FLLRIC Model for the Cayman Islands
Fixed Network Document Draft Costing Manual

Cable & Wireless Cayman Islands

Submitted 10 March 2006

Table of Contents

FLLRIC Fixed Network Model

1. Introduction

1. This document is the second part of a revised version of a draft LRIC costing manual, which C&W submitted on 14 December 2005 fulfilling requirements set out in the Authority's *Public Consultation on Costing Manual* (CD 2005-1), dated 27 October 2005, to submit a draft LRIC costing manual. That draft and this revised LRIC costing manual, as required by the Authority, includes

    a) our proposed costing manual along with supporting rationale and explanations;

    b) two example costing studies developed using this manual, the first being mobile termination service, the second being the residential fixed line access service;

    c) our proposal on how to allocate common costs, proposed determination and level of expense factors, and proposed economic asset lives;

    d) additional information from other jurisdictions where competition exists regarding the determination and level of expense factors as well as any information supporting the applicability of such factors to the Cayman Islands; and

    e) any supporting asset life studies used in developing its proposed economic asset lives.

2. The original draft costing manual also include two WACCs proposed for use in the fixed and mobile network models, respectively.

3. This revised version reflects the the Authority's revised process determination of 8 February 2006, which in addition to the above, requires C&W to file the costing models. With this additional requirement, C&W has had to expand its written submission to tie the documents more closely to the model. We have also used the intervening time to:

    a. gather more evidence with respect to expense factors,

    b. provide an alternative method of allocating fixed and common costs, and

    c. correct a number of typographical errors and make a number of clarifications to the original text.

4. This revised submission is divided into five parts:

   a. The Background Document:

   - explains our understanding of the principles and guidelines set out in the Authority *Decision for the Forward-looking Long-Run Incremental Costing Consultation* (ICT Decision 2005-4);

   - describes the overall methodological approach and treats issues common to both the fixed and mobile issues, including the cost of capital, expense factors, asset lives and treatment of retail costs; and

   - provides definitions for terms and acronyms used in the other parts of the submission.

   b. The Fixed Network Model Manual, which describes the structure and functioning of the fixed network model. The Manual includes a Retail Case study—Residential Fixed Line Service, which traces the inputs and calculations of costs relevant to the retail residential fixed line service to identify how outputs are determined.

   c. The Mobile Network Model Manual, which describes the structure and functioning of the mobile network model. The Manual includes an Interconnection Case study--Mobile termination, which traces the inputs and calculations of costs relevant to mobile termination to identify how outputs are determined.

   d. The cost separations methodology, which describes how the inputs to the expense factor analysis were developed.

   e. The LRIC models themselves, which are comprised of four modules: i) bottom-up fixed network model; ii) the bottom-up mobile network model; and iii) a consolidation module for presenting results and reports. As explained below, C&W has generated two versions of the LRIC models—a confidential version that it has submitted to the authority and a non-confidential version that it has submitted to other interested parties in the proceeding.

5. This document describes the structure and function of the LRIC Fixed Network model. The services, assumptions and calculations are identified. Appendices are provided which contain the template input and workings sheets. The manual concludes with a case study that demonstrates how the inputs flow through the model to determine incremental costs.

6. In the figure below we have grouped the fixed services in the model into different groups, retail and wholesale.

- Retail services are offered to end users, and can be grouped into access, domestic and international voice, domestic and international data and other.
- Wholesale services are offered by the modeled network operator to other operators and resellers.

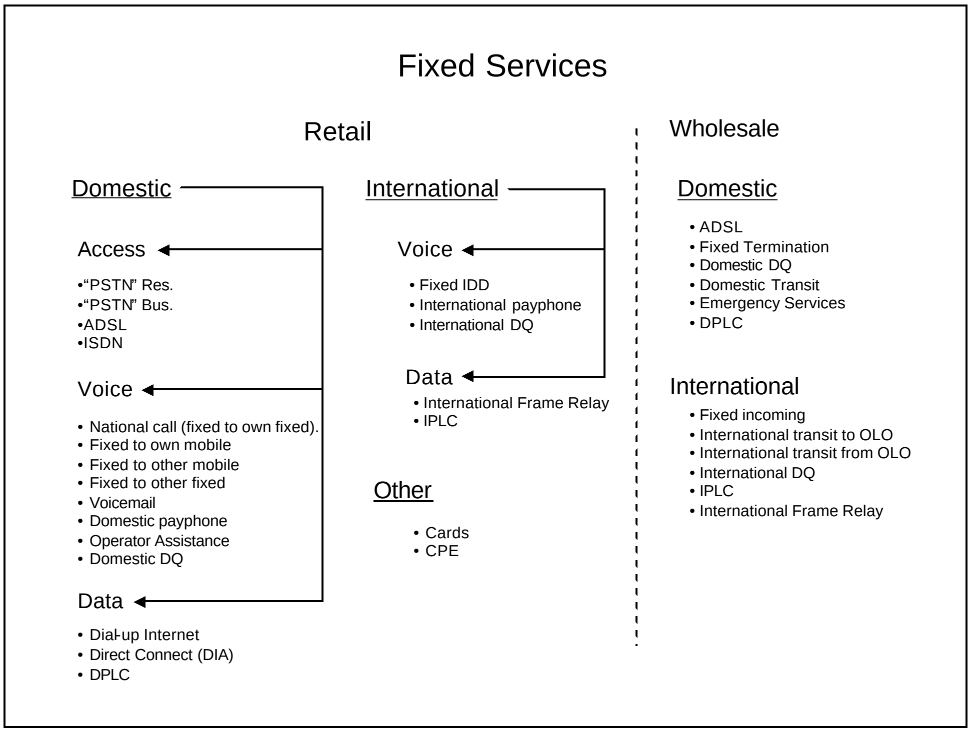


Figure 1 Fixed services in the LRIC model

2. Methodology

1. The fixed network that currently exists in Cayman is based on traditional technology, with a division into a core network and an access network (see figure 1 below, please note that this is a simplified structural representation and that the number of switches do not correspond to any actual network in the Cayman islands). The core network is based on circuit-switched technology, incorporating digital host switches and remote switching units and SDH transmission links. Originating and terminating internet traffic is routed through a broadband access server (BRAS). DSLAMs are located at the remote switching units.

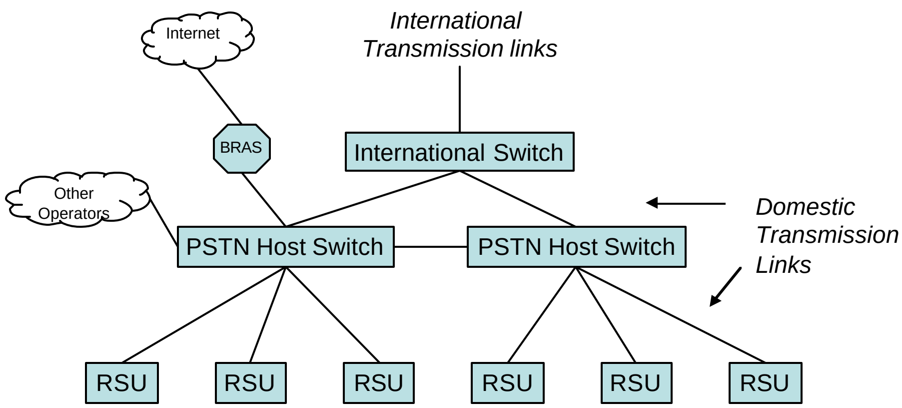


Figure 2 Core Network Architecture - Existing Network

2. The access network is based on copper multi-pair cables, both aerial and underground.

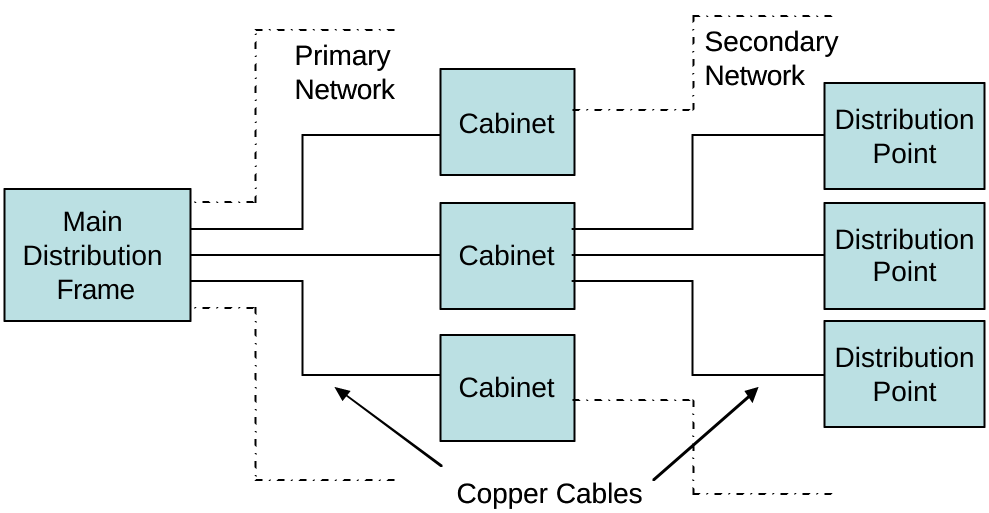


Figure 2 Access Network Architecture

3. The bottom-up model is constructed using the technology that an efficient operator would employ today. This means that there are some fundamental

differences in the modelled approach when compared with the existing network in Cayman. The key difference is next generation switching equipment is employed to provide a multi-service platform based in IP technology.

4. The implication of this in terms of equipment are that:

- existing PSTN remotes are replaced with voice/broadband-enabled IP concentrators supporting the existing range of services. These will be referred to Media Gateways (MGs) in this text. Please note that in the model we are retaining the RSU nomenclature for the network element;
- existing hosts switches are replaced with Mutltiservice Edge/Softswitch technology. Packet Voice Gateways are installed to allow interface with circuit-switched external networks;and,
- the core transmission network uses SDH Rings.
- the access network includes of DSLAMs at the Media Gateways.

5. The structure of the modelled core network is shown in the diagram below.

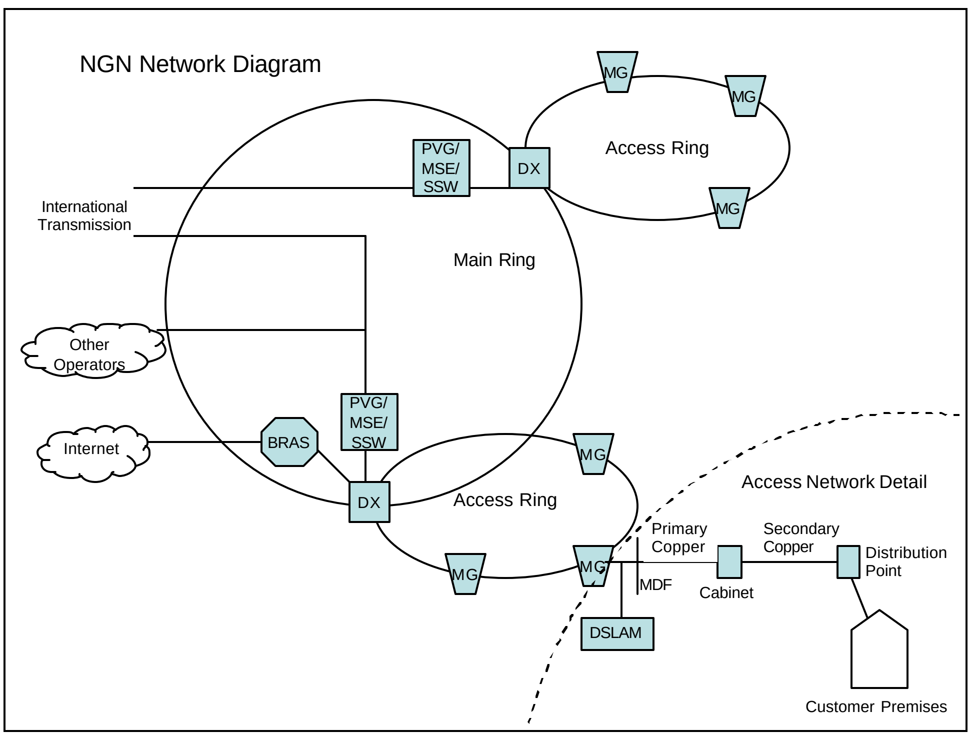


Figure 3 Core Network Architecture - Modelled Network

6. Although the IP technology is radically different to the traditional circuit switches, C&W Cayman plans indicate that the topological structure of the network in Cayman is likely to remain as it is today, with changes only in the type of equipment deployed at each node. As a result we have taken the same

approach to modelling the fixed network – which is also consistent with the scorched-node assumption that underpins the costing methodology.

7. There is therefore an equivalence between network components of the existing network, and network components in the modelled IP network as shown in the table below:

Existing Component	NGN Component
Access network cable and duct	No change
Core network fibre and duct	No change
Remote switching units	Media Gateways (MG) with DSLAMs
Host Switch with DSLAMs	IP Softswitch(SSW)/Multi-service Edge (MSE)/Packet Voice Gateway
International Switch	None

Description of Network Components

8. This section provides a description of the network components modelled.

Fixed Model - Access Network

9. The access network is based around a copper cable infrastructure and contains the following components:

- Copper multi-pair cables – these are used in a variety of sizes ranging from 6-pairs to 2000 pairs. Some of the cable is underground, either in ducts or directly buried, and some is aerial, mounted on poles.
- Joints – which provide the connections between the cables – they come in varying sizes according to the cable size.
- Manholes – these are use to provide access to cables joints for installation and maintenance purposes.
- Poles – these may be dedicated to the telecoms network, or may be shared with other utilities such as electricity.
- Duct – this provides an underground conduit for the cable. Some duct may be shared between the access and core networks.
- Distribution Points (DPs), Dropwires and Network Interface Devices – these provide the final link to the customer premises.

Fixed Model - Core Transmission

10. The core transmission network is based around optical fibre cables which may be either underground in ducts or aerial, supported on poles. The following components are used:

- Fibre Cables – these are provided in sizes ranging from 6 to 24 pairs.
- Fibre Joints – these provide the connections between separate lengths of fibre cable, and vary according to the size of cable jointed.
- Ducts, poles and manholes – these are shared with the access network.

11. It should be noted that the transmission network is based on traditional SDH equipment, in a resilient ring configuration. This provides a minimum of 1 STM1 link to each RSU. While in the future it may be possible to move to an optical Ethernet technology, giving greater circuit efficiency. However, Cable & Wireless plans involve the continued investment in SDH as a tried and tested approach which can be relied upon to give carrier-class quality of service.

Fixed Model - Switching

12. Media Gateway (MG) – this equipment connects to the copper access network, and provides the functionality for provision of voice and ISDN calls. ADSL services are provided via a collocated DSLAM unit.

13. Softswitch/Multi-Service Edge and Voice Packet Gateway – this equipment collocated and route calls between MGs, and provides the link between the IP infrastructure of the Cayman national network and outside networks.

Network dimensioning rules and assumptions

14. This section describes the rules and assumptions that underpin the dimensioning of the fixed and mobile networks.

Fixed Network - Access

15. For the access network, the cost driver is subscriber lines. By applying the scorched node assumption, we assume that all existing nodes in the access network will remain regardless of the driver volume. At the minimum point, when the driver volume is zero, we assume that there is a capability to provide a line to every customer via normal provisioning procedures. This implies the following at the minimum point:

- At least two pairs are provided to connect each distribution point.
- At least two pairs are provided to connect each cabinet (jumpering at the cabinet can then allow connection to the relevant DP).

- The ratio of aerial to underground cable is kept constant, as it is assumed that the geographical mix of customers does not change with changing volume.
- The total numbers of DPs and cabinets remains the same (scorched node assumption)

16. At the maximum point (i.e., where the volume driver is at the current levels of demand in the Cayman network), we assume that:

- The current lengths and sizes (i.e. pairs) of cable are appropriate to service the demand, including appropriate allowances for spare capacity.
- The current numbers of cabinets and poles are appropriate to service the demand.

17. In order to calculate the quantities of cables and joints to provide for particular levels of demand, the model interpolates between the minimum and maximum points, using the following method:

- Km length for each cable type remains the same (scorched node assumption)
- The size of each cable (ie number of pairs) is scaled according to the following formula: *Cable size = maximum point cable size * volume / max_volume*
- This size is then rounded up to the nearest standard cable size

Volume at Maximum	146,860	Volume Driver	50,000

Aerial Direct Feed	Pairs provided at maximum	km	Scaled pairs	Rounded pairs	Pair km at max point	Pair km at current volume
	6	6	2	6	34	34
	12	21	4	6	256	128
	18	36	6	12	656	437
	25	98	9	12	2,461	1181
	30	7	10	12	207	83
	37	15	13	18	571	278
	50	82	17	18	4,097	1475
	75	20	26	30	1,523	609
	100	90	34	37	8,974	3320
	150	34	51	75	5,055	2528
	200	129	68	75	25,790	9671
	300	83	102	150	24,915	12457
	400	44	136	150	17,787	6670

Figure 4 Access Dimensions Extract

18. The model extract above (from the “access calculations” sheet) gives an example illustrating how this works:

- In this example, the volume is set to 50,000 lines, compared with a maximum of 146,860 lines
- The first column shows the different sizes of cable at the maximum point
- The second column shows the km of each type
- The “scaled pairs” shows the new size of cable required when the volume is reduced to 50,000 lines
- The “rounded pairs” column shows the requirements using standard cable sizes

- The “pair km at maximum point” shows the pairs multiplied by km at the maximum point
- The “Pair km at current volume” shows the pairs multiplied by km at the volume of 50,000 lines.

19. So at the volume of 50,000 we have the same overall km of cable installed (as we still have to provide the same coverage to the cabinets and DPs), but the number of pairs in each cable length is reduced to service the reduced demand.

20. The same approach is used to dimension cables of the E-side and D-side, both for aerial and underground.

21. For cable joints, C&W data on the average separation of joints in a cable run is used to estimate the required number of joints of each type.

    The formula used is:
    Number of joints = cable km / average separation

22. For manholes and poles, the quantities are assumed to remain constant as they will be needed to provide coverage, regardless of the volume demand.

Fixed Network - Transmission

23. For the core transmission network, the quantities of fibre cable and associated joints are assumed to remain constant, as all the cable will be needed to provide connectivity regardless of the traffic demand.

24. The dimensions are therefore built up from C&W data, which breaks down the cables by type (i.e. number of pairs and underground/overhead) and gives the km length of each type.

Fixed Network – Submarine Transmission

25. Cayman currently makes use of a variety of submarine cable systems to provide international connectivity for voice and data. In order to model this, using current costs, an analysis is performed of one recent acquisition, which provides resilient connectivity via Jamaica, Panama and Miami.

26. A unit cost per STM-1 capacity is thus derived, and this is believed to be representative of the current costs involved in procuring the required connectivity. The international capacity required in Cayman is calculated from the “Demand Calculations” sheet, and this demand is used to drive the required number of STM-1s.

27. The submarine cable costs are also used to derive a unit cost for the National Submarine transmission (linking the Cayman Islands together). From a knowledge of the total km route length recently procured for the international

link, a unit cost per STM-1 km is calculated. This is multiplied by the distance between Grand Cayman and the other islands in order to calculate a unit cost per STM-1 for the national submarine link. The capacity demand for this link is then assessed (via the "demand calculations" sheet, and converted to a number of STM-1s required.

Fixed Network - Switching

28. The switching equipment is dimensioned according to recent supplier network design specific to Cayman. We note that as is so often the case for small islands, the switching equipment purchased is the minimum configuration produced by the vendor.

Fixed Network - MG Dimensions

29. For the MGs, the starting point is a list of all current C&W Cayman RSUs, and the installed lines capacity.

30. The dimensioned demand column is calculated by scaling the current installed lines for each RSU by the lines volume driver using the following formula:

    *Dimensioned demand = total lines * volume driver / total lines max point*
    The MG cost for each node is then calculated in the total cost per MG column via the following formula:
    *Cost = dimensioned demand * (1+voice/dsl provisioning ratio) / MG fill ratio * MG cost per port*

31. Although most of the MG costs comprise the costs of the access line interface, there remain some costs which relate to handling traffic. The above dimensioning formula does not allow for this distinction, so it is next necessary to calculate the split between traffic-related and line related costs.

32. This is done in the "MG analysis" sheet. Here, using data provided by our vendor to C&W relating to the replacement of certain RSUs by MG equipment, it is possible to derive the relationship between line-driven costs and the remaining fixed cost.

33. The resulting ratio of fixed costs as a % of total is then used to split the MG costs in the MG dimensions sheet into fixed (traffic related) and variable (line related) costs.

Fixed Network - Softswitch Dimensions

34. The two softswitches are located at the existing local switch sites in the C&W Cayman Islands' network. Each softswitch node consists of the following components:

- Softswitch hardware
- Softswitch software
- Gateway controller
- C7 Interface
- Central Office LAN

35. The quantity of softswitch base units is determined by the number of nodes, which is 2 in the Cayman network.

36. These quantities represent a minimum configuration, yet are capable of supporting the entire voice and data requirements for a market the size of Cayman. As such, the equipment costs for the softswitches are fixed and do not vary with volume.

37. It should be noted that the two softswitches are capable of handling all the international traffic, as well as national, and so there is no separate international switching element.

3. Model Structure & Operation

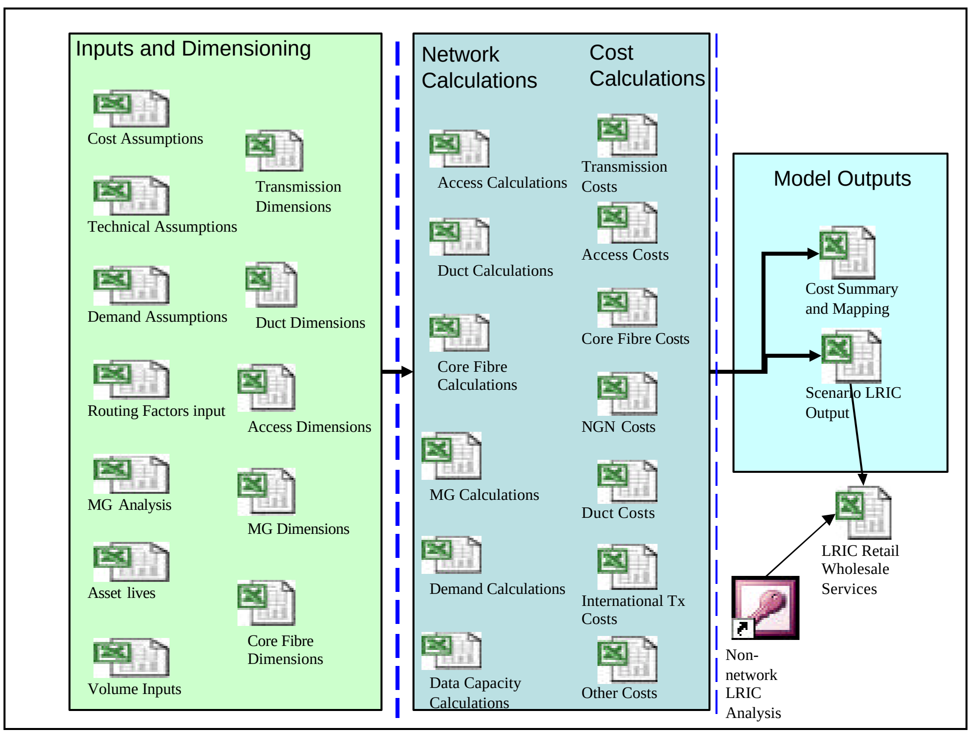
38. This section describes the various worksheets in the MS Excel Bottom-up model, and provides an overview as to operating procedures.

Fixed Model Structure

39. The fixed model is divided into the following modules:

- Model Inputs
- Network Dimensioning
- Network Calculations
- Cost Calculations
- Model Outputs

These modules are made up of a number of worksheets. The figure below outlines the structure of these modules and their composite sheets.



Model Inputs

40. This module contains the data required to run the model. It is divided into the following six sheets: Cost Assumptions, Technical Assumptions, Demand

Assumptions, Routing Factors input, MG Analysis, Asset lives, and Volume Inputs. As we are submitting this draft manual with a populated cost model, we do not reproduce version of each of the sheets in this manual. We do note however the list of all model inputs is given in Appendix I. Moreover, we have incorporated pop-up explanation of the function of each of these sheets within the sheets themselves.

- *Cost assumptions* – this contains the unit cost assumptions used for the duct, access, transmission and NGN parts of the network

- *Technical assumptions* – this contains the engineering assumptions that are used to dimension the network.

- *Demand assumptions* – this contains the assumptions regarding traffic, used to dimension the network.

- *Routing Factors input* – this is the source for the routing factors for all the services. We note that we use traditional notation for the network elements here, so "PSTN Host Switch" is used for the MSE/Softswitch/PVG element, "RSU" is used for the MG element.

- *MG Analysis* – this identifies the proportion of fixed, i.e., not line-driven costs within the MG network element.

- *Asset lives* – this contains the asset lives used in the model to calculate the annualised costs.

- *Volume inputs (Scenario Volumes and Data Volume Inputs)* – these are the sources for the volumes by service. It also includes leased lines, frame relay and direct internet connection –it is used to calculate the bandwidth required for these services.

Network Structure

41. This module contains the data which defines the structure of the network – it is divided into the following four worksheets:

- *Access Dimensions* – this contains information on the quantity of various types of cable, and other information such as the spacing of joints and the number of manholes and poles.

- *Transmission Dimensions* – this contains information on the quantity of different types of optical cable.

- *Duct Dimensions* – this has information on the quantity of different categories of duct.

- *MG Dimensions* – this contains information on the concentrator sites, and the number of lines installed at each site.

- *Core Fibre Dimensions*– this contains information on the quantity and length of fibre in the core network.

Network Calculations

42. This module contains the algorithms used to calculate the quantities of network equipment required to meet the service demand. It comprises the following three worksheets:

- *Demand Calculations* – this takes the volume inputs by service and scales up to allow for such thing as future growth. It then uses the routing factors to calculate the demand placed on each network element. This demand is then expressed both as an annual measure and a busy-hour measure.

- *Access Calculations* – this contains the calculations of the access network required to meet the demand.

- *MG Calculations* – this calculates the MG lines needed to meet the demand.

- *Duct and Core Fibre Calculations* – calculates the dollar amount of duct and core fibre needed to meet demand.

- *Data Capacity Calculations* – calculates the number of DPLCs and IPLCs need to meet data service demand.

43. Note that transmission equipment is effectively dimensioned to meet demand in its respective Dimension sheet.

Cost Calculations

44. This module contains the calculations of total costs for the main network components. It comprises the following sheets:

- *Access costs* – this uses the calculated dimensions of the access network, along with the unit prices, to calculate the total access network costs split by the various components. See Appendix XIII.

- *Core fibre costs* – this uses the core fibre dimensions to calculate total costs for fibre in the core network.

- *Transmission costs* – this uses the transmission dimensions to calculate total costs for the core transmission network.

- *NGN costs* – this calculates the costs of the NGN components, based on the dimensions, the traffic demand and the unit costs.

- *International Transmission* – this calculates costs for both the international and national submarine transmission links.

- *Other Costs* – this prices out the total number of payphone and DSLAM units.

Please note that it is in these Costs sheets that any mark-up for indirect capex is added. See Section 4 of the Background Document.

Model Outputs

45. The *Cost Summary and Mapping* sheet is the main output for the model. It summarises the costs for the network components, and provides splits where needed (e.g., to split duct between access and core, and to split the core transmission between voice, data and internet).

46. *Scenario LRIC outputs* provide bottom-up LRIC results in tabular form. A sample of the model outputs are presented in the case study.

4. CASE STUDY

Introduction

47. The preceding section of this document dealt with the structure and functioning of the model. In this section, screen-shot extracts will be given to show how actual numbers flow through the model.

48. In order to calculate the LRIC of each service, the model performs a series of iterations that simulates the following:

    1) Initially the model calculates the total costs of each network element for a given set of input cost assumptions, input technical assumptions and original input demand volumes.
    2) Removes the service volumes of each service one at a time
    3) Upon removal of each service volume, it recalculates new total costs of each network element for the given set of input cost assumptions, input technical assumptions and the reduced input demand volumes.
    4) It subtracts the new total cost from the original total costs to produce the pure LRIC associated with each service.
    5) It identifies the increment specific fixed costs (ISFCs) and network-wide common costs (FCCs) and marks up the pure LRIC to produce , D-LRIC and full LRIC for each service
    6) The output after each iteration is posted to the 'BU Output' sheet.

49. The following case study provides calculation steps, intermediate outputs and final outputs to demonstrate how the model determines the Pure LRIC for the Residential Access service

50. In order to make the presentation of results clearer, we have chosen to simplify that reporting somewhat. The simplifications are that

    a. we look at the direct capital costs GRC and annualized cost elements of the LRIC and leave out network opex and indirect capex derived from expense factors.

    b. we explicitly trace through the impact on two network elements--line-sensitive MGs and the DP/dropwire component of the access network). However, the impacts on all network elements appear at the end of the case study.

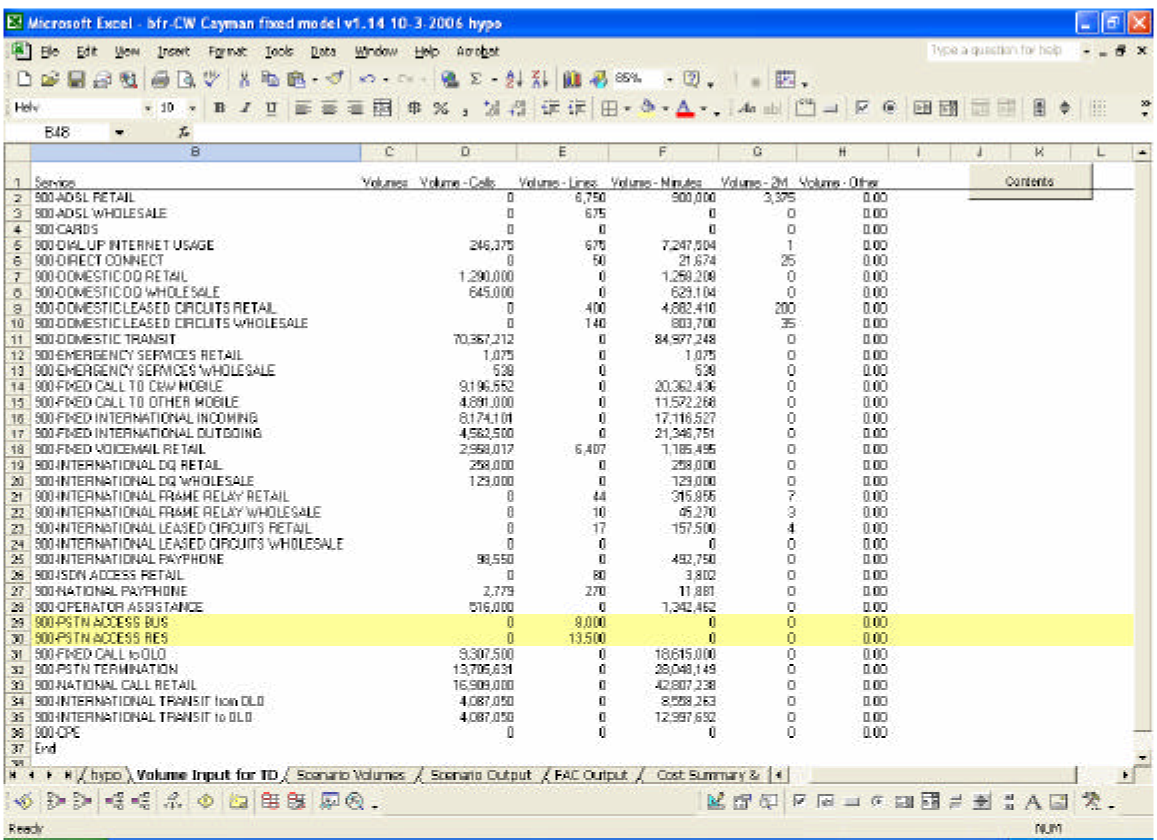
c. We demonstrate the calculation of the Pure LRIC values only in summary fashion as drilling down would require case studies of additional services.

51. Again, we have made these simplifications to facilitate presentation. Upon request we will be happy to provide a more detail demonstration of the Model.

52. This case study is for instructional purposes only and therefore costs and volume numbers presented in this case study may not be consistent with those submitted in the actual model and may not be representative of what C&W Cayman or other operators face.

The Starting Point

53. For this case study we have assumed that the number of lines served by the fixed network operator totals 21,500. We also assume that there are 8,000 business lines, and 13,500 residential access lines. This is captured in the *Volume Input for TD Sheet* and shown in Extract 1 below.

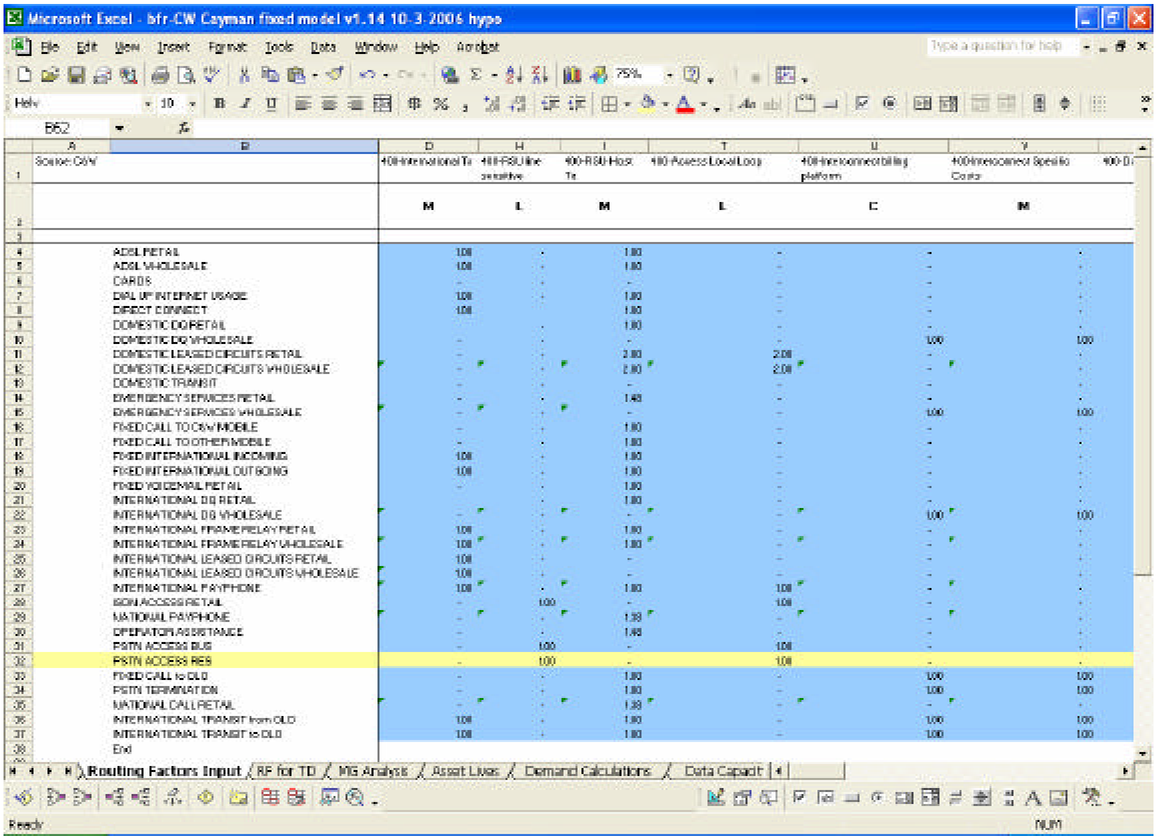


	Service	Volumes	Volume - Calls	Volumes - Lines	Volumes - Minutes	Volume - 2M	Volume - Other
2	900-ADSL RETAIL		0	6,750	900,000	3,375	0.00
3	900-ADSL WHOLESALE		0	675	0	0	0.00
4	900-CARDS		0	0	0	0	0.00
5	900-DIAL UP INTERNET USAGE		246,375	675	7,247,504	1	0.00
6	900-DIRECT CONNECT		0	50	21,674	25	0.00
7	900-DOMESTIC DQ RETAIL		1,290,000	0	1,258,208	0	0.00
8	900-DOMESTIC DQ WHOLESALE		645,000	0	629,104	0	0.00
9	900-DOMESTIC LEASED CIRCUITS RETAIL		0	400	4,882,410	200	0.00
10	900-DOMESTIC LEASED CIRCUITS WHOLESALE		0	140	803,700	35	0.00
11	900-DOMESTIC TRANSIT		70,367,212	0	84,977,248	0	0.00
12	900-EMERGENCY SERVICES RETAIL		1,075	0	1,075	0	0.00
13	900-EMERGENCY SERVICES WHOLESALE		538	0	538	0	0.00
14	900-FIXED CALL TO C&W MOBILE		9,196,552	0	20,362,436	0	0.00
15	900-FIXED CALL TO OTHER MOBILE		4,891,000	0	11,572,268	0	0.00
16	900-FIXED INTERNATIONAL INCOMING		8,174,101	0	17,116,527	0	0.00
17	900-FIXED INTERNATIONAL OUTGOING		4,562,500	0	21,346,751	0	0.00
18	900-FIXED VOICEMAIL RETAIL		2,958,017	6,407	1,185,495	0	0.00
19	900-INTERNATIONAL DQ RETAIL		258,000	0	258,000	0	0.00
20	900-INTERNATIONAL DQ WHOLESALE		129,000	0	129,000	0	0.00
21	900-INTERNATIONAL FRAME RELAY RETAIL		0	44	315,855	7	0.00
22	900-INTERNATIONAL FRAME RELAY WHOLESALE		0	10	45,270	3	0.00
23	900-INTERNATIONAL LEASED CIRCUITS RETAIL		0	17	157,500	4	0.00
24	900-INTERNATIONAL LEASED CIRCUITS WHOLESALE		0	0	0	0	0.00
25	900-INTERNATIONAL PAYPHONE		98,550	0	492,750	0	0.00
26	900-ISDN ACCESS RETAIL		0	80	3,802	0	0.00
27	900-NATIONAL PAYPHONE		2,779	270	11,881	0	0.00
28	900-OPERATOR ASSISTANCE		516,000	0	1,342,462	0	0.00
29	900-PSTN ACCESS BUS		0	8,000	0	0	0.00
30	900-PSTN ACCESS RES		0	13,500	0	0	0.00
31	900-FIXED CALL to OLO		9,307,500	0	18,615,000	0	0.00
32	900-PSTN TERMINATION		13,705,631	0	28,048,149	0	0.00
33	900-NATIONAL CALL RETAIL		16,909,000	0	42,807,238	0	0.00
34	900-INTERNATIONAL TRANSIT from OLO		4,087,050	0	8,558,263	0	0.00
35	900-INTERNATIONAL TRANSIT to OLO		4,087,050	0	12,997,652	0	0.00
36	900-CPE		0	0	0	0	0.00
37	End						

Extract 1

54. The *Routing factors Input Sheet* is a key input to the model that captures the extent to which each Network Element is used by each service. From this the

components of the LRIC for residential access will be the line-sensitive components of the MGs and various components of the access network. This is captured in Extract 2 below.



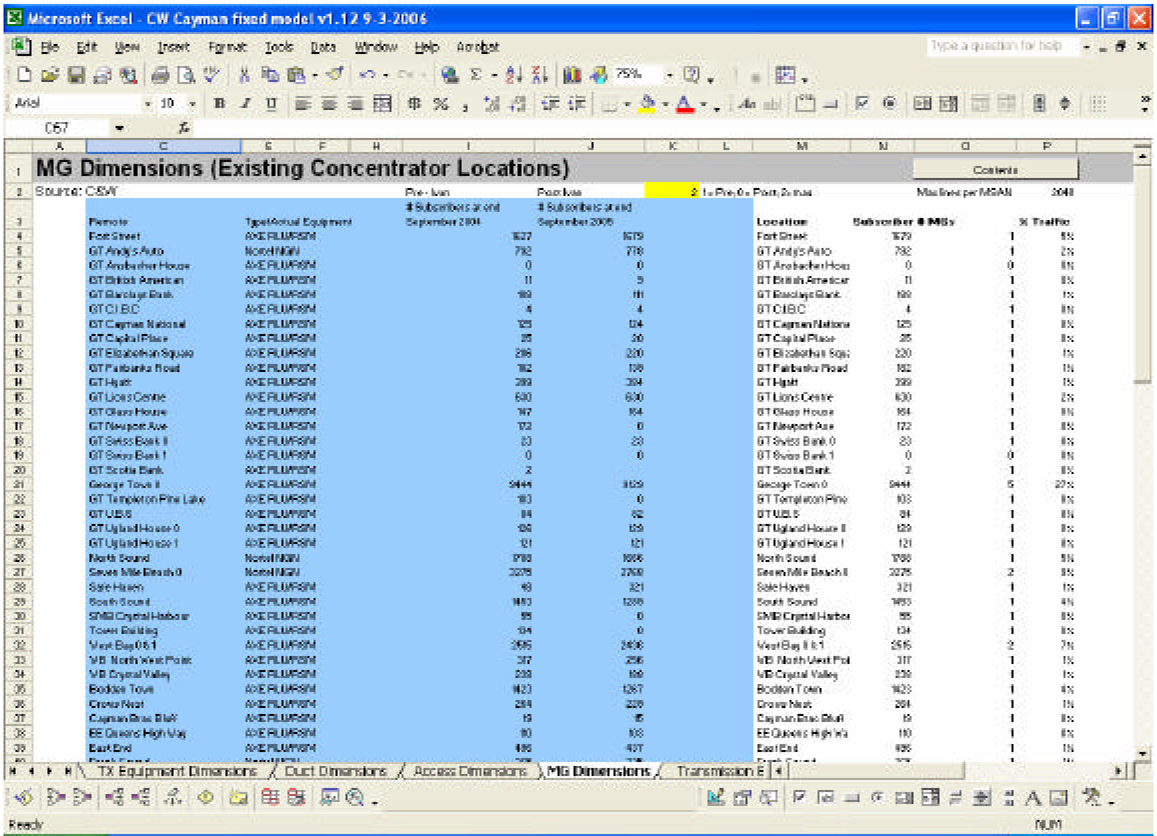
Microsoft Excel - bfr-CW Cayman fixed model v1.14 10-3-2006 hypo

Source: C&W	400-International Tx	400-RSU line sensitive	400-RSU Host Tx	400-Access Local Loop	400-Interconnect billing platform	400-Interconnect Specific Costs
	M	L	M	L	C	M
ADSL RETAIL	1.00	-	1.00	-	-	-
ADSL WHOLESALE	1.00	-	1.00	-	-	-
CARDS	-	-	-	-	-	-
DIAL UP INTERNET USAGE	1.00	-	1.00	-	-	-
DIRECT CONNECT	1.00		1.00	-	-	-
DOMESTIC DQ RETAIL		-	1.00	-	-	-
DOMESTIC DQ WHOLESALE	-	-	-	-	1.00	1.00
DOMESTIC LEASED CIRCUITS RETAIL	-	-	2.00	2.00	-	-
DOMESTIC LEASED CIRCUITS WHOLESALE	-	-	2.00	2.00	-	-
DOMESTIC TRANSIT	-	-	-	-	-	-
EMERGENCY SERVICES RETAIL	-	-	1.40	-	-	-
EMERGENCY SERVICES WHOLESALE	-	-	-	-	1.00	1.00
FIXED CALL TO C&W MOBILE	-	-	1.00	-	-	-
FIXED CALL TO OTHER MOBILE	-	-	1.00	-	-	-
FIXED INTERNATIONAL INCOMING	1.00	-	1.00	-	-	-
FIXED INTERNATIONAL OUTGOING	1.00	-	1.00	-	-	-
FIXED VOICEMAIL RETAIL	-	-	1.00	-	-	-
INTERNATIONAL DQ RETAIL		-	1.00	-	-	-
INTERNATIONAL DQ WHOLESALE	-	-	-	-	1.00	1.00
INTERNATIONAL FRAME RELAY RETAIL	1.00	-	1.00	-	-	-
INTERNATIONAL FRAME RELAY WHOLESALE	1.00	-	1.00	-	-	-
INTERNATIONAL LEASED CIRCUITS RETAIL	1.00	-	-	-	-	-
INTERNATIONAL LEASED CIRCUITS WHOLESALE	1.00	-	-	-	-	-
INTERNATIONAL PAYPHONE	1.00	-	1.00	1.00	-	-
ISDN ACCESS RETAIL	-	1.00	-	1.00	-	-
NATIONAL PAYPHONE	-	-	1.38	-	-	-
OPERATOR ASSISTANCE	-	-	1.40	-	-	-
PSTN ACCESS BUS	-	1.00	-	1.00	-	-
PSTN ACCESS RES	-	1.00	-	1.00	-	-
FIXED CALL to OLO	-	-	1.00	-	1.00	1.00
PSTN TERMINATION	-	-	1.00	-	1.00	1.00
NATIONAL CALL RETAIL	-	-	1.38	-	-	-
INTERNATIONAL TRANSIT from OLO	1.00	-	1.00	-	1.00	1.00
INTERNATIONAL TRANSIT to OLO	1.00	-	1.00	-	1.00	1.00
End						

Routing Factors Input / RF for TD / MG Analysis / Asset Lives / Demand Calculations / Data Capacit

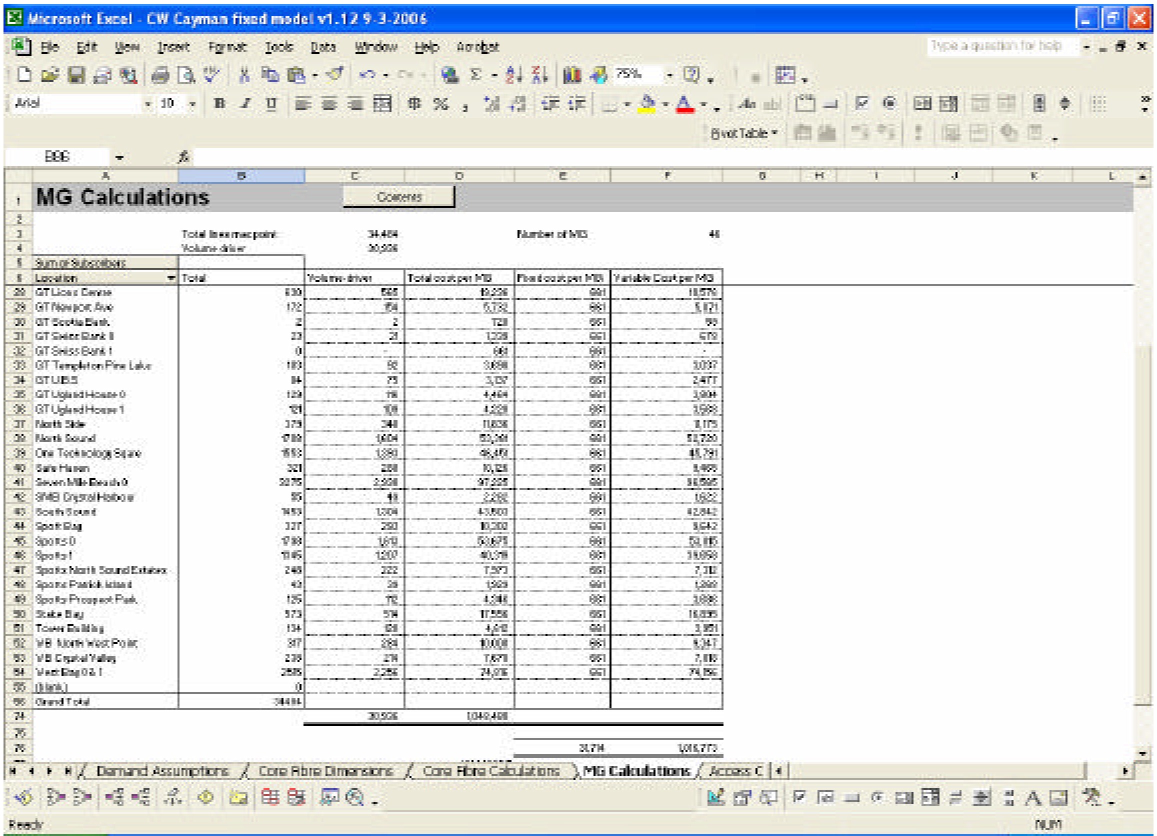
Extract 2

55. For the MG calculations and consistent with the scorched node methodology, the starting point is a list of all locations of C&W Cayman Remote Switching units (RSUs) and the installed line capacity. This input is captured in the *MG Dimensions Sheet* shown in Extract 3 below. Given the advent of hurricane Ivan the maximum capacity of pre and post Ivan is taken.



Extract 3

Based on the *MG Dimensions Sheet* inputs, the *MG Calculations Sheet* gives the locations and the associated costs of each MG as shown below in Extract 4.



	A	B	C	D	E	F
3		Total lines max point	34,484		Number of MG	46
4		Volume driver	30,926			
5	Sum of Subscribers					
6	Location	Total	Volume driver	Total cost per MG	Fixed cost per MG	Variable Cost per MG
28	GT Lions Centre	630	565	19,236	661	18,576
29	GT Newport Ave	172	154	5,732	661	5,071
30	GT Scotia Bank	2	2	728	661	66
31	GT Swiss Bank II	23	21	1,339	661	678
32	GT Swiss Bank I	0	-	661	661	-
33	GT Templeton Pine Lake	103	92	3,698	661	3,037
34	GT UBS	84	75	3,137	661	2,477
35	GT Ugland House 0	129	116	4,464	661	3,804
36	GT Ugland House 1	121	108	4,228	661	3,568
37	North Side	379	340	11,836	661	11,175
38	North Sound	1789	1,604	53,381	661	52,720
39	One Technology Square	1553	1,393	46,452	661	45,791
40	Safe Haven	321	288	10,126	661	9,465
41	Seven Mile Beach 0	3276	2,938	97,256	661	96,595
42	SMB Crystal Harbour	55	49	2,283	661	1,622
43	South Sound	1453	1,304	43,503	661	42,842
44	Spott Bay	327	293	10,303	661	9,642
45	Spotts 0	1798	1,613	53,675	661	53,015
46	Spotts 1	1345	1,207	40,319	661	39,658
47	Spotts North Sound Estates	248	222	7,973	661	7,312
48	Spotts Patrick Island	43	39	1,929	661	1,268
49	Spotts Prospect Park	125	112	4,346	661	3,686
50	Stake Bay	573	514	17,556	661	16,895
51	Tower Building	134	120	4,612	661	3,951
52	WB North West Point	317	284	10,008	661	9,347
53	WB Crystal Valley	239	214	7,679	661	7,018
54	West Bay 0 & 1	2585	2,256	74,916	661	74,256
55	(blank)	0				
56	Grand Total	34484				
74			30,926	1,049,498		
75						
76					30,714	1,018,773

Extract 4

56. The volume driver column is calculated by scaling the current installed lines for each RSU by the lines volume driver using the formula:

> 10.1 *Volume Driver for each MG = Installed lines * Dimensioned Demand / total installed lines max point*

57. The MG cost for each node is then calculated in the total cost per MG column via the following formula:

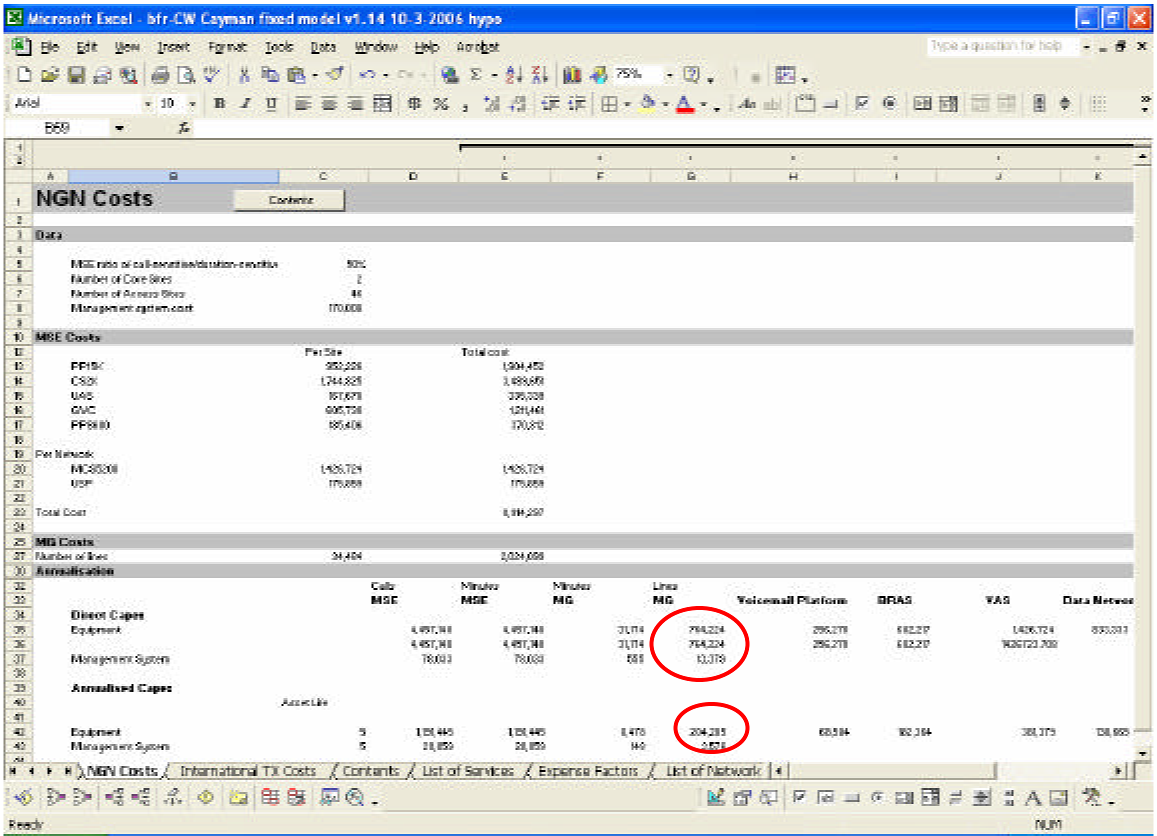
> *Cost = (Volume Driver / MG fill ratio) * MG cost per port + Fixed Cost per MG*

58. With respect to the fixed vs. variable cost, we note that, although most of the MG costs vary by the number of access lines , there remain some costs which are fixed. The break-down between fixed and variable comes from the "MG analysis" sheet. We have assumed that the proportion of MG fixed cost is 2.6% of the total. Thus total variable line related costs, in this example, is $764,224.

59. This figure appears in the *NGN Costs Sheet*, column 'G', which in turn is used to derive GRC and depreciation by network element. We note that, in addition to

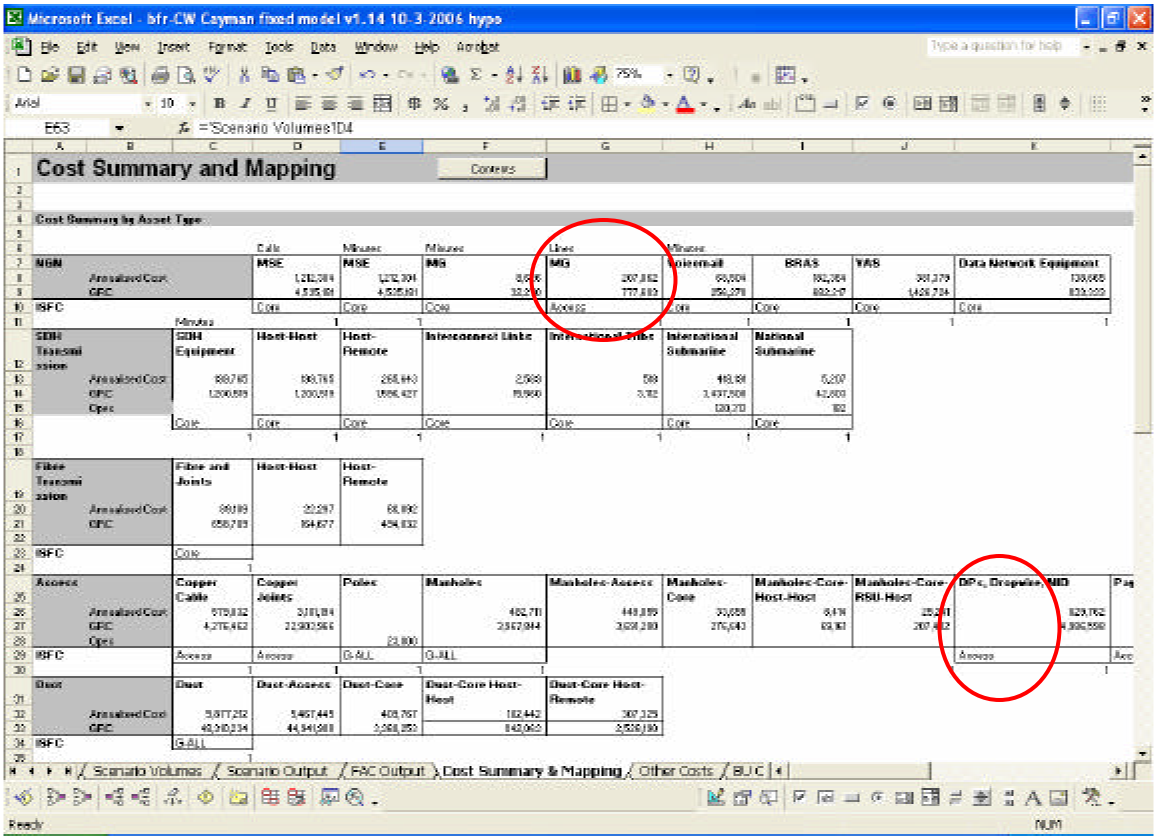
the relevant equipment costs, a “management system” component ($13,379) enters the line-sensitive.MG costs.

60. Please note that, for the purposes of this case study we have assumed a WACC of 10.52%.



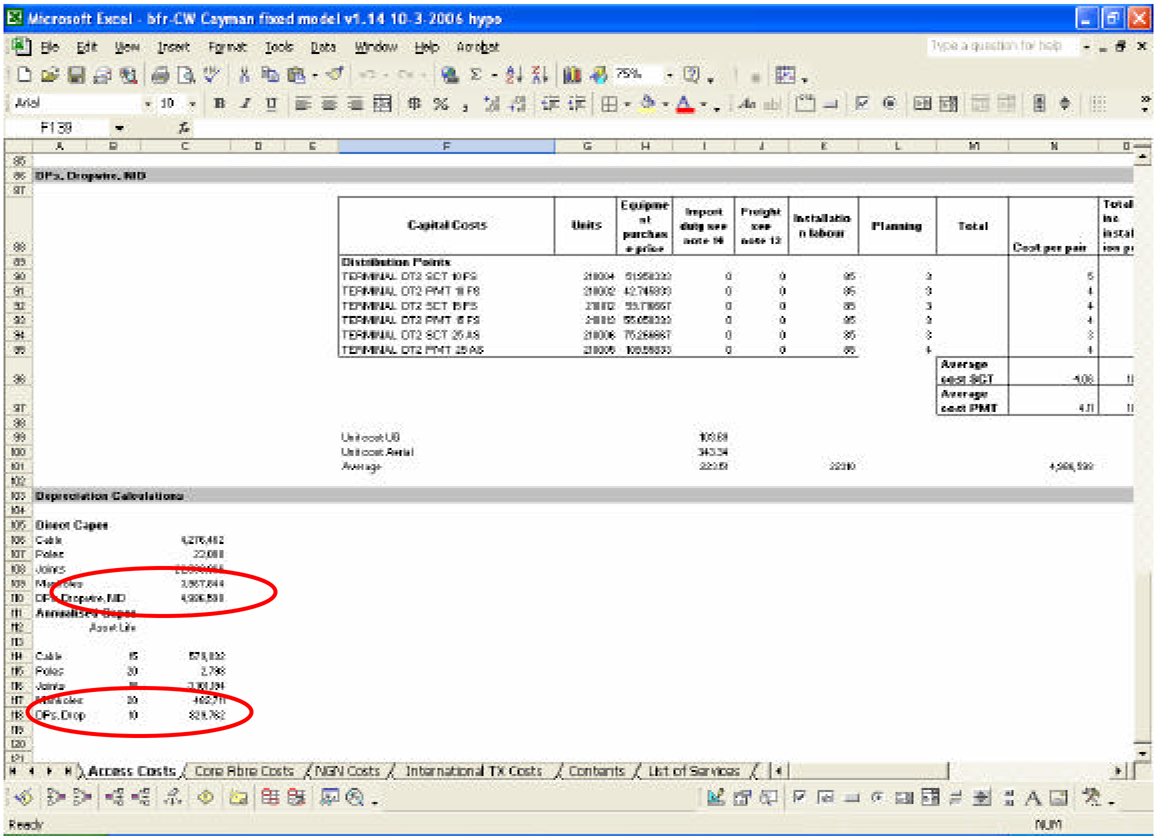
Extract 5

61. The resulting depreciation and GRC are carried over to the *Cost Summary and Mapping Sheet*.



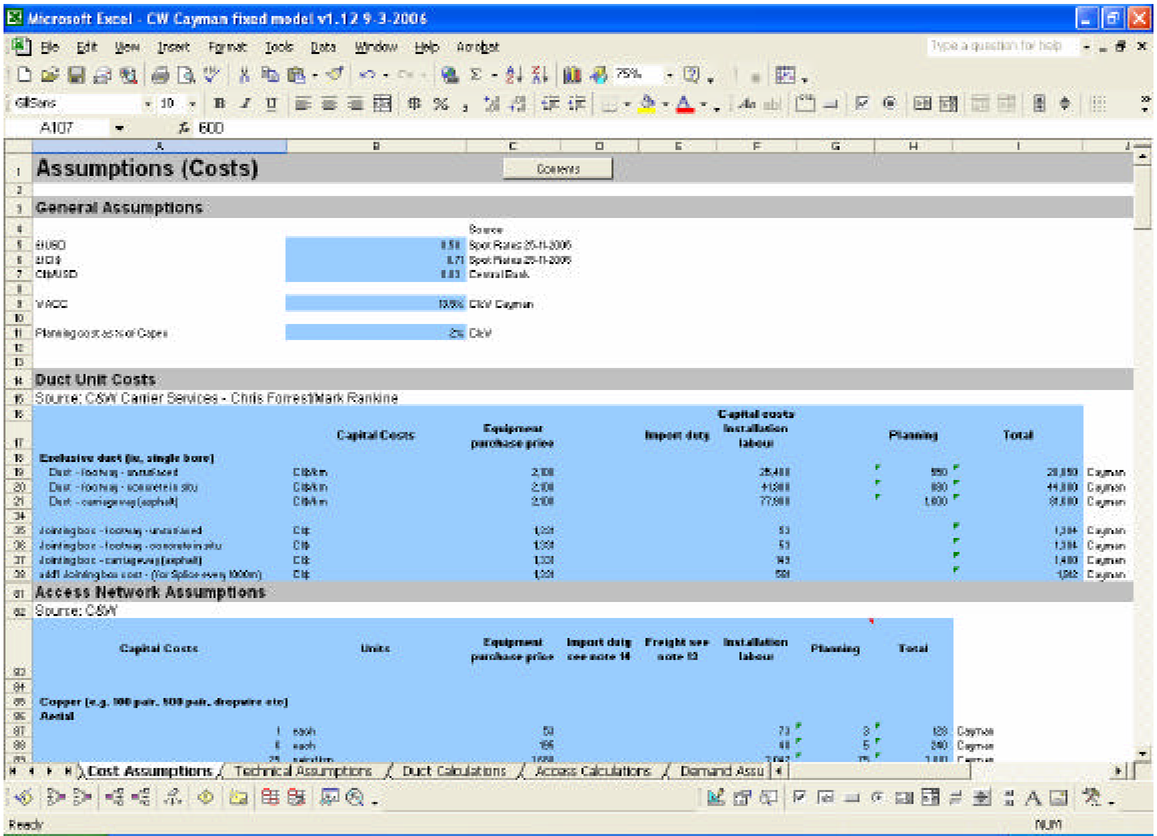
Extract 6

62. Similarly, we can trace the impact on the DP/dropwires/NIDs. Working backwards this time, we see in the *Cost Summary and Mapping Sheet* above, that the annualized cost and GRC associated with DP/dropwires is $829,762 and $4,986,598 respectively. These figures are determined in the *Access Cost Sheet*. See Extract 7 below.



Extract 7

63. Continuing to work backwards we see that the Access Cost figures originated from the *Cost Assumptions Sheet* are shown in Extract 8 below.



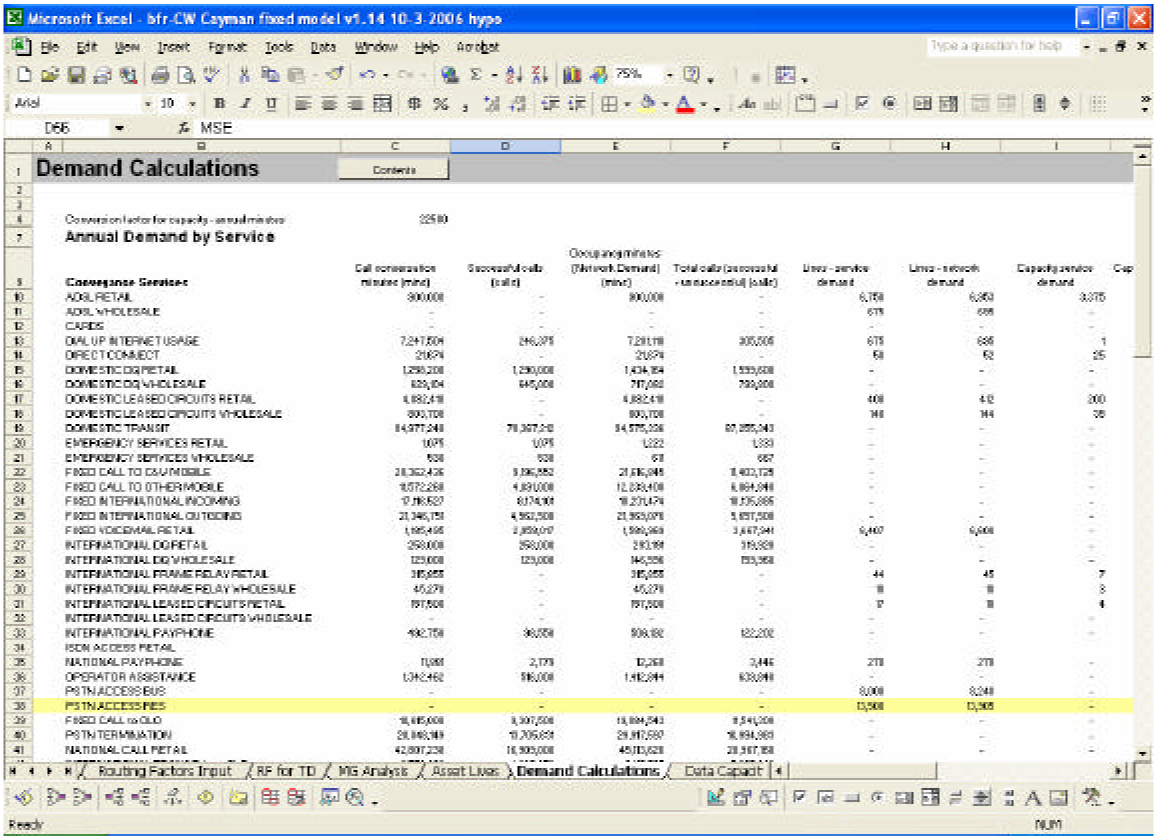
Extract 8

Calculating BU LRIC

64. The following steps describe the calculation process involved in computing the LRIC for the Residential Access service. We will follow the two network elements identified above--the line sensitive component of the MG (or concentrator) and DPs/dropwires--and observe changes in those elements after the Residential Access service is eliminated. Other network elements are impacted by a change in the residential access line volumes as well, but to ease the presentation we will just track the MG and DP/dropwire/NID costs. However, we show the calculation of the comprehensive set of impacts at the end of the case study.

65. In calculating the incremental cost of residential access line, we first set the volume of the service to zero using the *Scenario Volume Sheet*.

66. The reduction in the access line volume carries through to the *Demand Calculation Sheet* to the various network elements. See the Extract 9 below.



Extract 9

67. This drop in 13,500 PSTN Access residential lines lowers the variable MG element cost to $284,362 .

68. The annualized cost is reduced from $207,862 down to $77,413 and the GRC falls from $777,603 to $289,600 as is seen in the *NGN Cost Sheet*. The differences between the GRC and annualized costs before and after zero-ing out the residential access service volume are the components of the Long Run Incremental Costs. For Residential access the LRIC GRC is $488,004 and LRIC annualized cost is $130,449 respectively.

MG-line sensitive	Before	After	LRIC
Annualised Cost	207,862	77,413	130,449
GRC	777,603	289,600	488,004

69. Similarly, the DP/dropwire/NID elements' annualized cost moves from $829,762 down to $327,665 and GRC moves from $4,986,598 down to $1,969,159.

70. To give a flavour of the other impacts, in the table below we present both the NRC results from the all the elements of the Access network (whether they are impacted or not).

	Original GRC	Reduced GRC
Access ducting	44,941,980	44,941,980
DPs, Dropwires	4,986,598	1,969,159
Access Cable	4,276,462	4,276,462
Access joints	22,903,966	22,903,966
Access manholes	3,691,200	3,691,200
TOTAL	80,800,206	77,782,767

GRC LRIC of PSTN Access Residential Service = GRC LRIC Local Loop plus GRC LRIC MG Line Sensitive	80,800,206 – 77,782,767 = 3,017,439 + 488,004 = **3,505,443**

71. Pulling all these elements together, we get the total bottom-up pure LRIC for the access service.

Summary BU pure LRIC results for PSTN Access Residential service

WACC 10.52%

Volume - lines 13,500

A	B	C
Network Element	**LRIC value – GRC**	**LRIC value – Annualised Costs**
400-PSTN Access	$3,017,439	$ 502,097
400-MG line sensitive	$488,004	$ 130,449
TOTAL PURE LRIC	**$3,505,443**	**$ 632,546**

Appendices

Appendix I. List of Inputs

Cost Assumption Inputs:-

- **General Assumptions:**
  - Exchange rates
  - WACC
  - Planning cost as % of Capex

- **Duct Costs:**
  - Exclusive duct (ie, single bore)
  - Shared duct
  - Sub Duct

- **Access Network Costs:**
  - Copper (e.g. 100 pair, 500 pair, dropwire etc)
    - Aerial
    - NID
    - Underground
    - Other Information
    - Cabinets/Copper Cross connect
    - Poles
    - Islandwide Media mix
    - Media Mix (Entrant specific)
    - Manholes (list by type e.g. concrete, steel)
    - Costs for Asphalt/Concrete version
    - Distribution Points

- **Transmission Direct Capex Cost:**
  - Cable
  - Optical fiber joint

- **NGN Direct Capex Cost:**
  - MG, Per Port
  - SOFTSWITCH Node - Base, Per Node
  - SOFTSWITCH Node - 4 Port Access, Per 4 Port
  - Softswitch Per Port, Per Line/Trunk
  - Voice Migration Per Port, Per Line/Trunk
  - Voice Migration Planning, Per Line/Trunk
  - BRAS, Per DSL User
  - Network Management hardware, Per system
  - Network Management software, Per system
  - MG network interface card, Per card
  - Voicemail Platform, Per platform

Technical Assumptions:-

- **Engineering Assumptions:**
  - Conversion factor for minutes to erlangs
  - # of 64kbps channels in a 2 Mbps link
  - NGN Assumptions
    - Planning ratio
    - MG Fill Ratio
    - ADSL average bandwidth per line Mbit/s
    - ADSL Service Contention Ratio
    - SOFTSWITCH ratio of call-sensitive/duration-sensitive
    - Number of Core NGN Sites
    - Max capacity for Softswitch – minutes
    - Line/Trunk Ratio

Demand Assumptions:-

- **Traffic Data:**
  - % of traffic in busy hours
  - # of busy hours
  - Transmission capacity allowance
  - Provisioning Allowance
  - Annual growth rate for lines
  - Avg non conversation holding time for successful calls (minutes per call)
  - Ratio of total/successful calls

Asset Lives:-

- NGN Equipment
- Duct
- Fibre Cable
- Fibre Joints
- Poles
- Management Systems
- Manholes
- Copper Cable
- Copper Joints
- DPs, Dropwire, NID

Routing Factors

Volume Inputs by # Calls, # Lines, Minutes, 2M, Other for:-

- ADSL ACCESS RETAIL
- ADSL ACCESS WHOLESALE
- FIXED CALL TO C&W MOBILE
- FIXED CALL TO OTHER MOBILE
- CARDS
- CPE
- DATA OTHER RETAIL
- DATA OTHER WHOLESALE
- DIAL UP INTERNET USAGE
- DIRECT CONNECT
- DOMESTIC DQ RETAIL
- DOMESTIC DQ WHOLESALE
- DOMESTIC LEASED CIRCUITS RETAIL
- DOMESTIC LEASED CIRCUITS WHOLESALE
- DOMESTIC TRANSIT
- EMERGENCY SERVICES RETAIL
- EMERGENCY SERVICES WHOLESALE
- FIXED INTERNATIONAL INCOMING
- FIXED INTERNATIONAL OUTGOING
- FIXED VOICEMAIL RETAIL
- FIXED VOICEMAIL WHOLESALE
- DOMESTIC FRAME RELAY RETAIL
- DOMESTIC FRAME RELAY WHOLESALE
- INTERNATIONAL DQ RETAIL
- INTERNATIONAL DQ WHOLESALE
- INTERNATIONAL LEASED CIRCUITS RETAIL
- INTERNATIONAL LEASED CIRCUITS WHOLESALE
- INTERNATIONAL PAYPHONE
- INTERNATIONAL TRANSIT from OLO
- ISDN ACCESS RETAIL
- NATIONAL CALL RETAIL
- LOCAL CALL WHOLESALE
- NATIONAL PAYPHONE
- OPERATOR ASSISTANCE
- OTHER FIXED RETAIL
- PSTN ACCESS BUS
- PSTN ACCESS RES
- PSTN TERMINATION
- WHOLESALE FIXED
- OPERATOR ASSISTANCE INTERCONNECT
- INTERNATIONAL FRAME RELAY RETAIL

- INTERNATIONAL FRAME RELAY WHOLESALE

Network Structure Dimension Inputs:-

- **Duct dimensions:**
    - Exclusive duct (ie, single bore) lengths
    - Shared duct distance lengths
    - sub-duct lengths

- **Access Dimensions:**
    - Copper pair cable by type and length(e.g. 100 pair, 500 pair, dropwire etc)
        - Aerial Direct Feed
        - Aerial D-side
        - Aerial E-side
        - NID
        - Underground Direct Feed
        - Underground D-side
        - Underground E-side
    - Other Information
        - Average separation of jointing boxes by length
        - Average separation of fibre splices – underground by length
        - Average underground length of transmission between concentrator and distribution point
        - Average aerial length of transmission between cross connect cabinet and furthest distribution point
        - Average UG length of transmission between Exchange and the cross connect cabinet
    - Cabinets/Copper Cross connection points, units
    - Poles, units
    - Manholes (list by type e.g. concrete, steel)
    - DP's, units

- **MG Dimensions:**
    - Existing Concentrator Locations
    - Number of subscribers

- **Transmission Dimensions:**
    - Transmission type – aerial/underground
    - Lengths
    - Run
    - Sections
    - Fibre

- **Data Volume Inputs:**

- Retail Domestic LL Capacity (2M)
- Retail Domestic LL No Lines
- Wholesale Domestic LL Capacity (2M)
- Wholesale Domestic LL No Lines
- Retail IPLC Capacity (2M)
- Retail IPLC No Lines
- Wholesale IPLC Capacity (2M)
- Wholesale IPLC No Lines