ICT Decision 2008-2

Grand Cayman, 31 July 2008

Decision for the Costing Manual Consultation (CD 2005-1)

Overview

*The ICT regulatory regime in the Cayman Islands requires that Cable & Wireless (Cayman) Limited ("C&W") adopt a **F**orward-**l**ooking **L**ong-**r**un **I**ncremental **C**osting ("FLLRIC") methodology when it performs cost studies for regulatory purposes. FLLRIC costs are calculated using the least cost technology currently available and ignore historical costs or technologies.*

This decision is the conclusion of the second phase of a three phase process to implement an appropriate regulatory costing methodology. In this decision, the Authority makes determinations on the model, methodology and assumptions to be used by C&W when it develops costs for its services.

This decision results from the follow-up process initiated by the Authority's 2005 Phase I decision on the FLLRIC Principles and Guidelines, ICT Decision 2005-4. The reader may find it beneficial to review that decision for the background on those principles and guidelines.

Amongst other items, the Authority makes final determinations on a number of parameters and the methodology to be used in FLLRIC studies. For example, the Authority approves the cost of capital, the economic asset lives for various classes of network equipment, and the methodology to calculate annualised capital costs.

In this decision, the Authority also determines that while it is satisfied with much of the FLLRIC costing methodology proposed by C&W, there are a number of specific changes that are required in order to align the methodology with the Phase I Principles and Guidelines. For example, the Authority concludes that C&W's proposed methodology does not appropriately apportion shared and common costs amongst services that use common network elements. As another example, the Authority is not satisfied that C&W's suggested use of a 2G mobile network technology represents the technology choice that a new entrant entering the Cayman market would make.

In addition, the Authority requires additional information, supporting documentation and rationale from C&W for a number of its assumptions.

At the end of this decision, the Authority specifies the requirements for the Phase 3 process which will deal with the implementation phase of the FLLRIC methodology.

(Note: This overview is provided for the convenience of the reader and does not constitute part of the Decision. For details and reasons for the conclusions, the reader is referred to the various parts of the Decision.)

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INTRODUCTION

1. The Information and Communications Technology Authority ("the Authority") is using a three phase process for the development of a Forward-looking Long-run Incremental Costs ("FLLRIC") model. The phases are: Phase 1 - establish model foundation, Phase 2 - evaluate model implementation, and Phase 3 - final model implementation and use.

2. The first phase of that process was initiated by a public consultation on 24 May 2004 and concluded with the issuance of an Authority decision on 22 July 2005 entitled "ICT Decision 2005-4 - Decision for the Forward-looking Long-run Incremental Costing Consultation (CD (2004) 1)".

3. On 27 October 2005, after receiving input from interested parties concerning the process for the Phase 2 proceeding, the Authority launched the Phase 2 proceeding by issuing a public consultation on a costing manual to be used by Cable and Wireless (Cayman Islands) Ltd. ("C&W") to develop FLLRIC for its services.

4. This decision document marks the end of the second phase in the FLLRIC development process.

5. Phase 3 is the final implementation and application, where C&W is to file, among other things, a final costing model.

6. The purpose of constructing a FLLRIC model is threefold: the FLLRIC model will be used to establish cost based rates for interconnection services, to ensure that C&W's retail rates are not anti-competitive by providing input to imputation test analysis, and to quantify an access deficit if any. The initial purposes of the FLLRIC model are set out in C&W licence, although other uses for the model may become evident as the market develops.

7. This decision first provides a description of the main steps in the process that was used for this proceeding. That is followed by a detailed discussion and analysis of the model modules and manuals, including the Authority's determinations on the key issues. An assessment of whether or not the C&W proposed model is consistent with the Principles and Guidelines determined by the Authority in ICT Decision 2005-4 is then provided. Finally, this decision then describes the process the Authority intends to use for the Phase 3 - FLLRIC Implementation proceeding.

PROCESS

8. In Phase 1 of the FLLRIC process, the Authority established a foundation for the modelling work to be performed by setting out the overall modelling principles and guidelines. The Phase 1 decision, ICT Decision 2005-4, directed C&W to identify, by 9 September 2005, the date by which it would be prepared to file a completed draft costing manual and to identify its estimated time frame for the completion of two example cost studies. That decision also identified that other parties could provide comments on C&W's suggested time frames by 23 September 2005.

9. On 8 September 2005, C&W submitted a proposed schedule and suggested a multi-stage process whereby parties would make multiple submissions and the Authority would issue a number of determinations throughout the process.

10. In its 23 September 2005 letter, Digicel expressed concerns about C&W's proposed process and suggested that the Authority adopt an industry work group process to develop the costing model and Digicel committed to half or full day extended meetings to resolve issues.

11. On 27 October 2005, the Authority issued CD 2005-1, the Public Consultation on the Costing Manual. The process stipulated by the Authority provided for a single submission by C&W, a single submission by interested parties, an interrogatory process where parties and the Authority could seek further information on the submissions, and a final comment and reply comment phase. The process included neither industry forum meetings nor multi-stage submissions and determinations. C&W was directed to provide its submission on 12 December 2005.

12. On 8 December 2005 C&W indicated that due to limited personnel resources it would be unable to meet its time line and requested an extension of the filing date to 14 December 2005.

13. On 12 December 2005, the Authority approved C&W's extension request.

14. On 14 December 2005 the Authority (and interested parties) received draft FLLRIC manuals for both fixed and mobile networks and a background document. The background document explained C&W's understanding of the principles and guidelines set out in ICT Decision 2005-4 and provided an overall discussion of the methodological approach. The manuals provided an overview of the functioning of the draft FLLRIC model. In its submission, C&W stated that it viewed the manual and the case studies as living documents which would be revised a number of times over the coming weeks. Its submission also contained numerous references to C&W's intended future submissions.

15. In a 19 December 2005 letter, Digicel requested that the Authority direct C&W to provide electronic copies of the fixed and mobile cost modules. C&W replied that it had yet to built integrated FLLRIC modules and, therefore, did not have a set of spreadsheets that could usefully be reviewed by a third party.

16. In a 4 January 2006 letter, the Authority stated that it considered that provision of the modules would likely contribute to a better understanding of C&W's detailed methodology and thus enhance the record of the proceeding and directed C&W, by 11 January 2006, to provide it with the cost model with the confidential information intact and interested parties with the cost model with any confidential information removed, but leaving any formulas or calculations intact.

17. On 11 January 2006, C&W provided the draft cost modules as directed by the Authority and stated that it would have no responsibility to any party in respect of the contents of the spreadsheets.

18. On 16 January 2006, Digicel filed a request for a two-week extension to the date by which parties were to provide comments on C&W's submission.

19. On 17 January 2006, C&W indicated that it objected to the length of the extension requested by Digicel and it also indicated that it planned to submit a revised complete model in the proceeding.

20. On 19 January 2006, C&W wrote to the Authority suggesting a revised process and indicating that it could file a complete model by 10 March 2006.

21. On 8 February 2006, the Authority issued new time frames for the submission in the proceeding. The Authority indicated that it did not accept C&W's suggested schedule because it would require parties to provide comments and changes to an incomplete manual and would not allow parties to provide comments and changes to the complete manual and model. Therefore, the Authority concluded that the process it had originally specified in CD 2005-1 remained appropriate and that the dates should be changed to accommodate C&W's submission of a complete costing manual and electronic model.

22. On 10 March 2006, C&W submitted revised draft costing models, manuals and a background document.

23. On 21 April 2006, Digicel submitted a response to the C&W costing model and manuals prepared by its consultant Ovum. Ovum's report was dated 20 April 2006.

24. On 5 May 2006, C&W addressed interrogatories to Digicel and on 2 June 2006, Digicel responded to those interrogatories.

25. On 7 July 2006, C&W and Digicel filed comments.

26. On 11 August 2006, the Authority issued a Request for Proposals ("RFP") for a costing consultant to assist in the evaluation of the costing methodology. The Authority also provided potential consultants with the public version of the record of the proceeding to enable potential consultants to make meaningful responses to the RFP. During September to November 2006, the Authority evaluated the responses to the RFP, selected a consultant, and finalized a services agreement.

27. In a 26 January 2007 letter, the Authority informed parties that it had contracted the services of an external consultant, Telcordia Technologies, Inc. ("Telcordia"), to assist with the evaluation of C&W's proposed methodology and model. The conditions of the contract with the Authority ensured that Telcordia appropriately maintained the confidentiality of any information provided to it. In that letter the Authority also noted that Telcordia had reviewed the submissions of C&W and had identified a number of areas where additional information would be required, attaching a Telcordia document containing clarifying questions (the "first round ICTA/Telcordia interrogatories").

28. On 23 February 2007, C&W provided responses to the first round ICTA/Telcordia interrogatories.

29. On 16 April 2007, the Authority addressed a second round of interrogatories to C&W with responses due 16 May 2007. In addition, C&W was required to provide, by 23 April 2007, a revised version of the model correcting the numeric and formula errors that were identified in the previous interrogatories and acknowledged by C&W. This was to enable the Authority's consultant to continue its evaluation.

30. On 23 April 2007, C&W requested a two-day extension to file the revised model. The Authority approved the extension and C&W filed the revised model on 25 April 2007.

31. On 16 May 2007, C&W requested an extension to the due date for replies to the second round interrogatories with some responses being provided on 17 May 2007, some on 25 May 2007, some on 1 June 2007, and some on 8 June 2007. The Authority approved the extension requests.

32. On 8 June 2007, C&W requested a further extension to 22 June 2007 for a number of interrogatory responses. The Authority approved the request.

33. On 10 July 2007, the Authority issued a third round of interrogatories with responses due 31 July 2007.

34. On 30 July C&W requested a one week extension to the filing deadline of 31 July 2007 and subsequent deadlines. The Authority approved the extension request and C&W's responses to the interrogatories were provided on 7 August 2007.

35. Between August and November 2007, there were a number of submissions from both Digicel and C&W concerning Digicel's requests for disclosure of certain information filed in confidence by C&W.

36. Final comments by C&W were received 30 November 2007. Digicel requested and the Authority approved an extension to the comment date and Digicel submitted comments on 7 December 2007. Both Digicel and C&W provided reply comments on 21 December 2007.

37. The full public record for the CD 2005-1 proceeding is available for viewing on the Authority's website at: http://www.icta.ky/da_fllric.php or by selecting "Public Consultation" from the menu across the top of the www.icta.ky homepage and then selecting the "The Public Record of FLLRIC Phase II" link.

AUTHORITY'S ANALYSIS AND DECISION

Background

38. The FLLRIC model proposed by C&W has four components:

- a fixed network cost module,
- a mobile network cost module,
- a retail cost module, and
- a consolidation module.

39. In this Decision the Authority makes determinations regarding the methods and assumptions used in the FLLRIC model. While this analysis has been guided by the specific Principles and Guidelines from Decision 2005-4, the Authority has also relied on more generic criteria in its analysis, including:

- Reliability. The model should produce reliable results that are logically sound.
- Cost/Time. The benefit of having information and cost estimates developed in certain ways must outweigh the costs involved in developing those estimates.
- Applicability. The model must be able to meet to the overall requirements, namely be used for cost inputs in the development of cost based rates for interconnection services, be used to ensure that C&W retail rates are not anti-competitive by providing cost inputs to imputation analysis, and be used to quantify an access deficit if any.
- Understandable. The model must be reasonably clear and understandable.
- Flexibility. The model should provide users the capability to adjust key inputs in order to assess their sensitivities and ensure the validity of results.

40. This Decision first discusses modelling issues of a more general nature that, to a large extent, are common between the different modules or that require a consistent treatment between them. Then each module is reviewed in turn and directions are provided for further development and implementation.

41. In this Decision, frequent references are made to the Principles and Guidelines adopted by the Authority in Decision 2005-4. Such references are abbreviated to the word "Principle" or "Guideline", as appropriate, followed by the relevant number of the Principle or Guideline from Decision 2005-4, e.g. Guideline 3.

General modelling issues

Scorched node

42. In a submission on behalf of Digicel, Ovum criticized the scorched node approach adopted by C&W in the mobile module. According to Ovum, the key facilities to be configured according to the scorched node approach were the cell sites. Ovum noted that all existing C&W sites were listed in the Cost Assumptions sheet of the

module. However, those sites were only used to derive the average site leasing cost. Ovum noted that, in contrast, when determining the number of network nodes, C&W did not use existing cell sites and instead used a bottom-up approach and this resulted in the modelled network having a lower number of cell sites than the existing C&W network. In Ovum's view, the mobile module underestimates the number of cell sites by more than 20% in urban areas and by 50% in rural areas.[1] Ovum submitted that this approach does not follow the instructions laid down by the Authority in Guideline 3.

43. In its 7 July 2006 reply comments, C&W indicated that it was agreeable to the notion of using existing cell sites in the modelling as long as the number was not inflated. C&W noted that Digicel, prior to its acquisition of AT&T Wireless in Cayman, had 36 cell sites and this was the same as the number in C&W's GSM network.

44. Guideline 3 states:

> *The FLLRIC study shall be based upon the locations of, and planned locational changes to, the existing central office and facilities configuration. "Facilities" shall be interpreted to include feeder routes, central offices, drop wire, network interface devices, and other specific items that make up the facilities of a telecommunications company. This is referred to as the "scorched node" approach. The adoption of this approach does not imply that the modelled equipment located at the network nodes is of the same type or function as the equipment currently situated at those locations; however, the locations themselves are retained.*

45. It is the Authority's view this guideline provides considerable freedom in locational optimisation within a mobile network. The central office will in a conventional sense include equipment that is used for switching. In the mobile network and in particular in a mobile network the size of that in Cayman, one mobile switching centre may be sufficient, depending on the particular network configuration. In the Authority's view, neither the number nor locations of cell sites are fixed and can be varied to yield a cost efficient design. Likewise there is no upper or lower limit on the number of cell sites as long it is demonstrated that the final design can deliver the services required and at an appropriate Grade of Service ("GoS") or Quality of Service ("QoS").

The Authority's decision: Scorched Node

46. The Authority determines that the number and locations of cell sites should not be fixed at the currently existing number or locations. Accordingly, C&W is directed to:

- Allow for flexibility in costing the optimal number of cell sites.

[1] Ovum report "A Response to Cable and Wireless (Cayman Islands)' LRIC models dated April 20, 2006, section 4.2 p. 15.

- Provide evidence that demonstrates the optimality of the number cell sites adopted.

47. While the Authority would expect the number of cell sites to be similar to those currently deployed when the same network technology is used, deviations may be appropriate to minimise cost or where newer technology is deployed.

Network technology

48. Discussion and implementation of network technology plays a central role in the FLLRIC costing of services. The C&W model used Next Generation Network ("NGN") technology in the fixed network and 2G/2.5G technology in the mobile network.

49. Explicit in the Authority's choice of cost standard is the notion that it should be forward-looking. In respect to the technology used, forward-looking should not be interpreted as the cost using some technology of a distant future, rather it is the technology choice that would be made by an operator using the least cost currently available technology.

50. C&W stated that the Cayman service providers are currently moving towards IP-based networks, making it appropriate to base the FLLRIC methodology for the fixed network on an IP-based architecture, rather than the traditional Public Switched Telephony Network ("PSTN") that exists today.[2] On the other hand, for the mobile network, C&W has stated to its knowledge, no Cayman market participant is pursuing 3G technology. Therefore, in its view, it is appropriate for the FLLRIC methodology for the mobile network to be based on current Global System for Mobile Communications ("GSM") technologies.[3]

51. In the following the Authority discusses the technology choices in the fixed and mobile network modules respectively.

The fixed network

52. The C&W fixed network that currently exists in the Cayman Islands is largely based on traditional technology. The core network is based on circuit-switched technology, incorporating digital host switches, remote switching units and Synchronous Digital Hierarchy ("SDH") transmission links. Originating and terminating internet traffic is routed through a Broadband Access Server ("BRAS") and Digital Subscriber Line Access Multiplexers ("DSLAMs"). The access network is based on copper multi-pair cables, both aerial and underground.

53. C&W developed the FLLRIC model for the core network based on next generation switching equipment using IP technology. The implications of this choice were that:

[2] Background Document Draft Costing Manual, submitted on March 10, 2006; section 2, p. 4.
[3] Background Document Draft Costing Manual, submitted on March 10, 2006; section 2, p. 5.

- Existing PSTN remotes were replaced with voice/broadband-enabled IP concentrators supporting the existing range of services (also referred to as Media Gateways ("MGs"));
- Existing host switches were replaced with Multiservice Edge/Softswitch technology. It is assumed that the softswitch supports the same features as the traditional switch it is replacing and that it provides SS7[4] signalling functionality;
- Packet Voice Gateways were assumed to be installed to allow interface with circuit-switched external networks;
- The core transmission network was assumed to use Synchronous Digital Hierarchy ("SDH") rings with the figure presented in the costing model[5] showing the media gateways as part of the SDH rings[6]; and
- The access network was assumed to include DSLAMs at the Media Gateways. However, there is no change in the access network technology which remains copper based.

54. C&W assumed that the topological structure (location of central offices) of the network in the Cayman Islands would remain as it is in the current network. This is in accordance with the scorched node assumption.

55. On behalf of Digicel, Ovum submitted that C&W, in its fixed network modelling, was merely replacing low cost equipment with high cost equipment without obtaining any efficiency advantages of the change and that C&W had failed to demonstrate that the design adopted in its modelling was least cost.[7] As an example, Ovum noted the replacement of local switches on a like-for-like basis with MGs. Reference was also made to international experience and rationalization of network infrastructures when upgrading to IP. According to Ovum the implemented infrastructure in the FLLRIC model is grossly inefficient with the result that Digicel will be subsidizing the C&W roll-out of IP technology.[8]

56. Digicel and Ovum also expressed concern that the proposed NGN network was subject to more uncertainty in meeting service demands that would be associated with an equivalent PSTN network.[9]

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[4] The Signalling system number 7 (SS7) protocol is to establish connections between switches.
[5] Fixed Network Document Draft, submitted on March 10, 2006, figure 3, p. 6.
[6] The Authority notes that this would appear to be a simplification. More likely there is a link between a SDH node on the ring and a switching node, assuming the switching node can support a SDH interface. If not, another node is needed to interwork between SDH and an interface supported by the switching equipment.
[7] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006, p. 5.
[8] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006, pp. 11-12.
[9] Digicel letter dated December 21, 2007, p. 2.
Ovum report "A Response to Cable and Wireless (Cayman Islands)' LRIC models dated April 20, 2006, section 3.1 p. 11.

57. With regard to modelling an NGN network, C&W rejected the assertion that it inflates costs and sought to demonstrate its point by comparing annualized capital costs and depreciation of traditional PSTN assets using data from its 2005 asset register with that of NGN element costs produced by the FLLRIC model. C&W also rejected any references to rationalization given the size and scope of the Cayman market.[10]

58. As the Authority has noted above, it is the cost of building a network today looking forward by an operator now entering the market that is to be modelled. It is implicit in this concept that the choice is efficient and cost minimising within relevant constraints and time periods. In this respect, it would clearly be unacceptable within the FLLRIC concept if the C&W assumption of NGN was, as claimed by Ovum, merely increasing the costs of its services. While the Authority is not convinced of the appropriateness of the cost comparisons made by C&W, it nonetheless is of the opinion that NGN is an appropriate and cost efficient upgrade for the fixed network in the Cayman Islands. This is also demonstrated by the existing C&W upgrade and is consistent with international developments. While there is likely no cost advantage of an NGN over a traditional PSTN network if the only objective is to provide PSTN-like voice services, this is an inappropriate comparison. NGNs offer services beyond basic voice service and provide integration possibilities with other networks that are not found in traditional networks. In the Authority's view, an NGN therefore represents a valid and viable option for FLLRIC modelling.

The mobile network

59. Ovum stated that moving to IP technology in the fixed network is not consistent with the use of 2G GSM technology within the modelled mobile network. To be consistent, a model based on 3G technology should be used.[11,12] Further, Digicel stated:[13]

> *Irrespective of whether or not 3G technology is currently employed or prospectively employed in the Cayman Islands, 3G technology is not the 'least cost' solution for providing mobile voice termination for any "first time operator". However, if C&W are permitted to use higher cost technology in the form of IP technology for the fixed network a parallel assumption of 3G technology must be used in the mobile model and in particular if this technology is about to be employed in the Cayman Islands*

[10] Cable & Wireless Comments on the 21 April submissions and 2 June interrogatory responses, 7 July 2006, pp. 2-3.
[11] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, 20 April 2006, p. 5.
[12] 2G protocols use digital encoding and include GSM and CDMA. 2G networks support high bit rate voice and limited data communications. They are capable of offering auxiliary services such as short messaging. 2.5G protocols extend 2G systems to provide additional features, such as packet-switched connection and enhanced data rates. 3G protocols support much higher data rates, measured in megabits per second, intended for applications such as full-motion video, video conferencing, and full Internet access.
[13] Digicel letter June 2 Responses to C&W Interrogatories, p. 8.

60. In its response to Ovum, C&W claimed this position to be untenable and noted that replacement of 2G GSM technology is not currently being considered by C&W and to its knowledge no operator was contemplating such a move in Cayman.[14]

61. The Authority considers the 2G technology option adopted by C&W as representing a conservative modelling choice as the technology is mature, has well-known characteristics and is optimised for carrying voice traffic. 3G is currently not employed by operators in Cayman. However, 3G technology is expected to become the dominant network technology, in the long-run integrating voice and data traffic in an efficient manner.

62. Given that all operators in Cayman have access to 2G spectrum (and potentially to 3G spectrum) there are no entry barriers or restrictions on choice of spectrum when estimating forward-looking costs. In that respect a number of different mobile technology configurations and generations may be identified:

- a 2G only network;
- a 2.5G only network;
- a 2.5G and 3G network;
- a 3G only network; or/and
- a 3.5G only network.

63. The latest evolution is 3.5G (although statements regarding 4G have been made). The question in relation to FLLRIC is therefore which generation of technology and assets best reflect the efficient forward-looking operator in Cayman.

64. Principle 2 states, among other things, that FLLRIC should be based on the least cost technology currently available, and must reflect technologies that are currently operational and available in the marketplace. Whether or not a technology is used in the Cayman market is one, but not the only, indicator of whether a technology is currently operational and available. A reliance solely on whether or not a technology is used in the Cayman market place would be inappropriate as it would dramatically reduce the technology choices available for FLLRIC purposes and ignore many potentially cost-effective technology choices. Cleary, the "marketplace" stipulated in Principle 2 is the broader international Information and Communication Technology ("ICT") market and not the Cayman specific market.

65. In the Authority's view, 3G is certainly "available" technology and hence should be allowed within the framework for estimating the FLLRIC for mobile services. 3G networks have been deployed worldwide under many different and diverse conditions and are currently at the top of the mobile migration path. Some operators have even moved further with the deployment of High Speed Downlink Packet Access ("HSPDA") which by some is referred to as 3.5G. There therefore

[14] Cable & Wireless Comments on the 21 April submissions and 2 June interrogatory responses, 7 July 2006, p.3.

would not appear to be any restrictions on using 3G technology within a forward-looking concept to calculate the FLLRIC of a service. Further, observations of migration in other jurisdictions suggest it is only a matter of time before some variant of 3G is introduced in Cayman.

66. The Authority is of the view that the cost efficiency of 2G technology relative to 3G technology should be tested.[15]

67. During the interrogatory process, C&W indicated that it would take around two months to construct and fully document a 3G model module.[16] In addition, C&W raised a number of specific modelling issues, that would influence its assumption of a two month time period:

- the nature of the network to be modelled; and
- the analysis required for opex and retail costs.

68. With regard to the nature of the network, C&W mentioned two options: 1) modelling an overlay network where the 3G network was built out over an existing 2.5 G network or, 2) modelling a Greenfield approach which assumes no existing presence in Cayman.

69. As noted in the previous section, the Authority considers there is considerable flexibility in the scorched node assumption to be used in modelling the mobile network. The cell sites themselves are not in the Authority's view fixed and can be varied to yield a cost efficient design. Likewise there is no upper or lower limit on the number of cell sites as long it is demonstrated that the final design can deliver the services required and at an appropriate QoS.

70. In addition, the Authority does not consider an overlay approach (two networks running in parallel) to be appropriate. The modelling starting point should be that of a hypothetical new operator entering the Cayman market. However, this does not imply that information on the appropriateness of cell site locations or indeed existing cell site locations should be disregarded. On the contrary, it is the Authority's expectation that C&W would use its knowledge of the Cayman market to build a 3G model module that would accurately reflect the cost realities of Cayman.

71. Regarding the analysis required for operating and retail costs, C&W noted:[17]

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[15] The Authority is aware of modelling done by Ofcom in the UK, that shows 3G technology to be more efficient technology (compared with 2G technology) at relevant volumes of traffic. The Authority notes that 3G as modelled in the UK relies on higher frequencies relative to 2G which increases relative costs and raises coverage issues (in particular indoor). However, recent spectrum auctions in the US, suggest the use of the 700 MHz band for 3G and/or Long Term Evolution ("LTE") which is lower than that traditionally used for 3G. A distinguishing feature of this lower frequency is its ability to cover larger areas and provide good indoor coverage.

[16] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories, 17 May 2007, response to question 4.1.1.

[17] Ibid, question 4.1.1.

> *There are basically two ways to handle opex and retail expenses. One is to build a full-fledged top-down LRIC model, which would be integrated with the existing suite of models. This approach could be expected to be significantly more time consuming given the additional programming work that is likely to be required in respect of updating the access model to support the input from three bottom-up models. The other alternative is a stand-alone model using an expense factor approach to the calculation of non-network and retail costs.*

72. It is unclear to the Authority how C&W can build a top-down model when it has no 3G network. A top-down model is by definition built on data recorded by the operator and adjusted to the extent relevant based on the costing principle employed. When developing the operating and retail expenses, however, the Authority would expect C&W to make use of its knowledge of costings from its existing network. Indeed, it would be appropriate to follow similar methodologies for both 2G and 3G model modules. This will facilitate a comparison of costs and a reconciliation of differences that would assist the Authority in deciding upon the technology to adopt for FLLRIC purposes.

73. C&W also raised issues related to the product portfolio assumed in the modelling work. In particular C&W stated:[18]

> *The level of complexity in the dimensioning of the network will depend on the degree to which the additional functionality of a 3G network would be used to support next generation services over and above legacy voice and low-bandwidth data services. For example, the existence of high bandwidth products like video calling could significantly affect the dimensioning of the network, and hence impact the unit costs for regulated services such as voice.*

74. The Authority considers that the relevant product portfolio is that of a 3G operator looking forward. It would be inappropriate to take account only of voice traffic and low bandwidth data services in the dimensioning of the 3G network. There must be an allowance for significant growth in the network and in particular for higher bandwidth services. The Authority agrees with C&W that high bandwidth products will affect the dimensioning of the network and, most likely, the costs allocated to non-data services. It is precisely for this reason that the model structure should provide the flexibility to cater for different traffic forecasts.

75. The Authority has insufficient information on which to base a decision concerning the appropriate technology for the mobile network module and directs C&W to develop a costing module for a 3G network. This module will be reviewed in the upcoming Phase 3 FLLRIC proceeding. In addition, C&W is required to make the changes to the 2G mobile module that are detailed in other sections of this Decision. In Phase 3, the Authority will review both modules and come to a conclusion regarding the appropriate technology to be used for FLLRIC development.

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[18] Ibid, question 4.1.1.

The Authority's decision: Network Technology

76. C&W is directed to:

- Supply a fully functional and documented 3G mobile model, where account must be taken of growth in the network and in particular for higher bandwidth services.

77. In the section of this Decision dealing with the Phase 3 process, among other things, C&W is directed to provide proposed Mobile Termination Rates using each of the 2G/2.5G model and the 3G model. The Authority will select the technology to be used in the FLLRIC model based on which technology provides the lowest mobile termination rate ("MTR").

78. The Authority accepts the C&W modelling of an NGN solution for the fixed network.

Cost allocation to services

79. One of the distinguishing features of the C&W cost analysis is the cost allocation methodology which is based on the zeroing out of demand. Mathematically, the approach may be written as follows:[19]

$$FLLRIC_i = C(Q_1,...,Q_{i-1},Q_i,Q_{i+1},...,Q_n) - C(Q_1,...,Q_{i-1},0,Q_{i+1},...,Q_n)$$

80. In this formula, Q_i represents demand (or level of output) for service i and C represents the total cost at the particular level of demand. Note that Q_i has been replaced by a 0 (zero) in the second part of the formula to illustrate that the service has been removed. Where removing a service has no effect on costs, $FLLRIC_i$ is zero, i.e. the service has no volume-sensitive costs. Although this is an unlikely result for a telecommunications service, it is not uncommon for specific network elements whose costs might not change with a reduction in demand.

81. In Cayman, for example, the mobile market is relatively small in comparison to many other national markets. Hence certain equipment may only be available at capacity sizes that substantially exceed the immediate need of the customers on island. Removing volume may therefore have no effect on the dimensioning of that particular equipment.

82. Another issue that arises due to the zeroing out of demand approach is how to allocate increment specific fixed costs ("ISFC") and/or fixed common costs ("FCC") to individual services. When the demand of the whole network increment is reduced to zero, the cost output is the total cost reduction of removing that particular increment. That cost must necessarily be allocated to services using some metric.

[19] For the sake of simplicity and exposition, we disregard issues of annualisation, the inclusion of operating costs, definition of increments etc.

83. Having calculated FLLRIC of each service ("pure LRIC"), the C&W cost model calculates the ISFCs for each service. It does this by zeroing out demand for all services within the increment simultaneously and registering the change in cost (i.e. minus the sum of "pure LRIC" values of each individual service).

84. When zeroing out all demand services within an increment, the outcome is a summarised cost per network element that it is not allocated between different services using the network. Accordingly, the individual network element ISFCs must be allocated to the service according to some metric or key.

85. The C&W model allocated common costs proportionally based on the sum of "pure LRIC" and allocated ISFCs.

86. The Authority has a number of concerns with this approach:

- First, it needs to be implemented consistently, i.e. dimensioning of all network elements/cost components must be made with linkages to demand where appropriate. This is not the case in the C&W model. An example is the data service in the mobile module. The "Volume input for TD" sheet contains no demand for data services. Rather demand for data service is calculated indirectly using technical input assumptions. Removal of demand for data should have an effect on the network element "400-GSM: GPRS platform". However, no "pure" LRIC is registered for the "900-MOBILE DATA" service when the demand is removed. This difference in the treatment of data services compared to voice services also has knock-on effects on the allocation of costs.
- Second, the Authority is concerned with the ISFC allocation methodology used by C&W. Here a good example is provided by the allocation of costs to the service "900 Inbound Roaming". The initial calculation of service costs by zeroing out demand results in the full allocation of the cost of the GSM roaming platform to this service. Since this cost dwarfs the "pure" LRIC of other services, the result is that the inbound roaming receives a disproportionate share of total costs.[20]

87. The Authority notes that C&W, in addition to calculating the "pure" LRIC specific service costs by zeroing out demand for each individual service increment and using the above identified methodology to allocate the remaining costs to services, also has implemented another methodology to allocate costs to services. The 'Fixed Service Cost' and 'Mobile Service Costs' worksheets of the Consolidation module calculate service costs using methodology based on the network element's total annual costs, routing factors and individual service demand. This is the methodology used in revised costing as per file 07_08_07 Appendix 1_Revised Service Costing_conf.zip.

[20] Another example is in the fixed network model where the service "900-ADSL Retail" receives an allocation of the ISFC of the G-Fixed Access Sub Increment from the network element "400-Access Local Loop" (even though as per the routing factor table the service "900-ADSL Retail" does not put any load on the network element "400-Access Local Loop"), simply because the service "900-ADSL Retail" has a pure LRIC value that comes from its use of another network element ("400-ADSL Equipment").

88. This approach takes as a starting point the total annual cost of each network element and uses routing factors and demand to allocate these costs to services. The Authority notes that the approach of calculating network element costs and allocating costs to services using only routing factors and demand is not uncommon in regulatory proceedings.

89. In principle the process of calculating incremental and common costs in a FLLRIC exercise begins with the definition of the increment of the analysis. In this context an increment can be the addition of new service or group of existing services or an entire network (i.e. all services provided on a particular network platform). In practice, there is significant freedom in defining increments (and to the Authority's knowledge no accepted "best practice"). The Authority has previously determined that the increment to be modelled is the "total service" increment. To emphasize this point "TS" is sometimes added to LRIC to yield TSLRIC. In a previous Decision the Authority has explained the term "total service" in the context of TSLRIC indicates that:[21]

> *...the relevant increment is the entire quantity of the service that a company produces, rather than just a marginal increment over and above a given level of production. Depending on the services that are the subject of a study, TSLRIC may be for a single service or a class of similar services. TSLRIC includes the incremental costs of dedicated facilities and operations that are used only by the service in question.*

90. The services that are the subject of this cost modelling exercise encompass the majority of services provided by C&W as the fundamental objectives are: 1) to estimate the cost of interconnection (in both mobile and fixed networks), 2) assist in imputation tests (which by definition require the model to consider retail services and costs), and 3) assist in the calculation of any access deficit.

91. This suggests that TSLRIC considers the costs that are caused by the provision of a defined increment of output related to the "total service", where total service includes all services that use the same assets, i.e. have similar cost drivers. In the fixed network this translates into two predominant increments: the core network increment where the main cost driver is the traffic and the access network increment where the main cost driver is the number of subscriber lines. In the mobile network, the cost driver demarcation is less clear although the Authority believes the two appropriate increments are subscribers and traffic.[22]

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[21] ICT 2005-4, para 91, p. 23

[22] In addition to subscribers and traffic, it could be argued that coverage is an important cost driver in most mobile networks. Conceptually, a mobile network may initially be regarded as deployed in the form of a large coverage network. This initial network will contain a considerable amount of capacity and additional capacity may be added as required to support traffic levels over and above that already deployed. The Authority believes that the traffic handling capacity of the network equipment required for mobile coverage (not needed for coverage purposes, but due to the lumpiness or modularity in the deployment of capacity at each base station) should be part of the incremental cost of traffic. Accordingly, it is only the costs of site acquisition, preparation and lease, and the cost of network management system should be considered a common cost to the two mobile increments (traffic and subscribers).

92. Increments defined in this way are, by construction, large relative to those that only consider a single service. Accordingly, the Authority considers an allocation of costs to services should (within the specified increment) use a network element's annual costs, routing factors and individual service demand to calculate the cost of individual services. This approach also has a number of advantages: (i) it reduces the technical challenge of modelling numerous separate increments and common costs, including the need to estimate the efficient costs of delivering hypothetical combinations of services; (ii) it reduces the impact of the choice of mark-up method used; and (iii) generally increases modelling transparency.

The Authority's decision: Service allocation

93. The Authority is not satisfied that C&W's approach of allocating ISFCs and common costs by proportionate mark-ups on the sum of the "pure LRIC" costs is appropriate. The Authority therefore determines that the allocation of costs to services should (within the specified increment) use a network element's annual costs, routing factors and individual service demand to calculate the cost of individual services.

94. C&W is directed to:

- Implement a cost allocation methodology based on a large increment approach using the following methodology. Specifically, divide the total annual cost of each network element (incl. expense factors) within each increment by the total usage (measured by number of minutes, calls or lines as appropriate) for all services that use that element. This will yield a "per unit cost" of each network element. In order to determine how intensely a particular network element is used routing factors are used. Service unit costs are then to be calculated by multiplying the network element's per unit costs by the service's routing factor profile and adding up the individual network elements costs.
- Remove calculations related to the zeroing out of demand in both fixed and mobile modules.

Standalone networks

95. In the submission on behalf of Digicel, Ovum stated that C&W was costing its mobile network as if it were a stand-alone network operated by an independent business.[23] Ovum submitted that the presence of significant economies of scope including shared transmission costs and equipment co-location should be taken into account, otherwise C&W's costs would be exaggerated relative to those of other operators.

96. Ovum also submitted that the LRIC costs derived for transmission facilities in the fixed module should be used in the mobile module instead of commercial rates for transmission facilities. On page 14 of its 7 July 2006 submission, Ovum submitted that the current rates are provided on a monopoly basis and hence that

[23] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006, p.14

the tariffs charged for these transmission facility services are effectively monopoly rents.

97. Ovum further submitted that C&W's approach to modelling fixed and mobile networks is fundamentally at odds with FLLRIC Principle 1 and the approach would lead to inefficient market prices, i.e. result in prices that greatly exceed C&W's right to recover efficiently incurred costs, discourage C&W from operating in a cost efficient manner and provide the wrong incentives for facilities based investment, entry and exit. Ovum submitted that the modelling should based on the following:[24]

- Mobile termination rates on a self-standing network operator assumption; and
- Fixed termination rates on an integrated fixed-mobile operator assumption.

98. According to C&W, the subject of whether fixed and mobile networks should be self standing "*spawns a number of false assertions*" about economies of scale and scope and new entrant disadvantages. C&W noted that the appropriate benchmark is that of an efficient network operator and the particularities of Digicel's and/or C&W's business or investment is not relevant.[25] C&W asserted that the relevant question is what an efficient competitor network would install today, since costs are driven down to the level of the most efficient operator and the Authority should not attempt to map every operator's cost differences, because in the long run, they did not matter.[26]

99. Both Digicel and C&W raise a number of fundamental issues in their commentaries. The Authority agrees with the basic premise of the C&W argument that the appropriate benchmark for FLLRIC is that of a hypothetical new entrant to the market.

100. The issue raised by Ovum is one of basing costs on a standalone and/or integrated network. In particular, Ovum claimed that the cost of mobile termination should be based on a standalone mobile operator, while fixed termination should be based on an integrated fixed and mobile operator. In the Authority's view, Ovum did not provide a convincing argument for the proposed difference in treatment of fixed and mobile services.

101. In assessing the appropriate costs for transmission facilities, the Authority is of the view that an efficient operator would compare the costs of self-supplying its own transmission links to the costs of purchasing those links from an alternate supplier. C&W's model, however, assumed that the efficient mobile operator was using fixed-line transmission facilities obtained at commercial rates. The Authority does not consider C&W's approach to be reasonable.

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[24] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006, p. 7.
[25] C&W Comments on the 21 April submissions and 2 June interrogatory responses, 7 July 2006, pp 3-4.
[26] C&W Comments on the 21 April submissions and 2 June interrogatory responses, 7 July 2006, p. 4.

102. Concerning Ovum's contention that C&W's mobile module should be using the FLLRIC costs of such transmission facilities from a modelling approach that assumes an integrated fixed and mobile business, the Authority also does not find that a reasonable approach. An integrated operator would likely be able to internally provide transmission at the cost of production which may be lower than the corresponding price it could command in the market. Further, modelling the total C&W business to reflect any economies of scope would make the resultant model dependent on the structure and scale of the fixed-line business of C&W. Hence potential cost savings/advantages become C&W specific as noted by C&W in its response to Ovum.

103. Concerning Ovum's comments that the FLLRIC model should reflect benefits of site sharing and co-location, the Authority agrees that this type of sharing should be accounted for in the model. In addition, the FLLRIC model should reflect cost sharing between the mobile and the fixed business that may occur at the level of common business costs, through the sharing of certain business functions.

The Authority's decision: Standalone networks

104. The Authority considers that C&W's approach of modelling the fixed line business and the mobile business as standalone businesses with some shared costs is appropriate. However, this does not mean that sharing with other utilities or operators should be disregarded. Real life sharing opportunities should be reflected in the model (for example associated with building and land, other utilities etc.). The Authority also considers a stand-alone mobile network operator to be the appropriate benchmark for a hypothetical efficient mobile operator because it represents the likely characteristic of a new market entrant. Accordingly, C&W is directed to:

- Revise (where relevant) and clearly indicate in both fixed and mobile modules inputs or cost factors used to account for economically efficient sharing.
- Use transmission costs in the mobile network module, that are the lower of the rates for commercially provided fixed-line links or the costs of self-supplied wireless facilities.

Demand Assumptions / Projections

105. Demand assumptions include service and traffic parameters that are used to develop the service demand and dimension the network.

106. In each C&W network cost module, a list of assumptions related to the calculation of services demand was presented in a separate tab. They included the fraction of traffic in the busy hours, number of busy hours per year, spare capacity for the network, growth, non-conversation holding times and ratio of total/successful calls.

107. In the 7 August 2007 fixed network module the following specific assumptions were used:

- % of traffic in the busy hour ("BH"): 8%
- # of BH in a year: 365
- Avg. non-conversation holding time for successful calls (minutes per call): 0.11
- Transmission capacity allowance: 20%
- Provisioning Allowance: 5%
- Annual growth rate for lines: 3%
- Ratio of total/successful calls: 1.24

108. In the 7 August 2007 mobile network module the following specific assumptions were used:

- % of daily traffic in the BH: 10%
- # of busy hours in a month: 30
- Avg. non-conversation holding time for successful calls (minutes per call): 0.11
- Ratio of total/successful calls: 1.24
- Monthly data usage per sub (kbits) (both ways): 25.00
- Usage for each Short Message Service ("SMS") (kbits) (both ways): 0.500

109. C&W defined the percentage of daily traffic in the BH as the amount of traffic that falls within the BH of any particular day. This parameter was set at 10% in the mobile module and 8% in the fixed module.[27] The number of busy days in a month/year was the number of days in a month/year for which there is a busy hour. Average non conversation holding time (minutes per call) was defined as "*the non-conversation called minutes which are not logged as a part of the call (i.e., during the ringing phase)*".[28] The parameter was set at 0.11 per minute (in both modules) or 6.6 seconds per call. Using existing demand data in the mobile module, this figure was converted to a mark-up on traffic equal to 6.87%. Finally, the ratio of total/successful calls was defined to reflect that some calls are made, but not answered or (successful calls are those which are answered). C&W accounted for this by using a ratio of 1.24 is in both modules to adjust the demand data.

110. As an example of how this information was used, the formula used in the mobile module to estimate the annual traffic for dimensioning purposes is replicated below:

[27] Voice networks use the Erlang as a standard measure of capacity. The Erlang is a measure of total voice traffic in one hour, usually classified as the busy hour (BH), which is the 60-minute interval during a 24-hour period in which the traffic load is at a peak. One Erlang is equivalent to one user talking for one hour on one telephone. Consider 45 calls in a one-hour period, and each call lasting for 3 minutes. This equates to 135 minutes of calls. In hours, this is 135/60 = 2.25 Erlangs.

[28] C&W Fixed network model, Definitions tab. The Authority notes that an implication of this definition is that the traffic data used in the model should be billable minutes.

$$BH\ Erlang = Total\ Annual\ Traffic \times (1 + 6.87\%) \times 10\% \times \frac{1}{12} \times \frac{1}{30} \times \frac{1}{60}$$

111. During the proceeding, Digicel/Ovum proposed a higher proportion of unsuccessful calls (40%) than the assumed rate (24%).[29]

112. Digicel/Ovum also suggested the need to reconcile differences between the fixed and mobile module in terms of busy hour days (365 per year on the fixed module compared to 21 per month in the mobile module), and the percentage of traffic in the busy hour (8% and 10% respectively for the fixed and mobile modules). [30]

113. C&W acknowledged these comments and proposed for all three statements a "*middle of the road*" compromise by averaging each of the assumptions, resulting in an unsuccessful call rate of 32%, a total of 309 busy hours per year and a percentage of traffic in the busy hour of 9%.[31]

114. The mobile module also contained input parameters related to SMS and data, specifically the data requirements for sending an SMS and an assumed monthly data usage per subscriber. The Authority considers that a better approach would be to use SMS and data service statistics from billing records to estimate usage, rather than assumed average usage figures. The traffic volume generated by 2.5G mobile users typically represents a suite of services including voice, SMS and Multimedia Message Service ("MMS"). The volume of traffic associated with each of these services is essential for dimensioning each network element used. In addition, some network elements will be specific to certain services, for example GPRS Support Nodes for GPRS traffic. The Authority is concerned that the current approach in the mobile module will lead to an inaccurate dimensioning of the network and yield inappropriate allocations between services and hence final cost results.

115. The Authority also notes that the fixed module contains a transmission capacity allowance of 20%, a provisioning allowance of 5%, an annual growth rate for lines of 3%[32] and an allowance for holding time. There are no apparent equivalents in the C&W mobile module 'Demand Assumptions' sheet. However, the mobile module's 'Technical Assumptions' sheet does contains a 'Capacity planning max load factor' of 80%. This factor is used in various places in the mobile module and would appear to function as a capacity allowance factor. Nevertheless there is a need to coordinate and streamline the assumptions used in both fixed and mobile modules. Although the technology differs in each module, the grouping and the use of basic dimensioning inputs should, where possible, be similar between the network modules. This will increase the transparency and consistency in their use.

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[29] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006, p. 15.
[30] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006, p. 5.
[31] C&W Comments on the 21 April submissions and 2 June interrogatory responses, 7 July 2006, p. 11.
[32] This figure is only used for subscriber lines.

116. Regarding the provision allowance of 5% in the fixed module, this factor is applied to network element demand, i.e. all network traffic is marked-up by 5%. In comparison, the mobile module contained no such mark-up. However, C&W indicated in an interrogatory response that the call volumes used in the mobile module had been marked-up prior to using them as inputs in the module.[33] While the Authority considers the inclusion of growth in services demand to be appropriate, any adjustments to existing demand should be made explicit in the mobile module. This direction also applies to the fixed module which implicitly contains demand figures that take account of C&W's expectation of how the market and competition will evolve over the three years following the time of modelling (05/06). In a spreadsheet delivered separately from the FLLRIC model, C&W explained its view of how demand for individual services would evolve and provided adjusted service volumes to reflect its view.[34]

117. While the Authority considers the inclusion of growth factors for individual services to be appropriate, it is unclear why a provisioning allowance of 5% should also be added. The Authority notes that the provisioning allowance of 5% in the fixed module is defined as a factor that "*represents a capacity allowance for growth in demand*".[35]. Given this definition, an issue arises when computing dimensioning demand for network elements which have "lines" as the driver. In such cases, the fixed module applies two 'growth factors' to the actual demand; once to account for the 3% expected growth in lines, and a second time to account for another 5% growth in expected demand from the provisioning allowance. During the interrogatory phase, C&W indicated that the provisioning allowance was designed to provide for additional lines beyond the number currently in use and to allow for the fact that some installed lines would not be in use (for example, in the case of vacated premises). According to C&W, it should therefore not be regarded as a growth factor. The Authority is not satisfied that an adjustment for a provisioning allowance is appropriate and will require further information from C&W in the Phase 3 proceeding. To the extent that such a factor is incorporated into the FLLRIC model, it should be documented to justify its use and prevent any misinterpretation.

118. In the representative calculations and results included as part of the model documentation, the ADSL Retail service has been given 'Volume-Minutes' amounts which show up in both the 'Demand Calculations' sheet as well as the 'Volume for TD' sheet. It appears that the volume-minutes number is used in the process of allocating shared resource costs (e.g. local loop) between the broadband service and basic telephony services. It is unclear to the Authority what the appropriate interpretation of volume minutes should be with regards to the ADSL service. More specifically, the volume inputs contain 900,000 minutes

[33] C&W Cayman Islands Response to ICTA/Telcordia Round 1 LRIC Interrogatories 23 February 2007, answer to question 4.4.1.
[34] C&W Cayman Islands Response to ICTA/Telcordia Round 1 LRIC Interrogatories 23 February 2007, Confidential Appendix VI
[35] This definition can be found by double clicking on the Provisioning Allowance label, cell B9 of the Demand Assumptions tab.

associated with the ADSL Retail service. Given that ASDL is an access service, characterized by an always on mode of operation, it is not apparent how the minutes of use figure has been derived. C&W is directed to provide further explanation as part of the revised documentation.

The Authority's decision: Demand Assumptions / Projections

119. The Authority is not satisfied that the demand assumptions used by C&W were sufficiently supported by evidence. C&W is directed to:

- Increase the unsuccessful call rate from 24% to 32% in both mobile and fixed modules. This is in line with C&W's own recommendations and suggested compromise.
- Use a busy hour assumption of 25 days per month for both the mobile and the fixed modules[36] and adopt a percentage of traffic in the busy hour of 9%, also in both modules.
- Develop and document a clear and consistent definition of the factors used to develop actual, network and dimensioned demand. In particular, those associated with the provisioning allowance used for demand driven by lines should be addressed.
- Explicitly show existing demand and forecasted demand for services in both fixed and mobile modules, i.e. a growth rate should be shown for each service and the relevant planning horizon provided. When calculating the unit cost of individual services existing demand must be used in the denominator.
- Provide documentation and supporting evidence for the existing demand volumes and forecasted changes in demand.
- Provide justification for both explicit and implicit utilization[37] in the different parts of the network. For example, an explicit utilisation factor is the assumed circuit efficiency factor used to dimension transmission equipment in the transmission network. An implicit utilisation factor is one that may be calculated in the utilisation level for copper cable in the access network, i.e. pairs in use as a percentage of pairs in the network.[38]
- Provide supporting descriptions associated with all key volume input entries and in particular inputs such as ADSL Retail minutes.

Asset lives

120. Guideline 7 states that the FLLRIC studies should identify and provide a basis for the projected economic life used to calculate depreciation cost of the equipment involved in providing the service or element or group of services or elements.

[36] This is roughly equivalent to 312 busy hour days per year or busy hour every day except Sunday.
[37] Utilization factors, or fill factors, measure the efficient utilization of capital resources relative to the available capacity provided by the resource.
[38] Here utilisation will fall the further one moves away from the exchange to towards the subscriber. This may be explained by modularity as well as the need to allow for growth.

121. With regards to mobile network assets, the information received from C&W during the proceeding is summarised as follows. In Section 3 of the 10 March 2006 Background Document, C&W provided various publicly available benchmark asset lives for certain classes of network equipment. In the first round of interrogatories, when C&W was asked to provide the source of information and/or assumptions used to derive the economic asset lives for the mobile network assets, C&W explained that the source of information on actual GSM asset lives reflected the view of its engineers and network staff.[39] In the second round of interrogatories, C&W was asked to explain the instances where C&W's experience and estimates of asset lives were at variance with benchmarks. C&W then explained that Mobile Switching Centre ("MSC") and Home Location Register ("HLR") asset lives were based on C&W's replacement plans.[40] C&W also provided a set of benchmarks for some of the network elements in the mobile network and agreed to use a mid-point between its original assumption and the new benchmark lives, as shown below:

Table 1: C&W's agreed changes to asset lives for the mobile network

Element	Proposed asset life (From)	Proposed asset life (To)
BTS	5	7
BSC	5	8
MSC	5	7-8
HLR	5	7-8

122. C&W also stated it had not been able to find adequate comprehensive documentation supporting the asset lives it proposed for other mobile network components.[41]

123. For fixed network assets, C&W explained in its response to the first round of interrogatories, that it:[42]

> *...did not contact vendors specifically to ask them about the economic lives for PSTN networks in connection with the development of the LRIC model. There would have been little point.*
>
> *...*
>
> *The source of information on actual NGN asset lives (as well as the GSM asset lives) was the views of our C&W engineers and network staff who have a multi-year history of installing and operating IP equipment and GSM technology in the region and elsewhere throughout the world.*

124. Compared to its original submission of asset lives, C&W agreed to have the 3 year DSLAM asset life changed to 5 years, considering that its life in service

[39] C&W Cayman Islands Response to ICTA/Telcordia Interrogatories, Redacted Version 07_05_03, p. 4.
[40] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories [Part 5, 22 June 2007 submission, p. 3.
[41] ibid, p3.
[42] C&W Cayman Islands Response to ICTA/Telcordia Interrogatories, Revised Version 07_05_03, p4

could continue beyond the point at which the manufacturer produces and supports them.[43]

125. Ovum, on behalf of Digicel, noted concern that some of the asset lives proposed by C&W where significantly below those on public record.[44] As an example, Ovum noted 20 years for ducts, poles and manholes, where the quoted public record studies assume between 38-40 years for equivalent assets. In its response to Ovum, C&W acknowledged that 20 years is at the low end of the range normally used for such assets, but argued that recent replacement brought on by Hurricane Ivan would make its assumption quite reasonable.[45]

126. In the second round of interrogatories, C&W was asked to explain the instances where C&W experience and estimates of asset lives were at variance with the benchmarks, and to explain why the views of its engineers and network staff were different from those benchmarks. C&W stated it had not been able to find adequate comprehensive documentation supporting the asset lives it proposed for some of the network components, and it would accept the low end of benchmark life for duct, trenching, cabling and joints.[46]

127. In summary, during the interrogatory phase, C&W agreed to change the asset lives of certain fixed network elements as shown below:[47]

Table 2: C&W's agreed changes to asset lives for the fixed network

Element	Proposed asset life (From)	Proposed asset life (To)
DSLAM	3	5
Duct	20	38
Manholes	20	38
Fibre Cable	15	20
Fibre Joints	15	20
Copper Cable	15	20
Copper Joints	15	20
NGN Equipment	5	5-6

The Authority's decision: Asset lives

128. In the Authority's view, C&W has provided limited justification for the economic asset lives used for many of the network elements and equipment types. It appears to the Authority that the asset lives used by C&W were based on judgements rather than relying on a more systematic approach, e.g. benchmarks

[43] Ibid, p. 4.
[44] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006.
[45] C&W Comments on the 21 April submissions and 2 June interrogatory responses, 7 July 2006, p. 12.
[46] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories [Part 5 June 22 submission, p. 2
[47] C&W Cayman Islands Response to ICTA/Telcordia Interrogatories, Revised Version 07_05_03, p. 4 & C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories [Part 5 June 22 submission, p. 2 & C&W Cayman Islands Response to ICTA/Telcordia Round 3 FLLRIC Interrogatories, 7 August 2007, p. 15.

supported by economic depreciation studies. The Authority has taken into consideration the information on the record of this proceeding including the responses to interrogatories by C&W and the submissions of Ovum and the Authority determines that the C&W FLLRIC model should use the asset lives as set out in the table below.

Table 3: Authority's determination on asset lives

Equipment Type	Authority Life (yrs.)	C&W Life (yrs.)[48]
Fixed network		
NGN Equipment	**8**	5-6
Duct	**40**	38
Fibre Cable	**20**	20
Fibre Joints	**20**	20
Poles	**20**	20
Management Systems	**6**	5
Manholes	**40**	38
Copper Cable	**20**	20
Copper Joints	**20**	20
Distribution Points, Dropwire, Network Interface Devices	**15**	10
Transmission Equipment	**10**	10
Payphone Equipment	**8**	5
Digital Subscriber Line Access Multiplexer Equipment	**6**	5
Indefeasible Right to Use	**20**	20
Data Network Equipment	**10**	10
Mobile network		
Cell site	**15**	10
Transceiver	**8**	5
Base Transceiver Station	**10**	7
Base Station Controller	**10**	8
Mobile Switching Centre	**10**	7-8
Trunk Controller Unit	**8**	5
Home Location Register	**10**	7-8
Serving GPRS Support Node	**7**	5
Gateway GPRS Support Node	**7**	5
Packet Control Unit	**7**	5
Internet Gateway	**7**	5
Voicemail	**7**	5
Network Management Systems	**6**	5

Exchange rates

129. The exchange rate assumptions used in the latest versions of the model are summarised in the table below.

[48] Values suggested by C&W after the changes made during the three rounds of interrogatories.

Table 4: Exchange rates

	Fixed module		Mobile module	
Currency conversion	Exchange rate	Source	Exchange rate	Source
GBP/USD	0.58	Spot Rates 25-11-2005	0.54	Spot Rates 05-07-2006
GBP/KYD	0.71	Spot Rates 25-11-2005	0.64	Spot Rates 05-07-2006
KYD/USD	0.83	Central Bank	0.83	Central Bank

130. The table shows that the modules assume different currency conversion factors for GBP. This would appear to relate to a lack of updating of the spot rates.[49] The Authority notes that neither modules currently have any GBP equipment price inputs and hence has no implications for results.

131. For USD to KYD conversion the module should use C&W's current commercial exchange rate. The Authority notes that the Butterfield Bank exchange rate when using KYD to buy USD is 0.84.[50]

The Authority's decision: Exchange rate

132. C&W is directed to:

- Use commercial exchange rates.
- Provide documentation for all exchange rates used.

Import Duty

133. As noted in Principle 2, forward-looking costs should be calculated as if a service was being provided for the first time by a new carrier. For certain equipment, a new carrier to the Cayman market may be exempt from import duty the first two years of granting its licence. It is therefore relevant to consider whether this should be taken into account within the concept of FLLRIC adopted by the Authority.

134. One way to analyse this is to look more closely at the interpretation of "time" in the forward-looking concept. The forward-looking perspective can be understood as the costs of today looking forward, i.e. the cost of building the network today taking account of future demand. This is in line with the Authority's Principles. This suggests that the network is built over a very short period (some may even argue overnight). Guideline 4 also refers to the "*instantaneous build*" approach. Of course, trying to build a network overnight is practically impossible and would for example give rise to problems in the choice of equipment prices, scarcity of labour and effectively result in zero sharing with other utilities or other licensees.

[49] The Authority notes that current spot rates provide an immediate picture of the relationship between two currencies. However, these may fluctuate substantially over short periods of time and may not be representative of relationship over longer time period. In addition, some companies have a policy of hedging a substantial portion of annual budgeted foreign currency expenditure.

[50] http://www.butterfieldbank.ky/Personal/Treasury_Services/fx_sell_rates/home.htm

135. For the purpose of modelling, the Authority therefore considers it appropriate to assume that the network from a technical perspective is built overnight (or instantaneously), but all input parameters (sharing, equipment prices, etc.) are verifiable and reflect the costs of actual networks built over time. This means that equipment prices may follow from normal purchases and sharing may reflect normal planning and construction activity.

136. The question is therefore whether a competitive network could be built within the timeframe of duty exemption and indeed whether this is a realistic outcome. In the Authority's view the limited size and scope of the Cayman market suggests that a network could be purchased, imported and rolled out within a two year period. Further, once an entry decision has been made the Authority believes it would be prudent to act upon that decision within a short time period. Accordingly, the interpretation of the FLLRIC concept would suggest that an exemption from duty would be appropriate.

137. However, the Authority notes that not all equipment that is imported by service providers is eligible for the duty waiver. For example, among other exclusions, the Authority is aware that the duty exemption does not apply to equipment that is imported for resale.

The Authority's decision: Duty exemption

138. C&W is directed to:

- For equipment that is subject to the duty exemption, take account of duty exemption on imported equipment by modifying component costs in the FLLRIC model showing explicitly the cost with and without duty and use the cost without duty to develop unit costs.
- Provide documentation for categories of equipment that are subject to duty exemption.

Annualisation of capital costs

139. In a FLLRIC model for network based services, the recovery of capital costs usually accounts for a high proportion of total costs. Hence the appropriate method for the annualisation of capital costs should be the focus of considerable attention.

140. C&W used the PMT formula in Excel to annualise costs. The PMT function returns the periodic payment for an annuity based on constant payments and a constant interest rate when payments are due by the end of the year. In other words, the results obtained are the same ones which would be obtained by applying the standard formula for an annuity:

141. $$Annualised\ cost = \frac{WACC}{1-\left(\frac{1}{1+WACC}\right)^{Asset\ Life}} \times Asset\ Capital\ Cost$$

142. Where WACC is the Weighted Average Cost of Capital (see next section).

143. A standard annuity calculates the charge that recovers the asset's purchase price and financing costs in equal annual sums. In the beginning of an asset's lifetime, the annualisation charge will consist more of financing costs and less of depreciation charges. This reverses over time resulting in an upward sloping depreciation schedule.[51] The increase in the depreciation charge over time exactly counterbalances the decrease in the financing costs with the result that the annualisation charge is constant over time.

144. This simple annuity formula does not take account of two developments that will normally occur during the economic lifetime of an asset. The first is that asset/equipment prices change over time. The second is that for a part of its economic lifetime an asset is likely to be under-utilised and only be fully used as service volumes grow.

145. In a submission on behalf of Digicel, Ovum recommended the use of tilted annuities.[52] Tilted annuities take into account changes in price and hence are able to front load depreciation when asset prices are falling and back-load depreciation when asset prices are increasing.

146. In its response to the Ovum report, C&W also supported the use of the tilted annuity approach.[53] C&W noted that it had implemented the simple annuity approach because it had not received clear guidance from the Authority on this issue and it was easier to implement without the need for price trend data. C&W also provided a table of suggested price trends for a number of (major) asset categories.

The Authority's decision: Annualisation of Capital Costs

147. In the evaluation of whether or not a tilted annuity approach should be used, the Authority is mindful that the FLLRIC model will be used to develop rates for interconnection services, to ensure that C&W's retail rates are not anti-competitive, and to quantify any access deficit. When the FLLRIC model is used for rate setting purposes, the Authority anticipates that per-unit costs will be developed by dividing annual costs by annual demand. As the standard annuity approach provides a constant level of annualised capital costs, the Authority

[51] In other words, the depreciation profile is back-loaded over time i.e. more depreciation later in the asset life.
[52] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006.
[53] C&W Comments on the 21 April submissions and 2 June interrogatory responses, 7 July 2006, p. 5.

considers it more appropriate for rate setting purposes than the titled annuity and therefore determines that a standard annuity approach is to be used.

148. In addition, when the FLLRIC results are used in rate setting purposes (such as for the calculation of the imputation test), the calculation of the annuity charge is complicated by the fact that the revenue stream is received throughout the year rather than once at the end of the year. Hence if the annuity calculation was based on end of year revenue stream, costs would be inflated because they would not take into account that payments are received throughout the year. The Authority considers that, when the FLLRIC results are used for rate setting purposes, the annualisation methodology should assume monthly payments rather than annual payments.

149. Conversion from an annual to a monthly annuity requires a conversion of the inputs to the annuity formula. An asset life measured in years should be multiplied by twelve to get the number of months and the monthly equivalent of the cost of capital and price trends (on a annual base) should be calculated using the following formula:

$$Monthly\ rate\ = (1 + annual\ rate)^{1/12} - 1$$

150. The Authority determines that the C&W model's use of a simple annuity is appropriate. However, C&W is directed to change the annuity calculation to apply the annuity on a monthly basis.

Cost of Capital

151. Recurring capital-related costs are a direct function of invested capital and are composed of three components: depreciation, cost of money (return to investors) and income tax expense. Since there is no income tax in the Cayman Islands, C&W has no capital-related income tax expense. While the previous section has dealt with depreciation, this section looks specifically at the cost of capital or required return of investors.

152. Investors' capital is used to purchase telecoms equipment, and it is necessary to pay a return to those investors for the use of their capital. In the background document to the more specific costing manuals, C&W sets out its approach to the calculating the cost of capital. C&W defined the Weighted Average Cost of Capital ("WACC") as follows:

$$WACC = \frac{e}{e+d} R_e + \frac{d}{e+d} R_d \quad (1)$$

153. where:

- e = equity
- d = debt
- R_e = cost of equity capital

- R_d = cost of debt capital

154. The WACC is the weighted average of the cost of equity and the cost of debt, each cost weighted by its proportion to an optimal financial structure. It is a commonly used method for determining a return on an asset base. Given the capital-intensive nature of a telecommunications network business, the return on capital component can comprise a substantial amount of total costs. Small changes in the WACC can therefore have significant effect on the final service costs.

155. The cost of debt, R_d, should reflect the interest rate that lenders would require for lending their money, i.e. the risk free-rate adjusted to reward lenders for the risk that the borrower will default. The cost of debt is normally estimated as the sum of the risk-free rate and debt premium, i.e. the premium that should be added to the risk free rate to estimate the cost of debt.

156. The amount of debt relative to the market value of the company (the sum of equity and debt) is normally referred to the level of gearing or the leverage ratio. Hence gearing measures the degree to which a company's activities are funded by owner's funds versus creditor's funds.

157. Denoting the level of gearing g, the WACC formula (1) can be written as:

$$WACC = (1-g)R_e + gR_d \qquad (2)$$

158. In its submission, C&W adopted the Capital Asset Pricing Model ("CAPM") to estimate the cost of equity. The CAPM is widely used internationally and the Authority concurs with its use in the current context.[54] According to the CAPM, the cost of equity can be calculated as:

$$R_e = R_f + \beta(R_m - R_f) \qquad (3)$$

Where:

R_f	=	the risk-free rate
β	=	measures how sensitive asset j is to movements in the market portfolio
R_m	=	the expected return on the market portfolio (usually assumed to a stock market accumulation index) or more generally the estimated return available from investments in the market
$R_m - R_f$	=	the additional return expected by investors for accepting the systematic risk associated with investing in the market portfolio instead of a risk-free asset. It is often called either market risk

[54] The CAPM assumes that there is only one risk that is rewarded with a return in the market, and that is the systematic risk where returns to the stock are correlated with the returns to the market. All other risks are assumed to be diversifiable and not relevant to the pricing of stocks. A company will have volatility in its returns that are specific to the company, for example the success or failure of its research and development or its labour relations. These are risks that can be eliminated by an investor by holding a well diversified portfolio of stocks. This is of course a simplification of reality or an incomplete characterisation of security pricing, however, the CAPM is almost universally admired as an elegant and practical economic model.

premium or equity risk premium. The Authority adopts the term Market Risk Premium ("MRP") in the following.

159. In a submission on behalf of Digicel, Ovum supported the use of the CAPM for the estimation of the WACC.[55]

160. To take account of country specific risk C&W add a country specific risk premium (denoted R_c) to the standard CAPM formula. Hence the total cost of equity can be written as (where CRP denotes Country Risk Premium):

$$R_e = R_f + \beta(MRP) + CRP \qquad (4)$$

161. C&W made reference to Aswath Damodaran to justify its approach. Damodaran refers to the specific approach shown above as the Bludgeon Approach.[56] This is the most simple approach to deal with country risk and implicitly assumes that all companies (in Cayman) are equally exposed to country risk. There are however, two additional approaches: the Beta Approach and the Lambda Approach.

162. The Beta approach assumes that the company's exposure to risk is proportional to its exposure to all other market risk, which is measured by beta. Hence the cost of equity of a company can be written as:

$$R_e = R_f + \beta(MRP + CRP) \qquad (5)$$

163. The Lambda approach is more general as it allows each company to have an exposure to country risk that is different from its exposure to all other market risk. Damodaran denotes this exposure with lambda (λ). Hence the cost of equity can be written as:

$$R_e = R_f + \beta(MRP) + \lambda(CRP) \qquad (6)$$

164. The two previous approaches ((4) and (5)) are a special case of this more general approach. The first where λ=1 and the second where $\lambda=\beta$. A key determinant for λ is found in an analysis of the business operations of the company under consideration. A national provider of telecommunications services in Cayman has infrastructure investment in Cayman and sources its revenue (and earnings) from its Cayman operations. While some operators in Cayman derive some of their revenue from foreign markets, the Authority believes the implicit C&W assumption of λ=1 is likely to be reasonable in the current case.

165. The Authority notes that the risk-free rate appears in two places in the CAPM formula (3). It appears by itself in the first part of the equation while in the second part it is a component of the MRP. In determining an appropriate MRP, consideration therefore needs to be given as to whether the maturity of the second

[55] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006, p. 9.
[56] http://pages.stern.nyu.edu/~adamodar/New_Home_Page/valquestions/CountryRisk.htm [viewed 28 July 2008]

risk-free term, relative to which the market risk premium is measured, should be consistent with the first term of the CAPM equation. The CAPM itself provides no guidance on this issue, it is simply a single period model with an unspecified investment horizon. However, ensuring consistency between the two risk-free rates in the CAPM equation ensures a mathematical logic. The Authority is therefore of the view the period of the risk-free rate used to estimate the MRP should be the same as that used directly in the formula.

166. There a number of methodological issues that need to be discussed when applying the WACC.

167. First, WACC may be measured either in real terms or nominal terms. A nominal WACC is expressed in current terms, while a real WACC is expressed in real/constant terms. Hence, the real WACC shows the WACC excluding the impact of inflation and is normally defined as a nominal WACC deflated using expected CPI inflation. C&W fail to discuss this issue. However, it would appear from its approach that a nominal WACC is estimated. By using a nominal return on assets, investors are compensated for both their opportunity cost of capital and expected inflation. The Authority considers the WACC should be stated in nominal terms.

168. Second, the WACC may be estimated post-tax or pre-tax. The pre-tax WACC is the WACC adjusted to allow for corporate tax payments. When applied to the capital base, it indicates the (pre-tax) operating profit required to finance tax and interest payments, while providing shareholders with their required return. C&W or any other operators in Cayman incur no tax liability (corporate tax on income is zero) in the Cayman Islands, which would make any gross-up for taxes inappropriate. Taxation issues may therefore be bypassed in the setting of the WACC for a telecommunications operator in Cayman.

169. Third, in the current versions of the FLLRIC model C&W has calculated separate WACCs for fixed and mobile networks. The Authority notes that Guideline 8 states:

> *Among other things, the carrier is required to demonstrate, with specificity, the business risks it faces in providing certain carrier services such as interconnection and access to infrastructure sharing, as contrasted to the business risks it faces when providing retail services in competition with other carriers.*

170. Guideline 8 is in line with standard theory of corporate finance which prescribes that the cost of capital may be estimated for each individual investment project (or service in the current case) as the optimal capital structure and project specific uncertainty may deviate from that of the aggregate company.

171. However, C&W did not make any adjustments in its proposed WACC to account for any specific business risks it faces in providing carrier services as contrasted to the risks it faces when providing retail services. Instead, C&W proposed separate WACCs for fixed and mobile services. Ovum, on behalf of Digicel,

argued that the companies chosen by C&W to determine the fixed network beta to a large extent were integrated operators (both mobile and fixed) and hence that it would make sense to apply the resulting WACC to the whole C&W business.[57] In addition, Ovum noted that application of reciprocal rates for mobile termination would however, by implication, necessitate the calculation of a mobile-only WACC.[58]

172. With regards to calculating the WACC for different services (reflecting their unique risk characteristics), the Authority is mindful of the practical difficulties in such an approach. This is evidenced by the composition of operators C&W used to benchmark a beta value. Telecommunications operators are often integrated in nature and will provide a wide range of services. Finding adequate comparators or proxies for specific services is difficult. An example is identifying a business solely providing access services. While arguments may be advanced that comparators from other network industries may be used, the Authority is not convinced of the validity of such an approach. On the other hand, there are many companies operating a stand-alone mobile network making it fairly straight-forward to estimate a separate WACC for mobile operators as C&W has done. Indeed in other jurisdictions like Australia, New Zealand, the UK and Sweden, separate WACCs are used for mobile and fixed services.

173. Nevertheless, regardless of the potential differences between fixed and mobile operators, they will still share many characteristics, and there is an ongoing convergence between them. Further, the Authority is mindful of ensuring a technological neutral approach to services, i.e. separating a specific service from the underlying network.

174. The Authority therefore considers that there should be a single WACC that is applied in the FLLRIC model. However, as much of the WACC related information in this proceeding was based on separately calculated fixed and mobile network WACCs, the Authority will use the approach of estimating separate WACCs for fixed and mobile services and then blending them to determine a single WACC to be used in the model.

175. Estimation of the WACC requires consideration of the individual parameters in the formulas set out above: risk free rate, market risk premium, beta, gearing ratio and debt premium. Each parameter is discussed in the following.

Risk free rate

176. The risk rate is the expected return on an asset, which bears no risk at all. In practice, it is not possible to find an investment that is free of all risks. However, freely traded investment-grade government bonds can generally be regarded as

[57] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006, p. 9.
[58] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006, p. 9, fn 2.

having close to zero default risk (governments are unlikely to default) and zero liquidity risk.

177. C&W used US Treasury bonds. The Authority agrees that this an appropriate starting point for measurement of the risk-free rate.[59]

178. However, the CAPM provides no guidance as to the appropriate maturity of the risk free rate, nor does it deal with the degree of averaging over time.

179. In respect of the latter, it is the Authority's view that data used should be current. While C&W was not explicit in its treatment of averaging, it does appear to have chosen a specific day in its analysis. Regulators in other jurisdictions have different views on the appropriate averaging period. Some (Sweden) will take an average over 6 months, while others (Australia) will average over a number of days.[60] In principle, the latest observed rate provides the best forecast of future rates. Nevertheless, in some cases there may be information suggesting the last observed rate is not characteristic of markets' expectations due to, for example, large a volume of trades on particular day or some short term uncertainty affecting the market. To eliminate these effects, it is the view of the Authority that averaging of the rate should be done over the preceding month.

180. With regard to the choice of term, C&W chose a 30 year bond. The Authority notes that international experience with the application of the CAPM in regulatory proceedings suggest a maturity that either matches:

- the economic life of the assets used in providing the regulated service, on the basis that this reflects the planning (or investment) horizon of the company and the investors in its assets; or
- the duration of the regulator's determination ('the regulatory period'), given that the risk-free rate will be adjusted in any subsequent reset.

181. Proponents of the later argue that the WACC is not used to discount expected cash flows of a particular investment over the investment horizon, but rather to provide investors with a reasonable rate of return over the regulatory period. Hence the maturity period should be linked to the regulatory review period.

182. To the knowledge of the Authority, no consensus has been reached on this issue. However, the dominant view would appear to be the choice of a maturity that is longer than the regulatory period and more closely matches the asset lives or cash flows of the regulated business. This has typically resulted in the choice of a maturity between 5-10 years. A 30 year bond is in this regard clearly at the upper

[59] Provided that specific account is taken of country risk, use of the US Treasury bond as a proxy resolves issues of potentially double counting of risk.

[60] For Sweden see for example: http://www.pts.se/upload/Ovrigt/Tele/Bransch/Kalkylarbete%20mobiln%C3%A4t/M%C3%B6ten/Mobil_WACC_calculation.xls [viewed 28 July 2008]. For Australia, see for example: http://www.accc.gov.au/content/item.phtml?itemId=759855&nodeId=19c5d01d7bb2866b43d6655c4e9292de&fn=Final%20decision%E2%80%94Assessment%20of%20Telstra's%20ULLS%20monthly%20charge%20undertakings%E2%80%94August%202006.pdf [viewed 28 July 2008].

end of possible choices. In the current case, the Authority considers US Treasury bonds with a maturity of 10 years to be appropriate.

183. The 30 year risk-free rate quoted by C&W is 4.72%. This was the rate of the US Treasury bond in the first week of December 2005. A more recent estimate of the 10 (20) year US Treasury bond (end of April 2008) yields a rate of 4.4% (4.5%).[61]

Market risk premium

184. The MRP is the additional return expected by investors for accepting the systematic risk associated with investing in the market portfolio instead of a risk-free asset, i.e. in practice the premium of a broad portfolio of assets (stocks) over the risk free rate proxied by a Government bond. The magnitude of the MRP attracts considerable disagreement by practitioners and academics alike and arguments have been presented both for and against the different methods available to derive the MRP.[62] Recognising that all methodologies have limitations, it is not uncommon to consider an entire set of different approaches (and evidence), when making judgements on the value of the MRP.

185. The Authority notes that the typical regulatory and market practise approach is to calculate a value of the MRP based on historical data, but to adopt a final estimate that also reflects appropriate judgement about other available information and methods for estimating the MRP. These include recent changes in the market, survey evidence and forward-looking (prospective) approaches to calculating the MRP.

186. C&W used a comparison of the return of large US corporate stock to that of long term (20 year) Government bonds in the period from 1926 to 2004. The annual results were averaged over the specified period. This method yielded a MRP of 6.57% and was based on data provided by Ibbotson Associates. The Authority has been unable to verify the calculations.

187. Different estimates of the MRP are widely available and depend critically on the approach and dataset used. Ibbotson Associates dataset for the US used by C&W has been one of the most widely sourced and starts from 1926. An alternative source is Dimson, Marsh and Stauton (2006)[63] who discuss the historical development of MRP estimates from the turn of the century mentioning the Ibottson estimate covering 1926-1997 of 8.9% and their own estimate of 7.7%.[64].

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[61] Bond and Bill rates are available on: http://www.ustreas.gov/

[62] The apparent simple definition of the MRP as the difference between the (expected) return to risky assets (the market portfolio) and the return to riskless assets (government bonds or bills) gives a false impression of the complexity of calculating the MRP and the underlying importance of the MRP in the CAPM formula. One area of research deals with what has been termed the 'equity premium puzzle', because the level of the premium of equity over the risk-free rate is larger than can be explained by risk preferences.

[63] Elroy Dimson, Paul Marsh and Mike Stauton (2006), The Worldwide Equity Premium: A smaller puzzle, London Business School, 7 April. EFA 2006 Zurich Meetings Paper Available at SSRN: http://ssrn.com/abstract=891620 [viewed 28 July 2008]

[64] From E. Dimson, P. Marsh, and M. Staunton, The Millennium Book: A Century of Investment Returns. ABN AMRO/London Business School (2000), the U.S. arithmetic mean premium over the entire twentieth century.

According to Dimson, Marsh and Stauton (2006) academic consensus is now that estimates of the MRP that are lower than those reported earlier. Indeed based on their analysis of evidence over 106 years they estimate an arithmetic mean annual MRP relative to US bonds of 6.5%.[65] This figure is similar to that reported by Damodaran for the period 1928-2007 of 6.42% (arithmetic average relative to long term bonds).[66]

188. Lally (2004)[67] summarises the results of different methodologies. Using the historic approach in Siegel (1992)[68], Lally reports an estimate of 5-6% and 4.5% using Cornell (1999)[69]. Ofcom (2005)[70] summarises implied MRP estimates from various sources developed from market values and forecasts for the US ranging from 2.6% to 4.3%. Damodaran reports an implied MRP value of 4.37%.[71]

189. Graham and Harvey (2005, Table 1)[72] survey US CFOs and report a median estimate of 2.9% relative to ten year bond yields. Turning to a slightly older survey Welch (2001, Table 2)[73] surveys US academics and reports a median estimate of 5% defined relative to short-term bonds. At the time of the survey (August 2001), US ten year bonds were offering about 1.5% more than short-term bonds, implying a figure of about 3.5% relative to US ten year bonds.

190. Based on the estimates provided above, the Authority notes that historical measurements of the MRP would appear to be slightly above both forward-looking estimates and those derived from surveys. The use of historical information to estimate a forward-looking MRP is logical, but requires an assumption that the conditions underlying the historical returns are expected to be present in the future. This is a strong assumption. Further, the choice of time period and significant changes in market conditions over the past 50 years play a major role for the results presented in these analyses.[74] Similarly, forward-

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[65] Dimson, Marsh and Stauton (2006), table 3.
[66] http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histretSP.html [viewed 28 July 2008]
[67] Lally, M. (2004), The Weighted Average Cost of Capital for Gas Pipeline Businesses, Report for the New Zealand Commerce Commission, School of Economics and Finance Victoria University of Wellington, November 24, Available here: http://www.med.govt.nz/templates/Page____8085.aspx [viewed 28 July 2008]
[68] Siegel, J. (1992), The equity premium: Stock and bond returns since 1802, Financial Analysts Journal, Jan-Feb, pp. 28–38.
[69] Cornell, B. (1999), The Equity Risk Premium, John Wiley & Sons, New York. Cornell uses a forward-looking approach in which the discount rate on the market is found that is consistent with the current value of the market portfolio, the current dividend yield and forecasts of growth in dividends per share.
[70] Ofcom (2005), Ofcom's approach to risk in the assessment of the cost of capital, Final Statement, p. 35, Available here: http://www.ofcom.org.uk/consult/condocs/cost_capital2/statement/final.pdf [viewed 28 July 2008]
[71] http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/implpr.html [viewed 28 July 2008]
[72] Graham, J R. and Harvey, C R. (2005), *The Equity Risk Premium in June 2005: Evidence from the Global CFO Outlook Survey*, June 14. Available at SSRN: http://ssrn.com/abstract=743129 [viewed 28 July 2008]
[73] Welch, I (2001), *The Equity Premium Consensus Forecast Revisited,* September, Cowles Foundation Discussion Paper No. 1325. Available at SSRN: http://ssrn.com/abstract=285169 [viewed 28 July 2008].
[74] At least three factors may be identified: 1) There has been an explosion in the breadth of investment alternatives available to investors, both domestic and international. As a result, investors are far better

looking estimates also suffer from limitations and survey results are necessarily subjective.

191. The Authority considers that evidence before it demonstrates that an MRP of 6% is an appropriate balance of the available evidence. Although historical premiums typically suggest a higher MRP than 6%, more recent estimates of the MRP including more recent periods and forward-looking estimates typically suggest a MRP lower than 6%. Therefore, for this Decision, the Authority will use an estimate of 6% for the MRP.

Beta

192. Beta measures the relative risk to shareholders in the particular company or project (i.e. the sensitivity of an asset's return relative to market returns). It shows whether a company is more or less risky than the market. The higher the beta, the riskier the shares of a company and the higher the return required to compensate for this higher risk.

193. Risk relates to the volatility of returns, i.e. the possibility that expected returns may not actually materialise, or may be higher than expected. The total risk of an asset or business is made up of risk unique to the company (also called diversifiable or unsystematic risk) and market risk which in not unique to the company (also called undiversifiable or systematic risk). Examples of unique risks are risks associated with technology obsolescence, increasing competition, patent approval, labour contracts, management styles etc. These can be eliminated by diversification. Market risk cannot be eliminated by diversification; it is related to, and dependent on, the state of the economy as a whole.

194. Under the framework of the CAPM, only undiversifiable risk is relevant in determining the cost of equity. Investors are not compensated through the CAPM for diversifiable risk. The CAPM assumes that investors hold a diversified portfolio that eliminates unsystematic risk.

195. The asset beta (β_a) measures the sensitivity of a company's returns relative to market returns when the company has no debt. Equity beta (β_e) takes into account the company's leverage. The equity beta is related to the asset beta by the following formula:

$$\beta_e = \beta_a\left(1+\frac{d}{e}(1-t)\right) = \beta_a\left(1+\frac{g}{1-g}(1-t)\right)$$

196. If a company has no debt then its asset and equity betas are identical. Adding debt to a company's capital structure, increases its risk and its equity beta will be

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positioned to efficiently diversify their portfolios. 2) A wide range of new financial securities have been introduced advancing portfolio risk management. 3) Transactions and monitoring costs have declined markedly.

greater than its asset beta. The greater the proportion of debt, the greater the systematic risk associated with the residual cashflows available to shareholders, and the greater the difference between its asset and equity beta. For otherwise identical investments, a company with more debt in its capital structure will have a higher equity beta and a higher required rate of return on equity than a company with less debt.

197. The beta for a company may be estimated directly, by a regression of its return on that of the market return. Betas can only be directly estimated for companies listed on a stock exchange. It is not possible to estimate beta values for operators in Cayman. The alternative is to estimate a proxy or surrogate beta from comparable companies. This is the approach followed by C&W and sometimes referred to as a "pure-play" approach or a peer company analysis. The aim is to find a sample of companies engaged in similar activities to the company for which beta is being estimated. Ideally, the selection of suitable peers should be limited to those with similar characteristics including similar key market, operating and financial features, regulation, ownership structure and level of competition. In practice, however, this would limit the amount of available comparators. An alternative is to include a larger sample of peers and make relevant adjustments for differences. However, this may be equally problematic and introduce additional uncertainty.

198. In this case the Authority is minded to use the evidence presented by C&W in its Background Document Draft Costing Manual (Appendix 1A and Appendix 1B).

199. Based on an analysis of data from Bloomberg, C&W estimated an equity beta of 1.02 (asset beta of 0.52) for a fixed network operator and an equity beta of 0.93 (asset beta of 0.6) for mobile operators (although C&W would appear to have used the fixed beta value for the mobile operators in their subsequent calculation of the WACC). On behalf of Digicel, Ovum submitted that the C&W analysis appears to significantly underestimate the mobile beta and refer to studies in the UK (Ofcom) and France (ARCEP) which indicate beta values of a larger magnitude.[75] Specifically, Ovum refer to a range of 1.3 – 1.6 in the UK and 1.2 in France. It is unclear to the Authority where Ovum has sourced these figures. With regard to UK, the Authority notes the Ofcom view in its Statement on Wholesale Mobile Voice Call Termination from June 2004 that "*an equity beta range of 1.0 to 1.6 at 10% gearing remains appropriate.*"[76] The Authority has been unable to confirm the ARCEP beta.

[75] Ovum (2006), A response to Cable & Wireless (Cayman Islands)' LRIC models, A report on behalf of Digicel, 20 April 2006, p. 10.
[76] http://www.ofcom.org.uk/consult/condocs/mobile_call_termination/wmvct/annexb/ [viewed 28 May 2008], para B.44.

200. C&W criticized the Ovum analysis of beta values in other jurisdictions, arguing the Ovum analysis was selective and incomplete and its analysis, based on a much larger sample of operators, was superior to that of Ovum.[77]

201. Based on the evidence before it, the Authority has adopted an asset beta for fixed network operators of 0.5. For mobile operators, the Authority has considered the evidence put forward by C&W and comments provided by Ovum and has adopted an asset beta value of 0.7. This translates to an equity beta above one for both mobile and fixed network businesses.

Gearing ratio

202. Two main options exist with respect to selection of the weights used to determine WACC:

- ratios based on regulated company's existing financial structure; or
- optimal gearing inferred from the proportions present in the financial structure of comparator private sector companies (used to estimate the asset beta).

203. Calculations of the financial gearing should be based on market values (as opposed to book values) as these reflect the true economic value of the type of outstanding financing. The issue is therefore whether to use an operator's current gearing level based on current market value or its target ratio. At a given point in time, a company's gearing level based on market values (hereafter referred to as "gearing level") may not reflect the capital structure expected to prevail over the lifetime of the business or the optimal gearing level. Further, the use of actual capital structures will result in different gearing levels for different operators and may not be in line with the FLLRIC methodology, which is concerned with the cost of an efficient operator (with an optimal capital structure) rather than the costs of actual operators. Therefore, an optimal capital structure ideally should be used. However, such a target is difficult to estimate in practice. The C&W approach of estimating a financing structure on a survey of a number of different operators would appear to be a pragmatic and reasonable solution to the issue at hand.

204. C&W use a gearing level of 48.8% for the fixed business and 36% for the mobile business. These gearing levels were derived using the full set of surveyed companies in the C&W sample. In the Authority's view certain peers in C&W sample should be excluded from the sample, for example Advent Wireless[78]. In reviewing the average and the median gearing levels in the remaining samples, the Authority concludes that gearing levels of 45% for the fixed network business

[77] C&W Comments on the 21 April submissions and 2 June interrogatory responses in the ICTA's public consultation on the FLLRIC Manual, 7 July 2006, para 36, p. 13.

[78] Advent Wireless is a Canadian specialty retailer of cellular and wireless products, services and accessories. It earns its revenues from several sources including the sale of cellular phones, pagers and related products to customers at its retail locations. Advent also receives monthly commissions in connection with phone activations. It is affiliated and reliant on the products provided by Rogers Communications, but does own mobile network infrastructure and therefore should not be included in the sample.

and 35% for the mobile network business are appropriate to be used in the FLLRIC methodology.

Debt Premium

205. The debt premium refers to the interest premium or margin above the nominal risk-free rate that a business must pay to secure debt financing. Intuitively, a business must pay a premium above the risk-free rate to compensate the lender for the probability of default. The debt premium will vary depending on the entity's gearing, credit rating and the term of the debt. As an empirically calculated estimate, the debt premium requires no theory such as CAPM from which to derive an estimate. The debt premium is therefore inserted into the WACC formula directly.

206. C&W indicated in its background costing manual document that it follows the usual approach of adding a corporate debt premium to the risk-free return on government debt. The Authority agrees with this high-level approach.

207. However, the actual approach by C&W differed from this approach. C&W considered two measures: the historic yield to maturity of bonds issued by peer operators and a forward-looking bond rating.

208. With regard to the first measure, C&W appeared simply to average the cost of debt over selected operators. C&W had no discussion of the appropriate maturity to use, nor did it appear to correct individual debt costs with the relevant risk-free security to achieve a debt premium. Further, no consideration was given to whether the particular companies used in the sample were appropriate. Clearly, the relevance of Tele Sudeste Celular Participacoes Tsep with a cost of debt of 79% can be questioned with a gearing of 2% and only short term debt. The result of the C&W analysis of the actual debt was 10.34% for fixed line (integrated operators) and 11.65% for mobile operators. The Authority remains unconvinced as to the appropriateness of these estimates and notes that removal of certain comparators leads to a significantly lower cost of debt than that reported by C&W.

209. The second approach used by C&W was based on an average credit rating observed in the sample of operators converted to a cost of debt figure. The Authority agrees that the cost of debt, or in this case the debt premium, can be estimated by observing published credit ratings. These reflect financial fundamentals such as market capitalisation, earnings volatility, the free cashflow of a business and business risks specific to the company and/or the sector. Indeed credit rating agencies consider a wide range of financial indicators that inform on a different but related aspect of a business' debt service capacity. Based on the evidence submitted in the proceeding, the Authority accepts that the lower medium grade debt of Baa3 may be used as a starting point for estimating the debt premium (Baa3 is at the lower end of this scale from Baa1 to Baa3 using Moody or BBB+ to BBB- using S&P).

210. C&W calculated the cost of debt directly and not a debt premium as required by its stated methodology. The result was a cost of debt of 6.39%. No indication was provided on the maturity of the debt quoted, the industry on which it is based or the averaging period. The preferred methodology for the Authority would be to ensure consistency with the method adopted in calculating the risk-free rate, i.e. use the same averaging period and the same length to maturity of corporate bonds.

211. Based on publicly available information on corporate bond spreads[79] (with a 10 year maturity) a debt premium for medium grade debt in the utility sector may be estimated to be 1.6%. Adding this to the risk-free rate of 4.6% yields a cost of debt of 6.2%. The Authority has adopted this figure.

The Authority's decision: Cost of Capital

212. The individual parameter values adopted for this decision are shown in the table below.

Parameter		**Fixed network**	**Mobile network**
Nominal risk-free interest rate	a	4.40%	4.40%
Debt premium	b	1.60%	1.60%
Moody country rating	c	Aa3	Aa3
Country default risk spread	d	0.60%	0.60%
Relative equity market volatility	e	1.5	1.5
Country risk	f = d*e	0.9%	0.9%
Cost of debt	g = a+b+d	6.60%	6.60%
Market risk premium	h	6.00%	6.00%
Gearing	i	45%	35%
Tax	j	0%	0%
Asset beta	k	0.50	0.70
Equity beta	l = k*(1+(i/(1-i))*(1-j))	0.91	1.08
Return on equity	m = a+l*h+f	10.75%	11.76%
Nominal WACC	n = i*g+(1-i)*m	8.89%	9.96%

213. C&W is directed to:

- Adopt an average WACC of 9.5% in both fixed network and mobile network modules in line with the Authority's technology neutral approach to regulation.
- Ensure input values elsewhere in the FLLRIC model reflect the use of nominal WACC.

Expense factors

214. The expense factor components of the C&W cost model were used to derive the network operating expenses, annualised cost of support assets and network recharges. Non-network capital and operating costs that are common to both fixed and mobile networks were captured by the expense factors used in the Consolidation module. Capital and operating costs incurred in the operation of

[79] http://www.ejv.com/publicspreads.cgi

the retail business were calculated using the top-down module (see separate section on top-down retail module). Some non-network cost categories were allocated to both retail and network elements, as they were incurred in providing support to both the retail business and networks. All of the non-network cost categories were allocated to network elements and retail services through the C&W Activity Based Costing ("ABC") model.

215. The expense factors were based on the definition and allocation of activities in the C&W ABC model, such that the total costs in each cost centre were apportioned to the activities it performed. Where necessary, an ABC activity was mapped to more than one expense factor in order to reflect more precisely the sensitivity of that expense to particular parts of the business (e.g., fixed network, mobile network, retail). The mapping of cost centre/activity combination to expense factor was provided in Appendix II of C&W's response to second round interrogatories. The mapping exercise allowed the calculation of the total value of each expense factor, which could be reconciled back to the total activity costs extracted from the ABC model looking at the three FAC input sheets ('FAC Opex Input', 'FAC Asset Input' and 'FAC Working Capital Input') in Appendix III of C&W's response to second round interrogatories.

216. Ovum, on behalf of Digicel, submitted that the treatment of expense factors by C&W for the calculation of network operating cost, non-network capital costs and non-capital expenses was opaque. Ovum requested that C&W's expense factors, or at least those relevant to interconnection services, be represented as mark-ups and captured as follows:[80]

- Indirect network capital costs (i.e. capital costs not otherwise captured in the model) as a % of direct network capital costs. Ovum expected these to be 10-15% of direct capital costs.
- Direct network operating costs as a % of direct network capital costs. Ovum expected these costs to be 10-15% of direct capital costs.
- Indirect network operating cost as % of direct network opex. Ovum expected these to be 20-30% of direct network opex.
- Common cost as a % of investment. Ovum expected these to be 5-10% of direct capital costs.

217. Further, Ovum submitted that a categorization of expense factors as above would facilitate a comparison with international benchmarks.

218. In its response to Ovum, C&W expressed uncertainty in the interpretation of the mark-up definitions provided. In particular, C&W found the categorization of capital cost to be unclear. Moreover, C&W noted the lack of specificity in the

[80] Ovum report "A Response to Cable and Wireless (Cayman Islands)' LRIC models dated April 20, 2006, section 2.5 p. 8.

benchmark numbers provided and whether they applied to fixed and/or mobile networks.[81]

219. While the Authority has some concerns with the classification and categorisation of expense factors (as discussed below), it does not share Ovum's view that the C&W treatment of expense factors is opaque. While the Authority appreciates the need to treat expenses in a transparent and consistent manner, it does not believe simplifying the expense factor methodology in accordance Ovum's recommendations to be appropriate. In addition, the Authority agrees with C&W that Ovum fails to clearly define its benchmarks. The Authority considers there are currently no robust alternatives to the C&W expense factor methodology or indeed readily available benchmarks with which to make a comparison.

220. The following paragraphs discuss three particular aspects of the C&W methodology: (i) the appropriateness of cost categorisations, (ii) the use of existing expenses as a proxy for forward-looking costs, and (iii) the allocation of expenses to network elements.

221. The (revised) background draft costing model documentation provides the list of cost categories shown below.[82]

- Fixed network module
  - Distribution network operating expenses
  - Core network operating expenses
  - Other fixed network operating expenses
  - International network operating expenses
  - Interconnect specific operating expenses
  - Fixed network recharges
  - Fixed network specific costs
  - Fixed network support expenses
  - Annualised cost of fixed network working capital
  - Annualised cost of fixed network support assets
- Mobile network module
  - Mobile network operating expenses
  - Mobile interconnect specific operating expenses
  - Mobile network specific costs

[81] C&W Comments on the 21 April submissions and 2 June interrogatory responses in the ICTA's public consultation on the FLLRIC Manual (Ref: CD 2005-1), 7 July 2006, p. 6.
[82] FLLRIC Model for the Cayman Islands, Background Document Draft Costing Manual, Cable & Wireless Cayman Islands, Submitted 20 March 2006, pp. 20 – 21

- Mobile network overheads
- Annualised cost of mobile network working capital
- Annualised cost of mobile network support assets

o Consolidation module

- Fixed & mobile network overhead expenses
- General overhead expenses – apportioned to networks
- Overhead recharges
- Overhead specific costs

222. The interconnect specific operating expense cost category for the fixed network categories is very detailed compared to the equivalent category for the mobile network. However, it appears to the Authority that both the fixed and mobile interconnections expenses may have been fully charged to the fixed interconnect expenses cost categories. In particular, it appears to the Authority that C&W may have apportioned all costs in the ABC model associated with 'Manage Interconnect Billing' to the '100-Billing: Manage Interconnect Billing' cost category of the fixed network module and all costs in the ABC model associated with 'Support Regulatory Costing' to the '100-Support Regulatory Costing' cost category of the fixed network module. However, without detailed input from C&W it is not possible to verify the allocations made. In Phase 3, the Authority will require further information from C&W regarding these allocations.

223. The fixed network specific cost "100-Consultancy Fees (Hurricane Ivan)" captures the cost of consultancy fees that were incurred, but not capitalised, in the wake of Hurricane Ivan. Consultancy included both disaster recovery assistance and advice to deal with the immediate aftermath and strategic advice for reading future hurricanes (fixed network infrastructure only). The C&W description suggests the costs within this cost category were largely 'one-off costs' and hence should be annualised over a time period for which the advice has economic value. It is not clear whether these costs have already been annualised or not and thus further clarification from C&W is required. In addition the Authority is of the view that no costs specific to Hurricane Ivan should be included in the FLLRIC model unless they can be regarded as more generic to the operation of a telecommunications carrier in a hurricane prone area. In Phase 3, the Authority will require further information from C&W regarding these costs.

224. The fixed network specific cost '100-R&M Exchange Equipment – Ericsson Switch' is the cost of Ericsson support for the national and international switches. This includes emergency repair and maintenance, general advice and warranty provision. It is unclear to the Authority that these costs (being specific to an Ericsson switch) are relevant considering that C&W is modelling an NGN. In Phase 3, the Authority will require further information from C&W regarding these costs.

225. The mobile network operating expense "100-Provide Mobile Cellsites" captures the cost of identifying and arranging mobile cell sites. Specific tasks include specifying appropriate cell site locations, site acquisition and negotiation of related agreements (excluding any installation and commissioning costs capitalised). As can be seen in the mapping of cost centre/activity combination to expense factors provided in Appendix IIa of C&W's response to ICTA/Telcordia first round interrogatories, these appear to be employee labour costs. In the Authority's view, these costs are likely largely one-off costs that should be capitalised, although part of these costs may be recurring costs. In Phase 3, the Authority will require further information from C&W regarding these costs.

226. The mobile network operating expense '100-Provide Mobile Switching Equipment' captures the cost of providing mobile switching equipment (BSC and MSC). These are employee costs and general expenses – as can be seen in the mapping of cost centre/activity combination to expense factors provided in Appendix IIa of C&W's response to ICTA/Telcordia first round interrogatories. However, it is not clear whether these costs are one-off costs associated with the creation of the network (in which case they should be capitalised) or a kind of recurring cost associated with the maintenance of switching equipment. In Phase 3, the Authority will require further information from C&W regarding these costs.

227. The mobile network specific costs '100-Non Broadband Radio – Ericsson Support' and '100-Telecoms Equipment – Nortel Support' capture the costs of support provided by Ericsson and Nortel, respectively, under contract in relation to general mobile network equipment (including emergency-type support and others). Considering that C&W is modelling a forward-looking mobile network and these two cost categories are specific to Ericsson and Nortel (current) equipment, the Authority is unsure of the relevance of these cost categories for the modelled network. The Authority notes that some support costs are clearly required, but is unclear how these costs relate to the forward-looking technology. In Phase 3, the Authority will require further information from C&W regarding these costs.

228. With regards to the allocation of network and non-network operating costs and other non-network costs used in the C&W model, the Authority finds this to be a generally sound approach when ABC principles are used. However, as the Royalty fee is a revenue driven expense, the Authority determines that the allocation of the cost category '100-Licence Royalty' (specified as an overhead specific cost) should be based on revenue.

229. Whereas C&W has provided supporting information on how the relevant costs have been allocated to cost categories and network elements in the cost model, there is little supporting information for the total amount of costs included in the model and whether the costs are appropriate and representative of an efficient operator. In particular there are two issues that need to be considered. First, are the network and non-network operating costs and other costs from C&W's existing network reasonable to use when the modelled networks are optimised and in some cases based on fundamentally different technology? For example, in

regards to the accommodation of network related equipment, the size of equipment components has been decreasing for many years and exchange equipment today tends to be a fraction of the size of equipment with similar functionality from only 5-10 years ago.[83] A bottom-up approach would seek to estimate the space associated with the equipment modelled and use a market value per square metre to calculate the value of building (and land). However, the C&W approach appears to take these costs directly from its accounts. Second, no satisfactory documentation has been provided to show that the C&W costs are reflective on an efficient operator.[84] Indeed there may be significant room for productivity and efficiency gains to be considered in the calculation of expense factors.

230. C&W calculated all expense factors over Gross Replacement Cost ("GRC") of the network element, where the GRC of the network element is the bottom-up cost, and is, therefore, forward-looking. However, by applying expense ratios based on 'current' network expenses (drawn from top-down data) and 'forward-looking investments' (GRC), C&W implicitly assumed that the total "forward-looking" network operating expenses will be the same as its current total operating expenses, and there will be no productivity or efficiency gains from moving to the Modern Equivalent Assets ("MEA") installed by an efficient operator.

231. One simple way of dealing with this issue is to base the application of expense ratios on 'current investment'[85] (as opposed to 'forward-looking investment') and then to apply these ratios to the forward-looking investment. If the forward-looking investment has decreased relative to the existing investment, expenses will be reduced (and visa versa if forward-looking costs have increased[86]). In C&W's discussion of the potential cost savings coming from having one single fixed network to maintain and manage (instead of different networks for voice and data services) it notes:[87]

> *We agree there will be savings in network opex of the type described here. It is difficult to get a totally accurate reading from C&W Cayman's experience as it is in the middle of migration. Moreover, as with most networks involved*

[83] Newer equipment may also have influence on the size of common building-related costs including power supply units, cooling equipment etc.

[84] In addition to simple unit cost (ratio) analysis and basic Ordinary Least Squares ("OLS") regression analysis, there are two main ways of estimating relative efficiency across companies: Stochastic Frontier Analysis ("SFA") and Data Envelopment Analysis ("DEA"). Whereas SFA uses econometric techniques, DEA uses mathematical programming. Neither of these techniques are free from criticism and therefore efficiency studies normally use both, with the results of each method being used as a cross-check on the results of the other. However, the more advanced techniques require good comparable data which is likely to be difficult to find for Cayman.

[85] I.e. using physical quantities and current unit prices for the same or equivalent assets as in the C&W FAC model.

[86] One area of the network where this may take place is the access network. The access network is labour intensive to construct and maintain and to the extent it based on copper cable has seen the prices of copper rise substantially over the last five years.

[87] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories [Part 2 May 25 submission], p. 6, answer to question 2.4.3.b.

in this transition, at the end of the NGN project we still will not have a 100% fully converged, IP network (the existence of the media gateways at the access nodes testify to that.) However, in general, we believe that it is reasonable to assume that the opex reductions will be generally in line with the capex reductions, which is what the expense factors do.

232. Within certain bounds the Authority agrees that reductions in operating cost will follow capital expenditure. However, over time, changes in technology may change the relationship between expense factors and investment.[88] This is reflected in commentary provided by C&W:[89]

> *...on reviewing the network expense categories, we do find there would be economies among a couple of the service and platform provision and support. In particular, "maintaining internet service equipment" and "provide internet services" may be inappropriate given that the entire network is "going IP". There are several ways we could treat this. We would propose to simply eliminate these cost entries.*
>
> *There are two significant exceptions to this general expectation of reduction in network expense reductions:*
>
> *1) We have found an increase in electricity consumption associated with the migration to NGN facilities. We use about 64% more power on a KwH basis (even more on a monetary basis). This is due to the fact that both the power consumption of the new systems is greater and, as a result of the increased power consumption, the heat generated is greater, thus resulting in significantly higher A/C cooling requirements.*
>
> *2) Support costs for the NGN switch and IP platform has risen by three times (this specifically covers for maintenance issues, hardware repairs, software updates/patches for maintenance and new software upgrades which contain new functionality)….*

233. Indeed C&W has already made some adjustments to capture anticipated economies in expenditures by eliminating some annual switching operating costs allocated to the 'international switch' and some fixed network operating costs associated with recharges. The Authority agrees with these adjustments.

234. Basing expense factors on 'current investment' and applying them to the forward-looking investments in the model is a pragmatic approach to a potentially complex problem. The Authority does not believe that a fundamental review of existing expenses and/or further adjustments to account for forward-looking technology are warranted at this time. However, for avoidance of doubt, the Authority notes that it may not be possible for C&W to reap all the benefits (cost savings) associated with the 'forward-looking' technology, during the migration period to NGN. The FLLRIC approach should approximate those costs that

[88] The Authority notes that there are many expense factors especially in the consolidation model and of the non-network type that will be largely unaffected by an upgrade of technology.
[89] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories [Part 2 May 25 submission], p. 5, answer to question 2.4.3.a.

would be faced by a new carrier investing in the network at the time of the study assuming that the network will be fully constructed using the current generation of technology, without any allowance for the need to inter-work with previous generations (the 'instantaneous build' approach). Any costs that are redundant because of operating two networks at the same time should therefore be excluded. For example in the mobile network, C&W note:[90]

> *Our expense factors [in the mobile network] have embedded some TDMA costs. These should be excluded in anticipation of the total closure of that system. In particular, this will result in a ceasing of a … annual support contract with Ericsson. There is also an anticipated power (to the TDMA switch and BTSs) reduction …. Finally, the closure of the TDMA network permits elimination of a TDMA roaming circuit (a 56k signaling link to the US to permit and support TDMA roaming) …*

235. With respect to the non-network expenses, C&W proposed a 4.8% reduction in fixed and mobile non-network costs (corresponding to the productivity efficiency reduction that is found in C&W License and Agreement with Government).[91] C&W stated that these figures are consistent with its budgetary forecasts for the non-network opex from 2005-06 to 2007-08.

The Authority's decision: Expense Factors

236. C&W is directed to:

- Explain the apparent disparity in detail between interconnect specific costs incurred in the fixed module with those in the mobile module.
- Ensure that expense factors do not include any costs specific to Hurricane Ivan, but only those costs that are required in the operation of a telecommunications business in a hurricane prone area. Provide documentation on the hurricane specific costs included in the FLLRIC model.
- Explain the relevance of the fixed network specific costs "100-R&M Exchange Equipment – Ericsson Switch" considering that an NGN is being modelled.
- Split the cost centre/activity combination (in the ABC model) if relevant into what can be capitalised labour expenses (associated with the design, engineering, installation, creation of the network and commissioning) and non-capitalised labour expenses for the mobile network operating expenses '100-Provide Mobile Cellsites'. Alternatively, C&W must explain why spitting the costs would not be appropriate.
- Explain the cost centres/activity centres related '100-Provide Mobile Switching Equipment' (in the ABC model), and if relevant split them into capitalised labour expenses and non-capitalised labour expenses.

[90] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories [Part 2 May 25 submission], p. 5, answer to question 2.4.3.a.
[91] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories [Part 2 May 17 submission], p. 8, answer to question 2.1.8

- Explain the relevance of including both '100-Non Broadband Radio – Ericsson Support' and '100-Telecoms Equipment – Nortel Support' in the light of the forward-looking assumption and modelled technology.
- Allocate royalty costs based on revenue rather than costs.
- Base its network expenses factors on 'current investment' (as opposed to 'forward-looking investment') and 'current expenses'.
- Add an option to the FLLRIC model allowing the user to take account of efficiency improvements, i.e. by adding an input parameter that adjusts the expense factors directly by whatever efficiency improvement the user is investigating. This factor should per default be set to zero percent.

237. Subject to any further modifications resulting from the items in the preceding paragraphs, the Authority determines that C&W's expense factors should be used for both fixed and network cost modules and in the consolidation module. Further, the Authority determines that the same expense factors should be used for both 2G and 3G network modules.

Model Transparency and Clarity of Information

238. During the interrogatory phases, the Authority received several versions of the C&W cost model and the Authority notes that the Excel workbook structure has continually been improved. However, the Authority is of the view that the model continues to suffer from lack of transparency in some areas.

239. In general, the inputs assumptions, calculation of intermediate results and outputs contained in the fixed and mobile calculation workbooks are not presented concisely. Information is duplicated on a number occasions and in at least one case causing a possible error in the calculations.[92] In addition, the repetition of the network elements lists and service lists in all modules will make adding new network element and services difficult and time consuming.

240. The ordering and organization of the calculation worksheets within the fixed module workbook and the mobile module workbook make the calculations difficult to follow. Calculations of network element investments are often carried out across several worksheets that are spread throughout the workbook with many unrelated worksheets in between.[93] Many of the network elements investments could be calculated relatively independently from one another sharing only a few common assumptions, inputs, capacities, or investments. This would allow for all

[92] An example of this is found in the fixed model, where the total investments for all the Multi-Service Edge routers are inputted on the Cost Assumptions worksheet. These investments are divided by one or two to calculate the investments per MSE site. The investments per MSE site are then referenced on the NGN Costs worksheet and multiplied by one or two to calculate the total MSE investment. However, the MSE equipment item USP is divided by two on the Cost Analysis worksheet, but multiplied by one on the NGN Costs worksheet.

[93] For example, the calculation of the 400-RSU traffic sensitive network element is carried out across the 'MG Calculations', 'MG Dimensions', 'Cost Assumptions', 'MG Analysis', 'Asset Lives', 'Technical Assumptions', and 'Routing Factors Input' spreadsheets, none of which are adjacent to one another in the fixed model calculation workbook.

calculation worksheets used in the calculation of each network elements to be ordered together. Sheets containing common information could also be ordered together and referenced using range names. This would enable users to follow the entire calculation of a network element investment on consecutive worksheets and minimize the need to look up information on distant worksheets each time it is referenced.

241. Several implementation choices within each of the modules also make the calculations within the modules difficult to document and verify. These include:

- *Extensive use of pivot tables*: The modules pass data and intermediate calculated values from one calculation to another and from one module to another by copying values into pivot tables. These values are then copied and used in calculations by use of the GETPIVOTDATA function. The results of the GETPIVOTDATA function are not intuitively obvious, requiring an understanding of what the function does and of the layout of the pivot table it refers to in order to derive the result.
- *Extensive use of macro code*: The modules use macro code to copy data and calculate results into pivot tables, to make calculations, and to zero out input values to carry out the iterative processes associated with the FLLRIC calculations for each service. The use of macros makes it difficult for users of the modules to follow calculations step by step, by hiding the calculation within the code. Where it is appropriate to use macros, the calculations and steps performed should be clearly documented.
- *Lack of range names*: The modules consistently use cell references in cell equations and functions. Cell references do not allow users to readily know what the values used in equations and functions represent. Users are required to look up cell reference, sometimes across several worksheets to understand the values. Range names can assist in making cell references more clear by assigning a relevant explanatory name to a particular input or value.

242. In addition to these general issues, there are some specific transparency problems with both the fixed and mobile modules.

243. Within the fixed module some assumptions are provided without any documentation or clarifying descriptions, sometimes making it difficult to know what the assumption represents. For example the three assumptions, 'Number of Core NGN Sites', 'Main Exchange Sites', and 'Number of Core Sites', are all very similar in name but are not defined. In addition, some assumptions include either only a general note regarding the source, or no source at all.

244. The Authority has also identified assumptions that do not appear to be used in any equation in the modules. One example of this is the assumption 'Minutes Per Annum'.

245. Technical assumptions are typically values that are basic to the equipment deployed or the technology used in the network. They are values that are given as

capacity limits or engineering values which can not be derived. However, where values are derived, details should be included about their derivation.

The Authority's decision: Model transparency and clarify of information

246. To improve the readability and transparency of the C&W model, C&W is directed to:

- Introduce colour coding in the FLLRIC model, i.e. different cell or font colours depending on the nature of the cell. In Excel different styles can be defined. Examples of useful cells types include: Input data (where a user may enter a value), calculations, warning messages, cells that link to external data and confidential data.
- Remove Pivot tables in the FLLRIC model and replace these with alternative calculations, i.e. calculations that make use of Excel formula and which are directly performed in the relevant cell.
- Use named ranges in the FLLRIC model to assist in the understanding of calculations.
- Eliminate the use of macros in the FLLRIC model where possible. Where macros are used they should be well documented. Calculation processes should be noted and steps that are preformed by macros should be explained.
- Minimise duplication in the FLLRIC model.
- Show any hidden cells in the FLLRIC model. No calculations or input should be hidden anywhere in the workbooks.
- Provide clarifying descriptions associated with inputs making it clear from where each are derived and/or from where they originate.
- Remove redundant information in the FLLRIC model and remove assumptions and input which are not used for any purposes in the modules.

247. With regards to duplication, C&W is directed to reduce the amount of duplication in the model by eliminating excessive or unnecessary entries. An example, where duplication would appear to excessive is found in the network element list which is repeated across the Fixed and Consolidated module 19 times. Clearly the network element list is integral to both the investment and demand calculations, but for the sake of simplicity and ease of model use, efforts should be made to limit the number of times the network element list is repeated throughout the model calculation workbooks.

248. In addition to the directions provided above, for Phase 3, C&W is directed to consider whether it is appropriate to further improve transparency by adding a separate input workbook from which the fixed and mobile module could source inputs. Apart from separating out input from calculations and results, such an approach would have the advantage of collating information that is common to both network modules in the same spreadsheet. In the Authority's view, this would also help ensure that common input is properly used.

Sensitivity analysis and Model Function

249. In the current version of the model, sensitivity analysis is difficult and requires significant manual effort.

250. As part of the review of the model, sensitivity analysis was conducted on the model to determine the sensitivity of the service costs calculated to changes in key inputs and assumptions. During this analysis an apparent error was discovered in the mobile module demonstrating that for changes to certain inputs the module could not guarantee that the same set of output values would be produced for the same set of input values.

251. When asked about this apparent error C&W responded that this is a process problem rather than a problem with the operation of the modules and provided a step by step guide to run the modules illustrating very clearly the complexity in the process:[94]

> *For any change to the BU model variables such that the investment costs are affected, one would need to update the expense factors in both the BU model and Consolidation file. The process used in testing the models did not include updating of the expense factors, resulting in an inconsistency of the results. When running the models, please include the following steps:*
>
> *Open a new set of models including the expense factor file (see attached Appendix 2_Expense factors) (open fixed and mobile BU models, expense factor file, Consolidation file)*
>
> *Check that the expense factor sheet results are carried through to the ABS_VAL sheet.*
>
> *Record the mobile network results of the consolidation file. Also record the FAC results of the mobile BU model.*
>
> *Run the model through the Main sheet in the consolidation file*
>
> *Open the BU models (as they would have been closed)*
>
> *Record the results of the mobile network sheet of the consolidation file and also record the results of the FAC Output sheet in the mobile BU model (these results should be the same as the first run above)*
>
> *Select the mobile BU model and turn to the Technical Assumption sheet. Adjust the desired variable (in this case, the 1900 spectrum assumption)*
>
> *Select menu and click on the update FAC values.*
>
> *Select the expense factor sheet of the mobile BU model and update the expense factors. To update the exp factors: select cell E31 and type the following formula - "=VLOOKUP(A31,'[100306 Expense Factors and TD Categories_d17.xls]Expense Factor Adjusted'!$A:$D,4,FALSE)/D31"; copy*

[94] C&W Cayman Islands Response to ICTA/Telcordia Round 3 FLLRIC Interrogatories, answer to question 4.4.1.

this formula down for all listed factors in col E; select the new list of factors, copy and value paste in the same location.

Select menu and click on update FAC values

Save the mobile BU model.

Select the consolidation file and run the models. This must be done as the consolidation file must now reflect the new mobile BU model values (GRC, annualised cost and opex).

Re-open all the BU model files.

Select the expense factor sheet of the consolidation file In cell E55 type the following formula - "=VLOOKUP(A55,'[100306 Expense Factors and TD Categories_d17.xls]Expense Factor Adjusted'!$A:$D,4,FALSE)/D55", then copy this formula down the list for all factors. After copying the formula, select the new list in col E, copy and value paste in position. (this would have created the updated exp factors based on the new GRC, annualised cost and opex from the BU models)

Save the consolidation file

Select 'Main' and run the models again. The ensuing results should be the true and accurate values

252. The procedure outlined above was tested and it was confirmed that the same outputs were always produced for the same set of input values. However, the procedure is clearly very cumbersome and severely limits the practical use of the model and ability to conduct sensitivity analysis. The Authority is also concerned that such a complex procedure must be followed in order to use the model. In the Authority's view, requiring users to follow such a process introduces too many opportunities for errors.

The Authority's decision: Sensitivity analysis and Model function

253. The Authority cannot accept a model whose operation at times may require the number of steps outlined in the quote above. Accordingly, C&W is directed to:

- Revise the workings of the model to make it more simple to use. For example, input changes to capital costs, the WACC, asset lives etc. should to the largest extent possible flow automatically through the modules to service unit costs without the need for manual changes.
- Provide documentation for those parameters that require several steps to be performed when updating.

Fixed Network module

254. Network costs in the fixed module are divided into access, infrastructure, transmission and switching categories.

- *Access* is the part of the fixed network from the exchange to the subscriber and includes ducting, trenching, cabling, manholes, distribution points etc.
- *Infrastructure in the core network* includes ducting, cabling (fibre), submarine cable links, manholes, splicing etc.
- *Transmission* consists of electronics including Add Drop-Multiplexers ("ADM"), tributary cards, etc.
- *Switching* includes MGs and Multi-Service Edge ("MSE") gateways.

255. The methodology employed to derive the cost of each of these network categories is discussed in the following.

Access Network

256. C&W has modelled a copper cable infrastructure containing the following components:

- *Ducting and trenching* costs were estimated on the basis of the costs over different terrain (footway – unsurfaced, footway – concrete in situ, carriageway asphalt) and were categorized as being used on a shared or an exclusive basis.
- *Copper multi-pair cables* were assumed to be used in a variety of sizes ranging from 6-pairs to 2000 pairs. Some of the cable was underground, either in ducts or directly buried, and some was aerial and mounted on poles.
- *Joints* provided the connections between the cables. They come in varying sizes according to the cable size.
- *Manholes* provided access to cables joints for installation and maintenance purposes.
- *Poles* for aerial cable were categorized as either dedicated to C&W or shared with other utilities such as CUC and divided into owned and rented poles.
- *Distribution Points* ("DPs")[95], *Dropwires* and *Network Interface Devices* ("NIDs") provide the final link to the customer premises.

257. C&W determined the cost of each component by multiplying the component cost by the number of units for that component (taken form the 'Access Calculations' worksheet). In this process, C&W made a number of explicit and implicit assumptions, including:

- all existing nodes in the network will remain;
- the total numbers of DPs and NIDs remains the same as the existing network;
- the current lengths and sizes (i.e. pairs) of cable are required to service the demand, including allowances for spare capacity;
- the existing number of cabinets and poles are required to service the demand;

[95] Distribution points should here not be understood as various aggregation points between the exchange and customer premise (sometimes called primary and secondary distribution points), but rather exit points from the main cable to the customer premises.

- the km length for each cable type is the same as in the existing network; and

258. The Authority has reviewed the methodology in detail and has a number of concerns with the approach and identified some errors.

259. An overriding assumption made by C&W is that its existing access network is efficiently engineered. Inputs are derived directly from C&W's existing network. The Authority is concerned that C&W has not provided information sufficient to evaluate whether or not the existing network is appropriately sized for the assumed level of demand.[96] Related to this concern is also the use of copper based technology. As the C&W modelled access network is based on the existing network, copper based technology is used in the module. C&W provides no justification for this assumption or indeed any discussion of alternative access technologies that may be used as part of the FLLRIC modelling. It is also unclear to the Authority whether the inputs used reflect the appropriate planning horizons typical of an access network (for example, 5 or 10 years of spare capacity).

260. The Authority notes that the dimensioning of the access network is subject to varying degrees of scalability; some components are scalable, others are not. For example, the number of poles and manholes and the quantities of ducting and trenching are direct inputs to the module and not subject to scaling. From the perspective of calculating incremental costs as C&W has done, this is a major deficiency. Reducing demand will at some point have an effect on the number of poles, manholes, DPs etc.[97] The resultant network, with only a fraction of the subscribers, would represent a sub-optimal and inefficient network that would not be rolled out and hence would not accurately represent the costs that would be avoided. However, since the Authority is of the view that the allocation to services should be based on routing factors approach (i.e. within the access network the increment), this deficiency in the calculations is less of an issue. In Appendix C, the Authority provides further discussion of concerns with this approach.

261. With regards to cabling and jointing, the module makes extensive use of linear interpolation to derive component costs. This has, in some cases, resulted in erroneous component costs. For example, the cost of splicing an 800 pair cable is substantially below the cost of smaller sizes and the cost of spicing a 1500 pair cable is below that of a 1200 pair cable.

262. There appears to be an error in the calculations that results from a typo in the number of copper pairs available in one of the cable types. The first cable type under 'Aerial E-side' has 50 copper pairs instead of 5. The result is that the number of kilometres calculated for that cable type is overstated by a factor of 10.

[96] For example, C&W has provided no information to justify the use of 6 pair drop cable.

[97] Note that reducing demand in the access network is the same as removing a particular customer. The scorched node assumption defined by the Authority does not requires the equipment at each customer premise be retained which appear to be the assumption that C&W has used when changing demand in the network. This is a misinterpretation of scorched node.

263. C&W's duct calculations were separate from the other access calculations and used both for access and core networks. The demand for ducts for both access and core networks were an input to the module.

264. The component cost of each major duct type (measured by the number of bores) and duct demand were combined to yield an estimate of the total capital costs of duct. This total cost estimate was then allocated to access and core respectively based on the kilometres of duct in each part of the network.

265. The Authority has a number of concerns with this approach. First, the total kilometres of duct used as input differs from that used to allocate duct cost between access and core. Second, some of the duct used as input is classified as exclusive meaning that this duct is not shared use duct. The current approach implicitly assumes that exclusive duct is used in the same proportion as the number of kilometres of duct in each network.[98] It is unclear whether this is an accurate reflection of reality or reflective of a forward-looking operator.

The Authority's decision: Access network module

266. C&W is directed to:

- Justify the optimality of all the inputs used in the access network part of the fixed network module. The Authority emphasises that the access network should reflect forward-looking principles and a simple replication and re-valuation of C&W's existing access network cannot be regarded as a cost efficient solution without proper documentation. Justification should also be given for the assumed planning horizon.
- Align and use a consistent set of cable sizes through-out the access network modelling in the fixed network module.
- Ensure that interpolation between equipment sizes does not result in erroneous component costs in the fixed network module.
- Address the Authority's concerns with regard to the allocation of duct costs between access and core network.
- Provide documentation to show that exclusive duct is used in the same proportions as number of km in each network or where this is in error, correct the approach ensuring it is reflective of forward-looking operator.

Switching Network

267. C&W has used NGN equipment in the switching network. The solution consists of a number of MGs which replace existing Remote Subscriber Units ("RSU") and two softswitches that are assumed to be located at the existing local switch sites.

[98] For example, if there is 900 km of duct in the access network and 100 km of duct in the core network, then access would be allocated 90% of the cost of exclusive duct.

268. The switching network was dimensioned and developed within the 'MG Dimensions', 'MG Calculations' and 'NGN Costs' worksheets. The Authority considers that the MG network equipment inputs are presented in a clear and acceptable manner and calculations related to them are straight forward.

269. On the 'MG Calculations' worksheet, the MG total investment was calculated and split into a fixed and variable component. The Authority has identified two methodology problems with the MG calculations. First, the 'Fixed Cost' as a percent of 'Total RSU/MG Investment' is calculated at the intercept of the MG total investment vs. MG total subscriber curve, i.e. using linear regression of the data points consisting of MG costs and their associated capacity measured in number of lines.

270. Total fixed costs were calculated as a percentage of total costs by dividing the intercept cost by the total cost of all MGs used in the sample. The Authority considers this approach to as a basis for estimating a fixed cost share to be erroneous. Indeed it is unclear how the fixed cost as a percentage of total investment figure should be interpreted. With more (or fewer) data points the percentage would have been smaller (or larger). The intercept cost is the implied fixed cost element based on the data points provided and may be interpreted as the minimum one should expect to pay for a MG unit. The cost curve for a MG is likely to be a step function with the size of the step dictated by the modularity of the equipment rather than a linear function. If the linear regression method is accepted as a reasonable representation of the cost of a MG for different line sizes, the fixed cost element would be decreasing for larger sizes and not a fixed percentage, as suggested by C&W.

271. To further exacerbate the errors of the C&W calculation, the variable and fixed cost components were taken as proxies for traffic and non-traffic related (line related) costs, i.e. the fixed component was allocated as a minute related cost and the variable component as a line related cost by placing the costs into two network element categories: '400-RSU traffic sensitive' and '400-RSU line sensitive'. While the Authority agrees that there are elements of the MG/RSU that are traffic and line sensitive and some that are common between the two categories (such as racks, frames, etc.), the Authority is not satisfied with the allocations in the fixed network module.

272. In addition, the fixed cost investment per MG was separated into 'Fixed Cost per MG' and the 'Variable Cost per MG' on the 'MG Calculations' worksheet by multiplying the total investment per MG by a factor: 'Fixed Cost' as % of 'Total RSU/MG Investment'. However, the variable component used calibrated line data while the fixed component used actual line data. The Authority is of the view that a consistent demand set should be used.

273. Finally, the total investment per MG was calculated by multiplying the 'Fixed RSU/MG Investment per port' by the number of MG ports. However, the 'Fixed RSU/MG Investment per port' was not based on MG equipment only but was based on two different types of equipment: the Nortel NGN and the AXE

RLU/RSM. In the Authority's view, the likely result is that the MG fixed and variable costs are not forward-looking costs.

274. The two softswitches were assumed to be capable of handling all the international traffic, as well as national, and so there is no separate international switching element. The Authority considers this to be a reasonable assumption.

The Authority's decision: Switching network

275. C&W is directed to:

- Separate the MG investment into fixed and variable according to dimensioning rules and functionality of the equipment. Where this is not possible, C&W must correct for the methodological problems identified by the Authority.
- Use a consistent demand set to separate the fixed cost investment per MG into a 'Fixed Cost per MG' and the 'Variable Cost per MG'.
- Eliminate the use of estimates that mix old and new switching technologies and update the fixed network module to reflect MG investments based on NGN equipment only.

Transmission Network

276. C&W modelled a transmission network based on traditional SDH equipment, in a resilient ring configuration. The modelled network provided a minimum of one STM-1 link to each MG.

277. The transmission network consisted of the following SDH types and equipment:

- STM-1,
- STM-4,
- STM-16,
- STM-64,
- Add Drop Multiplexer ("ADM"),
- Tributary Cards, and
- Digital Cross Connects.

278. The modelling of transmission costs relied on a number of manual inputs which define the basic transmission structure of the network as noted above. The Authority's review of the 'Transmission Dimensions' worksheet revealed no errors in the calculations.

279. While the Authority broadly agrees to the basic structure of the transmission network, it is largely static in a network demand sense, i.e. changing base service demand in the network has no influence on dimensioning in this part of the

network.[99] While the Authority recognizes that the modularity of transmission equipment may influence this aspect of the modelled transmission network, further explanation from C&W is required to justify the reasonableness of the approach.

The Authority's decision: Transmission network

280. The Authority accepts the basic structure of the modelled transmission network, but requires further explanation from C&W regarding the appropriateness of the transmission network not changing in response to changes in demand.

Infrastructure Network

281. In the C&W fixed network module, transmission equipment was connected using optical fibre cables that were either underground cable in ducts or aerial cable supported on poles. Infrastructure costs consist of cabling, ducting (and trenching) and poles. The module used direct input from C&W's existing network to model infrastructure. For fibre cable this was the size (in terms of fibre strands/pairs) and length measured in kilometres and whether the cable was aerial or underground. For duct it was the number of bores and the length of each.

282. The fixed network module had an input of 122.98 km fibre cable of different pair sizes of which 40.78 km was aerial and the remaining 82.20 km was underground. In terms of duct, the module has a total input of 490.23 km of which approximately 13% was allocated to core cable and the remaining was allocated for the use of underground copper cable in the access network. The split between access and core was based on the number of underground cable kilometres in each network.

283. The Authority has a number of concerns with the approach:

- Cable size requirements may be satisfied by different combinations of cables of different sizes. For example, if a route requires a 32 pair cable, this requirement may be satisfied by a combination of a 24 pair cable and a 12 pair cable as well as by a 48 pair cable. The cheaper of the two combinations should be chosen. The module does not appear to make these considerations. In general, the need for different cable sizes should be determined taking into consideration the future demand to mirror the fact that digging of new trench represents a substantial cost. The need for excess capacity should therefore be based on rational economic considerations taking into account modularity and margins for growth;
- Using data directly from the current C&W network and hence existing routes will unavoidably include inherent legacy impacts of a network constructed and reinforced over many years. No attempt as been made to use distance minimisation techniques to provision for an efficient set of routes between nodes. It is therefore not possible to evaluate the efficiency of the inputs;

[99] The Authority notes that there would appear to be some off-line transmission calculations in the model related to access ring capacity.

- The input duct dimensions do not match the cost inputs used in the module. For example, a shared 3 bore duct input is costed as a 4 bore duct;
- For duct, no attempt has been made to model the cost differences due to trenching in different terrains. The fixed network module simply chooses the most expensive option – carriageway in asphalt, although it contains cost input for unsurfaced and concrete in situ footway. The Authority would expect it to be possible to derive a terrain profile based on trenching in the existing network; and
- Although a significant portion of fibre is on poles, the fixed network module does not appear to allocate any pole costs to the core network. All poles costs appear to be allocated to the access network.

The Authority's decision: Infrastructure network

284. C&W is directed to:

- Provide documentation for the optimality and/or efficiency of the infrastructure inputs used (cabling, ducting trenching etc.). This should include a discussion of how excess capacity has been taken into account, how legacy impacts[100] have been dealt with and the choice of trenching terrain.
- Correct the input duct dimensions to match the cost inputs used in the fixed network module.
- Ensure an appropriate portion of pole costs are allocated to the core network.

Unitization Methodology

285. Within the C&W model, the investments associated with each network element were unitized according to the demand cost driver associated with the network element, as shown in the table below.

Table 5: Unitization of network elements

Network Element	Unit of unitization
400-International Tx	Minutes
400-PSTN Host Switch - call sensitive	Calls
400-PSTN Host Switch – duration sensitive	Minutes
400-RSU traffic sensitive	Minutes
400-RSU line sensitive	Lines
400-RSU-Host Tx	Minutes
400-Host-Host Tx	Minutes
400-National submarine Tx	Minutes
400-PSTN Voicemail	Minutes
400-IP Equipment	2Mb Links
400-ADSL Equipment	Lines
400-Payphone Equipment	Lines
400-Prepaid PSTN Calling Card Equipment	Minutes
400-VAS platforms	Calls

[100] For example, duplicative cable runs in C&W's current network as a result of the construction and reinforcement of the network over the course of a number of years.

Network Element	Unit of unitization
400-DQ Operator services equipment	Minutes
400-Contact Centre Platforms	Calls
400-Access Local Loop	Lines
400-Interconnect billing platform	Calls
400-Interconnect Specific Costs	Minutes
400-Data Network Equipment	2Mb Links

286. C&W has not provided a rationale for the unitization presented. While most of the unitizations appear reasonable, the Authority is of the view that, in order to be consistent with other similar network elements, it may be appropriate that the unitization of the network element 400-Contact Centre Platforms should be on the basis of minutes and not calls. In Phase 3, the Authority will require C&W to provide justification for the use of calls as the network unitization.

The Authority's decision: Unitization methodology

287. C&W is directed to:

- Provide justification for the unitization of the 400-Contact Centre Platforms based on minutes rather than calls.

Cost Assumptions

288. Cost assumptions are the pricing values or component costs used to derive the cost of equipment or activities considered in the model cost analysis.

289. C&W's documentation for the fixed network module[101] provided an overview of the various access and core network components in the module (Sections 2.9 – 2.13). In addition, Appendix L of the revised manual provided a detailed listing of all the input parameters used in the module. Generally, the different cost inputs were categorised as follows:

- Infrastructure included a variety of duct configurations and associated elements (e.g. junction boxes). Duct component costs were provided as a function of distance. Other component costs included purchase pricing, installation effort and planning activity and optical fibre cables;
- Access Network included copper cabling, network interfaces, cabinets, poles, manholes and terminals;
- Transmission Equipment included ADMs (common equipment and line cards) and cross connect equipment;
- NGN elements included MG components (including network management) and multi-service edge components such as softswitches, controllers, and servers; and
- Other included routers, Ethernet switches, DSLAM equipment, payphones, broadband access devices and legacy equipment.

[101] File C&W Revised FIXED manual 2006_03_10

290. To confirm the appropriateness of the values used, the Authority attempted to compare the costs with other available reference values. As an example, the price of STM-1 ADM equipment fell within the range of available reference values, while the price for STM-4 ADMs exceeded the upper bound of available reference values. These differences could have been the result of variations in procurement volumes, configurations, or other considerations as discussed below.

291. A similar comparison was made for selected optical fibre cable costs. The inputs used in the module appear consistent with industry averages of which the Authority's consultant is aware. Differences between the input values for underground copper cables (50 and 100 pairs) and the industry reference values were in the order of 23 percent. Subject to the appropriate inclusion of supplier discounts as discussed below, the Authority considers those levels of variations to be acceptable given the factors influencing the price of material and equipment.

292. With regards to the cost inputs of the Multi-Service Edge (MSE) routers, these were input on the 'Cost Assumptions' worksheet and divided by one or two to calculate the investments per MSE site. These investments per MSE site were then referenced on the 'NGN Costs' worksheet and multiplied by one or two to calculate the total MSE investment. The MSE equipment item Universal Signal Point (USP) was divided by two on the 'Cost Assumptions' worksheet, but multiplied by one on the NGN Costs worksheet. It is not clear to the Authority which is the correct calculation.

293. The module provided an indication of the sources of the input costs by labelling costs as "C&W", "Benchmark" or simply "Cayman". The module provided no further explanation or supporting documentation for these sources.

294. The Authority considers a more explicit description of, and additional supporting information for, these sources would help in assessing how the input values were determined. The actual expenditure amount for a piece of equipment is generally a function of volume discounts (which in turn is impacted by whether C&W Cayman Islands is procuring equipment as an independent entity or as part of the larger C&W group), specific equipment configurations, bundling of the physical components with the software and cabling/interfaces, maintenance/extended warranty contracts, and other factors.

295. As part of the interrogatories, C&W indicated that supplier list pricing was used as inputs for the fixed NGN equipment.[102] C&W indicated that it was undecided as to the appropriate treatment of discounts as prices could vary among buyers and assets purchased. Prices also can vary over time.[103]

296. Whilst the Authority agrees that there may be significant variations in equipment discounts from list prices, the Authority is of the view that the usual practice in purchasing telephone equipment is that service provider generally acquires

[102] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories, 17 May 2007, response to question 3.6.1.
[103] Ibid.

equipment at a discount of the manufacture's list price. Therefore, in the Authority's view, it would be prudent to assign a "real life" discount to the equipment list prices; otherwise, investment results will be overstated.

297. The Authority also notes that in paragraph 8 of Appendix 3 of ICT Decision 2005-4, under the heading "Input prices", the Authority concluded that input prices *"... shall be based on prevailing vendor prices or vendor prices under consideration that reflect volume or term discounts off listed prices*" and "*[t]hese discounts shall be reflected in the cost study.*"

298. In regards to the treatment of spares, its response to first round interrogatories, C&W noted that:[104]

> *No, spares were not explicitly shown in the fixed model; however, a consideration for spares has been included in the investment costs listed.*

299. In the second round of interrogatories, C&W elaborated further on this issue noting that it was standard practice for vendors to include in spares in the initial kit shipments and that spares were often not broken out of the total. C&W also referenced the delivery of maintenance spares that were separately invoiced over the lifetime of the facilities. The cost of the additional spares was estimated to be between 2-7% of the original investments.

300. The Authority considers that the inclusion of spares is legitimate in a costing model reflecting real world practices. However, the cost of spares should reflect only the amount of spares that an efficient operator would require. The Authority is not satisfied with the current application of spares in the context of the fixed network module. Spares should be shown and accounted for separately. Although C&W has been forthcoming in its description of how the cost of spares may be incurred, the information provided is not sufficient to enable the Authority to assess directly the amount of spares included in different parts of the network. The Authority notes that the mobile network module takes into account the use of equipment spares by adding five percent to equipment costs.

The Authority's decision: Cost Assumptions

301. C&W is directed to:

- Provide information explaining in detail the source all assumptions marked as "C&W", "Benchmark" or "Cayman".
- Indicate whether one or two USP's are needed in the fixed network module.
- Amend the fixed network module to take account of the cost of spare equipment inventory in a manner consistent with the mobile network module approach, i.e. as an additional percentage of the original investment. The percentages used should be justified and documented.

[104] C&W Cayman Islands Response to ICTA/Telcordia Round 1 LRIC Interrogatories, 23 February 2007 submission, answer to question 3.5.2.

- All equipment cost inputs must reflect a "real life" level of discount from list pricing.

International Transmission / Infrastructure / Switching

302. The C&W fixed network module used submarine cable systems to provide international connectivity for voice and data. The module assumed that the costs associated with these systems were similar to the cost associated with one particular system that was recently acquired and provides resilient connectivity via Jamaica, Panama and Miami. Using the total cost of that particular deployment, a unit cost per STM-1 was developed and multiplied by the estimated busy hour demand for international traffic for the Cayman Islands (in STM-1 equivalents) to derive an estimated cost.

303. However, C&W has explained that the dollar amount of the investment used in the module to derive the per-STM-1 investment corresponds to a 25-year Indefeasible Right to Use ("IRU") contractual agreement on the existing Maya Consortium.[105] It does not represent the cost of deploying submarine cable and associated transmission equipment. The numbers are based on a consortium model, where costs are shared equally among participants, with no economies of scale or profit margins to be made. C&W indicated that these figures correspond to a commercial agreement among a number of parties for the use of a shared optical transport resource. There is no information available to understand how the price of the IRU was determined. C&W also indicated that the "per-STM-1" charge is an agreed rate that is proportional to capacity.

304. Further, there appears to be an instance of double-counting of a minor cost between the mobile and fixed modules. The mobile module includes the annualized operating cost for a full STM link for the National Submarine Cable Connectivity. This expense is taken from the fixed module and directly applied to the mobile module. However, only a portion of an STM-1 capacity would be needed to satisfy all the national inter-island traffic. Therefore this cost should be split between the fixed and mobile cost modules, rather than counted in both. The Authority notes that this annual expense is relatively small and has minimal impact on the results, but should be corrected nonetheless.

305. With regard to the international switching, C&W assumed that the two softswitches were capable of handling all the national and international traffic and as a result there was no separate international switching element. The Authority finds this assumption to be reasonable.

The Authority's decision: International Transmission/Infrastructure/switching

306. C&W is directed to:

[105] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories, Part 2, 25 May 2007, response to question 3.7.1.

- Provide documentation of the IRU price given that the cost of International Transmission (submarine) is a considerable component of total costs.
- Split the costs of the STM capacity for national inter-island traffic between the fixed and mobile modules by ensuring there is no double counting.

Technical Assumptions

307. Technical assumptions are parameters that are used to structure the network, select the locations to be modelled and identify the properties of the equipment considered in the cost analysis. These are often values that cannot be derived. For example the number of lines per MG is a basic capacity value associated with the type of MG equipment deployed in the network and is an example of a value which cannot be derived and is typically supplied by the equipment manufacturer. In the C&W fixed network module technical assumptions also included derived values, e.g. the SOFTSWITCH ratio of call-sensitive/duration-sensitive which appeared to be dependent on the termination and traffic mix of the MSE.

308. The technical assumptions used in the C&W fixed network module are shown below.[106]

Table 6: Technical assumptions fixed module

Assumptions	Values
Conversion factor for minutes to erlangs	60
# of 64 kbits/s channels in a 2 Mbits/s link	30
MG Fill Ratio	75%
SOFTSWITCH ratio of call-sensitive/duration-sensitive	74%
Number of Core NGN Sites	2
Max Lines per MG	2048
Circuit Efficiency Factor	66%
Main Exchange Sites	2

309. Most assumptions were provided without any documentation or clarifying descriptions making it difficult to know what the assumption represented. For example, Number of Core NGN Sites and Main Exchange Sites were both similar in name but were not defined. The softswitch ratio of call-sensitive/duration-sensitive assumption only noted "C&W" as the source and no documentation was provided showing how the value had been derived. The Max Lines per MG assumption, which ideally should have referenced a MG manufacturer's technical documentation, did not note any source at all.

310. The value for the SOFTSWITCH ratio of call-sensitive/duration-sensitive was particularly important because it determined how the MSE investment was divided between investment per calls and investment per minutes.

[106] The values are taken from the Technical Assumptions sheet. On this sheet there also appear to be a set of assumptions that are no longer in use and should be deleted, they are: Number Of Lines, Line/Trunk Ratio, Minutes Per Annum, Number Of Core Sites and Number Of Access Sites.

311. In the first round interrogatories, C&W was asked to explain and justify the assumed Circuit Efficiency Factor. In response, C&W noted that 66%:[107]

> *...represents a reasonable and conservative estimate of the level of utilization obtained for optical transmission systems, which may range between 65 percent and 75 percent.*

312. In the second round of interrogatories, C&W provided additional information and justification for the percentage used. The information provided suggested that for the domestic transmission network the utilization rate in C&W's network was actually lower than the assumed 66% and for international circuits the utilization rate was close to 66%. C&W concluded that 65-66% was a reasonable estimate to use.[108]

The Authority's decision: Technical Assumptions

313. C&W is directed to:

- Provide complete documentation and clarifying descriptions of each technical assumption, making it clear what each assumption represents and indicating its source. Where an assumption is derived, accompanying calculations are to be provided.

Routing Factors

314. In order to dimension the core network, C&W used a routing table approach. Routing factors specify, for each type of service, the average use made of each type of network element. Each service therefore has a routing profile indicating how the service uses the network elements. In the C&W model, routing factors were also used to allocate costs.

315. During the interrogatory process, a fairly extensive amount of information was provided on inputs used to derive the routing factors used in the fixed network module. While some of the routing factors could be derived as a matter of logic, e.g. a fixed to mobile call will use RSU to Host transmission once, there were other aspects that needed additional explanation. In an interrogatory response of 25 May 2007 to a question directly targeted at understanding how the routing factors have been derived, C&W stated:[109]

> *Observation of the route factor table in the "Routing Factor Input" sheet of the fixed network model reveals that some of the services carry routing factors 1 or 2. For example, ADSL Retail against the network element International Tx carries a routing factor of 1 in recognition of the fact that*

[107] C&W Cayman Islands Response to ICTA/Telcordia Interrogatories, first round, revised version 3 May 2007, p.16.
[108] C&W Cayman Islands Response to ICTA/Telcordia Interrogatories, first round, revised version 3 May 2007, p.16.
[109] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories, Part 2, May 25 2007 submission, p. 10

ADSL service being an IP based service must traverse the international transmission facilities, thus it has a factor of 1. This is to say that some routing factors were determined through having a thorough understanding of the network and how services are offered over the network.

There are other routing factors that are not that obvious, and, for example, for the call services an analysis of traffic patterns was conducted. The analysis did not cover all call services but in so far as traffic statistics were available to aid such an analysis one was done. For example, the routing factor for Fixed Call To C&W Mobile, row 16, column J above, carries a factor of 0.303 for the network element Host to Host Tx. This factor was determined through the traffic analysis study, see Appendix VI. In the Appendix sheet 'mins 04_05', range BL1593:BP1623, are the traffic sensitive factors determined for the Host to Host Tx network element. And cell BO1598 captures the factor (0.303) for the service Fixed Call To C&W Mobile (FTM).

The other traffic sensitive factors are capture along columns BL:BP starting from the lowest in row 1762 (National Submarine Tx) straight up to row 1085 - Host exchange. Taking another example, say the Fixed International incoming and outgoing in rows 18 and 19 above and for the network element PSTN Host Switch – call sensitive, the factor carried is 1.180 and is shown in Appendix VI, sheet 'calls 04_05', range BL1083:BP1113, cell BO1100. All the Call sensitive factors are calculated along columns BL – BP.

In some cases a network average routing factor was used where traffic statistics were not obtained. For example, network element Host Switch – Duration Sensitive route factors for the services Emergency Service retail and Operator Assistance shown above in rows 14 and 30 respectively, carry a value of 1.04. This figure can be obtained in the 'mins 04_05' sheet, cell BR1109, an average of the Fixed Local (calls within an exchange) and Fixed Trunk (calls across two exchanges) calling statistics.

316. Having analysed the routing factors using the spreadsheet provided, the Authority has a number of concerns with the fixed network routing factors, as stated in the following.

317. The data set on which many of the routing factors were derived included the period from April 2004 to March 2005 which was influenced by Hurricane Ivan. From the data it was clear that Hurricane Ivan had an influence on the absolute level of traffic in the network and whilst it is difficult to analyse whether there were equivalent relative effects, it seems plausible that these too would be influenced. In addition, Authority analysis of the sample data for March 2005 suggested it to only be a subset of the whole month.

318. While it is the relative level and distribution of traffic that is relevant for the routing factor analysis and not the absolute level, the significant fluctuation in the sample is of concern to the Authority. For the establishment of routing factors, the Authority is of the view that it is inappropriate to use sample data affected by significant abnormal events such as Hurricane Ivan. Ideally the same standard of data should be used as is used for network engineering.

319. In addition to the Authority's concerns about the traffic sample used to derive some of the routing factors used in the fixed module, there are other routing factor assumptions that require justification. In the following paragraphs, the Authority describes these concerns and specifies the additional information that is required from C&W regarding these items.

320. The services 'ADSL Retail', 'ADSL Wholesale', 'Dial-up usage' and 'Direct connect' use the network element 'International transmission' once, i.e. have a routing factor of one. There are two issues related to this usage pattern. First, a routing factor of one indicates that international transmission is used every time these services are used. The Authority requires further justification for this assumption. Second, internet usage of international transmission will likely differ between always-on data services and dial-up. For the data service 'ADSL Retail', for example, the fixed network module includes an estimate of 900,000 minutes. It is unclear to the Authority how the estimate has been derived.

321. The service 'Domestic Transit' only has routing factors related to Host Switch and interconnection elements. As such, domestic transit would appear only to consist of handing over traffic at the host exchange and not contain any transit between exchanges. More information on the 'Domestic Transit' service is needed to evaluate whether this is reasonable.

322. The services 'International DQ retail' and 'Domestic DQ retail' are equivalent from a network perspective. The same is the case with 'International DQ wholesale' and 'Domestic DQ wholesale'. However, the DQ wholesale services solely contain host switch elements and those relating to DQ and interconnection. This suggests that all wholesale DQ calls are handed over to C&W at a host switch with no need for transmission or further transport of the call to call centre or DQ service. It is unclear to the Authority whether this is an accurate reflection of how these services use the network.

323. The services 'Domestic leased line retail' and 'Domestic leased line wholesale' are equivalent from a routing factor perspective. In particular, both services make use of the network elements '400-RSU-Host Tx', '400-Host-Host Tx' and '400-National submarine Tx'. However, the routing factors for leased lines are not sourced from traffic matrix spreadsheet referred to above. It is not clear to the Authority whether the equivalence of the services is appropriate and further information is required from C&W to justify this assumption.

324. 'International Payphone' and 'National Payphone' have no use of the local loop, i.e. the routing factor for network element '400-Access Local Loop' is zero. Further (and consistent with not making use of the local loop), both services make no use of the network element '400-RSU line sensitive'. The Authority requires further explanation for this assumption as the Authority would expect a payphone service to make use of the access network.

325. Both international transit service both from and to Other Local Operator ("OLO") make use of the RSU element and 'RSU to Host transmission' element. It is

unclear to the Authority why these services would require a routing factor of one for the RSU element and 'RSU to Host transmission' element.

326. The routing factors for the service 'National Call' are derived by applying a split between local and trunk calls. The Authority agrees with the basic principle driving this split, i.e. that some national calls will be completed locally (within an exchange) while others will require the use of trunk transmission because the caller is requesting termination in another geographic area. Indeed, when deriving the routing factor of 0.63 for the local element (called 'Traffic portion on Host' in the traffic matrix spreadsheet), C&W appropriately excluded traffic internal to the RSU. However, it is unclear to Authority whether the correct traffic (local and trunk) numbers have been used in the fixed network module. Both are sourced from an external spreadsheet which C&W has not supplied to the Authority.

327. The C&W model relied on the assumption that routing factors for fixed to mobile (C&W) and fixed to mobile (other) were the same. Although it is possible that the factors are the same there is no reason to expect they should be. Given that the traffic matrixes show differences in traffic flows, the Authority does not consider it to be reasonable to make this assumption without further explanation.

The Authority's decision: Routing factors

328. C&W is directed to:

- Base the routing factor calculations on a revised traffic sample containing no irregular events that affect the distribution of traffic. If such data is not available, C&W should attempt to adjust for the impact of irregular events and justify the associated assumptions.
- Explain in detail routings for each service.
- Explain the use of international transmission every time the following services are provided: 'ADSL Retail', 'ADSL Wholesale', 'Dial-up internet usage' and 'Direct connect'.
- Explain the conversion of data usage to minute demand for data services.
- Explain why domestic transit only consists of handing over traffic at the host exchange and does not contain any transit between exchanges.
- Explain why the DQ wholesale services solely contain host switch elements and those relating to DQ and interconnection.
- Explain the equivalence of the services 'Domestic leased line retail' and 'Domestic leased line wholesale'.
- Explain why payphone services make no use of the network elements in the access network.
- Explain why the international transit service from and to OLO make use of the RSU element and 'RSU to Host transmission' element.

- Explain the derivation of the routing factors for the service 'National Call' that uses information to split between local and trunk calls by providing the underlying calculations and source values.
- Explain the assumed equivalence of the routing factors for fixed to mobile (C&W) and fixed to mobile (other).

Services

329. C&W grouped services into two major groups: retail and wholesale.

330. Retail services:

- Access Services
  - PSTN Residential
  - PSTN Business
  - ADSL
  - ISDN
- Domestic Voice Services
  - Fixed to same carrier fixed
  - Fixed to same carrier mobile
  - Fixed to other carrier fixed
  - Fixed to other carrier mobile
  - Voicemail
  - Domestic payphone
  - Operator assistance
  - Domestic DQ
- International Voice Services
  - Fixed IDD
  - International payphone
  - International DQ
- Domestic Data Services
  - Dialup internet
  - Direct connect (DIA)
  - DPLC
- International Data Services
  - International frame relay

- IPLC

- Other Services
  - Card
  - CPE

331. Wholesale services

- Domestic Services
  - ADSL
  - Fixed termination
  - Domestic DQ
  - Domestic transit
  - Emergency services
  - DPLC
- International Services
  - Fixed incoming
  - International transit to OLO
  - International transit from OLO
  - International DQ
  - IPLC
  - International frame relay

332. The way the list of services manifested itself in the module was inefficient and could prove to be unmanageable should the list of services need to be changed over time. For example, the list of services was featured across 17 worksheets in both the fixed network module workbook and the consolidation module workbook. In some cases the list is contained multiple times on the same worksheet. Often the lists were part of pivot tables or matrixes and a great deal of care and testing would be required in order to ensure that changes did not inadvertently effect calculations.

333. Nevertheless, the Authority considers the grouping of the services into the categories listed above as appropriate. It should be noted, however, that this list of services only includes services that are currently offered on non-NGN technology based networks. With the eventual use of NGN technology it is important that C&W ensure all data services are included within the modelling framework and that the module has some flexibility to deal with the introduction of new services and the challenges they will present for the model.

334. The Authority notes that C&W provides more services than those currently shown in its fixed network module, examples include NetSpeak and IP-VPN. In order to dimension and cost the modelled fixed and mobile networks correctly C&W is required to include all significant services it currently provides in the FLLRIC model. In addition, the inclusion of all services is also required to ensure an appropriate allocation of common costs through the specified expense factors in the consolidation module. If only a subset of the services provided by C&W are included in the modelling, the subsequent allocation of common costs, based on the whole business of C&W, would be in error as the modelled services would receive a disproportionate share of these costs.

The Authority's decision: Services

335. C&W is directed to:

- Where possible, reduce the number of times the services lists is duplicated in the modules and instead use references to one set of common data.
- Update the fixed network model and service list to reflect all significant services that C&W currently provides.

Mobile network module

336. The C&W mobile network module divides network costs into radio, transmission and switching network categories. Based on demand input and various technical parameters (including routing factors and an Erlang table), the module dimensions the various equipment types. Using the resultant equipment numbers the module then calculates capital costs using component cost inputs. In the following sections the Authority briefly discusses the methodology employed, the calculations performed and the inputs used.

Radio Network

337. The composition and scope of the radio network was defined in the module within the "Radio Calculations" worksheet. This worksheet was used to calculate the number of sites, number of cells, number of transceivers ('TRXs') and number of timeslots required for the mobile technology that is assumed. The values were then used to calculate the quantities of network switching equipment required in the network.

338. To calculate the number of cells required in the network, the module divided the mobile network coverage area into dense, medium and rural areas. The number of cells was determined through an iterative calculation. The starting point was the maximum cell radius from which the module calculated the required number of sites and cells (assuming both omni and sectorized sites), and determined the traffic per cell. The traffic per cell included both voice and data traffic carried on 850/900MHz and 1800/1900MHz cells. The module then used an Erlang-B[110]

[110] Erlang B is a formula derived from the Erlang distribution to describe the probability of call loss in a circuit switched network, or equivalent.

table to determine the required number of TRXs per site. This number was compared to the maximum number of TRXs per site. If the required number of TRXs exceeded the maximum available then it next lowered the cell radius and repeated the calculation. The calculation was repeated until the number of TRXs calculated was less than the maximum per site. From this calculation the module determined the number of sites and the number of cells required in dense, medium and rural areas, and the total number of TRXs required. This calculation was performed separately for voice and data. Total voice, data and SMS timeslots are also determined in this worksheet.

339. The Authority has not found any errors in the calculations on the radio calculations worksheet of the module.

340. A variety of assumptions were employed in the 'Radio Calculations' worksheet. In particular, due to the relatively small geographic area of the Cayman Islands and the population dispersion, it was assumed that no cell sites were required purely for coverage and that all cells had a traffic-handling requirement. Further, the assumed maximum cell radii by type of coverage area was 1.5 km for dense areas, 2 km for medium dense areas and 4 km for rural areas.

The Authority's decision: Radio network

341. The Authority accepts the radio network calculations for the purpose of dimensioning a 2G network.

Switching Network

342. The number and types of switching components for the mobile network are calculated in the 'Switching Calculations' worksheet.

343. The mobile network switching equipment is assumed to be made up of the following components:

- MSC – Mobile Switching Centre
- BSC - Base Station Controller
- TCU - Trunk Controller Units
- HLR – Home Location Register
- PCU - Packet Control Unit
- SGSN - Serving GPRS Support Node
- GGSNs - Gateway GPRS Support Node
- Internet Gateway unit.

344. Whilst the module assumes the BCS and TCU components have both variable and fixed costs, the other elements only have fixed costs. The costs of the BSC and TCU are therefore partially determined by the amount of traffic in Erlang (including a capacity planning allowance).

345. The capacity of the SGSN and GGSN is measured in the number of subscribers using the services these nodes provide. When estimating the required number of SGSN and GGSN, the Authority notes that C&W uses a tenth of the number of data and SMS subscribers as a proxy for the capacity required. No information has been provided to justify this assumption. In addition, it appears to the Authority that the module did not consider separately the cost of HLR and VLR (Visitor Location Register). The treatment of the HLR/VLR costs as a single cost component may not be appropriate as the VLR functions are generally used only for roaming services while the HLR functions are used for all access services.

The Authority's decision: Switching network

346. The Authority's review of the assumptions used for the switching calculations suggests they are generally reasonable for the current network. However, C&W is directed to:

- Provide information to justify the division of the number of data and SMS subscribers by ten and make the assumption explicit in the module.
- Split the cost of VLR and HLR and allocate the costs based on primary cost driver of each. If C&W believes it is appropriate to regard HLR and VLR costs together, detailed documentation must be provided to the Authority showing that this is an appropriate treatment of these costs.

Transmission Network

347. In order to provide transmission capacity, the C&W mobile network module assumed that transmission circuits were leased at market prices. The transmission calculations in the mobile network module were therefore used to estimate the leased line products required for transmission of traffic. The composition and scope of the transmission network was defined in the module within the 'Transmission Links' worksheet. That worksheet was used to calculate the number of leased links required on an omni and sectored basis.

348. In the worksheet, the number of leased links is based on the calculated number of TRXs for each cell radii and the radii is based on the classification of each cell as covering a dense, medium, or rural area. In particular the formula used is:

$$\textit{total TRX kbits/s} = \textit{Number of TRX per cell} \times \textit{Capacity per TRX kbits/s}.$$

349. Using the total TRX kbits/s required, a look-up was made in a leased line capacity table to determine the leased line product needed for omni cells and sectored cells in each geographic area.

The Authority's decision: Transmission network

350. In the Authority's view, the methodology used and assumptions included are appropriate for sizing the transmission capacity for a 2G network and no calculation errors were found. However, as noted in the section 'Standalone

networks' C&W is directed to apply transmission costs that are the lower of commercial rates provided fixed line links or self supplied facilities.

Unitization of Network Elements

351. Within the module, the investments associated with each network element were unitized according to the demand cost driver associated with the network element, as shown in the table below.

Table 7: Unitization of network elements

Network Element	Unit of unitization
GSM: BTS	Minutes
GSM: BSC	Minutes
GSM: MSC -call sensitive	Calls
GSM: MSC -duration sensitive	Minutes
GSM National Tx	Minutes
GSM: GPRS Tx	2Mbit Links
GSM: Voicemail platform	Minutes
GSM: GPRS platform	2Mbit Links
GSM: Roaming platform	Minutes
GSM: SMS platform	Calls
GSM: Prepaid platform	Calls
GSM: HLR/VLR - traffic sensitive	Calls
Cell site land & masts	Minutes
GSM: Handsets and SIM card/activation platform	Lines
GSM: HLR/VLR - subscriber sensitive	Lines

352. The Authority considers the list of network elements to be appropriate for the current network and is of the view that the units of unitization for those network elements are reasonable.

The Authority's decision: Unitization of network elements

353. The Authority is satisfied with C&W's unitization of network elements.

Cost Assumptions

354. Cost assumptions are the pricing values or input costs used to derive the cost of equipment or activities considered in the cost analysis. However, C&W also included allocation assumptions within this category.

355. C&W arranged cost assumptions into the following categories:

- Radio and core network included the various network elements that comprise the wireless network architecture: radio base stations, site costs, transceivers, base station controllers, mobile switching centre, telematics control, packet control units, home location register, support nodes, gateway, voicemail and network management. The BSC and the TCU inputs were structured as a fixed component and a variable component (per Erlang unit).

- Leased facilities provided connectivity links across the network, in capacities ranging from 64 kbits/s to 45 Mbits/s. Submarine cable connectivity charges are also listed.
- Cell site rental were the recurring lease charges for each of the cell sites in the network. A designation of rural or urban was also provided.
- Other included allocation percentages of certain equipment components between duration, call attempts and subscribers and cost estimates associated with spare equipment inventory.
- Platform costs recharged were the C&W Cayman share of service platform costs that were shared across other C&W businesses in the region.

356. In addition, the mobile module included a number of general factors such as currency exchange rates and the WACC (addressed in other sections of this Decision). The source of information provided was listed as "C&W", "C&W Price Lists" or "Benchmarks". The Authority does not consider listing one of these three sources to be sufficient rationale or support for the underlying information. C&W must provide detailed documentation showing the source of the cost assumptions.

357. As noted in paragraph 304, there appears to be an instance of double-counting of a cost between the mobile and fixed modules. The mobile module included the annualized operating expense for a full STM link for the national submarine cable connectivity. This expense was taken from the fixed module and fully applied to the mobile module. However, only a portion of an STM-1 capacity would be needed to satisfy all the national inter-island traffic. Therefore this cost should be split between the fixed and mobile networks, rather than fully counted in both. The Authority notes that this annual expense is relatively small and will have minimal impact on the results, but this double-counting should be corrected nonetheless.

358. With regards to the cost of equipment components, it is difficult to validate these prices. The prices listed in the mobile module were pre-discounted prices in 2006[111]. However without additional supporting information from C&W, it is not possible for the Authority to validate them. As noted previously, the Authority considers that the cost of equipment components should take into account typical vendor discounts.

359. In the second round of interrogatories, C&W noted that it is standard practice for vendors to include in initial kit shipments required spares that are often not broken out of the total.[112] C&W also referenced the delivery of maintenance spares that are separately invoiced over the lifetime of the facilities. The cost of the additional spares was estimated to be between 2-7% of the original investments. In the latest version of the mobile module a factor of 5% was used.

[111] C&W Cayman Islands Response to ICTA/Telcordia Round 1 LRIC Interrogatories, 23 February 2007 submission, answer to question 4.6.
[112] C&W Cayman Islands Response to ICTA/Telcordia Round 2 LRIC Interrogatories, Part 2, 25 May 2007, p. 8, answer to question 3.6.2.

The Authority regards that the inclusion of spares is legitimate and reflects real world practices. However, it should only be the amount of spares that an efficient operator would require that should be included.

360. The Authority notes that the burden is on C&W to provide adequate documentation of the inputs used.

The Authority's decision: Cost Assumptions

361. C&W is directed to:

- Provide documentation for the cost assumptions employed in the mobile network module, indicating in the documentation whether these inputs correspond to actual invoiced items, average values derived from recent procurement activity, benchmark values (and if so their origin) or some other source. In addition C&W must provide supporting documentation for the level of discounts off list prices.
- Provide information supporting its use of spares in the mobile network module.
- Split the costs of the STM capacity for national inter-island traffic between the fixed and mobile modules, rather than fully counting the costs in both fixed and mobile modules.

Technical Assumptions

362. Technical assumptions are parameters that are used to structure the network, select the locations to be modelled and identify the properties of the equipment considered in the cost analysis. Typically values are basic to the equipment deployed or the technology used in the network and are given as capacity limits or engineering values which cannot be derived. The numerous technical assumptions that were used by C&W in the mobile module are shown below.

Table 8: Technical input assumptions (mobile module)

Assumptions	Values
Available GSM 850 spectrum	10 MHz
Available GSM 1900 spectrum	15 MHz
Re-use factor GSM 850	5
Re-use factor GSM 1900	5
GSM Carrier bandwidth	200 KHz
Timeslots per carrier GSM	8
Radio Path GoS	2.0%
Tessellation factor used for planning	20.00%
Number of MSC	1
Traffic distribution Dense	59.10%
Traffic distribution Medium	32.10%
Traffic distribution Rural	8.80%
Coverage area surface (km^2) Dense	22 km^2
Coverage area surface (km^2) Medium	47 km^2
Coverage area surface (km^2) Rural	195 km^2

Assumptions	Values
Cell sectorization per area Dense	0%
Cell sectorization per area Medium	0%
Cell sectorization per area Rural	0%
Maximum cell radius: Dense	1.5 km
Maximum cell radius: Medium	2 km
Maximum cell radius: Rural	4 km
Capacity planning max load factor	80%
GPRS Design Factors TS data trans. rate (inc. overhead)	13 kbits/s
GPRS Design Factors Busy hour capacity per TS	48 Mbits/s
GPRS Design Factors Assumed traffic per 2Mbits/s E1*	20.3 E
MSC increment	125,000 subscribers
HLR increment	250,000 subscribers
Number of cell sites per BSC	20
PCU Capacity	270 timeslots
SGSN capacity	30,000 subscribers
GGSN capacity	90,000 subscribers
Internet gateway Capacity increment	100,000 subscribers
Erlang B table	Erlang B worksheet

* not used in module.

363. In addition to the numerical assumptions listed above, the following technical assumptions were made about the mobile network:

- As noted above, it was assumed that transmission capacity to connect the BTS units to BSC's and BSC's to switches was provided by renting leased circuits at market prices.
- Due to the relatively small geographic area of the Cayman Islands and the population dispersion, it was assumed that no cell sites were required purely for coverage and that all cells would have a traffic-handling requirement.
- The number of BSCs and MSCs required were determined using ratio calculations based on the following assumptions:
  - Each BSC was assumed to serve 20 BTSs.
  - Each MSC was assumed to be able to cater for 125,000 subscribers.
- Each BTS-BSC cable link required one 2Mbits/s leased link for omni cells or 8Mbits/s for sectored cells.

364. In its comments on behalf of Digicel, Ovum stated that the Capacity Planning Max Load Factor of 80% was set too high. Ovum submitted that maintaining quality of service, planned growth, and practical restrictions would require built capacity to be 150% to 200% of theoretical capacity given by C&W's bottom-up model.[113] In its 7 July 2007 submission, in response to Ovum's statements, C&W indicated that an Erlang B calculation is used to dimension the cell site capacity in addition to the 80% transmission utilisation. The Authority is satisfied that the

[113] Ovum report "A Response to Cable and Wireless (Cayman Islands)' LRIC models dated April 20, 2006, section 4.3 p. 15

Max Load Factor value of 80% and the methodology used by C&W to dimension the network are reasonable and provide for adequate capacity to meet the requirements placed on the network by quality of service, planned growth, and practical restrictions.

The Authority's decision: Technical Assumptions

365. The Authority is satisfied with the technical assumptions used for the modelled network.

Routing Factors

366. Routing Factors are ratios for the amount of a network element resource that is consumed by a service. The Authority has reviewed the routing factor information submitted by C&W and makes the following comments.

367. The SMS service made no use of the network element 'Cellsite land & masts' or 'GSM: BTS'. However, the module contained C&W analysis suggesting a routing factor of 1.63 for these network elements, but this has not been implemented in the module. Further, it is unclear to the Authority why the SMS service makes use of the network element 'GSM: MSC -call duration'.

368. The network element 'GSM: MSC -call sensitive' was used extensively by three services in particular: 'Mobile International Incoming', 'Mobile On-net' and 'Mobile Termination'. 'Mobile On-net' used this element 3.6 times while the other two were limited to 2.6, i.e. exactly 1 time less. In an interrogatory response[114] C&W explained that this approach is based on OFTEL in its submission to the Monopolies and Mergers Commission in 1998 to account for the additional processor time for outbound calls relative to inbound calls. While the Authority can accept the there may be added processor time for specific call types, the Authority is concerned that this difference may be equipment specific and less pronounced in newer mobile systems.

369. The 'Mobile Voice Mail (retail)' service made no use of the elements: 'GSM: BTS', 'GSM: BSC', 'GSM National Tx' and 'Cellsite land & masts'. It is unclear to the Authority if this accurately reflects the definition of the service. For example, use of the voice mail service may require the use of elements similar to that of mobile originated services.

370. It is unclear to the Authority why SMS makes use of the network element 'GSM: MSC -call duration'.

371. The 'Mobile On-net' service used the prepaid platform twice as intensely as other services. While this is consistent with origination and termination services only using the platform half as much, it is not clear to the Authority that this accurately reflects the use of this platform. In particular, C&W has both pre-paid and post paid customers which might put different requirements on the platform.

[114] C&W Cayman Islands Response to ICTA/Telcordia Interrogatories 23 February 2007, section 4.4 answer to question 1.

372. The mobile module relied on the assumption that routing factors for 'fixed to mobile (C&W)' and 'fixed to mobile (other)' were the same. The Authority is concerned that this assumption may not be reasonable, see paragraph 327 for further discussion.

The Authority's decision: Routing factors

373. C&W is directed to:

- Explain the routing factors used for the SMS service.
- Provide documentation showing that the added processor time for specific call types is reasonable within the mobile network it is modelling. The Authority does not regard the reference to OFTEL as satisfactory.
- Provide a service definition of the 'Mobile Voice Mail (retail)' service and justify the routing factors used for this service.
- Demonstrate that the routing factors in the mobile network module accurately reflect the use of the prepaid platform.
- Explain and justify the routing factors for 'fixed to mobile (C&W)' and 'fixed to mobile (other)' are the same.

Services

374. C&W grouped services into two major groups: retail and wholesale.

375. Retail services:

- Subscriber
  - The subscriber product covers the handset costs and any other subscriber related costs such as customer care
- On-Net Calling
- Mobile to Fixed
- Mobile to Other Mobile
- Voicemail
- Mobile Data
- SMS
- Mobile originated IDD

376. Wholesale services

- Mobile termination
- Mobile International Incoming
- Inbound roaming

377. In addition to these services, the Authority notes that C&W provides wholesale SMS termination and push to talk and it appears to the Authority that these services are not taken into account in the mobile module.

The Authority's decision: Services

378. C&W is directed to:

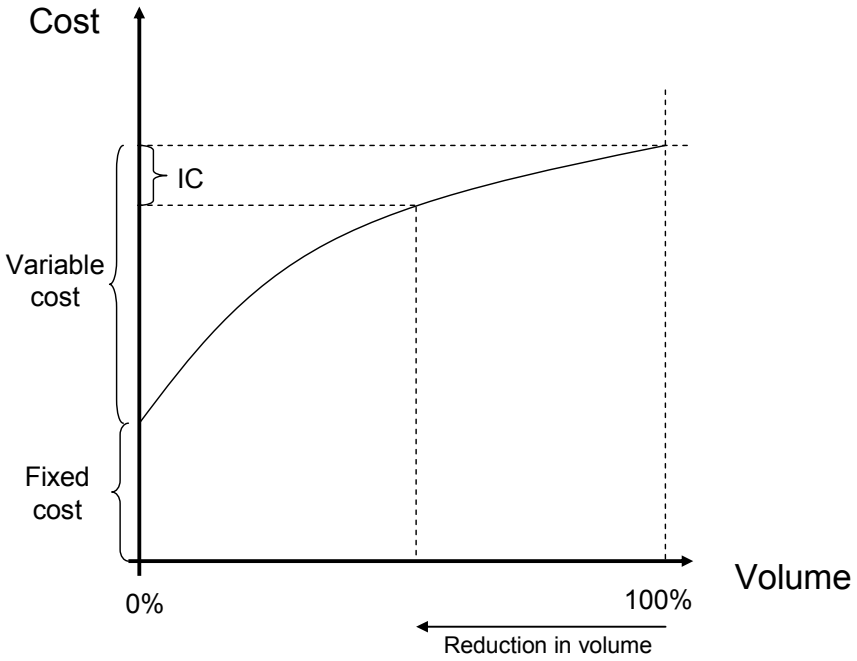
- Update the mobile network module to reflect all existing services in use.

Top-down retail module

379. C&W's top-down module allocated retail expenses and capital costs relating to the retail part of the business using a top-down LRIC approach in a separate Microsoft Access module. The results of this analysis were then imported to the service cost statements in the Consolidation module (i.e. allocated or added directly to service costs). The main groups of retail cost categories were retail expenses, general overhead expenses apportioned to retail, retail recharges, retail specific costs, annualized cost of retail working capital, and annualized cost of retail support assets. The actual total values of the cost categories were derived through the ABC Cost Model.

380. The C&W allocation methodology may be summarised as follows with reference to the following diagram.

Figure 1: Illustration of Cost Volume Relationship ("CVR") used in the retail module



381. For a given cost category, C&W first allocates the variable costs to cost categories. C&W starts from 100% of the volume and reduces the volume by the amount used by the service (see figure). On the vertical axis, C&W then reads of the associated ('incremental') costs to be allocated to the service. C&W then continues with the next service that uses the given cost category at hand, starting over from 100% of volume. A consequence of the approach is that the total amount of variable costs allocated to services may be higher or lower than the

actual total amount of variable costs. If the CVR curve is concave, the sum of the allocated costs will be less than the actual total; whereas if the CVR curve is convex, the sum of the allocated costs will be more than the actual total. In order to address this issue, C&W makes subsequent adjustments so that the total amount of variable costs allocated to services is exactly equal to the total amount of variable cost of each cost category.[115]

382. CVRs are used in the top-down part of the module for retail cost measurement. The "pure" LRIC of each service is calculated by removing the volumes of that service.

383. Each cost category has a CVR associated to it. However, a limited number of CVR curve forms exist so there is no need for as many distinct CVR shapes as cost categories. Most of the retail cost categories in C&W's top-down module are associated with SLTO (Straight Line Through the Origin) and FLAT[116] CVRs. The SLTO CVRs do not have a fixed cost element. The FLAT CVRs do not have a variable cost element (these costs, which do not vary with demand in aggregate, are fixed common costs). Other cost categories are associated with CVRs of different shape curves (CVRs 01-06).

384. Bad debt is an example of a cost category using a SLTO CVR. The Authority finds this to be reasonable. C&W's selection of the cost driver ('Total Revenue') is also reasonable. However, the Authority is concerned that C&W appears to include cost of bad debts only to retail services. In the Authority's view, bad debt should also be included as a cost in the provision of wholesale services.

385. The Authority would expect to see economies of scale and scope in some network cost categories (particularly, in the fixed network module), and economies of scale and/or scope in operational costs (such as maintenance) indirectly allocated to the network cost categories. These are both captured in the network modules. However, the Authority would not expect there to be major economies of scale in the retail cost categories considered in the top-down module, and would therefore initially accept an assumption of straight line CVR for most of retail cost categories in the top-down module.

386. The file "Appendix III of Interrog.1_CVRs (confidential)_f" submitted by C&W as part of its response to ICTA/Telcordia first interrogatory provides detailed information about the CVR associated with each retail cost category. The "Summary" sheet contains the list of all (retail) cost categories and their associated CVRs, and Columns I and J of the "Summary" sheet shows the rank of cost categories in terms of materiality. The Authority has reviewed this information and considers the most material and important cost categories and associated CVRs suggest these to be appropriate. However, for any particular

[115] In the case of a convex/concave CVR the joint costs would be negative/positive and proportionally allocated to each individual LRIC, so that the total of costs allocated will be exactly equal to the total amount of cost of the cost category.
[116] Horizontal Fixed Element.

retail service costing exercise, the Authority may need to review these in more detail.

387. The Authority notes that C&W's ABC cost model uses Fully Allocated Cost ("FAC") Historic/Book values ("HCA"). The Authority believes the use of a Current Cost Accounting ("CCA") cost base for the non-network asset categories would likely be more appropriate. However, the Authority accepts the current values for this proceeding, but for any particular service costing exercise, may revisit this issue in future filings by C&W.

388. The Authority also notes that the same cost of capital (WACC) has been used in the ABC model (when deriving the annualized capital costs of the non-network asset categories), and in the bottom-up models (when deriving the annualized capital costs of the network elements). The Authority expects C&W to update the ABC model with the Authority's determined WACC.

The Authority's decision: Retail top down module

389. The Authority is generally satisfied with the retail top-down module. However, due to the lack of more detailed information, the Authority could not verify the accuracy of the calculations performed in the 'Revenue Mapping' sheet. C&W is directed to:

- Provide supporting material to allow the Authority to verify the accuracy of the calculations performed in the 'Revenue Mapping' sheet in the top-down retail module.
- Apply a bad debt factor to both retail and wholesale services.

Consolidation module

390. The consolidation module pulls together the outputs of the network modules for network costs, generates the expense factors for non-network costs based on C&W's cost information and summarizes the FLLRIC results by service. To do this, the module imports a series of data from the fixed and mobile modules, such as for example: the allocation percentages of individual 400-level network elements to the relevant 900-level products, the route factor relationships, route factored volumes, and service volumes.

391. Since the consolidation module is primarily a reporting tool, the Authority has addressed any comments and/or issues in other sections of this decision.

Assessment of Model Relative to ICTA Principles and Guidelines

392. Throughout this decision, the Authority has evaluated C&W's proposed FLLRIC methodology against the Principles and Guidelines determined by the Authority in ICT Decision 2005-4. The Authority provides a summary of its conclusions in the following section.

393. Principle 1:

> *The FLLRIC methodology should capture those costs for services or network elements that would lead to prices found in an efficient market for provision of such elements or services. Efficient market prices are those that ensure the service provider has the opportunity to recover efficiently incurred, forward-looking costs and encourage the service provider to operate in a cost effective manner. In addition, efficient market prices should provide the right incentives for efficient facilities-based investment, entry and exit.*

394. In order to fulfil Principle 1 the Authority must be satisfied that the approach adopted by C&W as whole is reflective of a FLLRIC approach. While C&W at this stage has delivered a model and documentation for its approach, the Authority still has concerns over the approach adopted as illustrated by the directions provided to C&W for Phase 3. While it is clear that much progress has been made, there are elements of the C&W analysis and methodology which the Authority cannot accept at this stage.

395. Principle 2:

> *Forward-looking costs are the costs to be incurred by a carrier in the provision of a service. These costs shall be calculated as if the service was being provided for the first time by a new carrier and shall reflect planned adjustments in the company's plant and equipment. Forward-looking costs ignore embedded or historical costs; rather, they are based on the least cost technology currently available whose cost can be reasonably estimated based on available data. As such forward-looking cost estimates must reflect technologies that are currently operational used and available in the marketplace.*

396. The Authority considers C&W's FLLRIC material partially fulfils the requirements of Principle 2.

397. The Authority considers it appropriate that the FLLRIC methodology for the fixed network is based on an IP-based architecture and technology. Adoption of an NGN solution is consistent with C&W's current upgrade and reflects the general trend within the telecommunications industry where fixed networks based on circuit switched technology are being replaced by packet-switching alternatives with new functionalities in anticipation of more data intensive services.

398. However, with regards to the appropriate technology for the mobile module, the Authority is not convinced that FLLRIC costs should be based on a 2G/2.5G network. The Authority therefore considers it appropriate to investigate this issue further by requiring C&W to build a 3G module for Cayman.

399. Principle 3:

> *The forward-looking long-run incremental costs of services or network elements are to be based upon those costs assumed to be incurred by an efficient carrier operating in the Cayman Islands for the first time. A carrier is deemed to be efficient where the total capital and operating expenditures are those that are necessary and sufficient in order to meet the required demand at a particular grade of service.*

400. The Authority is satisfied that the modelled networks are capable of meeting required demand. However, the Authority has also raised significant concerns for certain methodological choices in the modelling of network capital costs regarding whether the modelled networks represent those of an efficient carrier. Likewise, the Authority has also raised several concerns with the operating expense factors used. While the Authority can appreciate the reliance on existing operating expenses from its own business, C&W has not demonstrated to the satisfaction of the Authority that these are efficient costs. Accordingly, the Authority has directed C&W to provide additional documentation for the certain elements of its approach and to estimate expense factors with reference to existing costs and then apply them to the forward-looking cost base.

401. Principle 4:

> *FLLRIC should include only those forward-looking costs that are incurred as a direct result of providing the service or network element in question. These are referred to as "causal" costs. Conversely, only costs that could be avoided by not offering the service or network element should be included in FLLRIC.*

402. C&W zeroed out demand to calculate the "pure LRIC" of each service and used this information to allocate remaining fixed common/joint costs. In this Decision the Authority has raised a number of concerns with this small increment approach. The Authority determines that a large increment approach (where the service increment is taken to be a whole network or group of services) is appropriate and routing factors and demand are to be used to allocate costs to services.

403. Principle 5:

> *Costs that remain the same whether or not the relevant course of action (e.g., proposed introduction of a new service, proposed reduction or increase in rates, or other changes to existing services) is undertaken are not causal to the course of action and therefore are not taken into account in calculating the incremental costs associated with that course of action. Since costs and revenues that have been realized prior to the start of the course of action cannot be affected by that course of action, incremental costs and revenues do not consider cost and revenue components prior to the course of action. Historical or sunk costs are an example of this type of cost because no action after a decision point can affect costs already incurred prior to that decision point.*

404. C&W use of current estimates for input costs satisfies this principle. However, the Authority is not satisfied that C&W's assumption that its current fixed network represents that of an efficient operator is appropriate. Sizing the modelled network based on the existing network may inappropriately include a component of historical or sunk costs.

405. Principle 6:

> *A FLLRIC study should include all relevant service or element-specific start-up costs, including installation costs.*

406. Based on its review of the relevant service and element-specific start-up costs included in the model, the Authority concludes that C&W's FLLRIC methodology fulfils the requirements of Principle 6.

407. Principle 7:

> *The FLLRIC of a service or network element should include both volume-sensitive and non-volume sensitive costs.*

408. While the Authority has questioned some the specific allocations of costs in this Decision, C&W's FLLRIC methodology fulfils the requirements of Principle 7 in that it considers both volume-sensitive and non-volume-sensitive costs.

409. Principle 8:

> *The FLLRIC of a service or network element is the forward-looking additional costs incurred by an efficient company to provide the entire output of a service or network element, including any required additional resources such as labour, plant, and equipment. These are the direct incremental costs of providing a service. FLLRIC excludes any costs, including any common costs that would be incurred if the service is not produced.*

410. C&W's FLLRIC methodology fulfils the requirements of Principle 8.

411. Principle 9:

> *Long-run costs are the economic costs over a planning horizon long enough so that there are no sunk inputs or costs.*

412. C&W's FLLRIC methodology fulfils the requirements of Principle 9.

413. Principle 10:

> *Common costs are those costs that a carrier must incur in order to operate and are not directly attributable to any particular service or network element or group of services or network elements. C&W has the onus to prove the specific nature and magnitude of any forward-looking common costs. A reasonable assignment of common costs should be applied to all services and network elements regardless of whether the purpose of the FLLRIC cost is a "price floor" or a "price ceiling".*

414. In this determination the Authority has raised some concerns with the application of expense ratios in the FLLRIC model and the magnitude of the resulting costs including common costs. While the Authority recognizes that an assignment of common costs has been made to service costs, the Authority has identified a number of concerns in this decision regarding the reasonableness of some of those assignments.

415. Principle 11:

> *The process used to generate FLLRIC cost information should be transparent. In this context, transparency means that the processes for generating cost information are clear and understandable, that the numbers are objective and based on verifiable data, and that any models used in the FLLRIC process are fully documented.*

416. C&W's FLLRIC material fails to fulfil the requirements of Principle 11. While transparency has improved through-out the Phase 2 proceeding, there still remain transparency issues that have not been properly addressed. In particular, the Authority has substantial concerns about the clarity of the calculations and the support and documentation for the model.

417. Principle 12:

> *C&W has the onus to establish to the satisfaction of the Authority that its costing methodology complies with the approved FLLRIC principles and guidelines and produces reasonable results.*

418. As explained elsewhere in this section C&W's FLLRIC methodology fails to fulfil the requirements of Principle 12.

419. Guideline 1:

> *The FLLRIC of a service or network element should be developed using a bottom-up methodology. That is, costs should be built up from the costs of the components that would be required in order to deliver those services or elements. The bottom-up approach requires the following steps:*
>
> *A. specifying the components necessary to provide the volume increment,*
>
> *B. estimating the volume increment and required capacity of each of these components,*
>
> *C. dimensioning the components to serve the estimated increment on an efficient, forward-looking basis,*
>
> *D. determining the cost of different components,*
>
> *E. estimating the capital costs and operating expenses associated with the different components,*
>
> *F. quantifying the unit costs of each component, and*
>
> *G. aggregating the component unit costs by the use made of them by different services or network elements. Routing factors may be*

used for this purpose pursuant to the definition and requirements specified below.

420. C&W's FLLRIC methodology fulfils Guideline 1 as the network modules address each of the steps described above.

421. Guideline 2:

> *The modeled network should also be capable of providing a particular grade of service. The issue of the appropriate service standards for the mobile and fixed line networks and services shall be addressed in phase two of this proceeding.*

422. While Authority believes that network modules are capable of meeting required demand information on the specific service standards reach by each service is lacking.

423. Guideline 3:

> *The FLLRIC study shall be based upon the locations of, and planned locational changes to, the existing central office and facilities configuration. "Facilities" shall be interpreted to include feeder routes, central offices, drop wire, network interface devices, and other specific items that make up the facilities of a telecommunications company. This is referred to as the "scorched node" approach. The adoption of this approach does not imply that the modeled equipment located at the network nodes is of the same type or function as the equipment currently situated at those locations; however, the locations themselves are retained.*

424. C&W's FLLRIC methodology fulfils Guideline 3.

425. Guideline 4:

> *Carriers are constantly upgrading, developing and refining their networks. As a result, a carrier's network will at any time include a range of technologies and vintages of equipment types, all of which must interwork. A FLLRIC approach, however, should approximate those costs that would be faced by a new carrier investing in the network at the time of the study. Thus, it is assumed that the network will be fully constructed using the current generation of technology, without any allowance for the need to interwork with previous generations. This is referred to the "instantaneous build" approach.*

426. C&W's FLLRIC methodology fulfils Guideline 4 in that it assumes fully constructed networks based on a single technology and without the need for inter-working with previous generations of technology.

427. Guideline 5:

> *The increment to be modeled is the total service increment.*

428. Whilst the total service increment is modelled, the Authority is not satisfied that C&W's FLLRIC methodology uses the appropriate increment when costing

specific services and the Authority has made directions on the increment to be costed.

429. Guideline 6:

> *If cost factors are based on historical data, historic averages or rely on ABC, C&W must provide the underlying supporting studies, analysis and documentation showing that those historical data, historic averages or the ABC relationships are relevant to the study of forward-looking costs.*

430. C&W has not provided studies, analysis and documentation justifying the application of expense factors as it implicitly assumes that the "forward-looking" network operating expenses will be the same as its "current" operating expenses, without justifying this assumption. The Authority believes that the use of "forward-looking" technology would likely reduce expenses due to increased efficiencies (in particular in the core network), although it also acknowledges areas where this might not be the case.

431. Guideline 7:

> *Each FLLRIC study shall identify and provide a basis for the projected economic life used to calculate depreciation costs of the equipment involved in providing the service or element or group of services or elements.*

432. In this decision, the Authority determines the appropriate economic asset lives to be used in the FLLRIC model.

433. Guideline 8:

> *FLLRIC should allow the carrier to earn a reasonable return on its investment as measured by a weighted average cost of capital ("WACC"). The carrier is required to provide support for the forward-looking WACC assumed in its FLLRIC analysis. Among other things, the carrier is required to demonstrate, with specificity, the business risks it faces in providing certain carrier services such as interconnection and access to infrastructure sharing, as contrasted to the business risks it faces when providing retail services in competition with other carriers. Alternatively, or in the absence of sufficiently robust supporting information, benchmarking analysis of the WACCs of similarly situated carriers providing comparable services may be used to support a proposed forward-looking WACC for C&W.*

434. The Authority has raised a number of concerns with the C&W WACC methodology. However, the Authority accepts the basic overall approach of the Capital Asset Pricing Model. Based on the information provided during the interrogatory process the Authority has determined a WACC to be used in FLLRIC studies.

PHASE 3 PROCESS

435. Below is a summary of the directions to C&W identified in this Decision. These are to be resolved in Phase 3. In particular, C&W is directed to:

- Allow for flexibility in costing the optimal number of cell sites. (paragraph 46)
- Provide evidence that demonstrates the optimality of the number cell sites adopted. (paragraph 46)
- Supply a fully functional and documented 3G mobile model, where account must be taken of growth in the network and in particular for higher bandwidth services. (paragraph 76)
- Implement a cost allocation methodology based on a large increment approach using the following methodology. Specifically, divide the total annual cost of each network element (incl. expense factors) within each increment by the total usage (measured by number of minutes, calls or lines as appropriate) for all services that use that element. This will yield a "per unit cost" of each network element. In order to determine how intensely a particular network element is used routing factors are used. Service unit costs are then to be calculated by multiplying the network element's per unit costs by the service's routing factor profile and adding up the individual network elements costs. (paragraph 94)
- Remove calculations related to the zeroing out of demand in both fixed and mobile modules. (paragraph 94)
- Revise (where relevant) and clearly indicate in both fixed and mobile modules inputs or cost factors used to account for economically efficient sharing. (paragraph 104)
- Use transmission costs in the mobile network module, that are the lower of the rates for commercially provided fixed-line links or the costs of self-supplied wireless facilities. (paragraph 104)
- Increase the unsuccessful call rate from 24% to 32% in both mobile and fixed modules. This is in line with C&W's own recommendations and suggested compromise. (paragraph 119)
- Use a busy hour assumption of 25 days per month for both the mobile and the fixed modules and adopt a percentage of traffic in the busy hour of 9%, also in both modules. (paragraph 119)
- Develop and document a clear and consistent definition of the factors used to develop actual, network and dimensioned demand. In particular, those associated with the provisioning allowance used for demand driven by lines should be addressed. (paragraph 119)
- Explicitly show existing demand and forecasted demand for services in both fixed and mobile modules, i.e. a growth rate should be shown for each service and the relevant planning horizon provided. When calculating the unit cost of individual services existing demand must be used in the denominator. (paragraph 119)

- Provide documentation and supporting evidence for the existing demand volumes and forecasted changes in demand. (paragraph 119)
- Provide justification for both explicit and implicit utilization in the different parts of the network. For example, an explicit utilisation factor is the assumed circuit efficiency factor used to dimension transmission equipment in the transmission network. An implicit utilisation factor is one that may be calculated in the utilisation level for copper cable in the access network, i.e. pairs in use as a percentage of pairs in the network. (paragraph 119)
- Provide supporting descriptions associated with all key volume input entries and in particular inputs such as ADSL Retail minutes. (paragraph 119)
- Use asset lives as set out in Table 3. (paragraph 128)
- Use commercial exchange rates. (paragraph 132)
- Provide documentation for all exchange rates used. (paragraph 132)
- For equipment that is subject to the duty exemption, take account of duty exemption on imported equipment by modifying component costs in the FLLRIC model showing explicitly the cost with and without duty and use the cost without duty to develop unit costs. (paragraph 138)
- Provide documentation for categories of equipment that are subject to duty exemption. (paragraph 138)
- Use a simple annuity to annualise costs and apply the annuity on a monthly basis. (paragraph 150)
- Adopt an average WACC of 9.5% in both fixed network and mobile network modules in line with the Authority's technology neutral approach to regulation. (paragraph 213)
- Ensure input values elsewhere in the FLLRIC model reflect the use of nominal WACC. (paragraph 213)
- Explain the apparent disparity in detail between interconnect specific costs incurred in the fixed module with those in the mobile module. (paragraph 236)
- Ensure that expense factors do not include any costs specific to Hurricane Ivan, but only those costs that are required in the operation of a telecommunications business in a hurricane prone area. Provide documentation on the hurricane specific costs included in the FLLRIC model. (paragraph 236)
- Explain the relevance of the fixed network specific costs "100-R&M Exchange Equipment – Ericsson Switch" considering that an NGN is being modelled. (paragraph 236)
- Split the cost centre/activity combination (in the ABC model) if relevant into what can be capitalised labour expenses (associated with the design, engineering, installation, creation of the network and commissioning) and non-capitalised labour expenses for the mobile network operating expenses '100-Provide Mobile Cellsites'. Alternatively, C&W must explain why spitting the costs would not be appropriate. (paragraph 236)

- Explain the cost centres/activity centres related '100-Provide Mobile Switching Equipment' (in the ABC model), and if relevant split them into capitalised labour expenses and non-capitalised labour expenses. (paragraph 236)
- Explain the relevance of including both '100-Non Broadband Radio – Ericsson Support' and '100-Telecoms Equipment – Nortel Support' in the light of the forward-looking assumption and modelled technology. (paragraph 236)
- Allocate royalty costs based on revenue rather than costs. (paragraph 236)
- Base its network expenses factors on 'current investment' (as opposed to 'forward-looking investment') and 'current expenses'. (paragraph 236)
- Add an option to the FLLRIC model allowing the user to take account of efficiency improvements, i.e. by adding an input parameter that adjusts the expense factors directly by whatever efficiency improvement the user is investigating. This factor should per default be set to zero percent. (paragraph 236)
- Introduce colour coding in the FLLRIC model, i.e. different cell or font colours depending on the nature of the cell. In Excel different styles can be defined. Examples of useful cells types include: Input data (where a user may enter a value), calculations, warning messages, cells that link to external data and confidential data. (paragraph 246)
- Remove Pivot tables in the FLLRIC model and replace these with alternative calculations, i.e. calculations that make use of Excel formula and which are directly performed in the relevant cell. (paragraph 246)
- Use named ranges in the FLLRIC model to assist in the understanding of calculations. (paragraph 246)
- Eliminate the use of macros in the FLLRIC model where possible. Where macros are used they should be well documented. Calculation processes should be noted and steps that are preformed by macros should be explained. (paragraph 246)
- Minimise duplication in the FLLRIC model. (paragraph 246)
- Show any hidden cells in the FLLRIC model. No calculations or input should be hidden anywhere in the workbooks. (paragraph 246)
- Provide clarifying descriptions associated with inputs making it clear from where each are derived and/or from where they originate. (paragraph 246)
- Remove redundant information in the FLLRIC model and remove assumptions and input which are not used for any purposes in the modules. (paragraph 246)
- Revise the workings of the model to make it more simple to use. For example, input changes to capital costs, the WACC, asset lives etc. should to the largest extent possible flow automatically through the modules to service unit costs without the need for manual changes. (paragraph 253)

- Provide documentation for those parameters that require several steps to be performed when updating. (paragraph 253)
- Justify the optimality of all the inputs used in the access network part of the fixed network module. The Authority emphasises that the access network should reflect forward-looking principles and a simple replication and re-valuation of C&W's existing access network cannot be regarded as a cost efficient solution without proper documentation. Justification should also be given for the assumed planning horizon. (paragraph 266)
- Align and use a consistent set of cable sizes through-out the access network modelling in the fixed network module. (paragraph 266)
- Ensure that interpolation between equipment sizes does not result in erroneous component costs in the fixed network module. (paragraph 266)
- Address the Authority's concerns with regard to the allocation of duct costs between access and core network. (paragraph 266)
- Provide documentation to show that exclusive duct is used in the same proportions as number of km in each network or where this is in error, correct the approach ensuring it is reflective of forward-looking operator. (paragraph 266)
- Separate the MG investment into fixed and variable according to dimensioning rules and functionality of the equipment. Where this is not possible, C&W must correct for the methodological problems identified by the Authority. (paragraph 275)
- Use a consistent demand set to separate the fixed cost investment per MG into a 'Fixed Cost per MG' and the 'Variable Cost per MG'. (paragraph 275)
- Eliminate the use of estimates that mix old and new switching technologies and update the fixed network module to reflect MG investments based on NGN equipment only. (paragraph 275)
- Provide documentation for the optimality and/or efficiency of the infrastructure inputs used (cabling, ducting trenching etc.). This should include a discussion of how excess capacity has been taken into account, how legacy impacts have been dealt with and the choice of trenching terrain. (paragraph 284)
- Correct the input duct dimensions to match the cost inputs used in the fixed network module. (paragraph 284)
- Ensure an appropriate portion of pole costs are allocated to the core network. (paragraph 284)
- Provide justification for the unitization of the 400-Contact Centre Platforms based on minutes rather than calls. (paragraph 287)
- Provide information explaining in detail the source all assumptions marked as "C&W", "Benchmark" or "Cayman". (paragraph 301)
- Indicate whether one or two USP's are needed in the fixed network module. (paragraph 301)

- Amend the fixed network module to take account of the cost of spare equipment inventory in a manner consistent with the mobile network module approach, i.e. as an additional percentage of the original investment. The percentages used should be justified and documented. (paragraph 301)
- All equipment cost inputs must reflect a "real life" level of discount from list pricing. (paragraph 301)
- Provide documentation of the IRU price given that the cost of International Transmission (submarine) is a considerable component of total costs. (paragraph 306)
- Split the costs of the STM capacity for national inter-island traffic between the fixed and mobile modules by ensuring there is no double counting. (paragraph 306)
- Provide complete documentation and clarifying descriptions of each technical assumption, making it clear what each assumption represents and indicating its source. Where an assumption is derived, accompanying calculations are to be provided. (paragraph 313)
- Base the routing factor calculations on a revised traffic sample containing no irregular events that affect the distribution of traffic. If such data is not available, C&W should attempt to adjust for the impact of irregular events and justify the associated assumptions. (paragraph 328)
- Explain in detail routings for each service. (paragraph 328)
- Explain the use of international transmission every time the following services are provided: 'ADSL Retail', 'ADSL Wholesale', 'Dial-up internet usage' and 'Direct connect'. (paragraph 328)
- Explain the conversion of data usage to minute demand for data services. (paragraph 328)
- Explain why domestic transit only consists of handing over traffic at the host exchange and does not contain any transit between exchanges. (paragraph 328)
- Explain why the DQ wholesale services solely contain host switch elements and those relating to DQ and interconnection. (paragraph 328)
- Explain the equivalence of the services 'Domestic leased line retail' and 'Domestic leased line wholesale'. (paragraph 328)
- Explain why payphone services make no use of the network elements in the access network. (paragraph 328)
- Explain why the international transit service from and to OLO make use of the RSU element and 'RSU to Host transmission' element. (paragraph 328)
- Explain the derivation of the routing factors for the service 'National Call' that uses information to split between local and trunk calls by providing the underlying calculations and source values. (paragraph 328)
- Explain the assumed equivalence of the routing factors for fixed to mobile (C&W) and fixed to mobile (other). (paragraph 328)

- Where possible, reduce the number of times the services lists is duplicated in the modules and instead use references to one set of common data. (paragraph 335)
- Update the fixed network model and service list to reflect all significant services that C&W currently provides. (paragraph 335)
- Provide information to justify the division of the number of data and SMS subscribers by ten and make the assumption explicit in the module. (paragraph 346)
- Split the cost of VLR and HLR and allocate the costs based on primary cost driver of each. If C&W believes it is appropriate to regard HLR and VLR costs together, detailed documentation must be provided to the Authority showing that this is an appropriate treatment of these costs. (paragraph 346)
- Provide documentation for the cost assumptions employed in the mobile network module, indicating in the documentation whether these inputs correspond to actual invoiced items, average values derived from recent procurement activity, benchmark values (and if so their origin) or some other source. In addition C&W must provide supporting documentation for the level of discounts off list prices. (paragraph 361)
- Provide information supporting its use of spares in the mobile network module. (paragraph 361)
- Split the costs of the STM capacity for national inter-island traffic between the fixed and mobile modules, rather than fully counting the costs in both fixed and mobile modules. (paragraph 361)
- Explain the routing factors used for the SMS service. (paragraph 373)
- Provide documentation showing that the added processor time for specific call types is reasonable within the mobile network it is modelling. The Authority does not regard the reference to OFTEL as satisfactory. (paragraph 373)
- Provide a service definition of the 'Mobile Voice Mail (retail)' service and justify the routing factors used for this service. (paragraph 373)
- Demonstrate that the routing factors in the mobile network module accurately reflect the use of the prepaid platform. (paragraph 373)
- Explain and justify the routing factors for 'fixed to mobile (C&W)' and 'fixed to mobile (other)' are the same. (paragraph 373)
- Update the mobile network module to reflect all existing services in use. (paragraph 378)
- Provide supporting material to allow the Authority to verify the accuracy of the calculations performed in the 'Revenue Mapping' sheet in the top-down retail module. (paragraph 389)
- Apply a bad debt factor to both retail and wholesale services. (paragraph 389)

436. C&W is also directed to provide a proposed Mobile Termination Rate ("MTR") filing detailing the cost of mobile termination and the derivation of the proposed rate using both the 2G/2.5G and 3G network modules. C&W is to include the

following information and provide appropriate references to the mobile cost modules:

- The total annual cost of all network elements making up the mobile termination service, subdivided into annualised capital cost, operating costs and overheads.
- The annual unit cost of the network elements making up the mobile termination service subdivided into annualised capital cost, operating costs and overheads.
- The demand assumptions on which the service unit cost is based, including assumed forecasts and a justification for each.
- Routing factors used in the calculation of the mobile termination service cost and detailed justification for each factor.
- The unit cost of mobile termination, i.e. a cost per minute and/or cost per call.
- Identify and quantify any costs that are shared between fixed and mobile module.

437. C&W must also provide a fixed network module where all relevant changes have been made to reflect the Authority's directions. This is necessary since costs are shared between the modules and failure to update one model may result in inappropriate sharing of costs between the modules.

438. The Authority stresses that the FLLRIC model must satisfy the Authority's Principles and Guidelines and C&W must therefore, in its revision of the model, ensure any changes adequately adhere to them.

439. For the Phase 3 process, the Authority intends to follow the same process it used for Phase 2. The process will be initiated by C&W filing the revised FLLRIC model and the MTR cost studies as described above. C&W will be required to provide any interested party with a full working copy of the model with any confidential information noted and replaced with dummy data. All formulas and calculations are to be left intact.

440. Any information filed in confidence should be done so in accordance with the Authority's Confidentiality Regulations and requests for disclosure will be dealt with in accordance with those Regulations.

441. The Authority intends that parties other than C&W will be permitted sufficient time to review C&W's submission and then may file any comments and proposed changes to C&W's model and MTR filings along with any supporting rationale and explanations.

442. Parties will be permitted to address interrogatories to other parties who filed submissions. The Authority also anticipates that it may address interrogatories to the parties. While the Authority may use more than one round of interrogatories for its questions, parties are to address all of their interrogatories at the same time.

443. When the Authority has completed any interrogatories it intends to address, it will set dates by which parties can file Final Comments and Reply Comments addressing the record of the proceeding.

444. For greater certainty, the Authority identifies that this process will not be an iterative process whereby C&W will be provided an opportunity to change its proposed costing information and models throughout the proceeding. C&W is encouraged to file complete and accurate information at the start of the proceeding and any interested party who intends to participate should file complete and accurate information in its submission.

445. In addition, the Authority identifies that C&W and other parties' submissions in the Phase 3 process should relate to the finalization of the unresolved issues identified in this decision and must not attempt to re-argue items on which the Authority has made determinations.

446. As dealing with disclosure requests took an inordinate amount of time during the Phase 2 proceeding, the Authority identifies that for the Phase 3 proceeding, it intends to require that any disclosure request be made within ten calendar days of the material being filed. Responses to disclosure requests and the determinations regarding such requests will be in accordance with the ICTA Confidentiality Regulations.

447. By 22 August 2008, C&W is directed to identify the date by which it will file a complete FLLRIC cost model reflecting the Authority's determinations in this decision and the two MTR proposed rates and supporting cost studies. By 22 August 2008, any other party that intends to make submissions in the Phase 3 process is to identify the number of calendar days it anticipates it will need in order to review C&W's submission and file any proposed changes to C&W's models and MTR filings along with any supporting rationale.

448. By 1 September 2008, parties may provide comments on the time-frames suggested by other parties in the 22 August 2008 submissions. Subsequently, the Authority will issue procedures and milestones for the Phase 3 proceeding.

APPENDIX A: LIST OF ABBREVIATIONS AND TERMS

2.5G	Upgrade to 2G
2G	Second Generation
3.5G	Upgrade to 3G
3G	Third Generation
4G	Fourth Generation
ABC	Activity Based Costing
ADM	Add Drop Multiplexer
ADSL	Asymmetrical Digital Subscriber Loop
ARCEP	Autorité de Régulation des Communications Électroniques et des Postes (France)
AT&T	American Telephone and Telegraph Company
BHE	Busy Hour Erlang
BRAS	Broadband Access Server
BSC	Base Station Controller
BTS	Base Transmission Station
BU	Bottom-Up
C&W	Cable and Wireless Cayman
CAPEX	Capital Expenditure
CD	Consultation Document
CFO	Chief Financial Officer
CPE	Customer Premises Equipment
CPI	Consumer Price Index
CRP	Country Risk Premium
CVR	Cost Volume Relationship
DEA	Data Envelopment Analysis
DIA	Direct Internet Access
DPLC	Domestic Private Leased Circuit
DSLAM	Digital Subscriber Line Access Multiplexer
DQ	Directory Inquiry
DWDM	Dense Wavelength Division Multiplex
FAC	Fully Allocated Cost
FCC	Fixed Common Costs
FLLRIC	Forward Looking Long Run Incremental Cost
FLLRIC+	FLLRIC including a contribution to common costs
GBP	Great Britain Pounds
Gbps	Gigabits per second (also Gbits/s)
GGSN	Gateway GPRS Support Node
GoS	Grade of Service
GPRS	General Packet Radio Switching
GRC	Gross Replacement Cost
GSM	Global System for Mobiles
HCA	Historical Cost Accounting
HLR	Home Location Register
HSDPA	High-Speed Downlink Packet Access
HSPA	High-Speed Packet Access
IC	Incremental Cost
ICT	Information & Communication Technology
ICTA	Information & Communication Technology Authority
IDD	International Direct Dial
ITU	International Telecommunications Union
IRU	Indefeasible Right to Use
IP	Internet Protocol
IPLC	International Private Leased Circuit
ISDN	Integrated Services Digital Network

kbps	Kilobits per second (also Kbits/s)
KYD	Cayman Dollar
KwH	Kilowatt Hour
LRIC	Long Run Incremental Cost
Mbps	Megabits per second (also Mbits/s)
MEA	Modern Equivalent Asset
MHz	Megahertz
MSC	Mobile Switching Centre
NGN	Next Generation Network
Ofcom	Office of Communications (UK)
OFTEL	Office of Telecommunications (UK)
OLO	Other Local Operator
OLS	Ordinary Least Square
OPEX	Operating Expenditure
ORC	Optimised Replacement Cost
PCU	Packet Control Unit
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RFP	Request For Propsal
RSU	Remote Subscriber Unit
SDH	Synchronous Digital Hierarchy
SFA	Stochastic Frontier Analysis
SGSN	Serving GPRS Support Node
SLTO	Straight Line Through the Origin
SMS	Short Message Service
STM	Synchronous Transport Module
TCU	Trunk Controller Unit
TDMA	Time Division Multiple Access
TRX	Transceivers
TSLRIC	Total Service Long-Run Incremental Cost
Tx	Transmission
US	United States
USD	US Dollar
USP	Universal Signal Point
VAS	Value Added Services
VLR	Visitor Location Register
VPN	Virtual Private Network
WACC	Weighted Average Cost of Capital

APPENDIX B: DEFINITION OF KEY TERMS

B.1. *2G* refers to digital voice cell phone systems that deliver both voice and data transmissions, using circuit-switched technology, where each call requires its own cell channel. 2G technology standards currently in use include Code Division Multiple Access ("CDMA"), Time Division Multiple Access ("TDMA"), and Global System for Mobile Communication ("GSM"). The prime focus is on voice communications. Transferring data over a 2G network involves a "data call" which uses as much network capacity as any other call and uses that capacity for the duration of the connection regardless of whether data is being transmitted at any one moment. Newer standards are much faster for data and only use network capacity when data is actively being transmitted.

B.2. *3G* is the third generation of mobile phone standards and technology and supersedes 2G. It is based on the International Telecommunication Union ("ITU") family of standards under the International Mobile Telecommunications program, IMT-2000. 3G technologies enable network operators to offer users a wider range of more advanced services while achieving greater network capacity through improved spectral efficiency. Services include wide-area wireless voice telephony, video calls, and broadband wireless data, all in a mobile environment. Additional features also include HSPA data transmission capabilities able to deliver speeds up to 14.4Mbits/s on the downlink and 5.8Mbits/s on the uplink.

B.3. *Access Network* refers to the series of wires, cables and equipment lying between a customer's telephone and the Media Gateway. Access networks consist largely of pairs of copper wires, each travelling in a direct path between the exchange and the customer. Wireless technology may also be used in the access network. More recently, access networks have begun to include more and more optical fibre technology.

B.4. *Activity Based Costing* ("ABC") is a method of assigning the organization's resource costs through activities to the products and services provided to its customers. It is generally used as a tool for understanding product and customer cost and profitability. As such, ABC has predominantly been used to support strategic decisions such as pricing, outsourcing and identification and measurement of process improvement initiatives.

B.5. *Cost category* is a grouping of costs into unique cost labels by identical cost drivers for use in the LRIC model.

B.6. *Cost driver* is the factor or event which causes a cost to be incurred.

B.7. *Cost-Volume Relationship* refers to a graph which defines the relationship between the cost (of a cost category) and its cost driver volume, where the driver can either be an exogenous or an endogenous variable to the costing system.

B.8. *Economies of scale* are said to exist if the average cost per unit declines with an increase in the volume of output.

B.9. *Economies of scope* are said to exist when the cost of producing two outputs, A and B, together is less than the cost of producing them separately.

B.10. *Embedded or historic costs* are costs that a company incurred in the past for providing a good or service and are recorded as past operating expenses and depreciation. Due to changes in input prices and technologies, incremental costs may differ from embedded costs.

B.11. *Market risk premium* is the excess return that an individual stock or the overall stock market provides over a risk-free rate. This excess return compensates investors for taking on the relatively higher risk of the equity market. The size of the premium will vary as the risk in a particular stock, or in the stock market as a whole, changes; high-risk investments are compensated with a higher premium.

B.12. *Fixed common costs* are fixed costs that are common to two or more activities and cannot be avoided except by the closure of all the activities to which they are common. Fixed common costs give rise to economies of scope.

B.13. *Forward-looking costs* are calculated as if the service was provided for the first time by a new carrier and reflect planned adjustments in the company's plant and equipment. Forward-looking costs ignore embedded or historical costs; rather, they are based on the least cost technology currently available whose cost can be reasonably estimated based on available data. Forward-looking cost estimates must reflect technologies that are currently operational and available in the marketplace.

B.14. *Increment* refers to the output over which costs are being measured.

B.15. *Incremental costs* are the additional costs (usually expressed as a cost per unit) that a company will incur as a result of expanding the output of a good or service by producing an additional quantity of the good or service. Incremental costs are forward-looking in the sense that these costs are incurred as the output level changes by a given increment. The costs that are considered incremental will vary greatly depending on the size of the increment. Forward-looking long run incremental costs including a portion of the forward-looking joint and common costs, are sometimes written as FLLRIC+, where the "+" indicates the inclusion of joint and common costs.

B.16. *Increment-Specific Fixed Costs* ("ISFC") refers to those costs that do not vary with a particular driver volume, but which can be attributed entirely to a single increment.

B.17. *Joint costs* refers to costs incurred when two or more outputs are produced in fixed proportion by the same production process (i.e., when one product is produced, a second product is generated by the same production process at no additional cost). In telecommunications this definition is sometimes relaxed and instead joint costs are simply referred to as shared costs, i.e. costs that are shared between services or increments (but not necessarily in fixed proportions)

B.18. *Long run* refers to the period over which all factors of production, including capital, are variable.

B.19. *Long Run Incremental Cost* refers to the incremental costs that would arise in the long run with a defined increment to demand.

B.20. *Media Gateway* is a device that converts multimedia input into and out of the different transmission and coding techniques used by the various different telecommunications network elements such as the PSTN access network: Next Generation Networks, mobile radio access networks, or PBXs. Media Gateways enable multimedia communications across network elements using various multiple transport protocols such as ATM and IP and by providing the different functions each network element needs such as the echo cancellation, DTMF, and tone sender functions for the PSTN access network. Media Gateways are controlled by softswitches which provide the call control and signalling functionality.

B.21. *Network component costs* refer to a group of costs which relate to a particular, identifiable part of the network infrastructure (e.g., a local switch), loaded with all the related direct and indirect costs.

B.22. *Next Generation Network* ("NGN") is a broad term to describe some key architectural evolutions in telecommunication core and access networks that will be deployed over the next few years. The general idea behind NGN is that one network transports all information and services (voice, data, and other media such as video) by encapsulating these into packets, like it is on the Internet. NGNs are commonly built around the Internet Protocol and therefore the term "all-IP" is also sometimes used to describe the transformation towards NGN.

B.23. *Provisioning Allowance* is a factor that represents a capacity allowance for growth in demand and is used to determine the maximum capacity required for network elements that are expected to be limiting factors in the network in that they will reach their capacity and require replacement. The provisioning allowance should be set to allow sufficient capacity to allow for maintaining quality of service, planned growth and practical restrictions.

B.24. *Routing Factors* show how individual services use the network. They are often displayed as average factors and are used to dimension the network and

apportion the unit cost of network elements to the services that use them based on the routes the individual calls of a service take through the network.

B.25. *Softswitch* is a programmable network switch that, among others, has the following capabilities: (1) control connection services for a media gateway and IP endpoints, (2) select processes that can be applied to a call, (3) provide routing for a call within the network based on signalling and customer database information, (4) transfer control of the call to another network element, and (5) interface to and support management functions such as provisioning, fault, billing, etc. The switching technology in a softswitch is in software rather than in the hardware as with traditional switching centre technology. This software programmability allows it to support existing and future IP telephony protocols.

B.26. *Transmission Network* is the network that connects service control devices like the softswitch to the access networks through signalling and Media Gateways. The transmission network usually has higher capacity and faster transmission rates than the access networks and include higher levels of optical fibre technology

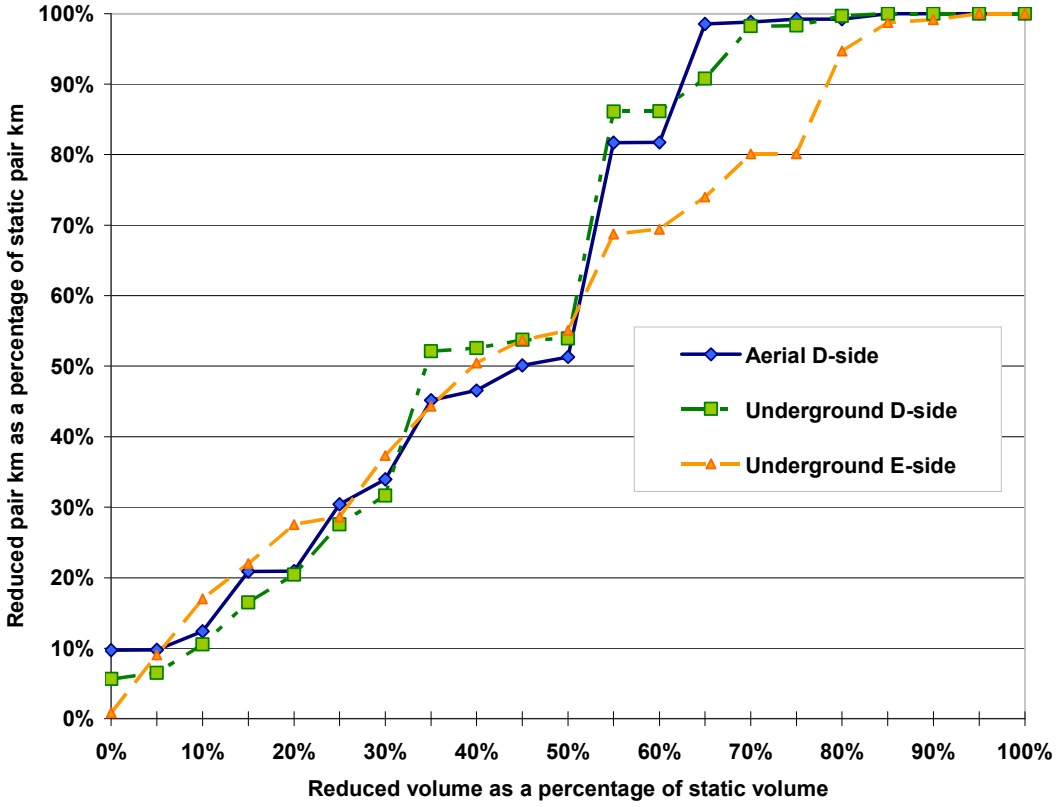
B.27. *Utilization* refers to the percentage of a network element's capacity which is actually used, over some period of time. The capacity is expressed in terms of performing a network function such as; processing calls, terminating lines, erlangs, etc.

B.28. *Weighted average cost of capital* ("WACC") is a calculation of a company's cost of capital in which each category of capital (equity and debt) is proportionately weighted.

APPENDIX C: EFFECTS OF REDUCING DEMAND IN C&W ACCESS NETWORK MODEL

C.1. The C&W model used as input the existing cable km and sizing (in number of pairs). When demand is reduced, such as by removing all business subscribers from the access network, it is not the total cable km that is reduced, it is cable sizing. For example, when demand is reduced by 50% from 20,000 to 10,000 the cable size is reduced in a linear fashion, i.e. a 10 pair cable is reduced to a 5 pair cable. However, to ensure cable size conforms to the sizes available in the model, sizes are rounded up to the nearest appropriate size, i.e. an 8 pair cable that is reduced to a 4 pair cable (using the same assumption as above) is rounded up to a 5 pair which is the smallest available size in the model. These pair sizes are in turn multiplied with the original cable input km. This yields the following figure showing the percentage change in demand relative to the percentage change in cable pair km.

Figure 2: Cable scaling in the access network



Source: Authority analysis of "Cayman fixed 7-Aug-2007.xls"

C.2. As the volume drops for both D-side and E-side cable, pair km is reduced. However, the D-side cable reduction in cable pair is insensitive to small decreases in volume (less the 75% of maximum volume) and consequently very sensitive to

further reductions. It is unclear to the Authority that changing the cable pair km as shown by the figure above is appropriate.

C.3. However, regardless of the above, in the further calculations the model only uses the scaled pair km. Having downsized the cable sizes and rounded up to the nearest cable size the model summaries the cable demand/profile data. This summary is erroneous as discussed in the following.

C.4. The Access Dimensions sheet contains the volume (km) of Arial D-side cable used in the module. The source for these cable lengths are indicated to be "Cayman". The cable lengths are provided for the following pair sizes: 5, 6, 7, 10, 12, 20, 25, 30, 50, 100 and 150. These quantities are transferred to the Access Calculations sheet. On this sheet the intention is to calculate new volumes based on a reduction in demand. However, the formulas used in this process are erroneous. Even without any change in volume the module selects only a subset of the original input cable lengths. This can be seen by comparing the lengths in the Quantity Summary section with those in the Dimensions Calculations section. It is only the cable lengths in the summary section are used in the costing of access cable. In other words, the total length of the Arial D-side cable used is only is 69% of the original input (with no change in volume). The solution to this problem is to align and use a consistent set of cable sizes through-out the model.