INTERCONNECT COMMUNICATIONS

Development of Cost Models and Pricing Framework for ICT Services in Botswana

Interim Report

Version 1

BOCRA

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INTERCONNECT COMMUNICATIONS
Consulting in Communications Regulation and Strategy

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Contents

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1. Introduction and Objectives

BOCRA has engaged InterConnect Communications Ltd (ICC) to develop a cost model and pricing framework for ICT services in Botswana for both wholesale services and retail services for the four main public operators, BTCL, Mascom, Orange and BOFINET, taking into account technological advancement such as convergence of technologies and next generation access networks, e.g. 4G and LTE networks and services. The main objectives of the project, as set out in the Terms of Reference are to:

1. Develop Cost Models and a Pricing Framework that is relevant for use now and in the future to calculate the cost of providing wholesale and retail services for mobile, fixed and internet services. The results of the model will be analysed and provide appropriate outputs for implementation. In developing the model all assumptions applied must be indicated;
2. Study the existing ICT services to develop appropriate cost model and appropriate pricing principles that are suitable to the Botswana market;
3. Review the recommendations of the previous studies in relation to pricing and costing and take appropriate action;
4. Develop Accounting Separation Guidelines and associated instruments that shall facilitate successful implementation of Accounting Separation where applicable; and
5. Provide training and transfer of skills to BOCRA staff on the cost modelling and pricing framework for the telecommunications/ICT services.

This document, the Interim Report, is the second deliverable of the project and presents the initial work which has been carried out regarding the services which are provided in Botswana and presents the initial recommendations as to how the activities within the project will be undertaken.

This report will be used to consult with industry and other interested parties as to how the different strands within the project will be addressed. These are:

- The range of wholesale and retail services which will be included within the project;
- General cost modelling issues;
- The approach to cost modelling which will be adopted in mobile networks;
- The approach to cost modelling which will be adopted in fixed networks;
- The approach to determining appropriate Weighted Average cost of Capital (WACC);
- The approach which will be adopted to developing Accounting Separation (AS) principles and guidelines;
- The approach which will be adopted to developing a framework for the introduction of Mobile Virtual Network Operators (MVNO);

- The approach which will be adopted to recommend how inbound international voice traffic which transits between operators should be tariffed;
- The approach which will be adopted to recommending an appropriate relationship between mobile retail on-net and off-net voice call tariffs;
- The approach which will be adopted to benchmarking of relevant wholesale and retail services.

A public workshop will be presented on Tuesday 22nd March 2016 at which the proposals in this document will be presented and at which questions can be asked. Following this public workshop, written responses to the consultation questions will be invited from interested parties.

2. Format and Purpose of Document

This document is presented in a series of sections dealing with the topics identified above. The consultant's proposed approach to each area of the project is presented together with a series of questions to seek the views of interested parties regarding the proposals. A summary of the questions is included in Annex A.

Stakeholders are expected to present their views on the proposals within this document during the public workshop on Tuesday 22nd March 2016. This will enable other stakeholders to understand their position.

All presentations must be followed up by a written submission to BOCRA by Tuesday 5th April 2016.

3. Wholesale and Retail Services Costing and Pricing Framework

BOCRA has responsibility for the regulation of all telecommunications services in Botswana. BOCRA therefore needs information regarding the costs of services in order to be fully effective when setting or approving tariffs for services. Regulation of tariffs in the telecommunications industry is usually based on the identification of markets and assessment of the level of competition within them, including consideration of services which could be realistically considered as substitutable, i.e. used as a realistic alternative. Remedies are imposed where an appropriate level of competition is not found. The remedies can be both ex ante or ex post and often include control of tariffs in some form.

The extent and nature of any costing and pricing framework largely depends on the existing and, perhaps more importantly, prospective level of competition for the services in question. Well-designed frameworks for costing and pricing are set for a period of three to five years, as the level of competition for services can change materially over such a timeframe. Levels of competition would therefore normally be reviewed over such a cycle which is the case in Botswana. Where services are deemed competitive, the market for those services should drive the decisions on prices made by the service providers. Where competition does not exist, and is not likely to evolve within the timeframe of the regulatory review, price control may be applied. Where services have the prospect of becoming competitive over the period of the review, an alternative level of price control may be appropriate. Where new services are introduced, it is often the case that no regulatory intervention on prices is made, in order to encourage innovation in service provision.

Decisions made within a costing and pricing framework also include the method by which prices will be determined. Differing costing methodologies exist and where cost-orientation of rates has been deemed inappropriate, a retail minus approach may be suggested, where existing retail prices are discounted by a percentage to reflect the cost base of the wholesale provision of a service. Each methodology will have its own set of input data and assumptions used to determine the regulated price. Once a price has been determined, its implementation may also be regulated. One example of this is the use of a glide path, whereby a proposed rate which differs considerably from the current price can be introduced over time to lessen the impact on the operator's revenues if this is considered appropriate.

The nature of the level of competition for services in Botswana has changed since the last review of the costing and pricing framework in 2010. Bofinet has been created, leading to competition in some wholesale fixed services and the introduction of new services such as FTTx. Increasing demand for mobile voice and data services and the recent deployment of 4G has had an impact on existing fixed network services and is likely to affect them further in the future.

The current review of the costing and pricing framework includes the following service types:

- Fixed voice termination;

- Mobile voice termination;
- Fixed broadband services;
- Mobile/Wireless broadband services;
- Wholesale Leased Lines;
- Wholesale International services;
- Dark Fibre and WDM services;
- Wholesale Access Services.

We discuss below proposals for the costing and pricing framework most appropriate for each service type.

Fixed Voice Termination

The framework for the regulation of the fixed voice termination service is well developed. It is recognised that the terminating fixed network operator has a monopoly on the termination of calls onto its network and therefore the rates charged to other operators to terminate those calls should be regulated and prices based upon relevant costs.

The previous costing and pricing review in 2010 calculated the cost of fixed termination using a bottom-up average LRIC model including a mark-up for common costs. It is proposed that this methodology continue within the new model to be developed in 2016. No glide path was considered necessary in 2010 and this potential approach will be reviewed again once the cost based rate for this service has been calculated.

Mobile Voice Termination

As for the fixed termination service, the regulation of the rate for termination of calls on a mobile network is also well developed.

The previous costing and pricing review in 2010 calculated the cost of mobile termination using a bottom-up average LRIC model including a mark-up for common costs. It is proposed that this methodology continue within the new model which will be developed in 2016. The approach to this modelling is discussed further in Section 8 below.

A glide path was recommended in the 2010 review and this potential approach will be reviewed again once the cost based rate for this service has been calculated.

Broadband Services at a Fixed Location

Wholesale broadband services at a fixed location are provided by BTCL through its wholesale business unit using ADSL technology.

It is proposed to apply cost based regulation to this service as there is no competition and therefore such an obligation would be appropriate. This service will be costed

within the fixed access cost model to provide a cost oriented rate which could be offered to other service providers on a wholesale basis.

Mobile operators also provide a retail broadband service to customers at a fixed location using wireless technology.

Mobile/Wireless Broadband Services

All three mobile operators provide data services to their retail customers through both handsets and other mobile devices. As such this service has a reasonable level of competitive supply. The prices for these services will be benchmarked as described in the following sections of this report. The results of the benchmarking analysis will inform as to whether any price regulation is required for these services.

Wholesale Leased Lines

The previous costing and pricing framework review in 2010 calculated the cost of leased lines and applied a global discount to the retail prices to reflect that the overall level of retail prices were above costs.

It is proposed to calculate the costs of leased lines, including alternative technological implementations of leased lines such as Metro Ethernet, within the fixed cost models. At the time of the 2010 review, there was no competition to BTCL in the provision of leased lines. Now Bofinet is also in that market, providing wholesale leased lines at similar and different speeds with a different service structure.

Consideration will be given to the structure of the prices and whether any glide path is needed once the costs of the services have been calculated.

Wholesale International Services

The 2010 review stated that there was concern at the level of the cost of international connectivity in Botswana and one recommendation of the review was to impose price control on the national leg of the international half circuits, which were then priced at a 40% premium over national leased lines.

It is proposed to benchmark the prices for international connectivity as described in the benchmarking sections below. In addition the cost of a range of IPLCs will be included in the fixed network cost model.

Dark Fibre and WDM services

Dark Fibre services are usually provided on a commercial basis and their prices are not usually subject to regulatory intervention.

InterConnect does not recommend that prices for any dark fibre services which may be offered in the future are subject to price regulation with the exception of non-discrimination obligations.

Wavelength Division Multiplexing (WDM) is a technology for high-speed optical fibre data transmission by which high speed leased lines can be offered to wholesale or retail customers. This is not, therefore, a distinct service as such, but an enabling technology for high speed leased lines and other services. The cost of the technology will be included in the fixed network cost model and applied to the services which use it.

Wholesale Access Services

The services under consideration in this category are:

- IP Transit
- FTTx and
- Wi-Fi Access

National and International IP transit/backbone services are currently provided by Bofinet and BTCL whereas only Bofinet provides Wi-Fi access and fibre access. These are relatively new services, where current and future demand and competition may be uncertain. As a result, a lighter touch regulatory approach to the price control of these services may be more appropriate.

The IP Transit and FTTx services will be included in the fixed costing model and the costs of providing these services will be identified. We will separately cost the additional activities involved in providing wholesale Wi-Fi Access using inputs from the main cost models as appropriate. The recommended level and structure of the prices will therefore be informed by the outputs from the cost model and the benchmarking analysis.

The outcome of the benchmarking analysis[1] will confirm the relative level of the existing prices which will in turn assist in a decision as to the most appropriate price regulation methodology. Having calculated the costs it would be possible to determine either a cost-plus price or a retail-minus price structure for these services.

Question 1: Do respondents agree with the proposed approach to regulatory price control proposed in this section? Please justify your response.

Question 2: Are there other services which should be included in the service types described in this section? If yes, please provide details of the services and your justification of why they should be included?

[1] It is unlikely that benchmark data will be available for Wi-Fi service costs as such services are generally unregulated in other countries.

4. Services to be included in benchmarking for the Costing and Pricing Framework

The services listed below are those which InterConnect proposes to include in the benchmarking analysis. BTCL, Mascom and Orange offer a considerable number of retail and, to a lesser extent, wholesale services. Bofinet is only licensed to provide wholesale services. The Scope of Work within the RFP for this project categorised a number of service types whose prices should be benchmarked, namely:

- Wholesale Leased Lines;
- Wholesale National Termination Rates for both mobile and fixed;
- Wholesale Dark Fibre/Wavelength Division Multiplexing Services;
- Wholesale Broadband Services (Wireless and Fixed);
- Wholesale International Services;
- Wholesale Access Services.

InterConnect recognises that all the service types listed above are classed as "wholesale". InterConnect's understanding of wholesale is where one licensed operator offers services to another licensed operator, who then uses these services or facilities to provide services to its own retail customers. This is an internationally recognised interpretation within communications regulation, but an alternative one is the use of wholesale to mean the offering of a bulk discount to essentially large retail customers. The price lists for some of the operators may imply that the latter interpretation is being used in some cases in Botswana which indicates the need for some clarification on this point.

It may be the case that in Botswana, not all the above service types are provided on a wholesale (carrier to carrier) basis at present, particularly by the mobile operators. As a result InterConnect intends to include both retail and wholesale (carrier to carrier) prices, where appropriate, within the benchmark analysis.

InterConnect has requested more information on the nature of the services offered by the operators, including the number of customers who currently take each service. This information in particular will assist InterConnect in selecting services to benchmark which are taken by a significant number of customers, rather than benchmarking prices for services which very few customers take up. Once this information has been provided to InterConnect, the services shown below may be modified to take into account their popularity, whereby some may be removed from the list and others added.

Issues relating to the benchmarking of prices for these service types are described in the sections below.

Wholesale Leased Lines (including Metro Ethernet)

The Scope of Work limits the analysis of Wholesale Leased Lines to those national leased lines within Botswana only. IPLCs will be considered as part of the Wholesale International Services analysis.

InterConnect has included Metro Ethernet services under the heading of Wholesale Leased Lines as we consider that they provide a similar service to leased lines using Ethernet technology.

Leased Lines

The operators offer leased lines at a variety of speeds and, in order to give boundaries to the benchmarking exercise, InterConnect proposes to compare prices for the following leased lines types, covering a range of speeds:

- 128kbits/s
- 2Mbit/s
- 45 Mbit/s
- STM-1
- STM-4

The distance criteria differ slightly between operators (BTCL and Mascom align with the bands 0-50km, 51-200km, 201-400km, >400km, whereas Bofinet has <250km and >250km bands). As a result, InterConnect will benchmark leased line prices which are covered by the 51-200km and 201-400km bands.

Metro Ethernet

InterConnect will benchmark the prices for the following categories of Metro Ethernet service:

- 2Mbit/s
- 45Mbit/s
- 155Mbit/s
- 622Mbit/s
- 1Gbit/s
- 10Gbit/s

For both types of leased lines, operators quote different pricing for contract lengths and whether or not protection is provided. InterConnect proposes to benchmark prices for the shortest contract period available (which may be “no contract” or for one year) and for prices which do not include protection. This approach allows the most straightforward benchmarking process as operators in different countries may not offer a range of contract lengths but are most likely to have a no contract or one year option. Similarly, the interpretation of what constitutes protection may differ from country to

country (if it is even offered as an option in some places), so the simplest and most consistent benchmarking approach would be one which did not include the prices for a protection option.

IP Transit/Backbone Services

InterConnect will benchmark the prices for the following categories of IP transit/backbone service, using those with the shortest (or no) contract period:

- 10Mbit/s
- 100Mbit/s
- 620Mbit/s
- 1Gbit/s

Wholesale National Termination Rates for both Mobile and Fixed

The definition of these services is well understood and therefore the benchmarking should be straightforward.

InterConnect understands that the fixed termination rate is not deaveraged by switching stage (i.e., local, single tandem, double tandem) and the benchmarking will reflect this. Therefore the services which will be benchmarked for this category are:

- Mobile Voice Termination
- Fixed Voice Termination

Wholesale Dark Fibre/Wavelength Division Multiplexing Services

InterConnect understands that these wholesale services are not yet provided in Botswana and may not be widely available in other African countries.

Bofinet offers some of its high speed leased line services using WDM technology, but in this case leased lines are the service, not WDM, which is the enabling technology. It is not possible to benchmark a technology, only a service. Therefore, InterConnect proposes that the benchmarking of WDM will be included indirectly, through the leased lines service.

Where dark fibre services are provided it is unlikely that they will be subject to any regulatory intervention, but instead be provided by privately owned operators at commercially negotiated prices. Therefore InterConnect believes it will be difficult if not impossible to benchmark prices for these services.

Wholesale Broadband Services (Wireless and Fixed), including ADSL and Wholesale Access Services

InterConnect will benchmark the following broadband services offered on both retail and, where available, wholesale bases.

This section includes the ADSL internet access service as InterConnect understands that this is the service by which broadband is provided by BTCL to retail customers.

Each broadband service will benchmark residential and business prices separately to reflect the different levels of service (including contention and repair times) provided for each category. Where data usage is capped, the lowest cap prices will be those included in the benchmark analysis to reflect the most affordable prices. Unlimited data packages will also be benchmarked to compare the prices at the other end of the usage spectrum.

The benchmarked prices will only include those options where no handset, modem or other equipment is included in the service.

For broadband services offered at a fixed location (by either fixed or wireless technology) both retail and wholesale (carrier to carrier) prices at the following download speeds will be benchmarked:

- Up to 512kbit/s
- Up to 2048kbit/s
- Up to 4096kbit/s
- Up to 10Mbit/s

For mobile retail data services prices the following packages will be benchmarked (both prepaid and postpaid):

- 100MB included
- 500MB included
- 1GB included

Wholesale International Services

InterConnect understands that BOCRA would like to examine the comparative pricing of international connectivity. Where such connectivity is used for access to the internet, the prices for IP transit/backbone services (as shown below) will be benchmarked.

InterConnect will benchmark the following International Private Leased Circuit prices, for a selected number of routes deemed appropriate for the comparison:

- 2Mbit/s
- 45Mbit/s
- STM-1

Question 3: Do respondents have any comments on the proposed services to be benchmarked and their appropriateness to the market in Botswana?

5. Proposed Benchmarking Process

Selected Countries

Various potential criteria were considered for use in selecting appropriate countries for the international benchmarking exercise, including geography, degree of economic development, population, population density, and the relative take-up of fixed and mobile services (teledensity). Analysis of the options available has led InterConnect to conclude that a combination of factors such as population density, likely network topology, the characteristics of typical product and service types, and relative levels of general economic development favours primary comparison of the situation in Botswana with that in other sub-Saharan African countries. In this regard, however, it must be noted that some of the wholesale services which BOCRA wishes to study (e.g. Dark Fibre, Wavelength Division Multiplexing) may not be widely available in other sub-Saharan African countries (or elsewhere in the world at regulated prices). For this reason, we suggest as a secondary comparison the inclusion of selected countries in North Africa and Eastern/South-Eastern Europe whose general economic and demographic characteristics may be comparable with – if not directly equivalent to – those of Botswana.

At this stage, InterConnect proposes to identify a select group of appropriate benchmark comparisons from within the following lists of countries[2]:

- Sub-Saharan Africa – Benin, Cameroon, Congo, Cote d'Ivoire, Gabon, Gambia, Ghana, Kenya, Lesotho, Mali, Mauritania, Mauritius, Namibia, Nigeria, Rwanda, Senegal, South Africa, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe;
- North Africa - Algeria, Morocco, Tunisia;
- Eastern/South-Eastern Europe - Bosnia, Croatia, Czech Republic, Macedonia, Moldova, Poland, Romania, Serbia, Slovak Republic, Slovenia, Turkey.

The final choice of countries will be dependent upon a number of factors, not least the availability of trustworthy public-domain information. It is important to note that not all country selections will support data for all benchmarked services (some services are not offered across all countries, and in some territories standardised prices for wholesale and business retail products are not customarily disclosed, operators instead adopting a policy of pricing by application and negotiation). In addition, selections may need to be different for fixed-line and mobile products. Wherever possible, however, InterConnect will endeavour to maximise the number of relevant product and service categories benchmarked across each comparator country.

[2] In this regard, we note a degree of similarity between our potential choices and the group of benchmark countries used by Analysys-Mason in their February 2009 study for the Botswana Telecommunications Authority entitled *Executive Summary of market study of the telecommunications and ICT sector in Botswana* (http://www.bocra.org.bw/sites/default/files/documents/Executve_Summary_of_the_Telecommunications_and_ICT_sector_in_Botswana.pdf).

Information Sources

In undertaking the international benchmarking exercise, InterConnect proposes to use a variety of source materials. Primary amongst these will be items of official documentation such as regulators' Determinations and other formal announcements of tariff-setting, approved Reference Offer documents, and benchmarking or other comparative studies undertaken by (or at least on behalf of) the regulatory authority or other governing body such as the communications Ministry or competition regulator. To supplement these, and with especial relevance to those products and services not subject to specific regulatory approval in the benchmark countries, reference will be made to operators' published price lists, formal product/service descriptions and other materials from those organisations' official websites (especially for retail offers). As a matter of course, priority will be given to obtaining data from primary sources such as operators and regulators in order to maintain accuracy and reduce the possibility of inadvertent propagation of erroneous data. Where primary source material is difficult to obtain, however, consideration will be given to the use of data contained within independent reports from reliable third-party sources such as the ITU, other international bodies, consulting or academic studies, and the contemporary reporting of regulatory actions in the national or specialist press.

Question 4: Do respondents agree with the proposed approach to benchmarking and the suggested countries for comparison purposes?

6. Cost Modelling General Issues

6.1 Background to the Cost Models

Cost models will be produced for fixed access, fixed core and mobile networks. Associated tasks will take account of previous costing exercises in Botswana, international best practice and relevant benchmarking. The modelling will be based on decisions made regarding methodologies, price and cost structures, increments and potential pricing frameworks. Models will reflect current and future infrastructures and demand forecasts, taking account of technological development, investment factors and relevant assumptions on cost recovery and depreciation of assets.

The general nature of models created, choices on increment units and relationship between models and structures within retail and wholesale markets will dictate the uses that BOCRA can make of unit cost outputs in regulating pricing in all markets and ensuring an effective, progressive regulatory environment.

In this and the following Sections we set out details on our proposed costing methodologies, associated decision making and the particular question that arises from conclusions reached. We also deal with issues to do with general model structure, those specific to mobile and fixed networks respectively and considerations affecting the use of model outputs and results.

6.1.1 Type of costing Fully Allocated Costing (FAC) vs Long Run Incremental Costing (LRIC)

In general, the process of competition is considered to be the mechanism of choice for setting prices. This is because the buyers and sellers in any market are best placed to judge the consequences and risks arising from agreeing a price at any given level and they are likely to bear most of those consequences and risks themselves. Aligning the information and risk with those directly involved in the market in this way may be expected to lead to an optimal allocation of resources (neither too much, nor too little consumed) and this approach results in the best possible outcome for consumers and citizens. At the same time, suppliers are able to cover their costs and make a reasonable profit.

However, regulators are expected to intervene in markets where there is evidence that they are insufficiently competitive, or can be expected not to be so. Usually this occurs as a result of sellers in the market amassing an excessive amount of power and misusing that power to raise prices, or to reduce the quality of the goods or services they supply as compared to what would happen in an effectively competitive market. At the same time, sellers with market power may tend to restrict supply in the expectation that this will lead to higher prices, without the fear that other suppliers will step in to fill the gap and drive prices down, or quality up.

In an industry such as telecommunications, furthermore, suppliers must make investments for which they hope to gain a return over a number of years. As a result, they may have to consider not only the potential actions of competitors already active in the market, who will themselves have had to make investments, but also the possibility that others will enter the market with newer technologies that give them the edge on price, quality, or features. Markets that offer the possibility of new competitors entering with better technology like this are said to be "contestable".

Market power can lead to reduced contestability, as well as to reduced competitiveness if sellers use it to create barriers to keep potential entrants out. For example, they might be prepared to price below cost for a limited period, particularly if the new entrant occupies a limited segment of the market. However, other factors such as licensing restrictions, or a shortage of spectrum can have the effect of reducing the contestability of a market.

Where an issue of market power and its actual or potential misuse has been identified, a primary regulatory remedy is to regulate the price that can be charged, for example by setting a maximum. In particular, the task of the regulator is to ensure that the price is as close as possible to being within the range that would be expected to prevail under effective competition. Since competition may be expected to drive prices towards costs over time, it is important to find a suitable method of calculating costs. We discuss the main approaches below.

6.1.2 Fully-Allocated Costs (FAC)

In addition to the concerns about maximising welfare for consumers, regulators often have an obligation to ensure that operators can recover their costs at a reasonable rate of return. Where this is the primary objective, or where there is little prospect of the market becoming competitive, FAC provides an attractive option. One advantage is that the methodology is closer to that typically used in compiling financial, regulatory and management accounts and so it is easier to reconcile to them, although it is unusual for such accounts to be compiled at the detail required to assess the costs of individual services.

6.1.3 Long-Run Incremental Cost (LRIC)

A key problem with FAC is that it is not a very good representation of the pricing behaviour that economic theory would lead us to expect in competitive and contestable markets. When a firm is evaluating whether to invest to launch a new service, it is reasonable to suppose that they would construct a business case that would compare the additional revenues over time with the additional costs of going ahead with the proposal. Since some costs are likely to be fixed with respect to the new service, costs calculated purely on this basis are likely to differ substantially from FAC, in which all costs (including those that are fixed) are distributed amongst the different output services. For example, a firm providing on-net and off-net call origination services might decide to add call termination. They would already have cell towers, backhaul and core network in place and would only need to add to these to the extent that additional capacity would be needed for the terminating minutes.

These fixed costs may either be incurred by a group of two, or more, services (for example voice services, but not data or SMS), or they may arise as a general cost of doing business (for example the CEO's office). Both these types of costs, which are known as shared and fixed costs, respectively, would need to be recovered by a firm operating in a competitive market, or they would be unable to make normal profits and would go out of business. The question becomes one of how such costs are distributed across services. We discuss some of the options for doing this below.

Before we discuss different forms of LRIC costing, it is important to note a further important difference from FAC, which is that LRIC costing can be forward-looking, as would be the case with the hypothetical business case referred to above, whilst FAC reflects backwards-looking costs (i.e. those cost that have been incurred in the past and are recorded in the accounts). In a contestable market, in which there is a prospect of new competitors entering with better technology, it may be anticipated that firms would reflect this in the way they recover costs over the lifetime of an asset. In particular, it would be rational for them to charge a higher price in the early years, so that they can remain competitive against new entrants later. This can be reflected through LRIC costing by "front-loading" the recovery of the costs of such assets.

6.1.4 Pure LRIC

Towards one extreme of the spectrum of choices of LRIC costing is an approach that has been advocated by the European Commission (EC), in which no fixed and shared or common costs are recovered from call termination. One effect of this is that none of the costs of providing mobile coverage are covered in mobile call termination charges. It is argued by the EC that subscribers to mobile telephone networks benefit from incoming calls, including those that originate on other networks and so it is reasonable for them to bear a share of the costs of those calls – in this case all of the fixed shared and common costs. It was also a matter of policy for the EC to drive mobile termination rates (MTR) down towards the level of fixed termination rates, which tended to be significantly lower. Pure LRIC is also applicable to modelling fixed telecommunications networks under the EC's framework, but the difference between Pure LRIC and LRIC+ tends to be less for fixed. One reason for this is that the cost of providing coverage is not included in Pure LRIC, because coverage is already required for services other than call termination. In a fixed network, coverage is provided by the access network, which is excluded from call costs with either methodology, because its costs are generally recovered from line rental and connection charges.

6.1.5 Stand-Alone Costs (SAC)

At the other extreme, a service might be made to bear all of the fixed shared and common costs. This is considered to be the maximum that a firm might be able to charge in an effectively competitive market. Whilst we are not aware of SAC being used as a standard for termination rates, it has been applied by Ofcom in the UK as a maximum in the case of certain wholesale data products, where it was considered that the market was close to being fully competitive and so only a "safety" cap might be required. The special characteristic of call termination as a "bottleneck" monopoly,

where each network has, in effect, a monopoly on termination of calls on their network, makes SAC unsuitable for this purpose and so a somewhat stricter control on pricing freedom would be appropriate.

6.1.6 LRIC+

The LRIC costing approach that has previously been used in Botswana and in many other countries in Africa and the rest of the world, including Europe prior to the introduction of Pure LRIC, is LRIC+. This approach strikes a happy medium between the two limiting cases described above, in that shared and common costs are borne proportionately by all services. The exact proportions may vary, but the usual approach is to distribute shared costs in proportion to the relevant volume measure (for example minutes) and common costs in proportion to the respective incremental cost of each service.

An important advantage of LRIC+ is that it provides greater assurance that the regulated firm can recover all of its efficiently-incurred costs, whereas under Pure LRIC, it is a matter of assumption that they will be able to do so from call origination and other services.

6.1.7 Conclusion

Whilst we would take the view that there are arguments for using different LRIC costing approaches in different circumstances, there seems to be no strong argument for changing the approach used previously in Botswana from LRIC+. In particular, it seems reasonable for call termination in mobile networks to bear some of the costs of mobile coverage, given that subscribers typically have multiple SIMs and so there is scope for significant imbalances in calls whereby those in rural areas who benefit from coverage for incoming calls might themselves make few calls because of affordability considerations. Operators that comply with the expectation that they roll out coverage in rural areas therefore risk finding themselves in a situation where they lack the opportunity to cover the costs of doing so.

Question 5: Do respondents agree that LRIC+ is the appropriate costing methodology to be adopted in Botswana and that the same costing methodology should be used for both fixed and mobile networks?

7. Model structure

7.1 Top-down models

One significant type of LRIC methodology is one that starts with the costs expressed in an operator's accounts and makes the necessary adjustments and translations to arrive at costs on a LRIC basis. This is known as the "top-down" approach. Its primary advantage is that it should be possible to reconcile the figures back to the operator's published and audited accounts.

The main disadvantages of the top-down approach are:

1. Its information requirements can be quite burdensome, in that it may be necessary to delve quite deeply into the underlying information systems to extract the required data;
2. The data complexity makes it realistic only for an operator to undertake and it is likely to be difficult for a regulator to do so without requiring very extensive and perhaps intrusive access to the operator's information base;
3. It can be difficult to determine to what extent the observed costs correspond to those of an efficient operator;
4. Company accounts are essentially backward-looking records of what has happened and, although assets may be revalued on a current cost basis, it may be difficult to evaluate varying assumptions on such things as future volumes.

7.2 Bottom-up models

An alternative is to build models that simulate the operation of the network under consideration by starting with the expected volume demands on the network (number of subscribers, calls, data volumes, etc.) and applying efficient engineering principles to determine the network equipment and associated activities that will be required to meet that demand. Once the hypothetical network and activities are specified, their costs can be derived. This approach is applied separately to mobile and fixed technologies.

Bottom-up models have a number of advantages and few disadvantages:

1. They can be constructed with relatively little input of data on the operator's actual costs;
2. They can be flexed to accommodate different assumptions and scenarios;
3. They can more easily reflect efficient provision of services;
4. They can be used to calculate forward looking costs for services which help to provide ongoing stability within the sector;
5. They are however theoretical and do not directly relate to the actual networks in place;
6. They often appear to be more complex and difficult to review as they incorporate forecasting and calculations over multiple years.

Given the advantages identified above the bottom-up approach is the most suitable for construction by, or on behalf of a regulator, for the purpose of identifying appropriate prices for services.

Question 6: Do respondents agree that a bottom-up approach is appropriate?

7.3 Cost causation

A fundamental principle underlying the treatment of costs in a LRIC model is cost causation. In other words, only those costs that arise as a direct result of an activity are

associated with it. So, for example, although having subscribers attached to a network is necessary for it to attract terminating traffic, only the costs caused by actually adding call termination as a service (or that are avoidable if the service were to be deleted) are counted towards the cost of that service. This would exclude costs that arise as a result of adding subscribers.

Question 7: Do respondents agree that cost causation should be the primary principle for determining costs within the mobile model?

7.4 Depreciation method

Many of the costs involved in operating a network are for capital items such as base stations, duct and trench networks and switching centres that must be paid for up front, but which continue to be useful for a number of years, perhaps for decades. Since the benefits of the investment continue to be realised during the useful life of the equipment, it is reasonable that the costs should be recovered over that period, or annualised. This is the effect of accounting depreciation policies.

However, since LRIC models need to be forward-looking if they are to reflect efficient investment decisions, assets should be valued at the prevailing rate, year by year. This means taking account of both price trends for the relevant equipment category and also of the effects of technology in providing new pieces of equipment to accomplish the same, or a wider range of functions, at a lower cost – the Modern Equivalent Asset (MEA) principle.

Furthermore, since the intensity with which an asset is used and hence the benefit derived from it may vary over time as volumes rise and fall, an optimally efficient annualisation methodology should take this into account also.

Although there are a number of different annualisation methodologies in use, ranging from straight line, as generally used in statutory and published accounts, through annuities and tilted annuity method and sum of digits, the methodology that is accepted as coming closest to the ideal is Economic Depreciation (ED), which takes proper account of both price trends and changes in volumes over time. Other annualisation methodologies are used as proxies for ED. A potential drawback with this method is that it is computationally more complex than the alternatives.

Theoretically, economic depreciation is the optimal annualisation method, as this is the most accurate way of measuring the economic value of the asset over its lifetime. Economic depreciation produces constant unit costs, in the absence of asset price inflation, which it also takes into account. It can be calculated as the estimated Net Present Value (NPV) of net cash flows generated by an asset for the remaining lifetime at the end of a given year less the estimated NPV of cash flows at the start of the year. This is the change in economic value where the economic value is the asset's 'earning power'.

A further issue with ED is that its proper application requires that the annualisation time series be projected over the full lifetime of the most long-lived assets, although this can

be somewhat shorter if a high discount rate (cost of capital) is applied. This period can be quite long – of the order of 20-50 years in some cases – and so the assumptions guiding the later years are necessarily sketchy. After all, looking back in the other direction, 20 years ago mobile telephony was in its infancy as a technology and 50 years ago it did not exist at all. Fortunately, however, the details of what is assumed in those later years have little, if any, effect on the early years of the time series, which are of interest for setting termination rates.

Economic depreciation provides a way of recovering costs that extends to operational expenses, too. The aim of this costing study is to estimate the service prices in a competitive and contestable market. A player with initially very low volumes could not fully recover its operational expenses at the beginning of its life cycle. If it attempted to do so, it would price itself out of the market. It would rather attempt to recover its costs over the life cycle of the business. Hence, the recovery path of operational expenses also has to reflect changes in output and input price levels.

Question 8: Do respondents agree that Economic Depreciation is the preferred method for the mobile cost model?

7.5 Allocation of common costs

In Section 6 we propose that incremental costs are the best available proxy to prices in a competitive market in the long term. A key problem with this is that, in the context of a firm with multiple outputs, not all costs would be recovered if each product were priced purely on this basis. The existence of such multi-product firms in a competitive market is an indication that there are scope economies available from producing the different products within a single firm. It is appropriate, therefore to mark-up the incremental costs attributed to each product with a share of these common costs.

The theoretically correct method of doing this is a procedure called Ramsey pricing, which takes account of the range of elasticities and cross-elasticities applicable to the relevant upstream (wholesale) and downstream (retail) products. This procedure is both technically complex and reliant on elasticity data that are unlikely to be available.

A generally accepted substitute is equi-proportional mark-ups (EPMU), under which the proportion of common costs marked up to each increment relates to the respective size of each increment.

Question 9: Do respondents agree that EPMU is the appropriate methodology for apportioning common costs?

7.6 Allocation of costs to services

Once the incremental costs for a large increment, such as with LRIC+, have been assessed, an allocation of costs is made by service. This is done by applying routeing

factors. These factors reflect the use made of each of the network components distinguished and costed within the model. For example, an on-net mobile call would pass through a BTS and BSC twice, once on the originating leg of the call and once on the terminating leg. By contrast, an incoming call from another network would pass through a BTS and BSC only once. The on-net call would have a routeing factor of two for the BTS and BSC components and the incoming call a routing factor of one, meaning the on-net call will receive twice the allocation of these particular elements of cost.

In this way, services are allocated a share of each of the various network component costs in proportion to their use of them, together with a share of network indirect costs, covering such things as network management systems, motor transport and human resources associated with network activities and a mark-up to cover common costs. Costs within the retail increment (e.g. the retail billing system, marketing) are not included.

Question 10: Do respondents agree that the cost allocation methodology outlined above is the appropriate way in which costs should be allocated within the cost models?

7.7 Treatment of Licence and spectrum fees

Licence and spectrum fees are chargeable to mobile operators in Botswana and so form part of the costs of undertaking network activities. As such they should be included in the model of fixed and mobile network costs as appropriate and depreciated over the period for which the corresponding licences are valid.

Question 11: Do respondents agree that licence and spectrum fee costs should be included within the cost models?

7.8 Use of results

The purpose of the cost models for both fixed and mobile networks will be used to inform BOCRA of the actual and relative costs for providing the range of telecommunications services in Botswana. As described in more detail in Sections 8 and 9 below separate models will be developed for:

- Mobile networks
- Fixed access networks
- Fixed core networks

Each of these models will output geographically averaged costs for the provision of the various services in their respective networks. These outputs are in line with the tariffing

arrangements which are normally adopted by mobile and incumbent fixed operators. It is not unusual to see bespoke service tariffing from competing fixed operators which target their services at specific customers and, because of their lack of Universal Service Obligation and level of market power, are usually not subject to any form of price control. With the creation of Bofinet, a government owned entity, working alongside BTCL it is appropriate and necessary to consider the sector for fixed services as a single one and to calculate service costs provided by a single efficient network.

Question 12: Do respondents agree with this approach to modelling and the use of the model outputs?

7.9 Determination of retail costs from Cost Model Outputs

The outputs from a LRIC+ model are representative of the costs for the provision of services in the absence of a fully competitive market which would normally drive them down towards cost. This costing approach is therefore normally used to determine the costs of wholesale services and inform regulatory decisions accordingly. We propose to develop models based on LRIC+ which will calculate the costs of services for a reasonably efficient network operator. These will therefore represent the wholesale costs for such services.

A regulatory remedy available to regulators is a requirement for a clear distinction between wholesale and retail services, and dominant operators are often required to provide equivalent wholesale services for all their retail services. These should be provided at the same price in a non-discriminatory way to all, including the retailing arm of the dominant operator to ensure fair competition in the retail market. The difference between the wholesale and the retail price therefore represents the costs of sales and marketing, customer management, billing and bad debt and profit. Such arrangements are usually managed by regulators through Accounting Separation. It is the intention of BOCRA to introduce Accounting Separation into the sector in Botswana and further details of this are presented at Section 11 below.

In reviewing retail prices within this project we would intend to look at the relationship between the calculated costs of wholesale services and their equivalent retail services. We would propose to assess the level of the retail mark up against relevant costs for such retailing activities.

Question 13: Do respondents agree with an approach to determining retail prices based on a retail mark-up on the wholesale costs?

8. Cost Modelling in Mobile Networks

In this Section we consider a number of further modelling principles primarily in the light of mobile network models, but the principles apply to both mobile and fixed networks except where we specify otherwise. Some distinct issues for fixed networks are then taken up in Section 9 below.

8.1 Which operators?

A number of considerations of a practical, regulatory and economic nature enter into the choice of how many models should be constructed and which specific operators' networks, if any, to simulate.

Efficiency and market share

Firstly, there is a requirement to simulate the costs of an efficient operator. Not to do so would risk rewarding inefficient investment and management choices on the part of some operators, at the expense of others, which might be more efficient.

However, efficiency is affected both by endogenous factors (those, such as technology and investment, that are under the operator's control) and exogenous factors, that may be determined by regulatory actions, particularly spectrum allocations, or by structural characteristics of the market, such as market share and entry timing.

In relation to spectrum, there is not an even allocation of spectrum between the operators. The allocation between the operators is shown below:

	Spectrum band	Spectrum allocation
Mascom	900MHz	8MHz
	1800MHz	10MHz
	2100MHz	15MHz
Orange	900MHz	8MHz
	1800MHz	10MHz
	2100MHz	15MHz
bemobile	900MHz	4MHz
	1800MHz	14MHz
	2100MHz	10MHz

As the allocations of spectrum differ between operators, especially for the 2G spectrum it may be necessary to reflect the implications of this in an engineering model.

It is unlikely that any new MNOs will enter the market in the near future, however the market shares of the current three operators are not yet equal although competition in the market can result in changes over time. Given that there are likely to be some significant scale economies in mobile networks, this raises the question of what market shares to assume in the model. Other things being equal, one might expect that *n* efficient operators in an effectively competitive market would tend towards shares of 1/*n* over the medium to long term. It may be unfair to an operator with a larger share now,

therefore, to assume that they will continue to enjoy the scale economies that arise from such a high market share.

On the other hand, it might be argued that there is a "first mover" advantage for early entrants, who have the opportunity to attract the most lucrative and least price-sensitive customers, who may be early adopters of the service. Later entrants may be faced with an uphill struggle to counteract this, since capturing a customer tends to be more expensive than retaining one. Equally, if early entrants are successful at attracting subscribers who make few, but receive many calls (and so attract above-average call termination revenues for the operator), it will be even more difficult to persuade them to defect. Hence it might be expected that it could take a long time for the effects of such asymmetries to unwind.

Appropriate use of regulatory resources

Secondly, creating multiple models adds to the complexity of the task and the resources required to complete it. If, as has been the case to date in Botswana, it is desired to have a single rate for all operators, then deriving slightly different values for instances of the model based on different operators creates a difficulty in determining which value to use, for which there is no unequivocally preferred solution.

Progression of market shares

Whether the single or multiple models option is chosen, it will be necessary to make some assumptions about how the market evolves towards a stable set of long-term market shares. For this purpose it is proposed to construct a market model that takes account of such factors as the rate at which subscribers churn from one operator to another and the pattern of development in other markets. It should be possible to test a range of different assumptions using this model.

Question 14: Do respondents agree that it is appropriate to model a single efficient mobile operator with a market share tending to 33.3% from a starting point of the current market shares for the existing operators over a number of years?

8.2 Which services?

The primary purpose of the model is to provide cost information to support the process of setting cost-oriented call termination rates for voice calls and data services, to understand the costs for retail services, including on-net and off-net calls and to inform recommendations on Mobile Virtual Network Operator arrangements. Nevertheless, the call termination service shares network capacity with a number of other voice and data services, including SMS, MMS, and data for both wholesale and retail customers. It will therefore be necessary to take all such services into account in dimensioning the model and to apportion the resulting costs appropriately to call termination.

Question 15: Do respondents agree that it is appropriate to take into account all services being carried by mobile networks?

8.3 Which technology in mobile networks?

It is generally accepted that regulators should try to avoid "picking winners" amongst either firms or technologies, but rather they should try to leave this to the market. In other words, regulators should aim to regulate services, irrespective of how those services are to be delivered. However, some decisions are clearly in the hands of the regulator, including the allocation of radio spectrum, a scarce resource, that may be required for implementing new technologies such as 3G and 4G in mobile networks.

To a significant extent 3G technologies are replacements for the 2G, in that they enable the same services to be delivered, with some scope for cost savings. However 3G does offer the possibility to provide significantly enhanced data rates and hence larger volumes of data and more advanced data services. In particular, the addition of HSDPA technologies[3] offers the prospect of supporting data rates of up to 7.2 Mbit/s in the download direction. Substantial take-up of such services might lead to a situation where 3G networks are substantially dimensioned to handle services of this kind, with the proportion of capacity occupied by voice services relatively small.

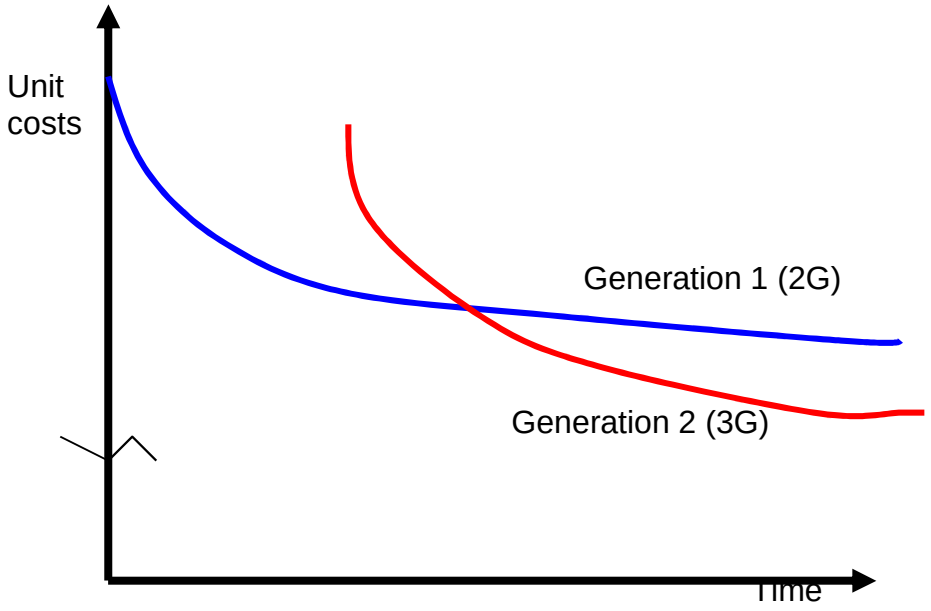

Figure 1: Illustrative effects of incorporating multiple generations of technology on modelled voice costs

In the case of 4G technologies these are primarily being deployed to support data services and the technology to provide voice services over the technology, so called

[3] HSPA (High-Speed Packet Access) encompasses High-Speed Download Packet Access (HSDPA) and High-Speed Upload Packet Access (HSUPA) protocols. These allow broadband-speed data transfers over 3G mobile connections.

"voice over LTE" has limited applications. 4G networks are more likely to support voice services through Voice over IP applications which are not within the control of the network operators and so the technology has little impact on the costs of voice services.

A model that therefore takes account of both 2G and 3G for voice services and 3G and 4G for data services appears to be the most appropriate at this point in time and looking forward.

Question 16: Do respondents agree with the proposal to develop a multi technology mobile model to deal with both voice and data services?

8.4 Network structure

Scorched earth

A potentially significant component of efficiency that is under the control of operators is the placement and configuration of network nodes. In principle, therefore, an efficient network model should incorporate an optimal design in this regard. However, real network designs are required to accommodate a range of different factors, such as terrain, "clutter" (the various natural and man-made obstacles that may affect radio signals), security issues and so on. These factors can make it difficult to agree on which design is optimal and so for this reason this "first-best" option is often rejected in favour of a design that takes more account of what actual operators have done, or plan to do. Similar considerations apply to fixed networks, where it can be very complicated to determine the optimal cable routes and location of network nodes without the depth of local knowledge that is available to operators.

Scorched node

A true scorched node model design takes the network operator's set of network nodes as a given and seeks to optimise other aspects of the simulated network around these. Most LRIC models, however, are built with at least the possibility of modifying the network operator's design where it is considered to be sub-optimal, for example where the modern equivalent of an asset would suggest different choices. This hybrid approach is known as "optimised scorched node".

In practice, although Botswana is relatively large country, much of it is very rural, and in these areas coverage is the key driver of network deployment. Major cities such as Gaborone and Francistown will have capacity drivers that will need to be taken into account. The switching networks of the network operators are known to be small and will therefore realistically represent an efficient network approach. It is proposed, therefore, to apply a modified scorched node approach, taking note of operators' actual network designs and of any particular design factors they may bring to the modellers' attention as part of the information-gathering process.

Question 17: Do respondents agree with the proposed approach in relation to network structure in the mobile model?

8.5 Defining the increment

An incremental cost is cost that is incurred in supporting a particular increment of demand, assuming that other increments of demand remain unchanged. The incremental cost can also be calculated as the avoidable costs of not supporting the increment. There is considerable flexibility in the definition of the increment – or increments – to apply in a costing model, and the choice should be suitable for the specific application. The range of choices includes (from narrower to broader):

- A marginal unit of demand for a service;
- The demand for a service as a whole;
- The demand for a group of services;
- The demand for all services or traffic on the network.

A narrow increment coincides more closely with marginal cost and hence with the theoretical ideal. However, the narrower the definition, the greater the proportion of costs that are common and so must be allocated across services. In other words, with a broad increment, more of the economies of scale and scope that arise from providing multiple services will be incorporated in the increment. The proposed treatment of these common costs is examined further in Section 7.5.

On the other hand, if the purpose of the model is to derive costs for a single service and an increment encompassing multiple services is chosen, then it will be necessary to determine the share of costs to be borne by the service in question.

This task is affected by the type of increment that is selected, the main options being average, incremental or marginal. The most usual approach is to use an average increment, which makes for simpler construction of the model, though it requires all traffic to be expressed on an equivalent basis, for example minutes in the case of a predominantly voice network. Having done that, the costs can be apportioned on the basis of usage (all minutes are treated as having an equal cost).

Question 18: Do respondents agree that a broad increment expressed on an average basis and incorporating all network services is appropriate?

8.6 Separation of coverage and traffic costs for mobile networks

Some LRIC models dealing with mobile call termination explicitly contain separate subscriber and traffic increments. The subscriber increment contains costs such as SIM cards and some portion of HLR and MSC processor costs. In principle one might also wish to draw a distinction between that part of the network investment that is directed at

achieving coverage – i.e. it is there to enable subscribers to make and receive calls – and that part that is directed at carrying traffic.

As it turns out, there can be considerable difficulties in making this distinction in practice. For example, one might compare the costs of a hypothetical minimal coverage network with a network that is configured to carry the actual traffic demands. However, even the minimal coverage configuration will have significant traffic-carrying capability. The minimal coverage configuration may also require different equipment that would need to be replaced for the full configuration (for example different types of base station configuration).

In other words, a large part of the network's costs are likely to be required in order to support subscribers and to carry traffic and so would fall into the category of costs that are common to these two activities. Since the incremental subscriber costs are likely to be quite low, this would mean that under an equi-proportional mark-up method of apportioning common costs (see Section 7.5), the bulk of these common costs would fall to traffic in any case.

In summary, although having separate increments within the model for subscribers and traffic has some attractions from a theoretical point of view, it presents considerable practical difficulties and is not likely to end up making much difference to the result.

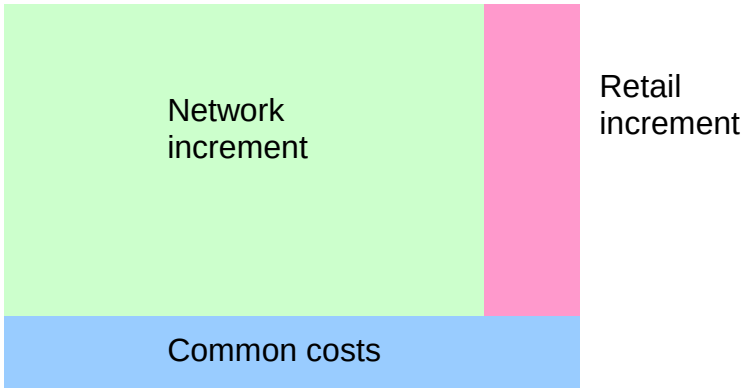

Figure 2: Incremental and common costs

Given the choice of a single, broad network increment, most of the remaining activities of the operator's business can be assumed to be within a separate retail increment, which is not explicitly modelled (see **Figure 2**). This leaves only a small proportion of common costs requiring to be allocated through mark-ups.

Question 19: Do respondents agree that a single network increment is appropriate?

9. Cost modelling in fixed networks

A number of additional issues arise in connection with modelling costs in the fixed network sector. We discuss these further in this section.

9.1 Number of Fixed Networks to be Modelled

Prior to the creation of Bofinet, there was one national fixed network operator in Botswana. Under these circumstances, the usual approach would be to model a single operator. This is the case even in countries where there are significant numbers of competing fixed operators, because it is unusual for more than one to have sufficient market power to make such an approach proportionate. However, the creation of a separation of functions between two operators with a monopoly, or near monopoly in their respective spheres of operation creates a different starting point to that which is usual in the sector.

However, even with a single regulated fixed network, it is usual to create separate models for core and access businesses. The reason for this is that in fixed networks these different groups of activities have distinct cost drivers. In particular, all the activities classified as falling into the access business are primarily driven by the number of connections (as well as the capacity and technology of those connections). By contrast, for switched voice and data services, core network costs are driven by the amount of traffic that is generated over those connections. The "businesses" here are logical definitions driven by regulatory considerations and not necessarily reflective of the way that a particular operator is organised. They enable costs to be derived in line with the underlying economics.

It is proposed, therefore, that the convention of creating separate models for access and core activities be retained and that BTCL and Bofinet's respective activities be combined for this purpose. In effect, the models will measure the end-to-end cost of an efficient fixed network operator providing the modelled services.

Question 20: Do respondents agree that single models should be developed for access and core networks and that BTCL and Bofinet services should be included in these models?

9.2 Services to be modelled

Both fixed and mobile networks are undergoing generational technology changes that tend to reflect the increasing predominance of data services as a proportion of total communications demand, as well as making the higher bandwidth available to make that possible. Whilst both fixed and mobile networks have always featured some degree of sharing of resources between voice and data, this has perhaps been less so for fixed networks. Legacy fixed network architectures were designed primarily to carry switched voice services, with separate adjunct networks occupying some of the same

physical network facilities, for example ducts, cables and exchange buildings, to provide data services.

This is now changing though and New Generation Networks (NGN) are designed to provide multiple services, including voice, data and video over a single packet-switched network. This is the norm for new network build and some elements of NGN are already in place in Botswana now, with further transition planned over time. In view of this, it is proposed that all services likely to be conveyed by NGN networks should be included in the fixed network models, so that the models can be properly dimensioned and costs calculated accordingly.

Question 21: Do respondents agree that it is appropriate to take into account all services being carried by fixed networks?

9.3 Technologies to be modelled

As is the case with mobile, fixed networks have experienced and continue to experience profound technological changes that affect the range of services that can be provided, their costs and the way that networks are structured. An extreme interpretation of the idea of efficiency would be to model exclusively the newest and most cost-efficient generation of technology. However, to do this would be to ignore the realities of the situation of an established operator in a contestable market. It would be unreasonable to assume that such an operator would be willing to throw away equipment that could be expected to have significant further useful life every time something newer and better is offered by the suppliers. Rather, it is likely that they would reflect the possibility of disruptive new technologies arriving by front-loading their depreciation, as discussed in Section 7.4, above. At the same time, they would be likely to phase in new technologies over a period of time as it became economic to retire old assets and replace them with new ones.

In the case of fixed networks, the new waves of technology include optical fibre replacing copper cables in the access and core networks and the replacement of circuit-switched with packet-switched and multi-service NGN networks. It is proposed, therefore, that consideration be given to the rate at which such technologies might reasonably be expected to be adopted and that this is reflected in the fixed network models. The rate at which it is reasonable to expect new technologies to be adopted will be considered in the light of the conditions in Botswana.

Question 22: Should new fixed network technologies such as optical fibre and NGN be included in the fixed network models in a way that reflects a reasonable phasing-in of such technologies?

9.4 Network structure: scorched earth versus scorched node

Similar considerations apply in fixed networks with respect to the degree to which the structure of existing networks should be reflected in the models. In the case of fixed networks, a scorched node approach would mean retaining the location of core network nodes (sites containing switching centres, concentrators, routers and associated equipment). However, the modelling process may determine that the use made of each site is sub-optimal and so, for example, a site currently hosting switching equipment should contain only a concentrator.

The concentrator (or its NGN equivalent) acts as the border between access and core networks. To this extent, the scorched node approach provides a starting point for the access network model also. The configuration of the network between the concentrator site and subscribers' homes and commercial premises can, however, be optimised within the model.

Question 23: Do respondents agree with the proposed approach in relation to network structure in the fixed model?

10. Weighted Average Cost of Capital (WACC)

One of the costs that firms need to cover in order to remain in business is the cost of raising capital. This is accomplished by the issue of shares and other equities, for which shareholders will expect to be remunerated by some combination of dividend payments and capital appreciation, and interest-bearing loans of one kind or another.

The two largest mobile operators in Botswana are subsidiaries of foreign-based multi-national firms and so, although they are not listed on the Botswana stock market, these operators have direct access to international stock market finance. The fixed and other mobile operator have significant Botswana Government ownership and so may have somewhat different access to capital investment.

The generally accepted methodology for calculating capital costs is the Capital Asset Pricing Model (CAPM), which generates an appropriately weighted estimate of the cost of capital, or WACC. Since efficiency considerations apply to capital as well as to other inputs, the optimal balance of debt and equity funding may not correspond exactly to that of the actual operators.

The WACC is generally derived:

- in nominal terms, since interconnection prices are fixed in nominal terms;
- pre-tax, since regulatory price-setting normally uses a pre-tax cost of capital to apply to the capital base to calculate annual capital costs before taxes.

The WACC may be different for particular services or types of investment, depending on the level of risk which may vary between them. For example the WACC for a fibre to the home network may be higher than other parts of the network due to its perceived higher risk.

The cost of equity is the expected rate of return that the market requires in order to attract funds to a particular investment. The cost of debt is the required rate of return for creditors or the rate at which the company can borrow money.

The WACC for a given company or service is calculated by weighting the average market values of the costs of debt and equity employed by the company.

To determine the WACC we would propose to use the following key formulas;

WACC = [Wd*Kd*(1-t)] + [We*Ke]

where

Wd = Weighted average amount of current cost of debt
We = Weighted average amount of market value of equity
Kd = Cost of debt
Ke = Cost of equity
t = Corporate income tax rate

This model provides nominal results as it takes into account price changes including inflation. Inflation is represented by the retail price index. Real WACC can then be converted into nominal WACC as follows:

$$\text{Nominal WACC} = (1+\text{real WACC}) * (1+\text{Inflation \%}) - 1$$

InterConnect proposes to use the above recognized formulae to calculate appropriate WACC for use in the cost models. We will seek appropriate input information from stake holders as part of the data collection process and would anticipate carrying out separate calculations of WACC for the fixed (access and core) and mobile cost models.

Question 24: Do respondents agree that a nominal, pre-tax WACC should be used?

Question 25: Do respondents agree that separate calculations of WACC should be carried out for use in the fixed (access and core) and mobile network models?

11. Accounting Separation (AS)

11.1 Background to Accounting Separation

The objectives relating to Accounting Separation within the project are as follows:

- To develop Accounting Separation Guidelines that take account of the new licensing framework;
- To develop regulatory instruments and manuals to assist in the implementation of accounting separation;
- To develop a capacity for BOCRA to monitor the implementation of accounting separation.

Accounting Separation (AS) as a regulatory remedy is commonly applied to dominant fixed operators to ensure that they are charging other operators the same for wholesale services as they are notionally "charging" their own retail business and that they are not cross-subsidising competitive services using revenues from non-competitive services. A network operator may also be separated into Access Network, Core Network, Retail and Other business units (as appropriate), which transfer charge each other for the use of their assets. The key motivation for the implementation of AS is to underpin equivalence of access and charging in markets requiring regulatory intervention to promote competition.

The previous BOCRA project on cost modelling and pricing, carried out in 2010, included the production of guidelines for AS. These included principles and a degree of detail on separation and service definitions, along with some detail on cost allocation, revenue and transfer charge reporting. The intention of the preparation of guidelines was that they could be applied to any relevant operator as a remedy, but it is believed that no actual implementation has been carried out. This means that AS exists as a remedy in Botswana, but that it is not currently being used.

One of the first tasks in this part of the project is to establish the status of AS as a remedy in Botswana. A review of the guidelines produced in 2010 will be required, followed by the initial specification of extra requirements for effective implementation. This will include clarifying the method by which licensees in Botswana will be identified as entities liable for regulation by AS. This process is important as the obligation to produce separated accounts and associated schedules and policies can be onerous for organisations that lack spare capacity and expert knowledge to perform the necessary work in the finance function. Relevant considerations will include the pricing framework for regulatory remedies, the number of regulated services supplied by an operator and identified bottleneck resources affecting competition in the market.

11.2 Implementation of Accounting Separation

A successful AS implementation will generate requirements for AS systems and processes across the fixed and mobile industry and within BOCRA. The regime designed must be proportionate in terms of complexity, materiality and capability within the organisations. The task will also encompass the definition of compliance monitoring requirements on the part of BOCRA. The various impacts on stakeholders create the requirement for positive engagement between them as the AS regime is devised.

The following issues will be considered in the development of AS guidelines:

- Relevant product / service sets offered by the operators in Botswana;
- Divisional structures (retail, wholesale etc.);
- Any existing internal trading arrangements e.g. transfer charging;
- Existing costing and management accounting systems and processes (avoiding unjustifiable exposure of commercially sensitive data);
- Alignment of products with regulatory regimes, existence of measures for compliance (non-discrimination, price publication etc.) and standard interconnection agreements.

Review work will enable the assessment of potential compliance issues, the nature of the compliance and monitoring regime and the length and nature of any transition period required. This will include potential penalties for non-compliance and the legal backing for them that BOCRA may rely upon.

InterConnect will produce a draft version of the AS rules and guidelines and associated cost allocation methodology, which may be used as a regulatory remedy in the Botswana communications market. The detail contained will be designed to cover relevant non-competitive, regulated services and will include any appropriate related processes covering monitoring by BOCRA.

The details to be considered in the drafting of the AS guidelines are:

- Regulatory accounting principles, covering cost analysis requirements (LRIC, FAC etc.) and aspects of accounting including CCA/HCA, depreciation and cost of capital;
- AS views required from modelling and reporting across divisions, markets and products;
- Cost apportionment and allocation methodologies for modelling, volume modelling, separated modelling required by the designed regime (e.g. LRIC);
- Rules on internal transactions of regulated products, to reflect transparency and equivalence requirements;
- Reconciliation requirements regarding AS vs management reporting vs statutory reporting;

- Specification of audit requirements, including the dominant operator (internal and external) and BOCRA (for monitoring and compliance);
- Detailed specification of how AS reporting is presented in terms of user-friendliness and levels of detail. This will include the requirements of BOCRA in the form of: printed material, raw data, models and databases etc.;
- Timescales for preparation, submission and approval of regulatory accounts, which must take account of the extra demands placed upon the regulated entity and the operational needs of BOCRA in terms of remedies and compliance monitoring.

The AS rules and guidelines will also cover issues including how BOCRA uses AS for any statutory duties (potential market reviews, for example), the rationale on commercial sensitivity and competition, the system for monitoring accounting treatment changes and technological developments and growth/contraction of markets.

The draft guidelines will include detail on processes and resources required within BOCRA to assess compliance of data reported and methods of feedback and review in connection with regulatory powers. This will cover statutory powers to take action on non-compliance, whatever they may be.

After relevant inputs from BOCRA and any other stakeholder have been received and taken into account, InterConnect will finalise and publish the completed AS guidelines and associated documentation.

Question 26: Do respondents agree with the approach being proposed for introducing AS in Botswana?

Question 27: Which network operators do respondents suggest should be subjected to AS obligations? Please justify these suggestions.

12. Mobile Virtual Network Operators (MVNO)

As a result of the new ICT Licensing Framework which was introduced by BOCRA in September 2015 it is now easier for companies to enter the market as a Mobile Virtual Network Operator (MVNO). MVNOs have developed since the late 1990s and now exist in many countries around the world where the regulatory environment permits or encourages their development.

The key to a successful MVNO is initially its business plan and ability to address opportunities and build a sustainable market position. Many successful MVNOs are set up by companies such as supermarkets which already have a large loyal customer base or well-known brands (such as the Virgin Group) looking to extend their identity into new areas of activity. Others have focused on the targeted provision of specialised services to a particular demographic or market segment. The ongoing commercial relationship between the MVNO and its host MNO is also important and usually only works when both parties want the relationship to succeed.

The key difference between an MVNO and MNO is that the MVNO has no ownership or control of the radio spectrum used to provide the services. This remains with the MNO. However, the MVNO may deploy other network infrastructure from billing systems and customer management systems to MSCs and HLRs. The decisions to make such investments are customarily commercial ones taken by the MVNO.

There are a range of regulatory approaches to MVNOs. At the licensing level some countries require them to comply with a specific MVNO authorisation regime, the number of licenses made available under which (and perhaps even choice of MNO partner) may be restricted. Other countries favour service-based formal licensing systems not discriminating between MVNOs and other parties offering comparable products, 'light touch' general authorisation or notification regimes permitting activities within set parameters, or other similar arrangements which do not impose a regulatory limit on the number of MVNOs that can operate.

BOCRA wishes to encourage the development of MVNOs in Botswana, although it is unclear what opportunities there are given the current level of penetration already achieved by the three existing MNOs. This project does not include an assessment of the existing mobile market or a determination of whether there is the likelihood of successful MVNOs entering it or how many could succeed.

Within the project we propose to develop a suitable framework for price regulation if any is needed. Clarity about the approach to price regulation that BOCRA would be likely to adopt should reduce uncertainty for potential MVNOs and for MNOs alike and this should in itself encourage productive investment in this sector.

Question 28: Do respondents agree that a framework for price regulation will be helpful to the development of MVNOs in Botswana?

13. International Voice Transit

BTCL, Mascom and Orange each operate an international gateway to route their voice traffic in and out of Botswana. Each network operator has relationships with overseas carriers to deliver outgoing international traffic and to forward inbound international traffic.

As there is currently no mobile number portability in Botswana it is possible for an overseas carrier to know which network a call is destined for and therefore potentially only offer connectivity to a specific mobile operator. An arrangement however exists based on a differential termination rate depending on the point of origination of the call; calls which originate in Botswana are terminated at 0.295 Pula per minute whereas calls which originate internationally are terminated at a high price of US$0.14 – US$0.19 per minute.

It is clearly undesirable to encourage an arrangement which presents the opportunity for arbitrage between both network operators and also third parties who may take the opportunity to benefit from any such opportunities. Such arrangements can result in the proliferation of SIM boxes and other bypass arrangements which result in a reduced quality of service which is outside of the control of the network operators.

As there are three international gateway operators there is clearly competition for the inbound international voice traffic. We would want to better understand the issue and the impact on each operator before making recommendations to BOCRA as to whether the existing differential arrangement should continue or whether the termination rates for all calls should be the same irrespective of the place of origination.

Question 29: What information can respondents provide regarding this issue?

Question 30: What solution would respondents suggest is the most appropriate for this issue and what impact would it have on connectivity and quality of service for calls to Botswana?

14. On-net, Off-net Mobile Voice Tariffs

BOCRA is concerned about the relative retail price for off-net mobile voice calls when compared to on-net mobile voice calls. Despite the significant reduction in mobile interconnection charges over the past 4 years, which form a significant element of the cost of an off-net call to another network, there has been little, if any, change in the differential between the tariffs for these calls. This is leading to a proliferation of multiple SIMs and complex usage patterns by customers in order to minimize their costs by restricting the calling to on-net only.

The mobile cost modelling work will provide detailed information about the relative costs to the network operators and we will use this information to determine the cost difference to the network operators to provide the on-net and off-net voice calls. In addition we propose to analyse the traffic patterns both within and between the mobile networks in order to quantify the issue.

Taking into account international best practice, InterConnect will provide guidance to BOCRA as to how the disparities between on-net and off-net call tariffs could be regulated. Options which may be considered could include:

- Cost based regulation of retail voice tariffs;
- 2 part charging for off-net calls to clearly identify the interconnection outpayment;
- Apply a maximum differential between off-net and on-net voice call tariffs.

Question 31: Do respondents have any comments on the suggested approach and potential remedies to the issue of off-net vs on-net mobile voice tariffs?

Annex A: Summary of Consultation Questions

We provide below a summary of the consultation questions included within this document.

Question 1: Do respondents agree with the proposed approach to regulatory price control proposed in this section? Please justify your response. (Page 9)

Question 2: Are there other services which should be included in the service types described in this section? If yes, please provide details of the services and your justification of why they should be included? (Page 9)

Question 3: Do respondents have any comments on the proposed services to be benchmarked and their appropriateness to the market in Botswana? (Page 13)

Question 4: Do respondents agree with the proposed approach to benchmarking and the suggested countries for comparison purposes? (Page 15)

Question 5: Do respondents agree that LRIC+ is the appropriate costing methodology to be adopted in Botswana and that the same costing methodology should be used for both fixed and mobile networks? (Page 19)

Question 6: Do respondents agree that a bottom-up approach is appropriate? (Page 20)

Question 7: Do respondents agree that cost causation should be the primary principle for determining costs within the mobile model? (Page 21)

Question 8: Do respondents agree that Economic Depreciation is the preferred method for the mobile cost model? (Page 22)

Question 9: Do respondents agree that EPMU is the appropriate methodology for apportioning common costs? (Page 22)

Question 10: Do respondents agree that the cost allocation methodology outlined above is the appropriate way in which costs should be allocated within the cost models? (Page 23)

Question 11: Do respondents agree that licence and spectrum fee costs should be included within the cost models? (Page 23)

Question 12: Do respondents agree with this approach to modelling and the use of the model outputs? (Page 24)

Question 13: Do respondents agree with an approach to determining retail prices based on a retail mark-up on the wholesale costs? (Page 24)

Question 14: Do respondents agree that it is appropriate to model a single efficient mobile operator with a market share tending to 33.3% from a starting point of the current market shares for the existing operators over a number of years? (Page 26)

Question 15: Do respondents agree that it is appropriate to take into account all services being carried by mobile networks? (Page 27)

Question 16: Do respondents agree with the proposal to develop a multi technology mobile model to deal with both voice and data services? (Page 28)

Question 17: Do respondents agree with the proposed approach in relation to network structure in the mobile model? (Page 29)

Question 18: Do respondents agree that a broad increment expressed on an average basis and incorporating all network services is appropriate? (Page 29)

Question 19: Do respondents agree that a single network increment is appropriate? (Page 30)

Question 20: Do respondents agree that single models should be developed for access and core networks and that BTCL and Bofinet services should be included in these models? (Page 31)

Question 21: Do respondents agree that it is appropriate to take into account all services being carried by fixed networks? (Page 32)

Question 22: Should new fixed network technologies such as optical fibre and NGN be included in the fixed network models in a way that reflects a reasonable phasing-in of such technologies? (Page 32)

Question 23: Do respondents agree with the proposed approach in relation to network structure in the fixed model? (Page 33)

Question 24: Do respondents agree that a nominal, pre-tax WACC should be used? (Page 35)

Question 25: Do respondents agree that separate calculations of WACC should be carried out for use in the fixed (access and core) and mobile network models? (Page 35)

Question 26: Do respondents agree with the approach being proposed for introducing AS in Botswana? (Page 38)

Question 27: Which network operators do respondents suggest should be subjected to AS obligations? Please justify these suggestions. (Page 38)

Question 28: Do respondents agree that a framework for price regulation will be helpful to the development of MVNOs in Botswana? (Page 39)

Question 29: What information can respondents provide regarding this issue? (Page 40)

Question 30: What solution would respondents suggest is the most appropriate for this issue and what impact would it have on connectivity and quality of service for calls to Botswana? (Page 40)

Question 31: Do respondents have any comments on the suggested approach and potential remedies to the issue of off-net vs on-net mobile voice tariffs? (Page 41)

Annex B: Acronyms

2G/3G/4G	Second/third/fourth generation (mobile technologies)
ADSL	Asymmetric digital subscriber line
AS	Accounting separation
BSC	Base station controller
BTS	Base transceiver station
CAPM	Capital asset pricing model
CCA	Current cost accounting
EC	European Commission
ED	Economic depreciation
EPMU	Equi-proportionate markup
FAC	Fully allocated cost
FTTx	Fibre to the x (home, kerb, cabinet, node etc.)
Gbit	Gigabit (data rate)
HCA	Historical cost accounting
HLR	Home location register
HSDPA	High speed download packet access
HSPA	High speed packet access
HSUPA	High speed upload packet access
ICT	Information & Communications Technology
IP	Internet protocol
IPLC	International private leased circuit
ISP	Internet service provider
LRIC	Long run incremental cost
LTE	Long term evolution (4G+ mobile technology)
MB	Megabyte (data quantity)
Mbit	Megabit (data rate)
MEA	Modern equivalent asset
MHz	Megahertz
MMS	Multimedia messaging service
MNO	Mobile network operator
MSC	Mobile switching centre
MTR	Mobile termination rate
MVNO	Mobile virtual network operator
NGN	Next generation network
NPV	Net present value
RFP	Request for proposals
SAC	Stand alone cost
SIM	Subscriber identity module
SMS	Short messaging service
STM	Synchronous transfer mode

WACC	Weighted average cost of capital
WDM	Wave division multiplexing
Wi-Fi	Wireless internet (LAN)