Telecommunications Authority of Trinidad and Tobago

The Long Run Average Incremental Cost (LRAIC) Data Request

For the LRAIC Model

July 2013

1   Introduction

In accordance with the Costing Methodology,[1] the Telecommunications Authority of Trinidad and Tobago (TATT) has developed a top-down long run average incremental cost (LRAIC) model of fixed and mobile networks in Trinidad and Tobago. Concessionaires are required to submit cost information and volume information as part of this process. This data request should be read in conjunction with the LRAIC Specification Paper[2]. The LRAIC Specification Paper sets out guidelines on the model's underlying principles and methodology and has been consulted upon by the Authority with all relevant concessionaires within the market.

Concessionaires are requested to submit information to TATT within six(6) months of their respective financial year end. Such information must include audited financial statements. As part of the LRAIC model data request, concessionaires are requested to submit information on:

- Operating costs and balance sheet items;

- External service volumes

- Usage and routing factors;

- Current number of employees, vehicles, power and floor space requirement; and

A Microsoft Excel spreadsheet template has been developed which sets out the data required for the LRAIC model as a pro forma.

TATT has issued a current cost accounting (CCA) data request separately to collect capital cost data. This also consists of an Excel data template and detailed guidelines.

The role of concessionaires is fundamental in ensuring that the model inputs, and ultimately the model results and any regulatory decisions based on the results thereafter, reflect the operating environment faced by concessionaires in Trinidad and Tobago. Data provided by concessionaires for the purposes of this study shall, in all instances, be treated as highly confidential and will not be made available to other concessionaires.

The rest of this section sets out an overview of the data collection process, the spreadsheet contents and some general guidance for completing the spreadsheet.

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[1]   "The costing methodology for the communications sector", TATT, 29 May 2008

[2]   "The Long-Run Average Incremental Cost (LRAIC) Model Specification Paper", TATT, 01 March 2010 and updated April 2012

This document sets out guidelines on completing each sheet and therefore follows the structure of the spreadsheet:

- Cover;

- Contact details;

- Labour costs and volumes;

- Other opex;

- Balance sheet items;

- Transmission allocation;

- Access allocation;

- Service volumes; and

- Routing factors.

Information on cost volume relationships (CVRs) and conversion factors will not be updated on an annual basis and thus do not form part of the annual data collection.

1.1   Overview of the data collection process

The table below summarises the next steps in the data collection process. This document represents the detailed data request.

Table 1. Overview of the data collection process

Stage	Role of the Authority	Role of concessionaire	Timeline
Issue of detailed data request	Issue LRAIC specification paper that sets out the requirements for the LRAIC modelling process and reflects the level of data available, the time scale for data collection and the LRAIC model requirements	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 LRAIC 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**

It is envisaged that concessionaires will need to work closely with TATT 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 TATT as soon as queries arise rather than waiting until the final deadline for submissions. After the initial submission of data, TATT may require a revised submission of data if there are errors or omissions in the data supplied.

2   Completing the data request

This section sets out:

- □   An overview of the spreadsheet contents; and

- □   General guidelines on completing the data request.

2.1   Overview of spreadsheet contents

The spreadsheet is split into a number of sheets with areas where concessionaires are required to provide data clearly highlighted in yellow (see Section 2.2 for more guidance on the formatting used). Short notes to provide concessionaires with guidance on how to complete the data request are also provided within the spreadsheet. The contents of the spreadsheet and the data requested are summarised in the table below.

Table 2. Data request contents

Sheet name	Description	Information requested from concessionaires
Cover	Version history, spreadsheet description (purpose and contents).	To update the version history table when submitting data to the Authority. To enter the time period the data relates to.
Contact_details	Contact details for the main people involved in the data collection should TATT require clarifications on data submitted.	To provide contact details for relevant staff.
Labour costs and volumes	Labour costs and volumes by department.	To provide total pay costs, number of employees, number of vehicles and number of computer workstations by department.
Other OPEX	Operating costs for assets and other activities.	To provide total operating costs for each of the categories listed.
Balance sheet items	Current assets and liabilities in the concessionaire's balance sheet.	To provide opening and closing values for the balance sheet items listed and to calculate year average values.
Transmission allocation	Data on the total capacity of transmission equipment in terms of links and length.	To provide data for each of the different transmission network elements, where relevant to the concessionaire.
Access allocation	Data on capacity allocated to broadband and voice services and capacity data for cable TV networks	To provide data on the (busy hour) capacity allocated to broadband and voice services and capacity data for cable TV networks.
Service volumes	Retail and wholesale volumes.	To provide volumes for fixed access, fixed call and mobile services.
Routing factors	Data on the average use of network elements by different call types.	To provide routing factors for fixed call and mobile services.

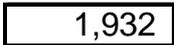## 2.2   General guidance for completing the spreadsheet

The spreadsheet has been developed so that it can be used by all concessionaires participating in the LRAIC modelling process. This means that it contains categories which may not be applicable to all concessionaires. Concessionaires are required to only provide data for the cost categories and services which are relevant to them.

A guide to the formatting used in the spreadsheet is presented below

Formatting guide

To assist concessionaires in providing the data required, the spreadsheet has been colour coded and annotated. The table below sets out a guide to the formatting used.

Table 3. Formatting guide

Formatting type	Example	Description
Input cells	*120*	Concessionaires are requested to enter data in these cells
Calculation cells	1,932	Cell values calculated by the spreadsheet - these cells should not be altered by concessionaires
Help cells	*Type description of asset*	Instructions and guidance notes for concessionaires

Source: Frontier Economics

Time period for data submission

The first request for data was made in the year 2010 and concessionaires were required to submit data for the reporting year that ended in the calendar year 2009. For example,

- concessionaires with April to March financial reporting years were required to submit data for the period April 2008 to March 2009 and

- for concessionaires with January to December reporting years, information was submitted for the period January 2009 to December 2009.

In this regard, upon annual request of the data by the Authority, concessionaires are required to provide information for the financial reporting period that ended in the calendar year previous from the year in which the request is being made.

All financial data, service volumes and operational data should be for the same period. For example, subscriber numbers should reflect the average number for the reporting year.

Further guidance

The LRAIC data request template is a generic template. As such, not all requested information may be relevant to each concessionaire. The Authority is happy to provide further guidance on what information is needed from each concessionaire.

Furthermore, certain parts of the LRAIC data request templates are focussed on mobile and fixed wireline network operations. In recognition of significant differences between these networks and, in particular, cable TV networks and fixed wireless network, annex 1 provides further guidance.

3   Cover

The "Cover" sheet of the spreadsheet provides general information about the contents of the spreadsheet and the data required from concessionaires.

The first table on this sheet is a version log. As described in Section 1, the data submission process may require the submission of revised information after the initial submission. Therefore, concessionaires are requested to enter in brief details of how versions of the data submitted vary from previous versions submitted. This will also help concessionaires to manage the data collection process internally.

Figure 1. Sample version log table

Date	User	Action
23-Feb-10	Jo Bloggs	Service volumes added

The remaining tables in this sheet set out:

- the spreadsheet purpose;

- spreadsheet contents (as set out in Table 2 above); and

- formatting guide (as set out in Table 3 above);

These tables do not require any input from concessionaires.

The table at the bottom of this sheet sets out the time period covered (this is used for labelling in other parts of the spreadsheet). Concessionaires are requested to enter the month in which their statutory reports start, from the drop-down menu (see the figure below) and to type in the year of the last reporting year.

Figure 2. Selecting starting month of reporting year

Source: Frontier Economics

4   Contact details

TATT requires contact details for key personnel should additional clarifications on the data submitted be required. Concessionaires should provide details (name, role, e-mail address and phone number) for a main point of contact in the "Contact details" sheet. Concessionaires should provide contact details for the people responsible for collecting financial information and technical network information where these people are different to the main point of contact.

Figure 3. Table for concessionaires to complete with contact detail information

Information required	Please type in yellow cells
Name	[First name] [Surname]
Concessionaire name	[Concessionaire X]
Role	[Job title/ description]
E-mail address	[e-mail address]
Phone number	[phone number]

5   Labour costs and volumes

Concessionaires are requested to enter the following data in the "Labour costs and volumes" sheet for each of the activities listed:

- ▫ All direct labour costs (including salaries, benefits and so on);

- ▫ Number of employees (full time equivalents – FTEs);

- ▫ Number of vehicles used; and

- ▫ Number of workstations used.

Figure 4. Extract from "Labour costs and volumes" sheet

Activity Category number	Activity category description	Notes	Total pay costs (TT$)	Number of employees (Full Time Equivalents)	Number of vehicles used (units)	Number of workstations (PCs/laptops)
NA01	Network executive management	Management of network activities and staff				
NA02	Network strategy, planning and procurement					

Source: Frontier Economics

5.1   Total pay costs

Concessionaires are requested to provide information on the total pay costs (including salaries, benefits and so on) for all staff including temporary staff and contractors split between each of the activity categories listed. This information should be available from the general ledger (GL). Costs should be entered in TT$ on an annual basis for the reporting year.

5.2   Number of employees

Concessionaires are requested to provide information on the average number of full-time employees (FTEs) including temporary staff and contractors working in each activity category during the reporting year. This may be estimated using company organisation charts. Where concessionaires are unable to provide the level of disaggregation required, concessionaires are requested to provide information on the total number of employees. These will then be allocated to the different activity categories in proportion to total pay costs.

5.3   Number of vehicles used

Concessionaires are requested to provide information on the average number of vehicles used by the staff in each work activity category during the reporting year. Where concessionaires are unable to provide the level of disaggregation required,

concessionaires are requested to provide information on the total number of vehicles. These will then be allocated to the different activity categories in proportion to the number of FTEs.

5.4   Number of workstations

Concessionaires are requested to provide information on the average number of computer workstations (PCs and laptops) used by the staff in each activity category during the reporting year. Where concessionaires are unable to provide the level of disaggregation required, concessionaires are requested to provide information on the total number of workstations. These will then be allocated to the different activity categories in proportion to the number of FTEs.

6   Other opex

For each of the categories listed, concessionaires are requested to provide information on the operating costs in the "Other OPEX" sheet.   This information should be available from the general ledger (GL). Costs should be expressed on an annual basis in TT$ for the reporting year.

Figure 5. Extract from the "Other OPEX" sheet

Operational expenditure

OPEX category number	OPEX category description	Notes	Total Opex (TT$)
NET01	Utilities (energy and fuel)	Energy, fuel and other utilities required for network equipment	
NET02	Site rental costs	Rental of sites for buildings and external equipment	
NET03	Network maintenance fees	Fees for 3rd party maintenance of equipment	
NET04	Frequency fees	Fees for usage of frequency	

Source: Frontier Economics

7   Balance sheet items

For each of the balance sheet items listed in the "Balance sheet items" sheet, concessionaires are requested to provide information on the year's opening and closing values. Concessionaires should inform TATT if the annual average for items is believed to be materially different from a simple average of the opening and closing values.

Figure 6. Current assets and liabilities

Current assets and liabilities

Balance sheet category number	Balance sheet category description	Notes	Opening value (TT$)	Closing value (TT$)	Average value in year (TT$)
BS01	Cash and cash equivalents				
BS02	Investments				
BS03	Inventory - Network				
BS04	Inventory - Non Network				
BS05	AR - Wholesale				
BS06	AR - Retail				
BS07	Short term loans				
BS08	AP - Employees				
BS09	AP - Trade Creditors				
BS10	Provisions				
BS11	Vat Payable				
BS12	Vat Receivable				
BS13	Deferred Income				
BS14					
BS15					

Source: Frontier Economics

8   Transmission allocation

Concessionaires are requested to enter information on how transmission capacity is split between different network elements in the "Transmission allocation" sheet.

As described in the LRAIC Specification Paper, there are two types of transmission equipment. The first is capacity dependent domestic transmission which consists of network components for which the cost is dependent on the number and capacity of links but largely independent of the length of links. Examples include transmission terminal equipment and cross connects. The second is length dependent domestic transmission which consists of network components for which the cost is dependent on the length of links they serve (which may also be dependent on the number and capacity of links). Examples include fiber cables and the duct which houses the cables.

For each of the network elements listed in this sheet, concessionaires are requested to provide details of the total capacity (in T1 equivalents or E1 equivalents as appropriate) and the total length (in T1/E1 km equivalents, for example, a T 1 link of 10km length should be recorded as 10 T1 km equivalents).

The figure below provides an extract from the "Transmission allocation" sheet.

Figure 7. Transmission allocation

Network element number	Network element description	Notes	Total capacity (T1/E1 equivalents)	Total capacity by length (T1/E1 km equivalents)
TR-BSS	BSS transmission	Backhaul from BTS to BSC		
TR-BSS-MSC	BSS-MSC transmission	Voice and SMS transmission between BSC and MSC		
TR-MSC-MSC	MSC-MSC transmission	Voice and SMS transmission between MSCs		
TR-MPD	MPD transmission	Mobile packet data transmission		

Source: Frontier Economics

The majority of the entries in the transmission allocation sheet are directed at those concessionaires who operate complex core transmission networks supporting hierarchical switching networks, for example, the incumbent's wire line network or mobile networks. Other concessionaires will only need to enter data in a small number of rows, for example detailing transmission links to other network. To facilitate navigation through the sheet, separate tables for each network type are presented.

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 are requested to provide data on the costs of the related transmission equipment separately and to provide separate allocations in the 'Transmission Allocation' sheet of the LRIC data request.

9   Access allocation

This sheet is only relevant to those concessionaires operating a cable TV network and those providing voice over IP (VoIP) services.

Concessionaires are required to provide information on the total capacity available and the portion of this capacity used for television, broadband and/or voice (VoIP) services.

Separate tables are provided for the required information on cable TV access networks and VoIP and broadband services.

Figure 8. Access allocation – Cable TV access network allocation tables

Service type	Units	Infrastructure used	
		km of duct	km of fibre pair
Co-axial network	Number of channels (downstream)		
Optical node to distribution hub	Number of channels (downstream)		
Transport Ring (head end to distribution hubs)	Capacity (Mbit/s)		

Service type	Units	Capacity used by application	
		Broadcast television and NVOD	IP (broadband/voice/ VOD)
Co-axial network	Total number of channels (downlink & uplink)		
Optical node to distribution hub	Total number of channels (downlink & uplink)		
Transport Ring (head end to distribution hubs)	Capacity (Mbit/s)		

Source: Frontier Economics

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/VoIP subscribers on the network should reflect the average number during the year.

For non-voice services, concessionaires need to provide information on the average (busy hour) capacity used for broadband services (including IPTV services, where relevant) and the number of subscribers.

Figure 9. Access allocation – VoIP and broadband allocation table

Parameter	Units	Downstream access network	Upstream access network
Voice codec rate	kbit/s		
Busy hour calling rate	Erlangs		
Number of voice subscribers	Thousands		
Busy hour voice capacity	Mbit/s	0	0

Parameter	Units	Downstream access network	Upstream access network
Busy hour broadband capacity (incl. IPTV)	per subscriber		
Number of broadband (incl. IPTV) subscribers	Thousands		

Source: Frontier Economics

10   Service volumes

Concessionaires are requested to provide annual volumes for the services listed in the "Service volumes" sheet of the data request using the units specified. For calls, volumes should be calculated based on call duration on a per second basis (in other words, there should be no rounding of minutes) and recorded in minutes.

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.

11   Routing factors

Concessionaires are requested to provide routing factors for each of the call types listed in the "Routing factors" sheet.

Routing factors are used to describe the way in which a call makes use of different network elements. Concessionaires are requested to provide routing factors for each of the network services listed in this sheet.

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 10. Simplified network diagram
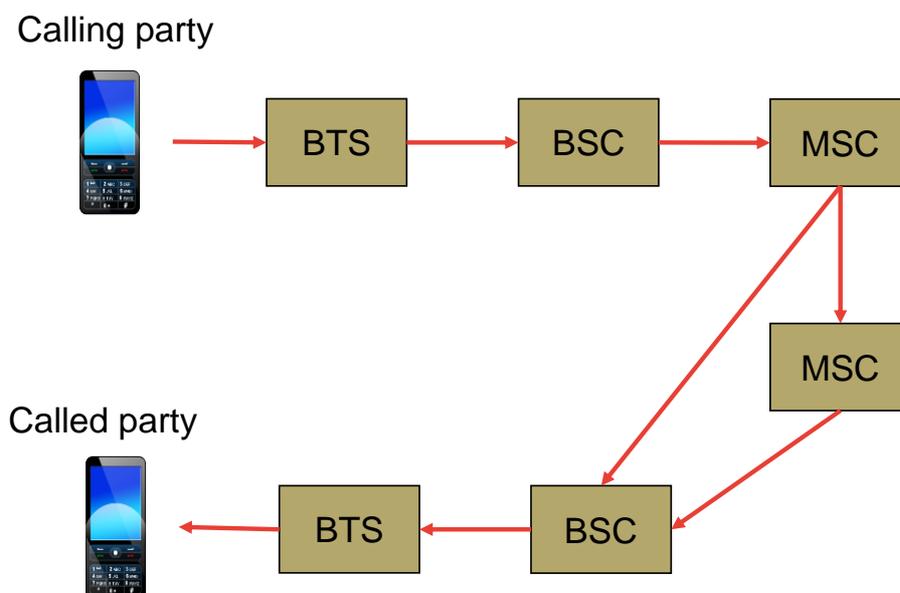
Source: Frontier Economics

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

This information should be readily available from concessionaires' network engineers as this information is typically used for network planning purposes.

Annexe 1: Technology specific guidance

## Treatment of CATV network assets in the data request

Below we outline our proposed treatment of CATV network assets, including:

- a mapping CATV networks to the asset categories;

- how to recover cost components across services; and

Mapping CATV networks to the asset categories

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

Figure 11. Overview of HFC Infrastructure
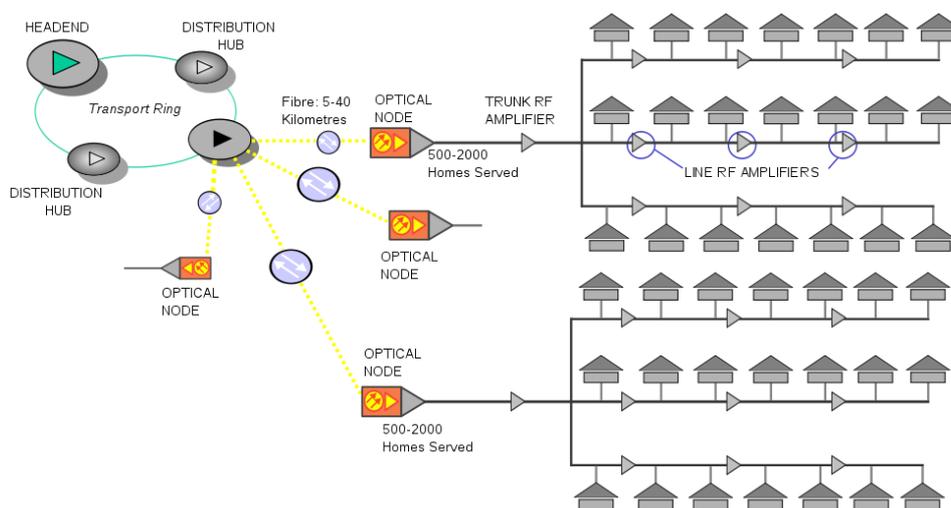
Source: Wikipedia

We assume 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.

Table 5. 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 nodes/Distribution hubs, head ends and core	ACI012	Fibre cables (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

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 elements must be attributed across the services that use the network element.

For network elements used by both voice and data services, the approach in the LRAIC modelling tool is to convert annual voice minutes to an equivalent peak bandwidth, based on the bandwidth required by the voice codec and the distribution of traffic in the year (i.e. a 'bottom-up' approach). This can then be used along with an estimate of the combined usage by broadband customers, and other applications such as television, to allocate the costs of elements across

services. This could be supplemented or replaced by 'top down' information from CCTL on the relative usage of particular network components by the different services.

The table below sets out Frontier's view on how costs should be attributed to services.

Table 6. Allocation of CATV network elements to services

Network element	Services recovered from	Attribution method	Notes
CPE - Fixed	Monthly subscription fee	Direct to subscribers	Where CPE owned and maintained by the concessionaire
Co-axial cable	Monthly subscription fee	Direct to subscribers	'Co-axial cables' and 'local loop poles' assumed to be incremental to number of subscribers but independent of service (traffic) volume
HFC Optical node	Television, broadband and voice	Combination of channels used (as between TV and other services) and bandwidth (as between VoIP and broadband services)	
Fibre cables (core)	Television, broadband and voice	Allocated to network elements on the basis of capacity on the core network	Network elements common to broadband and voice then allocated on the basis of routing tables and conversion factors
Cable headend equipment - Telephony	Voice only	Direct allocation to voice services	
Cable headend equipment - DOCSIS receiver	Broadband only	Direct allocation to voice services	
Cable headend equipment - television broadcast	Television only	Direct allocation to voice services	
Duct	Television, broadband and voice	If used for both core and access, allocated to network elements on the basis of GRC of cables (copper and fibre)	Network elements common to broadband and voice then allocated on the basis of routing tables and conversion factors
Transmission infrastructure	Television, broadband and voice	Allocated to network elements on the basis of relevant share in total GRC	Network elements common to broadband and voice then allocated on the basis of routing tables and conversion factors
Network buildings	Television, broadband and voice	Allocated to network elements on the basis of relevant share in	Network elements common to broadband and voice then allocated

		total GRC	on the basis of routing tables and conversion factors
Network land	Television, broadband and voice	Allocated to network elements on the basis of relevant share in total GRC	Network elements common to broadband and voice then allocated on the basis of routing tables and conversion factors
Motor vehicles - network	Television, broadband and voice	Allocated to network elements on the basis of relevant share in total GRC	Network elements common to broadband and voice then allocated on the basis of routing tables and conversion factors
Masts & towers	Television only	Direct allocation to television services	

Source: Frontier Economics

Access allocation

The 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 (see Section 9 above).

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 9 above).

Routing factors and CVRs

In general, given the relatively flat network hierarchy, routing factors should be relatively straightforward (i.e. either 1 or 0). Furthermore it is not necessary for concessionaires operating CATV networks to provide information on Cost Volume Relationships (CVRs).

Fixed Wireless Access Networks

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

Figure 12. Fixed wireless network structure
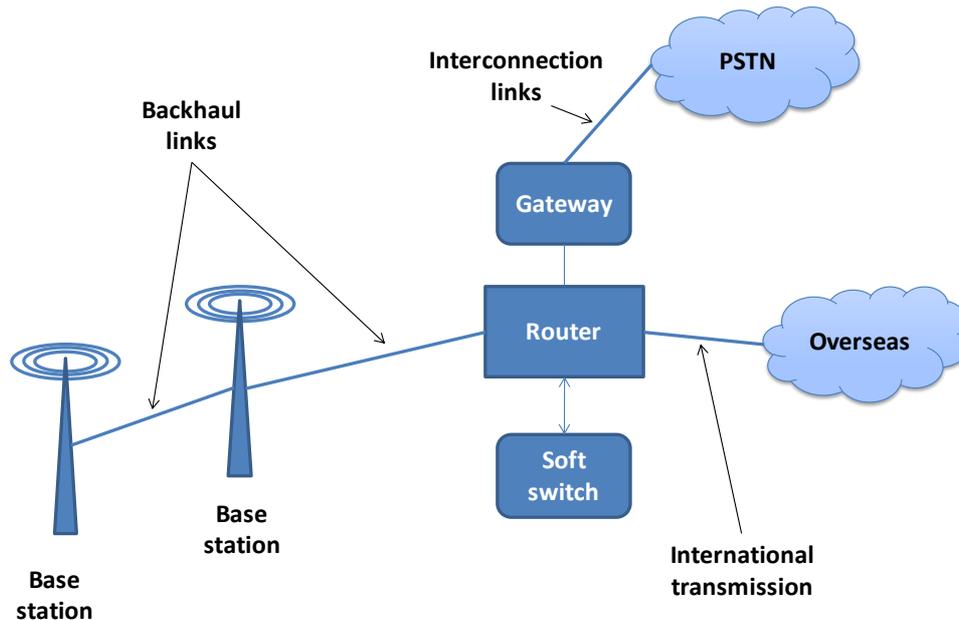
Source: Frontier

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 than 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 with 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. Broadband, voice and IPTV traffic may be delivered over the common (IP-based) radio network. The cost allocation will attempt to allocate the costs of the radio network based on the usage of the network by the different services.

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. Internet traffic to and from the access network will then be routed to the Internet.

The simple structure of fixed wireless networks is reflected in the LRAIC modelling for these concessionaires and resulting information requests. Note the Authority's CCA and LRAIC data request templates sent to concessionaires represent generic templates aiming to cover all network structures and technologies currently deployed in Trinidad and Tobago. As such, not all information may be relevant to/required from each concessionaire. Below we provide further guidance on the LRAIC modelling of fixed wireless networks and the resulting information required for concessionaires operating fixed wireless networks.

LRAIC modelling of FWA networks

Key outputs of the LRAIC modelling process are unit cost estimates for each service provided by concessionaires. Determining these LRAIC unit service cost estimates requires allocating costs to individual services. This is undertaken in three main allocation steps:

1. Grouping relevant items in the concessionaire's fixed asset register (FAR) into CCA asset categories in order to map these to network components

2. Allocating asset categories to network elements

3. Allocating network elements to services (i.e. determining how network element costs are recovered across services)

Step 1: Mapping FAR data to network segments

As an initial step all items in the concessionaire's FAR need to be allocated to CCA asset categories in order to map these to network segments (as well as to re-value the cost of each asset categories from historic to current costs).

Table 1 sets out the proposed mapping of the CCA asset categories to network components for concessionaires operating a fixed wireless network. Note, not all concessionaires may have installed all asset categories listed below. Further, any FAR entries relating to base stations, base station controllers and associated backhaul links should be allocated to "Point to Point wireless" (ACF013) or "Point to multi-point wireless" (ACF014) in the CCA data request template.

Table 7. Mapping of the CCA asset categories to network components

Network components	CCA asset categories
Core network	• Cable headend equipment - television broadcast • Fibre cables (core) • Duct • Masts& towers • Transmission Infrastructure • Microwave transmission equipment (core) • Packet switched router • VOIP soft switch or media gateway
Access network	• Point to point wireless • Point to multi-point wireless • Customer premise equipment – fixed
General network	• Network management system • Power equipment • Motor vehicles - network • Network management • Network buildings • Network land • Motor vehicles – network
Overheads	• Furniture and office equipment • IT /General purpose computers • Billing system • Land - non network • Non-network buildings • Other work equipment (tools, testing and training) • Vehicles - non-network • Marketing, retail, customer support • Billing system • Customer management system

Whereas all core and access network related CCA asset categories can be directly allocated to network elements (see Step 2 below), "general network" and "overheads" need to be attributed to network elements by identifying appropriate drivers.

Step 2: Treatment of network elements

As a second step within the cost allocation process, asset categories are mapped to network elements. There are three mapping options.

- For some access and core network related asset category there is a one-to-one mapping to a network element. This includes the "Packet switched router", "VOIP soft switch or media gateway" and "Customer premise equipment - fixed" asset categories, set out in Table 1 above.

- For all remaining access and core network related asset categories, there is a many-to-one mapping. For example, the "Point to point wireless" and "Point to multi-point wireless" access network related asset categories are mapped to a single 'Fixed network (wireless)" network element.

- For general network related access categories there is a one-to-many mapping. For example, the "Power equipment" and "Motor vehicle – network" categories are allocated across all core and access network elements relevant to the specific concessionaire.

To facilitate the allocation process to network elements, concessionaires are required to provide further information on the transmission links installed in their networks as part of the 'Transmission Allocation' sheet of the LRAIC data request template. This is further discussed below.

Transmission allocation

Within this sheet of the LRAIC data request all concessionaires are required to provide information on the total capacity and total capacity distance of the transmission links installed in their networks.

The majority of the entries in this sheet are directed at those concessionaires who operate complex core transmission networks supporting hierarchical switching networks, for example the incumbent wireline network or mobile networks. Other concessionaires, including those operating FWA networks will only need to enter data in a small number of rows, for example detailing transmission links to other network.

The table below provides further guidance on the Authority's view on how the transmission related network elements of FWA networks should be treated in the LRAIC data request template.

Table 8. Further guidance on the treatment of selected FWA network elements in the 'Transmission Allocation' sheet

Network Element	Components include	Notes
Access network	Backhaul links in FWA network	Transmission capacity for backhaul from fixed wireless access base stations to core network should be identified in sheet 'Transmission allocation' in category 'TR-FWA'
Television transmission	Transmission links for broadcasting and TV traffic	Transmission capacity for broadcast television transmission (excluding IPTV) not shared with the common IP network should be identified in sheet 'Transmission allocation' in category 'TR-TV'
Interconnection	Gateway Interconnection links	Interconnection links with other concessionaires should be identified in the sheet 'Transmission allocation' in category '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'

Step 3: Allocating network elements to services

As a final step, network elements costs are allocated to individual services. Given the converged nature of most networks deployed by concessionaries, the costs of network elements must be attributed across the various services that use the relevant element.

There are three specific sheets within the LRAIC data request template which contain information to facilitate the service costing exercise. These are discussed in turn, with particular focus on the information required from concessionaires operating a fixed wireless network.

Access allocation

Converged networks, which may include a FWA network, are used to deliver television, broadband and voice (VoIP) services. The associated costs therefore need to be recovered across all these service.

In order to allocate the costs of the shared access network between the various applications the Authority uses information on the total capacity available and the portion of this capacity used for each service. The sheet 'Access Allocation' in the LRAIC data request template is intended to collect this information (see Section 9 above).

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/VoIP subscribers on the network should reflect the average number during the year.

For non-voice services, concessionaires need to provide information on the average (busy hour) capacity used for broadband services (including IPTV services).

Routing factors

Routing factors are used to describe the way in which a call makes use of different network elements. They are used within the LRAIC model to inform the allocation of costs to individual services.

All concessionaires, including those operating FWA networks, are requested to provide routing factors for each of the relevant network services listed in the 'Routing factors' sheet (see Section 11 above). This information should be readily available from concessionaires' network engineers as this information is typically used for network planning purposes.

In general, given the relatively flat hierarchy of FWA networks, routing factors should be relatively straightforward (i.e. either 1 or 0). The table below provides

further guidance on the treatment of selected network elements commonly used by FWA operators within the 'Routing Factors' sheet.

Table 9. Further guidance on the treatment of FWA network elements in 'Routing Factors' sheet

Network Element	Components include	Notes
Router	Router	Use of router identified in sheet 'Routing factors' as network element 'Packet switched router (N3)'
Soft switch	Soft switch	Use of soft switches identified in sheet 'Routing factors' as network element 'VOIP soft switch or media gateway (VOIP)'
Interconnection	Interconnection links	Use of interconnection link identified in sheet 'Routing factors' as network element 'Transmission interconnection links (TR-IX)'
Overseas transmission	Transmission links for voice and data traffic	Use of international transmission links identified in sheet 'Routing factors' as network element 'Transmission international (TR-INT)'

Service volumes

Concessionaires are requested to provide annual volumes for each access and call service they currently provide, listed in the "Service volumes" sheet of the LRAIC data request using the units specified (see Section 10 above).

In case of concessionaires operating a fixed wireless network, the Authority expects these to cover one or more of the following services:

- FAS03 - Broadband access line (asymmetric);

- FAS04 - Broadcast television subscriber;

- FAS05 - Metro ethernet access;

- Selected retail call services (FCS01 to FCS06); and/or

- Selected wholesale call services (FCS07 to FCS13).