In addition to the availability of broadband access at an affordable cost for the population, there will not be any incentive to get connected if no relevant content is available.

However, content provision is a complex ecosystem involving many different players, financial flows and business models. The emergence and development of local applications and content which can bring real value to customers (business or mass market) is the result of a complex combination of private and public investment as well as the ability to choose the best segment or domain. Therefore, in order to maximize the impact of potential public investment, it is necessary to analyse how the value chain works and where and how such investment can be placed.

Figure 5-1: Simplified Value Chain of on-line content



From a broad point of view, the value chain can be described with the following five segments:

Content Creation

Content creation involves many forms and players which have various business models, such as the examples described below:

a) **Mainstream**: content provision is the basic activity (e.g. On-line Information providers, or entertainment such as on-line gaming…). In this case, the economic model is based on subscriptions and advertising, most of all for Internet "pure players" (i.e. enterprises who only provide their content online). Costs are generally independent of the number of users, but revenues (whether subscriptions or advertising) depend directly on the number of users or on the audience. There is no limit to the diversity and nature of on-line content.

b) **Electronic-commerce**: e-commerce and mobile commerce (m-commerce) have had a huge growth in the US and Europe, and may constitute a significant driver of broadband adoption. Of course, content creation and provision is only a part of the business model of e-commerce, as it constitutes a distribution channel among others, except for on-line pure players such as Amazon. In any case, sales are directly related to the audience, but there are other major criteria such as price and scope of offering. E- and M-commerce involve either major players (PayPal, E-bay, Amazon, etc.) or local players that can use existing platforms.

c) **Mobile Banking**: m-banking may be considered as a specific category on content provision since it involves specific partnerships (operators and banks) and constitutes a significant opportunity for mobile broadband adoption and for the economic development of remote areas with low purchasing power (see later the case for Kenya and Ghana)

d) **Government and public services**: the domains cover a very large scope, including e-administration, public health, education and training, culture (libraries…). These services are not merchandisable most of the time, so that the business model is only constituted of public (and/or private) subsidization.

e) **Corporate sites or other showcase sites**: there is no need for economic case since these sites are not intended to generate direct profit

f) **Others,** such as application providers: the main driver comes from the direct sales to the final customer.

Content edition and aggregation

There is a much smaller number of large worldwide players such as Google, YouTube, Facebook, Twitter in this segment of the market. The business model for these players is uniquely based on audience, financed in the majority by advertising, and works with large externalities and network effects. The network effect comes from the fact that the utility of the site for the end user depends on the scope of content included, and that the utility for advertisers (including the

Google Adwords model) depends on the number of users. This explains why there is an oligopolistic situation for content aggregators.

Platforms and marketplaces

Online marketplaces are virtual spaces that gather goods (virtual or real) to be sold. The business model in a market place model is similar to content aggregators as it implies also externalities and network effects, and leaves space for a few major players such as Appstore and Android market.

Infrastructure: networks, hosting and Internet Exchange Point

Networks are not relevant for this section. Web hosting may be relevant for traditional business models, with limited externalities, but faces competition on a worldwide basis. Nevertheless, there are opportunities for local web hosting, which would lower the bandwidth needs and costs, as long as some critical success factors are satisfied, such as security, flexibility, reliability, bandwidth and cost.

User interface: handsets and operating systems

There is no need to comment on business models of major suppliers who compete on a worldwide basis. However, there are some promising initiatives for low cost smartphones, such as the Microsoft / Huawei 4Afrika Windows Phone, which should be sold at 150 USD (source: NY Times, 5/2/2013).

It is clear from the above value chain analysis that from a local point of view, there can be only drivers for specific segments of the value chain, namely:

- Local content and applications
- Web hosting

Table 5-1: Possible local incentives and actions for various value chain segments

Value chain segment			Possible local incentives and actions
Content creation	Mainstream	🟢	Targeted investment, subsidization or specific promotion
	E-commerce	🟢	Targeted investment, subsidization or specific promotion
	M-banking	🟢	Targeted investment, subsidization or specific promotion
	Government & Public services	🟢	Direct investment
	Corporate	🔴	Limited interest
	Others	🟢	Targeted investment, subsidization or specific promotion
Content Edition & Aggregation		🔴	No impact
Platforms & Market places		🔴	No impact
Infrastructure	Networks		Not relevant for this section
	Web hosting and web agencies	🟢	Targeted investment, subsidization or specific promotion
	IXP	🟡	Targeted investment, subsidization or specific promotion
Handsets and operating systems		🟡	Facilitate introduction in the country of low cost smartphones (e.g. Nokia Lumia 620, Microsoft / Huawei 4Afrika Windows Phone…) in the range of 100 to 200 USD

🟢 initiative of high interest (must have)

🟡 initiative of relative interest (nice to have)

🔴 initiative of low interest

5.1.2 Identification of key development areas

From our experience, international studies and the results of the Phase 1 of this project, some major fields represent great opportunity for the development of broadband services.

5.1.2.1 Content services and domains

There are key opportunities where broadband services can provide lots of benefits for the population. Most of these opportunities are described in the Millennium Development Goals (MDGs) for 2015 program of the United Nations. The ITU has described some examples of initiatives already taken that contribute to some of the MDGs.

According to the ITU (*Source: The State Of Broadband 2012: Achieving Digital Inclusion For All, A Report By The Broadband Commission September 2012*), and other sources (World Bank, reports from Equipment Suppliers…) there are numerous areas where broadband content may bring benefit to the population. The following are some examples of areas that will benefit greatly from the provision of broadband services:

Education:

- Experiments in Senegal, Portugal, Uruguay (provide laptops to students and teachers) (ITU).
- Initiatives from Qualcomm in China, India, Vietnam, Nepal.
- It was recently reported that the Botswana College of Distance and Open Learning (BOCODOL) "state-of-art centre in Maun will offer degree and masters programmes though tele-education" (source – Mmegi 16 August 2012). Recently the Executive Director of BOCODOL called for low internet connectivity packages for educational institutions (Source – The Monitor: 11 February 2013).
- The Ministry of Education is rolling networked computers in schools around the country.

Health:

- Child health (ITU: ChildCount+ = community health reporting and alert platform, monitoring health status of children under five)
- Diagnosis and treatment advisory
- HIV/AIDS programs (ITU: Bozza = on-line platform sharing content across Africa / South Africa, Nigeria, Kenya, Tanzania / SMS txtAltert system to remind HIV patients about appointments and treatment)

Farming and agriculture

- Weather alerts and forecast,
- Market prices
- Procurement…
- In India, JV between Bharti Airtel / IFFCO provides specific information to famers

The experience shows that these projects are generally the result of various initiatives from governments, NGOs, operators, private companies, driven by concrete and operational partnerships.

5.1.2.2 E-Commerce and M-commerce

E-commerce has become a common practice in many countries and M-commerce is now facing a similar development. According to Forrester Research, M-commerce will experience a double digit figure growth in the USA for the coming years, and e-commerce will still grow quicker than traditional commerce:

Figure 5-2: Forecast – US Retail Revenues and Growth Rates, 2012 to 2016

Botswana should follow similar trends in the growth of E- and M-Commerce, provided that some prerequisite conditions are satisfied, such as the existence of proper legislation to ensure security for the transactions, and an appropriate access to on-line banking or on-line payment (see next section). On the other hand, E- and M-commerce could be additional drivers for getting connected to a broadband network.

5.1.2.3 M-banking

M-banking may be defined as "all banking transactions using a mobile terminal (phone, PDA, smartphone ...) to the exclusion of a laptop" (*Source: The Adoption of 'Transformational Mobile Banking' by the Unbanked: An Exploratory Field Study, by Peter TOBBIN, in "Communications et Stratégies", n°86*). Most applications need to have a specific application on the SIM cards, which transform the handset to an electronic wallet and make transactions (deposit, withdrawal, transfer) with other users. One of the important advantages of m-banking is that it provides potential access to banks for consumers who would otherwise be excluded from accessing financial institutions.

According to the GSM Association, more than 140 m-banking services were operational in the world at the end of 2011. In Africa, Kenya is experiencing a very important development of M-Mesa Safaricom service which provides m-banking services to 54% of the mobile users. However, this success appears to be isolated, although other countries have also launched m-banking services, such as Tanzania and Ghana, and of course Botswana, where mobile operators and commercial banks provide cash services through m-banking.

A study conducted in Ghana showed that m-banking could improve access to banking services by removing some of the barriers (such as the difficulties to access banks or the cost of traditional banking services) provided that other conditions are met (confidence in the system, compatibility with practice, etc.) and this independently of the poverty level of the population.

Two models coexist for m-banking services:

- Driven by a bank: the service is offered by a bank that has a relationship with the client, and uses the operator as a distribution channel;
- Driven by an operator: the relationship with the client is held in this case by the operator, in many cases this is done in partnership with a bank.

Operators' ability to reach a large audience makes the second model more attractive in most African countries.

5.1.3 Priorities for Botswana

Considering the number and variety of possible initiatives, some priorities have to be established in order to focus on actions which can bring the best benefit to the population, with the best efficiency in terms of time and cost. We present below some qualitative analysis, in terms of cost, impact on the population, consistency with government's objectives, etc.

Table 5-2: Type of investment, impact and cost for on-line contents

	Type of investment required	Potential impact	Cost level
Content services – Education	• Capitalize on existing initiatives in Botswana • Capitalize on existing initiatives in the region • Find the appropriate partners • Set up specific programs • Facilitate private investment and developments	+++	+ to ++
Content services – Health		+++	+ to +++
Content services – Agriculture		+++	+ to ++
Content services – Others			
E and M-commerce	• Ensure appropriate legislation to secure transactions	++	++
M-banking	• Capitalize on existing initiatives in Botswana • Promote and develop partnerships banks / Operators • Ensure appropriate legislation to secure transactions	++	++

	Type of investment required	Potential impact	Cost level
Web hosting and web agencies	• Promote the creation of incubators and techno-zones • Develop specific incentives (investment, tax exemptions…) • Promote partnerships and facilitate recruitments of talents	+++	++

Notes:

1- Content services in the fields of education, health and agriculture are recognized by international organizations (ITU…) as being of first importance to contribute to Millennium Development Goals (MDGs) and therefore have a maximum potential impact. The cost of these initiative may vary from a limited cost (e.g. corresponding to the procurement of software platforms already developed in other countries) to high cost (involving hardware deployment or vast digitalization of existing content, or developing specific medical applications such as tele-surgery);

2- The e-Government initiative has a number of projects related to putting Government services online, using broadband services to improve the delivery of Government services and generally transforming the way Government interacts with business community and citizens.

3- The cost of development of E and M-commerce is essentially software for front and backend systems, as well as the development of on-line catalogues, and the usage of these services is highly dependent on consumption patterns;

4- M-banking requires the participation of banks or financial institutions and development and/or utilization of security software and protocols as well as appropriate legislation;

5- Web hosting and software development requires appropriate infrastructure and competencies, which may be costly, but are a prerequisite for the development of local content and services.

5.1.4 Actions required and funding

The precedent analysis suggests that the Government should establish a multi-sector institution with representatives from public and private sectors to coordinate and prioritize the rollout of broadband infrastructure and services.

Recommendation 14 Focus public investments and resources on priorities 1 and 2 listed in *Table 5-3: Actions and funding*

a) Priority 1: Develop Web Hosting and Web agencies.

b) Priority 2: Develop appropriate content and applications

Table 5-3: Actions and funding

	Priority level	Actions required	Type of funding
1	**Develop Web hosting and web agencies**	• Set up a consultation for content developers, software companies, Web hosters, universities… with questions and proposals relative to: • Type of technical investment required (housing, servers…) • Type of competencies required (engineers, marketing, …) • Potential effective projects (incubator, technical centres…) • Form private / public cooperation: financing, facilities provision, promotion… • Determine a procedure that should be used to evaluate and decide which initiatives should be included in the program	Public funding could consist in: • Direct investment in techno-zones (infrastructure, promotion…) • Tax incentives (exemptions) for companies investing in projects selected for the program • Awards (including prices) for best projects (develop transparent selection criteria for choosing projects that should be funded)
2	**Develop appropriate content and applications**	• Initiate discussions between the Committee and relevant partners (education, health, agriculture… and by function: content, applications, software, equipment…) based on existing experience in Botswana and other countries. • Formalize projects that require public support or financing	Public funding could consist in: • Direct investment in development (software or hardware) or in private / public partnerships • Tax incentives (exemptions) for companies investing in projects identified for the program • Awards (including prices) for best projects

	Priority level	Actions required	Type of funding
3	**M-banking**	• Initiate discussion with operators and banks as regards challenges and constraints they face. • Identify public contribution (promotion, legislation…) • Ensure appropriate legislation to secure transactions	
4	**E and M-commerce**	• Ensure appropriate legislation to secure transactions	
5	**Rollout of broadband services**	• Prioritise the rollout of broadband services. • Coordinate infrastructure rollout with the rural electrification programme.	• PPP between operators and the Government. • BPC, Government and Development Partners.
6	**Publicise e-Government Services as they come online and provide Public Training in using ICTs**.	• Publicise e-Government Services as they come online through public forums. • Use existing initiatives such as Sesigo (BNLS) to provide public training on the use of ICTs to access e-Government services. • Leverage existing programmes	• Public and private funding. • Assistance from development partners.

Question 2: Usage promotion

a) Out of the recommended actions listed in Table 5-3: Actions and funding, which ones should be prioritised in order to foster the development of Broadband usage?

b) Are there other priorities and/or actions that should be considered?

c) I□□□□u agree with the proposed funding mechanism?

d) What other means could be used for funding for the envisaged actions?

5.2 Legal and Regulatory Tools

5.2.1 Introduction

The strategy needs to be supported and nurtured through a number of interventions. From a legal perspective, a country should have ICT related legislation or other rules or voluntary regulatory mechanisms supportive of broadband services usage. A legal framework supports and facilitates the deployment and utilisation of the broadband

infrastructure as well should engender trust and confidence in the use of e-commerce and e-transactions. This means that it should have effective enforcement mechanisms and remedies.

During the development of the Botswana National ICT Policy (Maitlamo), an exhaustive analysis of the Botswana legal framework was undertaken. Legislative gaps were identified. These included the following:

- Lack of comprehensive legislation dealing with data crimes.
- Inadequate legislative dealing with internet pornography or undesirable content.
- Lack of legislation to deal with e-commerce and online consumer protection.
- Inadequate legislation on personal data protection.

It would serve no useful purpose repeating the analysis undertaken as part of Maitlamo. This section therefore recaps, in summary form, the Maitlamo debates with the necessary updates.

The strategy will impact different sectors of the economy and society in different ways. It is not practical to address all the legal issues that may emerge as a consequence of the implementation of the strategy. Some issues could best be addressed by, for example, community education and training (public awareness campaigns of the risk). We adopted the list of areas identified in the Maitlamo Legislative Framework and Change Report as priority ones. These are:

- Electronic Commerce and Transactions
- Protection of online consumers
- Protection of Personal Privacy
- Security of information and networks
- Cybercrime and lawful access

5.2.2 E-Commerce and Digital Signatures

5.2.2.1 International Trend

The United Nations Commission on International Trade Law (UNCITRAL) Model Law on Electronic Commerce (MLEC) and Model Law on Electronic Signatures provide minimum internationally accepted rules on how to promote e-commerce and create a stable legal framework for trusted e-commerce transactions.

The fundamental principle underlying the UNCITRAL model laws is that a transaction or a contract is not invalid solely by virtue of the fact that it is electronic. Similarly signatures or records are not denied legal effect solely because they are electronic. The model laws promote media neutral language. It supports and promotes a movement from a paper bias language in legislation to a technology neutral law. A number of countries including Canada, New Zealand and the United States relied extensively on the UNCITRAL Model in developing their electronic commerce laws

and signatures legislation. However, each country has to varying degrees extended the reach of the Model Laws through their respective national legislation. Australia and New Zealand legislations, unlike the UNCITRAL Models, apply not just to commercial transactions, they extend to all transactions.

As Botswana develops its electronic commerce and signature law, it would be necessary to determine whether the principles in such laws should be limited to commercial transaction or apply to all types of transactions.

Generally countries create exceptions from the coverage of the electronic commerce and signatures legislation. The Canadian law for example does not apply to wills, powers of attorney for property or personal care, etc. In New Zealand certain types of notices (for example cessation and or assignment of utility contracts by public utility providers) must continue to be in writing. The general approach seems to be that the electronic commerce and signatures law does not apply to transactions that require for their validity ceremonial acts of a traditional handwritten signature.

Another key lesson from international practice is that the electronic commerce and signature legislation must take a functional approach. The rationale for requiring documents to be in writing for example is to enable subsequent accessibility for purposes of subsequent reference. This then means that when consideration is given to e-commerce and signature legislation, the key provisions must create a functionally equivalent document that meets the requirements of a statute for a written document.

The *OECD Guidelines for Consumer Protection in the Context of Electronic Commerce* has provisions intended to ensure that consumers receive the same level of protection when they shop online as they do when they transact on a person to person basis.

The South African *Electronic Communications and Transactions Act* regulates cryptography providers. A Cryptography Service Provider is expected to register its name with the Accreditation Authority. Accreditation confers recognition of an authentication product or services designed to identify the holder of an electronic signature to other persons. Accreditation is voluntary. The Act sets out criteria for recognition (e.g., financial stability, quality of hardware and software systems, independent audits).
In Canada, the *Principles for Electronic Authentication document deals with electronic signatures.* The principles are intended to be technologically neutral. The Canadian legislation sets the conditions to be satisfied by a “secure electronic signature” which include the following criteria:

a) The signature is under the control of the person or entity using it and no other person or entity uses the signature;

b) It is possible to independently verify the association of the person or entity with the signature; and

c) The signature is linked to data in such a manner that if any part of the data is changed, the signature is altered.

Most countries established personal data protection agencies. These agencies have enforcement power and regulatory or advisory powers with respect to personal data. In some regimes, self-regulation through industry codes of practice plays a stronger role than in others.

5.2.2.2 Regional Approach (SADC)

SADC is in the process of developing a model law on Electronic Transactions and Commerce. The principles contained in the draft model are fundamentally similar to those adopted by the UNCITRAL Model Laws and the OECD Guidelines. With respect to electronic commerce and signatures, the SADC Model Law *inter alia* provides for:

- Recognition and formation of electronic contracts. It incorporates the principle that a contract should not be denied legal validity solely on the ground that it is electronic.
- List of transactions exempted from the electronic commerce legislation. Example of these are alienation of immovable property; long-term lease of immovable property in excess of 20 years; the execution, retention and presentation of a will, etc.
- Rules relating to authenticity of signatures.
- Admissibility of data evidence in legal proceedings.
- Equivalency rules for retention of documents, production of documents etc.

5.2.2.3 Summary of Key Lessons

a) The overall objective of e-commerce and transaction legislation should be to remove obstacles and uncertainties about the use of electronic documents and electronic communication.

b) The legislative approach must be functional *inter alia* by creating electronic equivalence rules to writing and signature.

c) Three possible approaches to legal reform are available:
    - Piecemeal amendments to various legislations to make them pro-e-commerce and less bias to paper based transactions.
    - Enactment of a new statute or statues such as Electronic Transactions which would lay broad framework applicable across the entire legal landscape.
    - A combination of the above two approaches

d) E-commerce legislation should be technology or media neutral.

e) E-consumers should not be disadvantaged compared to face-to-face transactions.

f) The legal framework should be a combination of legal coercion and voluntarism. People should have the freedom, to the extent possible, to opt in to the e-based transactions or to opt out in specific instances.

g) The scope of electronic commerce legislation may be extended beyond commercial transactions.

h) The creation of an accessible, predictable, safe and transparent trading environment, which operates across territorial borders and jurisdictions.

i) An application of neutral definitions for key legal concepts to avoid being paper biased.

j) Legal recognition and effect for data messages.

k) Promotion and protection of party autonomy with respect to e-transactions.

l) Obligations of on-line suppliers are clearly spelt out in legislation.

m) Addresses the liability of service providers.

n) The authentication of e-signatures.

Question 3: Electronic commerce law implementation

a) Should some transactions be exempted from the reach and scope of electronic commerce law; if so; which transactions in the context of Botswana should be so exempted?

b) Should electronic commerce law apply only to commercial transactions or should parties be at liberty to rely on such law in concluding other transaction of an non-commercial nature

5.2.3 Protection of Personal Data

5.2.3.1 International Trends

The OECD and the European Union have contributed immensely to the development of best practice elements for the protection of personal privacy in the context of electronic data. The OECD *Guidelines Governing the Protection of Privacy and Transborder Flows of Personal Data* establishes the following core principles on the protection of personal data. These are:

a) Collection Limitation Principle - There should be limits to the collection of personal data. Any such data should be obtained by lawful and fair means and, where appropriate, with the knowledge or consent of the data subject.

b) Data Quality Principle - Personal data should be relevant to the purposes for which it is to be used. It should be accurate, complete and kept up-to-date.

c) Purpose Specification Principle - The purposes for which personal data are collected should be specified not later than at the time of data collection.

d) Individual Participation Principles - An individual should have the right to obtain from a custodian of his/her data or otherwise; confirmation of whether or not the data custodian has data relating to him or her; challenge data relating to him or her, etc.

e) Accountability Principle - A data controller should be accountable for complying with measures that give effect to the principles stated above.

The OECD Guidelines are reflected in the European Community Parliament and Council *Directive on the Protection of Individuals with Regard to the Processing of Personal Data and on the Free Movement of Such Data*. The EU Directive in particular provides that data processing systems must respect fundamental rights of individuals, including the right of privacy.

5.2.3.2 SADC Approach

The SADC Model Law on Data Protection broadly adopts the approach in the European Union and within the OECD. The approach is centred along the following core principles and objectives**:**

- Only personal data that is necessary and relevant for the specified and declared purpose should be collected.
- The person who determines the purpose/goal of data collection should have an obligation to update the data and a limitation in collection and treatment of data.
- Data is not to be disclosed without permission of the individual or a legal provision.
- A distinction must be made between sensitive and non-sensitive data.
- Individual must have control over their own data through *inter alia* the right of access, from which will result, among others, a right of rectification, opposition, etc.
- To have an effective system of sanctions to make the law fully effective.
- Effective regulation of cross-border treatment of personal data by establishing the rules that govern such transfers.

5.2.3.3 Summary of key lessons

a) The use of broadband services should not weaken the protection of personal data.

b) The collection, storage and processing of personal data must be necessary for a specified and declared purpose.

c) An obligation to update the data and a limitation in collection and treatment of such data must be in place.

d) Disclosure of personal data must only be pursuant to legal power and or consent of the subject.

e) Effective and capacitated institutions are critical to ensure the safety of the collection and storage of personal data.

f) The entities overseeing personal data must be accountable.

g) Proper categorization and treatment of data.

h) An individual should have control over his/her own data.

i) Clear rules for cross border transfers of data are necessary to ensure the protection of personal data.

j) The establishment of a protection regime for personal data in the form of a regulatory agency is crucial.

5.2.4 Cyber Crimes

Cybercrime can be divided into two areas. These are one where a computer or computer technology is used in the commission of a more traditional crime (such as theft, fraud) and one where the crime is intrinsically related to the computer or computer technology (such as the introduction of a virus, altering data or hacking).

5.2.4.1 International Trends

The Council of Europe *Convention on Cybercrime* deals with offences committed through the use of telecommunications networks such as money laundering, violations of copyright, and offences that violate human dignity and the protection of children. The Convention creates offences relating to computers; provides for the adoption of procedural powers to investigate and prosecute cyber-crime; and for the promotion of international cooperation through mutual legal assistance and extradition in the prosecution of cybercrime. At the core of the convention is to deal with “inappropriate” content on the Internet that warrants the attention of the law.

The European Union defined the following issues that must be addressed to control illegal, inappropriate or harmful content:

- Protection of minors.
- Protection of human dignity.
- Economic security.
- Information security.
- Protection of privacy.
- Protection of reputation.
- Intellectual property protection.

The South African *Regulation of Interception of Communications and Provision of Communications-Related Information Act, 2002* establishes a regime relating to lawful access, prohibitions on access by unauthorised persons, real-time and archived information, provision of warrants, and assistance to be provided by service providers. The Act also prohibits the provisions of telecommunications services that do not have the capability to be intercepted.

5.2.4.2 The SADC Approach

The SADC approach on this area is evidenced by the draft model law on Computer Crime and Cybercrime. The model law deals in great detail in terms of the

requirement for lawful access. It *inter alia* outlaws unlawful interception; unauthorised access to a computer; generation of spam; child pornography, computer related forgery; computer related fraud.

The model law also provides for the admissibility of computer generated evidence. In proceedings for an offence against a law, the fact that evidence has been generated from an electronic system does not by itself prevent that evidence from being admissible. It also facilitates investigation by providing for circumstances under which authorities may intercept data messages.

Part VIII of the model deals with liability of several players in the communication chain. As a general principle Internet service providers do not have an obligation to monitor the information which they transmit or store on behalf of another. They also do not have a general obligation to actively seek facts or circumstances indicating illegal activity to avoid criminal liability. Similarly an access provider is generally not criminally liable for providing access and transmitting information provided he does not initiate the transmission; select the receiver of the information and does not select or modify the information contained in the transmission.

A caching provider is not criminally liable for the automatic, intermediate and temporary storage of that information, performed for the sole purpose of making more efficient the information's onward transmission to other users of the service upon their request. There are exceptions to this principle.

An Internet service provider who enables the access to information provided by third person by providing an electronic hyperlink is not liable for the information if the internet service provider

a) expeditiously removes or disables access to the information after receiving an order from any public authority or court to remove the link; and

b) upon obtaining knowledge or awareness about specific illegal information stored by other ways than an order from a public authority, expeditiously informs a public authority to enable them to evaluate the nature of the information and if necessary issue an order to remove the content.

5.2.5 Security of Systems and Networks

International trends on protection of privacy as exemplified by the European Union *Directive On the Protection of Individuals with Regard to the Processing of Personal Data and on the Free Movement of Such Data*, the OECD Guidelines, the SADC Model law on Data Protection and laws of selected countries have direct implications for the security of data and electronic communications systems. The full implementation of the National Broadband Strategy will depend, among other matters, on secure systems and networks.

5.2.5.1 International Trends

In OECD, the guiding tool is the OECD *Guidelines for the Security of Information Systems and Networks: Towards a Culture of Security*. Reliance is also placed on internationally recognised standards. ISO standards inter alia provide guidelines for management standard specification for Information; Security Management Systems; sets up the necessary steps required to establish a management framework.

The OECD *Guidelines for Cryptology Policy* promotes the use of cryptology to foster confidence in networks, systems and communications infrastructure generally. The guidelines *inter alia* provides for lawful access to plain text, or cryptographic keys of encrypted data. In terms of the OECD Guidelines, users should have a choice of cryptographic methods, which should be developed in response to market needs. The liability of individuals or entities that offer cryptographic services or hold or access cryptographic keys should be clearly stated.

5.2.5.2 Summary of lessons

Users' confidence in electronic commerce and transactions depends on the confidence they have in the security of the data transmitted over the networks.

Cryptography is a critical tool for ensuring the confidentiality and the integrity of data. It can however raise security concerns. If not properly regulated, it can facilitate illegal activity and compromise national security.

5.2.6 Protection of Online Consumers

Measures discussed previously in relation to electronic commerce and signatures can also contribute to or ensure protection of online consumers. This subsection should therefore be read in conjunction with the discussion of electronic commerce and signatures subsection. In some jurisdictions (such as in the SADC Model Laws), the electronic commerce and signature legislation deals with the protection of online consumers as well.

5.2.6.1 International Trends

The *OECD Guidelines for Consumer Protection in the Context of Electronic Commerce* are intended to ensure that consumers receive the same level of protection when they shop online as they do from a face to face transaction. The Guidelines set out core characteristics of effective consumer protection for on-line business transactions and reflect existing legal protections available to consumers in more traditional forms of commerce. They recommend a mixture of legislative intervention, public awareness and voluntary self-regulatory mechanisms.

5.2.6.2 SADC Approach

The SADC approach is evidenced by the Draft Model law on Electronic Transactions and Electronic Commerce. The model law provides for the obligations of online suppliers as well as the rights of online consumers.

The suppliers' obligations are mainly related to the provision of information on the goods or services for sale, for hire or for exchange by way of an electronic transaction. The supplier is required for example to make the following information: information available to consumers:

a) Its full contact details;

b) a sufficient description of the main characteristics of the goods or services offered by that supplier to enable a consumer to make an informed

decision on the proposed electronic transaction;

c) the full price of the goods or services, including transport costs, taxes and any other fees or costs;

d) information regarding the payment system that is sufficiently secure with reference to accepted technological standards at the time of the transaction and the type of transaction concerned;

e) any terms of agreement and the manner and period within which consumers can access and maintain a full record of the transaction.

The supplier is also under an obligation to provide a consumer with an opportunity:

a) to review the entire electronic transaction;

b) to correct any mistakes; and

c) to withdraw from the transaction, before finally placing any order.

The SADC Model law has detailed provision intended to ensure that online contracts are complied with by the supplier. This includes timelines within which the agreement should be performed. Consumers are also given a cooling off period, being the time within which a consumer is entitled to cancel without reason and without penalty any transaction and any related credit agreement for the supply. The Model law also regulates online marketing.

5.2.6.3 Summary of Lessons

The key objective of legislation with respect to broadband is to ensure protection of online consumers.

The overall objective should be to ensure that consumers are not disadvantaged by the use of e-commerce and have access to the same remedies and protection that they would have in face-to-face transactions

Legislation should mandate information provision by the supplier to consumers

5.2.7 A Review of the Botswana Legal Framework

As already pointed out the Maitlamo process undertook a detailed analysis of the extent to which Botswana legal framework is supportive of the uptake and usage of ICT services. It also provided detailed recommendation as regards the legal interventions required. We only provide a high level summary under this section.

5.2.7.1 Electronic Commerce and Signatures

There is no specific legislation speaking to electronic commerce and signatures. Although the Maitlamo Legal Change Report made detailed and well-reasoned recommendations on this subject; very little has been done by way of legislative reform. A lot of legislation still contains paper bias provisions such as those requiring signature, witnesses; affidavit, oath, prescribed forms, etc.

Given the plethora of legislation that needs to be amended to be media neutral, we consider and recommend that an e-commerce and signature specific legislation be enacted to close the identified legal gaps. Drawing from global and regional review, we recommend that the proposed electronic commerce and signature be characterized by the following.

- Its scope should be beyond commercial transactions, to cover other types of communication.
- It should be a mixture of mandatory and voluntary approaches in the sense of giving people the choice to either be subjected to its provisions or not and or select provisions that would be applicable to their specific transactions.
- There should be limited exception to the scope of the e-commercial law. The precise documents and or transactions that would be excepted has to be determined following detailed consultations but could include preparation of deeds for transfer or burdening of land, wills, etc.
- Provide for rules and regulations relating to contract formation.
- Modification of rules of evidence to accommodate the functional equivalency of electronic documents to paper-based documents.

Linked to e-commerce is the issue of electronic signatures. Currently there is no legislation speaking to authentication of such signatures. As with respect to other areas, we are of the opinion that the SADC and UNICITRAL Model Laws address this issue in detail. We are advised that a lay draft Bill based on the SADC Model Law on Electronic Transaction and E-Commerce is being prepared. The proposed law would deal with e-commerce and electronic signatures.

Recommendation 15 We recommend that Botswana should domesticate the SADC Model Law on Electronic Transactions and E-Commerce. As already pointed out, the SADC Model Electronic Transactions and Electronic Commerce Law is broadly in line with international best practice.

5.2.7.2 Protection of e-commerce consumers

The major identified legal gap in the case of Botswana is the total absence and or lack of legislation, code of conduct or guidelines dealing with the rights of consumers on an e-environment. The Consumer Protection Act did not contemplate e-commerce. Online consumers are thus left to resort to the Common law for protection. The Common law lacks the basic instruments to protect online consumers who may be buying and/or procuring goods and services from across borders. The Consumer Protection Act does not, for example, address key issues of concern such as:

- Cooling off period;
- Obligations of online suppliers;
- General rights of online consumers;
- Remedies and enforcement in extra territorial transactions, etc.

Recommendation 16 Based on the review of the international and regional legal approaches, we recommend statutory intervention to provide adequate protections for online consumers. Following the emerging SADC approach, this issue can be addressed in the electronic transactions and commerce law. Overall, our recommendation is that Botswana should domesticate the relevant provisions of SADC Model Law on Electronic Transaction and Electronic Commerce to address the issue. Part IV of the Model Law deals in an exhaustive and satisfactory way with the protection of online consumers. The approach adopted therein is in line with international best practices.

5.2.7.3 Protection of Personal Data

There is no specific legislation dealing with data protection and or regulation of personal data in the country. This applies to all types of data. However the Communications Regulatory Authority Act (this Act will come into force on 1st April 2013) has provisions intended to protect personal privacy and data to some extent. Section 54 makes it an offence for a provider of telecommunications services to:

- Intercept customer messages;
- Disclose to any person the contents of any messages;
- Disclose to any person information about a customer;
- Use any information about the customer for its benefits.

Section 54 exempts information that was required for criminal investigations and or for criminal proceedings. Section 55 also addresses some aspects of personal privacy. It is an offence to send an electronic message that is:

- Indecent;
- Obscene;
- Intended to cause annoyance, inconvenience or anxiety to another person.

Recommendation 17 We were informed that there is currently a lay draft Bill on Data Protection. While we have had no sight of such a draft, we recommend that Botswana should domesticate the SADC Model Law on Data Protection as such model, in our opinion is fully compliant with best practice.

5.2.7.4 Cyber- and Computer Crime

The concept of “cyber-crime” covers a wide area of activity. For our current purpose, it is critical to establish the extent to which the main criminal statutes deal with cyber-crime. Our review of the Penal Code, Botswana’s main criminal statute, reveals that it generally provides sufficient safeguards against traditional crimes, such as theft or fraud, committed with the aid of a computer. However, there are certain crimes that are intrinsically related to the computer or computer technology such as the introduction of a virus, altering data or hacking, which the Penal Code does not sufficiently deal with.

The legislative response to cyber-crime is often a mixture of coming up with a new overarching Act on cyber-crimes and the amendment of existing traditional statutes. In Botswana cyber-crime dedicated legislation has been effected. This is the Cybercrime and Computer Related Crimes Act of 2007. As its long title suggests, the main objective of this Act is to combat cybercrime and computer related crimes, to repress criminal activities perpetrated through computer systems and to facilitate the collection of electronic evidence. It attempts to plug some of the gaps identified under Maitlamo. It provides for tools for the collection and storage of evidence with respect to computer related crimes.

The Act also deals with the protection of minors from child pornography as part of regulating appropriate content. It prohibits online and e-child pornography. The Act is generally in line with international best practice as regards its scope, including provisions related to the protection of children. However, the Cyber and Computer Related Crimes Act is not completely aligned to SADC Model on Computer Crime and Cybercrime Law. It does not, for example, sufficiently addresses such issues as liability of key actors (such as access, hosting, catching, hyperlink, and search engine providers) in electronic or online content.

Recommendation 18 In the premises we recommend a review of the Cyber and computer related Crimes Act to align it to the SADC Model law.

There are also some provisions that sit uneasily with the constitutional value of privacy. For example, access to pornographic material from a computer is in itself a crime. This is regardless of whether the person accessing such material does so in the privacy of his/her home; whether the material being accessed is child or adult pornography or not. These provisions may be found wanting if challenged on constitutional basis.

5.2.7.5 Cyber security

There is currently no specific legislation dealing with network security. This lacuna would greatly compromise the confidence investors and consumers have or ought to have in e-commerce and e-transactions. However, the Communications Regulatory Authority Act deals with some aspects of network security. It amongst others outlaws:

- Wilful interference with; hindering or impeding the erection, maintenance, inspection or alteration of any telecommunication or broadcasting system.
- Interference with or obstruction of the operation of the telecommunication, broadcasting or postal equipment.
- Wilful damage or destruction of any telecommunication, broadcasting or postal equipment.

A clear gap that exists is total absence of law and or policy for the encouragement of the use of appropriate cryptology so as to foster confidence and trust in the Internet and e-commerce. The issue of cryptology is a complex one. While it promotes protection of privacy, it may if not properly implemented sacrifice national security. It is therefore critical to strike an appropriate balance as between privacy and national

security concerns. The approach taken by the OECD of combining law and market voluntary self-regulation and standard setting is recommended. There is no doubt for example that the proposed legislation should prohibit certain types of cryptology particularly those that cannot be intercepted by security agents. We have been advised that there is a working lay draft Bill on cyber security which has not been availed to us. We will comment on such Bill if it is provided to us within the time frame of our assignment.

5.2.7.6 Infrastructure Deployment and Usage

The existing legal framework in Botswana is supportive of an orderly deployment of infrastructure. There is for example provision for an infrastructure service providers' licence. In terms of optimal usage of existing infrastructure there exist provisions for interconnections and guidelines for infrastructure sharing.

5.2.8 Conclusion

The SADC ICT laws harmonisation project has built the necessary foundation on which Botswana should build its legal framework to promote the uptake of broadband services. The SADC Model Laws on such areas as Electronic Transactions and Electronic Commerce, Data Protection and Cyber Crimes are based on international best practices. There is no reason why Botswana should remake the wheel. In any case Botswana is and or was an active participant in the promulgation of the SADC Model Laws.

We accordingly recommend that Botswana should domesticate the SADC Model Laws on Electronic Transactions and Electronic Commerce; Data Protection and Cyber Crimes. Such an approach would ensure in a speedy and effective manner the implementation of the recommendations of Maitlamo as well as laying the legislative foundation for the implementation of the proposed National Broadband Strategy.

6 An outline of the Draft National Broadband strategy

The Draft National Broadband Strategy will be developed and presented to stakeholders during the next and final phase of this assignment. This section presents an outline of some of the key issues that will be considered during the development of the National Broadband Strategy.

Section 4 provides details regarding how broadband infrastructure should be extended to provide coverage to all villages, towns and cities with populations greater than 500 inhabitants. This section provides options for possible implementation of the infrastructure.

6.1 Mobile Broadband Licensing

As discussed in Phase 1, mobile broadband provides the quickest and most cost effective means of providing broadband services especially in rural areas where the available of copper network is not widespread.

Currently the three mobile operators, BTC, Mascom and Orange have been assigned radio spectrum for 3G services. However, no rollout obligations were associated with the 3G spectrum. As result the three operators rolled out 3G services to areas they determine would provide the best returns on their investment. It is standard practice to license mobile spectrum subject to minimum rollout obligations.

The radio spectrum is a valuable and scarce resource which should be put to good use to provide services which would otherwise be unavailable to consumers. Accordingly, the BTA has a duty to ensure that this resource is put to good use by all operators who have access to it, failing which BTA may repossess the unused spectrum and reallocate it to operators who are prepared to use it to meet Government's objectives of providing broadband services to all parts of the country. This section presents options that BTA, the Government and stakeholders should consider as regards the licensing of spectrum for mobile broadband services.

6.1.1 Options for Mobile Broadband Licensing in Clusters 4, 5 and 6

The analysis in Section 4.2 showed that villages with population less than 10,000 inhabitants (clusters 1, 2 and 3) would not be profitable for the rollout of mobile broadband services without some form of subsidy. On the other hand, villages and towns with populations of more than 10,000 inhabitants (clusters 4, 5 and 6) would be profitable for an operator will a market share of more than 20% and thus would not require any subsidy from the Government/BTA.

Considering the above, it is our view that BTA should require all the three mobile operators to provide broadband services to all villages, towns and cities in Clusters 4, 5 and 6 on a competitive basis and without any subsidy from BTA or the Government. Any operator who objects to this requirement should be allowed to opt out but BTA shall either have the right to repossess and assign any or all of their 3G spectrum to other operators to redeploy at any of the villages, towns and cities in Clusters 4, 5 and 6 where the said operator does not use such spectrum.

Alternatively, BTA should allocate 4G spectrum on condition that the operator agrees to provide 3G/4G coverage to all villages, towns and cities in clusters 4 to 6.

With the exception of urban area, villages do not have defined/identifiable boundaries which can be used to ascertain whether an operator provides full coverage to a specified village or town. To address this problem, prior to issuing licences for the provision of broadband services in Clusters 1 up to 6, BTA should collect and publish coordinates that define the boundary of each village for purposes of broadband licences. Since this process could take a long time, an alternative would be to identify and specify key institutions that should be covered in every village (e.g. kgotla, clinics, all schools, all government institutions, etc.). While this latter option is easier, it leaves the possibility of some residential households that may be on the outskirts of a village being outside the coverage area.

Recommendation 19 All mobile operators shall provide broadband services in Clusters 4, 5 and 6:

a) BTA should require all operators with 3G-spectrum to provide broadband services in Clusters 4, 5 and 6 without any subsidy from BTA or the Government.

b) Each operator shall provide full 3G coverage in each village/town in Clusters 4, 5 and 6 accordance with boundaries and coordinates (or institutions) specified by BTA and within a period of no more than 2 years.

c) BTA should identify and assign 4G spectrum to all operators who agree to comply with requirements (a) and (b). Operators with 4G spectrum should be allowed to determine villages and towns where they will use 3G or 4G spectrum.

d) 4G spectrum shall only be made available to operators who agree to comply with requirements (a) and (b).

Question 4: All mobile operators shall provide broadband services in Clusters 4, 5 and 6:

c) Which parts of Recommendation 19 do you agree with?

d) Please state which parts of Recommendation 19 you do not agree with. State you reasons for disagreement.

e) Provide alternatives to the recommended proposals with supporting arguments for your proposals.

6.1.2 Options for rolling out mobile broadband infrastructure in Clusters 1, 2 and 3

As discussed in Section 4.2, the rollout of mobile broadband infrastructure in clusters 1, 2 and 3 will require some form of subsidy on account of the fact that these are

none profitable areas. This section presents options as regards how this infrastructure may be rolled out.

6.1.2.1 Award a single national broadband licence for Clusters 1, 2 and 3

Under this option, BTA and the Government would issue a tender for a single national licence to rollout broadband infrastructure and services in Clusters 1, 2 and 3. The tender would be opened to the three Public Telecommunications Operators (PTOs) only.

6.1.2.1.1 Advantages of this option:

a) Since the licence would cover practically the whole country, the combined customer base for the winner would be large. A large customer base will ensure that operators offer competitive bids which should lead to an overall reduction in the required subsidies.

b) The licence would give the winner the opportunity to provide broadband services to a large customer base at a subsidized capital expenditure. The increased competition should drive down the required subsidy per village.

c) A large customer base will increase sustainability in the provision of broadband services.

6.1.2.1.2 Disadvantages of this option

This option has the following disadvantages:

a) The rollout of broadband services to Clusters 1, 2 and 3 would take a long time since it would be done by only one operator.

b) Issuing a single national licence could be viewed as introducing a monopoly operator for broadband services in Cluster 1, 2 and 3. This could be detrimental to consumers in these areas since they would not have the benefits of competition in terms of options to choose service providers or to change service providers in the event there are not happy with the service they get from their service provider.

6.1.2.2 Subdivide the country into a number of areas and issue a single broadband licence for Clusters 1, 2 and 3 for each area

This option would be similar to how Nteletsa 2 was implemented. During Nteletsa 2, the Government divided country into four regions and issued a tender for each area.

6.1.2.2.1 Advantages of this option:

a) This option ensures a faster provision of broadband services to the whole country since multiple service providers would rollout services simultaneously.

6.1.2.2.2 Disadvantages of this option:

a) Dividing the country into more than one region reduces the size of the market per licence. Operators may lose interest in bidding for the licences if they feel that the size of the individual markets would be too small to justify their capital and operational cost, even taking into account subsidies. This could be

particularly the case for the western parts of the country which consist of large distances between small villages.

b) There is always the risk that if the size of the market is too small, it may never be self-sustaining after the initial subsidy. Thus the result could be that each region could require a perpetual subsidy to sustain the provision of services. Such a scenario is highly undesirable.

6.1.2.3 Incorporation of a company to rollout 4G infrastructure

Some countries (e.g. Kenya) have allowed operators to form a jointly owned company/consortium that would then be licensed to own and operate 4G infrastructure. The objective of this arrangement is to share the cost of rollout out 4G infrastructure.

6.1.2.3.1 Advantages of this option:

a) Operators share the cost of rolling out 4G infrastructure thereby reducing the cost incurred by each operator.

b) This option has the potential to reduce the level of subsidy required to rollout 4G infrastructure in non-profitable areas.

c) The shared cost of rolling out the infrastructure should benefit consumers in the form of reduced cost for services.

6.1.2.3.2 Disadvantages of this option:

a) To get competitors to agree the structure, governance and operation of the joint entity is likely to be very difficult.

b) The establishment of a single broadband operator would lead to a monopoly operator with attendant monopolistic tendencies.

c) The establishment of such an entity could encourage collusion amongst operators to the detriment of consumers.

d) Considering that Botswana's market is fairly small, there might be no business case for the establishment of a new company to rollout 4G infrastructure and services considering that this company would be in direct competition with the existing PTOs.

e) The policy and regulatory framework in Botswana is such that licences for PTOs are granted on the basis of open tendering process. Thus BTA may have difficulties granting a licence in a manner that is contrary to this generally established procedure.

6.1.2.4 Infrastructure Sharing Constraints

BTA issued Regulations on Passive Infrastructure which came into effect on 1st October 2012. The main thrust of these regulations is to encourage sharing of passive infrastructure amongst all licensed operators.

Infrastructure sharing could be extended to sharing active components (Radio Access Network (RAN) equipment. In this case, operators can share the cost of

rolling out the 4G infrastructure and dimension the capacity of each node to cater for their combined requirements. Each operator keeps their identity, and traffic from their respective customers will be routed and billed by the respective operators.

The structuring scheme for property of the shared infrastructure has to be studied and clearly defined: infrastructure could belong to a single operator, with lease agreements to others, including long term agreements such as Indefeasible Rights of Use (IRUs), or it could be placed in a joint venture between operators.

6.1.2.4.1 Advantages of this option:

a) The operators share the cost of rolling out the broadband infrastructure.

b) Each operator keeps their identity, routes and bills their customers directly. Thus from a commercial point of view, the operators continue to compete against each other in the same way they would if they did not share in the cost of rolling out the infrastructure.

c) Consumers benefit from the fact that all the PTOs would provide service in each area and thus avoid the situation where certain areas are only served by one operator (as is the case with infrastructure rolled-out under Nteletsa II.

d) This option retains the benefits of full competition at service delivery level while reducing the cost of infrastructure development for each operator.

e) Sharing the cost of infrastructure rollout increases the chances of profitability even in areas where that would not be the case if each operator incurred the full cost of infrastructure development on their own.

6.1.2.4.2 Challenges of this option:

a) Operators will still have to agree on a formula for sharing the cost. For example the cost could be shared equally, prorated in proportion to market (customer base) share, etc. Agreeing to an acceptable methodology could prove difficult.

b) The infrastructure rollout process could be delayed on account of different procurement procedures amongst participating operators.

c) Agreeing procedures for upgrading the shared infrastructure could be complicated.

d) Agreeing an acceptable method of recording/recognising the shared assets in each company's books could be a challenge.

e) Suppose an operator wins a licence to provide mobile broadband services in an area. Should he then be forced to share the infrastructure (including RAN equipment) in his area if other operators approach him requesting to share in the rollout? If so, should be subsidy that he got be reduced? What if he argues that sharing reduces his potential target market size and thus modifies his business model?

f) There are today 3 PTOs in Botswana who appear to be natural candidate for the coverage of the rural areas. However, some do already have more sites in rural areas, some of which have been already subsidised by the

implementation of the Nteletsa program. Before starting a tendering process for broadband coverage in rural areas, the infrastructure sharing mechanism should be implemented and transparent enough as to insure a level playing field for all candidates.

g) Would there be any point in issuing a competitive tender for funding if the winner will be compelled to share the same infrastructure with the losers?

h) If the PTOs are granted funding for the shared infrastructure without the benefit of a tender, the required subsidy could be much higher than if they bid for the funding. It would also be difficult to determine what constitutes a reasonable amount for the requested subsidies in the absence of competition for same.

Question 5: Which option should be adopted as regards rolling out a mobile broadband network in Clusters 1, 2 and 3?

a) Should BTA issue a single nationwide mobile broadband licence?

b) Should BTA subdivide the country into regions and issue a mobile broadband licence for each region?

c) Is the feasibility of establishing a company jointly owned by the PTOs to rollout 4G infrastructure worth considering?

d) Should BTA grant a single nationwide **shared** mobile broadband licence to be executed by all PTOs through RAN sharing? How would BTA/Government address the challenges associated with this arrangement as highlighted above?

e) What are the conditions to ensure a level playing field for all operators likely to roll-out a network in Clusters 1, 2 and 3?

f) In general, should operators only share infrastructure on voluntary basis or should sharing of RAN equipment be mandatory if requested by another operator?

g) Should the network sharing be based on a mechanism such as RAN sharing or is a national roaming solution preferable? Please provide reasons in support of your stated preference.

6.2 Fixed Wireless Access Infrastructure by ISPs

Some internet service providers (ISPs) use fixed wireless access (FWA) radios operating in various frequency bands (5 GHz unlicensed band and 2.6 GHz licensed band) to provide broadband internet services.

The capital cost of FWA equipment is mainly determined by international markets. As a result high usage at international level of equipment operating in the unlicensed band leads to a lower cost for this equipment compared to equipment operating in the licensed bands. On the other hand the quality of service for equipment operating

in the unlicensed band cannot be guaranteed due to interference problems, especially in urban areas.

It is reported that BTC has recently offered to provide access to Botsgate (the internet gateway) to ISPs in the major villages and towns at the same cost for the same capacity under its wholesale Metro Ethernet service. Thus an ISP in Maun will connect to Botsgate at the same cost as an ISP in Gaborone for the same capacity, subject to a minimum capacity of around 3Mb/s. While this presents an opportunity for local ISPs in major villages and towns, the fact of the matter is that the majority of ISPs with sufficient expertise and resources are based in the major towns. Some of them would like to expand their services by establishing Local Internet Access Points (LIAPs) in other parts of the country. However, these LIAPs would not be fully fledged stand-alone ISP operations. Rather, their traffic would have to be backhauled to their main centres in either Gaborone or Francistown and then aggregated with the rest of the ISP's traffic before being delivered to Botsgate. The main challenge which FWA ISPs face when they attempt to rollout LIAPs in areas outside their main centres of operation is the cost of backhauling traffic to their control centres which are mainly based in Gaborone or Francistown.

6.2.1 Options for encouraging ISPs to rollout services in rural areas

Currently internet usage in rural areas is in its infancy. That said, BTA and the Government should encourage those ISPs who are willing to promote internet usage in rural areas to do so.

The rollout of e-Government services will only have a positive impact on the lives of the majority of people in rural areas if they can access these services in their villages. This will not be just a matter of convenience. It will save rural inhabitants time and the cost of travelling from their respective villages to major urban centres where such Government services may currently be available. Thus it is critical that Government and the BTA should consider the subsidising for the roll out of Local Internet Access Points (LIAP) in all areas where broadband infrastructure is targeted.

It would be ideal if local community centres (Kitsong Centres), which currently provide basic ICT services (photocopying, faxing, printing, limited Internet access) could be upgraded to provide broadband services and also include equipment that would upgrade them into wireless LIAPs to enable residents of such villages to subscribe directly with ISPs that will be operating such facilities. Thus, while some residents of such villages could use the Kitsong Centre to access broadband services, those who can afford could subscribe to have access directly in their homes and small businesses in the village.

Some Kitsong Centres were established by the PTOs as part of the Nteletsa II Project and they were a requirement imposed by the Government as part of the funding conditions. On the other hand, Botswana Post also operates Kitsong Centres in some of its post offices and intends to rollout such facilities to more post offices. Some villages have two Kitsong Centres: One established by a PTO under Nteletsa and normally run by a local entrepreneur or Village Development Committee and another run by Botswana Post. Information gathered during Phase 1 of this project showed that such a situation puts the sustainability of the private Kistong Centre into question.

Recommendation 20 Potential means of increasing the roll out of Local Internet Access Points (LIAPs) in rural areas

a) The cost of backhauling internet traffic from LIAPs to ISP's main centres should be assessed.

b) The three PTOs should offer excess capacity on their backhaul links to ISPs to establish internet LIAPs on a competitive basis. The LIAPs should be collocated with PTOs' base stations or at the Kitsong Centre to reduce the cost of rolling LIAPs.

c) Backhaul links for the broadband network should cater for ISPs' capacity requirements.

d) BTA and the Government should prepare a rollout schedule for internet LIAPs, starting with urban areas and large villages and eventually smaller villages as the demand for broadband service develops.

e) The programme for the rollout of internet LIAPs should be synchronised with the rollout of e-Government services to ensure a quick adoption of broadband services.

Question 6: Potential means of increasing the roll out of Internet LIAPs in rural areas

a) Do you agree with proposals in Recommendation 20? If not, state what you do not agree with, and offer alternatives for addressing the lack of internet access points in rural areas.

b) How should the problems of sustainability of the private Kitsong Centres in cases where they compete with Botswana Post's Kitsong Centre be addressed?

c) In cases where both Kitsong Centres are allowed to co-exist, which one should be upgraded to include a LIAP and why?

d) Should the tender for the rollout of Local Internet Access Points (LIAPs) be separated from that of the rollout of broadband infrastructure or should one tender be issued for both broadband infrastructure and LIAPs?

e) Please outline other issues which you believe should be considered and state your reasons.

6.3 xDSL Infrastructure

The analysis done in Phase 1 shows that practically all BTC's telephone exchanges are equipped with ADSL 2+/Re-ADSL. The cost of deploying copper is very high and its rollout takes a long time. Accordingly, while it is critical that the existing copper infrastructure be maintained and used to provide broadband services, it would not be advisable to rely on expanding the copper infrastructure as a means of providing

broadband services because of the high cost and delays in rollout out the infrastructure.

That said, it is recommended that BTC's exchanges should be upgraded to provide symmetrical DSL (SDSL), especially in commercial areas so as to provide reliable symmetrical broadband services for professionals and Government institutions that may generate symmetrical data (symmetrical upload/download data).

Recommendation 21 Upgrading of xDSL Infrastructure

a) BTC should upgrade its xDSL infrastructure to incorporate SDSL so as to provide symmetrical broadband speed for professionals, businesses and Government institutions.

b) Since BTC has no competitor in this market segment, it (BTC) should cover all costs associated with upgrading the xDSL infrastructure with its own funds. However, as with the case for ADSL, wholesale conditions should make it possible for all ISPs to build competitive SDSL retail offers.

6.4 Satellite access

As explained in Phase 1 of this assignment, satellite connections in Botswana are only suitable for remote locations and not for mass market. Nevertheless in areas where the roll-out of a terrestrial network is not affordable, this technology could provide solutions for enterprise connections and Kitsong (Community) Centres.

Question 7: Should the National Broadband Strategy define an action plan aimed at helping the most remote areas to get equipped with satellite connections? If so, what should be criteria for choosing remote areas, communities and institutions that should eligible for public funding?

6.5 Policy Objectives

6.5.1 Introduction

The National Broadband Strategy should be anchored within broader national policies. The strategy must therefore be seen and understood as providing a basis through which the national policy objectives outlined in various policy documents and government initiative and intervention can be achieved. The Strategy is not an isolated intervention. It is intertwined with various government policy objectives and must be designed such that it facilitates and enables the achievement of larger national policies.

Some of the key policy initiatives and strategic interventions against which the strategy is being developed include the following:

- The economic diversification drive or initiative
- The National Vision 2016.

- The National ICT Policy (Maitlamo).
- The e-government strategy
- The National Human Resource Development Strategy.
- The science and technology initiative to be driven in part by the Innovation Hub.
- The Tertiary Education Policy: Towards a Knowledge Society.

6.5.2 Policy Objectives

The strategic policy objectives for the National Broadband Strategy are, as already pointed out, derived from various national policies and interventions. The policy objectives are:

- Development and adoption of a national consensus on the meaning and definition of broadband in line with international best practice
- Creation of an enabling environment for the deployment of broadband infrastructure and utilization or up take of broadband services
- To promote and create an environment conducive to the growth of the demand for and utilisation of broadband services.
- To ensure universal access to broadband services by development of appropriate funding mechanism that involves public private sector partnerships and or targeted subsidies.
- To ensure the implementation of diverse Government policies and initiatives that are conditional upon the availability of broadband infrastructure and services.
- To create an enabling legal and regulatory framework that:
  a) is conducive to the rapid deployment of broadband infrastructure;
  b) encourages and ensure increased uptake and usage of broadband services by all citizens;
  c) engenders confidence and trust in electronic commerce and transactions;
  d) promotes the protection and respect of privacy and personal dignity through appropriate instruments for regulation of personal data;
  e) addresses potential illegalities and unacceptable content;
  f) ensures the integrity and security of the broadband networks;
  g) introduces and promotes flexibility in the use of scarce resources such as spectrum to ensure the broader availability of broadband services;
- ensures the availability and accessibility to broadband services for diverse uses;
- Facilitate and encourage economic diversification inter alia by promoting and facilitating -

a) Research and development;

b) Innovation;

c) Creation of appropriate and relevant local content.

- creates an enabling environment necessary for making Botswana a regional ICT Hub;
- creates an enabling environment for e-government initiative.

Question 8: Do the policy objectives presented in this outline of the NBS as well as the recommended legal and regulatory tools adequately cover the general ambition that the National Broadband Strategy should have? If not, suggest other areas that should be highlighted.

6.6 Funding mechanisms

The previous chapters have shown that some of the levies that can be used by the Government and the BTA to promote the development of broadband in the country are not limited to funding only. Other actions that can be used include, legal and regulatory decisions, tax incentives, encouraging the development of competition, awards, etc.

Nevertheless some actions will need a direct financial involvement of the state. The roll-out of infrastructure in rural area is the segment that will require mobilising the major financial resources.

The most simple and straightforward kind of action is to subsidies directly the deployment over given areas, similar to the process that was used for the Nteletsa II programme (provided an assessment is carried out as stated in Recommendation 8), with an open competitive bidding process (such as an auction or a reverse-auction mechanism). Such an intervention should respect the following principles:

- Justifying the subsidy: the subsidy should be necessary, i.e. it should only compensate the additional or net costs related to the characteristics of the investment that would be prone to hinder such investment.
- Proportionality of the subsidy: the subsidy should be proportionate to the above mentioned additional costs.
- Transparency and equality of process for all candidates: the conditions for the provision of subsidies should not put any candidate at an advantage over others.

Recommendation 11 in section 3 proposes that the establishment of a Universal Service Fund could be used to provide subsidies. The conditions of funding should be similar to those presented here above for direct funding. The only difference comes from the origin of the funds (direct state subsidy or funding by the operators).

It should be noted that allocating direct subsidies has some drawbacks:

1. Beyond the network roll-out (which is of general interest), the operator remains the owner of the network and infrastructure acquired in part through

or in whole through the subsidies. Some may argue that public funds should not be used to procure assets for private companies. The counter argument is that the private sector would not provide services in areas where they would not make profit. Thus such funding is necessary.

2. While regulatory institutions have a duty to monitor the quality of service provided by operators, in practice such monitoring is difficult to implement. Obviously in really bad cases of poor service, the regulator can impose fines or demand a refund in case conditions for funding are not fulfilled. That does not detract from the fact that it is difficult to determine whether the public always gets value for money in all cases of such subsidised networks. Nevertheless in a telecommunication network project, when a subsidy is granted, about 80% of it goes to the infrastructure and 20% to the service execution, which makes it difficult to assess the overall efficiency of usage.

In order to limit these drawbacks and optimise the usage of subsidies by forcing operators to provide the best quality of service, the reverse-auction could include some constraints:

- Operators commit to roll-out the network but also to fulfil some obligations such as infrastructure sharing, access and interconnection, meet minimum specified quality of service key performance indicators, minimal bandwidth available, pricing constraints, etc.
- If these obligations are not fulfilled, the regulator/Government would be entitled to recover not only the part of the subsidy dedicated to service provision but the whole subsidy, in addition to penalties as may be deemed appropriate. However, it is also important to note that too stringent obligations, overly intrusive requirements or attempts to micromanage infrastructure rollout may be a disincentive for operators, especially in small markets such as Botswana.

Question 9: Does the principle of a subsidy granted through a reverse-auction mechanism similar to Nteletsa II or another competitive process appear adequate for the funding of a Next Generation Access network deployment in rural areas?

Question 10: Should there be direct state funding and Universal Service funding? Which criteria would be used to choose the appropriate funding?

Question 11: What kinds of obligations should be imposed as conditions for funding? Please provide reasons for your proposal and identify quality control mechanisms that would be relevant without being disincentives for operators.

Other funding mechanism could be implemented such as a Build, Operate and Transfer (BOT) whereby a private entity could build and operate the infrastructure for an agreed period and then hand it over to the government at the end of this period. Public-Private Partnerships (PPP) or Private Finance Initiative (PFI) are common instruments for setting-up such projects.

Nevertheless it appears that such mechanisms are not commonly used in Botswana. They are usually relatively complex. The telecommunication sector, due to its rapid changes and evolution might add another level of complexity. Therefore, it is probably not advisable to experiment with such a model for the deployment of broadband infrastructure.

Question 12: Could you identify other financial instruments that could be mobilised for funding the broadband infrastructure?

6.7 Implementation methodology

As discussed in previous chapters, broadband services can be provided through mobile wireless networks, fixed wired or fixed wireless networks. Countries use different method to award licences for rolling out broadband infrastructure. These methods include but are not limited to:

- Granting licences through competitive bidding open to existing PTOs only where the bidder that requests for the minimum subsidy is granted the licence subject to rollout obligation.
- Granting licences open to all licensed operators (PTOs and ISPs) with each entity able to use whatever technology it is licensed to use (e.g. PTOs would use mobile or fixed wireless networks while ISPs would only be restricted to fixed wireless technologies (FWA/Fixed WiMAX spectrum). Detailed proposals in respect of implementation methodology will be discussed in the next and final stage of this assignment.

Question 11: PTOs Versus ISPs

a) Should tenders for the rollout of broadband infrastructure and services be open to PTOs only or should ISPs also be invited to bid?

b) If ISPs are invited, how should BTA and the Government reconcile the differences in the technologies which PTOs have access to versus ISPs who are only limited to fixed wireless technologies?

7 Appendix

7.1 Geotypes clustering

Cluster 1 Population of 500 to 1,000 inhabitants	
Name of location	**Population**
Gamodubu	501
Khekhenya/Chepetese	501
Mononyane	503
Bokspits	507
Diloro	509
Papatlo	511
Monwane	513
Maubelo	514
Moreomaoto	518
Struizendam	519
Maisane	519
Galekgatshwane	526
East Hanahai	532
Ikongwe	533
Habu	533
Inalegolo	533
Kgari	534
Diphuduhudu	535
Suping	537
Lefoko	537
Mogome	540
Lepashe	544
Leshibitse	545
Gungwe	545
Sechele	547
Butale	549
Kavimba	549
Semane	549
Mohembo East	550
Botlhatlogo	555
Mokoswane	556
Bere	559
Goo-Sekgweng	563
Mabudzane	563

Cluster 2 Population of 1,001 to 5,000 inhabitants	
Name of location	**Population**
Makalamabedi	1008
Makuta	1014
Tshane	1020
Mokatako	1021
Shorobe	1031
Kutamogoree	1035
Mbalambi	1037
Boatlaname	1049
Bray	1049
Dutlwe	1055
Segwagwa	1056
Gasita	1063
Tshokwe	1070
Pitseng	1074
Maboane	1085
Jackalas 1	1093
Shashe Bridge	1095
Middlepits	1121
Mmatshumu	1122
Matobo	1136
Malwelwe	1146
Mafongo/Hobona	1151
Samochema	1156
Lorwana	1177
Lekgolobotlo	1177
Sekoma	1190
Khwee	1196
Mosojane	1210
Moshaweng	1222
Jackalas 2	1222
Kokotsha	1224
Kedia	1237
Gopong	1246
Makaleng	1256

Phuduhudu	564
Mambo	569
Kweneng	570
Ramonaka	573
Leporung	575
Mogonye	577
Moremi	579
Maralaleng	586
Tsonyane	588
Talana Farm 43	589
Kotolaname	596
Taupye	598
Kolonkwane	599
Moreomabele	602
Tswaane	603
Dinatshana	603
Mmopane Lands	604
Satau	605
Malotwana	608
Mahetlwe	610
Lesoma	613
Letsholathebe	614
Mogojogojo	619
Lejwana	621
Mokolodi	624
Sekondomboro	629
Masukwane	630
Tshokatshaa	634
Kacgae	634
Bonwapitse	635
Gonutsuga	635
Majwanaadipitse	638
Mmanxotae	643
Jamataka	650
Ditlharapa	653
Gakgatla	654
Ikoga	673
Masingwaneng	677
Tswaaneng	679
Sepako	682
Phihitshwane	682
Makunda	685
Lephephe	696

Kareng	1259
Makobo	1268
New Xade	1269
Semolale	1288
Natale	1288
Siviya	1289
Matsitama	1309
Senyawe	1339
Motopi	1340
Ditladi	1344
Gakuto	1350
Kachikau	1356
Zoroga	1358
Botlhapatlou	1395
Motokwe	1413
Lokgwabe	1417
Kgomokasitwa	1423
Rakhuna	1428
Magotlhwane	1433
Matlapana	1449
Motlhabaneng	1456
Ramatlabama	1469
Sesung	1481
Borotsie (Nr Tonota)	1501
Moshaneng	1512
Mabesekwa	1528
Ramokgwebana	1548
Xakao	1565
Lorolwana	1568
Goshwe	1574
Nlakhwane	1583
Nxamasere	1584
Mokoboxane	1594
Selokolela	1610
Lotlhakane West	1637
Themashanga	1648
Moletemane	1664
Dekar	1668
Marobela	1672
Makalamabedi	1674
Xhumo	1684
Moroka	1692
Makopong	1697

Morwamosu	696
Mabolwe	701
West Hanahai	702
Sedibeng	708
Mokgomane	708
Toromoja	710
Qangwa	710
Kgoro	711
Tlhareseleele	711
Ramaphatle	719
Eretsha	720
Tlhankane	722
Tshidilamolomo	723
Seherelela	723
Semitwe	724
Gudingwa	725
Hatsalatladi	726
Metlojane	726
Gani	727
Mabalane	738
Mmakgori	741
Poloka	743
Gamabuo	744
Gachibana	746
Matlhako	752
Mmeya	752
Sesung	752
Hunhukwe	753
Kumaga	758
Qabo	762
Chobokwane	771
Muchinje/Mabele	773
Xhauga	777
New Xanagas	777
Bodibeng	778
Dumadumane	783
Mantshwabisi	786
Serinane	787
Gulubane	797
Kule	807
Pitsana-Potokwe	816
Khwawa	817
Leologane	823

Mohembo West	1770
Mosetse	1787
Mapoka	1789
Mosu	1792
Pandamatenga	1809
Tsootsha	1857
Mokubilo	1907
Zwenshambe	1943
Pitshane molopo	1945
Lehututu	1956
Ncojane	1958
Tsao	2000
Kauxwhi	2040
Maokane	2044
Nokaneng	2067
Tobane	2075
Khudumelapye	2080
Ditshegwane	2114
Kobojango	2138
Nshakashokwe	2168
Nswazwi	2185
Mabule	2260
Tshesebe	2277
Marapong	2283
Sepopa	2283
Ntlhantlhe	2342
Etsha 13	2377
Matsiloje	2380
Tsamaya	2387

Cluster 3 **Population of 5,001 to 10,000 inhabitants**	
Name of location	**Population**
Mathangwane	5075
Mmathethe	5078
Borolong (Nr Ftwn)	5184
Gweta	5304
Kumakwane	5545
Masunga	5666
Bokaa	5680
Oodi	5687

Robelela	829
Mmadikola	830
Dovedale	832
Mokgenene	835
Mogomotho	843
Magoriapitse	846
Groote Laagte	849
Mmutlana	854
Kalakamati	858
Mahotshwane	861
Moralane	866
Tloaneng	868
Sekhutlane	871
Gathwane	879
Kubung	881
Karakobis	891
Metlobo	891
Sorilatholo	897
Khuis	897
Parakarungu	899
Toteng	902
Omaweneno	917
Ngware	919
Oliphant's Drift	925
Shadishadi	928
Kokong	928
Mmanoko	932
Beetsha	941
Borotsi(tswapong)	942
Sekakangwe	946
Hebron	950
Lepokole	955
Motshegaletau	958
Mokhomba	959
Etsha 1	965
Mulambakwena	974
Shakwe	976
Ngarange	988
Keng	992
Damochojena	993
Phepheng/Draaihoek	994
Matlhakola	996
Maitengwe	5890
Kang	5992
Sefophe	6062
Good Hope	6362
Rakops	6396
Shakawe	6693
Nata	6714
Mmankgodi	6802
Lerala	6858
Letlhakeng	7229
Molapowabojang	7520
Otse(South East)	7661
Tati Siding	8112
Gumare	8532
Metsimotlhabe	8884
Tsabong	8945
Kasane	9084
Kopong	9312
Orapa	9538
Shoshong	9679

Cluster 4

Population > 10,000 inhabitants and population density < 1,500 inhab./km^2

Name of location	Population
Tutume	17528
Serowe	50820
Moshupa	20016
Thamaga	21471
Tonota	21031
Bobonong	19389
Mmadinare	12086
Mahalapye	46409
Mochudi	46914
Molepolole	66466
Kanye	47013
Mogoditshane	58079
Palapye	37256
Maun	60273

Cluster 6: main cities	
Name of location	**Population**
Gaborone	231626
Francistown	98963

Cluster 5 Population > 10,000 inhabitants and population density > 1,500 inhab./km²	
Name of location	**Population**
Gabane	15327
Letlhakane(Central)	22948
Jwaneng	18016
Ramotswa	28952
Lobatse	29007
Tlokweng	35326
Ghanzi	14809
Selibe Phikwe	49411
Mmopane	15450

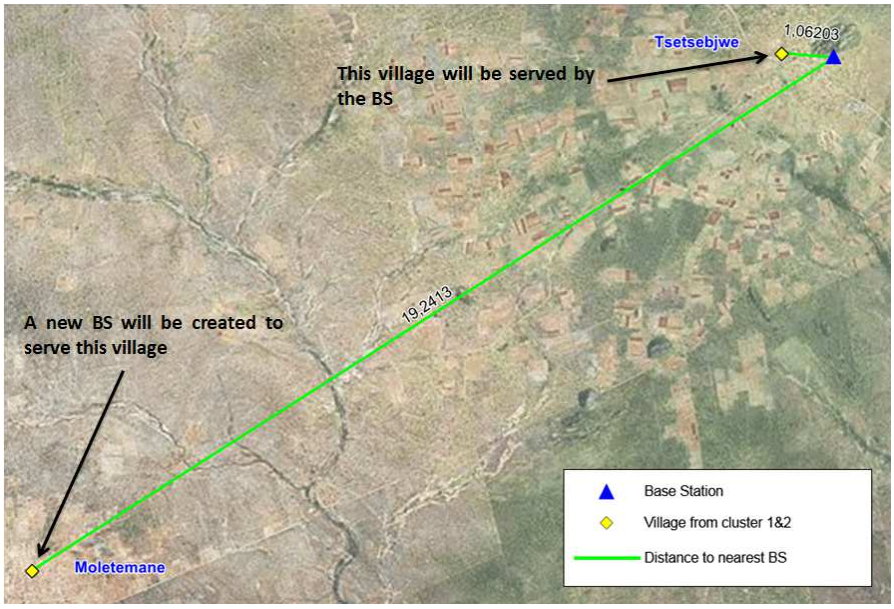
7.2 Wireless network model

7.2.1 Identification of access base station

This section describes the methodology to identify the location of base stations dedicated to serve the villages. The priority has been given to the reuse of existing 2G/3G sites.

For each village, represented by a geo-localized point, the nearest existing 2G/3G base station among all operators equipment was identified within a 7.5 km radius. This station is then considered as being the one to be used for the NGA network, and the model takes the incremental cost for upgrading the existing infrastructure to provide broadband services. When no base station exists within that range, a new site is created and the model includes also the cost of installing a new site. (incl. tower).

Figure 7-1: Selection of access base station



For more dense area the limiting factor is not the coverage range but the traffic to be carried by the station. The number of stations needed to cover an area is calculated considering that one station can be placed for an area with a population of 10,000 inhabitants. Sites have been selected within the database of existing 2G/3G sites. As explained above, the increase in the number of sites (BS densification) due to the increase of traffic over time is taken into account separately in the model.

7.2.2 Example of LTE coverage areas

The pictures hereafter illustrate the NGA base stations used in the cost model for urban and rural areas

Figure 7-2: Coverage of base stations in cluster 1 and 2

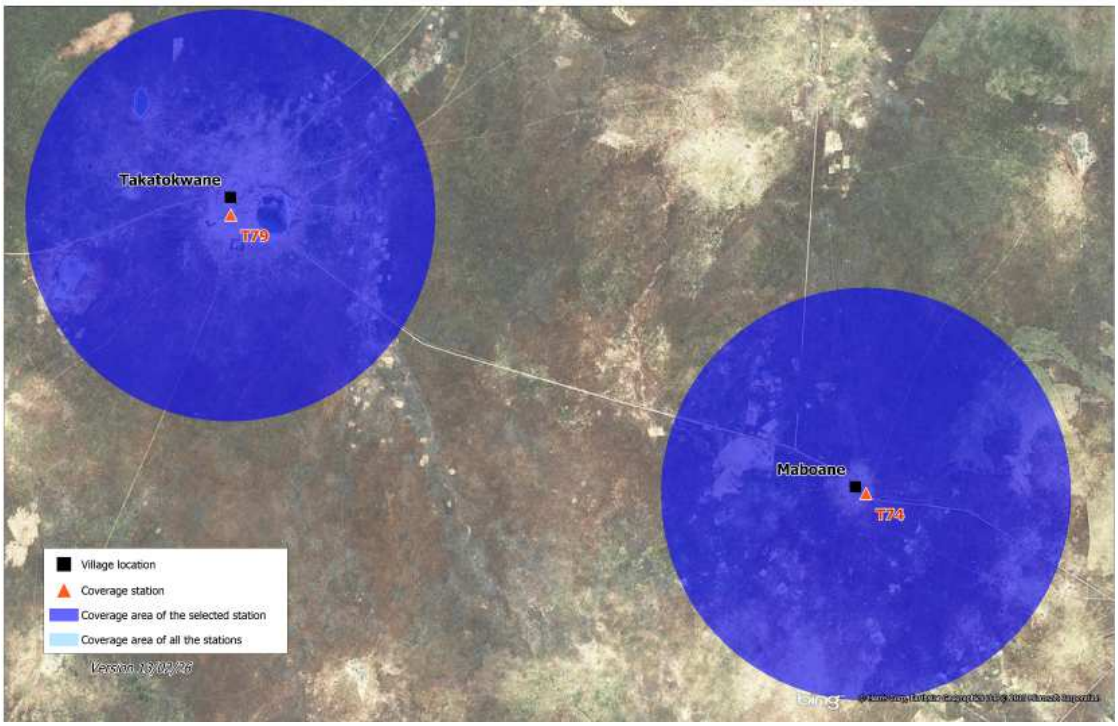


Figure 7-3: One BS covering many villages in cluster 1 and 2

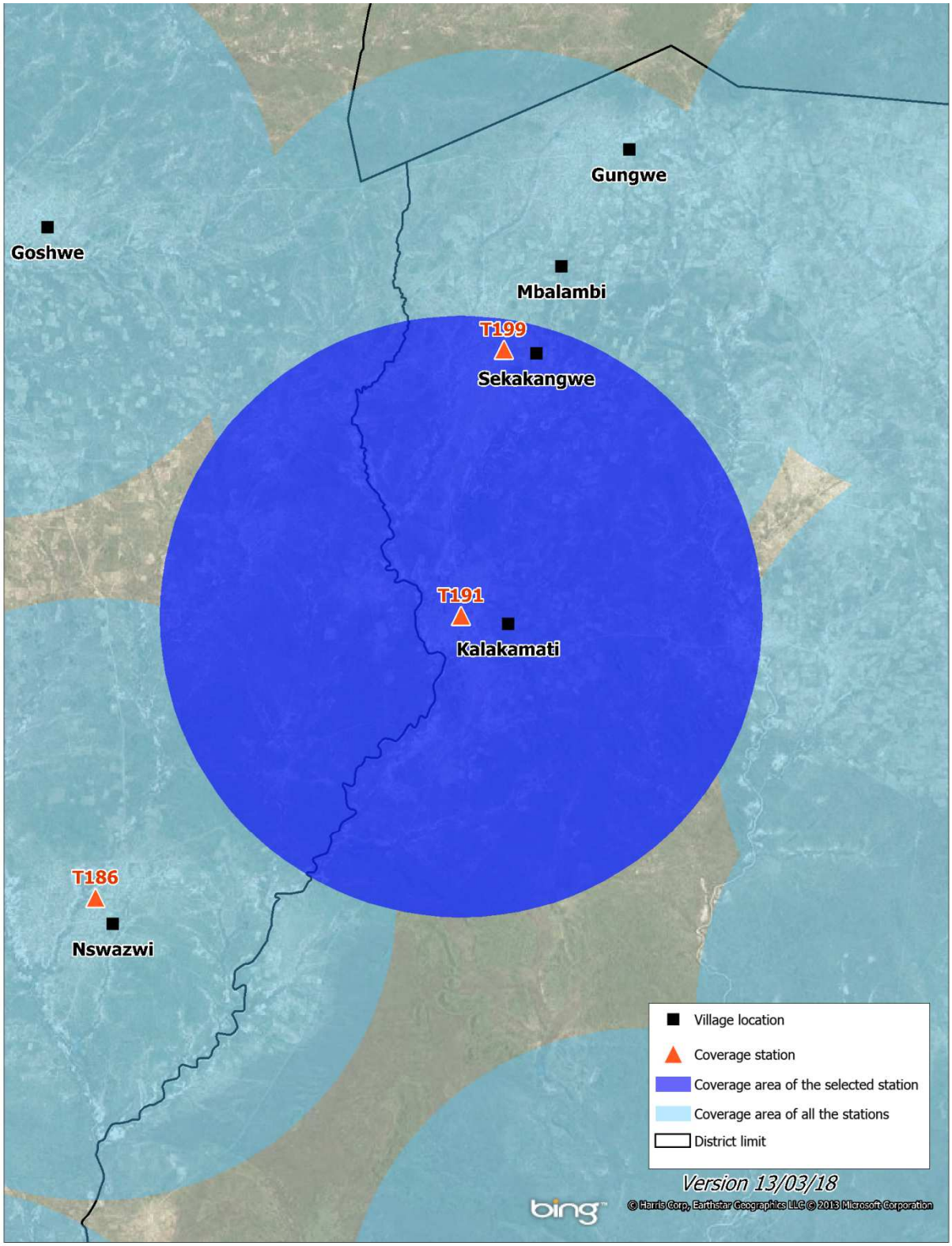


Figure 7-4: One BS covering a village (cluster 3)

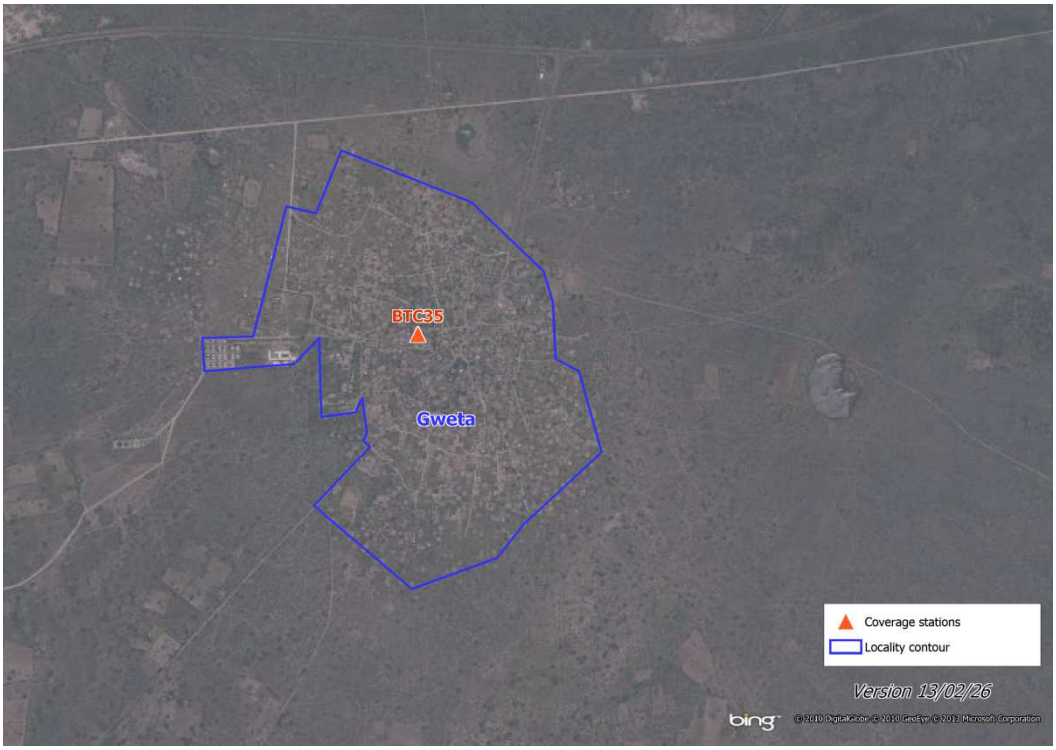
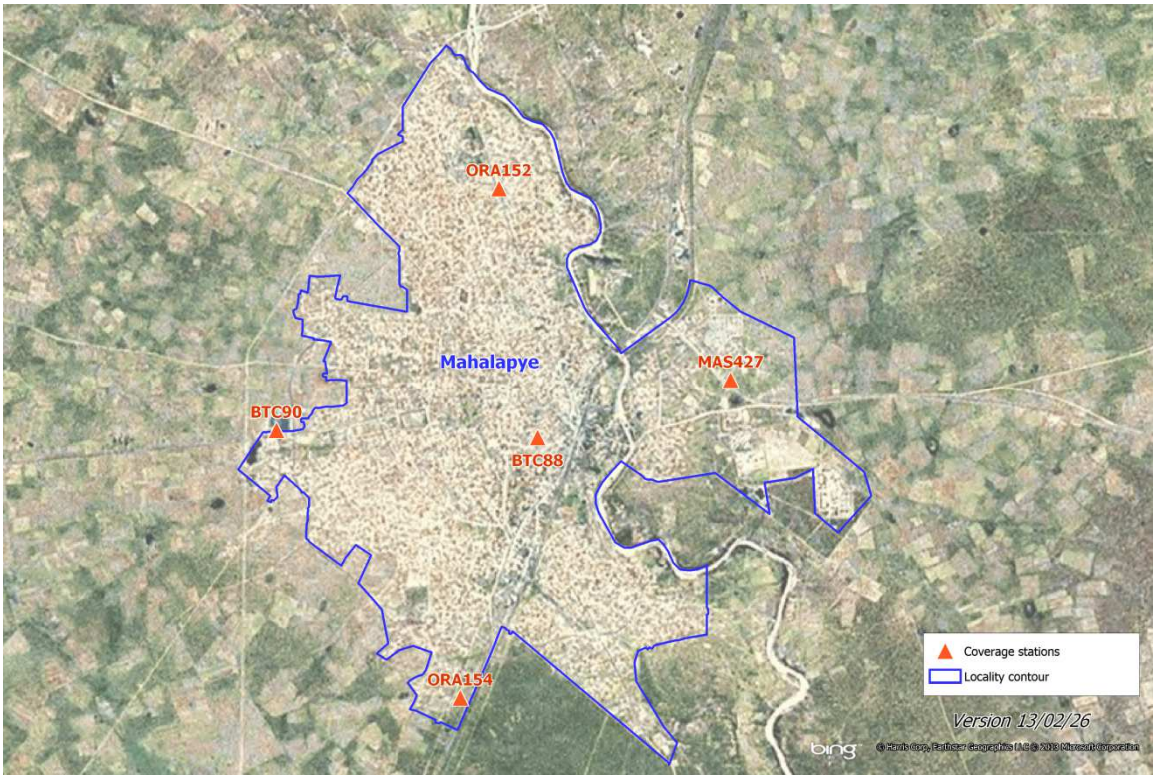


Figure 7-5: A large village covered by many BS (cluster 4)



7.2.3 Examples of LTE backhaul networks

The pictures hereafter illustrate the backbone and backhaul network used in the cost model.

Figure 7-6: Backbone / Backhaul Network

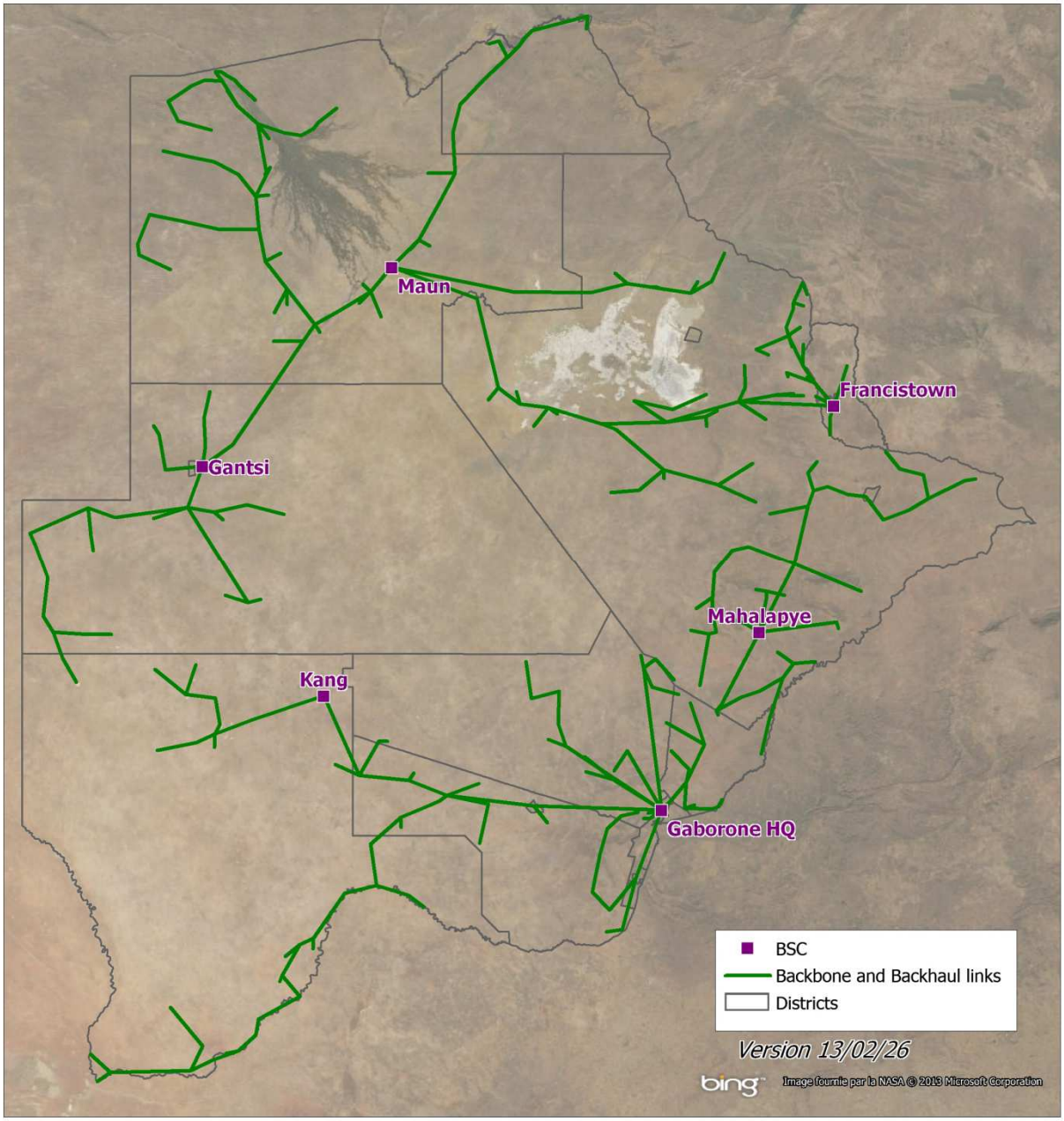
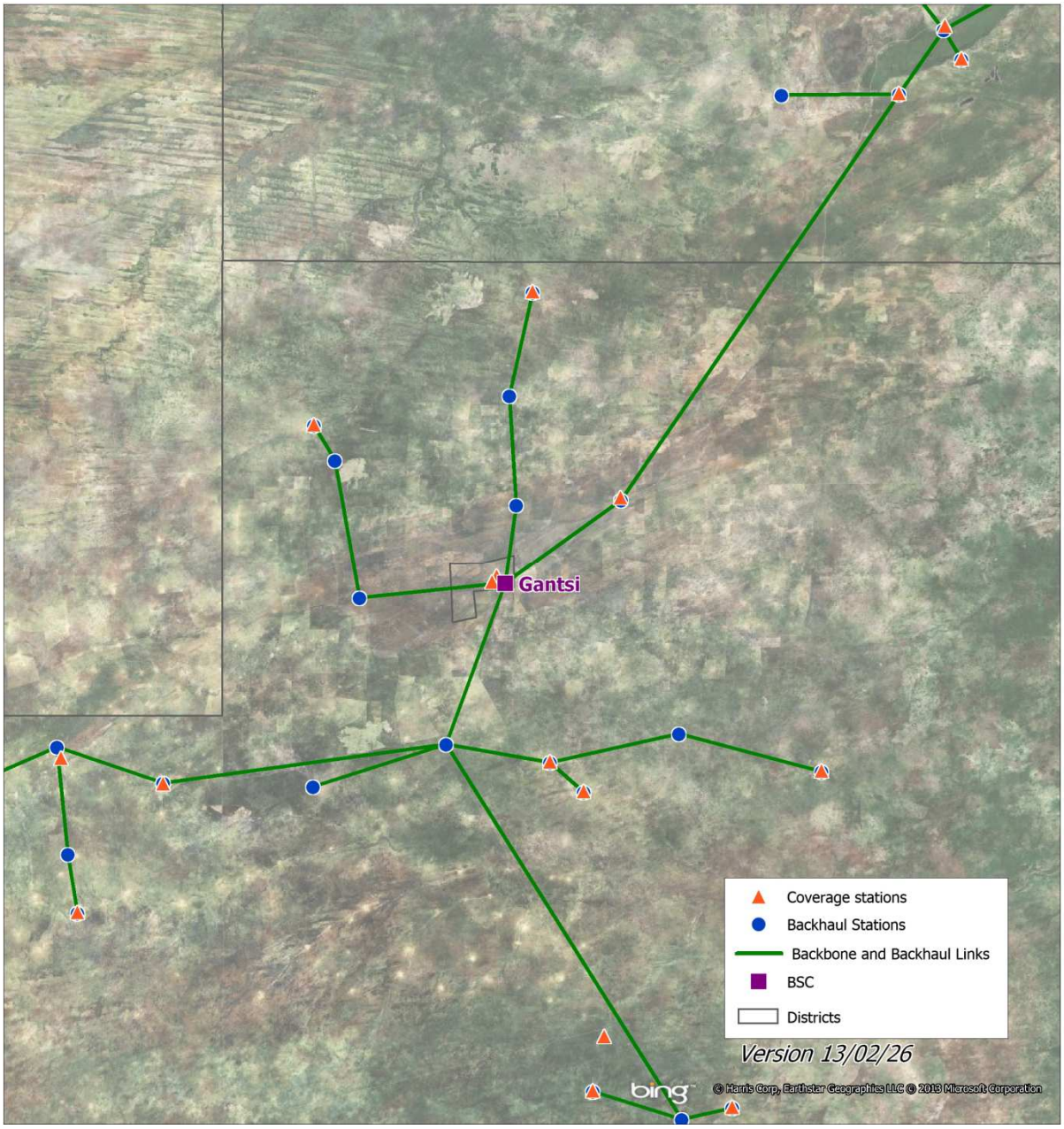


Figure 7-7: backhaul network detail around Gantsi



7.3 Market Model

7.3.1 International benchmarks for mobile data traffic

There are many market analyses and prospective studies which show that mobile data volume is currently increasing at a high pace and that this will continue for the coming years. Hereafter are listed some sources and results showing relevant trends for the data market.

Observed data show that mobile data traffic has been increasing exponentially in many European countries and in the US, with a 2 to 3-fold increase each year, with usage levels of 200 to 300 MB per inhabitant per month in 2010.

AT&T mobile data traffic has grown by 200% in 2009 (source: IDATE);

UK Mobile data traffic has grown by more than 200% in 2009 and 100% in 2010 (source: Ofcom);

European data traffic has grown with annual growth rate in the range of 150% to more than 400% in recent years, according to CEPT works, with monthly mobile data traffic reaching usage levels of 200 to 300 MB/Inhabitant in 2010 for the most advanced countries:

Table 7-1: Growth rate for mobile data traffic observed in 2010

	Duration (years)	MB/Month/ inhabitant	CAGR
Austria	4.3	223	158%
Finland	2.5	311	377%
Portugal	1.5	119	141%
Sweden	5.0	248	388%
Germany	4.0	34	253%
Ireland	0.9	148	267%
Denmark	2.5	139	408%
Iceland	1.0	59	299%
Estonia	2.9	31	46%

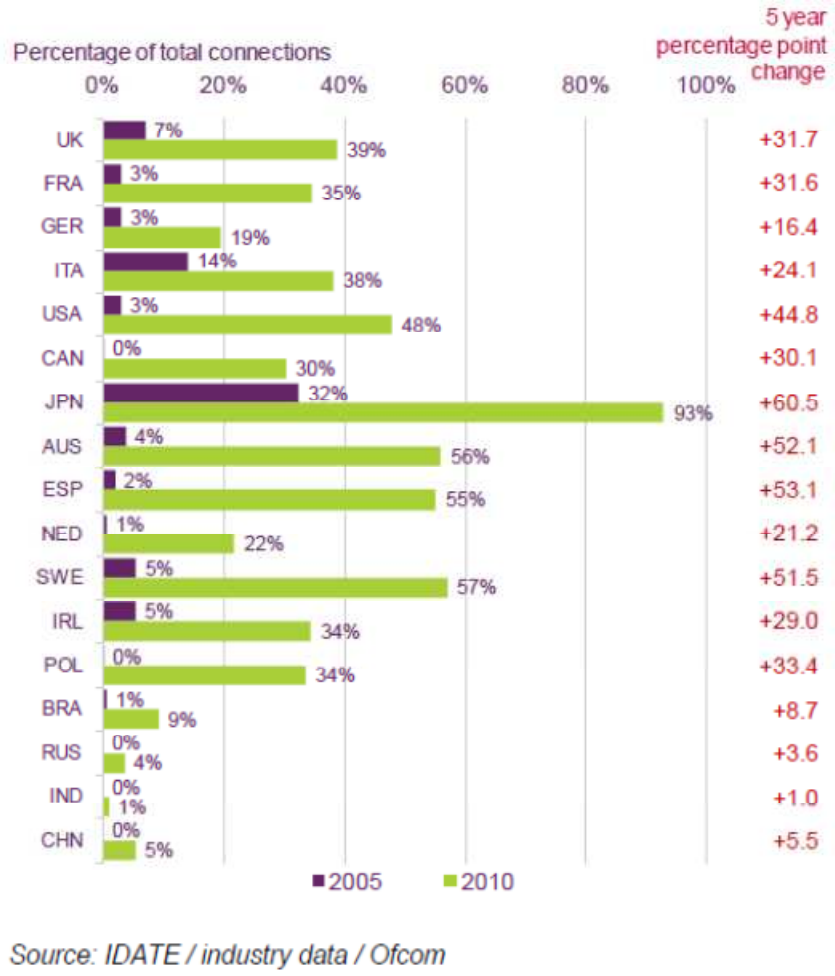
Source: CEPT ECC PT1 INTERNAL REPORT ON MOBILE BROADBAND LANDSCAPE, September 2011

Worldwide mobile data traffic grew 2.3-fold in 2011, more than doubling for the fourth year in a row, with a 2011 mobile data traffic growth which was higher than anticipated, according to Cisco studies (Cisco white paper on mobile data).

3G Penetration rate is currently at levels higher than 50% of mobile users in developed countries, though remaining at lower levels for Brazil, Russia, India and China (5% in 2010).

Ofcom data shows that 3G penetration rate (3G as a proportion of total mobile connections) was 43% on average in 2010, compared to 6% in 2005, whereas the average was only of 5% for BRIC (Brazil, Russia, India, China):

Figure 7-8: 3G as a proportion of total mobile connections, 2005 to 2010



Source: Ofcom, Communications Report, 2011

Moreover, IDATE study shows that the 3G subscribers are in the range of 60% to 100% in a selection of developed countries (Germany remaining at a level of 25%) (Source: UMTS Forum Report 44, Mobile Traffic forecasts 2010-2020, IDATE study for UMTS, January 2011).

The growth of mobile data traffic comes from the growth in the number of users and of individual usage, which has reached a level 1.5GB per month for the most advanced countries, with an average usage of 155 MB per month. Video usage is a major contributor to the growth.

Usage in Finland has increased by 68% in less than one year, reaching a level of 1460 MB/month in August 2012 for high end users (source: http://www.forbes.com/sites/terokuittinen/2012/10/15/as-iphone-mobile-data-usage-soars-voice-calls-dive/). The same observation was made in the UK and in Germany.

Average smartphone usage nearly tripled in 2011. The average amount of traffic per smartphone in 2011 was 150 MB per month, up from 55 MB per month in 2010 (Source: Cisco white paper).

One of the main factors for usage is now video, which represented more than 50% of the total traffic in 2011 (source: Cisco white paper).

Smartphones represent 82% of Mobile data traffic, but only 12% of handsets.

Smartphones represent only 12% of total global handsets in use today, but they represent over 82% of total global handset traffic. In 2011, the typical smartphone generated 35 times more mobile data traffic (150 MB per month) than the typical basic-feature cell phone (which generated only 4.3 MB per month of mobile data traffic) (Source: Cisco).

There were 175 million laptops on the mobile network in 2011, and each laptop generated 22 times more traffic than the average smartphone. Mobile data traffic per laptop was 2.1 GB per month, up 46% from 1.5 GB per month in 2010 (Source: Cisco).

Non-smartphone usage increased 2.3-fold to 4.3 MB per month in 2011, compared to 1.9 MB per month in 2010. Basic handsets still make up the vast majority of devices on the network (88%) (Source: Cisco).

Mobile data traffic should continue to increase in the coming years, as a result of the increase of the number of smartphones and of the usage per smartphone, which could reach a range of 2 to 3 GB per month in the years 2016-2018

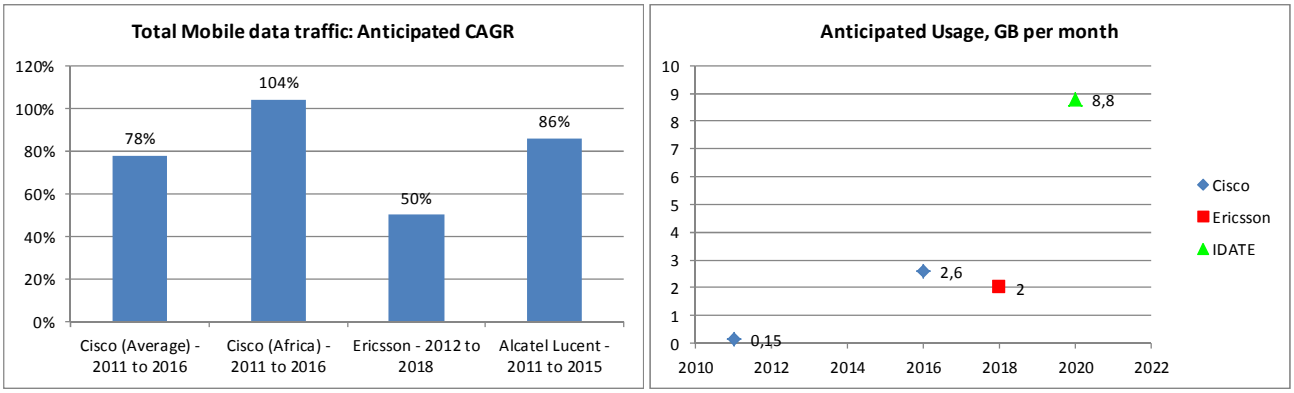
Cisco predicts that mobile data traffic will grow at a compound annual growth rate (CAGR) of 78% from 2011 to 2016 and that the strongest growth will take place in Middle East and Africa (CAGR: 104%). Two-thirds of the world's mobile data traffic will be video by 2016. The average smartphone will generate 2.6 GB of traffic per month in 2016, a 17-fold increase over the 2011 average of 150 MB per month. Aggregate smartphone traffic in 2016 will be 50 times greater than it is today, with a CAGR of 119% (Source: Cisco).

On the other hand, Ericsson predicted that mobile data traffic will grow at a compound annual growth rate of 50% between 2012 and 2018, creating a 12-fold increase by 2018. Smartphone usage will grow from 450 MB per month in 2012 to 2 GB in 2018, and mobile PC from 3 GB in 2012 to 10 GB in 2018 (Source: Ericsson Mobility Report, November 2012).

Alcatel Lucent predicts a 86% CAGR for mobile data growth between 2012 and 2015, corresponding to a 20-fold increase between 2010 and 2015 (Source: WWSMC July 27, 2011, Evolution of Mobility in Future Wireless Networks).

Finally, IDATE forecasts an average of 294 MB per day for smartphones in 2020, and 503 Mb per day for dongles, representing a monthly usage of 8.8 GB for smartphones and 15 GB for dongles, for a representative Western European country (Source: Idate, Mobile traffic forecasts 2010-2020 & offloading solutions, 15 May 2011).

Figure 7-9: Summary of mobile data forecasts



Mobile Usage will be driven mainly by video, which will represent 70% of the traffic in 2016

According to Cisco data, Mobile video will increase 25-fold between 2011 and 2016, accounting for over 70% of total mobile data traffic by the end of the forecast period (Source: Cisco).

Ericsson states also that the growth will be driven mainly by video.

In terms of applications, comScore research shows that the fastest growing applications in the US are social networking, News, Sport information, Bank Accounts and Weather.

Figure 7-10: Fastest growing content categories (USA)

Fastest-Growing Content Categories via Application Access
3 Month Avg. Ending Apr. 2010 vs. 3 Month Avg. Ending Apr. 2009
Total U.S. Age 13+
Source: comScore MobiLens

	Total Audience (000)		
Application Access Category	**Apr-2009**	**Apr-2010**	**% Change**
Total Audience: 13+ yrs old	232,000	234,000	1
Used application (except native games)	54,414	69,639	28
Social Networking	4,270	14,518	240
News	4,148	9,292	124
Sports Information	3,598	7,672	113
Bank Accounts	2,340	4,974	113
Weather	8,557	18,063	111
Movie Information	3,296	6,359	93
Maps	8,708	16,773	93
Online Retail	1,416	2,701	91
Photo or Video Sharing Service	3,131	5,950	90
Search	5,434	10,315	90

Fastest-Growing Content Categories via Browser Access
3 Month Avg. Ending Apr. 2010 vs. 3 Month Avg. Ending Apr. 2009
Total U.S. Age 13+
Source: comScore MobiLens

	Total Audience (000)		
Browser Access Category	**Apr-2009**	**Apr-2010**	**% Change**
Total Audience: 13+ yrs old	232,000	234,000	1
Used browser	55,503	72,872	31
Social Networking	15,708	29,835	90
Bank Accounts	7,801	13,154	69
General Reference	7,246	12,084	67
Sports Information	14,033	21,549	54
Search	23,266	34,912	50
Stock Trading	3,214	4,817	50
Online Retail	4,968	7,326	47
News	17,957	26,003	45
Movie Information	10,295	14,895	45
Classifieds	7,039	10,181	45

Source: comScore

Source: comScore data in UMTS Forum study

As Mobile traffic and usage grows, prices per MB are falling down, and mobile data ARPU should grow in a limited range: current prices will fall from 5 cents to 3 cents in North America in 2014, with ARPUs remaining in a 30 USD range.

Ofcom Data shows that whilst mobile data volumes has experienced a 163% CAGR between 2008 and 2010, revenues have only grown at a pace of 12%, meaning that the price per MB has decreased by 60% each year (Source: Ofcom Communications Report, 2011).

Alcatel Lucent studies on a North American Operator predict that data ARPU should remain at a level of 30 to 31 USD per month until 2014, corresponding to a huge decline in the revenue per MB (from around 16 cents in 2010 to 3 in 2014, with a CAGR of -33% between 2009 and 2014) (Source: Alcatel Lucent, The Declining Profitability Trend of Mobile Data: What can be done? Assessing Network Costs and Planning for Sustainable Revenue Growth).

In addition, IDATE study for UMTS Forum showed that current prices of 0.05 USD per MB are common among US operators.

7.3.2 Evolution of prices of mobile data in Botswana

The ARPU is calculated based on a distribution of users among level of usage, for a given mean, and priced at the lowest offer available in the market.

Then the model uses 3 sets of price evolution factors for each scenario:

Low usage (less than 100 MB per month)

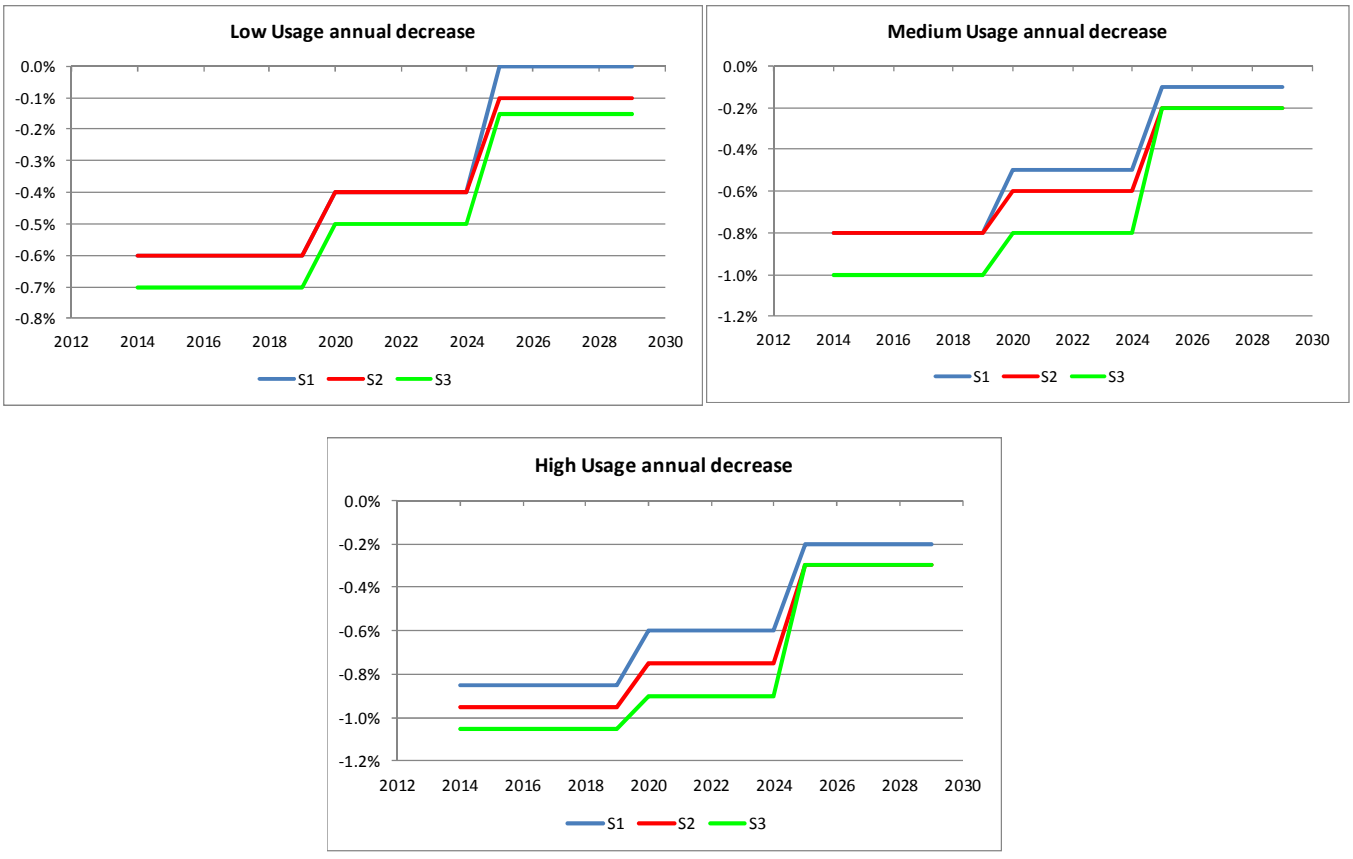
Medium usage (greater than 100 MB and less than 1000 MB per month)

High usage (greater than 1000 MB per month)

The main issue is to ensure that prospective prices are compatible with the budget and willingness to pay for the population targeted in each scenario.

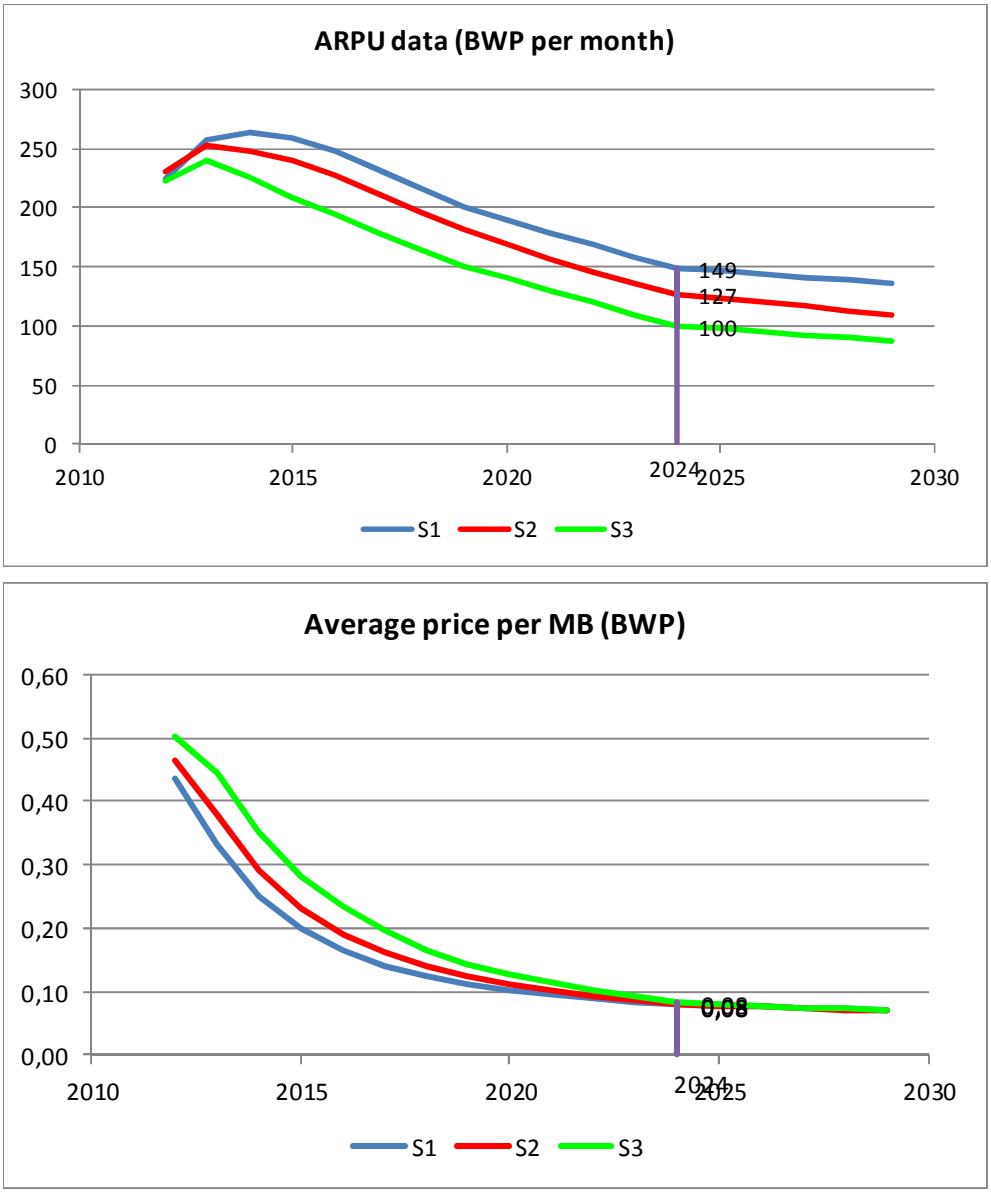
The evolution factors are shown in the following figure:

Figure 7-11: Evolution factors for data prices



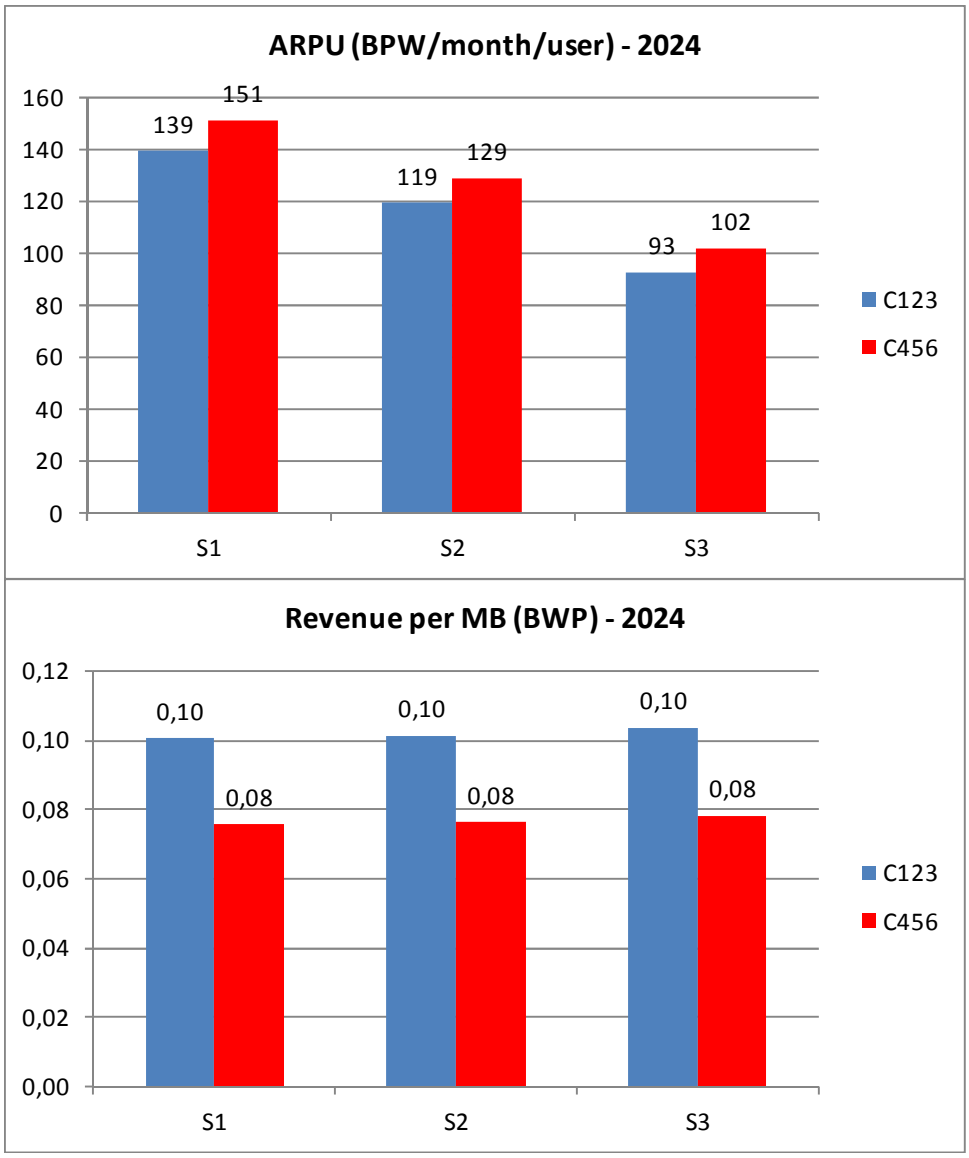
The evolution of ARPU and price per MB is represented below:

Figure 7-12: Evolution of ARPUs and prices per MB



The differentiation between urban and rural areas is illustrated below:

Figure 7-13: ARPU and Average Revenue per MB, 2024



7.3.3 Detailed results of the market model

The first output of the model is the CAPEX for each operator and for each scenario. For purpose of showing the impact of covering clusters 1 to 3, the figures have been separated for the 2 types of areas.

Table 7-2: Cumulated CAPEX 2014-2024 (MBWP)

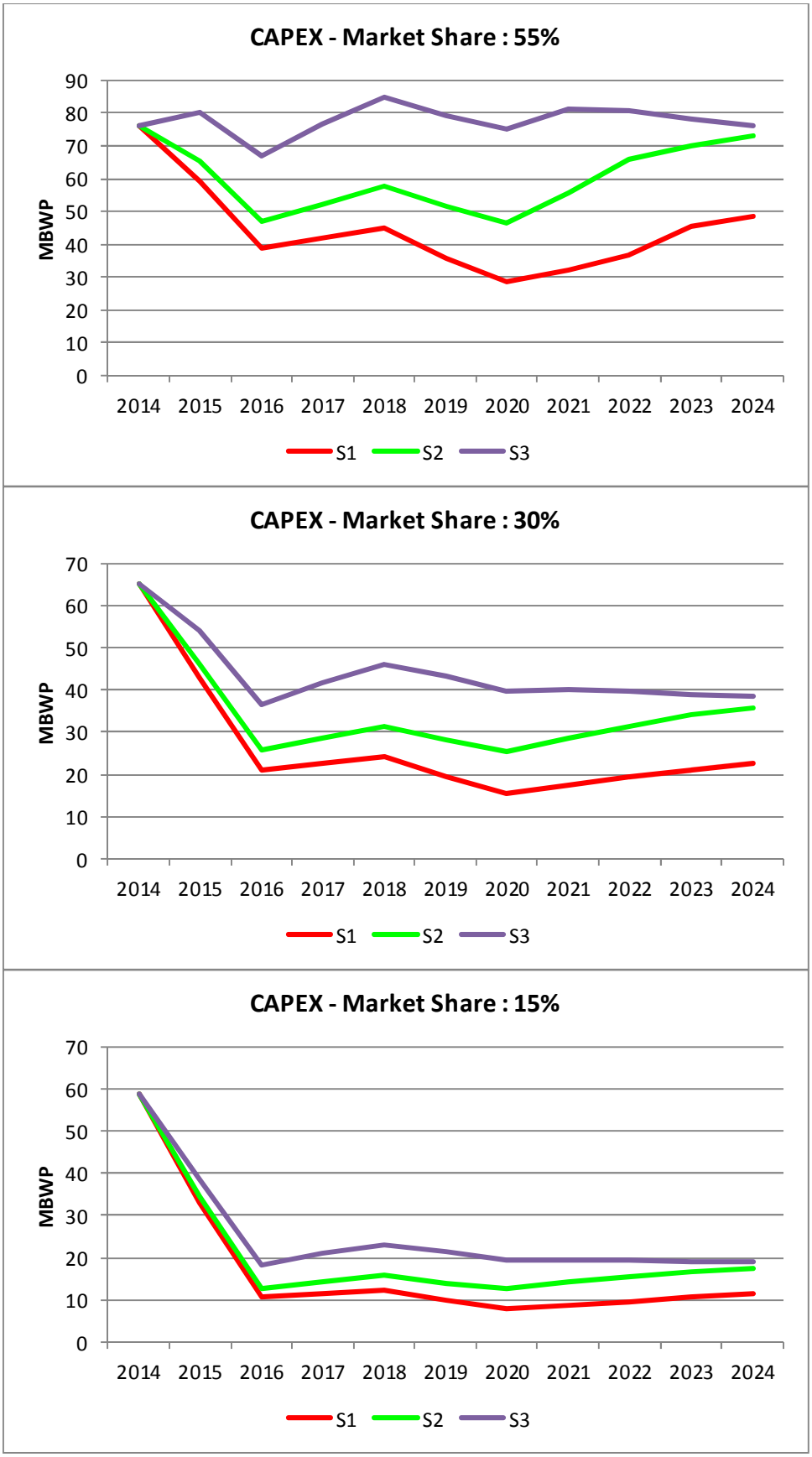
Total clusters 1 to 3	MBWP
Scenario 1	292
Scenario 2	374
Scenario 3	430

Scenario 1	C456	C123	Total
Operator 1 - Market Share: 30%	182	88	270
Operator 2 - Market Share: 55%	279	161	439
Operator 3 - Market Share: 15%	129	44	173

Scenario 2	C456	C123	Total
Operator 1 - Market Share: 30%	232	112	344
Operator 2 - Market Share: 55%	382	206	588
Operator 3 - Market Share: 15%	153	56	210

Scenario 3	C456	C123	Total
Operator 1 - Market Share: 30%	317	129	446
Operator 2 - Market Share: 55%	542	236	778
Operator 3 - Market Share: 15%	194	64	259

Figure 7-14: CAPEX per year

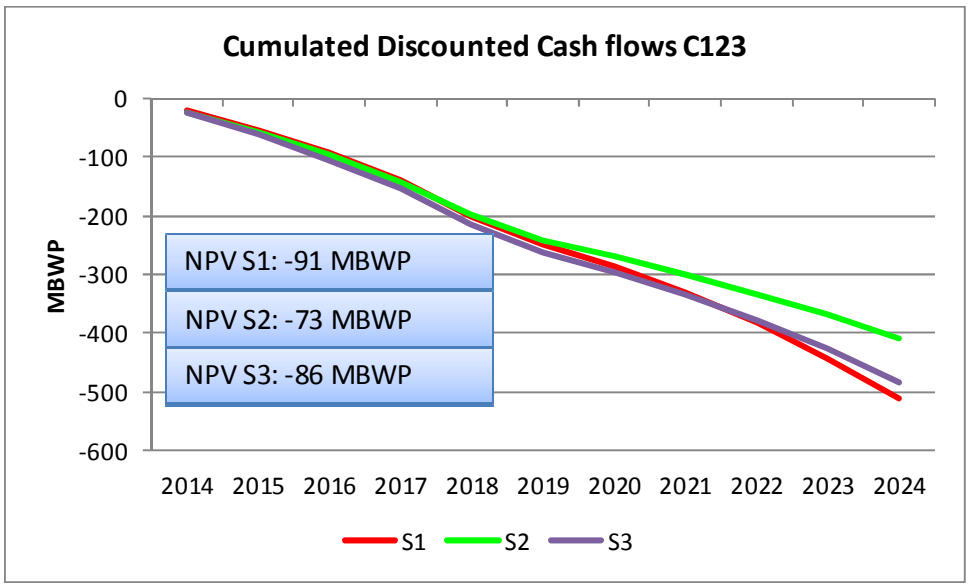


The CAPEX is high in the 2 first years as a result of the initial investment for covering clusters 4 to 6. Additional investment in the next years represents the coverage of clusters 1 to 3 and investment for capacity (densification) increase of the network in clusters 4 to 6.

In a second step, the model calculates the cash-flows for each operator. We present hereafter the cumulated discounted cash-flows for the various situations (with a discounted rate taken at a high level of 17%).

The first result is that in any case, there is no economic potentiality for covering clusters 1 to 3, even if taken as incremental (with only incremental costs for core network):

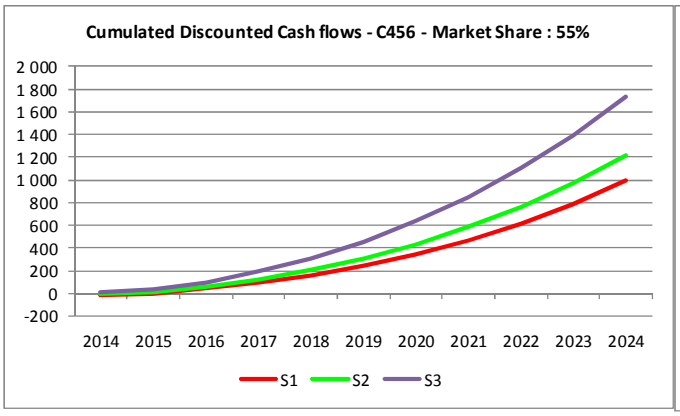
Figure 7-15: Cumulated Discounted Cash-Flows for clusters 1 to 3

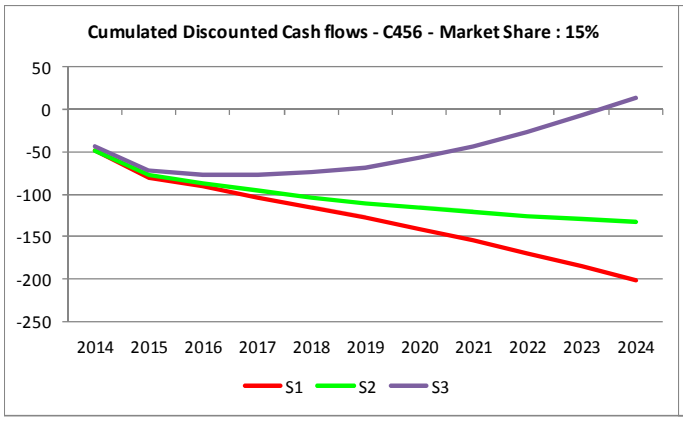


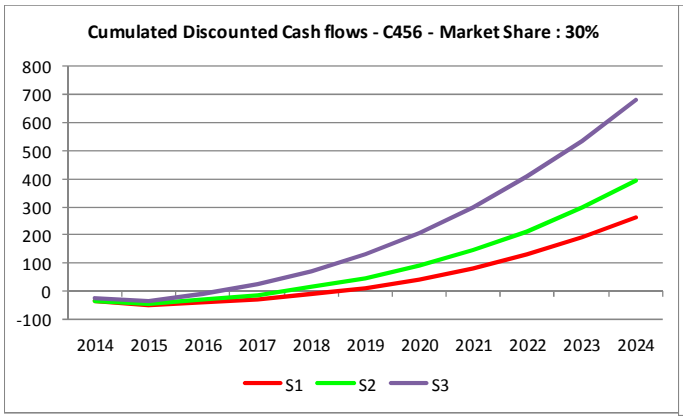
The model shows that the operational margin is positive (revenues minus operating costs), but the capital costs are never covered.

Figure 7-16: Cumulated Discounted Cash-Flows for clusters 4 to 6 and 1 to 6

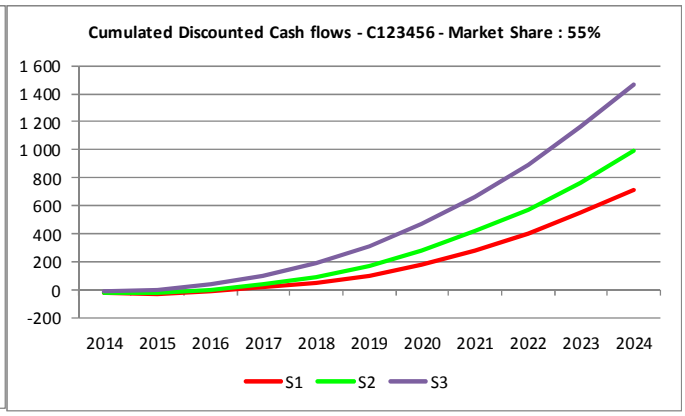
Clusters 4 to 6

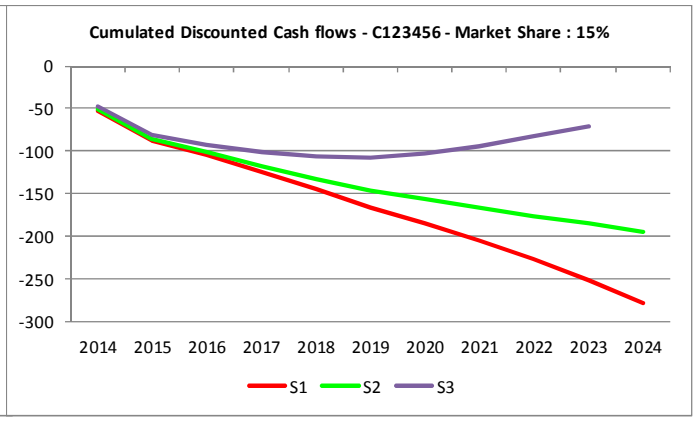






Clusters 1 to 6





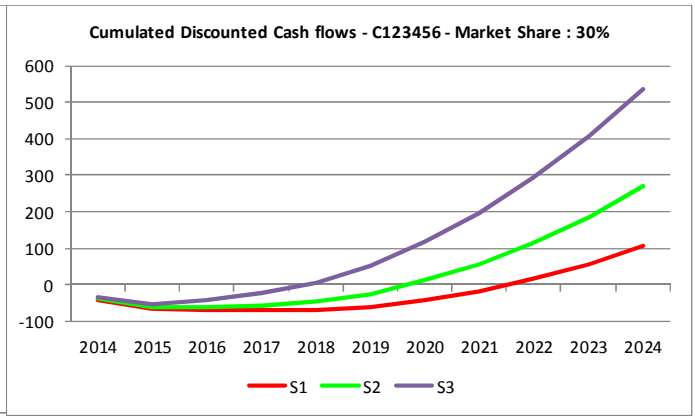


Table 7-3: Impact on NPV (Net Present Value) (MBWP), and Pay-back

Net Present Value (MBWP)

Operator 1 - Market Share: 30%	C456	Total	Impact of C123
S1	46.5	19.2	-27.3
S2	69.9	48.0	-21.9
S3	120.9	95.2	-25.7
Operator 2 - Market Share: 55%	**C456**	**Total**	**Impact of C123**
S1	177.5	127.4	-50.1
S2	216.7	176.6	-40.1
S3	307.4	260.2	-47.2
Operator 3 - Market Share: 15%	**C456**	**Total**	**Impact of C123**
S1	-35.8	-49.5	-13.7
S2	-23.6	-34.5	-10.9
S3	2.5	-10.3	-12.9

Pay-Back

Operator 1 - Market Share: 30%	C456	Total
S1	2019	2022
S2	2018	2020
S3	2017	2018
Operator 2 - Market Share: 55%	**C456**	**Total**
S1	2015	2017
S2	2015	2016
S3	2014	2016
Operator 3 - Market Share: 15%	**C456**	**Total**
S1	NA	NA
S2	NA	NA
S3	2024	2027

Values for clusters 12 / 3456

Table 7-4: Cumulated CAPEX 2014-2024 (MBWP)

Total clusters 1 to 2	MBWP
Scenario 1	263
Scenario 2	322
Scenario 3	364

Scenario 1	C3456	C12	Total
Operator 1 - Market Share: 30%	202	79	281
Operator 2 - Market Share: 55%	294	145	438
Operator 3 - Market Share: 15%	146	39	186

Scenario 2	C3456	C12	Total
Operator 1 - Market Share: 30%	259	97	355
Operator 2 - Market Share: 55%	411	177	588
Operator 3 - Market Share: 15%	174	48	223

Scenario 3	C3456	C12	Total
Operator 1 - Market Share: 30%	347	109	457
Operator 2 - Market Share: 55%	578	200	779
Operator 3 - Market Share: 15%	217	55	272

Figure 7-17: Cumulated Discounted Cash-Flows for clusters 1 to 2

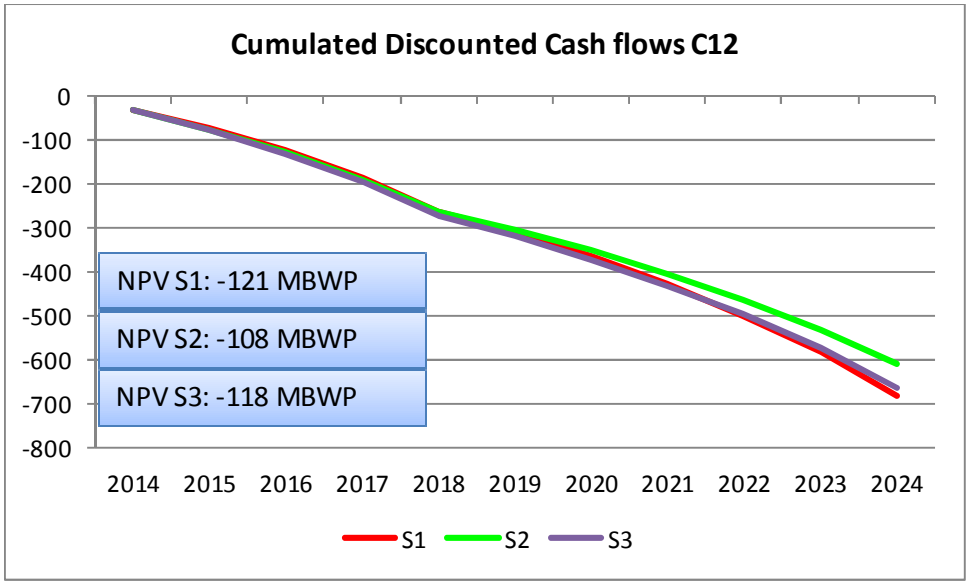
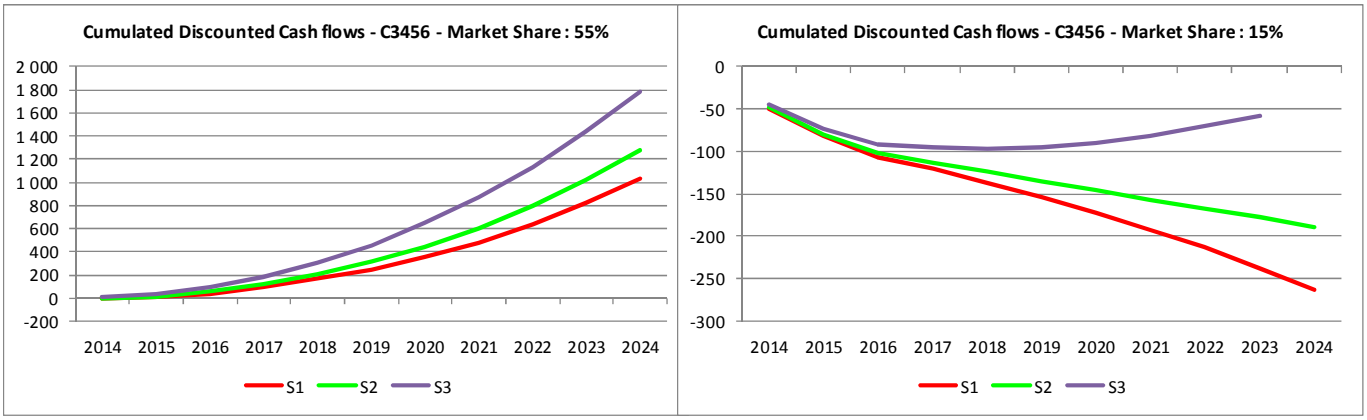


Figure 7-18: Cumulated Discounted Cash-Flows for clusters 3 to 6



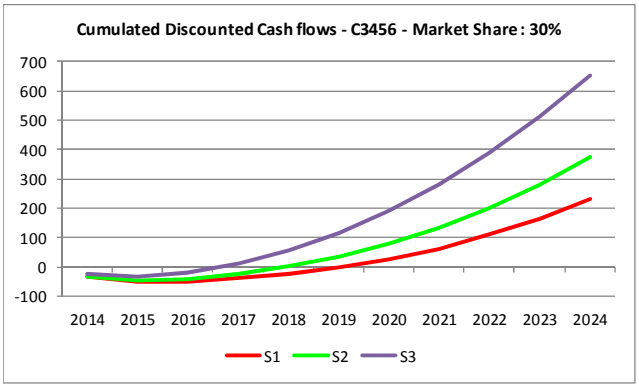


Table 7-5: Impact on NPV (Net Present Value) (MBWP), and Pay-back

Net Present Value (MBWP)

Operator 1 - Market Share: 30%	C3456	Total	Impact of C12
S1	41.2	4.9	-36.3
S2	66.7	34.2	-32.5
S3	116.4	81.1	-35.3

Operator 2 - Market Share: 55%	C3456	Total	Impact of C12
S1	183.9	117.3	-66.6
S2	226.7	167.1	-59.6
S3	316.2	251.5	-64.7

Operator 3 - Market Share: 15%	C3456	Total	Impact of C12
S1	-46.9	-65.1	-18.2
S2	-33.7	-49.9	-16.3
S3	-8.3	-26.0	-17.6

Pay-Back

Operator 1 - Market Share: 30%	C3456	Total
S1	2020	2024
S2	2018	2021
S3	2017	2019

Operator 2 - Market Share: 55%	C3456	Total
S1	2015	2018
S2	2015	2017
S3	2014	2016

Operator 3 - Market Share: 15%	C3456	Total
S1	NA	NA
S2	NA	NA
S3	2027	NA