Office of Utilities Regulation

Cost Model for Fixed Termination Rates – Principles and Methodology

Consultation Document

OFFICE OF UTILITIES REGULATION

Publication Date: January 19, 2015

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Comments from Interested Parties

Persons who wish to express opinions on this Consultation Document are invited to submit their comments in writing to the Office of Utilities Regulation ("OUR") by post, delivery, facsimile or e-mail addressed to:

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P.O.Box 593,
36 Trafalgar Road,
Kingston 10

Attention: Rohan Swaby

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Responses are requested by February 17, 2015.

Responses which are not confidential pursuant to sections 7(6) and 7A of the Telecommunications Act will be posted to the OUR's website (www.org.jm). Respondents are therefore requested, where possible, to supply their responses in electronic form to facilitate such postings.

COMMENTS ON RESPONSES

The OUR's intention in issuing this Consultation Document is to stimulate public debate. The responses to this Consultation Document are a vital part of that public debate. There will therefore be a specific period for respondents to view other responses (non-confidential) and to make comments on them. The comments may take the form of either correcting a factual error or putting forward counterarguments and/or providing data relating to cost, traffic, revenues, etc. **Comments on responses are requested by March 3, 2015.**

Arrangements for viewing responses

This Consultation Document and responses and comments received by the OUR will also be made available to the public through the OUR's Information Centre ("OURIC"). Persons who wish to view the Consultation Document, responses and comments should make an appointment by contacting **Kishana Munroe** (Co-ordinator OURIC/Information Officer) by one of the following means:

Telephone: (876) 968 6053 (or 6057)
Fax: (876) 929 3635
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Individuals with appointments should visit the OUR's offices at:

3rd Floor, PCJ Resource Centre,
36 Trafalgar Road,
Kingston 10

Photocopies of the Consultation Documents and selected responses and comments may be provided on request at a price which reflects the cost to the OUR.

CONSULTATIVE TIMETABLE

The timetable for the consultation is summarized in the table below:

Event	Date
Publish Consultation Document	January 19, 2015
Response to the Consultation Document	By February 17, 2015
Comments on Responses	By March 3, 2015
Issue Determination Notice	By April 14, 2015

Abstract

This Consultation Document has been prepared to facilitate discussion and consultation on the approach that the Office of Utilities Regulation (OUR) will take in the development of a cost model to calculate the cost of wholesale fixed interconnection services, in accordance with the requirements of the Telecommunications Act (the "Act").

The Act stipulates that prices shall be established:

- Based on forward looking long run incremental cost[1] for fixed termination.
- Between the total long-run incremental cost ("TLRIC") and the stand alone cost (SAC) in the case of other interconnection services.

This document explains the application of the Act to the determination of the cost and prices of wholesale fixed interconnection. It also sets out in some detail the OUR's plans to develop a generic bottom-up model dimensioned for the current traffic level using a modified scorched node approach based on the fixed networks operating in Jamaica (please see Chapter 6).

After receiving and considering the responses to this Consultation Document, the OUR plans to undertake the appropriate modelling and determine interconnection rates. In parallel, data requests have been sent to telecommunications operators (the "operators"). The data requested will be necessary regardless of the approach which is finally taken in the development of the cost model.

[1] Whereby the relevant increment is the wholesale termination service and which includes only avoidable costs.

Chapter 1: Legal and Regulatory Framework

1.1. As part of its overall functions to regulate specified services and facilities under section 4(1) of the Act, and in keeping with its express power to determine the rates which may be charged in respect of the provision of a prescribed utility service under section 4(4) of the Office of Utilities Regulation Act ("OUR Act"), the OUR is authorised to determine the prices charged by telecommunications operators for the provision of interconnection services.

Section 4(1)(a) of the Act states:

> "(1) The Office shall regulate telecommunications in accordance with this Act and for that purpose the Office shall -
>
> (a) regulate specified services and facilities"

Section 4(4) of the OUR Act states:

> "(4) The Office shall have power to determine, in accordance with the provisions of this Act, the rates or fares which may be charged in respect of the provisions of a prescribed utility service."

1.2. A "specified service" is defined in section 2 of the Act to mean, inter alia, a telecommunications service, while a "prescribed utility service" is defined in section 2 and the First Schedule of the OUR Act to include the provision of telecommunications services.

1.3. The legal framework governing interconnection, which is a type of telecommunications service, can be found in Part V (sections 27-37A) of the Act.

1.4. The Act at Section 29 (1) states:

> *"Each carrier shall, upon request in accordance with this Part, permit interconnection of its public network with the public network of any other carrier for the provision of telecommunications services".*

1.5. The Act grants the OUR specific powers with regard to the determination of tariffs charged for interconnection services. Sections 29 (4)(a) and (5) state:

> *"(4) The Office may -*
>
> *(a) on its own initiative, in assessing an interconnection agreement, make a determination of the terms and conditions, including charges;*
>
> *…*
>
> *"(5) When making a determination of an operator's interconnection charges, the Office shall have regard to -*
>
> *(a) the principles of cost orientation or reciprocity;*
>
> *(b) local or international benchmarks; or*
>
> *(c) any other approach that is relevant to the determination of interconnection charges."*

1.6. The Act at section 30 requires that dominant public telecommunications carriers provide interconnection in accordance with various principles. In particular section 30 (1)(a)(iii) requires that charges for interconnection services "…*shall be cost oriented and guided by the principles specified in section 33".*

1.7. These principles of cost orientation are stated in Section 33 as follows:

> *"(1) Where the Office is required to determine the charges for the provision of interconnection by a dominant carrier, it shall, in* making that determination, be guided by the following principles -
>
> *(a) costs shall be borne by the carrier whose activities cause those costs to be incurred;*

(b) non-recurring costs shall be recovered through non-recurring charges and recurring costs shall be recovered through recurring charges;

(c) costs that do not vary with usage shall be recovered through flat charges and costs that vary with usage shall be recovered through charges that are based on usage;

(d) costs shall include attributable operating expenditure and depreciation and an amount estimated to achieve a reasonable rate of return;

(e) with the exception of interconnection charges for wholesale termination services, interconnection charges shall be established between the total long run incremental cost of providing the service and the stand alone cost of providing the service, so, however, that the prices shall be so calculated as to avoid placing a disproportionate burden of recovery of common costs on interconnection services;

(f) where appropriate, interconnection costs shall include provision for a supplementary charge, being a contribution towards the access deficit of the interconnection provider; and

(g) in the case of charges for wholesale termination services, charges shall be calculated on the basis of forward looking long run incremental cost, whereby the relevant increment is the wholesale termination service and which includes only avoidable costs.

(2) Where the Office has been unable to obtain cost information that it is reasonably satisfied is relevant and reliable it may take into account local and international benchmarks, reciprocity and any other approach that in the opinion of the Office is relevant."

1.8. In keeping with its express statutory powers to determine the charges for interconnection services as mentioned above, the OUR now embarks on

this consultation exercise to develop a cost model for the determination of costs and associated charges for wholesale fixed interconnection services.

Chapter 2: Introduction

2.1. Having determined that Cable & Wireless Jamaica Limited (“LIME”) is dominant with respect to the fixed call termination service offered and given the mandatory requirement that interconnection tariffs must be cost oriented, the OUR needs to ensure that the charges imposed for this service conform to statutory requirements. While LIME is currently the only operator which has been found dominant with respect to fixed call termination service, the model to be developed will estimate a cost for interconnection services for a generic fixed line operator such that the rates from the model can be applied to any fixed network operator found to be dominant in the future. That is, the model will not calculate a cost specifically for LIME’s fixed network.

2.2. The OUR will develop a cost model to determine the cost oriented rate for interconnection services. "Cost orientation" is a term that covers a range of costing standards. The purpose of this consultation is to set out in more detail the approach the OUR intends to take with respect to determining the cost oriented rates and to seek comments on this approach. This Consultation Document therefore addresses issues such as:

- Whether a top-down or a bottom-up model should be used (Chapter 3: General Characteristics of the)
- What period of time will be modelled (Chapter 3: General Characteristics of the)
- Which sources of information will be used to populate the model (Chapter 3 : General Characteristics of the)
- How costs will be allocated to services (Chapter 4: Costs)
- How common costs will be allocated to services (Chapter 4: Costs)
- Which costs should be included (Chapter 4: Costs)

- How the operating expenditures will be calculated (Chapter 4: Costs)
- How capital expenditures will be calculated and annualised (Chapter 4: Costs)
- Which operator will be modelled (Chapter 5: Definition of the Reference Operator)
- What should be the main characteristics of the network modelled (Chapter 6: Network)
- What services will be offered by the modelled operator (Chapter 6: Network)
- How the increments will be defined (Chapter 6: Network)
- Whether different prices should be set for peak and off-peak times (Chapter 7: Glide Paths, Price Gradients and)
- Whether the change in prices should be introduced through a glide path (Chapter 7: Glide Paths, Price Gradients and)
- What should be the charging basis for the fixed termination rate (Chapter 7: Glide Paths, Price Gradients and)

2.3. Following this consultation, the OUR plans to proceed with the development of a suitable model. The results will be sent to the operators for comment and then the OUR will determine the wholesale interconnection rates for a period of five (5) years (from 2016 to 2020), taking account of any further comments from the operators.

Chapter 3: General Characteristics of the Model

Main Modelling Approach

3.1. There are two different types of models that can be used:

- **Top-down long run incremental cost models:** The main input of these models is the costs of the company from the general ledger (both OpEx and CapEx). Based on a number of steps (generally 2-3) and a number of allocation criteria, these costs are distributed between the final services. Top-down models ensure full calibration with the costs of the operator but do not allow forecasting and have limited power to identify inefficiencies. These models are not able to calculate the costs for theoretical operators.

- **Bottom-up long run incremental cost (BULRIC) models:** The calculations are based on a set of basic inputs (e.g. demand, coverage, geographical and technical information). Based on a number of engineering rules, the network is modelled from scratch and the number of network elements obtained. The cost of the network is calculated based on the network elements and their unitary costs, which are allocated to the services based on certain criteria. This approach does not calibrate exactly with the financial accounts of the operator, but it can be properly calibrated to accurately represent the operations in the country. Bottom-up models allow the calculation of forecasts, what-if analysis, different scenarios, etc. Additionally, the model is able to obtain the costs of a reference operator that is not exactly the same as one of the operators in the market (theoretical operator). However, certain non-network costs can be difficult to model by a bottom-up approach (especially retail costs).

3.2. The OUR proposes to develop a single bottom-up model.

3.3. The reasons for this approach are the following:

- Compared to top-down models, bottom-up models are more amenable to sensitivity analysis.

- Bottom-Up models offer greater transparency than a top-down approach as the inputs, engineering rules and assumptions used in a bottom-up engineering model are all visible and can be more objectively tested. Transparency and visibility are important to help address the information disadvantage that the regulator has compared to the regulated operators.

- Bottom-up models are state of the art according to the European Commission's Recommendation.

- In developing the bottom-up model, the OUR will take account of whatever top-down information is provided by the operators and will make sure that bottom-up models are realistic. With this approach, the most important limitation of bottom-up models (see above: *"does not calibrate exactly with the financial accounts"*) will be neutralised.

- As far as the OUR is aware, the fixed operators in the Jamaican market do not have in place reliable and updated regulatory cost accounting (top-down) systems. Given this circumstance, a bottom-up model is the most practicable approach.

Question 1: Do you agree with the proposal to use a bottom-up model? Please explain your views.

Period of Time Modelled

3.4. Given that the unit costs of services calculated depend on the demand at a specific point in time, the period of time modelled will be crucial in the scope of the possible analyses of the model's results.

3.5. The model should include, at least, one past year to allow a proper calibration with the reality of the telecommunications operations in Jamaica.

3.6. Therefore, the OUR considers that a time frame starting in the year 2013 (which is the last year full financial year) would ensure the proper calibration of the model.

3.7. It is the intention of the OUR to define wholesale interconnection rates for a period of five years. Taking into account that the model is expected to be ready at the end of 2015, the OUR will define the wholesale interconnection rates for the period 2016 to 2020.

3.8. Based on the above, the OUR proposes that the LRIC model covers the period 2013-2020, with interconnection rates set for the period 2016 - 2020.

Question 2: Do you agree with the decision of covering the period 2013-2020? Please explain your views.

Data Sources

3.9. BULRIC models require a significant number of inputs to be able to model the network accurately and to reliably represent the specificities of the Jamaican market. Data required includes inter alia, information about traffic volumes, traffic statistics and patterns, number of network elements, location of network sites, network dimensioning rules or CapEx and OpEx unit costs.

3.10. The OUR plans to use the information provided by the operators as a primary and preferential source to populate and calibrate the BULRIC Model. To do so, the OUR will issue one or more data requests and will engage with the operators to facilitate the exchange of information. The OUR expects swift and close co-operation by all operators concerned to ensure the completeness and accuracy of the data gathered.

3.11. Data provided by operators in this process shall be regarded as confidential by the OUR, unless other treatment is justified. Information which is already in the public domain will not be considered as confidential.

3.12. In cases where data are not available, or not provided by the operators, the OUR will resort to the use of international benchmarks as the preferred alternative data source.

3.13. In cases where a particular piece of data provided by the operators is not considered sufficiently reliable by the OUR (for instance, in the case of a material deviation versus the international norm or in the presence of large variations in the values provided by different operators) the OUR will communicate this to the operator concerned to justify the value provided with supporting evidence. In the event that such justification is not deemed acceptable, and thus the provided data is not considered to be sufficiently reliable, the OUR may resort to the use of international benchmarks as the preferred alternative data source.

3.14. The illustration below shows the decision tree the OUR will apply in determining the appropriate data sources for the implementation of the BULRIC model.

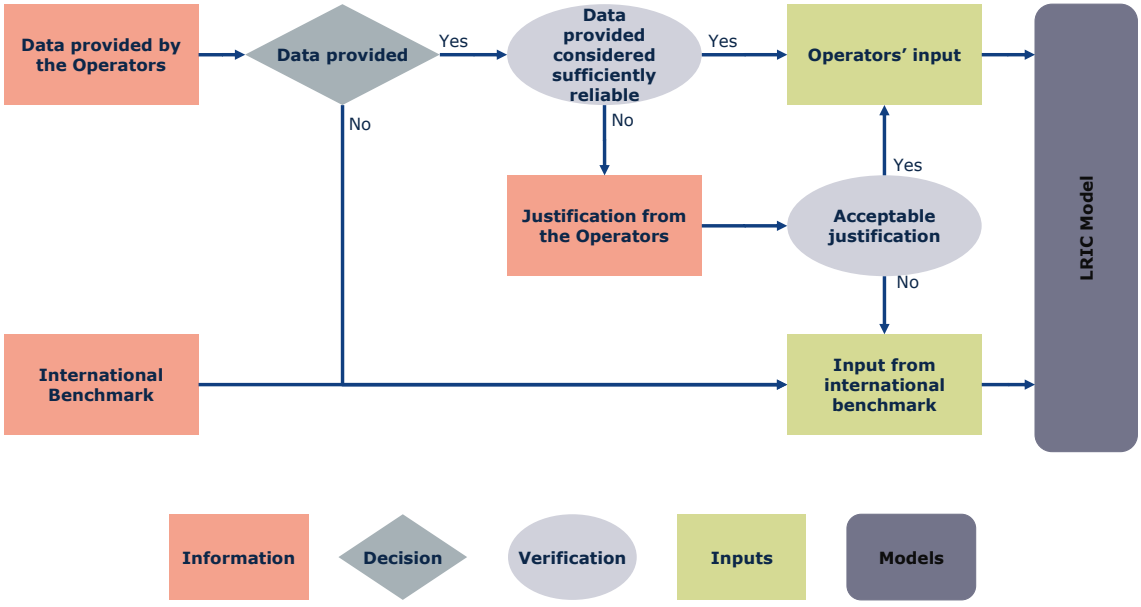

Exhibit 3.1 Diagram of OUR's data revision process. [Source: Axon Consulting]

3.15. Additionally, the BULRIC model is planned to cover a period up to the year 2020 (see section "Period of Time ") and, therefore, forecasts are required, especially for traffic demand. In the opinion of the OUR, the operators are

the most appropriate source of this kind of information as demand forecasting is an activity required for the preparation of business plans.

3.16. However, the reasonability and feasibility of the forecasts provided by the operators will be assessed by the OUR to ensure they are aligned with recent and expected market trends. In case the forecasts provided are considered non-reliable, the OUR will use its own knowledge of the Jamaican market to estimate a reasonable level of demand for future years.

3.17. Therefore, the OUR proposes to rely on the forecasts developed by the operators as the primary and preferential source of future data for the development of a BULRIC model.

Question 3: Do you agree with the proposed data sources to be used? Please explain your views.

Chapter 4: Costs Treatment

Cost Standard

4.1. The selected standard for network costs is a key issue in wholesale service costing. The methodological approaches that are more commonly followed for distributing network costs to services are outlined below:

- **Fully Allocated Costs (FAC):** this methodology attributes all the network costs (including common and joint costs) to services, based on the utilisation each service makes of the different network assets.

- **Pure Long Run Incremental Costs (Pure LRIC):** this methodology calculates the costs that would be saved if certain services, group of services or activities (defined as an increment) were not provided (avoidable costs). These incremental costs are aligned with the variable costs in the long run. Using this approach, neither common costs, nor joint costs are allocated to the services.

- **Long Run Incremental Costs plus Common Costs (LRIC+)**: unlike the pure LRIC approach, this allows the recovery of common and joint costs that are not incremental to any given service. This approach corresponds to the TLRIC standard defined in the Act.

- **Stand Alone Costs (SAC):** it calculates the costs of a network developed to provide only a group of services (increment).

4.2. As described in Chapter 1, the Act specifies that interconnection rates (with the exception of termination) should be between TLRIC (LRIC+) and SAC.

4.3. In the case of termination services, the Act states that the charge should be based on the avoidable costs (Pure LRIC).

4.4. Based on the constraints of the Act, the OUR needs information about service costs under the three standards (Pure LRIC; LRIC+ and SAC). Therefore, the OUR proposes that the BULRIC model includes these three standards.

4.5. In the case of the LRIC+ standard, it is important to define how the common and joint costs are allocated to the services. The following subsections address this topic, that is divided into:

- Allocation of common and joint network costs
- Allocation of common and joint non-network costs

Allocation of Common and Joint Network Costs for the LRIC+ Standard

4.6. As indicated earlier, the LRIC+ cost standard incorporates a fair share of common and joint costs. Thus, a methodology needs to be defined to establish the criteria that will be employed for cost allocation to services; in other words, to define what 'fair share' of these costs each specific service should bear.

4.7. The OUR has identified a number of potential methodologies that can be used for the allocation of common costs:

- **Equi-Proportional Mark-Up (EPMU) -** allocating common and joint costs to services in proportion to their incremental costs. This method is commonly used and it is simple to implement.
- **Efficient Capacity[2] -** allocates common and joint costs based on the capacity used by each service at the busy hour.
- **Shapley-Shubik -** consists of setting the cost of a service equal to the average of the incremental costs of the service after reviewing every possible order of arrival of the increment.

[2] Also called required capacity.

- **Ramsey Pricing -** recovers common costs from the services, based on the services' relative marginal cost of production and price elasticity.

4.8. The Ramsey Pricing approach is generally perceived as the most relevant approach in economic terms for common costs recovery, however the high level of complexity and data involved in its calculation has proven to be a considerable burden in its implementation. No national regulatory authority (NRA) is known to have adopted this approach in practice.

4.9. Alternatively, the EPMU approach is commonly employed as a considerably more workable solution. While the EPMU approach has the advantage of simplicity, it may also present severe limitations, particularly in cases where common and joint costs represent a significant amount of the cost base.

4.10. A main difficulty using the EPMU approach may arise when there are common and joint costs that may be common to several increments, but may not necessarily be relevant for all services. This is often the case of common and joint costs related to the network. The following exhibit illustrates this phenomenon in the particular case of a fixed BULRIC model, showing how there are different types of common and joint costs that may be relevant to different increments and services:

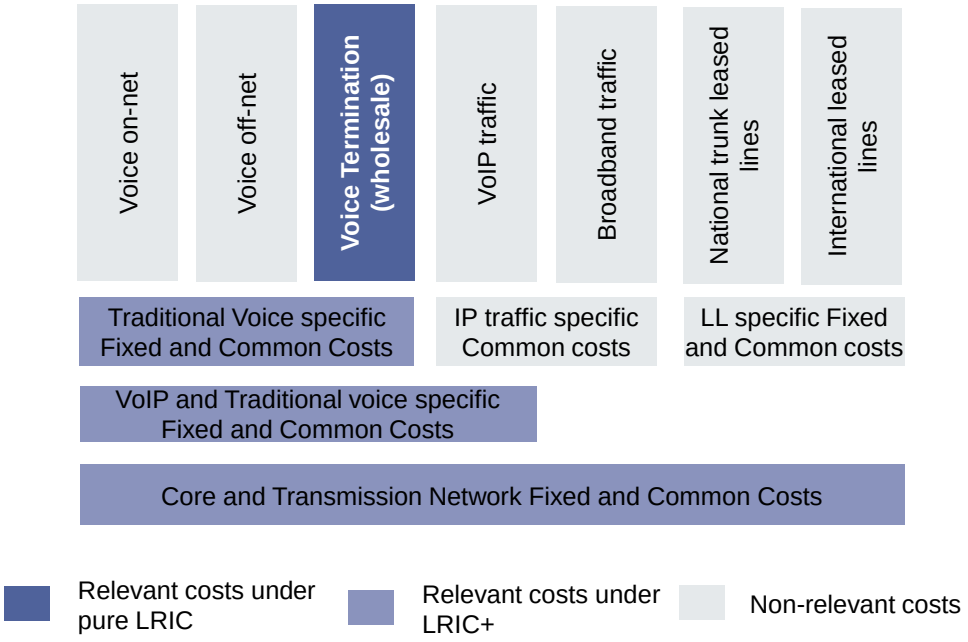

Exhibit 4.1: Example of relevant incremental costs under both the pure LRIC and LRIC+ standards of fixed voice termination [Source: Axon Consulting]

4.11. It would be inaccurate, in such cases, to allocate all common and joint costs indistinctly based on a simple mark-up of purely incremental costs. A potential solution to this problem is the use of combinatorial analysis, by which different combinations of increments are run to more accurately identify those costs that are common, only to a sub-set of increments or services. This, however, results in a significant complication in the design of the BULRIC model and reduces transparency of cost calculations.

4.12. Based on the above, the most appropriate methodologies for the allocation of common and joint network costs are 'efficient capacity' and Shapley-Shubik.

4.13. During the consultation processes issued in the context of the LRIC model for mobile networks, there was a debate to decide which of these methodologies is more appropriate. In the determination notice published on 24th July 2012, the OUR concluded:

> *"the 'required capacity' approach may not favour the development of new services that are heavy consumers of bandwidth, the Office believes that the Shapley Shubik approach is worth being*

implemented when calculating the TLRIC rate. This method can provide more stability to operators' revenues and is more forward looking."

4.14. On the other hand, it is important to note that the implementation of the Shapley-Shubik approach implies higher modelling complexity. Despite the higher complexity, the OUR believes that the Shapley-Shubik approach is more appropriate. Moreover, applying this methodology in the model for fixed termination would ensure consistency with the methodology applied in other models used by the Office. Therefore, the OUR proposes the use of Shapley-Shubik approach for the allocation of network common and joint costs to services.

Allocation of Non-Network Common Costs for the LRIC+ Standard

4.15. As indicated in Chapter 4, the OUR intends to include general and administrative (G&A) costs as part of the cost base to be considered in the BULRIC model.

4.16. Unlike network-related common and joint costs, those common costs related to G&A are normally only relevant to a particular set of services. Establishing a measure of 'efficient capacity' for such costs is often not obvious. The OUR thus intends to employ an EPMU to allocate G&A common costs to services under the LRIC+ standard.

Question 4: Do you agree with including Pure LRIC, LRIC+ and SAC standards in the BULRIC model and the methodologies chosen for the allocation of common and joint costs? Please explain your views.

Costs Elements to be Considered

4.17. BULRIC models may include a number of cost elements, which can typically be classified within the following groups:

- Network CapEx
- Network OpEx
- Licences, frequency usage fees and way fees

- Retail costs
- G&A costs

4.18. The categories listed above are analysed in the following sections:

Network CapEx

4.19. Network CapEx includes the investments made by the operators for developing the network. More specifically:

- Network equipment purchasing (for example, switches), including related software;
- Network infrastructure (for example, network buildings, ducts);
- Supporting IT systems such as network OSS;
- One-off fees for subcontracted network services (for example, leased lines activation charges);
- Installation costs associated with the items above.

4.20. The OUR proposes that all the listed CapEx elements related to the modelled network and its installation costs should be included in the BULRIC models.

4.21. Notably, the section titled: ***Treatment of Capital-Related Costs*** addresses the annualisation method which is to be applied to CapEx. This is the way in which the network CapEx will be recovered along the useful life of the asset.

Network OpEx

4.22. Network OpEx includes the recurrent costs associated with operating the network. This includes:

- Network personnel;
- Outsourced maintenance services;

- Power (electricity and fuel);
- Recurrent charges for subcontracted network services (for example, leased lines, dark fibre);
- Network sites rentals and other administrative fees or taxes.

4.23. The OUR proposes the consideration of all the categories of network OpEx listed above.

Licences, Spectrum Fees and Way Fees

4.24. Licence costs and spectrum fees represent a significant cost to telecommunications operators. They have different purposes:

- Licences are related to the permission required to provide telecommunications services to the public, and they can take the form of annual or one-off fees. Both options will be considered in the models. They are commonly considered a non-network common cost and are included in BULRIC model as part of G&A costs;
- Spectrum fees (for example, microwave links) represent the rental of a resource that is essential for the network, and they can take the form of annual or one-off fees. Although the spectrum is crucial when using microwaves transmission, the fees represent a negligible cost within the overall fixed network costs. Therefore the OUR considers that microwave spectrum fees are not considered in the model, unless the operators prove that they represent a relevant part of their costs.
- Way fees represent the payments related to passing cables (and supporting infrastructure such as poles) through the property of a third party (for instance a piece of land or a building).Since these fees are mostly used for the development of the access network (which is not expected to be included in the model as described in

chapter 6), the OUR proposes that way fees are not included in the model for fixed networks.

Retail Costs

4.25. The retail costs can be divided into the following categories:

- Marketing
- Sales
- Commissions to dealers
- Cost of Goods Sold (terminals, SIM cards, interconnection payments, etc.)
- Customer care
- Billing and invoicing
- Content and valued added services

4.26. The cost categories listed above are related to the provision of retail services and should not be allocated to wholesale services. Additionally, it is important to note that modelling retail costs based on a bottom-up approach could divert the efforts that should be dedicated to network modelling.

4.27. The OUR is of the opinion that retail costs should be included in the model to ensure the accurate representation of all operations of the fixed network. They will be included in the model based on relatively simple mechanism based on the real costs of the operators and simple allocation criteria, namely:

- Marketing, sales and commissions to dealers: allocation to all retail services based on the traffic. If it is possible, a previous allocation to group of services (i.e. voice, broadband, leased lines) will be done based on the information available at operators' accounts. Notably, these costs are associated to both access and traffic services, only the costs associated to the latest will be included in the model. The percentage of costs included in the model will be based on the percentage of revenues associated to traffic services over the total revenues of the fixed services.

- Cost of Goods Sold: The costs associated to terminals are associated to the access and they will not be included in the model. Regarding interconnection costs, they will be allocated to the related services based on consumption (i.e. minutes).

- Customer care, billing and invoicing: These costs are associated mainly to the subscription (access) and therefore they will not be included in the model.

- Content and valued added services: They will be allocated to the services associated to these costs. If allocation to more than one service is required, it will be based on the traffic.

General & Administrative Costs

4.28. G&A costs are associated with management activities and are common for network and commercial activities (human resources, finance, management, etc.). It is common practice to include G&A costs in BULRIC models based on a mark-up on top of network costs.

4.29. The OUR proposes to include G&A costs in the BULRIC models based on a mark-up percentage on top of costs. This percentage will be calibrated based on the data provided by the operators (see Chapter 3).

Cost of Capital

4.30. Costing of services needs to take into account a reasonable amount of return on the invested capital an operator would be able to earn in a truly competitive market. In order to estimate this reasonable amount of return, the OUR proposes the use of **Weighted Average Cost of Capital (WACC)**, which is defined as the sum of the weighted cost of equity and debt. These weights are based on the market value of debt and equity, respectively.

4.31. The use of the WACC is the overwhelmingly preferred mechanism to reflect a reasonable regulated profit level in the telecommunications industry and is a de-facto international standard in the implementation of BULRIC models.

4.32. To set the appropriate rate of return, the OUR will apply the WACC approved in the determination "Determination Notice for Estimate of the Weighted Average Cost of Capital for Telecommunications Carriers" Document No: TEL2009005_DET001 of December 9th, 2010. Specifically, the pre-tax point estimate for fixed networks will be used (24.39%).

4.33. The section on **Treatment of Capital-Related Costs** addresses the annualisation method to be applied to CapEx, which incorporates the effect of the cost of capital, based on the WACC value.

Question 5: Do you agree that Network CapEx, Network OpEx, Licence, Retail costs, G&A Expenses, and Cost of Capital should be included in the cost base of the BULRIC Model in the manner indicated? Please explain your views.

Treatment of OpEx

Determination of Network-related Operations and Maintenance Costs

4.34. Network-related operations and maintenance costs commonly represent a significant part of the operators' costs. Therefore, the precise calculation of these costs is a major factor to take into consideration when designing a BULRIC model.

4.35. There are two common methodological approaches when considering the operating costs associated with the operation and maintenance of the network, which are outlined below:

- **Based on percentages over CapEx**: OpEx is calculated indirectly using a percentage provided by operators. Operators often provide an estimation of what represents the annual operating cost expressed as a percentage of the investment. Also, some NRAs have estimated these percentages (for example,

ComReg considered the OpEx related to DSLAMs as 10% of the investment[3])

- **Based on bottom-up calculation** (unit cost per element): the cost is calculated directly from bottom-up modelling of the operating costs for the modelled network. For instance, power costs can be calculated based on average kwh consumption per site and the average cost per kwh paid by the operators in the market.

4.36. The international practice shows that both methodologies are valid approaches to determine Network OpEx, and reveal that a combination of both is frequently employed on a case-by-case basis. For instance, the United Arab Emirates' telecommunications regulatory authority (TRA), whose approach is based on percentages over CapEx, states in its public consultation[4] that the bottom-up approach requires a detailed examination of each of the activities undertaken by the operator in question and, as a result, bottom-up models have tended to use other methodologies. On the other hand, Bahrain's TRA states in its public consultation[5] that:

> *"Operating costs should be calculated using the operators' actual costs (top-down) with adjustments, or with a bottom-up calculation depending on the feasibility".*

4.37. In the OUR's view, the calculation of OpEx, based on a percentage of CapEx is not an optimal practice, especially since the ratios are commonly obtained from top-down models and may not necessarily be representative or applicable to BULRIC models.

4.38. The OUR proposes that OpEx will preferably be based on bottom-up calculations in those cases where such bottom-up determination of OpEx

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[3] See ComReg, Wholesale Broadband Access Consultation and draft decision on the appropriate price control, Document No: 10/56
[4]The Development of bottom-up LRIC Models of Telecommunications Network in the UAE, July 2012
[5]Development, implementation and use of bottom-up fixed and mobile network cost models in the Kingdom of Bahrain, May 2011

is feasible and adequate data is available. For those specific cases where there may be not enough information available, it would be preferred to calculate OpEx as a percentage over CapEx.

Determination of General and Administrative Costs

4.39. General and Administrative costs (G&A) include the expenditure related to the management of the company and supporting departments, which are mainly the costs associated to the General Management and Finance, Human Resources and Legal functions.

4.40. The consideration of the G&A will be made taking into account that LIME has both fixed (access and traffic) and mobile operations under one company. Under this consideration, the G&A expenses that will be included in the model for fixed interconnection will be the ones allocated to the fixed traffic services according to their earnings compared with the total company.

Question 6: Do you agree with the proposal on the treatment of OpEx in the BULRIC models? Please explain your views.

Treatment of Capital-Related Costs

Assets Valuation Method

4.41. The OUR identifies two main potential approaches to be used for assets valuation:

- A **static approach,** by which all the assets are valuated based on the price of the year. Depending on how the unitary price is calculated there are two methodologies:
  - Historical Cost Accounting (HCA) is the average price paid historically by the company to acquire an asset, based on the operator's book
  - Current Cost Accounting (CCA) reflects the current and expected market value of the assets

- A **cash-flow** methodology, by which asset acquisitions are valued per the unitary price for the year when they are purchased. Unitary prices then vary over time, based on cost trends for each asset type

4.42. The cash-flow methodology is more comparable to the real operations of an operator. However, its implementation is complex. Moreover, when applying tilted annuities (see section **Annualisation** below) and a yearly dimensioning approach (see section Network Dimensioning in Chapter 6), the results are equivalent to the static CCA approach.

4.43. The OUR considers the static CCA approach to be a more appropriate choice, since it sends accurate price signals in the market and avoids increasing the complexity of the model unnecessarily.

Question 7: Do you agree with the OUR's view in how assets should be valued? Please explain your views.

Consideration of Modern Equivalent Assets

4.44. The concept of forward-looking costs generally requires assets to be valued using a Modern Equivalent Asset (MEA). A Modern Equivalent Asset is defined by the IRG as:

> *"The lowest cost asset, providing at least equivalent functionality and output as the asset being valued".*

4.45. These assets should correspond to the ones a new operator would be expected to employ to build a new network.

4.46. According to the Accounting Guide published by the ITU[6],

> *"Modern Equivalent Assets (MEA) should be used whenever it is possible, as it is the most accurate valuation criterion to reflect the*

[6] 'International Telecommunication Union Regulatory Accounting Guide', 2009

cost of an efficient operator, since it will capture the associated costs (and efficiencies) that an entrant/alternative operator would face, if entering into the market at a specific time."

4.47. Accordingly, the OUR proposes that the telecommunication equipment is substituted for an MEA in the case that the existing asset is not commonly installed by new entrants in the telecommunications industry. For instance, traditional switching nodes should be substituted for newer technologies, like soft-switching based network. The section **Technologies to be** (in Chapter 6) describes in detail the technologies that will be considered in the model.

Question 8: Do you agree with the OUR's view in the application of MEA? Please explain your views.

Annualisation Method

4.48. The pattern of cost recovery over time is critically dependent on the depreciation methodology assumed. The OUR is of the opinion that, when estimating the annualised costs for assets, the Financial Capital Maintenance (FCM) principle should be considered. The concern of the FCM is to maintain the financial capital of the company. This maintenance is achieved when the value of shareholder funds is the same in real terms at the start and at the end of the period. In practical terms, the FCM principle ensures that the costs incurred for the provision of services are recovered, including an appropriate level of profit, as discussed in the section '**Costs Elements to be** '.

4.49. A number of annualisation methods may be used, which are compatible with the FCM principle:

- **Straight line depreciation** is the method most commonly used in financial accounts. It simply spreads the original cost of an asset evenly across its economic lifetime. The method is popular because of its simplicity, but is criticised for not reflecting economic reality. It also ignores the cost of capital, which must be calculated separately.

- **Standard Annuity** also spreads the cost of an asset over its economic life, but in addition takes into account the opportunity cost of capital, i.e. the interest forgone which would have been earned had the cash been invested elsewhere. Therefore, annuities consist of two separate elements: the annualised cost of the asset (depreciation), and a financing or cost of capital charge. In a standard annuity, the annual charge remains constant over the life of the asset. Again, the method has been criticised for failing to reflect the true depreciation profile of the asset.

- **Tilted Annuity** relaxes the assumption of constant prices. In telecommunications networks, equipment prices tend to fall over time, whereas infrastructure costs (digging trenches, for example) tend to rise over time. If, for example, the standard annualisation method does not take into consideration falling prices, Entrant 2 would have an advantage over Entrant 1 as it would benefit from lower asset prices and consequently lower depreciation charges. When asset prices are falling, a tilted annuity recovers more of the capital value in the early years (and vice versa), which ensures that two entrants with an identical asset base, though acquired in different periods, have identical depreciation charges

- **Economic depreciation / Adjusted Tilted Annuity.** Economic depreciation is defined as the period-by-period change in the market value of an asset. The market value of an asset is equal to the present value of the net cash flows that the asset is expected to generate over the remainder of its useful life. As net cash flows vary with output, assets are depreciated at a rate consistent with use, resulting in a true depreciation profile. In practice, given the difficulty of objectively determining the economic depreciation, this is approximated by an **adjusted tilted annuity**, in which the tilt in the amount of depreciation each year incorporates, in addition to the variation in the asset price, the amount of output produced by the asset.

4.50. International practice shows that the tilted annuity and the economic depreciation/adjusted tilted annuity are the most commonly used methods when implementing BULRIC models.

4.51. The OUR considers the tilted annuity approach as the preferred annualisation methodology, as it offers the best equilibrium between economic accuracy and ease of implementation. The tilted annuity allows the consideration of the evolution of network prices, while avoiding potential deviations due to uncertainty of traffic forecasts, which can affect the calculations in the case that an economic depreciation/adjusted tilted annuity method is used.

4.52. The useful lives of each asset class will be determined based on the data provided by the operators, with the safeguards described in Chapter 3 in cases where the data provided present material deviations from internationally accepted useful lives.

Question 9: Do you agree with the OUR's view to implement tilted annuities in the BULRIC model? Please explain your views.

Treatment of Working Capital

4.53. Working capital is the amount of capital that a company uses in its day-to-day trading operations. More formally, the working capital is calculated as the current assets minus the current liabilities. If positive, this working capital generates revenues; if negative, it generates financial costs for the operator.

4.54. The OUR will consider working capital requirements in its BULRIC Model.

4.55. Working capital comprises network CapEx, network OpEx and Retail components.

- CapEx-related working capital refers to the fact that an operator requires a certain period of time before equipment can be fully installed and operational, and thus start generating revenues. The BULRIC Model to be developed by the OUR will capture this effect

through the use of the planning-horizon concept[7], which avoids the need to include it in the depreciation formulas. The OUR thus believes that no additional mechanism is required to consider network CapEx-related working capital beyond that use.

- On the other hand, network OpEx working capital mainly reflects the liquidity that any company must maintain in order to operate all network-related payments swiftly, such as network staff or site rentals, and to finance the gap between the time these costs are incurred and revenues are generated. The OUR considers that, in the case where operators justify that the working capital associated to network OpEx has been efficiently incurred and presents a certain level of materiality, it should be incorporated in the BULRIC models. The working capital will be calculated as a percentage of OpEx for each year, based on information provided by the operators.

- In the case of retail activities related working capital, it is proposed that these be incorporated in the retail costs to be included in the model, as described in the section **Costs Elements to be** .

Question 10: Do you agree with the OUR that Network OpEx Working Capital (and not CapEx related) should be considered in BULRIC Models, provided it is relevant and has been efficiently incurred? Please explain your views.

[7] Planning-horizon concept represents that the operators usually anticipate the purchasing of network equipment in order to capture the time encompassed between the purchase of a resource and its commissioning. This concept also takes into account that the resources are dimensioned to satisfy the demand within a period of time, without requiring capacity upgrades. Note that the planning-horizon concept already includes any required working capital term related to the Network CapEx, as it already accounts for the time elapsed between the purchase of the equipment and its commissioning.

Question 11: Do you agree with the OUR that Retail Working Capital should be included in the retail costs considered? Please explain your views.

Chapter 5: Definition of the Reference Operator

5.1. One of the most important methodological issues to be defined for the development of BULRIC models is the kind of operator that will be modelled - the so-called reference operator. One of the following options can be adopted:

- Developing one BULRIC model for each fixed operator in the market;
- Developing a BULRIC model that represents a hypothetical generic existing operator; or
- Developing a BULRIC model representing a hypothetical generic new entrant.

5.2. Unlike in the case of mobile networks, it is often difficult to define a generic operator for a fixed network that has enough economies of scale to be efficient. For example, the European Commission stated the difficulty in defining a generic fixed operator for BULRIC modelling:

> *"When deciding on the appropriate single efficient scale of the modelled operator, NRAs should take into account the need to promote efficient entry, while also recognising that under certain conditions smaller operators can produce at low unit costs by operating in smaller geographic areas. Furthermore, smaller operators which cannot match the largest operators scale advantages over broader geographic areas can be assumed to purchase wholesale inputs rather than self-provide termination services."*[8]

5.3. Accordingly, the most common international practice is for BULRIC models to represent a fixed operator with a demand similar to the incumbents.

[8] European Commission – Explanatory note on the recommendations of TR - 2009

5.4. In the case of Jamaica, there is one fixed-line operator with national coverage at present: LIME.

5.5. On the basis of this reality, and in agreement with international practice, the OUR proposes to model a reference operator which will have similar characteristics to the incumbent, LIME. In particular, the reference operator will be presumed to have the same demand as LIME.

Question 12: Do you agree with the OUR that the BULRIC model for fixed interconnection should consider a reference operator with the characteristics described above? Please explain your views.

Chapter 6: Network Details

Network Dimensioning Optimisation Approach

6.1. In BULRIC models, two different approaches are generally identified in the dimensioning and optimisation of a network, which may have a direct impact on the services' cost:

- Yearly approach: It estimates the number of assets for a given year without taking into consideration the network status in previous years; and
- Historical approach: Dimensioning relies on the network built in previous years.

6.2. The OUR is of the opinion that the yearly approach is the most appropriate to send accurate pricing signals in the market, due to the fact that its results represent the optimum network for each year. Additionally, the yearly approach avoids introducing unnecessary complexity into the models. At the same time, it should be noted that when traffic demand is increasing year on year, these two approaches tend to produce similar results.

Question 13: Do you agree with the OUR that the BULRIC model should be based on a yearly approach and that a forward-looking filtering tool should be implemented? If not, please explain your views.

Fixed Services and Increments

List of Services

6.3. The BULRIC model for fixed interconnection should include the services provided, or those that shall be provided in the foreseeable future, by the operators in Jamaica at a level of disaggregation that allows the accurate modelling of the networks and their costs. On the other hand, it is important not to over-split the services so as to avoid unnecessary complexity. Specifically, services should be individually considered in the BULRIC model on the basis of the following criteria:

- **Materiality:** services representing a significant number of connections or amount of traffic should be incorporated in the model.

- **Technical Singularity:** the provision of services implies that relevant technical differences in the use of network resources should be treated separately.

6.4. Additionally, the model should include all the services that share the resources used by the relevant services (that is, fixed interconnection). This factor is important to ensure that the model represents the economies of scale and scope achieved by Jamaican operators. Specifically, the OUR is of the opinion that retail voice services, broadband services, and leased lines services should be included since they use the core and transmission network.

6.5. On the other hand, sharing of resources between interconnection and access services is limited and, therefore, the OUR does not foresee the need to include access services in the model.

6.6. Accordingly, the OUR considers that a first categorisation should be made based on the type of service, namely:

- Wholesale voice traffic
- Retail voice traffic
- Other services (broadband and leased lines)

6.7. Annex A details a list of the services proposed by the OUR, which is to be incorporated into the BULRIC model.

Definition of the Increments

6.8. The definition of increments is of high relevance when developing BULRIC models. The increments in a BULRIC model are generally defined as a group of services for which incremental cost is calculated.

6.9. As described in Chapter 1, the Act at Section 33(1)(g) states in part that:

"…the relevant increment is the wholesale termination service…"

6.10. Therefore, the model should differentiate the termination service from other services included in the model.

6.11. On the other hand, there are significant technical differences between the provision of voice services and other services to be included in the model (i.e. broadband and leased lines). With the objective of accurately representing the incremental costs of other voice services, the OUR proposes to define different increments for other voice services (apart from termination) and non-voice services.

6.12. Based on the above, the proposed increments are:

- Voice termination
- Other voice services
- Non-voice services

Question 14: Do you agree with the proposed list of services and the grouping of services into increments for the BULRIC model for fixed interconnection? In the case that you have a different view, please support with rationale.

Fixed Network Design

6.13. This section describes the following issues related to the design of the modelled fixed network:

- Boundary between access and core networks
- Network topology design
- Technologies considered

Boundary Between Access and Core Networks

6.14. Fixed networks can be separated mainly into two main blocks: access network and core network. In the view of the OUR, the definition of the boundary between both parts of the network is required to ensure that all

the resources required for the provision of traffic services are included in the model and those related to the provision of access services are not.

6.15. The OUR proposes to define the following separation between access and core networks:

- **Access network** would include the equipment and infrastructure that is mainly subscriber-dependent. More specifically, access network would include the assets between the customer's premises and the line card (included);

- **Core network** would include the equipment above the line card, mostly capacity-driven. In particular, core network would include switching equipment, platforms, backbone and supporting infrastructure, etc.

Network Topology Design

6.16. The topology of the network to be designed is mainly defined by the locations of the nodes. There are three common approaches used for the network topology design in BULRIC models:

- **Scorched node:** this uses the location of existing network nodes. This option is relatively simple to implement but it may include potential inefficiencies in operators' networks.

- **Modified scorched node:** this is a variant of the scorched node approach. With this approach, the location of network nodes is not strictly equal to operators' network but is based on the existing nodes. Under this methodology, locations may be modified in cases where inefficiency is identified. The implementation complexity of this option is similar to the previous one, but allows the elimination of inefficiencies.

- **Scorched earth:** this approach estimates the locations of an optimised network without restrictions of the existing network. This option allows the calculation of a theoretical efficient network, not

relying on existing networks. However, this option is significantly more complex to implement.

6.17. In the case of fixed networks, the complexity of designing an optimal network topology makes the Scorched Earth approach virtually unfeasible. Because of this, and especially in those cases where the reference operator is based upon the demand of the incumbent operator, it is standard practice to take the incumbent's existing geographical distribution of the main network access nodes as a given in the network design process. By main network access nodes, the OUR refers to those facilities where wireline connection is terminated (for example, location of the Main Distribution Frame in the case of traditional copper access networks).

6.18. Maintaining the existing main access nodes does not mean that potential inefficiencies cannot, or should not, be addressed. For instance, the ERG[9], which advocates the use of existing node locations as a starting point for the fixed network design in BULRIC models, states that:

> *"It can be appropriate to modify the scorched node approach in order to replicate a more efficient network topology than is currently in place. Such a modified scorched node approach could imply taking the existing topology as the starting point, followed by the elimination of inefficiencies. This may involve changing the number or types of network elements that are located at the nodes to simplify and decrease the cost of the switching hierarchy. Other important issues in this respect are how to deal with spare capacity in the network and the existence of stranded costs. When the modified scorched node approach is not applicable because the elimination of inefficiencies is not practical, it could be more appropriate to use a scorched earth approach."*[10]

[9] ERG was the predecessor to the Body of European Regulators for Electronic Communications (BEREC)
[10] ERG - Recommendation on how to implement the commission recommendation C(2005) 3480 - 2005

6.19. A review of international practice shows how that the use of modified scorched node approach is the most widespread methodological choice for network topology design.

6.20. The opinion of the OUR is that a modified scorched node approach is the most adequate methodological choice for the implementation of a fixed BULRIC model in Jamaica. By adopting a modified scorched node approach, the OUR shall make the following methodological assumptions:

- The existing geographical locations of the main access nodes (for example, local exchanges) will be taken as the starting point for the reference operator's fixed network design.
- The geographical locations of the main access nodes of the reference operator may be altered, only in cases where clearly identified inefficiencies are detected. The nature of the changes introduced would depend on the type of inefficiency detected.

6.21. When developing LRIC model, the location of the starting point nodes is commonly obtained from the reference operator's real network. In the specific case of Jamaica, it is important to bear in mind that the reference operator's (LIME) parent company is in the process of acquiring another fixed operator's (FLOW) parent company. If the acquisition is finally accomplished, LIME's network can be merged with FLOW's network, which will likely affect the location of the nodes and the topology of the remaining network. In this context, the OUR foresees two valid approaches:

- Considering LIME's current nodes
- Considering the nodes that would result if LIME and FLOW's networks were merged

6.22. The OUR is favourable to reflect the network that would result when merging both networks, as it is considered more representative of the likely evolution of fixed networks in Jamaica. However, to be able to represent such scenario, it is required that the OUR has a clear visibility of

any merging plans (for instance, the final list of nodes that would be operative if the merging process is closed and the final topology).

Technologies to be Modelled

6.23. This section describes the proposed technologies that are to be modelled in the BULRIC model for fixed interconnection. It has been divided into the following subsections:

- Core network technologies
- Transmission technologies

Core Network Technologies

6.24. The following core technologies are currently used by fixed operators:

- **Legacy TDM switching,** based on switching exchanges (local, secondary, nodal, tandem, etc.). This technology is only suitable for voice services and it is complemented with a packet switching network for broadband services.

- **NGN core network**, core network is based on one all-IP network. The provision of traditional services (i.e. voice) is supported by dedicated servers such as soft-switches. Additionally, it is common practice to use Media Gateways (MGW) to provide TDM connectivity for interconnection with traditional networks.

6.25. Although a number of incumbent operators still use their legacy switching networks for voice services, this kind of equipment is being increasingly phased out and is not easily available in the market. Moreover, new entrants develop their core networks based on an NGN approach.

6.26. In the opinion of the OUR, the NGN core network represents the MEA of the traditional fixed networks. In that context, a NGN core network is able to provide all retail and wholesale services currently sold. Therefore, the OUR suggests considering a NGN core network in the BULRIC model for the fixed network. The following diagram presents an illustrative example of a NGN core network structure:

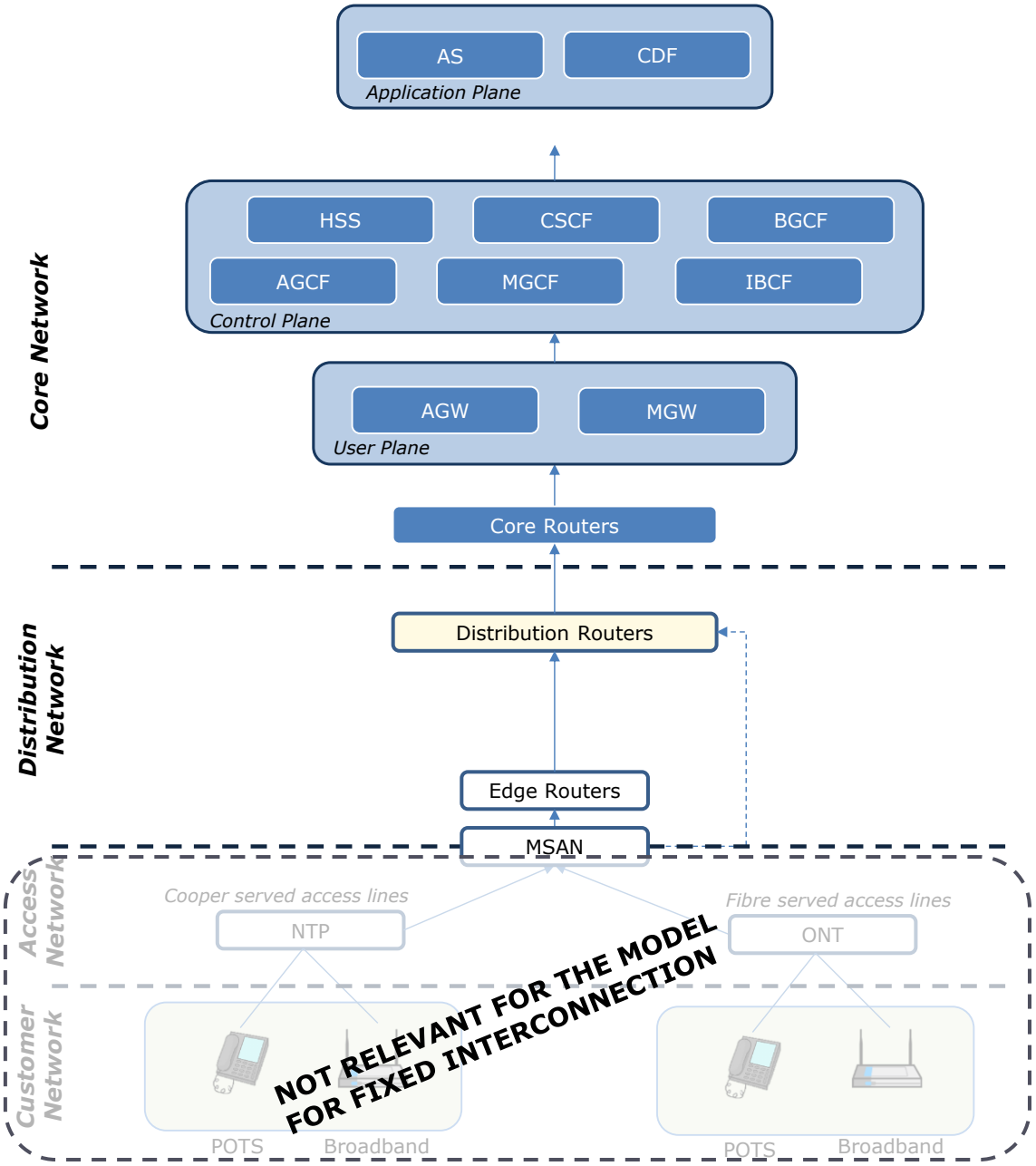

Exhibit 6.1: Illustrative structure of a fixed network based on NGN technology. [Source: Axon Consulting]

6.27. As presented above, the network elements associated to the access network and customer network are not considered relevant for modelling fixed interconnection and, therefore, they will not be included in the model. Notably, part of the MSAN equipment (apart from the line cards) is proposed to be taken into account as processors and transmission ports are traffic-dependent.

6.28. On the basis of the selection of technologies presented above, Annex B gives a preliminary list of the network elements which shall be considered in the BULRIC model for fixed interconnection.

Transmission Technologies

6.29. The following technologies are generally considered for transmission dimensioning:

- **SDH Fibre Transmission** (ADM and Cross-connect equipment).
- **Native Ethernet Fibre Transmission,** assuming that the dissociation between the different traffic flows at layer 2 will be done by VLAN technology.
- **WDM Fibre Transmission,** based on wavelength division multiplexing equipment.

6.30. Regarding the different technologies available, the OUR considers that, even though SDH transmission has been and is still commonly used by fixed operators, this technology is being largely substituted by native Ethernet transmission.

6.31. Therefore, the OUR proposes to consider Native Ethernet fibre transmission and Ethernet over WDM technologies in the BULRIC model for fixed interconnection.

6.32. In addition to the technologies listed previously, the OUR considers that microwave links should be used for the connection of remote nodes for which this technology is more cost-efficient than fibre links.

Question 15: Do you agree with the OUR's approach for Fixed Network Modelling? In the case that you have a different view, please support with rationale.

Chapter 7: Glide Paths, Price Gradients and Charging Basis

Use of Glide Paths

7.1. Models calculate unit costs of services. These unit costs can then be used to set regulated rates.

7.2. The cost model will probably estimate rates that are different from the rates currently used by the operators. In some countries, where a large change to termination rates would occur if the results of modelling were applied immediately, the regulator sets a "glide path" for a sequence of changes to bring the wholesale termination rates to the level of the costs.

7.3. Given that LIME's fixed termination rate was already regulated under a FAC regime, the OUR does not anticipate that the termination rate that results from this process will be substantially different, in dollar terms, from what exists now. If the existing termination rate is above the TLRIC rate estimated by the model then that means operators would have reaped significant benefit from having a termination rate which is above cost. In this case, the OUR proposes to immediately adjust the termination rate to its TLRIC level. However, given that the amended Telecommunications Act stipulates that the termination rate is to be calculated using only avoidable cost, the OUR will allow a glide path from TLRIC rate to the pure LRIC rate where there is a significant difference in the rates in dollar terms.

7.4. The length of this glide path cannot be determined at this point as it will depend on the size of the difference between the TLRIC and Pure LRIC termination rates. It should also be noted that the mobile termination rate was immediately adjusted to the Pure LRIC level which has created an anomaly, which needs to be corrected, where the fixed termination is higher than the mobile termination rate and is set using a different cost standard. The OUR is however mindful that the glide path needs to be reasonably short to curtail the negative effects of having a fixed termination rate which is above cost. As such, the OUR will decide on the

exact length of the glide path after the model is developed and the fixed termination rate is calculated. However, the maximum time period that will be considered for rates to adjust to cost is two (2) years.

7.5. The OUR intends to set rates for the 5 years (2016 to 2020) but will amend the regulated prices in case significant changes in the parameters or structure of the models needs to be reflected.

Question 16: Do you agree with the OUR's proposal to implement a glide path for adjusting rates from the TLRIC termination rate to the pure LRIC termination rate if there is a significant dollar value difference between the rates? Please provide reasons for your response.

Use of Gradients

7.6. Price gradients are where an operator charges higher prices at peak times and lower prices at off-peak times. Where there are gradients in the retail prices, it is desirable that there should be similar gradients in the wholesale prices to avoid creating opportunities for arbitrage. Currently, neither Columbus Communications Jamaica Limited ("Flow") nor LIME uses price gradients in their retail rates. These differences exist in the current retail rates charged by Digicel (Jamaica) Limited ("Digicel") for its fixed line services, although the differences between peak and off-peak rates are not significant.

7.7. Therefore, the OUR proposes that price gradients will not be allowed in the wholesale interconnection rates.

Question 17: Do you agree with the proposal not to allow peak/off-peak price gradients for fixed interconnection rates? If not, please explain your views.

Charging Basis

7.8. The current charging basis for LIME's wholesale fixed interconnection rates differentiates the following concepts[11]:

- Interconnect Specific charge (per minute)
- Call setup charge (per call), differentiating by interconnection level (local, regional or national) and by time (peak, off-peak and weekend)
- Call duration charge (per minute), differentiating by interconnection level (local, regional or national) and by time (peak, off-peak and weekend)

7.9. In the opinion of the OUR, these charging basis are significantly complex and the OUR proposes a simplification of the fixed interconnection services charging basis.

7.10. Specifically, the OUR proposes that all the fixed interconnection services are charged based on a duration. This would simplify billing as there is one single charge per minute but billed on a per second basis.

7.11. On the other hand, it is observed that the migration to NGN technologies is expected to lead to a reduction in the number of interconnection points used by the operators compared with the number of interconnection points used in a PSTN network. In this context, the ITU in its document "Coexistence of traditional and IP interconnection", states:

> *"the number of points of interconnection (PoIs) in an NGN will be reduced compared with the number of POIs in a PSTN network."*

7.12. Additionally, the differences in the cost of the interconnection levels are reduced due to the fact that transmission costs usually decrease over

[11] Fixed interconnection services can use one or more of these concepts.

time and due to the effect of the economies of scope associated to the increase in broadband subscribers.

7.13. Therefore, the OUR is of the opinion that the simplification of the charging bases with regards to the interconnection level would be more aligned with the evolution of the telecom operations. Specifically, the OUR foresees the following alternatives to simplify the charging basis:

- Defining one interconnection charge independently of the interconnection level.
- Defining two charges depending on the interconnection level (1 - local and 2 – National/regional).

7.14. Currently, the telecom operators in Jamaica are using a number of interconnection points, including interconnection from a local level to a national level. In this context, the definition of one interconnection charge would not capture the cost savings that induce the operators in interconnecting at a local level.

7.15. Therefore, the OUR proposes to define two charges depending on the interconnection level (1 - local and 2 – National/regional).

Question 18: Do you agree with the proposal to charge for fixed interconnection using only duration per minute billed on a per second basis? If not, please explain and propose alternatives.

Question 19: Do you agree with the proposal to define two charges depending on the interconnection level? If not, please explain your views.

Annex A: Preliminary list of fixed services to be included in the BULRIC model for fixed networks

Voice Services

A.1. Services enclosing voice calls (measured in minutes), disaggregated based on the segment (wholesale and retail) and call direction:

Retail

- On-net voice calls
- Off-net voice calls to national fixed
- Off-net voice calls to national mobile
- Calls to international destinations
- Voice calls that ends in voicemail
- Calls to voicemail for retrieving messages
- Calls to emergency services
- Calls to weather warning service
- Calls to national directory inquiry service
- Calls to international directory enquiry service
- Calls to 1-888-Call CWJ access service
- Calls to national Freephone access service
- Calls to international Freephone access service
- Calls to home country direct collect service
- Calls to national collect service

Wholesale

- Voice termination (local level)
- Voice termination (regional/national level)
- Voice origination (local level)
- Voice origination (regional/national level)
- Domestic transit voice traffic
- International transit voice traffic
- Termination call to emergency services
- Termination call to weather warning service
- Termination call to national directory inquiry service

- Termination call to international directory enquiry service
- Termination call to 1-888-Call CWJ access service
- Termination call to national Freephone access service
- Termination call to international Freephone access service
- Termination call to home country direct collect service
- Termination call to national collect service

Other services

A.2. Other services that use the core and transmission network:

- Broadband traffic (measured as throughput in Gbps in the busy hour)
- Leased lines and Corporate Data services capacity (measured in Gbps), differentiated based on their use of the core network, namely:
  - Local exchange to local exchange
  - Core node to core node
  - Core node to international
  - Other

Annex B: Preliminary list of network resources to be included in the BULRIC model for fixed networks

B.1. The following table shows an illustrative example of the resources considered in one of our models:

Category	Name	Unit
Site	For remote node	#
Site	For access node	#
Site	For core node	#
Site	Diesel Generator	#
Site	Electricity	KWH
Site	Fuel	litres
Access nodes	MSAN chassis medium	#
Access nodes	MSAN chassis large	#
Access nodes	Fast Ethernet port	#
Access nodes	Gigabit Ethernet port	#
Trunk fibre[12]	Fibre Cable 2 strand	km
Trunk fibre	Fibre Cable 8 strand	km
Trunk fibre	Fibre Cable 12 strand	km
Trunk fibre	Fibre Cable 24 strand	km
Trunk fibre	Fibre Cable 48 strand	km
Trunk fibre	Fibre Cable 72 strand	km
Trunk fibre	Fibre Cable 96 strand	km
Trunk fibre	Fibre Cable 192 strand	km
Microwave Transmission	Ethernet Mw link	#
Fibre Transmission	DWDM Chassis	#
Fibre Transmission	DWDM amplifier	#
Fibre Transmission	DWDM lambda inserter	#
Edge Routers	Edge routers chassis	#
Edge Routers	Gigabit card	#
Edge Routers	10 Gigabit card	#

[12] Fibre elements including supporting infrastructure resources such as trenches, poles and ducts.

Category	Name	Unit
Distribution routers	Distribution routers chassis	#
Distribution routers	Gigabit card	#
Distribution routers	10 Gigabit card	#
Core routers	Core routers chassis	#
Core routers	Gigabit card	#
Core routers	10 Gigabit card	#
Converters	TDM to IP converter chassis	
Converters	E1 Card	
Converters	E3 Card	
Converters	STM 1 Card	
Converters	STM 4 Card	
Converters	STM 16 Card	
Converters	Gigabit Ethernet card	
Converters	10 Gigabit Ethernet card	
Core Network	Call Session Control Function (CSCF) hardware	#
Core Network	Call Session Control Function (CSCF) software	#
Core Network	Access Gateway Control Function (AGCF) hardware	#
Core Network	Access Gateway Control Function (AGCF) software	#
Core Network	Softswitch hardware	#
Core Network	Softswitch software	#
Core Network	Application server (AS) hardware	#
Core Network	Application server (AS) software	#
Core Network	Charging Gateway (CG) hardware	#
Core Network	Charging Gateway (CG) software	#
Core Network	Packet Switched Server (PSS) hardware	#
Core Network	Packet Switched Server (PSS) software	#
Core Network	Media Gateway Controller Function (MGCF) hardware	#
Core Network	Media Gateway Controller (MGCF) software	#
Supporting platforms	Network Management System (NMS) hardware	#
Supporting platforms	Network Management System (NMS) software	#
Supporting platforms	Home Subscriber Server (HSS) hardware	#
Supporting platforms	Home Subscriber Server (HSS) software	#
Supporting platforms	Voice Mail Server (VMS) hardware	#
Supporting platforms	Voice Mail Server (VMS) software	#
Supporting platforms	VAS, IN hardware	#
Supporting platforms	VAS, IN software	#
Supporting platforms	Billing system hardware	#
Supporting platforms	Billing system software	#

Table 1: Illustrative example of resources to be considered in the BULRIC model for fixed networks. [Source: Axon Consulting]

Annex C: Summary of Questions

Question 1: Do you agree with the proposal to use a bottom-up model? Please explain your views.

Question 2: Do you agree with the decision of covering the period 2013-2020? Please explain your views.

Question 3: Do you agree with the proposed data sources to be used? Please explain your views.

Question 4: Do you agree with including Pure LRIC, LRIC+ and SAC standards in the BULRIC model and the methodologies chosen for the allocation of common and joint costs? Please explain your views.

Question 5: Do you agree that Network CapEx, Network OpEx, Licence, Retail costs, G&A Expenses, and Cost of Capital should be included in the cost base of the BULRIC Model in the manner indicated? Please explain your views.

Question 6: Do you agree with the proposal on the treatment of OpEx in the BULRIC models? Please explain your views.

Question 7: Do you agree with the OUR's view in how assets should be valued? Please explain your views.

Question 8: Do you agree with the OUR's view in the application of MEA? Please explain your views.

Question 9: Do you agree with the OUR's view to implement tilted annuities in the BULRIC model? Please explain your views.

Question 10: Do you agree with the OUR that Network OpEx Working Capital (and not CapEx related) should be considered in BULRIC Models, provided it is relevant and has been efficiently incurred? Please explain your views.

Question 11: Do you agree with the OUR that Retail Working Capital should be included in the retail costs considered? Please explain your views.

Question 12: Do you agree with the OUR that the BULRIC model for fixed interconnection should consider a reference operator with the characteristics described above? Please explain your views.

Question 13: Do you agree with the OUR that the BULRIC model should be based on a yearly approach and that a forward-looking filtering tool should be implemented? If not, please explain your views.

Question 14: Do you agree with the proposed list of services and the grouping of services into increments for the BULRIC model for fixed interconnection? In the case that you have a different view, please support with rationale.

Question 15: Do you agree with the OUR's approach for Fixed Network Modelling? In the case that you have a different view, please support with rationale.

Question 16: Do you agree with the OUR's proposal to implement a glide path for adjusting rates from the TLRIC termination rate to the pure LRIC termination rate if there is a significant dollar value difference between the rates? Please provide reasons for your response.

Question 17: Do you agree with the proposal not to allow peak/off-peak price gradients for fixed interconnection rates? If not, please explain your views.

Question 18: Do you agree with the proposal to charge for fixed interconnection using only duration per minute billed on a per second basis? If not, please explain and propose alternatives.

Question 19: Do you agree with the proposal to define two charges depending on the interconnection level? If not, please explain your views.

Annex D: Glossary

AGCF	Access Gateway Control Function
BC	Billing Center (also referred to as Billing System)
BIPT	Belgian Institute for Postal Services and Telecommunications (National Regulatory Agency)
BULRIC model	Bottom-up Long Run Incremental Costing model
Busy Hour	Period of 60 minutes during which occurs the maximum traffic load in a period of 24 hours
CapEx	Capital Expenditure
CCA	Current Cost Accounting
CG	Charging Gateway
ComReg	Commission for Communications Regulation (Irish National Regulatory Agency)
CSCF	Call Session Control Function
DSLAM	Digital Subscriber Line Access Multiplexer: equipment in charge of the connection of multiple subscriber line interfaces into a high-speed channel using multiplexing techniques
EPMU	Equi Proportional Mark-Up
ERG	European Regulators Group. ERG was the predecessor to the Body of European Regulators for Electronic Communications (BEREC)

FAC	Fully Allocated Costs
HCA	Historic Cost Accounting
HSS	Home Subscriber Server
IRG	Independent Regulators Group
ITU	International Telecommunication Union
Line Card	Printed circuit board that interfaces with a telecommunications access network
LRIC	Long Run Incremental Cost
MEA	Modern Equivalent Asset
MGCF	Media Gateway Controller Function
MSAN	Multi-Service Access Node
NGN	New Generation Network
NRA	National Regulatory Agency
NMS	Network Management System
OpEx	Operational Expenditure

PSS	Packet Switched Server
UAE	United Arab Emirates
VAS	Value Added Services
VoIP	Voice over IP. Voice over Internet Protocol

Office of Utilities Regulation

Cost Model for Fixed Termination Rates

Supporting Annex

OFFICE OF UTILITIES REGULATION

Publication Date: XX

Supporting Annex: International Benchmark on selected methodological issues

As part of the decision process of determining the best alternatives for each of the methodological approaches described in this document, the OUR has reviewed the alternatives adopted by a number of other NRAs, an exercise which is summarised in this supporting annex.

Even though the OUR has taken into account the international practice[13], the methodology described in the public consultation has been carefully designed to reflect the reality and specificities of the telecoms market in Jamaica and to serve the OUR's regulatory objectives. Therefore, participants in the public consultation are advised that they should not aim to establish a direct relationship between the proposed methodology and this benchmark exercise or any other benchmark or international references which may be additionally provided.

The countries covered in the benchmark have been included so as to have sufficient representation of the methodologies applied to LRIC models for fixed networks that have been published by other NRAs in the Caribbean, Latin America, Europe and Middle East. The table below shows the list of countries that have been used for this analysis:

[13] The OUR has not only analysed on the number of countries adopting one option, but has also taken into account the trend followed the NRAs that have developed the most recent models (for instance, although the majority of NRAs have not modelled NGN networks in their models for fixed networks, the most recent models tend to consider them).

REGION	COUNTRY/GROUP
CARIBBEAN AND LATIN AMERICA	BRAZIL
	CAYMAN ISLANDS
	COLOMBIA
	ECTEL[14]
	EL SALVADOR
EUROPE	BELGIUM
	FRANCE
	NORWAY
	SPAIN
	SWEDEN
	UK
MIDDLE EAST	BAHRAIN
	JORDAN
	SAUDI ARABIA
	UAE

Table 2: List of countries included in the benchmark [Source: Axon Consulting]

The table below describes the specific sources (models, models' documentation or public consultation documents) that have been employed in each case:

COUNTRY/ GROUP	Document	Date released
BRAZIL	Documento com a abordagem conceitual para os modelos bottom-up de rede móvel e fixa	September 2013
CAYMAN ISLANDS	Decision for the Costing Manual Consultation (CD 2005-1)	July 2008
COLOMBIA	Informe Modelo Convergente NGN	December 2011
ECTEL[15]	Draft Manual for the LRIC Models of the Fixed and Mobile Telecommunications Networks for the ECTEL Member States	June 2008
	Fixed LRIC Model	June 2008
EL SALVADOR	Descripción del modelo diseñado para la estimación de los costes asociados a los distintos servicios contemplados en el Decreto 295	September 2010

[14] The Eastern Caribbean Telecommunications Authority (ECTEL) is the regulatory body for telecommunications in Commonwealth of Dominica, Grenada, St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines.
[15] The Eastern Caribbean Telecommunications Authority (ECTEL) is the regulatory body for telecommunications in Commonwealth of Dominica, Grenada, St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines.

COUNTRY/ GROUP	Document	Date released
BELGIUM	Consultation document for the draft NGN/NGA models	December 2011
	Bottom-up fixed network cost model for BIPT (version 1.0)	December 2011
FRANCE	Model documentation: Modèle technico-économique des coûts de la terminaison d'appel fixe en France	July 2013
	Modèle technico-économique des coûts de la terminaison d'appel fixe en France	July 2013
NORWAY	NPT's fixed long-run incremental cost model: Final access model documentation	September 2012
	LRIC-modell aksessnett versjon 1.7	September 2012
SPAIN	Public consultation document for the BULRIC Model for interconnection costs in fixed networks	December 2012
	BULRIC Model for interconnection costs in fixed networks	December 2012
SWEDEN	Hybrid Model Documentation v9.1	December 2012
	Hybrid model v9.1	December 2012
UK	Ofcom Narrowband Charge Control model	February 2013
BAHRAIN	Draft Position Paper on the "Development, implementation and use of bottom-up fixed and mobile network cost models in the Kingdom of Bahrain"	May 2011
JORDAN	Notice requesting comments on the construction of TSLRIC+ models for the costs of interconnection services	June 2009
SAUDI ARABIA	LRIC Model Guidelines for the Kingdom of Saudi Arabia	March 2008
UAE	Consultation document on "The Development of Bottom-Up LRIC Models of Telecommunications Networks in the UAE"	July 2012

Please note that a number of regulators have developed separate models for access and transmission fixed network. In these cases, only the model associated to transmission fixed network has been analysed.

The results of the benchmark conducted are outlined below (where information is not available, cells have been left blank). They have been structured

according to the same criteria employed in the main body of the public consultation document:

- Common features for mobile and fixed BULRIC models
- Period of time modelled
- Cost standard
- Allocation of common and joint network costs
- Cost elements to be considered
- Cost of Capital
- Treatment of OpEx
- Assets valuation method
- Consideration of modern equivalent assets
- Annualisation criteria
- Working Capital
- Operator to be modelled
- Network Optimisation Approach
- Boundary between access and core networks
- Network topology
- Technologies to be modelled - Core network technologies
- Technologies to be modelled - Transmission technologies

Period of time modelled

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Static (1 year)	x	√		√	√	x	x	x	x	x	x	x	x		x	**3/13**
Dynamic (several years)	√	x		x	x	√	√	√	√	√	√	√	√		√	**10/13**
Period of time modelled (years)		*1*		*1*	*1*	*50*	*15*	*60*	*50*	*40*	*40*	*4-5*	*5*		*5*	

Table 3: Benchmark: Period of time modelled. [Source: Axon Consulting]

Cost standard

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway[16]	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Fully Allocated Costs (FAC)		x		x		x	x	x	x	x	x	x	x	x	x	**0/12**
Pure Long Run Incremental Costs (Pure LRIC)		x		x		√	√	√	√	√	√	x	x	x	x	**6/12**
Long Run Incremental Costs plus Common Costs (LRIC+)		√		√		x	x	√	x	x	x	√	√	√	√	**7/12**

Table 4: Benchmark: Cost standard. [Source: Axon Consulting]

[16] The model developed by Norwegian regulator (NPT) is able to calculate the costs under both Pure LRIC and LRIC+, but LRIC+ is used.

Allocation of common and joint network costs

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Equi-Proportional Mark-Up (EPMU)	√	x		√	√	√	√	√	√	√	√	x	√	√	√	**12/14**
Effective Capacity	x	√		x	x	x	x	x	x	x	x	√	x	x	x	**2/14**
Shapley-Shubik	x	x		x	x	x	x	x	x	x	x	√	x	x	x	**1/14**
Ramsey Pricing	x	x		x	x	x	x	x	x	x	x	x	x	x	x	**0/14**

Table 5: Benchmark: Allocation of common and joint network costs. [Source: Axon Consulting]

Cost elements to be considered

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Network CapEx	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	**15/15**
Network OpEx	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	**15/15**
Retail Costs	x	√	x	√	x	x	x	x	x	x	x	√	x	x	x	**3/15**
G&A Costs	√	√		√		√	x	√	x	√	x	√	√	√	√	**10/14**

Table 6: Benchmark: Costs elements to be considered. [Source: Axon Consulting]

Cost of Capital

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Weighted Average Cost of Capital (WACC)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	**15/15**
Other	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	**0/15**

Table 7: Benchmark: Costs of capital. [Source: Axon Consulting]

Treatment of OpEx

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Based primarily on percentages over CapEx	√	x	√	x		x	√	√	x	x	√	x	√	√	√	**8/14**
Based primarily on Bottom-up calculation	x	√	x	√		√	x	x	√	√	x	√	x	x	x	**6/14**

Table 8: Benchmark: Treatment of OpEx. [Source: Axon Consulting]

Assets valuation method

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Static approach - HCA	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	**0/15**
Static approach - CCA	x	√	x	√	√	x	x	x	x	x	x	√	x	x	x	**4/15**
Dynamic approach (Cash-flow)	√	x	√	x	x	√	√	√	√	√	√	x	√	√	√	**13/15**

Table 9: Benchmark: Assets valuation method. [Source: Axon Consulting]

Consideration of modern equivalent assets

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Modern Equivalent Assets considered	√	√		√		√	√	√	√	√	√	√	√	√	√	**13/13**
Modern Equivalent Assets not considered	x	x		x		x	x	x	x	x	x	x	x	x	x	**0/13**

Table 10: Benchmark: Consideration of modern equivalent assets in the fixed core network. [Source: Axon Consulting]

Annualisation criteria

	Brazil	Cayman Islands	Colombia[17]	ECTEL	El Salvador	Belgium	France	Norway[18]	Spain	Sweden	UK	Bahrain[19]	Jordan	Saudi Arabia	UAE	TOTAL
Straight line depreciation	x	x	√	√		x	x	x	x	x	x	x	x	x	x	**2/14**
Standard Annuity	x	√	x	x		x	x	x	x	x	x	x	x	x	x	**1/14**
Tilted Annuity	x	x	x	x		x	√	√	x	√	x	√	√	√	√	**7/14**
Economic depreciation (Adjusted Tilted annuities)	√	x	x	x		√	x	√	√	x	√	√	x	x	x	**6/14**

Table 11: Benchmark: Annualisation criteria. [Source: Axon Consulting]

Working Capital

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Associated to Network CapEx	x		√	√	x	x	x	x	x	x	x	√		√	√	**4/12**
Associated to Network OpEx	√		√	√	x	√	x	√	√	x	x	x		√	x	**6/12**

Table 12: Benchmark: Treatment of Working Capital. [Source: Axon Consulting]

Operator to be modelled

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Each Operator in the market	x	x	x	x	x	x	x	x	x	√	x	x	√	x	x	**2/15**
Generic Operator (based on incumbent)	√	√	√	√	√	√	√	√	√	x	√	√	√	√	√	**14/15**

Table 13: Benchmark: Operator to be modelled. [Source: Axon Consulting]

[17] In addition, the model used in Colombia includes the accelerated and geometric depreciation methods.
[18] The NRA in Norway defines two different annualisation methodologies to be employed in the BULRIC model for fixed network depending on the level of the network. That is, it uses tilted annuities for core network equipment, whereas for the access network equipment it uses tilted annuities and economic depreciation (depending on the specific asset)
[19] The TRA in Bahrain proposed to implement tilted annuities and adjusted tilted annuities in the BULRIC models

Network Optimisation Approach

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Yearly approach	√	√		√		√	√	√	√		√	√				**9/9**
Historical approach	x	x		x		x	x	x	x		x	x				**0/9**

Table 14: Benchmark: Network dimensioning approach. [Source: Axon Consulting]

Boundary between access and core networks[20]

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Access network up to the line cards (not included)						√	√	√	√	√	√	√				**7/7**
Other boundaries						x	x	x	x	x	x	x				**0/7**

Table 15: Benchmark: Boundary between access and core networks. [Source: Axon Consulting]

Network topology

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Scorched node	x	√	x	√		x	x	x	x	x	x	x	x	x	x	**2/14**
Modified scorched node	√	x	√	x		√	√	√	√	√	√	√	√	√	√	**12/14**
Scorched earth	x	x	x	x		x	x	x	x	x	x	x	x	x	x	**0/14**

Table 16: Benchmark: Network topology. [Source: Axon Consulting]

[20] NRAs in UAE, Saudi Arabia, Jordan and Zimbabwe have not established a specific boundary delimiting access and core networks in their public consultation documents

Technologies to be modelled – Core network technologies

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Legacy TDM network	√	x	x	x		x	√	√	x	x	√	x	√	√	x	**6/14**
NGN Core network	√	√	√	√		√	√	√	√	√	√	√	√	√	√	**14/14**

Table 17: Benchmark: Technologies to be modelled - Core network technologies. [Source: Axon Consulting]

Technologies to be modelled - Transmission technologies

	Brazil	Cayman Islands	Colombia	ECTEL	El Salvador	Belgium	France	Norway	Spain	Sweden	UK	Bahrain	Jordan	Saudi Arabia	UAE	TOTAL
Microwave links	√	x		x		x	x	x	x	√	x	x		x	x	**2/12**
SDH Fibre transmission	√	√		√		x	x	√	x					√		**5/8**
Native Ethernet Fibre Transmission	x	x		x		x	x	x	x							**0/7**
WDM Fibre Transmission	√	x		x		√	√	√	√							**5/7**

Table 18: Benchmark: Technologies to be modelled - Transmission technologies. [Source: Axon Consulting]