



Consultative Document

Draft Revised Top Down Long Run Average Incremental Cost (LRAIC) Model Specification Paper

May 31st 2016

TATT 3/5/3/2

Maintenance History		
Date	Change Details	Version
September 1, 2009	First Draft	0.1
December 22, 2009	Second Draft, incorporates revisions in response to submissions from concessionaires made in first round of consultation	0.2
March 1, 2010	Final version, incorporates revisions in response to submission from concessionaires made in the second round of consultation. Annexe on data request deleted as separate formal data request will be issued shortly.	1.0
October 23, 2012	Updated version, incorporates amendments and additions required due to implementation decisions made during the LRAIC modelling in 2011.	1.1
July 6, 2015	Draft Revised Draft LRAIC Specification Paper published for consultation	1.2
May 31 st , 2016	Updated version incorporates amendments and additions required due to stakeholder feedback during the 2015 consultation process.	1.3

Table of Contents

1	Introduction	7
1.1	Review Cycle.....	7
1.2	The Consultation Process.....	7
1.3	Modelling objectives.....	8
1.4	The Authority's requirements	10
1.5	Need for operator input.....	11
1.5.1	Capital costs.....	11
1.5.2	Operating costs	12
1.5.3	Volume data	12
1.5.4	Cost volume relationships	12
1.6	Overview of the LRAIC modelling process and the CCA revaluation study.....	12
1.7	Outline of this document.....	15
2	LRAIC principles	16
2.1	Definition of LRAIC.....	16
2.2	Summary of principles	16
3	LRAIC model outputs	20
3.1	Ex ante regulatory requirements.....	20
3.2	Ex post competition cases.....	22
3.3	Potential efficiency adjustments	23
4	Networks to be modelled	24
4.1	Access Networks.....	24
4.1.1	Fixed access Networks.....	24
4.1.2	Mobile access Networks	25
4.2	Core network components	25
5	Increments	27
5.1	Cost categories, increments and network elements	27

5.2	Definition of network elements.....	27
5.2.1	Fixed access	28
5.2.2	Fixed narrowband conveyance	29
5.2.3	Fixed broadband services	30
5.2.4	Leased line services	31
5.2.5	Mobile networks	31
5.3	Definitions of increments.....	32
5.3.1	Transmission	32
5.4	Cost categories	32
5.5	Defining the increment hierarchy.....	33
6	LRAIC model inputs	35
6.1	Base cost.....	35
6.2	Cost of capital.....	37
6.3	LRAIC cost categories	37
6.4	Drivers	38
6.4.1	Exogenous cost drivers.....	38
6.4.2	Endogenous cost drivers	39
6.5	CVRs.....	41
6.5.2	Development of concessionaire-specific CVRs.....	45
6.6	Hierarchy of dependencies	48
6.7	Transmission allocation	49
6.8	Service volumes, conversion and routing factors.....	50
6.8.1	Volume of services	50
6.8.2	Routing factors.....	51
6.8.3	Conversion factors	53
6.9	Example of conversion factor calculation steps.....	54
7	LRAIC Base costs for CATV and FWA Networks	55
7.1.1	Mapping CATV networks to the asset categories	55
7.1.2	Recovery of cost components across services	56

7.2	Fixed Wireless Access Networks.....	59
7.2.1	Network Elements	60
7.3	Treatment of Voice over IP (VoIP) Traffic.....	61
8	LRAIC model calculation	62
8.1	Model overview.....	62
8.2	Overall structure of the incremental costing model	63
8.3	Inputs.....	63
8.4	Calculation of incremental costs.....	64
8.5	LRAIC of measured increment including mark-ups	65
8.6	Allocation of element costs to services - element based costing.....	66
	Annex 1: Glossary	67
	Annex 2: Defined network elements	71
	Annex 3: Defined increments	75
	Annex 4: LRAIC cost categories	81
	Annex 5: Required CVRs	88
	Annex 6: Network Services	90
	Annex 7: Decisions on Recommendations – LRAIC Specification Paper	93

Table of Contents

Figure 1. Exogenous cost drivers	39
Figure 2. Endogenous cost drivers	40
Figure 3. A typical CVR	42
Figure 4. Typical CVR functions	44
Figure 5. CVR construction	46
Figure 6. A typical dependency hierarchy	49
Figure 7. Simplified network diagram	51
Figure 8. Structure of fixed NGN	53
Table 1. Overview of the data collection process	13
Table 2. Product and service markets	21
Table 3. Fixed Access Network Drivers by Technology	29
Table 3. Simplified calculation of routing factors for an on-net call	52
Table 4. Glossary of terms and abbreviations	67
Table 5. Network elements contained in the LRAIC model	71
Table 6. Level 4 increments defined in the LRAIC model	75
Table 7. Level 3 increments defined in the LRAIC model	79
Table 8. Level 2 increments defined in the LRAIC model	80
Table 9. Level 1 increments defined in the LRAIC model	80
Table 10. LRAIC Cost Categories contained in the LRAIC model	81
Table 11. CVRs for which concessionaires will be required to provide inputs	88
Table 12. Defined Network Services	90

1 Introduction

This document describes the underlying principles and methodology applied by the Authority, in consultation with operators, to implement the top down LRAIC model. The remainder of this section is structured as follows:

- Review cycle
- The Consultation process
- summary of the objectives of the LRAIC model;
- decisions taken to date on the form of the LRAIC model;
- discussion of role of operators in the modelling process;
- description of the data collection process; and
- overview of the rest of this specification.

1.1 Review Cycle

As telecommunications markets evolve and the sector develops, changing costing and market dynamics may necessitate the revision and update of costing principles and considerations adopted by the Authority.

This Paper is a subset of the Costing Methodology and can be considered the parent document on the specification of the Long run Average Cost Modelling approach. From time to time, where necessary, supplementary documents will be produced and be appended to this LRAIC Specification Paper in accordance with the Authority's Procedures for Consultation¹. The Maintenance History of this document will be modified and maintained accordingly.

1.2 The Consultation Process

The Consultation Period 2009 to 2010

The LRAIC Specification Paper was finalised in March 2010 after undergoing several rounds of consultation with stakeholders during the consultation period September 1st 2009 to March 1st 2010.

¹

<https://tatt.org.tt/Portals/0/Documents/Procedures%20for%20Consultation%20in%20the%20Telecommunication%20and%20Broadcasting%20Sectors.pdf>

The Consultation Period 2012 to 2015

Following the course of initial model development and data gathering in 2010-2011, revisions were proposed in 2012 to ensure that the LRAIC model best captures the operational and financial situation of service providers. The revisions incorporated into the 2015 document for consultation were aimed at providing more guidelines to concessionaires in the submission of data required for the LRAIC model.

The main revisions over this period included:

- Updates to fixed access networks including the consideration of fibre networks connecting directly to end-user premises etc.
- Updates to account for the Evolution of GSM technology
- Additional information on the treatment of foreign exchange adjustments in the LRAIC model
- Inclusion of NGN structures and associated routing tables
- An updated list of Cost Categories (Annex 4)
- An updated list of network elements, increments, cost categories, CVRs and network services defined within the LRAIC model
- Inclusion of consideration for CATV and FWA networks

The Consultation Period 2015-2016

Following the period of consultation in 2015 on the LRAIC Specification Paper, the Paper has been revised and issued for second round of consultation on 31st May 2016. The following revisions have been made:

- Updates to the application of principles of thinning and scorched node
- Clarification on applicable CVRs including an example of conversion factor calculation steps
- Specification on the treatment of components of costs for capital equipment costs
- Decisions on Recommendations to all comments solicited in the 2015 consultation period.

1.3 Modelling objectives

The Authority's overall requirements are set out in "*The Costing Methodology for the Telecommunications Sector*" published on the 29th May 2008. The primary objective of the LRAIC model is to provide the Authority with a standardised tool that

allows making informed regulatory decisions to enhance effectiveness and competitiveness of communication services in Trinidad and Tobago. The model will be used to assist in a range of regulatory purposes, which may include, at a minimum:

- “the determination of interconnection rates for all concessionaires when required;
- the determination of rates for accessing to facilities of any concessionaire where applicable;
- the determination of rates, where necessary, for any telecommunications service in which there is a monopoly or exclusive provider the determination of rates, where necessary, for any public telecommunications service provided by a dominant provider any exercise by the Authority to detect unfair cross subsidies or any act of anti-competitive pricing.”²

The Authority has decided to follow a long run average incremental cost approach in order to set and monitor prices where competition is not sufficient or may be distorted, to establish prices at a welfare maximising level, in accordance with its legal mandate.

Incremental costing models attempt to understand the cost of delivering an increment of demand, that is, the change in cost resulting from adding or subtracting an increment thereof. ‘Long-run’ signifies that the incremental cost calculation should include both costs that may vary in the short-run (for example, operational expenditure) and costs which vary in the long run (such as capital costs). Costs that are fixed or common across increments will not form part of the incremental cost³ as such, but may be added through a mark-up, to ensure investors receive a reasonable return overall.

‘Long run average incremental cost’ refers to a modelling approach that calculates prices with respect to increments such as total demand, and hence which set service prices based on “average” prices across this increment of total demand.

² See Section 1.1.4 of the Costing Methodology

³ Fixed and common costs are typically recovered through mark-ups to ensure that an operator is able to recover its total costs

1.4 The Authority's requirements

In the Costing Methodology, the Authority defined some key characteristics of the top down LRAIC model. These are set out below.

- The top down approach requires the use of cost information that initially consists of historic, most likely statutory accounts data. The data that is used for the model however, is required to reflect current cost on the basis of modern equivalent assets (MEA).
- Depreciation of assets should follow the tilted straight line approach.
- The cost of capital is to be determined on an annual basis using the weighted average cost of capital (WACC) approach.
- Cost volume relationships (CVRs) should be based on engineering models and activity based costing (ABC).
- Network element costs will be attributed to services on the basis of service volumes and routing factors. Routing factors for all network elements should be established and justified by concessionaires for the use in the model. Alternatively, the Authority may estimate efficient routing factors for individual network types on the basis of the data concessionaires have provided.
- Common costs which would otherwise not be included in the service cost in a pure LRAIC approach should be included by applying an equi-proportionate mark up (EPMU).

However these characteristics alone are not sufficient to determine fully the approach to be taken. This specification builds on and develops these key principles in order to provide a more complete view of the implementation of the model. This development is based on international best practice drawn from top down LRAIC models implemented in other jurisdictions, such as the United Kingdom. The specification also takes account of the relatively small size of Trinidad and Tobago and hence the resources available to both the Authority and the concessionaires in implementing the model. The approach has been simplified as far as possible whilst remaining consistent with the Costing Methodology and meeting the requirements of the Authority.

1.5 Need for operator input

The Costing Methodology sets out the requirements for concessionaires to implement a costing system. All of those concessionaires who are dominant in a relevant market need to implement a costing model. More specifically, the Costing Methodology states, "a concessionaire that provides interconnection service shall be considered dominant in providing termination services on its network." In addition, the costing model is developed as per requirements set out in the Telecommunications Interconnection Regulations, Pricing Regulations and Access to Facilities regulations.

Based on a common model template, a model is prepared for a concessionaire, reflecting their relevant network structure, costs and demand for services. The results for each concessionaire thus represent the costs for that concessionaire. This approach differs from that used in some other jurisdictions where a single hybrid industry model representative of a number of networks (for example mobile networks) has been developed with the results being a representative "average" cost for the industry.

Given the range of network topologies currently used by concessionaires, the template LRAIC model will be sufficiently flexible to reflect the different networks used in accordance with the principles and methodology determined.

Given that the LRAIC model has been constructed on a top down basis using the costs of the networks and associated assets of concessionaires, concessionaires are required to submit data relating to both operating costs and capital costs. In addition, the concessionaires need to supply information necessary to model the relationships between costs and demand, for example cost volume relationships. A high level view of the data required is described below and set out in further detail in Section 6.

The model will be populated on an annual basis covering each concessionaire's financial reporting year.

1.5.1 Capital costs

Concessionaires need to provide cost estimates for all their assets used for the provision of fixed and mobile services in Trinidad and Tobago. The role of concessionaires is fundamental to ensure that the model inputs, and therefore the model results and any regulatory decisions based on the results, reflect the operating environment faced by concessionaires in Trinidad and Tobago.

The LRAIC model requires asset valuation (including installation costs and import duties) and the associated depreciation and amortisation charges to be calculated on a current cost accounting (CCA) basis. Therefore, the Authority conducts a CCA study for each concessionaire to revalue their relevant assets each year, based on information provided by concessionaires. The process

required is described in the separate CCA Reference Paper⁴ which complements this specification document

Concessionaires are also required to provide information on the level of working capital (i.e., their current assets and liabilities). This however resembles a categorisation exercise with no change in the reported level of costs.

1.5.2 Operating costs

Concessionaires further need to take operating costs from their financial systems (general ledger) and categorise them into the appropriate cost categories. However this again is a categorisation exercise with no change in the reported level of costs.

1.5.3 Volume data

In order to model the impact of changes in demand on costs, the model requires information on the current level of demand in terms of services delivered to end users or other concessionaires.

In addition, information is required on the volumes relating to the internal operations of the business, such as head count.

1.5.4 Cost volume relationships

Key network cost volume relationships (CVRs) are based on information supplied by concessionaires to ensure these CVRs reflect the networks deployed in Trinidad and Tobago. Due to the limited resources available to concessionaires in Trinidad and Tobago, the model has been designed to minimise the number of CVRs required. For some concessionaires, there will be no requirement to submit CVR data while for those concessionaires required to submit CVRs, the CVRs will only need to be updated when the cost structure of the network has materially changed.

In the absence of concessionaire-specific information, international benchmark data will be used to inform the CVRs.

1.6 Overview of the LRAIC modelling process and the CCA revaluation study

To ensure that regulated charges are in line with the current market environment and concessionaires' cost structures, the LRAIC model will be regularly updated.

⁴ CCA Reference Paper - April 26th 2012

Concessionaires will be required to submit new input data for each update. This is an annual exercise and concessionaire-specific LRAIC and CCA data will be required within six (6) months of the concessionaire's financial year end. Such information must include Audited Financial Statements. In the event that audited financial statements are not available within this time, concessionaires may submit unaudited statements until the audited information become available.

Within each revision, the Authority will update the CCA studies for each concessionaire which will then form an input to the LRAIC modelling process.

The current versions of the LRAIC Specification Paper and CCA Reference Paper reflect the Authority's current approach. The Authority reserves the right to publish revised versions of either of these documents in the future, to reflect any changes to the overall market environment or other developments. This will be done in accordance with the Authority's Consultation Procedures.

The table below provides an overview of the LRAIC model development showing the roles of the Authority, Frontier Economics and the concessionaires at each stage and the anticipated timeline for each stage.

Table 1. Overview of the data collection process

Stage	Role of the Authority/Frontier	Role of concessionaire	Timeline
Issue of detailed data request	Issue data request which seeks to capture the information required to build the LRAIC model based on the specification	Seek clarification on any aspects of the data request not fully understood	2 weeks

Submission of initial LRAIC data	Review LRAIC data as it is submitted Request clarification of data submitted where necessary Provide clarification of data requested as required by operators Assist operators in methodological issues and identifying potential data sources	Submit data as it becomes available and before the deadline for data submission Provide clarification/validation of data requested as required within a reasonable time period	6 weeks
Submission of final version of LRAIC data		Submit final version of data and full documentation of methodology, sources and results	5 weeks
Input data submitted into LRAIC model	Input data into LRAIC model and sense check the outputs	Provide clarification where necessary	5 weeks

As set out in the table above, the data collection process will start with a detailed data request being issued by the Authority which consists of an Excel data template and detailed written guidelines on how to prepare data for the study. Such forms and guidelines are published on the Authority's website. Concessionaires are encouraged to submit data as it becomes available and to seek clarification from the Authority as and when queries arise. The Authority's staff will be available to concessionaires throughout the data collection process to assist with queries relating to the data collection that concessionaires may have.

The data collection process is an iterative process and it is envisaged that concessionaires will need to work closely with the Authority in order to prepare the requested data. Therefore, if further clarification is required with respect to the data requested and the data collection process, concessionaires should contact the Authority as queries arise rather than waiting until the final deadline for submissions

1.7 Outline of this document

The remainder of this document sets out the additional specifications required for the LRAIC modelling process. In particular:

- The overall methodological principles used to implement the approach set out in the Costing Methodology is covered in Section 2 of this document;
- The main model outputs are set out in Section 3;
- The networks contained within the LRAIC model are described in Section 4;
- The increment structure modelled is defined in Section 5;
- The input data required for the LRAIC model is set out in Section 6; and
- Section 7 provides an overview of the calculation methodology used in the LRAIC model (reflecting the specifications set out in Sections 2 - 5).

A series of annexes, setting out the structure of the LRAIC model, are attached. These annexes relate to:

- Annex 1 sets out a glossary;
- Annex 2 defines the network elements contained within the model;
- Annex 3 sets out the increments defined within the model;
- Annex 4 describes the LRAIC cost categories;
- Annex 5 defines the CVRs within the LRAIC model; and
- Annex 6 contains a list of network services contained within the model.
- Annex 7 details Decisions on Recommendations which address all concerns raised by operators.

2 LRAIC principles

This section introduces the LRAIC concepts and discusses the key assumptions that are applied in the LRAIC calculation.

2.1 Definition of LRAIC

Incremental cost refers to the change in cost resulting from adding or subtracting increments of demand for a product/service, where a company produces a multitude of products/services.

As a result, only those costs that would be incurred (avoided) if an increment of demand for a product or service was added (subtracted) are included in the incremental cost estimate for that increment. Costs that are fixed or common across increments do not form part of the cost of that increment.

In the LRAIC calculation, incremental cost is measured over the long run. This signifies that estimates of incremental cost should include both costs that may vary in the short run, such as operating expenditure, and also costs which vary in the long run such as capital costs.

Under a LRAIC approach, as set out in the Costing Methodology, incremental cost are estimated for increments of demand which relate to individual network elements rather than end to end services. The costs of end to end services are estimated through a combination of the LRAIC cost of the elements, service volumes and routing factors.

2.2 Summary of principles

The Costing Methodology sets out three principles that should be followed when calculating incremental cost estimates. These principles are:

1. A top down approach should be adopted.
2. Current cost and efficiency adjustments must be made to actual costs.
3. An Equi-Proportionate Mark-Up (EPMU) approach should be used to attribute common costs to increments.

A summary of the additional principles, that are also applied when building and populating the LRAIC model, are set out below and then described in more detail in the remainder of this section.

- LRAIC must be calculated based on the principle of scorched node rather than scorched earth.

- Thinning – existing transmission routes are required to provide connectivity between network nodes, independent of the scale of activity.
- Service levels – it may be assumed that existing levels of quality of service are maintained.
- Mix – the mix of demand characteristics that impact on the volume axis of a cost function should be assumed to be constant with respect to scale.
- Recovery of fixed common and joint costs – the EPMU approach is to be applied for the recovery of fixed common and joint costs individually on a cost category by cost category basis rather than as a mark-up across all costs.

These principles are widely used in other top down LRAIC models. The choice of the approach takes into account the need, as far as possible, to ensure that output LRAIC prices reflect cost causality and hence results in efficient prices. The principles have also been derived from experience in implementing LRAIC models, to ensure the implementation is based on readily available information and the implementation is proportionate. The principles are explained in more detail below.

The “scorched node” principle and the “thinning” principles are used to determine the appropriate cost volume relationship (CVR) to use in the calculation of incremental costs to feed into the calculation of LRAIC service costs. For the initial LRAIC model implementation the Authority considered that it was disproportionate to require concessionaires to provide a fully range of CVRs as the resources required would be large and the benefit, in terms of more accurate LRAIC estimates, would be relatively low compared to using notional CVRs with a “straight line through the origin” (SLTO) form (see also Section 6.5 below). As such the principles of “scorched node” and “thinning” have not been implemented in the current version of the LRAIC model.

Top down

A top down model is based on (and reconciles to) the actual costs of the business under consideration. Therefore the top down modelling approach analyses the level of costs for the modelled concessionaire’s business and determines the extent to which they are incremental or otherwise with respect to the defined set of increments.

Current cost

The Costing Methodology requires that the cost models are based on current cost accounting (CCA) principles. Under CCA, charges related to fixed assets are based on the capital expenditure that would be incurred if an operator were to roll out a network today. Prices set on the basis of CCA place the incumbent

and new entrant on a level footing and provide appropriate signals for entry to the market. As a result, interconnection and access charges determined using CCA asset values can provide new entrants with better 'build or buy' signals.. Therefore, CCA is generally preferred to historic cost accounting (HCA) for the determination of regulated charges.

Before LRAIC can be calculated, the HCA based costs of each concessionaire's assets reported in statutory accounts are therefore adjusted to reflect the current value of the equipment. This is undertaken in a separate CCA study, which is discussed in more detail in the CCA Reference Paper.

Mix

The LRAIC model has been built with the assumption that the mix of demand characteristics that impact on the volume axis of a cost function is assumed to be constant with respect to scale. That is, as volume is reduced to the minimum point, the existing demand profile (in terms of type of customers, relative demand for services, call duration, etc.) should not be altered.

Service levels

When reducing the capacity of the network to the minimum point, it is assumed within the LRAIC model that network performance and quality of service should be maintained at current levels. If the number of alternative routes is reduced, then network performance may not be maintained in some cases. For example, the percentage of dropped calls is partly a function of the number of alternative routes in the network. Therefore, it may be necessary to include some duplicate equipment at the minimum point to ensure that current service levels can be adequately maintained.

Recovery of fixed common and joint costs

One of the outputs of the LRAIC model is the cost of network components including a mark-up to cover fixed common and joint costs. This mark-up is calculated on the basis of EPMU on a LRAIC cost category by cost category basis.

Fixed common costs are those, which span more than one of the increments identified and are invariant to changes in a concessionaire's volumes.

Joint costs are also costs that span more than one increment and are predominantly variable with respect to volume, in contrast to fixed common costs. Some element of these joint costs may also be fixed. For example, the cost of transmission equipment varies according the volume of traffic carried over the network. However, there is a fixed cost associated with the minimum "thinned" network that covers all routes.

The LRAIC model has been designed so that the fixed common and joint costs between increments are recovered by use of an EPMU, whereby fixed common costs are recovered pro rata to incremental costs. The model calculates common costs for subsets of increments, (such as the network) on a cost category by cost category basis as set out below.

- For each LRAIC cost category the sum of component incremental costs (where each component is removed in turn) is compared to the incremental cost for the subset of components as a whole (where all components are removed at once).
- The difference between these two sets of costs is the fixed common and joint costs across these increments for this cost category. These common costs to the subset of components are then allocated to the components using an EPMU approach.

3 LRAIC model outputs

This section provides further discussion of the outputs of the overall costing process. The requirements for the model outputs are driven by the nature of regulation which may vary for different services. This will then feed into the definition of the increments (see Section 5 and Annexe 3) which will be determined as an output of the LRAIC modelling process.

Wholesale and retail services that are subject to *ex ante* price controls may require a full determination of the costs associated with the services. For wholesale services subject to retail minus price regulation, only the cost of the retail and customer service operation would be required. Assessing the potential anti-competitive practices may require the estimation of the incremental costs of different services or of the cost differential between retail and wholesale services. The Authority may also use the model as an input to calculate the size of any access deficit. The Authority should therefore be able to use the LRAIC model outputs to cost different components and activities to cater for these requirements including:

- network components including a division between subscriber sensitive (access) and traffic sensitive (core) components;
- costs associated with non-network activities related to serving end users (retail activities);
- activities related to serving wholesale customers; and
- corporate activities.

3.1 Ex ante regulatory requirements

Where there is a regulatory requirement that a concessionaire is required to provide cost estimates for its services, with the completion of this model, these estimates must be based on the LRAIC approach.

As the relevant markets for call termination is defined as call termination on an individual operator's network, then all concessionaires offering voice services including call termination shall be dominant in at least that market and thus must produce LRAIC service costs.

In addition, and as stated in the Price regulation Framework the Authority will only consider imposing ex ante price regulatory mechanisms in those markets which have been classified as contested or un-contested. Markets with higher HHI levels will be given more consideration by the Authority in determining whether there is need for conducting dominance assessments or whether ex ante

price regulation mechanisms should be imposed. Such markets are further defined in the Table below.

Table 2. Product and service markets

	Retail	Wholesale
Domestic fixed	Narrowband (voice) access	Unbundled access
	Broadband access	Broadband access
	Voice services	Internet services
	Narrowband internet	Interconnection services – origination
	Broadband internet	Interconnection services – transit
		Interconnection services – termination
		Domestic leased circuits
International	International voice calls	International leased circuits
		International fixed termination
		International mobile termination
		International fixed origination
		International mobile origination
Domestic mobile	Voice calls	Interconnection services – origination
	Messaging services	Interconnection services – termination
	Narrowband internet	
	Broadband internet	
	Roaming	

Source: "Price Regulation Framework for Telecommunications Services in Trinidad and Tobago", Telecommunications Authority of Trinidad and Tobago

The model should therefore provide inputs to costing products and services in the relevant markets defined. The model further needs to take into account any services that:

- are provided over the same infrastructure as the above, as this may change the scale of the infrastructure and hence the cost that are incremental to the above services; and
- share common cost with the above services; as this may impact the portion of common cost that is allocated to the above services.

The ex-ante determination of these relevant markets, means that the output of the model process in terms of service costs is defined. However as the market develops the structure of the relevant markets may evolve. Thus the LRAIC model reflects a forward looking view of networks, as far as this is possible and proportionate.

It should be noted that the market definitions are technology neutral. The LRAIC model needs to take account of services in the same market carried using differing technology, for example voice calls carried over legacy TDM networks or as voice over IP packet switched networks or mobile calls carried over 2G, 2.5G or 3G networks. However for the purposes of service costing, the LRAIC model does not explicitly produce separate costs for services using differing technology.

While the focus of the cost modelling is on network costs, total retail specific costs are also identified separately within the modelling. Given that retail costs are typically subscriber driven rather than product driven, retail costs may be considered to be joint and common costs across services. Estimates of the costs of retail services may be estimated by applying appropriate mark ups to the costs of network services.

3.2 Ex post competition cases

In some cases adverse competitive behaviour is not pre-empted and regulated accordingly. In such cases regulators or competition authorities often face the need to assess whether prices have been consistently set at adverse levels. Whether a pricing behaviour reflects normal competitive behaviour or only intends to harm competitors the Regulator must analyse the price relative to the cost of service provision.

Given that the nature and scope of *ex post* competition investigations cannot be defined in advance, the LRAIC model has been developed to be flexible enough to provide inputs to the process for any services or markets required.

3.3 Potential efficiency adjustments

The Costing Methodology requires the Authority to undertake an efficiency study for all dominant concessionaires as part of the LRAIC modelling process.⁵ This is to ensure that the LRAIC model unit cost results reflect an efficient level of costs of providing these services.

The LRAIC model produces estimates of the costs faced by concessionaires in Trinidad and Tobago based on top down data provided by the concessionaires. Since being based on information on concessionaires' actual cost base and network structure, this data may include inefficiently incurred costs arising from potential current inefficiencies in operations or past inefficiencies in investment. Although the LRAIC model is based on current cost accounting (CCA) data (rather than historic costs), this CCA revaluation process does not control for any potential inefficiencies of concessionaires.

As such, the Authority has undertaken a separate efficiency study which assessed the need for any efficiency adjustments to the LRAIC modelling results of concessionaires.⁶ This study aimed to determine, for each concessionaire, whether any efficiency adjustments to the LRAIC modelling results are needed, and if so, how large these adjustments shall be (i.e. the efficiency adjustment factors). If required, these efficiency adjustment factors may then inform the Authority's process of determining regulated prices based on the LRAIC cost results (i.e. by applying the efficiency adjustment factors to the LRAIC unit cost values).

The exact process of determining particular regulated prices will be determined on a case-by-case basis and the Authority will issue further communication on these processes closer to the time of determining the relevant prices. The Authority shall be guided by its Consultation Procedures in this regard.

⁵ See Section 5.1 of "The Costing Methodology for the Telecommunications Sector", 29 May 2008

⁶ Methodology for an Efficiency Study, 09 May 2011

4 Networks to be modelled

A range of networks are used by the various concessionaires to provide the wholesale and retail services and the costs of these therefore need to be estimated. For fixed markets, quite different networks are deployed by concessionaires to deliver products in the same markets. For example, networks that employ twisted pair copper cable, fibre, co-axial cable and wireless technologies are all used to deliver fixed services in Trinidad and Tobago.

The LRAIC model has been designed to be sufficiently adaptable to allow costing services for all concessionaires based on their respective mix of networks whilst being sufficiently generic to ensure that cost estimates resulting from the different concessionaires are comparable.

Where an indexation approach has been used to revalue assets (the default approach), the LRAIC model reflects the current network structure and cost volume relationships. Where the CCA revaluation has been carried out on a Modern Equivalent Asset (MEA) basis the LRAIC model also reflects the MEA technology both in terms of the increments defined in terms of network components and the cost volume relationships modelled.

4.1 Access Networks

Different concessionaires will be using differing networks to deliver services. Traditional fixed wireline, CATV, fixed wireless and mobile (cellular) access networks differ clearly in terms of structure, costs and capabilities to such an extent that the model needs separate cost categories for each type of network.

4.1.1 Fixed access Networks

Even where networks offer similar services to the end user (for example fixed voice calls can be provided over traditional fixed wire line access networks, cable television networks and fixed wireless networks), the networks differ to such an extent that differing cost categories will be needed for each type of network.

Therefore, the Authority has decided to include cost categories and network elements for four principle types of fixed access networks in the model:

- traditional fixed wire line networks, using twisted pair copper to deliver services;
- traditional co-axial and hybrid fibre co-axial (HFC) cable television networks;

- fibre networks connecting directly to end user premises based on point to point connections or passive optical networking (PON) technology; and
- fixed wireless networks including broadband wireless access (BWA) networks.

A single operator may operate a range of different access technologies. For example over time it is likely the some customers currently served using traditional twisted pair copper will be migrated to fibre connections.

4.1.2 Mobile access Networks

The two principal mobile networks for voice traffic use the GSM family (GSM/GPRS/EDGE) standards. In addition, the incumbent mobile provider operates a CDMA network, principally for data services. If 3G (UMTS) services are introduced it is likely that these networks will be introduced as an overlay to the existing GSM networks, with customers with dual mode handsets using either network depending on both the availability and capability of the network.

The existence of multi-mode handsets and the sharing of towers and, in some cases, the core network between different technologies means that it is effectively impossible to separately cost networks or the services that use these networks. For voice services there is little or no differentiation between services offered by the different networks from the perspective of the user.

In addition cellular access networks tend to have similar structures across differing technologies even if the implementation of standards by different vendors may differ somewhat.

For these reasons, the Authority has decided not to distinguish between the differing technologies used currently, and technologies that may be introduced in the future, for the purposes of service costing on the basis of the LRAIC model.

4.2 Core network components

In the long term it is expected that mobile and fixed access networks will be served by a single converged packet switch network based on IP/MPLS technology. Currently voice traffic is generally switched using traditional TDM switches, while data services are carried over a range of overlay networks. In addition where operators have both mobile and fixed networks the switches for these are generally separate although there is typically some sharing of underlying infrastructure such as buildings or transmission.

While the convergence to a single integrated IP/MPLS network carrying both narrowband voice and broadband data traffic is the long term target, this is unlikely to be achieved in the short to medium term. Indeed those operators who had hoped to be at the forefront of such a migration, for example BT with

its 21CN, are now expecting to continue to run traditional TDM switches for a number of years.

Therefore, the Authority has decided to maintain separate cost categories for fixed and mobile network components and for narrowband voice components and data components. These cost categories are set out below:

- fixed dedicated voice components such as traditional TDM switches and soft switches;
- fixed (or converged fixed and mobile) broadband data components including DSLAMs, aggregation nodes and routers;
- mobile specific voice components such as mobile switching centres (MSCs);
- mobile specific data components, such as SMS messaging centres (SMSCs).

As networks converge over time the LRAIC model will need to be populated in a way that reflects this convergence. For example, where narrowband voice traffic is carried over the packet switched network also used for broadband traffic (voice over IP), this usage of a converged network will be included through the routing factors for the relevant services. When this transition is complete the legacy components defined in the LRAIC model will no longer be needed.

5 Increments

This section begins with a high level overview of the cost categories, increments and network elements and then continues to describe them in further detail. This section also sets out the increment hierarchy within the LRAIC model.

5.1 Cost categories, increments and network elements

The LRAIC model attempts to attribute costs of each of the concessionaires to individual network services. Network services are the access and conveyance services underlying both wholesale and retail services provided to other concessionaires and end users respectively. The costs of these services exclude any retail or wholesale specific costs such as product management and customer care. In order to carry out the attribution, a number of intermediate stages are defined:

- cost categories into which the costs of the concessionaires are mapped;
- increments for which incremental costs are calculated; and
- network elements consisting of sets of network components, to which costs are attributed as an intermediate step in the service costing process on a LRAIC basis.

These concepts and the relationship between them are described in further detail below.

5.2 Definition of network elements

Network elements are one of the building blocks of regulatory cost accounting and are used to represent logical network components. Service costs are calculated by attributing the cost of network elements across the services that utilise the element based on routing and usage factors.

In order to identify the appropriate network elements, services should be separated into five broad groups of services delivered by logically separate network. These service groups consist of:

1. fixed access services;
2. fixed narrowband conveyance services;
3. fixed broadband services;
4. leased line services; and

5. mobile voice and data services;

When defining network elements, the Authority has taken into account whether a single cost driver can be used to allocate the cost of the element between services. This means that network elements do not typically include any routing within the element itself.

5.2.1 Fixed access

The fixed access network is generally considered a single network element in LRAIC models developed for fixed line incumbents, with the cost driver being the number of lines. This reflects the dedicated access nature of traditional twisted pair infrastructure, where each subscriber has dedicated capacity from their premises to the MDF

Other technologies, such as point to multi-point wireless and HFC cable TV networks include an element of shared access in the access network since a number of customers shared a fixed amount of bandwidth. The costs of these network elements are however also driven to a significant extent by the need to provide ‘coverage’ of customers, i.e. the ability to connect potential customers. In a fixed network there will be a relationship between the coverage of the network and the number of customers served, with increased coverage benefiting the additional customers that can be served. Recovering costs of these elements of the access network will therefore reflect both cost causality and the distribution of benefits. It will also increase the degree of comparability between the different access methods used by the concessionaires. Given the above, the Authority has defined three network elements for access networks:

- fixed dedicated access, which include traditional wireline networks, and other networks with dedicated capacity to a single customer such as point-to-point wireless and direct fibre connections;
- HFC cable access, which include those elements of access networks for cable TV networks; and
- fixed wireless access, which include point-to-multi-point technologies such as WiMAX as well as point to point systems.

The implicit separation of these network elements into subscriber sensitive and traffic sensitive elements will be dependent on the drivers used as the inputs to the related cost categories in the LRIC model. These are outlined in the table below for the three broad categories of fixed access networks

Table 3. Fixed Access Network Drivers by Network Type

Type of network	Driven by number of subscribers	Driven by both subscribers and traffic	Driven by traffic only
Fixed wireline	Copper local loop and access fibre	Local switches, DSLAMs, MSANs and optical line termination (OLT) equipment	Transmission equipment and fibre, tandem switches, routers, etc.
HFC cable	Co-axial cable network	HFC optical node	Transmission equipment and fibre, head end equipment, routers, etc.
Fixed wireless	Point to multipoint systems and point to point systems used to directly connect customers		Wireless and fibre based backhaul, routers, soft switches, etc.

Source: Frontier Economics

5.2.2 Fixed narrowband conveyance

The services in this group include voice call services: end to end calls; call origination and call termination.

A typical traditional TDM network has a four level switching hierarchy:

- remote switches/concentrators;
- local exchanges;
- transit switches; and
- international gateway switches.

Remote switches/concentrators and local exchanges to which subscribers are directly connected are further divided into the line card element which is dedicated to a single subscriber and those elements that are sensitive to traffic. There has been a trend towards flatter network hierarchies within some cases, local exchanges also acting as transit switches and switches acting as both national transit switches and international gateways. Within the LRAIC

methodology such 'collapsing' of layers in the network hierarchy can be achieved via the cost allocation of the relevant switch with dual functionality (for example, by allocating the costs to one or another cost category and then ensuring that the routing factors reflect the dual use).

Given that call services are routed through different levels in the network hierarchy, the corresponding transmission links between nodes will need to be separately identified.

Incumbent operators are gradually transitioning narrowband voice traffic to packet based soft switches, but the current topology is likely to endure for a number of years. During the migration from TDM networks to packet switched networks, both technologies will be in use, with a single call potentially using both technologies. Given the technology neutral approach set out in this paper, the LRAIC model does not attempt to separately cost calls carried over the various combinations of technology. Instead the routing factors reflect the mix of technologies in use for each time period with the resulting costs being a weighted average.

New entrant fixed operators who have rolled out voice networks more recently are likely to use flatter networks based on soft switches, rather than traditional TDM switches. In this case the network elements used should reflect the lower number of levels in the hierarchy, for example not including separate transit and international gateway switches.

5.2.3 Fixed broadband services

Services in this group include broadband services' typically used for internet access. Incumbent fixed operators, using ADSL to deliver the access part of the service typically have a four level hierarchy (mimicking the hierarchy in the narrowband network) consisting of:

- DSLAMs (Access Nodes);
- aggregation nodes;
- core routers; and
- broadband remote access servers (BRAS).

Each of these levels is defined as a network element, along with the transmission links between them.

Other fixed networks, such as fixed wireless access (FWA) operators have less complex network hierarchies and should map their respective network components onto the relevant network elements.

5.2.4 Leased line services

Leased line services provide end-to-end connectivity between two customer (wholesale or retail) premises. Typically they consist of two “tails” providing connectivity from the customer premises to the network and matched capacity within the core/aggregation network.

The appropriate driver for the access part is the capacity of the links. Generally the leased line will be provided over the existing fixed access network. Thus the Authority has decided not to define a separate network element for leased line access.

For the core element, leased line transmission is shared with other transmission. Thus for leased line services the Authority has decided to define a single network element: leased line transmission capacity⁷.

5.2.5 Mobile networks

GSM networks

The main mobile networks are GSM and as such are highly standardised.

The base station subsystem consisting of the base stations (BTS) and base station controllers (BSCs) and the backhaul networks between them can be considered a single network element. Unlike the traditional fixed network, this is a shared access network and so the appropriate driver is traffic based rather than the number of subscribers.

The relatively small mobile networks in Trinidad and Tobago appear to have a flat switching hierarchy. As such there is no need to distinguish between types of MSC.

Other network components also need to be included as separate network components. In particular:

- location registers – the home location registers (HLRs) and the visitor location registers (VLRs) where they can be separately identified;
- the SMS message centre (SMSMC); and
- packet switched data network (SGSN, GGSN and so on).

⁷ At the network level there is no distinction between leased lines bought by end users (“retail”) and those bought by other concessionaires (“wholesale”) although there may be differences in the types of lines bought and the level of customer care offers which may be reflected in prices.

Evolutions of GSM technology, such as 3G (WCDMA) and LTE are likely to be added to the network over the coming years. The associated equipment can be allocated to the corresponding GSM network categories.

Other mobile networks

The direct costs of other mobile networks which carry predominantly non-voice traffic, such as paging networks and CDMA networks, are separately identified.

5.3 Definitions of increments

Under a LRAIC approach the LRIC output of the model is the cost of the network elements which are then used to determine service costs. In general, the network elements are defined as the sub-increments in the costing. Larger increments, consisting of sub-sets of network elements, are also defined at higher levels in the increment hierarchy. This allows the recovery of common costs across network elements in a manner that reflects cost causality where possible.

In general, the network elements identified above are physically separate components and thus can be defined as increments at the lowest level in the increment hierarchy. However there are two principal exceptions.

- The first is remote concentrators/switches, hybrid fibre coaxial (HFC) optical nodes and local switches which sit on the boundary between the core and access networks. These elements were decomposed into logical network elements by applying appropriate Cost Volume Relationships.
- The second is the core transmission network where the same set of components, for example making up a SONET ring, is often used to deliver a range of the transmission network elements set out above.

5.3.1 Transmission

While in theory it is possible to estimate the incremental costs of the individual network elements for the transmission network, in practice the resources required may not be proportionate given the limited accuracy of the results. For the transmission network the Authority has decided to include an increment as the combined set of relevant network elements and then to allocate costs to the network elements as a separate stage.

5.4 Cost categories

Concessionaires need to categorise costs according to a defined set of cost categories for the purpose of inputting costs to the LRAIC model. For the purposes of the CCA study, assets may need to be further disaggregated than is

required for the LRAIC modelling. For example if assets in a single LRAIC cost category have different asset lives then the assets need to be separated for the purposes of calculating the CCA capital charges.

Relationship between increments, cost categories and network elements

In many cases there is a one-to-one mapping between a physical asset and an increment and hence a logical network element (for example a Mobile Switching Center). Where such a relationship exists, the cost categorisation is designed to allow the separate identification of the relevant assets and related cost categories.

However, in other cases a physical asset, for example a duct, is mapped to a number of increments reflecting a more complex causal relationship. Similarly, most network operating expenditure do not have a one-to-one mapping to increments and network elements. In this case, the cost categories are defined in such a way as to allow cost causality between the increments (and underlying network elements) and costs to be accurately captured.

5.5 Defining the increment hierarchy

The network elements or sets of network elements defined in Section 5.3 form the lowest level of the increment hierarchy. However, a number of intermediate levels (known as an increment hierarchy) are typically defined for two reasons:

- first, to provide aggregate estimates of the costs of groups of activities broadly consistent with “businesses” defined for accounting separation purposes; and
- second, to identify fixed and common costs between groups of network components in order to calculate EPMU to recover these costs.

The increment hierarchy in the LRAIC model consists of five levels as set out below.

- **Level 0** – at the highest level the whole enterprise can be considered as a single increment, with the incremental cost equal to the total cost of the business;
- **Level 1** – the total business can be divided into the network increment consisting of the cost of operating and maintaining the network, the “Retail and other” increment which consists of non-network activities;
- **Level 2** – the network can be divided into mobile networks and fixed networks. As in integrated fixed/mobile business the fixed network makes greater use of the transmission network, in this case the transmission

network can be included in the fixed network. The “Retail and Other” increment can be divided into “Retail”, “Wholesale” and “Other”;

- **Level 3** – the mobile and fixed networks are divided into “core” and “access” networks;
- **Level 4** – the lowest level of increments (in most cases corresponding to network elements).

6 LRAIC model inputs

This section discusses the inputs to the LRAIC model and how they integrate to calculate the LRAIC of the defined increments.

The basis for construction of a top down model is that for each activity which gives rise to costs, a cost driver must be identified. The cost driver must be a measure for each activity and the cost of the activity should be wholly dependent on the level or volume of the cost drivers. Thus the identification of appropriate cost drivers for each cost and applying the defined relationship between the costs and their respective drivers is the primary task of the top down model.

This means that the LRAIC model requires the following key inputs:

- base cost information used in the model;
- the cost of capital applied to the mean capital employed;
- LRAIC cost categories;
- cost drivers;
- CVRs;
- hierarchy of dependencies; and
- increment specific fixed and common costs (ISFC).

6.1 Base cost

As part of CCA and LRAIC modelling processes, concessionaires are required to provide information on their current, annual cost base, including amongst others annual operating expenditure, HCA-based information for fixed assets and balance sheet items. The fixed asset data forms the input to the CCA study undertaken by the Authority, the results of which then feed into the LRAIC model.

To facilitate this data collection process, the Authority has prepared a data request template file and accompanying guidelines which are published and resubmitted to concessionaires each year.

Operational expenditure, direct costs and cost of sales

Concessionaires are required to provide operating expenditures, direct costs and cost of sales based on a specified template provided to them by the Authority as part of the LRAIC data request.

Depreciation

The depreciation charges included in the LRAIC model are based on CCA and form an output of the CCA study undertaken by the Authority for each concessionaire. The methodology for this is set out separately to this document in the CCA Reference Paper.

Capital employed

The value of capital employed included in the LRAIC model for fixed assets is the Net Replacement Cost (NRC) taken from the outputs for the concessionaire-specific CCA study undertaken by the Authority. For current assets and current liabilities the values are taken from the balance sheet and will be classified into the appropriate cost categories. The methodology for this is set out separately to this document in the CCA Reference Paper.

Taxation and Finance Costs

The model excludes all direct costs relating to financing of the business and taxation, for example interest payments, foreign exchange gains/losses, taxation and the working capital associated with these cash flows. However, according to IAS 16 (Property, Plant and Equipment), the treatment of components of costs for capital equipment costs should include the purchase price inclusive of import duties and non-refundable purchase taxes and should be included in the Fixed Asset Register. The cost of capital, which is calculated pre-tax, implicitly provides for the recovery of these costs, implicitly including a premium to take account of issues such as exchange rate risks.

Other financial costs relating to the operation of the business, for example collection costs associated with customer billing should be included in the relevant operational expenditure category. One off exchange rate adjustments, both positive and negative, are excluded from the cost base used as input to the LRAIC model.⁸

⁸ Currency adjustments are by their nature unpredictable, with the possibility for the adjustments to vary over time or even change sign from one reporting period to the next. There is no reason to believe that the level and direction of currency adjustments in a given accounting period provide any information on the direction or level of future currency adjustments. The Authority therefore considers zero to be a reasonable expected exchange rate adjustment forecast. Given that the aim of the LRAIC model is to estimate the level of forward looking efficient costs for services excluding currency adjustments is likely to provide a more accurate estimate of these forward looking costs. However, where the results of the LRAIC model are being used for regulatory purposes, the Authority shall, in the decision making process, take

6.2 Cost of capital

The cost of capital estimates the return that a concessionaire must be expected to earn on the capital it employs in its business in order to attract investment funds. As such, it plays a key role in estimating the overall cost of the business and hence of services. The cost of capital is typically measured using a weighted average cost of capital (WACC) and includes both the cost of equity and debt finance, weighted by the assumed debt to equity ratio for a company.

The Authority has undertaken a separate study to determine the WACC values for different groups of concessionaires⁹. These values form an input to the LRAIC model. The WACC study may be updated as networks evolve and the most recent publication should therefore be referred to.

6.3 LRAIC cost categories

In the LRAIC model the cost data is supplied on the basis of LRAIC cost categories. To group cost information together into a LRAIC cost category it is necessary that:

- costs included share the same driver; and
- costs included have the same dependencies with regard to other cost drivers further down the driver hierarchy.

The LRAIC cost categories are grouped into nine categories:

- fixed and mobile network components;
- network infrastructure and support equipment (such as network power equipment and network buildings);
- non-network assets (such as office furniture and billing systems);
- network activities (including network maintenance);
- product management (for example, interconnect product management);

into account all information available to it, which may include information relevant to exchange rate movements.

⁹ The Weighted Average Cost of Capital, May 9th 2011

- support activities (such as human resource and finance department costs);
- network Opex
- general and administration expenditure
- direct costs, cost of sales, and so on (such as interconnection out payments); and
- balance sheet items.

Annexe 4 contains a full list of the cost categories.

6.4 Drivers

For each of the LRAIC cost categories, a cost driver, or in a small number of cases two cost drivers, have been identified. The cost driver of a LRAIC cost category is considered to be the variable(s) which influences the level of costs in the cost category through the volume or dimension of the network component or activity purchased. The respective unit cost of the cost category is not a direct input to the LRAIC model (although may form an input to the CCA valuation).

Drivers can be classified into two broad groups.

First, exogenous drivers are directly dependent on levels of demand for services as specified by the increments. For example, the cost of a mobile network BSS is driven by the volume of BSS traffic.

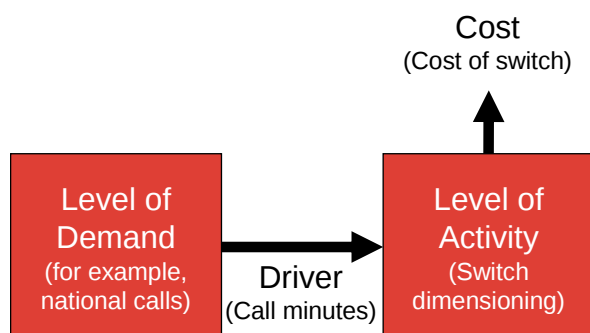
Second, endogenous drivers are dependent on internal demand from other activities within the concessionaire's business and their related cost categories. For example, the cost of HR (human resources) department is driven by the number of employees in the business, which in turn will depend indirectly on the demand for services as defined by the increment.

These two broad groups are described in further detail below.

6.4.1 Exogenous cost drivers

Some activities and hence costs are driven directly by the level of demand as shown below. Activities or cost categories that are driven directly by demand are only dependent on the level of the increments. Such drivers are "exogenous" drivers, i.e. the level of the drivers is dependent on demand which is external to the concessionaire.

Figure 1. Exogenous cost drivers



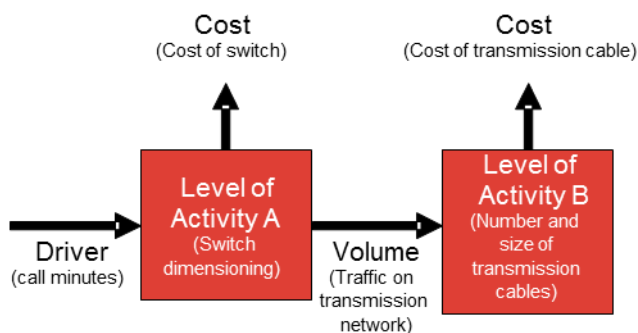
The increments have been specified so that exogenous drivers are dependent on a single increment. For instance, BSS equipment cost is driven by the volume of BSS traffic. As a result these drivers are set either at 100% or 0% of current demand during the calculation of incremental costs.

6.4.2 Endogenous cost drivers

Endogenous cost drivers are those that are dependent on internal demand for activities and only indirectly on external demand.

For many activities and hence costs, the causal link between demand and the level of costs is indirect. For these activities (e.g. Activity B below), the level of their corresponding drivers is dependent of the level of other activities (Activity A below), which in turn is dependent on the input drivers for these other activities as illustrated below. Such drivers are endogenous, i.e. dependent on demand which is internal to the operator.

Figure 2. Endogenous cost drivers



The LRAIC model uses five different types of endogenous drivers:

- endogenous network drivers;
- non-network endogenous drivers;
- employee drivers;
- gross replacement cost drivers; and
- other cost drivers.

Endogenous network drivers

Endogenous network drivers drive the costs of network support cost categories. As the dimension of network components (such as MSCs) vary in response to changes in demand, the demand for network support functions will also vary. Linear relationships are used to drive the relationship between the dimensioning of network components and the demand for network support equipment. For example, network floor space is proportional to an endogenous network driver, namely the floor space requirements of network components which in the model is proxied by the replacement cost of the associated equipment.

Non-network endogenous drivers

Non-network endogenous drivers drive the cost of some non network activities. For example demand for vehicles is driven by a combination of network operations and other commercial and administrative activities. These drivers are defined by the base level of the driver associated with each activity (for example

the number of vehicles in each department) and the relationship between demand for the activity and the level of the driver.

GRC drivers

GRC is used as a driver where it is believed that the driver for a cost category (typically a network support cost category), can be a reasonable proxy of the total acquisition cost of the equipment it supports. Intuitively, it seems reasonable that there will be a strong degree of correlation between the support costs of equipment (which will increase with the number and complexity of network components), and the replacement cost of the equipment (which will also increase with the number and complexity of network components). Using GRC as a driver also has the following advantages:

- it is a common cost driver that can be applied to all assets; and
- a common CVR can be used because GRC can be assumed to vary in the same manner as annualised costs.

Employee drivers

Employee drivers are used for LRAIC cost categories for which the values are expected to vary in relation to the number of staff, either in total or for a department or group of departments. Examples of LRAIC cost categories driven by employee numbers include HR costs or the cost of office machinery (PCs, office furniture, etc.).

Other cost drivers

Some activities, for example finance, can be considered to be driven directly by the total costs of a given subset of activities (or in the case of finance, all activities). The drivers here are thus the costs of the relevant activities calculated in the LRAIC model.

6.5 CVRs

In order to calculate LRAIC, it is necessary to understand how costs vary according to the volume of services produced. CVRs are used to define how costs change as the volume of the driver also varies. The quantification of the relationship between the volume of services offered and the cost of providing those services is fundamental to the calculation of LRAIC.

CVRs are typically expressed as two-dimensional charts, plotting the relationship between the value of the volume driver and the value of the affected cost category. The relationship can be mapped with cost driver volumes on the X-axis

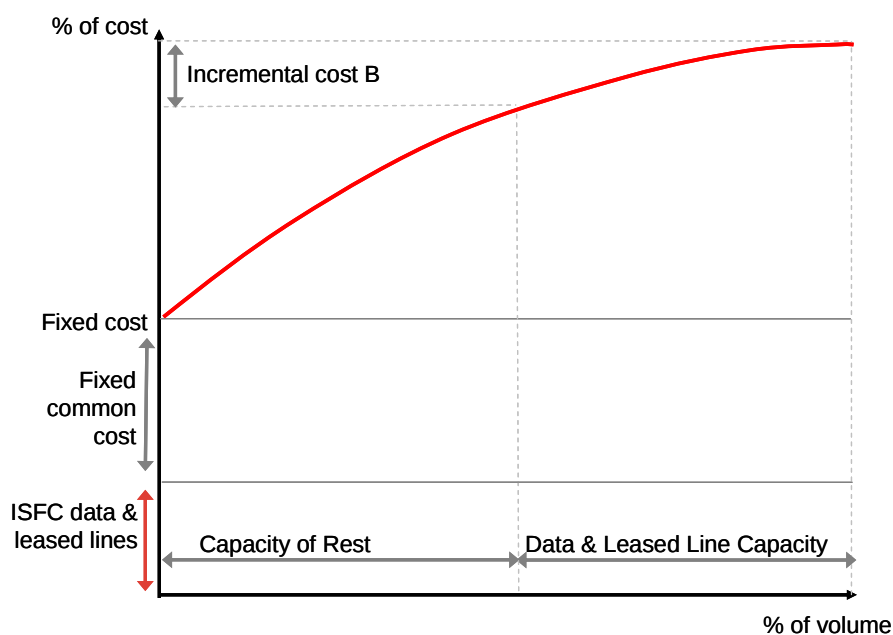
and the costs, caused by the cost driver, on the Y-axis, and with both costs and volumes expressed as percentages of current values.

The two key characteristics of CVRs are:

- the shape of the curve, reflecting the relationship between variable costs and volumes; and
- the extent of fixed (and/or common) costs exhibited in the relationship (the X-axis intercept).

In Figure 6, two increments, A and B, drive the total volume of the cost driver. The incremental cost of B is shown given that increment A is already produced.

Figure 3. A typical CVR



For some LRAIC cost categories there are fixed costs. That is, costs do not fall to zero as the volume of the cost driver falls to zero. The intercept with the y-axis of the CVR represents the fixed cost associated with the cost category. A fixed cost may either be uniquely associated with the production of one increment or shared between increments.

Increment specific fixed costs

That portion of the fixed cost that is not shared with any other increment is known as increment specific fixed costs (ISFC, see Figure 3 above). These costs are included as part of the incremental costs of the increment they are associated with.

Shared fixed costs

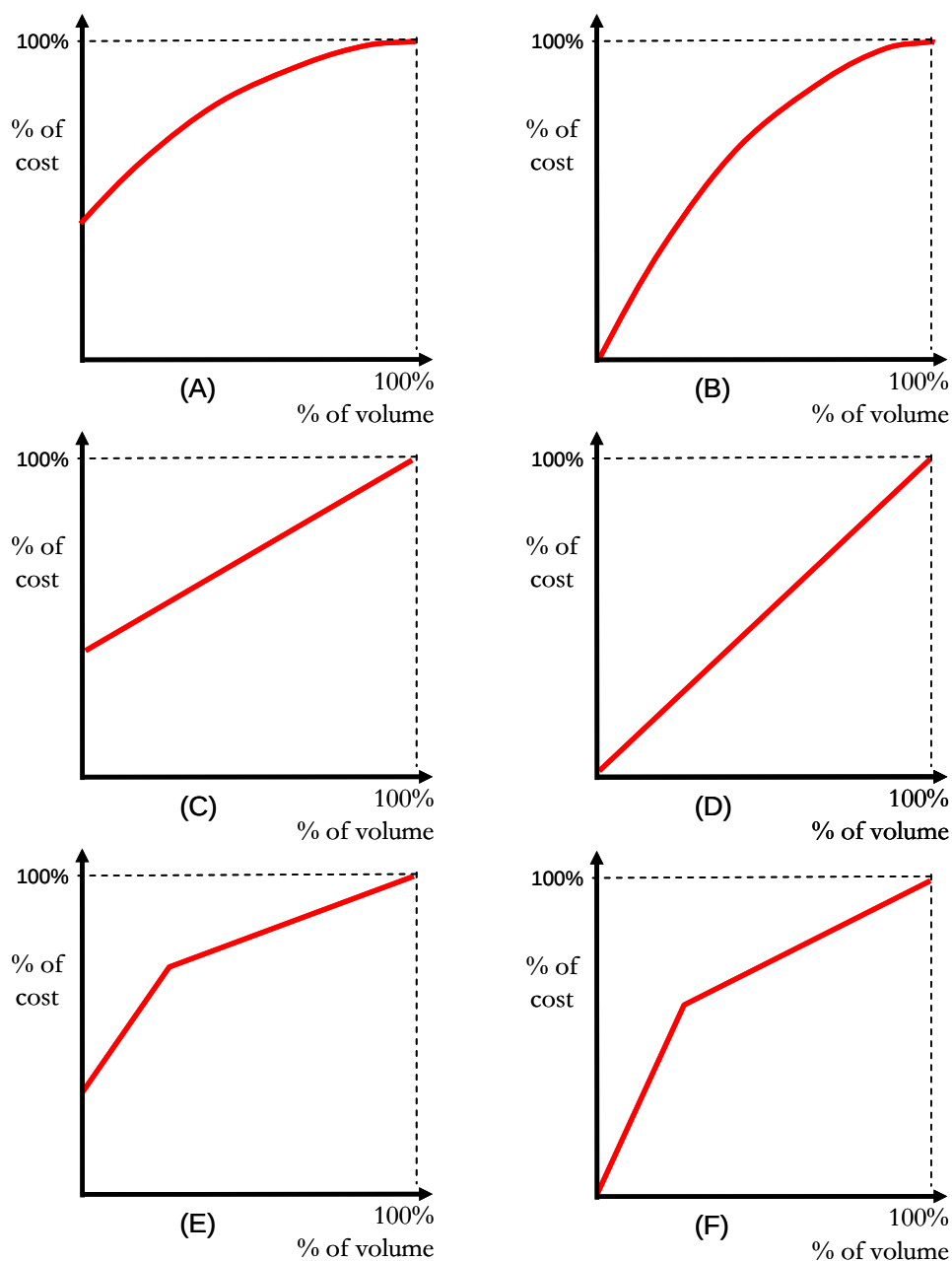
Fixed costs which are not increment specific are called fixed and common costs. The existence of such costs indicates the presence of economies of scope¹⁰.

The mapping of CVRs to cost categories can be one to one or one to many, as different cost categories may share the same cost driver and the same CVR. However, a CVR can only be shared by cost categories where the cost causality for each cost category is identical.

CVRs can take many forms, a selection of which are represented graphically as shown in **Figure 4**.

¹⁰ Economies of scope are present when it is more cost effective to produce two or more outputs together rather than separately.

Figure 4. Typical CVR functions



In developing the LRAIC model, the Authority has paid regard to the need to minimise resources required to develop CVRs where appropriate, by making simplifying assumptions:

- **CVRs are not required for those cost categories driven by a single exogenous cost driver with no increment specific fixed costs, as this**

driver is either set to the current level of demand or to zero, at which point the modelled cost of the cost category is zero. This results in a significant reduction in the amount of resources required to develop CVRs compared to the practice in other countries, such as the UK, where CVRs are required for all cost categories.

- In the current version of the LRAIC model it is further assumed that that **CVRs for cost categories driven by endogenous cost drivers** with no ISFCs **are linear with no fixed costs** (i.e. costs are directly proportional to the driver, see (D) in Figure 4 above), unless specified otherwise by the concessionaire. As such, no inputs from concessionaires are required to determine these CVRs.
- **CVRs are required for all remaining cost categories (i.e. those driven by multiple cost drivers or where there are ISFCs).** In order to simplify the information requirements and the calculation for those remaining CVRs, the Authority has made the assumption that **these CVRs are linear with a fixed cost [(C) above]**. The input data for CVRs of this form is reduced to the percentage of the cost that can be avoided when the relevant cost driver has zero value, i.e. the intercept with the Y-axis.¹¹

As a result inputs are only required for CVRs for those cost categories driven by more than one driver or where there are ISFCs. These are set out in Annex 5. These CVRs are only required for a subset of concessionaires and hence not all concessionaires are required to submit CVR information. Further, where relevant concessionaires are not able to provide the required information to derive CVRs, the Authority will develop CVRs based on benchmarking data from other jurisdictions.

6.5.2 Development of concessionaire-specific CVRs

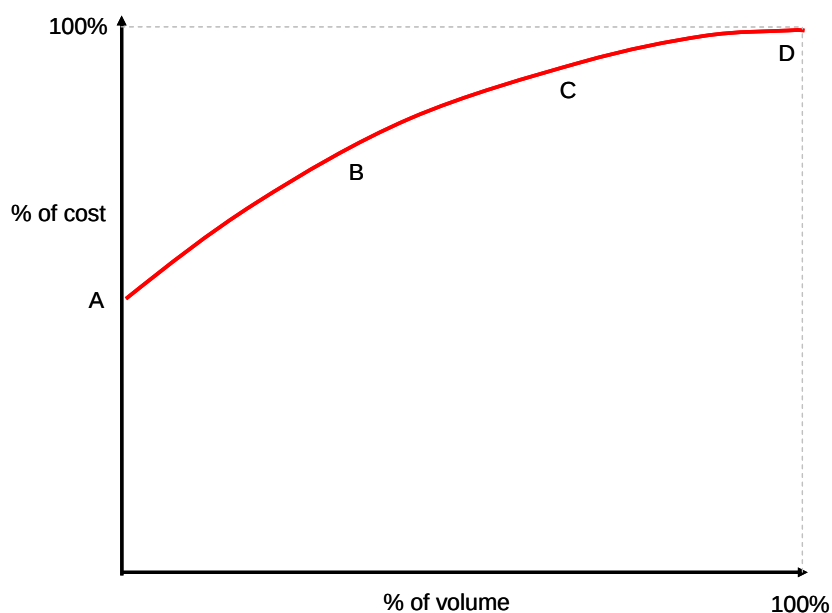
For each concessionaire the number of CVRs within the LRAIC model depends on the networks used.

For each CVR required it is necessary to identify:

¹¹ All CVRs in the LRAIC model are defined with the potential to include both ISFCs and relevant volume drivers. For example CVR6 for network buildings has four potential inputs: (1) “GRCD6 GRC network in buildings” (2) “FA Fixed access”, (3) “MC Mobile core” and (4) “FNFixed network”. The last three inputs reflect potential ISFCs but these have been set to zero in the absence of information on ISFCs. As a result the only non-zero input is GRCD6 which related to the gross replacement cost of equipment typically housed in buildings. The percentages quoted are derived endogenously in the LRAIC model based on the Gross Replacement Costs calculated in the CCA model. This data, and data on employee numbers and costs, is combined with data on the “Employee and GRC Subsets” sheet to estimate the drivers.

- the minimum point [Point A in Figure 5], as defined within the scorched node and thinning assumption, i.e. the proportion of costs which would remain if the volume of the driver was to move towards zero;
- the elements of this fixed cost which are specific to a particular increment, i.e. which would be avoided if the particular increment were not delivered.

Figure 5. CVR construction



The following process is undertaken for estimating each CVR required for a concessionaire:

- the current cost and equipment quantity relating to the CVR category is established. The current cost values and quantities are based on operator input;
- the amount/volume of equipment relating to the minimum point is determined, which is then expressed in cost terms;
- any equipment and hence cost relating solely to one increment at this minimum point is determined, and then expressed in cost terms.

Sources of information

Whilst the maximum point of a CVR is obtained from inputs to the LRAIC model, it is necessary to estimate the minimum point. There are two main methods to do this:

- engineering simulation models(which is most likely to be initially used to estimate most inputs); and
- interviews and field research.

Engineering simulation models: For the required CVRs for network components, concessionaires are required to estimate the reduction in cost from moving drivers toward zero. This will require implementing engineering models.

The steps in the modelling process are as follows:

- break down the cost category into its components (for example, breaking the remote concentrators into individual components such as line cards, power supplies, etc.);
- determine the unit cost for each of the components;
- populate a model with data reflecting demand driving the component volumes;
- establish dimensioning rules linking demand to component volumes;
- apply the relevant unit costs to each asset component, in order to capture any difference in the mix of component parts; and
- modify the volume of the identified cost driver to derive a cost volume relationship.

Information from concessionaires (interviews and field research): By interviewing experts within each area that contributes towards the cost of a cost category, the concessionaries should be able to estimate the fixed and variable cost and hence the shape of the CVR. This relationship also takes into account reasons why costs may change as volume alters, such as vendor discounts and the impact of outsourcing services.

6.6 Hierarchy of dependencies

All costs within the LRAIC model are directly or indirectly related to the volume of output of the increments. However, while certain costs are directly related to those volumes, others only have an indirect relationship to the volume of increments, mediated through other intermediate cost drivers and volume-volume relationships.

Exogenous cost categories

Exogenous cost categories are those, whose volume driver has a direct relationship to the external demand for an activity, i.e. they are not dependent on any other cost categories. The cost driver volume for an exogenous cost category is exogenous to the model and known without calculation.

Endogenous cost categories

Endogenous cost categories are intermediate cost categories. These do not have a direct relationship with an exogenous cost driver, but are dependent on other cost categories. Consequently, before the incremental cost can be calculated, the cost categories feeding into the relevant cost driver volumes must be calculated. Endogenous cost drivers are typically used for indirect and support costs.

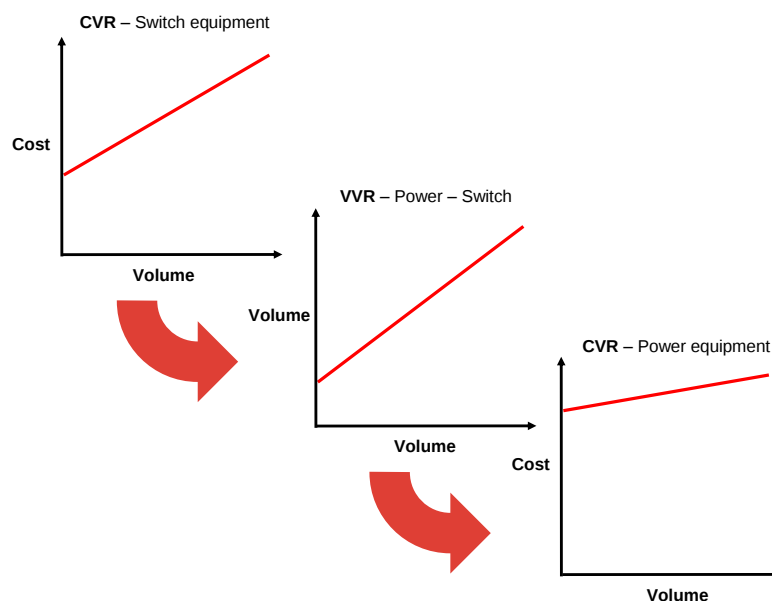
In order to capture the full set of costs, it is necessary to define hierarchies of relationships within the LRAIC model. This allows for those costs that are driven directly by exogenous drivers to be calculated first, with successive interdependencies being rippled through the model. The dependency hierarchy is defined in such a way as to ensure there is no circularity in the dependencies.

The guiding principle is to define those costs that are specific to network assets at the top of the hierarchy (since these are generally the costs which are driven by exogenous variables such as call and line volumes). Following this it is possible to define those costs that are driven by endogenous drivers.

An example of a dependency hierarchy is shown in the figure below. In this example, based on legacy TDM technology, it can be seen that:

- the volume of switch minutes (an exogenous variable) drives switch costs;
- the volume of switch minutes also drives the requirement for network power; and
- the demand for network power (an endogenous variable) drives the cost of network power equipment.

Figure 6. A typical dependency hierarchy



6.7 Transmission allocation

As noted in Section 5.3.1, transmission equipment and infrastructure is used to support links that in turn support a range of services. Given the high proportion of joint and common costs it is difficult to precisely attribute costs to individual links and hence services through an incremental costing approach and such an approach would require a disproportionate amount of resources.

The approach adopted in the LRAIC modelling is to define two increments for the domestic transmission network:

- Domestic transmission (capacity dependent). This consists of those network components whose costs are dependent on the number and capacity of links but largely independent of the length of links. Examples include transmission terminal equipment, cross connects, etc.
- Domestic transmission (length dependent). This consists of network components whose costs are dependent on the length of links they serve (which may also be dependent on the number and capacity of links). Examples include fibre cables and the duct housing the cables and may include wireless links where multiple hops are required or where longer distance links require more expensive equipment and/or frequency.

The costs of these two increments are then allocated to the defined transmission network elements on the basis of the relevant volumes of each network element:

- The total capacity of links for each network element expressed as the number of T1/E1 equivalents; and
- The sum of the capacity multiplied by length of the links for each network element expressed as T1 km equivalents. For example a T1 link of 10 km length being recorded as 10 T1 km equivalents.

Ethernet versus SDH networks

Next generation networks may use packet switched transmission (e.g. Gigabit Ethernet links over fibre) in addition to legacy TDM transmission links (e.g. SDH). While the two transmission technologies may provide substitute functionality, the cost allocation to services will be more accurate if the costs of the two technologies are separately identified and allocated. Where concessionaires operate both technologies they should provide data on the costs of the related transmission equipment separately.

6.8 Service volumes, conversion and routing factors

The costs of network elements are allocated to network services on the basis of the total volume of each service combined with the average usage that each unit of the service makes, of a given network element.

The defined network services are set out in Annex 6.

A discussion of each of these elements follows.

6.8.1 Volume of services

The units used for the total volume of service are typically:

- conversation minutes in the case of circuit switched services;
- messages in the case of SMS services;
- bytes in the case of packet switched services.

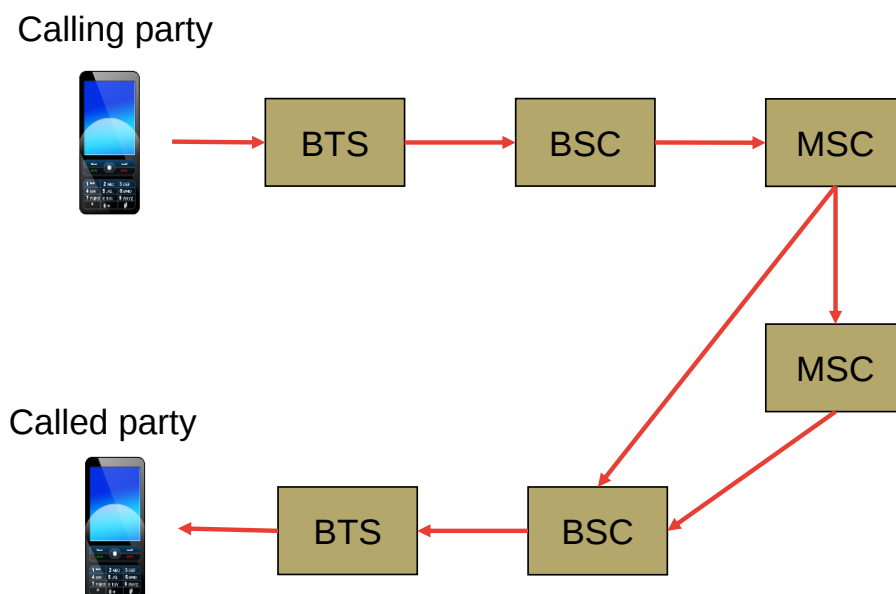
Care must be taken when measuring volumes of similar services, to ensure a consistent approach is used or to ensure the estimates are adjusted to take account of differences in measurement. For example, data from retail billing systems often present data in terms of “billed minutes” where conversation time is rounded up to the nearest billing increment, while interconnection minutes are usually billed on a per second basis and so output from interconnection billing

systems is generally on a per second basis. In the case where retail billing increments are of similar duration to average call length, there can be a significant difference between “billed” minutes from the retail billing system and minutes on a per second basis from the interconnection system, with “billed” minutes being materially higher than minutes on a per second basis. In this case, a conversion factor should be used to convert to a per second basis. Conversion factors are discussed in 6.8.3 below.

6.8.2 Routing factors

For services delivered over networks with a complex hierarchy such as voice calls, different services may use greater or fewer network elements. Routing factors are used to describe the way in which a call makes use of different network elements. The figure below shows a simplified diagram of how mobile calls are routed in different ways over the mobile network and therefore make different use of network elements in order to explain how concessionaires should calculate routing factors.

Figure 7. Simplified network diagram



Source: Frontier Economics

In this simplified example, an on-net call could be routed in two different ways, either:

- It would be routed via a BTS, a BSC, an MSC and then directly to the BSC and BTS of the called party (A); or
- It would be routed via a BTS, a BSC, an MSC and to another MSC before being routed to the BSC and BTS of the called party (B).

If 70% of on-net calls are routed in the first way (A) and 30% in the second way, (B) the routing factors would be calculated as set out in the table below.

Table 4. Simplified calculation of routing factors for an on-net call

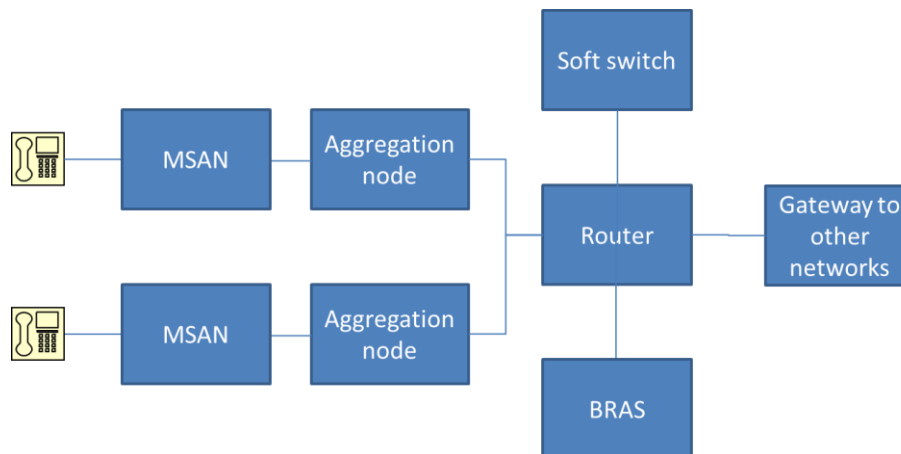
	BTS	BSC	MSC	% of on-net calls routed in this way
On-net call (A)	2	2	1	70%
On-net call (B)	2	2	2	30%
Average on-net call	2	2	1.3 $=(1*0.7)+(2*0.6)$	n/a

Source: Frontier Economics

Routing factors should be an estimate of the **average** number of each type of network components used for a given type of service. Where a number of potential routings exist for a service the routing should be a weighted average of the number of components used for each route, with the weights based on the proportion of traffic (by volume) taking each route.

Under NGN the network structure of fixed networks is also converging to a simple structure with typically one layer of routing, rather than the complex switching hierarchies that were typical in TDM networks. As a result routing tables tend to be relatively simple with for example calls traversing one MSAN if the call is originated r terminated off net, or 2 if the call is both originating and terminating on-net.

Figure 8. Structure of fixed NGN



Source: Frontier Economics

6.8.3 Conversion factors

While the routing factor shows how many times a given service on average uses a component, this does not form a useful basis for allocating costs in a mobile network as different services are measured using different metrics (minutes/messages or bytes). In addition there may be differences in the relative load placed on network components by different services even where they are measured on a consistent basis. In order to convert network usage to a consistent basis, conversion factors are applied.

Where volumes of services using the same network components are measured using different units, for example voice, SMS and GPRS traffic using the GSM air interface, conversion factors are necessary to convert the usage to a consistent basis. These conversion factors may vary depending on the component, for example while an SMS may use minimal capacity in the air interface, the load it may place on an MSC processor may be comparable to a call set up.

In order to derive the conversion factors to be used the following approach should be adopted:

1. Defining an appropriate common unit of capacity, for example a unit of equipment (of a typical configuration) or an underlying physical unit of capacity, for example an Gigabit Ethernet link or a 2 x 5 MHz 3G carrier;
2. Where necessary determining a suitable quality of service for the relevant service, such as a blocking rate for voice calls; and

3. Estimating the volume of traffic that can be carried within the unit of capacity for each service.

An example of a conversion factor relating minutes to Mbytes for a 3G node B is outlined below.

6.9 Example of conversion factor calculation steps

1. For base station of a 3G network, a relevant unit of capacity could be a single 2 x 5 MHz carrier.
2. For voice traffic a suitable quality of service could be a 2% blocking rate and for data service 'best effort' such that capacity could be fully utilised.
3. Based on Release 99¹², a reasonable assumption for the number of voice calls that can be carried simultaneously over a 5 MHz carrier is 60. At a 2% blocking rate this equates to 49.6 Erlangs or 2,976 minutes in the busy hour (49.6 * 60 minutes). A corresponding assumption for user throughput for packet data for HSDPA may be 5 Mbps per 2 x 5 MHz carrier. This equates to 2,250 Mbytes in the busy hour (5Mbps x 3600s/8 bits per byte).

This provides a conversion factor $2,976 : 2,250 = 1 : 0.756$ minutes : Mbytes.

The conversion factors will vary over time due to changes in technology and may differ between network elements within the same time period.

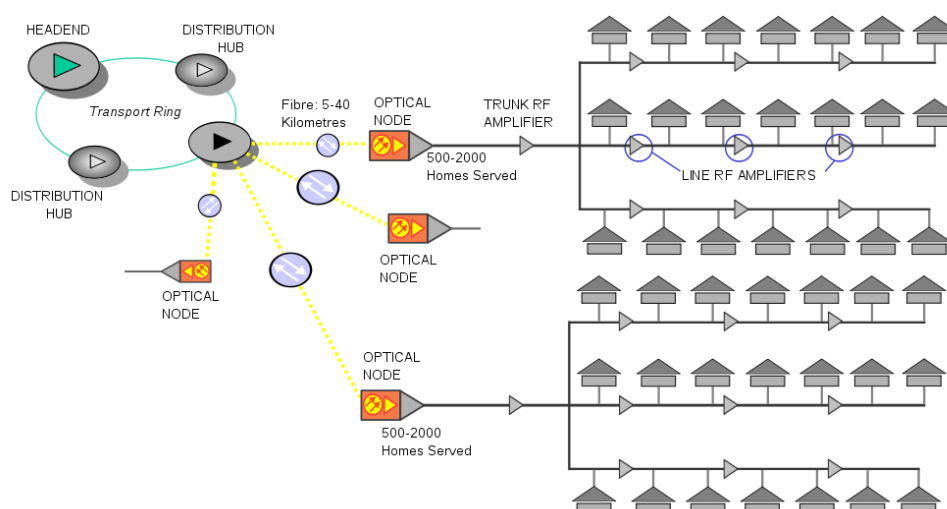
¹² Release 99 Features of the 3rd Generation Mobile System developed within 3GPP

7 LRAIC Base costs for CATV and FWA Networks

7.1.1 Mapping CATV networks to the asset categories

The Figure below provides an overview of a common hybrid fibre-coaxial (HFC) network structure.

Figure 9. Overview of HFC Infrastructure



Source: wikipedia

It is assumed that upgraded CATV networks have a basis topology that reflects the diagram above. Based on this topology the components would be mapped to the following asset categories.

Mapping CATV network components to LRAIC Asset Categories

Network component	Notes	LRAIC cost code	LRAIC description
Cable modem/MTA		ACN010	Customer premise equipment - fixed
Co-axial cable	Including RF amplifiers	ACF009	Co-axial cable
Optical node		ACF012	HFC optical node
Fibre	Including all fiber connecting Optical	ACI012	Fibre cables (core)

	nodes/Distribution hubs, head ends and core		
Duct	Including both access and core duct	ACI001	Duct
Distribution hub		ACF025	CATV distribution hub
Cable Modem Termination System (CMTS)		ACF019	Cable headend equipment - DOCSIS receiver
Television head end equipment	Broadcast and other (e.g. VOD)	ACF018	Cable headend equipment - television broadcast
IP Routers		ACF022	Packet switched router
Call Management Server		ACF006	VOIP soft switch or media gateway
Media/Signalling Gateway		ACF006	VOIP soft switch or media gateway

Source: Frontier Economics

7.1.2 Recovery of cost components across services

Upgraded (HFC) cable networks typically carry a triple play of services (video, broadband and voice) over a common set of network components. In order to derive cost oriented prices for individual services, costs of network components must be attributed across the services that use the component.

One of the critical concepts in regulatory service costing for fixed networks is the division between subscriber sensitive and traffic sensitive elements of the network. In traditional TDM networks the subscriber sensitive elements of the network are considered to be the copper access network and the subscriber dedicated parts of remote concentrators and local exchanges (e.g. line cards). In the case of CATV networks the Authority considers the co-axial network and CPE to be subscriber sensitive (i.e. the cost of the network is partially dependent on the number of subscribers but independent of traffic) with the remaining network components assumed to be subscriber sensitive.

Based on the proposed definition of the split between subscriber- and traffic-sensitive network components, there is only one network component (i.e. “HFC optical node”) which is both subscriber- and traffic-sensitive. Thus, there is only need to define a CVR for this network component. In line with Section 6.5 above and Annexe 5 below, as part of the initial LRAIC model implementation; the Authority has defined this CVR (i.e. CVR08 in Annexe 5) as being linear with a fixed cost. This reduces the information required from concessionaires to determine this CVR.

The table below sets out the Authority’s view on how costs should be attributed to services.

Allocation of CATV network components to services

Network component	Services recover from	Attribution method	Notes
Cable modem/MTA	Monthly subscription fee	Direct to subscribers	Where CPE owned and maintained by the operator
Co-axial cable	Monthly subscription fee	Direct to subscribers	Co-axial cable assumed to be incremental to number of subscribers but independent of service (traffic) volume
Optical node	Television, broadband and voice	Combination of channels used (as between TV and other services) and bandwidth (as between VoiP and broadband services)	HFC optical node
Fibre	Television, broadband and voice	Allocated to network elements on the basis of capacity length	Network elements common to broadband and voice then allocated on the basis of routing tables and conversion factors
Duct	Television, broadband and	Allocated to network elements	Network elements common to

	voice	on the basis of capacity length	broadband and voice then allocated on the basis of routing tables and conversion factors
Distribution hub	Television, broadband and voice	Allocated on the basis of capacity used for television services and broadband/voice services	
Cable Modem Termination System (CMTS)	Broadband and voice	Allocated on the basis of routing and conversion factors	Conversion factor reflecting the voice codec bit rate and average traffic usage by broadband subscribers
Television head end equipment	Television only	N/A	
IP Routers	Broadband and voice	Allocated on the basis of routing and conversion factors	Conversion factor reflecting the voice codec bit rate and average bandwidth traffic for broadband subscribers
Call Management Server	Voice	N/A	
Media/Signalling Gateway	Voice	N/A	

Source: Frontier Economics

The data request sheet 'Access Allocation' requests the information required to allocate the costs of the CATV access network between broadcast television, including Near Video on Demand (NVOD) and services delivered over the IP network, including voice over IP (VoIP), broadband Internet Access and true Video on Demand (VOD) services.

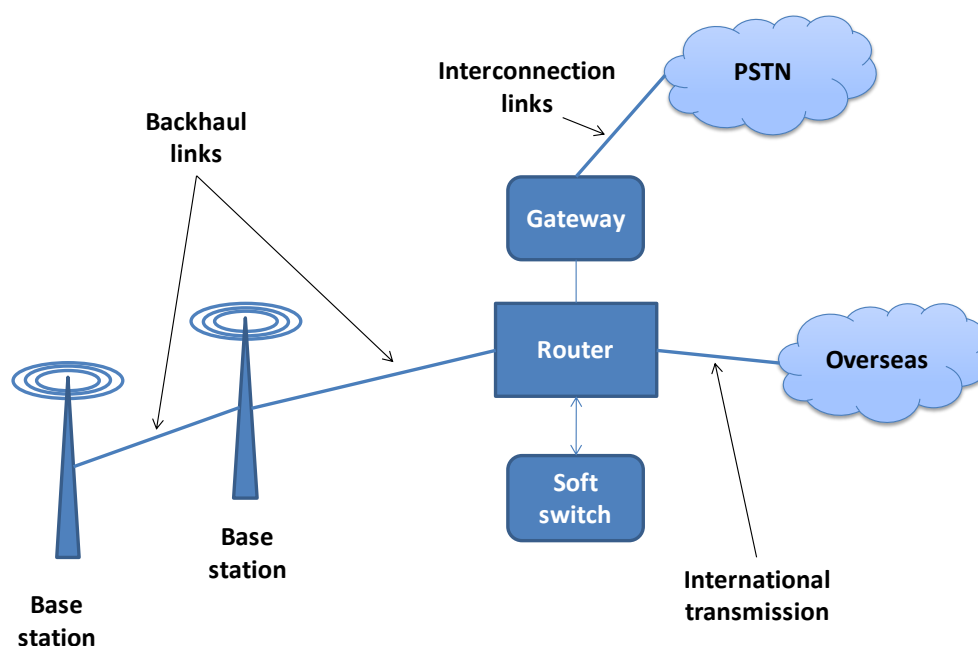
The allocation of costs to voice and non-voice services will be based on estimates on the proportion of bandwidth used by VoIP services (see section below). In

general, given the relatively flat network hierarchy, routing factors should be relatively straightforward (i.e. either 1 or 0).

7.2 Fixed Wireless Access Networks

Concessionaires operating fixed wireless networks typically have a relatively simple network structure as shown in the diagram below.

Fixed wireless network structure



Source: Frontier

Point to multipoint fixed wireless access networks consist of a number of base stations which provide the final connection to the end user. These base stations are then connected to a router in the core network through a series of 'backhaul' transmission links. These links can be in various configurations, for example direct connections to a core network site in a star topology base stations being 'daisy chained' with distant base stations connected to the core network via nearer base stations. As no switching occurs in the access network, the combination of the base stations and backhaul transmission can be considered a single network element.

Internet traffic to and from the access network will then be routed to the Internet. Voice traffic to and from the access network may be routed to the PSTN via a gateway and interconnection links, under the control of a soft switch.

7.2.1 Network Elements

The table below sets out the Authority's view on how the network elements of FWA networks should be treated in the LRAIC data request template.

Treatment FWA network elements

Network Element	Components include	Notes
Access network	Base stations Backhaul links	Transmission for backhaul links identified in sheet 'Transmission allocation' in category 'TR-FWA' Use of access network by VoIP identified in sheet 'Access allocation' as set out below
Router	Router	Use of router identified in sheet 'Routing factors' as network element 'N3'
Soft switch	Soft switch	Use of soft switch identified in sheet 'Routing factors' as network element 'VOIP'
Interconnection	Gateway Interconnection links	Interconnection links with operators in Trinidad & Tobago should be identified in sheet 'Transmission allocation' in category 'TR-IX' Use of interconnection link identified in sheet 'Routing factors' as network element 'TR-IX'
Overseas transmission	Transmission links for voice and data traffic	Transmission for backhaul links to cable landing stations identified in sheet 'Transmission allocation' in category 'TR-INT' Use of international transmission identified in sheet 'Routing factors' as network element 'TR-INT'

There will be no need for concessionaires only operating fixed wireless access networks to complete the CVR sheet.

7.3 Treatment of Voice over IP (VoIP) Traffic

Converged networks, which may include HFC cable networks and fixed wireless networks, may deliver both data (e.g. broadband Internet access) and voice (e.g. VoIP) traffic over shared capacity.

In order to allocate the costs of the shared access network between the two applications the Authority proposes to use information on the total capacity available and the portion of this capacity used for VoIP. The sheet 'Access Allocation' in the revised LRIC template is intended to collect this information.

Where the bandwidth is shared between voice and other applications, concessionaires are request to input data that can be used to calculate the peak bandwidth used for voice services:

- the bandwidth used for a voice call;
- the busy hour calling rate (in Erlangs) for an average subscriber; and
- the number of voice subscribers on the network.

The bandwidth used for a call should reflect the codec used for voice calls plus all overheads for session management, packet headers etc. If the codec used is adaptive, i.e. varies depending on the network capacity available, then the average bandwidth used in peak periods should be used.

The busy hour call rate should estimate the proportion of the busy hour that an average subscriber is using the voice service. If direct estimation of this parameter is not available then an estimate can be made based upon the average traffic per subscriber and the proportion of this traffic that occurs in the 'busy hour'.

The number of voice subscribers on the network should reflect the average number during the year.

8 LRAIC model calculation

This section of the specification provides an overview of the LRAIC model calculation process.

8.1 Model overview

The LRAIC model can be broadly split into two parts:

- An incremental costing module, which has as its output the incremental cost of a set of network components;
- A service costing module which allocates the incremental costs of the components to services to give LRAIC estimates.

The incremental costing module is split into four sections:

- a section where the overall structure of the model is established, consisting of the relationships between costs, CVRs and drivers (see as described in Section 8.2);
- a section where the input data in terms of base costs, base driver volumes and CVRs are entered (see Section 8.3 and Section 6 for more detail);
- a section which calculates the level of costs for a given level of demand, defined by the increments (see Section 8.4 and Section 5 for more detail); and
- a section which calculates the incremental costs for each increment and the incremental costs including mark ups (see Section 8.5).

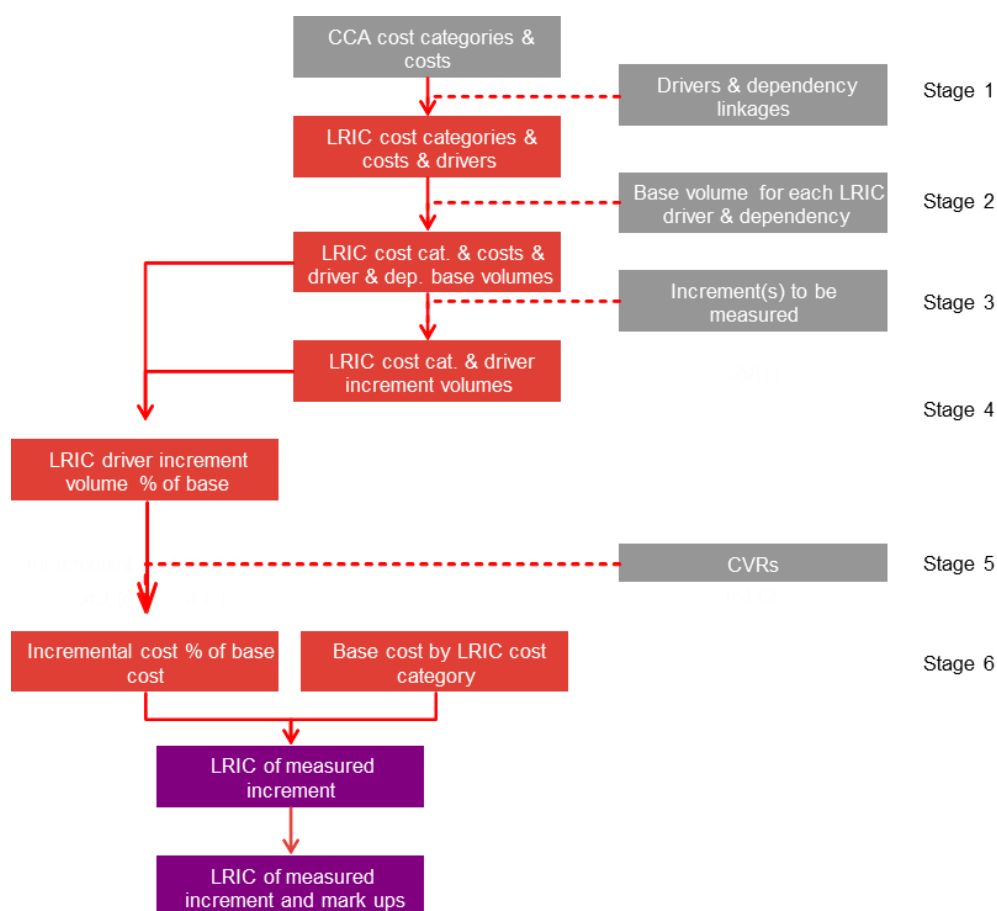
The results of the incremental costing module are then allocated to services through a two stage process:

- transmission costs are allocated across network elements based upon the usage of the transmission network by each of the network elements;
- the costs of the network elements are allocated across services based on an element based costing approach (see Section 8.5).

8.2 Overall structure of the incremental costing model

This section sets out the overall structure of the LRAIC model. However, it does not include any numerical data, either on the base level of costs or drivers, or on the form of the CVRs. The data entered in this section largely defines the dependencies within the LRAIC model. The structure of the model is shown in Figure 9.

Figure 9. Outline of the LRAIC calculation process



8.3 Inputs

This section of the model includes all of the numerical data used to populate the model including the base cost information, information on base volumes for calculation of drivers and CVR inputs.

Cost input

The net replacement cost and depreciation data relating to fixed assets on a CCA basis (which, where appropriate, takes into account the costs of MEA technology) form an input to the LRAIC model. Operating cost will also be required as an input (see Sections 6.1 and 6.2). This data is then aggregated into the LRAIC cost categories as described in Section 6.3.

Base driver inputs

In addition to the cost data, a number of measures which form the base value of drivers are entered into the LRAIC model (see Section 6.4).

Currently three measures relating to employees are included as base driver inputs:

- The number of employees by department;
- The number of non-network vehicles used by department; and
- The number of IT workstations by department.

CVR inputs

For each CVR where concessionaire inputs are required (see Section 6.5 above), the avoidable cost when the relevant increment is set to zero is required.

8.4 Calculation of incremental costs

The LRAIC model calculates the cost of each increment in turn. As noted previously the costing is carried out in a decremental fashion with demand for the increment that is being measured being set to zero, whilst the demand for all other increments is maintained at current levels.

The calculation of the cost of the business excluding the increment is carried out in the following order:

- calculation of the exogenous cost categories;
- a number of stages, corresponding to each of the levels in the dependency hierarchy with the output from each stage being endogenous drivers used for the following stage; and
- the final calculation of costs, once all drivers have been calculated.

Each of these stages is described further below.

Calculation of exogenous cost categories

As set out in Section 6.4.1, for exogenous cost categories driven by a single increment the value of the cost category is set to 100% or 0% depending on the increment being costed. For example costs of all the core network components are set to zero if the “core” increment cost is being calculated. Demand for all other increments is set to 100%, i.e. the current level of (external) demand.

For those exogenous cost categories driven by more than one increment, the CVR must be calculated based on the avoidable cost for those increments which are set to zero.

Calculation of endogenous drivers

As set out in Section 6.4.2, most indirect cost categories can be assumed to be dependent on the level of costs for other cost categories at lower levels in the dependency hierarchy.

As a result, a number of cost drivers are dependent on other drivers. The values of these endogenous drivers are therefore calculated by the model in a number of stages.

Calculation of costs

Once all of the drivers are available, the cost of the business for the given level of demand can be calculated by applying the CVRs.

8.5 LRAIC of measured increment including mark-ups

The model calculates incremental costs by setting demand for the corresponding increments to zero, which in turn yields the cost of total business excluding the increments to be measured.

LRAIC is then calculated as:

$$LRAIC_{Increment(s) \text{ to be measured}} = Cost_{Corporate Entity} - Cost_{Corporate Entity \text{ excluding } Increment(s) \text{ to be measured}}$$

LRAIC of measured increment including mark-ups

Common costs, and hence mark ups, are calculated by comparing the incremental cost of an increment, (e.g. mobile core) with the sum of the incremental costs of each sub increment included within an increment (e.g. MSC, VLR, SMSC, etc.) for each LRAIC cost category. The difference forms the fixed common costs (FCCs) across all the relevant sub-increments.

The model calculates and sequentially marks-up four different sets of common costs for each LRAIC cost category reflecting the four levels in the increment hierarchy.

8.6 Allocation of element costs to services - element based costing

The principle of element based costing is that component costs are allocated across services in proportion to the use made of the component by a service. In order to carry out this allocation one needs to calculate the use made of each component by each service. The use that each service makes of a component can be decomposed into three elements:

- first, the total volume of service delivered by the network measured on an appropriate basis (for example call minutes);
- second, the number of times *on average* that the service uses the component; and
- third, a conversion factor that converts the units used for each service to a comparable basis in terms of the load resulting on the component.

Annex 1: Glossary

Table 5. Glossary of terms and abbreviations

Term	Description
ABC	Activity based costing
BRAS	Broadband remote access servers
BSS	Base station
CAPM	Capital asset pricing model
CATV	Cable television
CCA	Current cost accounting
CDMA	Code division multiple access
CVR	Cost volume relationship
DSLAM	Digital subscriber line access multiplexer
DSLAM	Digital subscriber line access multiplexer
EC	European Commission
EDGE	Enhanced data rates for GSM evolution
EPMU	Equal proportionate mark-ups
ERP	Equity risk premium
FAR	Fixed asset register
FCM	Financial capital maintenance
FWA	Fixed wireless access
GBV	Gross book value
GGSN	Gateway GPRS support node
GPRS	General packet radio service
GRC	Gross replacement cost
GSM	Global system for mobile

Table 5. Glossary of terms and abbreviations

Term	Description
HCA	Historic cost accounting
HFC	Hybrid fibre co-axial
HLR	Home location register
IP	Internet protocol
ISFC	Increment specific fixed costs
LRAIC	Long run average incremental cost
MDF	Main distribution frame
MEA	Modern equivalent asset
MPLS	Multiprotocol label switching
MSC	Mobile switching centre
NBV	Net book value
NPV	Net present value
NRC	Net replacement cost
PDH	Plesiochronous digital hierarchy
PPI	Producer price index
SDH	Synchronous digital hierarchy
SGSN	Serving GPRS support node
SMSC	Short message service centre
SONET	Synchronous optical networking
TATT	Telecommunications Authority of Trinidad and Tobago
TD	Top down
TDM	Time division multiplexing
UMTS	Universal mobile telecommunications system

Table 5. Glossary of terms and abbreviations

Term	Description
VAT	Value added tax
VLR	Visitor location register
WACC	Weighted average cost of capital

Annex 2: Defined network elements

Table 6. Network elements contained in the LRAIC model

Abbreviation	Label	Description	Maps to Level 4 increment
FAD	Fixed access network (dedicated access)	Network providing conveyance from customer premises to operator's network premises offering dedicated capacity to customers (e.g. twisted pair networks or fibre networks)	FAD
FAS	Fixed access network (shared access)	Wireline network providing conveyance from customer premises to operator's network premises sharing capacity between customers (e.g. Cable TV networks)	FAS
FAW	Fixed access network (wireless)	Wireless network providing conveyance from customer premises to operator's network premises sharing capacity between customers (e.g. Cable TV networks)	FAW
N1S	Remote narrowband access node (subscriber sensitive)	Subscriber specific part of network component providing an interface between the access network and the switched network without full switching capabilities (e.g. remote concentrator line cards)	N1S
N1T	Remote narrowband access node (traffic sensitive)	Traffic sensitive part of network component providing an interface between the access network and the switched network without full switching capabilities (e.g. switch facing ports on remote concentrator)	N1T

Table 6. Network elements contained in the LRAIC model

Abbreviation	Label	Description	Maps to Level 4 increment
N2S	Local exchange (subscriber sensitive)	Subscriber specific part of a local switch (e.g. local switch line cards)	N2S
N2S	Local exchange (traffic sensitive)	Traffic sensitive part of a local switch (e.g. local switch processor)	N2S
N3	Transit exchange	Switch only connects to other switches (i.e. which does not connected to the access network/remotes)	N3
N4	International gateway	Switch the connects to networks overseas	N4
TR-N1-N2	Transmission N1-N2	Transmission between levels 1 and 2 in the narrowband network hierarchy	
TR-N2-N2	Transmission N2-N2	Transmission within level 2 in the narrowband network hierarchy	
TR-N2-N3	Transmission N2-N3	Transmission between levels 2 and 3 in the narrowband network hierarchy	
TR-N3-N3	Transmission N3-N3	Transmission within level 3 in the narrowband network hierarchy	
TR-N3-N4	Transmission N3-N4	Transmission between levels 3 and 4 in the narrowband network hierarchy	

Table 6. Network elements contained in the LRAIC model

Abbreviation	Label	Description	Maps to Level 4 increment
B1	Broadband level 1 - access node	Network component providing an interface between the access network and the core broadband network (e.g. DSLAM)	B1
B2	Broadband level 2 - aggregation node	Network component aggregating traffic from a number of access nodes but not providing routing capabilities	B2
B3	Broadband level 3 - BRAS	Network component providing access control to the network	B3
B4	Broadband level 4 - router	Network component routing broadband traffic within the core network	B4
TR-B1-B2	Transmission B1-B2	Transmission between levels 1 and 2 in the broadband network hierarchy	
TR-B2-B3	Transmission B2-B3	Transmission between levels 2 and 3 in the broadband network hierarchy	
TR-B3-B4	Transmission B3-B4	Transmission between levels 3 and 4 in the broadband network hierarchy	
TR-B4-B4	Transmission B4-B4	Transmission within level 4 in the broadband network hierarchy	
TR-IX	Transmission interconnection links	Transmission between the operator's network and other domestic networks	
TR-INT	Transmission international	Transmission between the operator's network and overseas networks	

Table 6. Network elements contained in the LRAIC model

Abbreviation	Label	Description	Maps to Level 4 increment
M-BSS	Base station subsystem	The GSM base station subsystem and equivalents (e.g. BTS and BSC)	M-BSS
M-MSC	Mobile switching centre	Voice switches for mobile traffic	M-MSC
M-MPD	Mobile packet data network	Core packet data network for mobile	M-MPD
M-LR	Mobile location registers	Location registers in the mobile network (e.g. HLR and VLR)	M-LR
M-SMS	SMS messaging centre	SMS meesage centre	M-SMS
TR-BSS	BSS transmission	Transmission within the BSS (e.g. BTS-BSC)	
TR-BSS-MSC	BSS-MSC transmission	Transmission between the BSS and MSC (e.g. BSC-MSC)	
TR-MSC-MSC	MSC-MSC transmission	Transmission between MSCs	
TR-MPD	MPD transmission	Transmission within the mobile packet data network (e.g. GGSN to SGSN)	

Source: Frontier Economics

Annex 3: Defined increments

Table 7. Level 4 increments defined in the LRAIC model

Abbreviation	Label	Description	Maps to Level 3 Increment
FAD	Fixed access network (dedicated access)	Network providing conveyance from customer premises to operator's network premises offering dedicated capacity to customers (e.g. twisted pair networks or fibre networks)	FA
FAS	Fixed access network (shared access)	Network providing conveyance from customer premises to operator's network premises sharing capacity between customers (e.g. wireless or HFC networks)	FA
N1	Remote narrowband access node	Network component providing an interface between the access network and the switched network without full switching capabilities (e.g. remote concentrator)	FC
N2	Local exchange	Local switch	FC
N3	Transit exchange	Switch only connects to other switches (i.e. which does not connected to the access network/remotes)	FC

Table 7. Level 4 increments defined in the LRAIC model

Abbreviation	Label	Description	Maps to Level 3 Increment
N4	International gateway	Switch the connects to networks overseas	FC
B1	Broadband level 1 - access node	Network component providing an interface between the access network and the core broadband network (e.g. DSLAM)	FC
B2	Broadband level 2 - aggregation node	Network component aggregating traffic from a number of access nodes but not providing routing capabilities	FC
B3	Broadband level 3 - BRAS	Network component providing access control to the network and routing traffic onto the core network	FC
B4	Broadband level 4 - core router	Network component routing broadband traffic within the core network	FC
TR-DC	Transmission domestic (capacity)	Transmission domestic (capacity)	FC
TR-DL	Transmission domestic (length)	Transmission domestic (length)	FC
TR-INT	Transmission international	Transmission between the operator's network and overseas networks	FC
FIX-OTH	Other fixed network	Network components delivering other fixed services and capabilities	FC

Table 7. Level 4 increments defined in the LRAIC model

Abbreviation	Label	Description	Maps to Level 3 Increment
M-BSS	Base station subsystem	The GSM base station subsystem and equivalents (e.g. BTS and BSC)	MA
M-MSC	Mobile switching centre	Voice switches for mobile traffic	MC
M-MPD	Mobile packet data network	Core packet data network for mobile	MC
M-LR	Mobile location registers	Location registers in the mobile network (e.g. HLR and VLR)	MC
M-SMS	SMS messaging centre	SMS message centre	MC
M-OTH	Other mobile network	Network components delivering other fixed services and capabilities	MC
RET	Retail activities	Activities driven by the provision of retail services to end users (e.g. Sales & Marketing, Billing & Collection and Customer Care)	RAO
WS	Wholesale activities	Activities driven by the provision of wholesale services to other operators (e.g. wholesale product management and interconnect billing)	RAO
OTH	Other activities	Other activities not concerned with the provision of telecommunications services	RAO

Source: Frontier Economics

Table 8. Level 3 increments defined in the LRAIC model

Abbreviation	Label	Description	Maps to Level 2 Increment
FA	Fixed access	Fixed access network	FN
FC	Fixed core	Fixed core network	FN
MA	Mobile access	Mobile access network	MN
MC	Mobile core	Mobile core network	MN
RAO	Retail and other	Non-network activities	RAO

Source: Frontier Economics

Table 9. Level 2 increments defined in the LRAIC model

Abbreviation	Label	Description	Maps to Level 1 Increment
FN	Fixed network	Fixed network	NET
MN	Mobile network	Mobile network	NET
RAO	Retail and other	Non-network activities	RAO

Source: Frontier Economics

Table 10. Level 1 increments defined in the LRAIC model

Abbreviation	Label	Description
NET	Network	Network activities
RAO	Retail and other	Non-network activities

Source: Frontier Economics

Annex 4: LRAIC cost categories

Table 11. LRAIC Cost Categories contained in the LRAIC model

Abbreviation	Cost category	CVR or Level 4 Increment
Fixed network components		
ACF001	Main distribution frame	FAC
ACF002	Remote switching unit	CVR01
ACF003	Digital local exchange	CVR02
ACF004	Digital tandem exchange	N3
ACF005	International switch centre	N4
ACF006	VOIP soft switch or media gateway	N3
ACF007	Network management system	FIX-OTH
ACF008	Intelligent network platform	FIX-OTH
ACF009	Co-axial cable	FAC
ACF010	Twisted pair cable	FAC
ACF011	Access fibre	FAC
ACF012	HFC optical node	CVR08
ACF013	Point to point wireless	FAW
ACF014	Point to multi-point wireless	FAW
ACF015	Pre-wiring of client premises and first time installations	FAC
ACF016	DSLAM	CVR03
ACF017	MSAN	CVR04
ACF018	Cable head end equipment - television broadcast	TV
ACF019	Cable head end equipment - DOCSIS receiver	B2

Table 11. LRAIC Cost Categories contained in the LRAIC model

Abbreviation	Cost category	CVR or Level 4 Increment
ACF020	Cable head end equipment - Telephony	N3
ACF021	Packet switched aggregation node	B2
ACF022	Packet switched router	B3
ACF023	Broadband remote access server	B3
ACF024	Assets not used in T&T	OTH
ACF025	CATV Distribution hub	TR-DC
Mobile Network Components		
ACM001	Base station (BTS)	M-BSS
ACM002	Base station controller (BSC)	M-BSS
ACM003	Mobile switching centre (MSC)	M-MSC
ACM004	GPR, GGSN and SGSN	M-MPD
ACM005	Short message service centre (SMSC)	M-SMS
ACM006	Voice mail system (VMS)	M-OTH
ACM007	Home location register (HLR)	M-LR
ACM008	Network management system (NMS)	GRCD9
ACM009	Signal transfer point	M-MSC
ACM010	BTS to BSC link	M-BSS
ACM011	Assets not used in T&T	OTH
Network Infrastructure and Support Equipment		
ACI001	Duct	CVR05
ACI002	Local loop poles	FAC
ACI003	Signalling equipment	FIX-OTH
ACI004	Transmission Infrastructure	GRCD10

Table 11. LRAIC Cost Categories contained in the LRAIC model

Abbreviation	Cost category	CVR or Level 4 Increment
ACI005	Transmission equipment - SDH	TR-DC
ACI006	Transmission equipment - PDH	TR-DC
ACI007	Power equipment	GRCD5
ACI008	Network buildings	CVR06
ACI009	Masts & towers	CVR07
ACI010	Network land	CVR06
ACI011	Motor vehicles - network	ED03
ACI012	Fibre cables (core)	TR-DL
ACI013	Microwave transmission equipment (core)	TR-DC
ACI014	Assets not used in T&T	OTH
ACI015	International subsea cables	TR-INT
Non network assets		
ACN001	Non-network buildings	ED01
ACN002	Land - non network	ED01
ACN003	Furniture and office equipment	ED01
ACN004	Training equipment	ED01
ACN005	Vehicles - non-network	NNED01
ACN006	Payphones	OTH
ACN007	IT /General purpose computers	NNED02
ACN008	Network management	GRCD02
ACN009	Marketing, retail, customer support	RET
ACN010	Customer premise equipment - fixed	OTH
ACN011	Customer premise equipment - mobile	OTH

Table 11. LRAIC Cost Categories contained in the LRAIC model

Abbreviation	Cost category	CVR or Level 4 Increment
ACN012	Prepaid service platform	RET
ACN013	Billing system	RET
ACN014	Customer management system	RET
ACN015	Interconnect billing	WS
ACN016	Assets not used in T&T	OTH
Network Activities		
NA01	Network - Executive Management	ED02
NA02	Network strategy, planning and procurement	GRCD02
NA03	Network management	GRCD02
NA04	Network field operations - outside plant	GRCD03
NA05	Network field operations - core	GRCD04
Product Management		
PM01	Retail product management	RET
PM02	Marketing and communications	RET
PM03	Sales	RET
PM04	Customer care	RET
PM05	Billing and collection	RET
PM06	Wholesale product management	WS
Support Activities		
SA01	Facilities management	ED01
SA02	HR Services and training	ED01
SA03	Finance	OCD01
SA04	IT	NNED02

Table 11. LRAIC Cost Categories contained in the LRAIC model

Abbreviation	Cost category	CVR or Level 4 Increment
SA05	Procurement	GRCD02
SA06	General management, Corporate Affairs and Regulatory	OCD01
Network operational expenditure		
NET01	Utilities (energy and fuel)	GRCD5
NET02	Site rental costs	GRCD6
NET03	Network maintenance fees	GRCD02
NET04	Frequency fees	GRCD7
NET05	Other regulatory fees	OCD01
NET06	Network insurance costs	GRCD02
NET07	Network transportation	GRCD02
NET08	Leased transmission	TR-DL
NET09	Leased building (co-location) space	GRCD6
NET10	Leased mast/tower (sharing)	GRCD7
NET11	Other network costs	GRCD02
General and administration expenses		
GA01	Building rent (non network)	ED01
GA02	Building expenses (non network)	ED01
GA03	Consumables	ED01
GA04	Insurance costs (non-network)	GRCD8
GA05	Travel expenses	ED01
GA06	Other G&A	OCD01
Direct costs and costs of sales		

Table 11. LRAIC Cost Categories contained in the LRAIC model

Abbreviation	Cost category	CVR or Level 4 Increment
COS01	Customer acquisition costs	RET
COS02	Equipment buy in costs	RET
COS03	Fixed termination	RET
COS04	International termination	RET
COS05	Mobile termination	RET
COS06	Roaming charges	RET
COS07	Number portability database queries	RET
COS08	Distribution costs	RET
COS09	Marketing and promotions costs	RET
COS10	Printing, Delivery and collection costs	RET
COS11	Bad debt	RET
Balance Sheet Items		
BS01	Cash and cash equivalents	OCD01
BS02	Investments	OTH
BS03	Inventory - Network	GRCD02
BS04	Inventory - Non Network	OTH
BS05	AR - Wholesale	WS
BS06	AR - Retail	RET
BS07	Short term loans	OCD01
BS08	AP - Employees	ED01
BS09	AP - Trade Creditors	OCD01
BS10	Provisions	OCD01
BS11	Vat Payable	OCD01

Table 11. LRAIC Cost Categories contained in the LRAIC model

Abbreviation	Cost category	CVR or Level 4 Increment
BS12	Vat Receivable	OCD01
BS13	Deferred Income	RET

Source: Frontier Economics

Annex 5: Required CVRs

Table 12. CVRs for which concessionaires will be required to provide inputs where appropriate

Abbreviation	CVR	Increments (for ISFCs)/Drivers
CVR01	Fixed voice (TDM) concentrator	Remote narrowband access node (subscriber sensitive) Remote narrowband access node (traffic sensitive)
CVR02	Fixed voice (TDM) switch	Local exchange (subscriber sensitive) Local exchange (traffic sensitive)
CVR03	DSLAM	Broadband level 1 - access node (subscriber sensitive) Broadband level 1 - access node (traffic sensitive)
CVR04	MSAN	MSAN - subscriber sensitive Broadband level 1 - access node (traffic sensitive)
CVR05	Duct	Fixed network (cabled) Transmission domestic (capacity)
CVR06	Network buildings	GRC network in buildings ¹³ Fixed access Mobile core

¹³ Driver as a proxy for the relative floor space used by different types of equipment in buildings

Table 12. CVRs for which concessionaires will be required to provide inputs where appropriate

Abbreviation	CVR	Increments (for ISFCs)/Drivers
		Fixed network
CVR07	Masts and towers	GRC radio equipment ¹⁴ Transmission domestic (capacity) Mobile network Fixed network
CVR08	HFC optical node	Television broadcast Broadband level 1 - access node (subscriber sensitive) Broadband level 1 - access node (traffic sensitive)

Source: Frontier Economics

These CVRs only need to be determined in the case where an operator has deployed the corresponding asset. As such CVR01, CVR02, CVR03 and CVR04 only need to be completed by fixed wireline operators and CVR08 by operators of HFC cable networks.

¹⁴ Driver as a proxy for the volume of equipment placed on masts.

Annex 6: Network Services

The list of services would be periodically updated, in accordance with the data collection exercises.

Table 13. Defined Network Services

Abbreviation	Service	Units
Fixed access services		
FAS01	Narrowband PSTN access line	Number of lines
FAS02	Narrowband ISDN BRA line	Number of channels
FAS03	Broadband access line (asymmetric)	Number of lines
FAS04	Broadcast television subscriber	Number of lines
FAS05	Metro Ethernet access	Number of lines
FAS06	Fully unbundled loop	Number of lines
FAS07	Shared access unbundled loop	Number of lines
FAS08	Domestic retail leased circuit	T1-equivalents
FAS09	International retail leased circuit	T1-equivalents
FAS10	Domestic wholesale leased circuit	T1-equivalents
FAS11	International wholesale leased circuit	T1-equivalents
FAS12	Wholesale partial private circuit - local end	T1-equivalents
FAS13	Wholesale partial private circuit - trunk segment	T1-equivalents
FAS14	Other services	Number of subscribers
Fixed call services		
FCS01	Voice - fixed to fixed (onnet)	Minutes
FCS02	Voice - fixed to fixed (offnet)	Minutes
FCS03	International call from fixed	Minutes

Table 13. Defined Network Services

Abbreviation	Service	Units
FCS04	Call to domestic mobile from fixed	Minutes
FCS05	Dial up Internet access from fixed	Minutes
FCS06	Other retail calls from fixed	Minutes
FCS07	Wholesale domestic fixed call origination	Minutes
FCS08	Wholesale international fixed call origination	Minutes
FCS09	Domestic fixed call termination	Minutes
FCS10	International fixed call termination	Minutes
FCS11	Transit between domestic operators	Minutes
FCS12	Transit from international to domestic	Minutes
FCS13	Transit from domestic to international	Minutes
Mobile services		
MOB01	Mobile subscribers (active)	Number of subscribers
MOB02	Mobile to mobile voice calls - on-net	Minutes (per second basis)
MOB03	Mobile to mobile voice calls - domestic off net	Minutes (per second basis)
MOB04	Mobile to fixed calls - domestic	Minutes (per second basis)
MOB05	Mobile to international calls	Minutes (per second basis)
MOB06	Wholesale mobile call origination - domestic	Minutes (per second basis)
MOB07	Wholesale mobile call origination - international	Minutes (per second basis)
MOB08	Domestic mobile call termination	Minutes (per second basis)

Table 13. Defined Network Services

Abbreviation	Service	Units
MOB09	International call termination	Minutes (per second basis)
MOB10	SMS - originated	Messages
MOB11	SMS - terminated	Messages
MOB12	MMS - originated	Messages
MOB13	MMS - termination	Messages
MOB14	Packet switched data (GPRS)	Mbytes
MOB15	Packet switched data (EVDO)	Mbytes

Source: Frontier Economics

Annex 7: Decisions on Recommendations – LRAIC Specification Paper

The following summarizes the comments and recommendations received from stakeholders on the draft of this document (dated 6th July 2015, and consultation ending September 2015), and the decisions made by TATT as incorporated in this revised document dated 31st May 2016.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
GENERAL	TSTT	TSTT welcomes the opportunity to provide our views on the LRAIC Specification Paper and its companion document, Draft CCA Reference Paper. Unfortunately, we firmly believe that there are a few significant procedural issues with this present consultation process, compounding fundamental philosophical challenges with the proposals contained within the document, which make our agreement with the Authority's proposed determinations difficult.	TSTT posits that without a comprehensive review of the decade old Costing Methodology, this process is no longer relevant to market realities. In accordance with the spirit of its own Consultation Procedures, the Authority	The Authority is of the view that the Costing Methodology is still relevant to today's markets. TSTT has not provided any evidence, including evidence on market realities to support its view that this document is outdated. The Authority would welcome any new information from TSTT on whether there are new rules, new philosophies, or other proven methodologies to develop cost models,

¹⁵ Regional regulatory or Governmental agencies, Existing service and/ or network provider and affiliates, Potential service and/ or network providers and affiliates, Service/ Network Provider Associations/ Clubs/ Groups, General Public

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		TSTT expresses its further objection to the Authority issuing these two, voluminous and complex documents as it has, with limited timeframe for meaningful analysis by stakeholders. These documents do not rethread the same issues; but take significantly distinct, while related, directions with the issues under consideration. Given that the Authority has not consulted on this matter in five (5) <u>years</u>, and the last iteration of the document left much to be desired, TSTT thinks that it is unreasonable to request concessionaires to review these documents <u>together</u> in six (6) <u>weeks</u>! In the future, and in accordance with the spirit of its own Consultation Procedures, the Authority should provide no less than four to six weeks of consultation period, to run consecutively, for each document – giving operators sufficient time to make robust evaluations of the proposals.	should provide no less than four to six weeks of consultation period, to run consecutively, for each document. That is, the period should be no less than 6 weeks for one document; 12 weeks for two documents, or 18 weeks for three documents; etc.	which are not already considered and assessed in the Costing Methodology¹⁶ which would make the document more relevant to today's market realities. The Authority highlights that the Costing Methodology assesses the various approaches to developing cost models, and along with in depth consultation with all stakeholders, agreed on the use of the TD LRAIC Cost model. In comments solicited from TSTT in that process, TSTT advised that it had, <i>“no disagreement with the implementation of a properly structured LRIC model”</i> and TSTT further concurred with the Authority that <i>“the LRAIC is a</i>

¹⁶ The Costing Methodology for the Telecommunications Sector, 2008

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		TSTT expressly states that failure to address any issue raised in this Consultation does not necessarily signify its agreement in whole or in part with any position taken on the matter by the Authority or any respondents. TSTT reserves the right to comment on any issue raised in this Consultation at a later date.		<i>practical approach to incremental costing.”</i> Furthermore, jurisdictions such as Albania, Austria, Bahrain, Columbia, Germany, Greece, Israel, Spain, United Arab Emirates (UAE) and the UK have implemented long run incremental cost models. More recently, the Office of Utility Regulation (OUR) of Jamaica, in 2013/2014 implemented a LRIC model for mobile networks. The Authority further notes TSTT’s comment on the voluminous and complex nature of the documents. However, the Authority notes that operators have been privy to all information and all issues which have resulted in the revisions to these Consultative documents. For this reason, the period granted by the Authority, from July to September 2015 provided the

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				operators with sufficient time to review already known and published modelling and implementation specifications. Whilst the Authority is mindful of the fact that it needs to provide stakeholders with sufficient time to consult on regulatory instruments, there is also a need to balance these timeframes with the timeliness required for regulatory intervention. Furthermore, in this specific instance, the Authority believes that the documents are interrelated and should be considered in parallel. It is fair to concessionaires, and it is a transparent practice to issue these documents for simultaneous consultation. All concessionaires should be afforded the opportunity to assess the entire cost implementation process in a complete and

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				comprehensive manner. The Authority further reminds TSTT that the Authority will continue to consult on all documents in accordance with its established Consultation Procedures.
Section 1				
1 Introduction <i>"This document describes the underlying principles and methodology applied by the TATT to implement the top down LRAIC model developed by Frontier Economics for the Authority."</i>	TSTT	The Authority has taken a non-transparent approach and built a model in the absence of the required collaboration in good faith with the marketplace. Precedence has demonstrated that, for success in the definition of such instruments, there should be independent eye-witnesses to regulator-stakeholder deliberations on the Model's progress, or in the current telecommunications environment, camera sessions, working groups and then consultations on what is modeled each step of the way. It was only after strong lobby by providers that the Authority opened an already developed Model to viewing by concessionaires and then, only in a limited way. Indeed, many of TSTT's comments about anomalies in its Model's	The Authority must clearly articulate the terms of reference for this LRAIC Specification paper in model cost estimate calculations, and underscore the subordinate relationship of this paper to the Costing Methodology. Where this model departs from the approach outlined in the Costing Methodology, then either such departure should be removed or the Costing Methodology	The Authority reminds TSTT that the Costing Methodology provides a balanced and thoughtful weighing of approaches to costing. In fact, during that consultation period operators were advised that the document was intended to outline the general principles that will be adopted in the establishment of cost models. The Authority further advised that subsequent consultations would be undertaken on the specific cost modes which would involve the implementation of said principles. This is set out in the <i>LRAIC Specification and CCA Reference Papers</i> . The LRAIC Specification

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		implementation remain unanswered up to the time of the issuance of the document being reviewed. As an example, TSTT reminds the Authority of its concerns with some of the dynamic calculations in the Model. TSTT reminds the Authority of the instances where TSTT identified certain assumptions, the values for which were pasted in or static values that did not correlate with TSTT's submissions. These assumptions fed directly into interim outputs where there were either incorrect allocations or deviation of principles established in the Costing Methodology. It is in this context that TSTT reaffirms its position that the Authority has <u>not</u> developed a reliable industry model. As it stands, the TSTT is of the view that the current Model does not reflect the general topology or structure of its networks, and as such, cannot in any way reflect a reasonable estimation of its networks. TSTT opines that this outcome is not unexpected given the Authority's approach thus far - instead of engaging the concessionaires, the Authority has instead sought to foist information gathering templates on	amended via due process. The Authority must identify the problems inherent to this market, and the Model must adequately reflect these unique considerations. The Authority must hold joint, camera sessions and working groups with concessionaires. The Authority must undertake this process in an open, transparent fashion if it hopes to develop a reliable industry model; otherwise the output of this exercise will not be fit for its regulatory purpose. The TATT must allow operators proper time to	Paper does not depart from the principles identified in the Costing Methodology and therefore would not require an amendment to the Costing Methodology. An amendment will be made to the LRAIC Specification Paper to reiterate the consultative process undertaken. The Authority disagrees with this recommendation as it is the Authority's view that the Model adequately and efficiently assesses costs of the existing market structures. In fact, as a general characteristic of LRAIC Models, the model captures each operators' network structure (elements and usage) and takes into account the actual operator data, making it a reliable tool. The Authority disagrees with this

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		concessionaires that, as evidenced from the initial outputs to which TSTT has been privy, have failed to adequately contextualize the information submitted. The Authority continues to use these templates as a reason to not have a truly collaborative approach to commenting on the work done. The little allotted periods allowed for Model access and testing have left much to be desired, as the Authority will attest, as TSTT did not finish reviewing the basics of the Model over the prolonged period of limited interaction. TSTT insists the Authority's outline the terms of reference of this "Specification Paper." This statement suggests that there is a methodology employed in this Paper which is not consistent with the Authority's published Costing Methodology. Indeed, on review of the document, this suggestion seems to be validated with the inclusion of certain concepts not outlined in the Costing Methodology, and the proposed application of such concepts on particular data sets in a way that was not covered in the latter document.	review the work done to build model. The LRAIC Specification Paper should not veer from the methodology defined in the Authority's Costing Methodology. If there are failings or omissions in the Costing Methodology, that document should be reviewed in the appropriate process. Foisting principles that were not agreed to in the Methodology in this way seems surreptitious and is not in accordance with operation in good faith.	recommendation and does not share a similar view with the respective comment. The processes undertaken by the Authority have been transparent. The Authority shall continue to adhere to its established consultation procedures. The Authority has offered more than adequate time for operators to properly review the work of the Authority in this regard. The Authority has provided operators with a total of four years, which included the opportunity to address concerns in relation to the model and all related published documents. The Authority further concluded with providing operators with an opportunity to physically test the model. The Authority confirms that the LRAIC Specification Paper does not depart from the principles identified in the Costing

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				Methodology. The Authority reminds operators that all aspects of this cost model were developed with full consultation with all stakeholders. All Papers underwent several rounds of consultation, meetings were held at the Authority's offices, emails were exchanged and feedback obtained from all parties, including TSTT. The list of anomalies is well received and by way of this consultation process, all issues, including model amendments are being addressed.
General concerns with the Consultation Process	TSTT	As commented on in response to the CCA Reference Paper, the DORs for the previous consultations for this LRAIC Specification Paper have been omitted not even mentioned in the contents of the document while the TATT seeks to make additions. Having notified the TATT of the CCA DORs TATT did not exercise due diligence to look at the LRAIC Specification document and make the necessary adjustment and	The Authority is called upon to practice due care in the in the documents issued to stakeholders for review and input. The Authority must ensure that it provides complete documents when issuing consultations.	The Authority disagrees with TSTT's recommendation. This document was issued for a completely new round of consultation on an approved document, and there is no requirement to maintain DORs from previous consultations, in said approved document.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		reissue the document. Further, the DoRs referenced in the advice quoted above, reflected comments made in response to a prior consultation process that ended in 2010. Further still, there is no evidence of responses to any consultation that resulted in the 2012 version of the LRAIC Specification Paper. For responders on this document to appreciate what preceded this version, they must first find the DoRs from previous documents that led to this particular round. While there is a trail of consultation up to the completion of the 2010 version, there is no trail of any legitimate process which led to the publication of the 2012 document. TSTT is led to believe that these anomalies seem to suggest that there has been some breach in the Authority's procedures with respect to public consultation in the production of the 2012 version of the document. If it is indeed that the 2012 version of the document was not subject to consultation, the document is not	The Authority should abort this consultation process and only reinitiate when any anomalies with respect to the progress of the document are rationalized. TATT must conduct public consultations as procedural.	Nevertheless, the Authority, on its website continues to make available at all times all past DORs and all information related to any past consultative document. This ensures full transparency and accessibility at all times. Full and open access to all information underpins the Authority's principle on stakeholder engagement. The Authority informs that all perceived anomalies have been rationalized, by virtue of this current consultation process, which shall include two (2) rounds of consultation, at a minimum, and therefore there is no need to abort. The Authority agrees with the recommendation that it must conduct public consultations as procedural and maintains its commitment to consult in accordance with the Authority's established Consultation Procedures.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		legitimate according to the Authority's own procedures. In that context, anything derivative of that document would also be similarly illegitimate. If TSTT's deductions prove accurate, the Authority should withdraw this document and reconvene a legitimate first round of consultation. TSTT draws the TATT attention to TATT's procedures even where closed concessionaires agreements may have been agreed this does not mitigate the need for public consultations on public documents. This will include the Cost of Capital, Efficiency study and all other substantive documents.		
1.2 The Consultation Process	CCTL	The summary of main revisions on page 8 is not complete, e.g., it does not highlight the major change in approach to CVRs. More substantively, as a "track changes" version of the draft specifications were not provided, it is difficult to confirm that we have caught all the changes from the previous document.	The Authority, when consulting on revised documents should supply interested parties with a "track changes" version of the document, so that the interested parties can be confident they have been made aware of all revisions made.	The Authority takes note of CCTL's comment. Furthermore, CVRs have been captured under the summary of main revisions, which identifies the areas wherein major changes were made to the document. Operators are reminded that all versions or draft and final documents are permanently housed on the Authority's website for the purpose of referencing.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
1.3 Modelling objectives “● <i>the determination of interconnection rates for all concessionaires when required;</i> ● <i>the determination of rates for accessing to facilities of any concessionaire where applicable;</i> ● <i>the determination of rates, where necessary, for any telecommunications service in which there is a monopoly or exclusive provider the determination of rates, where necessary, for any</i>	TSTT	While TSTT notes that the Authority has identified the Model which this Specification Paper outlines as key to making regulatory decisions pursuant to Sections 25, 26 and 29 of the Act, the Authority should also recognize the practical limitations of legitimate use of the Model in this regard. TSTT believes that a number of the proposals proposed herein, and in the Costing Methodology no longer reflect a best fit for the regulatory objectives identified. Firstly on a practical point, as outlined in our comments to the CCA Reference Paper, it is unwieldy and impractical to require operators to expend resources to undertake this exercise annually. Indeed the timelines proposed in that document would suggest the dedication of resources that would exclusively provide reports to the authority even though there was no material change in the network. This would represent the Authority imposing a gross inefficiency in the marketplace to limited material benefits to either the consumer or the concessionaires. As expressed therein, as Interconnection Agreements have a dedicated lifespan, the Authority should only seek to undertake	The Authority must abandon its approach to undertaking the Cost Modeling exercise annually, as such is overly burdensome on the resources of operators in an increasingly competitive marketplace. This process should be pursued on the periodic review of the IRIO by interconnection service providers. The Authority ought to build a model to more reliably reflect variations evident in real market economics. The application of incremental costing approaches to non-transient products such as network and non-network facilities should be reviewed.	As part of operators’ regulatory requirements, due consideration should be given to ensure that adequate resources are available to satisfy such requirements. The Authority has not been unreasonable in regard to operators’ regulatory requirement in the development of the cost model. Considering that the cost modelling exercise has been ongoing for the past five years, the Authority expects that operators would have assigned relevant resources to the exercise. The Authority notes that the extent of work required on annual updates should be streamlined and thus not as extensive as the initial year of model implementation. For this reason the Authority has developed standard data templates and guidelines which can be standardized and adopted by operators.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
<i>public telecommunications service provided by a dominant provider any exercise by the TATT to detect unfair cross subsidies or any act of anti-competitive pricing."</i>		this function on a periodic basis that is not less than five (5) years or not more than ten (10) years, and should be in accordance with the periodic renewal of the IRIO by parties so obliged to establish. Secondly, on a philosophical point, as also outlined in the CCA Reference Paper, TSTT reaffirms its position that the Authority's assumption that costs associated with the distinct Core and Access Networks would change similarly over time is flawed. TSTT's understanding of the market has deepened considerably since the time of the consideration of the Costing Methodology approximately a decade ago. In that context, TSTT thinks it is prudent to review the concept that the costs of both the incremental delivery of a transient service (such as voice minutes, the value of which reduces to a terminal value in time) and the lease of a non-transient product (space on a tower, pole or in a building, the value of which would increase in time) would should be treated in a one-size fits all LRAIC approach. Accordingly the Model as designed may be a better fit for interconnection or retail (incremental delivery of a transient commodity) services as opposed	The Costing Methodology and LRAIC Specification Papers must both be reviewed to identify how the Methodology can be used to regulate wholesale and retail services as proposed. This consultation should be aborted until modifications to the Methodology are completed. The Authority is reminded of its statutory remit, and should limit the application of this Model accordingly. If the Authority believes that this Model is appropriate for use, a	The Authority disagrees with TSTT's recommendation for abandoning annual updates of the model. The Authority believes that the yearly data collection gives the model strength and validity for the following reasons: • The Authority will not be changing the model yearly but rather inputting annual data so that the Model will generate reliable and relevant current costs. • The Model is not static as it is made up of manipulative variables as well as constant variables. This allows for the reflection of real market conditions and the realities faced by the operator. This is further necessitated by the fact that the model is top down, thereby utilising actual operator annual costs and not

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		to access to facility (lease of a non-transient product) services. In this context, TSTT believes that the exercise should better reflect real-world market economics, and recognize the distinction in market dynamics identified. Thirdly, it is also inappropriate in principle to use the same cost base for the regulation of interconnection (a wholesale service) and retail services. The Authority has attempted to bundle the outputs of this Model to both spheres without clearly articulating how the outputs of the Model would be adjusted to effect such. To the point, it is patently impractical and philosophically improper to assume that retail costs could tend towards regulated wholesale costs. Accordingly, if the Model is to be deployed in this fashion both the Costing Methodology and the LRAIC Specification Paper must identify the adjustment to Model inputs and/ or outputs that could facilitate such diverse application. TSTT reminds the Authority that, pursuant to Section 26 of the Act, agreements between parties for the provision of access to facilities are, as much as possible,	better case must be made. The Authority ought to build a model to more reliably reflect the network topologies in the marketplace. Thereafter, proper application of distinct cost drivers should be appropriately applied in accordance with a Revised Costing Methodology.	hypothetical costs. Cost and financial reporting processes are also annual reporting requirements of operators. Where rates are required for regulatory intervention, the Authority may easily be accused of being myopic in its assessment where, for example, trended costs over years are not considered to normalise for any sudden increases or decreases in any particular year's costs. Given the foregoing, the Authority believes that annual updates would assist in reliably reflecting variations evident in the real market. The Authority disagrees with TSTT and confirms that the Costing Methodology provides a balanced and thoughtful weighing of approaches to costing and

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		to be subject to commercial negotiation. Notwithstanding the provision in the Regulations, the Authority has never explained how this Model will be practically used in the context of this statutory context. The Authority proposed establishing a framework to treat with such issues (Draft Standards and Guidelines for Reference Access Offers, September 2014) to which TSTT responded and our concerns have never been addressed. Those concerns are relevant here as well. The Authority should, in the Costing Methodology and/or this LRAIC Specification Paper outline its statutory authority to act in this particular matter. Thereafter, TSTT's comments above about the propriety of using LRAIC for non-network facilities are again relevant. TSTT points out that some of the assumptions the Authority states in this document are either outdated or do not reflect the current architecture of the networks it proposes to Model. In particular, TSTT notes that its overviews of Fixed, Mobile and Fixed Wireless Networks do not conform to best practice, TSTT's deployment, and we suspect, any other deployment in the marketplace.		makes determinations on the application of same to retail and wholesale services. These principles are provided for in the LRAIC Specification Paper. This consultation process will continue to be carried out in accordance with the Authority's established Consultation Procedures. The Authority's statutory remit for cost determinations are set out in the Costing Methodology and are reiterated below: • Section 25 (2) (m) of the Act requires that concessionaires, amongst other things, disaggregate their network(s) and on a cost basis, in such a manner as the Authority may prescribe. Regulation 18(1) of the Telecommunications (Access to Facilities) Regulations specifies that a concessionaire shall set access rates based on its costs determined in accordance with such costing

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		TSTT reminds the Authority of the fundamental principle that an economic model must closely reflect the system it seeks to emulate. From the assumptions outlined in this document and consistent with TSTT's comments during the Model Access sessions, the proposed Model does not now reflect the operational networks they seek to reflect. In that regard, even where the Authority properly models network topologies in the market, TSTT's comments about the bundling in the model of interconnection, retail and facility costs as proposed needs to be reviewed. Indeed, the Authority ought to build a model to achieve real market economics.		methodologies, models or formulae as the Authority may, from time to time, establish. • Regulation 15 (1) of the Telecommunications (Interconnection) Regulations states that a concessionaire shall set interconnection rates based on costs determined in accordance with such costing methodologies, models or formulae as the Authority may, from time to time, establish. • Further, due to the mandates of Section 29 of the Act, certain price regulation regimes require the determination of appropriate regulated costs. The Authority disagrees with TSTT and confirms that the Cost Model reliably reflects the network topologies of operators, based on information provided by operators for the purpose of the

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				modelling exercise. Further, the Authority confirms that the Model can be used for the determination of rates for accessing facilities of any concessionaire, where applicable. Such services, in accordance with the Access to Facilities Regulations (2006) are listed under Table 13 in the LRAIC Specification Paper. Where there are network changes, the Authority would welcome this new data and ensure that the model adequately accommodates for same.
1.4	Digicel	TATT says “the approach has been simplified as far as possible whilst remaining consistent with the Costing Methodology and meeting the requirements of the Authority” During the Alpha Testing Digicel has realized that the model is not as simple as possible. For example, we	Based on the detailed comments in the sections below, Digicel recommends that TATT performs testing and finalization of the alpha model as in Digicel’s opinion it cannot be considered to be	The Authority agrees with Digicel on the need to address the alpha testing concerns. The Authority has provided all operators with CCA Modelling Documentation which provides detailed information on the model’s structure, each worksheet and a

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		were able to see in the Alpha-tested model that the table function was feeding costs through into sub-categories, but we were not able to trace through the formulae and driver quantities to know how the table function was actually working. Furthermore, we highlight TATT's confusion as to whether the model actually contains circular/iteration calculation or not. While Digicel has received multiple communications from TATT on the explanation of the Table function in the model, it remains an opaque black-box model to Digicel because Digicel does not have any way of opening up the model to attempt further understanding, or even confirmation of TATT's explanations. We also observed a number of areas where Digicel's input data was adjusted without explanation – undocumented changes which need to be searched for within multiple spreadsheets, adds considerably to Digicel's ability and effort in the activity of reviewing the beta models.	correct and finalized ready for the Beta phase. Digicel also recommends that TATT provides additional documentation of the model and/or annotation explaining the 'complex' calculations in each stage of the model, so the beta stage can commence with the best possible chance of Concessionaires' understanding. Given the anticipated volume of material in the beta phase, Digicel recommends that TATT conducts a fully transparent beta phase. Digicel recommends that there is full sharing of the beta models and associated full explanation of data insertion/processing	script of all calculations. Furthermore, the Authority has also published detailed LRAIC Model documentation which not only provides full documentation on all calculations contained in the model but such information is accompanied by screen shots and visibility of the model. This document can be found on the Authority's website since October 23rd 2012 https://www.tatt.org.tt/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=132&PortalId=0&TabId=222 The Authority takes note of Digicel's recommendation for sharing the model. As stated by the Authority in its meetings with operators in 2015 on determining a collaborative approach on the LRAIC Model, the Authority is willing to provide concessionaires with a copy of the model for future testing. This provision is contingent on the Authority's acquisition of cost data

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
			which has been carried out by TATT in setting up the beta models, including active or fully annotated spreadsheet links to source data files so that Digicel can observe and verify the usage of its data in each of a number of models.	from operators with which the Authority will conduct its own testing. Concerning Digicel's specific model comments, the Authority responds as follows: • The Authority notes that the model is created in a way that prevents circular referencing. The Authority can therefore confirm that there is no circular referencing contained within the model. Further confirmation is provided as Excel does not show the circular reference warning. • Furthermore all calculations for the model are undertaken in either the LRAIC or the CAA modelling file and are therefore transparent. • Regarding the specific request on the Table functions the Authority notes that the mechanics of the calculations are known and transparent but will replace

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				them with a macro to increase the understanding of the model. This change will have no impact on the functionality of the model as the macro will simply replicate the functionality of the TABLE () function. • All of the inputs to Digicel's LRIC model link directly back to the data submitted by Digicel with one exception where we had to amend the input for 'Domestic Call Termination' based on the understanding that the data supplied by Digicel erroneously included both termination of traffic received from other networks in Trinidad, but also termination of 'on-net' traffic. Given that this input was only supposed to include call termination from other networks and exclude 'on-net' traffic, we subtracted the Digicel entry for 'On-net' traffic from their input to get the implied call termination originated from other networks. Thus, the amendment was

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				informed by a reconciliation of the data from other operators on calls originated on their network which terminated on mobile networks. • The alpha phase was in part designed to allow concessionaires a further review of the data used in the model.
1.4	Digicel	TATT says that “Network element costs be attributed to services on the basis of service volumes and routing factors. Routing factors for all network elements should be established and justified by concessionaires for the use in the model” Digicel agrees that network elements should be attributed to services on the basis of service volumes and routing factors. However, in the Alpha-Tested model, we realized that TATT has adjusted inputs in Digicel’s routing table. For instance, Digicel’s input table reported a routing factor of 1 for “MMS termination” under the heading of “BTS”. By contrast, TATT’s “LRAIC model” uses a routing factor of zero for this service under the equivalent heading of “base station	Digicel requests TATT to explain all instances where TATT has adjusted Digicel’s input data, in a document accompanying each version of the model which TATT sends to Digicel for Digicel’s beta test review.	The Authority disagrees with Digicel that a routing factor of zero for “MMS termination” under the heading of “BTS” was used by the Authority. The Authority confirms that a factor of one was used in Digicel’s 2009 modelling file. During this iterative process, Digicel had the opportunity to review and comment on these adjustments. Further, as mentioned above, the alpha phase was in part designed to allow concessionaires a further review of the data used in the model.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		subsystems”.		On the specific subject of the routing factor for “MMS termination”, the Authority confirms that a routing factor of 1, as reported by Digicel, is used in the alpha modelling file. This reflects the fact that MMS being sent or delivered will transverse the BTS once.
1.4	Digicel	TATT says that “Common costs which would otherwise not be included in the service cost in a pure LRAIC approach should be included by applying an equi-proportionate mark up (EPMU).” During the alpha testing session, we saw that no common cost mark-up has been applied so all common costs are excluded from “Network costs”.	Digicel requests that TATT investigates its own model to assess whether it conforms to the principle of identifying common costs and applying an EPMU, and to confirm the correctness or changes in the model and associated input data relating to common costs prior to finalizing the alpha phase.	The Authority can confirm that the model allocates all common costs using a LRIC+EPMU approach on a cost category by cost category basis. In some cases the estimated fixed and common costs will be zero and as such no mark up will be applied. For example no fixed costs from “IT/General purpose computers” are allocated to “Mobile Core” (see Sheet “Mark Up By Category” J116). The Authority can confirm that all relevant costs have been considered in the LRAIC

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				model. In particular, the “Checks” sheet contains several crosschecks to ensure that the total LRAIC service costs equal the total costs so no costs are excluded. The Authority notes Digicel’s comments about apparent negative mark ups for certain cost categories. These appear to be artefacts of the model not being fully recalculated leading to inconsistencies in the intermediate calculations. This presentational issue has been addressed in the model.
1.4	Digicel	Based on our alpha review, we believe a mistake may have occurred in linking the cost per network element in the Network Element Costing sheet. Consequently, the model appears to be reporting the costs associated with “Transmission international” for “Transmission interconnection links”. Similar linking mistakes seem to have occurred for “Transmission leased lines” and “Transmission interconnection links”, “BSS transmission” and “SMS messaging centre”, “BSS MSC transmission”	Digicel requests TATT to investigate whether the model has been built to correctly link categories in the Network Element Costing sheet, and to confirm the correctness or changes in the model, prior to	The Authority notes that all the incorrect linking identified by Digicel arises from a missing network element (“MSAN – subscriber sensitive”) in the source sheet “Increments to elements”. All of Digicel’s references relate to the missing “MSAN – subscriber sensitive”

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		and “BSS transmission” as well as “MSC-MSC transmission” and “BSS-MSC transmission”	finalizing the alpha phase.	network element. Once this is included, all this issues are resolved.
1.4 The TATT's requirements	TSTT	Statutory reporting is historical since it is only after a year will results exist for a concessionaire. However, the Costing Methodology speaks to the development of forward-looking cost estimates. Nothing contained in the Model or stated principles of definition reflects this fundamental idea of determining forward-looking cost estimates. There is no discussion of any economic forecasting principles, and no evidence of the inclusion of same into the Model. TSTT requests that the Authority clarify how the principles of Model developed espoused in Specification Paper achieves the objective of forward looking cost estimation and assists with long run application for the market.	The Authority must clearly articulate how the ability of these characteristics will assist with future business or market development. The Authority must identify and build economic forecasting principles into model.	The model is forward looking in its considerations of asset valuations and economic depreciation. The Authority has developed the model to consider forward looking costs, having understood that historical costing methods may overstate the current long run marginal cost of production, because current long run marginal cost should depend on the current cost of replacing assets and not on the historic cost of purchasing such. This resulted in basing model outputs on costs calculated using the current replacement cost of assets instead of original purchase cost. Costs calculated under such a methodology are often referred to as “forward looking costs.” <i>See Salinger (1998),</i>

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				<i>Hausman(2000), Falch(2002), Rosston and Noll(2002), Tardiff (2002) and Federal Communications Commission(2003).</i> The Model also provides for the inclusion of a share of joint and common costs from all services. This approach encourages competition in telecommunications markets by promoting efficient entry and exit in relevant downstream markets; encourages economically efficient investment in infrastructure and provides the appropriate incentives for further investment in the most efficient technology available. The Authority agrees that any delay in historical data may impact forward –looking costs. To account for this, the Authority considers the timely and complete submission of yearly cost data from operators is crucial.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
1.5	Digicel	Based on our alpha review it seems that there is a mismatch between the model's reporting period and the fiscal year of the model's input data.	Digicel requests TATT to investigate whether the model is set up to correctly use the 'year' input and to confirm any corrections to the model or corrections required to input data prior to finalizing the alpha phase.	The Authority notes that the LRAIC tool is based on a single year's data which for Digicel was the fiscal year 2009/10 running from April 2009 to March 2010. As such, any potential mismatch between reporting periods should have no bearing on the modelling results.
1.5 Need for operator Input	CCTL	CCTL remains concerned that the approach of using individualized models will give too much scope for the operator's to game the system. The statement, for example, "Given the range of network topologies currently used by concessionaires, the template LRAIC model will be sufficiently flexible to reflect the different networks used while harmonising the principles and methodology as far as possible" (pp. 10-11) suggests that the Authority may compromise "principles and methodologies".	The Authority must include in the model review process a means by which licensees, whose finances are materially impacted by the rates charged by other operators, can review the models of those other operators to determine the extent to which the specifications have been correctly implemented. It is	The Authority clarifies that it has not developed individualized models but rather only one (1) model. The Authority assures operators that the model is standard with the same structure, working and generic assumptions for all operators. There will be no compromise in the principles and methodologies. The Authority disagrees with CCTL's

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
			standard practice to prepare versions of models for review in which confidential information is masked. Such redacted models would enable other interested parties to vet the structure, workings and generic assumptions.	recommendation for review of other operators' modelled costs and outputs. This is due to the fact that the LRAIC model is top down in nature and thereby uses specific and actual cost data which is confidential to each operator. The Authority must further honour such confidentiality based on its mandates set out in the Act and Concession Agreement. As a result, the Authority does not see it feasible to have such confidential information reviewed by other operators. The Authority would also amend the statement in the LRAIC Specification, as referenced by CCTL to provide more clarification on this process.
1.5 Need for operator Input	CCTL	The Authority states that "The model will be populated on an annual basis covering each concessionaire's financial reporting year." We continue to maintain that TATT has set up itself and the industry for an overly burdensome process. Just how burdensome will only be fully revealed when we have adequate time to review	For those operators who have not been deemed dominant in markets outside termination (interconnection) markets, there is no need for populating their models	Information for the generation of costs for regulatory decision making is required from all operators. This is mandated for in Interconnection and Access to Facilities Regulations and the Telecommunications Act (Chap 47:31).

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		the models. But it is already clear that the top-down approach, the individualized modelling and annual updates will require unusually (and unnecessarily) heavy direct and indirect resource expenditure from the service providers. While in some cases, annual updates are indeed necessary; in others requiring annual update is unnecessary and disproportionately burdensome.	annually. Interconnection rates are set for periods exceeding one year. In these cases the models need be populated only in advance of an interconnection rate review proceeding.	The Authority agrees with CCTL that costs should be derived for interconnection services. Further, the Authority makes reference to the comment of the Arbitration panel, which stated, <i>Considering mobile termination is a monopoly market, the panel interprets the approach to cost based charging in The Act and Concessions as originating from the expectation that there is likely to be a lack of competitive effects on interconnection charges that it is necessary to mandate by law and regulation that they be cost based, set pursuant to methodologies prescribed by the regulator...</i> " the Authority concurs, along with virtually every jurisdiction where the calling party pays, that each mobile operator is dominant as it relates to calls terminated on its network.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				The Authority believes that these rates need to be updated on an annual basis which gives the model strength and validity for the following reasons: •The Authority will not be changing the model yearly but rather inputting annual data so that the Model will generate reliable, relevant and current costs. •The Model is not static as it is made up of manipulative variables as well as constant variables. This allows for the reflection of real market conditions and the realities of the operator. This is further necessitated by the fact that the model is top down, thereby utilising actual operator annual costs and not

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				hypothetical costs. Cost and financial reporting processes are annual reporting requirements of operators. •Where rates are required for regulatory intervention, the Authority may easily be considered short-sighted in its assessment where trended costs over years are not considered to normalise for any sudden increases or decreases in any year's costs. Given the foregoing, the Authority believes that annual updates would assist in reliably reflecting variations evident in markets.
1.5 Need for operator input	TSTT	The prescribed used for this Model, as per the Authority's assertions here, conflicts with the presumption put forward. International best practice suggests that various LRIC processes, including the cost estimates (via, for example CCA Revaluations) and Cost Value Relationships are distinct between Fixed and	The TATT must follow industry best practice, and provide distinct Model characteristics for Fixed and Mobile Networks	It is a fact that the Authority has developed the LRAIC Model through research and evaluation of other models, in consultation with the industry. The Authority has made the distinction for

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		Mobile Networks. The Authority presumes to apply such processes in a one-size fits all approach which may be inappropriate given the differences in the networks and the markets they service. As stated previously, the annual calculation of concessionaires cost is an onerous, redundant exercise that only provides for the Authority inefficient intervention in the market ostensibly for collection statistics. Indeed the process articulated would suggest concessionaire dedication of resources for over 18 weeks annually, presuming no delays. Further, in that specific regard and as discussed in the consultation on the CCA Reference Paper, TSTT questions the Authority's regulatory remit to request information in the apparently ad hoc fashion suggested. There are already adequate regulatory obligations through which concessionaires submit audited financial statements and regulatory accounts for Accounting Separation. Given the above, and considering the multi-year term of interconnection agreements, it is recommended that the Authority limit its requirements for data submission to those already identified in regulation, and further,	The Model should only be reviewed every five to ten years. Further with respect to data submission, the Authority should limit the burden of ad hoc data submission request and limit itself as much as possible to statutory accounts already required by Regulations.	fixed and mobile networks. Operators are required to provide separate information for their fixed asset register (FAR) for mobile and fixed and this distinction is applied throughout the model. Furthermore, considerations of all inputs including CVRs, WACC, CCA revaluation indices are distinct for fixed and mobile assets. The Authority disagrees that the Annual cost collection is a mere matter of statistics. This request is not ad-hoc. The Authority is mandated to determine costs for regulatory decision making in the interest of consumers and the orderly development of the market. The Authority reiterates its reference to Section 25 2(m) and Section 29 of the Act, and Interconnection Regulation (R 15 (1)) and Access to Facilities Regulations (R18 (1)). Further, it should be noted that matters on

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		that the CCA reevaluation exercise be limited to a period in accordance with the renewal of the interconnection agreement: a period not less than five (5) years and not greater than ten (10) years.		costs and anticompetitive behaviour, including below cost pricing arise even during the course of active interconnection agreement periods.
1.5.1 Capital costs <i>"...the Authority conducts a CCA study for each concessionaire to revalue their relevant assets each year, based on information provided by concessionaires."</i>		TSTT reaffirms that the CCA Revaluation exercise should be undertaken by the individual operator, in accordance with standards established by the Authority for transparency. To impose Authority established asset revaluations on an operator would effectively facilitate the Authority's determination of an operators' functional rate of return on its investment. Such would not only be impractical as valuations thereby derived would have no impact on the valuation of a firm's assets in the capital markets, but would also be <i>ultra vires</i> Section 29 of the act. The Authority should not seek to usurp the responsibility of an operator to manage its overall financial affairs, as they would accept no liability if and when such imposition results in market failure.	The Authority should refrain from acting <i>ultra vires</i> the powers provided it in the Telecommunications Act. Further, the Authority should not seek to operate in a manner not provided for in the Costing Methodology.	The Costing Methodology provides for the adoption of the indexation approach for revaluing assets. This approach has been consulted upon with all stakeholders before its adoption. The Authority has reviewed TSTT's comment and does not agree that the CCA revaluation exercise is <i>ultra vires</i> Section 29 of the Act. Furthermore, the approach is consistent with the requirement of Section 25 (2) (m) of the Act, which states that in respect of the concessionaire's obligation, the Authority shall require the concessionaire to: <i>disaggregate the network and, on a cost basis, in such manner as the</i>

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				<i>Authority may prescribe, establish prices for its individual elements and offer the elements at the established prices to other concessionaires of public telecommunications networks and public telecommunications services.</i> In addition, the Authority notes that the Rates of Return applicable to operators for regulatory purposes are determined via a consultative process with all stakeholders under the “Weighted Average Cost of Capital.” TSTT is reminded that the Cost Model is a tool to remedy market failures.
1.5.2	Digicel	Based on our alpha review we saw that ‘direct costs and cost of sales’ was allocated to a “spare” cost category	Digicel requests TATT to investigate where line items may be incorrectly allocated to blank, dummy, spare categories, and to confirm any corrections to the model or	The Authority confirms that the opex category “COS12” was wrongly labeled as “spare” instead of “retail and other”. This resulted from a mislabeling in the input data file, rather than the functionality of the LRAIC modelling tool.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
			corrections required to input data prior to finalizing the alpha phase.	The Authority has corrected this categorization in the Model. The Authority would amend the model template by adding further cross-checks and/or building in an error trapping functionality where possible. The Authority has assessed the remaining line items and can confirm that these are correct.
1.6 Overview of the LRAIC modelling process and the CCA revaluation study	TSTT	Post-dated exercise which the operator has the responsibility. The concessionaires have an economic business model to pursue and as such will not be in a position to pay operating cost of the TATT and also maintain employees to partake in an annual exercise that is resource demanding.	The TATT and its consultant can do analytical review of submits.	The Authority takes note of TSTT's comment. However, in the Authority's understanding, cost models continue to be developed by regulators (for example the Office of Utility Regulation (OUR), Jamaica, 2014) and continue to be used for regulatory decision making (for example FTC, Barbados, 2015). Furthermore, whilst the Authority appreciates and supports the economic business goals of all operators, the Authority must carry out its mandate in determining appropriate regulated costs.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				The Authority also notes that other operators, even those operating on a much smaller scale than TSTT have been providing annual cost data to the Authority. In the case of interconnection, this activity is not of minimal importance but of paramount importance to all operators and in particular, of interest to operators who are net terminators of traffic.
1.6 Overview of the LRAIC modelling process and the CCA revaluation study	CCTL	The Data collection process set out in Table 1, page 13, is unrealistic as the experience of the past several years of this process has shown. It may be possible that TATT and its consultants could develop some workarounds to streamline the data gathering and analysis process, but it is not clear at what cost to the validity of cost measures.	The Authority should reconsider its timeframes for Table 1. Furthermore, one means of ensuring that the Authority is capable of timely review of submissions is by restricting the number of operators that have to make annual submissions, as we have recommended above.	The Authority agrees with CCTL's recommendation and has reviewed the timeframes set out in Table 1. The Authority concludes that it supports the indicative timelines proposed. Further, given the annual and repetitive nature of the process when implemented, the Authority considers that upon resolution of model access and testing issues, which have been the focus for the past several years, the annual exercise should follow the timeline as indicated. The Authority may amend the timeline following the next period of data collection and model

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				population, where the process may differ from indicated. As stated previously, the requirement for the provision of costs extends to all operators.
Section 2				
2.1	Digicel	In the alpha tested model we observed services with traffic, but resulting in zero LRAIC unit cost (e.g. MMS originated)	Digicel requests TATT to investigate whether all services with traffic have resulting costs, and to confirm any correctness or changes in the model prior to finalizing the alpha phase.	The Authority notes that this is likely to be caused by conversion factors for MMS which were left blank in the alpha model version, in absence of any data provided by concessionaires. The Authority will assess possible conversion factors for MMS services based on inputs from the concessionaires. The model will also incorporate a check that costs for services with non-zero volumes will be non-zero.
2.1 Definition of LRAIC	TSTT	TSTT believes that the Authority's document seems to	Costing methodology	TSTT is requested to state specifically what

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
<i>“Under a LRAIC approach, as set out in the Costing Methodology, incremental costs are estimated for increments of demand which relate to individual network elements rather than end to end services. The costs of end to end services are estimated through a combination of the LRAIC cost of the elements, service volumes and routing factors.”</i>		reflect an internal conflict or cognitive dissonance with its authorized Costing Methodology. While the principles behind most of the discussion in the Methodology focused on wholesale (core) network elements, this approach has apparently adopted by the Authority as a one size fits all approach to regulatory costing – the outputs of which can be used to a wide range of regulatory objectives. This is an inappropriate application of a Methodology which already struggled with systemic weaknesses. In this context this Model also seems to create a singular approach to costing network and non-network elements, some of which have distinctly different cost drivers and economic lives, in a myopic singular fashion. This compromises the weaknesses already inherent in the Model, and TSTT suggests, compromises the integrity of the Model – even in the context of the limited scope it was originally intended to achieve. with TSTT believes that a review of the Costing methodology is required, in accordance with public consultation procedures of the Authority.	consultation required. The TATT should accede to the Costing Methodology seems to be for only wholesale network elements.	are the systemic weaknesses being referenced. Different drivers and economic lives are applied to network and non-network assets. The purposes for which the Model will be used are provided in the recommendations of the decision of the Arbitration Panel of the First Dispute and various frameworks established by the Authority. The Model may be used for the determination of, for any given concessionaire, inter alia: a. the cost for the provision of a variety of Interconnection services to concessionaires; b. the cost for the provision of a variety of wholesale facilities; and c. the cost for the provision of a variety of telecommunications services to the general public; This list is, of course, not exhaustive but does provide an overview of the matters for which regulatory authorities generally apply

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		Key among the issues to be deliberated upon is the propriety of the use of a Costing Methodology geared explicitly for wholesale network elements, on retail services, non-network elements, etc.		Cost Models and Model derived information. The Authority does not agree with the comments provided by TSTT. TSTT is asked to provide evidence of the statements made.
2.2 Summary of Principles	CCTL	The description of how the “scorched node” principle will be practically implemented is not clear, particularly in respect to mobile networks. Scorched node does <i>not mean</i> that the network modelled has to have exactly the same number and distribution of nodes as does a network of the operator submitting the data. It means that the relationship between the drivers of node deployment and actual node placement, are similar in the model to those actually seen in the networks of real operators. For example, nodes in similar locations should be assumed to be co-located and not housed in separate buildings or cabinets. For mobile models, the placement of base stations should be cross-checked against a bottom- up calculation of what should be expected to determine if there are likely inefficiencies that would be avoided in new entrant deployment.	The Authority should expand its section on scorched node and indicate how it will modify inputs from operators to ensure that raw data on node locations are not simply transferred into the models. As called for above, the Authority should allow licensees, whose finances are materially impacted by the rates charged by other operators, to review the models of those other operators to determine that the scorched node assumption	The “scorched node” principle as well as the “thinning” principle is used to determine the appropriate cost volume relationship (CVR) to use in the calculation of incremental costs to feed into the calculation of LRAIC service costs. For the initial LRAIC model implementation the Authority considered at the time that it was disproportionate to require concessionaires to provide a fully range of CVRs as the resources required would be large and the benefit, in terms of more accurate LRAIC estimates, would be

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
			has been reasonably implemented.	relatively insignificant compared to using notional CVRs with a “straight line through the origin” (SLTO) form. As such the principles of ‘scorched node” and “thinning” are not currently implemented in the model. The Authority will update the LRAIC Specification Paper accordingly. CCTL also suggest that there should be a crosscheck of the cost against engineering based “bottom up” models. The Authority has previously consulted on the approach to applying efficiency adjustments in the LRAIC methodology https://tatt.org.tt/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=220&PortalId=0&TabId=222 The Authority intends to apply efficiency

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				adjustments determined based on this methodology to the results of the LRIAC model. As such CCTL's proposal to build a bottom up model to test the efficiency of the TD LRAIC Model is not practical. CCTL is reminded that the Authority fully consulted on the approach to be used in the development of the sector Model, for which the recommended approach was a top down LRAIC Model.
2.2 Summary of Principles	CCTL	The description of how "thinning" will be practically implement is not clear. Top-down cost information will have to be modified so that they reflect optimized transmission costs.	The Authority should expand its section on thinning and indicate how it will modify inputs from operators to optimize transmission costs. As called for above, the Authority should allow stakeholders, whose finances are materially impacted by the rates charged by other operators, to review the	Due to the use of simplified CVRs, described above, the principle of thinning is not currently implemented in the LRAIC model. The Authority will update the Paper to reflect this current status. Similarly, due to the approach taken on efficiency adjustments, the suggestion to 'optimize' transmission inputs is not

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
			models of those other operators to determine that the scorched node assumption has been reasonably implemented.	practical
Section 3				
3.1 Ex ante regulatory requirements. <i>“While the focus of the cost modelling is on network costs, total retail specific costs are also identified separately within the modelling. Given that retail costs are typically subscriber driven rather than product driven, retail costs may be considered to be joint and common costs</i>	TSTT	As discussed above, TSTT believes that, conceptually, the Authority seems uncertain on its actual intent with the Model this paper seeks to specify. While clearly stating that the Model is targeting the development of wholesale costs of network elements, this statement proceeds to postulate that its implementation can also treat with the question of retail cost definition. Without discussing the vagaries of such a function given the constraints upon the Authority’s price intervention powers under Section 29 of the Act, TSTT contends that despite the (questionable) scope of the Costing Methodology, the Model under consideration cannot be all things to all parties or situations. The Authority must be clear on the purpose of the primary document The Costing Methodology generally, and the Model	The Authority must be clear on the purpose of this tool. As it stands the Model seems most appropriate, when rationalized, to treat with wholesale costs of network elements with a view to determining interconnection rates. All other claims that the Model can do otherwise should be excised from the specification paper. The Authority should seek to develop a distinct Model to more appropriately treat with	The Model produces a range of outputs other than interconnection rates. TSTT is asked to refer to Table 13 of the LRAIC Specification Paper.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
<i>across services. Estimates of the costs of retail services may be estimated by applying appropriate mark ups to the costs of network services."</i>		developed specifically. The Authority should be clear: is the Model primarily associated with the determination of wholesale cost elements for the definition of benchmark interconnection termination rates? If that is so, the Authority should be specific and pointed in that regard. This will then facilitate concerted concessionaire focus on that specific issue so that this protracted process can be brought to a satisfactory conclusion. In this way, after headway is made in that regard, the Authority can liaise with market stakeholders to develop a more reasonable costing approach to non-core network elements and facilities.	other aspects of its regulatory remit, such as facilities charges etc. The Costing Methodology should be reviewed to identify better, more appropriate approaches to treating with the costing of non-core network elements.	
3.1 Ex ante regulatory requirements	CCTL	The text in section 3.1 has been changed apparently to give more justification to the application of modeling to every operator and service offering. However, we are unconvinced that this heavy-handed approach is necessary for operators who are not dominant outside the interconnection market, as discussed above. Indeed, even the Authority backs away from the value of	For those operators who have not been deemed dominant in markets outside termination (interconnection) markets, there is no need for populating their models annually. Interconnection	As stated earlier, the Authority considers all operators who provide interconnection service to its network, to be dominant in the provision of call termination services on its network. The Authority has also provided its reasons for conducting annual cost updates.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		results for price regulation on page 23 when it states “the exact process of determining particular regulated prices will be determined on a case-by-case basis and the Authority will issue further communication on these processes closer to the time of determining the relevant prices.” Why require the entire industry to spend so much effort in modeling ex ante when the regulation will be determined on a case-by-case basis?	rates are set for periods exceeding one year. In these cases the models need be populated only in advance of an interconnection rate review proceeding.	The Authority would carry out a case by case application of implementing pricing regimes such as price caps, rate of return regulation etc.
3.2 Ex post competition cases. <i>“Given that the nature and scope of ex post competition investigations cannot be defined in advance, the LRAIC model has been developed to be flexible enough to provide inputs to the process for any services or markets required.”</i>	TSTT	This statement again underscores how the credulity of the Authority’s approach is stretched beyond reason as it seeks to make this Model a one-size-fits all regulatory panacea. TSTT would like the Authority to elaborate on the practicality of designing and building a model where there is no definition of how its output shall be used. Further, TSTT would appreciate an understanding how such a Model can accurately account for unknown future inputs for <i>ex post</i> competition scenarios that have not been defined, and is not currently the Authority remit in law.	The Authority needs to align the model with specific, cogent regulatory purposes that are achievable and not “pie in the sky”.	The Authority reiterates that the regulatory uses of the model were made clear from inception in Section 1.1.1, "Legislative and Regulatory Requirements" of the Costing Methodology for the Telecommunications Sector, which was finalized in 2008. The Authority further notes that these regulatory uses were restated by the Authority in Section 1.1 "Modelling Objectives" of the LRAIC Specification Paper, having then undergone two rounds of public Consultation. It is noted that this document identified all the services for which costs would be determined under Annex 6:

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		These auspicious objectives need to be tempered by pragmatism. Is the Model to be used to develop reasonable estimates of fixed and/ or mobile interconnection charges? This is a reasonable and achievable objective. If that is the objectives the Authority would do well to trim down the elaborate aspects of the Model and focus on delivering a product that is implementable.		Network Services.. TSTT is further reminded that the Telecommunications Act (“the Act”) reinforces the need for a Cost Methodology to enable the Authority to deal with specific regulatory issues. The following Sections of the Act refer: Section 25: Interconnection Section 25(2): <i>“In respect of a concessionaire’s obligations pursuant to subsection (1), the Authority shall require a concessionaire to-</i> <i>... (b) provide, upon request, points of interconnection in addition to those offered generally to other concessionaires, subject to rates that reflect the concessionaire’s total economic cost of constructing additional facilities necessary to satisfy such request</i> <i>(l) permit other concessionaires of public telecommunications networks and public telecommunications services to have equal access to telephone numbers, operator services,</i>

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				<i>directory assistance and directory listing at a cost efficient rate without unreasonable delay, in accordance with requirements prescribed by the Authority; and</i> <i>(m) disaggregate the network and on a cost basis, in such a manner as the Authority may prescribe, establish prices for its individual elements and offer the elements at the established prices to other concessionaires of public telecommunications networks and public telecommunications services.”</i> Furthermore, the Cost Model can be used in ex-post cases as it relates to the current remit under Section 29 of the Act, including matters of anti-competitive pricing or acts of unfair competition. The Telecommunications (<i>Interconnection</i>) (R. 15(1)) and Telecommunications (<i>Access to Facilities</i>) Regulations (R.18 (1)) also relate.
3.3 Potential efficiency adjustments	CCTL	The Authority refers to the Efficiency Study conducted in 2011. CCTL has serious doubts as to whether this study appropriately measures the efficiencies that should be	The Authority should initiate another efficiency study or replace the 2011 with a more	The Authority agrees with CCTL on the need to update the Efficiency Study. This Study was put on hold pending the resumption of

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		captured in the LRAIC modeling process.	transparent and suitable approach to introducing efficiency adjustments into the LRAIC modeling. This update or review should be begun immediately so as not to delay implementation of cost-based rates.	operator cooperation in the provision of data to the Authority (this came to a halt in 2011). When the LRAIC process is resumed with full cooperation from all operators, in the provision of data, the Authority will update the subsidiary documents related to the model, such as the Efficiency Study and the Weighted Average Cost of Capital, in full consultation with the public.
Section 4				
4. Networks to be modeled <i>"The LRAIC model has been designed to be sufficiently adaptable to allow costing services for all concessionaires based on their</i>	TSTT	There seems to be a challenge which has brought the Model to a standstill. The fundamental challenge is tangentially inferred at in the review of the LRAIC Specification Paper. This section in particular underscores the weakness of this paper, and thus the Model, in adequately reflecting the heterogeneous technology environment that characterizes the telecommunications and broadcasting sector in Trinidad and Tobago in 2015. These issues also seem to have insinuated themselves	The Authority needs to clarify whether the output is mobile, fixed line interconnection termination rates, or whether the output could realistically be reflective of anything else. The Authority must decide whether this Model is better suited with treating with either the Access network or	The Authority clarifies that the Model's outputs are defined in Annex 6 of the LRAIC Specification Paper, under defined Network Services. The Authority does not agree that such a decision in treating with either the Access network or Core network is necessary. Based on the defined network services, the

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
<i>respective mix of networks whilst being sufficiently generic to ensure that cost estimates resulting from the different concessionaires are comparable.”</i>		into the process of Model development and have had a negative impact on the process. The vision of the Costing Methodology seems to be blinded by the misinterpretation of fundamental telecoms costing practices and principles. The misinterpretations range from the uncertainty in defining the different networks (Core and Access) and their divergent costing approaches and regulatory application, to the lack of consistency with its Authorization Framework, recognizing the distinction between Fixed and Mobile Networks, while creating an artificial distinction between Fixed and Fixed Wireless Networks. The Authority cannot ignore how these misinterpretations have negatively impacted the product of the process thus far, hoping to forge ahead to achieve some redeemable outcome. TSTT recommends that the Authority start treating with a key recurrent truth which seems evident on review of the Model's implementation: that the Model, if not the larger Costing Methodology: (i) did not treat with material practical concerns of network implementation and operational	Core network, and once decided upon constrain its application to the legitimate regulatory purpose. The Authority must review the Model towards adjusting it to be truly technologically neutral, and not TDM voice network focused; as it purports such technology neutrality is a key philosophy of its administration.	model can be used for treating with both access and core networks. It should be noted that the model is built on existing networks. The Model is not TDM voice network focused but also seeks to normalize these different types of networks into a form required for the costing formulae to be applied. The Model is technology neutral as it caters for all technology types that are currently deployed in Trinidad and Tobago. Further, as networks evolve, and new asset types are incorporated into an operator's asset base, the model will not discriminate against any particular technologies, but rather considers all technologies on a fair basis. Further, the LRAIC model template is

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		(ii) feasibility of the proposed administrative structure, and is overly TDM voice network focused despite the Authority's claim of "technology neutrality."		technology agnostic. As such, whilst currently being reflective of 2G/3G technologies, it would not require model re-creation to incorporate LTE going forward [e.g. one of the required changes would be the assumed conversion factors which require already review at this time].
4.1 Access Networks	TSTT	Despite the introduction of this section, the Authority has failed to acknowledge a fundamental concept of the implementation of Costing Models and Methodologies that Core and Access Networks, regardless of technology, are usually subject to distinct costing approaches. Access Network elements are deemed directly allocatable to the particular customer or group of customers which drive its specific deployment. In that regard, there must be the clear delineation of where the access network ends (at the customer premises side) and where it begins (at the network side.) In the latter instance, the point of demarcation between the Access Network and the Core Network is critical. Quizzically preferring to present the anemic discussion	The distinction between Access and Core Networks from a Cost Modelling perspective is required, in the Costing Methodology generally, but also in this LRAIC Specification Paper. Without proper definition and demarcation this process is doomed to a stillborn conclusion. This consultation should be aborted until the Costing Methodology is reviewed to	The Authority notes, but disagrees with TSTT's position on the need to redefine the access and core networks in the Costing Methodology and LRAIC Specification Paper. Section 5.2.1 of the latter clearly defines the fixed access network as a network element which contains all subscriber driven assets. It then sets out in Table 3 what that means for fixed wire line, HFC and fixed wireless technologies. In case of the fixed wire line networks this means all network assets from the customer premises to the local switch/exchange/MDF.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		on the variety of access technologies that may be deployed, the Authority has failed yet again to provide a definition for the Access Network to facilitate allocation of network element between that Network and the Core. This fundamental weakness undermines the conversation that follows as the Model continues to presume the aggregated “economic thinning” of costing for the Core and Access Network elements, when the different cost drivers underscore that they should not be treated together in this regard. Further, the TSTT would point out that the Authority’s description of the market is significantly outdated. References to particular technologies allegedly in operation expose another key weakness of the Costing Methodology, and this Specification Paper specifically: that it is based on out-of-date information and is no longer reflective of the market it purports to emulate.	treat with the definition of particular, distinct treatments with respect to Core and Access Networks, as well as non-network facilities. The Authority should revert to first principles and review this document, and the Costing Methodology as a whole to ensure continued applicability and relevance to the marketplace, which has evolved significantly since this process began.	
4.2 Core network components	TSTT	The Authority has failed to acknowledge a fundamental concept of the implementation of Costing Models and Methodologies that Core and Access Networks, regardless of technology, are usually subject to distinct costing approaches. Core Network elements are	The distinction between Cost and Access Networks from a Cost Modelling perspective is required, in the Costing Methodology generally, but	TSTT is asked to provide the specific references to the Costing methodology which demonstrate how it is fundamentally flawed.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		deemed resources shared in the provision of services to distinct access network instances. As such, these costs are not directly allocatable to a particular customer, group of customers or services offered thereto. In the Core, costs are allocatable based on the probability of use. In that regard, there must be the clear delineation of the point of demarcation between the Core and Access Networks. The discussion offered by the Authority in this section does not achieve this fundamental definition. This persistent fundamental weakness undermines the entire process of Model definition, as the Model continues to presume the aggregated “economic thinning” of costing for the Core and Access Network elements, when the different cost drivers underscore that they should not be treated together in this regard. In going forward, in determining the appropriate approach to treatment of Core Network elements, and concepts such as the economic thinning of the shared resources, TSTT again implores the Authority to adopt procedures that facilitate transparent participation and cooperation of operators. Otherwise, these	also in this LRAIC Specification Paper. Without proper definition and demarcation this process is doomed to a stillborn conclusion. This consultation should be aborted until the Costing Methodology is reviewed to treat with the definition of particular, distinct treatments with respect to Core and Access Networks, as well as non-network facilities.	The Authority has clearly defined both core and access networks and has applied a transparent and recommended approach to cost causation to these networks.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		fundamental failings and contention related thereto will continue to delay the completion of this process, already almost a decade in continuance.		
Section 5				
5.2.1 Table 3	Digicel	TATT indicates that “Fixed Wireless... Driven by traffic only: Wireless and fibre based backhaul, routers, soft switches, etc.” Part of the costs of the fixed wireless network are driven to a significant extent by a need to provide access coverage of fixed line customers, and therefore part of the costs of the fixed wireless network should be driven by number of subscribers and not only driven by traffic as stated in table 3.	Digicel requests TATT to reconsider the allocation of fixed wireless costs in relation to coverage related (subscriber) costs, and to explain any change or no change to the model prior to finalizing the alpha phase.	“Coverage” costs of point to multi-point wireless networks, i.e. the fixed costs which would remain if (hypothetically) traffic were to be reduced towards zero, are effectively fixed and common costs of the network. These costs are not variable with respect to the number of customers and as such are not directly analogous to wire-line “access” networks. Under a LRIC+EPMU approach these fixed and common costs are recovered across variable costs. As the vast majority of variable cost in wireless

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				networks varies with traffic, rather than the number of subscribers served, the implicit coverage costs within the costs of the network are most appropriately recovered from traffic services. This is analogous to the treatment of costs in mobile networks where the cost of the radio access network is attributed to traffic services rather than to a notional access service. The Authority reminds Digicel that Table 3 differentiates between point-to-point/point-to-multipoint systems used to connect the customers and all other networks components in the fixed wireless access network (including, amongst others, routers and soft switches). The former is driven by the number of subscribers and the latter by traffic. Further, the Authority clarifies that incremental cost associated with fixed

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				wireless networks relates to traffic as the driver, based on the understanding that the network has met its coverage obligations which are of a predetermined limit. The network considered in the forward looking cost estimation is a fully built network. This would also avoid any double counting of costs where the incremental increase in network element cost would be primarily for capacity and not for coverage.
5.2.1 Fixed Access	CCTL	The Authority's approach to CATV access costing is unclear. On page 28, TATT states "Other technologies, such as point to multi-point wireless and HFC cable TV networks include an element of shared access in the access network since a number of customers shared a fixed amount of bandwidth. The costs of these network elements are however also driven to a significant extent by the need to provide 'coverage' of customers, i.e. the ability to connect potential customers." Yet, Table 3 indicates that the coaxial cable network will	Ensure that only Co-axial cable in drop is subscriber driven. Co-axial cable in the distribution and trunk network should be traffic driven. The optical node is not the demarcation point between the access and core network for a CATV system.	The Authority notes CCTL's disagreement on the drivers of co-axial cables and whether the optical node is the demarcation point between the access and core network. The Authority understands that modern HFC networks are commonly dimensioned using engineering rules that typically set a target value for the number of homes passed per

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		be attributed to numbers of subscribers. We disagree. It is true that the subscriber drop is subscriber driven; however, the coaxial cable capacity also appears in the trunk and distribution network. This capacity is traffic driven		optical node in order to provide an appropriate quality of service, particularly on the uplink. This means that the number of optical nodes and the cost of the co-axial cable from the optical node to the subscriber, will be driven by the number of homes passed and hence the number of subscribers. Co-axial cables have a fixed capacity and the cost of the cable will not vary depending on the amount of traffic carried over it and as such cannot be considered traffic sensitive. To the extent that co-axial cables are used in the trunk network, presumably these cables are used to provide CATV services rather than 2-way services and as such should not be allocated to services such as voice or broadband services. As such, the Authority understood that the

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				co-axial cable is part of the access network (i.e. between the optical node and the customer) and thus being subscriber driven. Further, there is a separate network component for fiber cables in the transmission /core network. These are traffic driven. The Authority trusts that the above clarification affords CCTL sufficient evidence for the demarcation point determined for use in the Model.
5.3 Definition of increments	CCTL	The Authority states that “... remote concentrators/switches, hybrid fibre coaxial (HFC) optical nodes and local switches which sit on the boundary between the core and access networks.” While we agree that the MDF at the remote concentrators and switches sit on the boundary of the core and access networks for traditional fixed networks, the optical node does not for CATV networks.	Revise approach to CATV cost allocation so that traffic drives co-axial cable capacity between the optical node and the subscriber drop.	See response to previous comment.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
Section 6				
6.1	Digicel	TATT says the model “excludes all direct costs relating to financing of the business and taxation, for example interest payments, foreign exchange gains/losses, taxation and the working capital associated with these cash flows.” Withholding or import taxes paid for network items should be included, either within the fixed asset register, or explicitly as mark-ups to capital equipment costs.	Digicel requests TATT’s confirmation that these costs should be included in the cost base used in the model.	The Authority confirms that as per IAS 16 (Property, Plant and Equipment), the treatment of components of costs for capital equipment costs should include the purchase price inclusive of import duties and non-refundable purchase taxes and should be included in the Fixed Asset Register. The LRAIC Specification Paper will be updated to reflect this.
6.4	Digicel	In our alpha review we believe that TATT may have applied inconsistent names to drivers allocating costs to cost centres (“Mobile location registers”, “MSCs”, “Base station subsystems”, “Transmission domestic (length)” and “Transmission domestic (capacity)”). For example, the same percentage distribution of opex among cost centres (0.3%, 90.7%, 9.0%, 0.0% and 0.0% respectively) seems to be referred to by TATT both as “GRCD6 GRC network in buildings” and “CVR6”. We found similar issues for other drivers: “NNED02 Workstations”,	In order to understand the model, Digicel requests TATT to provide a complete list of the cost drivers and CVRs used in the model, along with a written explanation for the percentage allocators for each CVR and cost driver. Digicel requests that TATT	The CVRs are defined with the potential to include both increment specific fixed cost (ISFCs) and relevant volume driver. So for example CVR6 has four potential inputs: GRCD6 GRC network in buildings FA Fixed access MC Mobile core FN Fixed network The last three inputs reflect potential ISFCs but these have been set to zero in the

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		"OCD01 total costs", "OCD01 total costs", "EDO1 employees", "EDO1 employees total", "ED 01 employees total", "GRCD02 GRC network", "GRC powered network", "GRCD5 powered network", "GRCD02", "GRCD02 GRC network", "GRCD02 GRC network", "GRC D02 GRC network"	explains where CVR and cost driver percentages are based on Digicel's submitted data, and any processing of that data undertaken by TATT to reach the applied proportions in the model. This is so that Digicel can verify the proportions applied, and if required, submit new data to determine up-to-date driver proportions.	absence of information on ISFCs. As a result the only non-zero input is GRCD6 which related to the gross replacement cost of equipment typically housed in buildings. The percentages quoted are derived endogenously in the model based on the Gross Replacement Costs calculated in the CCA model. This data, and data on employee numbers and costs, is combined with data on the "Employee and GRC Subsets" sheet to estimate the drivers.
6.5 CVRs	CCTL	The Authority states that "In order to simplify the information requirements and the calculation, the Authority has made the assumption that all CVRs are linear with a fixed cost [(C) above]. The input data for CVRs of this form is reduced to the percentage of the cost that can be avoided when the relevant cost driver has zero value, i.e. the intercept with the Y-axis." While we welcome simplifications in order to arrive at cost-based interconnection rates as soon as reasonably possible, this revision in the approach to CVRs is significant, and we will only be able to assess the impact	Allow operators, whose finances are materially impacted by the rates charged by other operators, to vet the models to assess the impact of the new approach to CVRs. Revise Costing Methodology to be consistent with simplified approach taken with specifications.	The Authority is constrained by confidentiality agreements with operators. As this was also reiterated at the start of the development of the cost model, the Authority must uphold such commitments. The Authority takes note of the comment on the use of specific models for determining CVRs and will amend the LRAIC Specification Paper to reflect the practical measures for

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		when we are given adequate time to review a properly populated model. Furthermore, this approach is inconsistent with the Costing Methodology which states that <i>"The Authority shall require concessionaires to use engineering models and activity based costing in the determination of Cost Volume Relationships."</i>		determining CVRs, which became evident in the model runs and data gathering phases.
6.7	Digicel	The report states two increments for the domestic transmission network which seems correct, however the implementation is not correct. In some occasions the data provided by Digicel has not been taken into account in the model, the capacity figure provided by Digicel for "transmission to another network in Trinidad" has been adjusted by TATT. Digicel reported 333 E1 but the model contains only 249.75 E1.	Digicel requests that TATT investigates the transmission allocation and explains the adjustments and rationale for revising Digicel's input data prior to finalizing the alpha phase. Digicel requests that TATT explains whether the model is correct or if it requires revisions to perform the transmission allocation correctly, along with any further explanation of the appropriate data which should be submitted by Digicel prior to finalizing the alpha phase.	This relates to the need to convert Digicel's input data from 333 T1s to E1s, resulting in 249.75 E1 [i.e. $333 \times 1.5\text{Mbps} / 2\text{Mbps}$]. This calculation is performed in Digicel's LRAIC modelling file [i.e. cell E22 in "Transmission allocation" sheet] and an explanatory note is included in a comment.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
6.7	Digicel	The report states two increments for the domestic transmission network which seems correct, however the implementation is not correct. To allocate the cost of transmission (by length and capacity) to network elements, the model uses Digicel inputs for “total capacity” and “total capacity by length” per network element. The elements “Transmission N2-N2”, “Transmission N2-N3”, “Transmission N3-N3”, “Transmission N3-N4” and “Transmission B3-B4” are assigned capacities by Digicel (E1 and E1/km respectively) and costs are allocated proportionally (TTD 21.6 million for these five elements, i.e. 28% of total transmission costs). However, these transmission elements relate to fixed infrastructure and do not re-appear in TATT’s routing matrix so that their transmission costs do not flow through to the model’s results.	Digicel recommends TATT investigates whether the model is set up with correct transmission allocations and to confirm any corrections to the model or corrections required in order to input data prior to finalizing the alpha phase.	The Authority confirms that there are no routing factors and usage factors implemented for the transmission elements in the fixed network as Digicel does not provide fixed services. To the degree that these transmission elements are used by Digicel for the provision of mobile services then they should be re-classified by Digicel to one of the mobile transmission network elements in future submissions. In the event that Digicel cannot provide the alternative data, the Authority can extend the LRAIC model to include a common core transmission network element.
6.8.3	Digicel	TATT say “In order to convert network usage to a consistent basis, conversion factors are applied.” During the alpha testing session, in some cases we	Digicel requests TATT to provide a further explanation on the conversion factors applied in the model.	The conversion factors in the LRAIC model were based on the technologies used by concessionaires at the time of the initial

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		found that the conversion factors were not calculated according to today's best practices and even missing for some services.		model development. The Authority understands that there may have been significant changes in both the demand side and supply side since then and the conversion factors should be updated to reflect this, bearing in mind the need to maintain internal consistency within the LRAIC model and consistency in treatment of similar networks. As these conversion factors are dependent on the technology being used by the concessionaires and will change over time they should be provided, with suitable justification, by the concessionaires based on an outlined approach set out in the revised LRAIC Specification Paper.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
Section 7				
7.1.2 Recovery of cost components across services <i>“In the case of CATV networks we propose to consider the co-axial network and CPE to be subscriber sensitive (i.e. the cost of the network is partially dependent on the number of subscribers but independent of traffic) with the remaining network components assumed to be subscriber sensitive.”</i>	<i>TSTT</i>	The highlighted section in the quoted texts seems to underscore the challenge the Authority faces: the continued reticence to address TSTT's requests for the inclusion of critical definitions may be explained as the Authority seems unable to even describe the medium for connectivity to the cable network, and the associated necessary network elements. Can the Authority clarify which elements are deemed “subscriber sensitive” and which are not? Can the Authority then concede that where an network element is deemed subscriber sensitive that it would be subject to different reduction analyses that an element that is sensitive to another cost driver (such as volume)? TSTT notes with some interest the internal inconsistency with the quoted statement from page 44, and the apparent description of the way forward in the excerpted statements from page 45. Based on the two quotes from page 45, TSTT wonders when would a CVR be required?	The Authority must define network elements properly if this process is to move forward. Thereafter the Authority must recognize the conceptual failing of treating elements of distinct networks with different cost drivers and investment profiles as similar. The Authority must acknowledge that in the light of its own vacillation on key principles that the Model is not a fit and proper tool for the objectives defined.	The Authority has judged the approach adopted for HFC networks to be appropriate and proportionate. The fact that HFC networks provide multiple traffic services is not directly relevant to the number of CVRs that are required, given that the attribution of network element costs to traffic services is largely a function of the element based costing approach, which is a characteristic of the LRAIC Model The Authority considers that all network elements have been defined appropriately (see, for example, the table on page 54/55), mapping CATV network components/elements to LRAIC asset categories). Concerning CVRs, as TSTT is aware, the Authority decided to streamline the

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
<i>Page 44:</i> <i>"the Authority has made the assumption that all CVRs are linear with a fixed cost [(C) above]."</i> <i>Page 45:</i> <i>"CVRs are not required for those cost categories driven by a single exogenous cost driver..."</i> <i>"...it is assumed that that CVRs for cost categories driven by endogenous cost drivers are linear with no fixed costs"</i>		When considered in the context of the deliberation at Section 7 of the document, it seems that the Authority has braved cognitive dissonance in its meandering seeking to exempt Cost Volume Relationship for HFC networks is noteworthy and is conceptually incongruence based on the principles outlined in the Costing Methodology. The HFC Network – where the same network elements are used to carry voice, data and CableTV signals - should be the baseline example of a network that requires the use of the CVR as it is defined. As the Authority itself says in the document, Core Networks are generally migrating to this service agnostic operation, and if the CVR is not applicable for HFC's the question arises why it would be relevant for other Network types, TDM or otherwise. Since the CVR framework is one of the three primary principles of the Costing Methodology then either the Methodology itself is flawed and needs revision, of this Model's application of the methodology's principles is flawed and it should be abandoned.	The Authority must revisit the Costing Methodology. In any case, the Authority must abandon this Model as not reflective of the Costing Methodology as it stands.	development of CVRs for the LRAIC modelling due to concessionaires' feedback on data availability. This is reflected in Section 6.5 and Annex 5 of the LRAIC Specification Paper. In particular: • Page 45 then sets out when CVRs are required for the LRAIC modelling – i.e., in order to minimize the resource requirements, CVRs are only required for cost categories driven by multiple cost drivers. • These CVRs will be linear with a fixed costs (as stated on page 44) • Table 12 in Annex 5 then sets out the 8 CVRs for which concessionaires will be required to provide inputs going forward The Authority notes TSTT's reference to the discussion on component cost recovery across services delivered over HFC networks in Section 7.1.2.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				However, as stated in Table 13 of Annex 5, a CVR for HFC networks has been developed (i.e., CVR08 HFC optical node). This is reflected in the revised Section 7.1.2 of the LRAIC Specification Paper.
7.2.1 Network Elements <i>“There will be no need for concessionaires only operating fixed wireless access networks to complete the CVR sheet.”</i>	TSTT	TSTT is astounded that the Authority would put forth such a flawed argument, and, despite evidence to the contrary in its own document seek to exempt yet another network model from adhering the CVR framework proposed by the Costing Methodology. First off, TSTT posits that the Authority’s overview of the generic fixed wireless access network is inherently flawed. This network, as proposed by the Authority would not allow the commercial provision of service. Just as the Authority proposes to estimate costs for the HLR and VLR in a mobile network’s switching costs, surely the Authority recognises that a pure BWA network operator would have to deploy authentication servers to limit its service provision to subscribers of its service? Further, surely the Authority would recognise	The Authority needs to do proper analysis of the architecture and operation of FWA networks. The Authority must revisit the Costing Methodology. In any case, the Authority must abandon this Model as not reflective of the Costing Methodology as it stands. The Authority must convene	Based on the experience to date and on proportionality , the Authority does not consider it necessary for CVRs to be provided for fixed wireless networks given the relatively low proportion of traffic carried by these technologies. Instead, and in line with Section 6.5, the Authority will inform CVRs based on international benchmarks. The Authority furthermore confirms that all costs reported by TSTT have been included in the model. This also includes costs for HLR or equivalent (see sheet “CCA_Model_Output”

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		that operators of such networks can deploy voice and/or video services based on their rudimentary architecture. Accordingly, surely the Authority would recognise that such operators could meet the criteria of a party providing more than one service to customers? In light of these obvious statements of potential TSTT must query the unfathomable position of the Authority to propose to exempt an entire model of operation from adhering to the CVR framework. This is all the more disconcerting since the CVR framework is one of the three primary principles of the Costing Methodology. Indeed, one may think that the Authority's decision in this regard seeks only to cynically regularise a clear shortfall in the architecture and structure of the Model as currently developed. To allay such concerns, the Authority must proceed through a process of transparency where all operators are given a better appreciation of the operation of the Model.	camera sessions with operators and stakeholders to elaborate on its decision making process so that there can be material deliberation on aspects of the Methodology and the Model which are still relevant going forward.	row 19)

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
Section 8				
8.3	Digicel	TATT says “This section of the model includes all of the numerical data used to populate the model including the base cost information, information on base volumes for calculation of drivers and CVR and VVR inputs” In the alpha-tested model, we have not identified any CVRs or VVRs, but there exists a driver named “CVR6” but not any VVR.	Digicel requests TATT to confirm whether CVRs and VVRs are used and, if applicable, to document how they are calculated prior to finalizing the alpha phase.	Based on the difficulties faced by operators in developing this data, most of the CVRs are calculated within the model. See comments above for more details on the calculation of CVRs. This can be considered consistent with international practice where the costing approach required has generally been simplified, for example with EIR in Ireland no longer required to produce LRIC regulatory cost statements. To the Authorities knowledge the only operator currently required to produce CVRs on an ongoing basis is BT PLC in the UK. The Authority confirms that no VVRs have been used in the LRAIC model. The LRAIC Specification Paper will be updated accordingly.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
8 LRAIC model calculation	TSTT	TSTT reserves the right to comment on this area since all the principles must be translated mathematically into the model. The Authority is aware that TSTT barely had time to inspect the integrity of the Model's calculations with respect to the proposals of the Methodology. Indeed, the Authority surely recalls that what little visibility was afforded TSTT, questions were raised that remain unanswered to this date. In this context, TSTT reiterates its call for the Authority to host joint camera sessions with operators to facilitate the appropriate robust scrutiny of the Model's interpretation of the Methodology's formulae. Recognising the commercial sensitivity of operators' data, the Authority could redact concessionaire's information when presenting the Model's functionality in these sessions. Pursuant to these working sessions, the Authority should undertake a properly constituted consultation in accordance with its procedures. Only then will the output of this process even tend to meet the confidence of concessionaires and stakeholders, and	TATT is well advised to have joint camera sessions. If necessary the Authority could redact concessionaires' data when presenting camera sessions. The Authority must conduct proper consultation on the model build procedure. As such this process should be scrapped and reinitiated when the proper foundation has been established.	The Authority disagrees with these comments and recommendations because: • The approach to costing and the model build process were heavily consulted upon with all operators. • Full access to the Model was extended to all operators, based on an approach to alpha testing which was discussed with operators and set out under "<i>Collaborative LRAIC Process for 2013</i>" between the Authority and concessionaires. dated 16th April 2013. • Operators were afforded additional sessions upon request. Access sessions were available for a period of five (5) months • The Authority wishes to confirm that these sessions were held on a face to face basis with each operator.

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
		have the credibility required for the Model to be used in regulatory decision making.		
Annex				
Annex 5	Digicel	TATT lists “Required CVRs ...CVR07 Masts and towers” During the Alpha Testing session, we have not identified any CVR07 for mast and towers.	Digicel requests TATT to investigate whether the model is missing any of the listed drivers, and to confirm and correctness or changes in the model prior to finalizing the alpha phase.	The Authority confirms that the CVR07 is contained in the LRAIC model. However, based on concessionaires’ feedback at the time on the relevant data required to estimate the inputs for this CVR, the Authority understood that these costs are to be modelled as fully variable with respect to the associated drivers (i.e., the volume of equipment located on masts and towers). The cost of towers will be partially variable with respect to the amount of equipment housed in the towers, for example an increased weight of antennae will increase costs. However determining the CVR would be a complex task. The Authority considers that this will not have a material impact on the results of the LRAIC model as the costs of the infrastructure will be recovered across the network elements using the

Document Sub-Section	Submission Made By: Stakeholder Category¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				infrastructure in proportion to incremental costs in either case. This also holds for CVR06.
Annex 6	Digicel	Table 13 lists the network services. Some services listed are not relevant today (e.g. Dial-up internet).	Digicel requests TATT to review the list of services and to remove any unnecessary services for today's market.	The Authority agrees in principle and these lists shall be updated periodically in the Model and reflected in the Specification Paper. Periodic reviews will be done in tandem with annual data collection and model population. Please note that the services listed under Table 13, are reflective of the data submitted by concessionaires in 2009 which includes Dial-up internet, which still exists in Trinidad and Tobago's market, to date.
Annex 6	Digicel	Table 13 lists the network services. Some services should be added to the list because they are highly relevant to today's market, e.g. Access to Ducts	Digicel requests TATT to review the list of services and to add new services which are relevant for today's wholesale and retail markets.	The Authority agrees in principle and these lists shall be updated periodically in the Model and reflected in the Specification paper. Periodic reviews will be done in tandem with annual data collection and

Document Sub-Section	Submission Made By: Stakeholder Category ¹⁵	Comments Received	Recommendations Made	TATT's Decisions
				model population.

