‘yes’ OPTUS

Optus Submission to

the Australian Competition and Consumer Commission

on

the WIK Mobile Network and Cost Model for Australia

March 2007

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1. Consultation Process

1.1 The Mobile Terminating Access Service ("MTAS") Pricing Principles Determination is due to expire on 30 June 2007. To support a future pricing principles determination for MTAS, the ACCC has engaged WIK-Consult to develop a bottom-up cost model that estimates the efficient cost of supply of MTAS in Australia using a TSLRIC+ conceptual framework ("the Model"). This model has been released for consultation and comment as part of the ACCC's processes for developing those pricing principles.

Access conditions

1.2 Interested parties such as Optus have been allowed to access the WIK Mobile Network and Cost Model CD-Rom by signing up to the conditions set out in the WIK mobile Network and Cost Model Access Deed. A CD-Rom was made available from 16 February 2007 to 16 March 2007 for this purpose, but the CD ROM would be deemed inoperative from 16 March 2007 ("access period"). Submission on issues set out in the ACCC's accompanying Discussion paper is also due on the same day, that is 16 March 2007.

1.3 Optus submits that the period granted by the ACCC for parties to access and comment on the WIK model is far too short for short given the many complex issues such a model raises. The examination of a mobile network cost model is a necessarily a difficult exercise as it involves many different complex issues and requires considerable time and resources for affected and interested parties. The reasons for such a constrained consultation process have not been adequately explained by the ACCC.

1.4 It is Optus' view that arguments that the timeframe for the consultation process has been affected by the need to protect the intellectual property rights of WIK are unhelpful and contrary to the objectives of the Commission in respect of establishing pricing principles for regulated services.

1.5 Optus has had less than one month to access the model. Upon receiving the CD-Rom from the Commission, Optus' use of the CD-Rom encountered technical errors that took time to resolve. Optus requested an extension from the ACCC. This request was in Optus' view unreasonably denied. The nature of the Commission's approach to consultation on the model, such as requiring all correspondence to be in writing, contributed to this delay.

1.6 The Commission's approach to this consultation must be contrasted to its criticisms of Telstra and the transparency of the PIE II model and access to that model. In respect of recent consultations on Telstra undertakings, Optus notes that the first phase of the consultation typically ran for a 6 week period and only commenced once the ACCC was satisfied that parties had appropriate access the relevant material, including the underlying cost model. Optus finds it puzzling that the Commission would on the one hand criticise Telstra for limiting access to its model and then apply a more restricted approach to consultation on its own model. As a result of the issues outlined above, Optus' review of the WIK model is necessarily limited and as such the fact that Optus has not at all or fully critiqued any aspect of the model should not be taken as acceptance of the quality or appropriateness of any part of the model.

Pricing principles

1.7 After preliminary examination of the Model, Optus submits that the Model is not capable of capturing with sufficient accuracy the underlying practical considerations of running a mobile operation in Australia. It should not, therefore, be used to support future pricing principles for MTAS.

1.8 The WIK model contains inaccurate datasets and theoretical calculations. It does not contain sufficient information about traffic mix, traffic profile, spatial distribution of traffic, and geographical landscape in Australia in order to accurately dimension a mobile network for Australian conditions. As discussed elsewhere in this submission the WIK model is a scorched earth model with apparently inaccurate and potentially biased assumptions. Even with adjustments, the results produce the lowest bound of cost estimates for a reasonable charge for MTAS.

1.9 As discussed elsewhere in this submission, the theoretical calculations used to dimension the traffic network have serious limitations which mean the estimates produced by the model could be highly inaccurate. Further, these calculations have not been calibrated or checked against the actual experience of mobile operators in Australia. This means there are very few checks on the model's integrity and accuracy.

1.10 Further, Optus believes the model in certain areas has taken an 'aggressive' rather than a 'conservative' approach in choosing network parameters and modelling decisions, which is inconsistent with the Commission's past approach in setting MTAS prices and to its pricing principles for other declared services. Optus would go as far as suggesting that the model has been "force fitted" to produce a predetermined outcome.

1.11 As the WIK model does not appropriately model costs in an Australian environment, Optus believes the model cannot readily be relied upon as a regulatory tool to set more than the lowest bound of reasonable cost estimates for the MTAS. As the Commission is aware, any inaccuracies in the future pricing principles for mobile termination will likely have a significant adverse financial impact on Optus which in turn will compromise Optus' legitimate future business interests.

WIK-Consult

1.12 Optus submits that WIK's lack of familiarity and experience in the Australian market will have likely contributed to the flaws within the model.

1.13 Whilst we acknowledge that WIK has more than 20 years experience in the telecommunication regulation, we understand that it has limited experience in developing a model to estimate the efficient cost of the supply of MTAS. We understand it is possible that WIK has developed a mobile cost model in Austria, but WIK's experience is not detailed in its report.

1.14 Further, much of its experience and focus is drawn from Europe. Whilst information from overseas jurisdictions, including Europe can be useful in such modelling processes, nevertheless their relevance needs to be specifically tested against Australian conditions. Further, as Optus demonstrates later in this submission certain assumptions need to be Australia-specific.

Improvements

1.15 Optus believes the Commission should establish processes to improve the development of the model and the development of pricing principles for the MTAS. Optus requests that the Commission:

(a) Provide Optus and interested parties with all of its correspondence, meeting notes, file notes and working papers that have been produced during the preparation of the WIK model. This would allow the mobile network operators (MNOs), through their particular knowledge of the industry, to add value to the future process and alert the Commission to the different issues and concerns parties may have.

(b) Make immediately available the WIK model to interested parties on a permanent basis. This will facilitate improvements in the modelling, assist negotiations between parties and allow adequate consultation. It may also allow parties to submit undertakings using the Commission's model.

(c) Allow an additional six weeks for responses to the model on technical issues.

(d) Implement processes within the Commission for more open and constructive dialogue on the model development. This would include a process of public hearings with the Commission and WIK to understand and discuss the model with industry and relevant experts.

(e) Establish a process for commercial in confidence material to be shared with the consultant so the model can incorporate Australian conditions and to establish a mechanism for checking the realism of the assumptions and outputs of the model.

1.16 Optus would be happy to engage with the Commission, including the supply of confidential information flagged in this submission as [C-i-C] and additional confidential information, if features of this request are incorporated into the Commission's future processes.

2. Conceptual Issues

2.1 Optus contends that a scorched earth model does not produce a cost estimate for the MTAS which is reasonable.

2.2 Notwithstanding this contention, even as a scorched earth model the WIK model produces an infeasible model of a mobile network in Australia. The model does not take into account many fundamental challenges and limitations faced by existing MNOs and a new entrant in designing a mobile network.

2.3 It is, therefore, inaccurate to describe the network produced by the WIK model as being designed in a more efficient manner than existing mobile networks in Australia. This is because the network produced by the WIK model is not feasible and would not provide the same level and quality of service produced by mobile networks in Australia.

2.4 Further, Optus believes the WIK model has in particular areas taken an 'aggressive' rather than a 'conservative' approach in choosing network parameters, modelling assumptions, decisions and algorithms and the scenarios chosen (though it purports otherwise). These matters are explored in this submission.

Optimisation

Conceptual framework

2.5 In bottom-up modelling there is an implicit (or explicit) decision to be made in terms of optimising the network design. The model either takes into account aspects of the existing network topology (scorched node), or redesigns the network such that it is based on an ideal topology (scorched earth) without reference to existing network nodes.

<u>Scorched earth</u>

2.6 The scorched earth approach emphasises theoretical efficiency, re-designing the network with minimal constraints. It implies that all elements of the network (e.g. BSCs, base stations, MSCs, etc) can be situated at theoretical optimal locations, with the number of each element built also optimised.

2.7 This approach risks underestimating what a reasonably efficient network deployment would be as in practice a network operator faces a number of restrictions. As such it may not allow an existing operator to recover prudent but historically incurred costs.

<u>Scorched node</u>

2.8 The scorched node approach assumes that some of the current and established network layouts of MNOs are reasonably protected from optimisation given their historical deployment considerations and constraints (e.g. market conditions, available locations, etc). As a result scorched node models have the benefit of substantially implying the degree of analysis and information required to design an optimal network.

2.9 It is unlikely that the ideal network for supporting demand at present-day levels will be perfectly reflected in the actual networks that are currently deployed. Therefore, in some situations, it is appropriate and reasonable to optimise network elements in order to replicate a more efficient network topology.

2.10 The scorched node approach takes the existing topology as a starting point and seeks to eliminate inefficiencies (e.g. convert to improved technology). This process is commonly referred to as 'calibrating' the model.

WIK model

2.11 Generally, the WIK model is a bottom-up model so it is intended to model a hypothetical new entrant's network, rather than a particular operator's network. Nevertheless if the model is to produce a realistic estimate of the efficient costs of a new entrant in the Australian market it must take account of the conditions and constraints that MNOs face in that market.

2.12 In this sense the WIK model even goes beyond a scorched earth model because it excludes many considerations of existing network design (all elements are optimised) and also does not adequately take into account local conditions such that the network produced would not deliver the same service as is offered by existing MNOs.

2.13 The variety and subtlety of such conditions and constraints means that it may be difficult to model them directly. Nevertheless modellers can capture the effects of these local conditions by incorporating into the model parameters derived from the experience of local mobile operators or calibrating the outputs of their models against such experience. This is common practice on the part of international regulators.

2.14 For example, in the context of bottom-up modelling for the Dutch regulator OPTA, Analysys have recommended that the results of the model be calibrated against actual operator data, "*to ensure node counts correspond with reality*".[1] According to Analysys, "*this ensures that the level of assets in the model is not underestimated due to factors that are not explicitly modelled.*" Similarly in the UK, OFCOM aims to align parameters with actual data supplied by mobile network operators, and in the model used by the Norwegian regulator NPT, the number of network nodes is determined in accordance with actual network designs.

2.15 By contrast, the WIK model, unusually, does not incorporate parameters based on the experience of local mobile operators. Parameters used for network deployment in the WIK model (108-113) are based only on general data such as terrain and population parameters.

2.16 Consequently, the model's results may not reflect crucial practical constraints. For example, the model appears to assume no limitations on the location of a BSC, however BSC locations are actually restricted by the availability of

[1] Analysys, June 2006, Final report for OPTA, Conceptual design document, p.25.

infrastructure such as roads and power and no consideration is give to the operational requirements of maintaining BSCs that are located in remote locations (such as Thursday Island). Similar examples can be identified in the modelling of every level of the network, from base station deployment through to the core network.

2.17 WIK criticises the practise of calibrating models at page 5 of its report as follows:

> "...*different approaches to model calibration can sacrifice the efficiency aspects of the bottom-up costing elements of a hybrid model when it adopts the cost structures and the cost levels of specific operators. WIK-Consult considers that the approach to calibration adopted by Ofcom used in its current modelling exercise is at risk of such a compromise.*"

2.18 This quotation illustrates a general feature of WIK's approach to modelling: that it is essentially uncompromising in its approach. We observe that throughout the modelling exercise, WIK have consistently assumed the most cutting edge technology (that is not evidently best or in-use in Australia), the most complete information and the most efficient theoretically possible network configurations, with little concession to the legitimate business interests of and the practicalities faced by actual MNOs or a new entrant in Australia.

2.19 This approach essentially penalises operators who have made prudent business decisions simply because new information or new technology has emerged. If applied, such a hard-line approach would deter investment in the industry. Legislators have recognised this fact by including in the Act objectives requiring that the legitimate business interests of network owners be taken into account, alongside efficiency and competition objectives. The Act recognises that the public interest requires a careful balancing of these competing objectives. That is, it requires some compromise.

2.20 At best, with some adjustments the WIK model could then be said to produce the lowest bound of MTAS rates in Australia.

International mobile network models

2.21 Optus has reviewed a number of mobile network models from other jurisdictions and notes the more or less unanimous use of scorched node optimisation. The WIK model is the only one to implement scorched earth rather than scorched node optimisation.[2]

2.22 The scorched node approach is unanimously preferred for a number of reasons, largely because regulators have recognised the practical inability of MNOs to locate networks elements in any location, an issue previously raised in this submission.

2.23 Scorched node is also supported due the view that mobile networks have been efficiently deployed and operated due to the existence of facilities-based

[2] Optus also notes that in previous modelling for the German fixed line network WIK have supported using the scorched node approach: WIK, *Analytical Cost Model for the Local Loop - Consultative Document 2.0*, 8 November 2000, page 1.

competition.[3] Given the high degree of infrastructure competition in the Australian mobile market, a characteristic which has led to less regulatory intervention from the Commission[4], Optus submits there is no reason not to assume a similar degree of efficiency in historical investment and deployment decisions by Australian MNOs.

2.24 In mobile network models produced for other countries there are a number of cautionary remarks in regards to the use of scorched earth modelling. In particular, the Netherlands' mobile model notes that such modelling risks underestimating efficiently incurred costs of network operators, a risk that can be mitigated through scorched node optimisation:

> *The use of radio planning tools, whilst potentially valuable, runs the risk of underestimating what a reasonably efficient network deployment would be, and thus not allowing the existing operators to recover their efficiently incurred costs...The scorched node approach mitigates this risk.*[5]

Comparison with fixed network modelling

2.25 Internationally, the majority of fixed network models also apply the scorched node approach.[6] Further, in Australia, the Commission continues to have no issue with Telstra's PIE II fixed network model being based upon a scorched node framework.[7] The ACCC / NERA model of Telstra's fixed line network was based on a scorched node approach.

2.26 The scorched node method has been unanimously preferred because regulators have recognised that due to reasons of simplicity and feasibility, as well as historical factors, applying a scorched earth approach is generally not feasible. Such a viewpoint is also explicitly supported by the Independent Regulators Group (IRG) that considers the scorched node approach to be a "principle of implementation and best practise" in LRIC network modelling.[8]

2.27 Optus submits that given international experiences with both fixed and mobile network modelling, as well as the nature of the Australian mobile network, the Commission needs to strongly re-consider whether the scorched earth model is a reasonable and appropriate approach.

Calibration

2.28 To compensate for the inadequacies of bottom-up models, regulators in other jurisdictions have undertaken a process of cost calibration. This review mechanism seeks to compare actual data with that produced by the model to

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[3] Analysys Consulting Limited, *Conceptual Design Document – Final Report for OPTA*, 14 June 2006, page 25.
[4] Ed Willett (Commissioner), AMTA Annual Conference Address, Sydney, 15 September 2005.
[5] Analysys Consulting Limited, *Conceptual Design Document – Final Report for OPTA*, 14 June 2006, page 27.
[6] Jurisdictions where the scorched node approach has been used for fixed network modelling has been applied include the European Union, United Kingdom, Germany and United States.
[7] ACCC, *Final Determination for model price terms and conditions of the PSTN, ULLS and LCS services*, October 2003, page 41.
[8] IRG, *Principles of implementation and best-practice regarding FL-LRIC cost modelling*, 24 November 2000, page 3.

verify the legitimacy of such results. Actual data is also used to endogenously adjust important output parameters (such altering the number of base stations to match those actually deployed by operators) to better replicate a network that a hypothetical entrant would produce.

2.29 Optus submits that in the context of numerous concerns relating to inputs and model design, and as no cost calibration has been performed, the WIK model's results bear little resemblance to actual conditions faced by operators.

2.30 Optus further contends that many of the parameters used in the model are based on unrealistic and unjustifiable estimates that are not suitable for modelling the realities of the Australian mobile network. For example, the number of busy-hour Erlangs per subscriber is not only based upon an estimate used for a fixed telecommunications network rather than a mobile network but is derived from another country.[9]

2.31 Optus believes that it is in the interests of all parties for there to be increased collaboration to produce a more finely calibrated and realistic model.[10]

Network resilience

2.32 WIK take an overly casual approach to network resilience. Its discussion of network resilience (p73) demonstrates the theoretical nature of its model and its rudimentary understanding of mobile network design.

2.33 In order for the model to be applied it would be useful for WIK to demonstrate that the network produced by its model is capable of providing equivalent resilience and quality of service to existing MNOs. Unfortunately no such attempt has been made and WIK has resorted to frankly, meaningless statements such as that it considers "current telecommunications network equipment is already engineered in a way that in combination with network maintenance and testing the network availability can be considered to be very reliable". This statement essentially denigrates important network design decisions to protect the network from failure and to protect its quality of service and the MNO's brand in the marketplace.

2.34 Optus considers that in designing its model, WIK has underestimated the importance of network resilience. Optus' network has a number of features, including built-in redundancy, protected transmission topologies (providing diversity) and an additional tandem switching layer, all of which improve the resilience of the network to outages of key network elements. Such resilience is a crucial feature of a well constructed network, since the customers of mobile networks place a high premium on the reliability of their chosen telecommunications provider. Poor reliability leads to lost revenues, lost customers and reduced customer loyalty. Consequently, the long-term cost of low investment in network resilience can be substantial. This fact is recognised in the industry, as the following extract from an industry media article illustrates:

[9] WIK, *Mobile Termination Cost Model for Australia*, January 2007, page 107.
[10] Optus notes this has been the method used by many regulators internationally (e.g. OPTA and Ofcom) and is preferable to the current process.

Before you determine how much network reliability you can afford, consider that you cannot afford to be without it. Reliability is rudimentary. You may have gotten your customers' attention with flashy phones and special service plans, but reliability is the reason they will stay ... Studies show that as reliability decreases, churn increases. [11]

2.35 To the extent that WIK's model does not incorporate such resilience features it would appear that the modelled network may not meet the reliability standards expected of MNOs in Australia. In relation to network resilience, further examples of the inadequacy of the model are noted in the section of this submission which deals with technical comments on the network layers.

Scenarios

Size of network operator in the reference case

2.36 In recent hearings before the Australian Competition Tribunal (ACT) there have been a number of recommendations that discredit, and likely reject, the validity of applying the 25% standard for the size of a hypothetical mobile operator.[12][13] The main reasons for the ACT decisions were:

(a) It was not convinced such a market share was achievable, nor further that a four-player shared market was a sustainable outcome in the long run, and

(b) It believed the standard fails to account for issues relating to market behaviour. For example the legitimate business case of niche providers (by service or location) that may allow them to operate on a limited scale with much less than 25% market share.

2.37 Optus submits that having due regard to the directions given by the ACT it is not reasonable for the WIK model to use a 25% market share in the reference case without providing further justification.

Alternative reference cases

2.38 The WIK model produces also a further hypothetical scenario in which there is an integrated mobile and fixed line operator. Clearly this scenario closely reflects two actual carriers in the Australian telecommunications market and may therefore be used to draw assumptions about their network costs. Optus highlights that the ACT has recently provided direction in terms of the type of hypothetical operator that an actual operator should be compared with.

2.39 The ACT was clear that an integrated mobile operator such as Optus should be treated as if it were a stand-alone mobile operator, stating:

If the objective of regulation is to replicate, as far as possible, the environment of a competitive market, then it is desirable to use as a

[11] Nikki Swarz, Telephony's Wireless Review, Oct 1, 1999, *Reliability requirements*

[12] Australian Competition Tribunal, *Vodafone Network Pty Ltd & Vodafone Australia Limited* [2007] ACompT 1.

[13] Australian Competition Tribunal, *Optus Mobile Pty Limited & Optus Networks Pty Limited* [2006] ACompT 2.

benchmark criteria or principles which would exist in a competitive market, such as determining the cost of an operator operating in that market.[14]

2.40 The ACT further determined that treating Optus' as a stand-alone carrier best promoted objectives under the *Trade Practices Act 1974* by:

(a) Likely resulting in the promotion of competition for listed services under s 152Ab2(c);

(b) Likely resulting in a price that encourages the economically efficient use of, and investment in, infrastructure under s152AB(2)(e); and

(c) Having appropriate regard to Optus' legitimate commercial interests under s152AB(6)(b).[15]

2.41 Optus therefore strongly submits that the results of modelling an integrated carrier, as currently produced by the WIK model or indeed future models, are irrelevant in determining the appropriate cost of services supplied on the Optus network.

Modelling an operator with a 3G network

2.42 Optus submits that the migration of traffic to a 3G-based network has not been adequately addressed in the WIK model. Specifically, future investments in the use of 3G technology are not included in the baseline data produced by the model. This is an area of concern as 3G subscribers will represent an increasing proportion of the mobile market as evidenced by the increased numbers of subscribers each year. In December 2005 3G subscribers represented only 4% of the total mobile market, however this increased to 15% only a year later.[16]

2.43 Given current and forecast market demands it is likely that a new entrant would design a network based upon supplying a 3G service. Therefore, in order to replicate the hypothetical market faced by new entrants, the WIK model needs to better account for such operators producing a 3G network.

2.44 All carriers have announced network upgrades to the 3G standard based upon forecasts of increased demand for the data and information services that 3G can provide. Optus recently announced plans for a major expansion to its 3G network, including plans for extensive coverage in rural and regional areas.[17]

2.45 As 3G migration accelerates, higher 3G subscriber acquisition costs are expected to negatively impact mobile margins in 2007 and beyond.[18] Further there is also a higher average cost in providing 3G services (as compared to

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[14] Australian Competition Tribunal, *Optus Mobile Pty Limited & Optus Networks Pty Limited* [2006] ACompT 2, paragraph 122.

[15] Australian Competition Tribunal, *Optus Mobile Pty Limited & Optus Networks Pty Limited* [2006] ACompT 2, paragraph 123.

[16] JPMorgan Asia Pacific Equity Research, *Australian Mobile market - CY06 mobile market review*, 05 March 2007.

[17] Optus Media Release, *Optus announces bold expansion of its 3G mobile network across national footprint*, 30 Jan 2007.

[18] JPMorgan Asia Pacific Equity Research, *Australian Mobile market - CY06 mobile market review*, 05 March 2007.

2G and 2.5G) due to both the technology used and the small (although increasing) subscriber base.

2.46 Optus submits that the current WIK model would not allow 3G operators to receive an appropriate return on their investment. Further the 3G network is likely to be more costly (at least initially) than previous 2 and 2.5G services. At best this inadequacy provides a disincentive to invest in new 3G technology, and at worst it does not allow operators to recover their costs of providing voice termination over the 3G network.

3. Network Design

3.1 In this chapter we discuss aspects of the network design by the WIK model's Strategic Network Planning Tool (SNPT), including the model's methodology and WIK's choice of parameters.

3.2 In summary Optus submits that it would be unreasonable to draw significant conclusions about the design of an efficient mobile network in Australia using the WIK model. It would also be unreasonable to prefer a scorched earth optimisation such as that advocated by WIK to an approach based on the current layout of mobile networks with some calibrations for efficiency.

3.3 The chapter is organised according to the breakdown of network layers defined by WIK, beginning with base station deployment and ending with the core network layer.

Base station deployment

3.4 Optus has a number of concerns with the WIK model's deployment of base stations. These relate to the model's radio propagation modelling, its restrictions on base station deployment and more generally to its apparent under-deployment of base stations, which appears likely to have resulted from WIK's failure to take into account the real practical constraints faced by network planners in deploying base stations.

Radio propagation modelling

3.5 Radio propagation characteristics and cell radius for the GSM 900 MHz frequency are determined using the Okumura-Hata model. For the 1800 MHz band the model "implements the modification of the COST 231 project adapted to the Okumura-Hata model".

3.6 The Okumura-Hata model is a well documented model of wave propagation that can be applied to various circumstances in order to estimate the range of large and small macro-cells. However its use is subject to recognised limitations. In particular, the Okumura-Hata model is not appropriate for: [19]

- cell ranges of less than 1 kilometre, which means it is not appropriate for either micro or pico cell sites, nor macro cells with ranges of less than 1 kilometre;
- base station antenna heights that are less than 30 Meters above the height of adjacent buildings (i.e. the effective height of base station antenna should be at least 30 Meters).

3.7 These limitations were recognised by the COST 231 project, which proposed a combination of the Walfisch and Ikegami models, the COST-Walfisch-Ikegami (COST-WI) model, in order to address these limitations. The COST-

[19] PCS Extension to Hata Model COST-231 Model (1500~2000 MHz) EURO-COST group (Co-operative for Scientific and Technical research) "Urban transmission loss models for mobile radio in the 900 and 1800 MHz band" rev.2, the Hague, Sep. 1991.

WI model allows for improved path-loss estimation by consideration of more data to describe the character of the environment namely:

- height of buildings;
- widths of roads;
- building separation;
- road orientation with respect to the direction of the radio path.

3.8 Mobile network operators in Australia are commonly faced with circumstances that require cell ranges of less than 1 kilometre. Base station antenna heights are often less than 30 meters above adjacent buildings. WIK has apparently not taken into account the limitations of the Okumura-Hata model in these circumstances. Since WIK does not utilise the more accurate COST-WI model, it cannot take sufficient account of local circumstances found in Australia. Consequently, Optus does not believe that the WIK model can be relied upon to accurately determine cell ranges and therefore network costs.

3.9 In practise, when network designers make use of radio propagation models, they calibrate the model results through extensive testing, which may necessitate substantial adjustment and optimisation of the network design. Optus considers that correct identification of the costs of providing mobile services in Australia requires such calibration, or alternatively the development of a reliable propagation model utilising a large set of additional local data.[20]

Restrictions on base station deployment

3.10 The WIK model restricts the deployment and characteristics of base stations in a number of ways.

3.11 According to the WIK-MNCM model the deployment and characteristics applied to macrocells, microcells and picocells are restricted as set out in WIK's Table 4.2 "Characteristics of different types of base stations". These restrictions are arbitrary and have not been justified. They should not be applied because the set of restrictions faced in practice by a mobile network operator is not the set assumed by WIK (and indeed many of the restrictions assumed by WIK do not apply):

- macrocell and microcells can be deployed in urban areas;
- picocells are not limited to urban areas; they can also be used to provide coverage in buildings in suburban and rural areas;
- macrocells are not restricted to 1-2 sectors or 1-2 transceivers (TRX), MNOs deploys both 3 and 4 cell sector macrocells (with 3 sector likely being the most common type deployed);

[20] We note in this regard that WIK say in "actual operational planning, more sophisticated solutions are required, such as ray tracing" (p63). This is incorrect. No MNO uses ray tracing in planning its network. Such approaches are computationally intensive and require enormous amounts of local data which would be subject to change with urban development.

- microcells are not restricted to 3 sectors or to 1-3 TRX;
- TRX power does not have to be set at 10 for macrocells, 1 for microcells and 0.25 for picocells.

3.12 In practise, MNOs are less likely to differentiate between macrocells and microcells. Macrocells are deployed in mobile networks in Australia in all areas and the 'classical division' made by WIK between cell types is not followed in modern network planning. WIK also defines and deploys 'picocells'. In practise, MNOs deploy in-building cells and macrocells. It is unclear whether the practice of network planning follows and can be accurately compared with WIK's nomenclature.

Number of base stations deployed

3.13 The WIK model outputs in the standard 25% scenario include:

- 2,504 base station sites
- 4,266 base stations comprising:
  - i) 2,504 base stations at the 900MHz frequency
  - ii) 1,762 base stations at the 1800MHz frequency (all collocated at 900MHz sites).

3.14 The number of network elements modelled by WIK differs significantly from the number deployed in Optus' network. The WIK model results in a substantially higher number of 1800MHz base stations and a smaller number of GSM base stations and sites compared to Optus' actual deployment.

3.15 WIK assumes that 1800MHz base stations are deployed when the modelled cell radius is limited by traffic. In practice however, the deployment of 1800MHz base stations in an efficient network is less common than WIK assumes and 900MHz solutions using an increased number of TRX are often used in preference to provisioning 1800MHz. WIK appear to assume that in a given geographic region, as soon as an operator needs to add 1800MHz to a site, it will need to add it to every site in that region. WIK say in "cases where due to the traffic load the 1,800m MHz band is also required, the WIK-MNCM installs 1,800 MHz base stations in *all* 900 MHz base station locations" [emphasis added]. This assumption is not consistent with prudent network design. Deployment of 1,800MHz is a site-by-site decision. Part of this decision involves consideration of whether the spectrum is available. Optus has 1800MHz spectrum in the five major capital cities only. This does not appear to be taken into account in the WIK model. For example, the WIK model provisions 'dual band' base stations in Cowra (in NSW) and Cobram (in Victoria). MNOs in Australia would not have spectrum to support this network.

3.16 More fundamentally however, the WIK model deploys a substantially lower number of base stations than are deployed in Australian mobile networks. As discussed above, WIK has not taken into account information derived from observation of existing mobile networks in Australia, and in doing so it departs from standard modelling practice. For example, the number of base station sites in Optus' network is substantially greater than the number of sites in

WIK's hypothetical network. There are a number of potential explanations for this.

3.17 First, the WIK model appears to neglect some important drivers of base station deployment. The model determines the demand input by reference to the relevant population for each district (p62). Postal areas below a set number of inhabitants are excluded from network coverage. In cases of very low population density, a single base station is positioned in the centre of the postal area (p111). In rural areas this population-based approach neglects the need for continuous coverage along highways including highways running through very sparsely populated areas. In urban areas the WIK model treats coverage and traffic as the main drivers for base station location. In practice however, penetration of radio signal into buildings is a further significant driver in urban areas which appears to have been overlooked. Consequently, the model results in lower number of base stations than are required in real world networks in Australia.

3.18 Second, WIK's model does not appear to take sufficient account of the impact on base station siting decisions of terrain features. The model classifies postal areas on a topological basis as flat, hilly or mountainous. This information is presumably used in determining the propagation capabilities of radio equipment located in a particular postal area. Optus considers that the size of postal areas makes them impracticable to use for network planning purposes. The terrain classification system employed in the model is too coarse to be useful. In practical terms, requirements for radio coverage must be driven by more localised requirements.

3.19 For example ensuring radio coverage in a deep valley may also result in the signal spreading well outside the target area. Another issue is that radio signals travel freely across water. To give a specific example, it is not possible to service Melbourne's bay-side suburbs with base stations some distance inland, since the signal reaches the water and spreads up and down the bay causing major interference problems. The only solution is base stations sited effectively on the water's edge, transmitting signal inland only. Often quality problems caused by terrain issues such as these can best be managed by siting additional base stations (and TRXs). It is unsurprising that a desktop model such as WIK's results in fewer base station sites and fewer TRXs than are deployed in reality, since the simple algorithms used by such models do not reflect real world complexities such as those discussed above.

3.20 Another possible explanation for the WIK model's under-deployment of base station sites is that it does not take sufficient account of the dynamic nature of subscriber demand.[21] Capacity demand does not arise in a uniform pattern. It is influenced by concentrations of people and activity which can vary over time. Changing land uses, for example, new business or residential developments, and variations in the number of customers that a particular carrier has in a locality (for example, relocation of a major business customer to premises in a different suburb) can lead to substantial fluctuations in demand for capacity in a given area of an operator's mobile network. Not only does the operator need to provide for capacity and coverage greater than

[21] This issue is also discussed in the following section, *Dynamic influences on the design of mobile networks*.

currently required in order to anticipate such fluctuations, but also in some circumstances the operator may find that its network continues to have capacity greater than required in some areas if an anticipated increase fails to materialise. This latter situation may be consistent with an initial prudent decision to increase coverage, since fluctuations in demand are often unpredictable. A desktop model, by contrast, need not grapple with such uncertainties, and thus may employ a standard design with base station locations pre-determined. Such an approach would not result in a network capable of meeting the changing needs of actual mobile subscribers.

3.21 A further potential source of the model's low number of base station sites is that it takes no account of environmental planning requirements. Base station sites must be environmentally suitable, and the rights of operators to deploy base stations are often heavily constrained, particularly in environmentally sensitive areas such National Parks and Heritage Areas. Local authorities may oppose deployment based upon concerns about visual impact, impact on property values and adverse health impact concerns about electromagnetic energy or radiation. Further, gaining approval for base station sites would be more difficult for a new entrant than it has been for the existing players. Existing towers were often built before 1997 when a different and much less stringent regulatory regime was in place. They are frequently in locations which would now require the approval of the local Council, but where such approvals would now be unlikely to be granted. These issues make securing sites a complex task, and often preclude optimal base station location. This is likely to result in an increased number of base stations to serve a given level of demand.

3.22 In summary, the model fails to take account of unavoidable practical difficulties, and thus assumes efficiencies that cannot be made by existing MNOs or a new entrant. The WIK model's failure to consider the practical constraints faced by network planners in the real world has caused it to underestimate significantly the required deployment of base stations (and consequently of TRXs).

Dynamic influences on the design of mobile networks

3.23 The design of a mobile network is heavily influenced by inter-temporal factors and as such the optimal or efficient configuration of the mobile network will vary depending upon the build date and constraints at the time. In each period, network deployments are made on the basis of traffic and demand forecasts that may or may not eventuate. For example, an operator may have to increase network capacity in the future to extend coverage and/or capacity to an unplanned development (eg housing estate or transport corridor).

3.24 It is significant to note that the capacity of the network to handle traffic is as important as, if not more important than, coverage. Operators may be able to reach all the customers in a region with a single cell (or base station) however traffic demand is likely to necessitate the construction of multiple cells. The existence of multiple cells within a region creates further logistical and network management considerations for the wider network. The operator must manage issues such as frequency allocation and cell cross-overs, essentially performing a 'juggling act' to manage competing demands and considerations across the broader network.

3.25 Hence the design of current networks therefore is highly correlated with legacy decisions, the placement of an initial network element having a significant influence on future extensions to the network. Optus further submits that the WIK model does not account for a number of other optimisation decisions that are required for it to represent a reasonable scorched-earth model of the mobile network. Although it evaluates alternative locations for network elements (base stations, MSCs, etc) to a degree, it fails to assess their feasibility in terms of such constraints as construction conditions, routing and linkages.

3.26 Geographic and economic trade-offs are significant if the model is to provide a realistic interpretation of an optimal network design. For example at the basic level, potential base station locations determined by the model may not be able to house the associated equipment (e.g. tower, connections, etc) and certain locations are likely to be more costly than others depending on land values and other factors. The Netherlands mobile model used by OPTA highlights the issue of comparing historical deployment decisions with a hypothetical scorched earth design:

> *For example, a network deployed in an efficient manner at a given time, might have a new housing development constructed in a previously rural area built some time after the network was deployed. In this circumstance the efficient choice for the network operator is likely to be to add new sites even though an efficient network being deployed after the construction of the housing development might locate its base stations in different places.*[22]

3.27 It is Optus' experience that finding suitable locations to install base stations is an extremely complex and time-consuming task. Securing a base station site follows a laborious process which includes finding a site that:

- is environmentally suitable;
- can be secured on satisfactory commercial and legal terms;
- meets relevant business case criteria in terms of construction and operation costs;
- can be deployed in a reasonable timeframe; and
- meets the radio performance and quality objectives of the network.

3.28 Optus submits that the WIK model fails to adequately consider any of the above constraints and is therefore overly simplistic in modelling the mobile network. For a network model to determine the least-cost network design from all combinations of alternative locations it would require the use of a complex optimisation algorithm. Optus submits that the WIK model does not have the capacity to perform such complex calculations and is therefore unable to

[22] Analysys Consulting Limited, *Conceptual Design Document – Final Report for OPTA*, 14 June 2006, page 27.

provide reasonable results without significant adjustment and even then it would form the lowest bound of cost estimates.

Aggregation network

3.29 In determining the number of BSCs, as elsewhere in the model, WIK have not taken into account information derived from observation of existing mobile networks in Australia. In this regard, we observe that the number of BSCs determined in the standard 25% scenario and also in the 31% scenario (twenty) is significantly lower than the number of BSCs actually employed by MNOs. This discrepancy requires explanation as the conclusion that it relates to efficiency in network design would be critical for the model's conclusions and validity.

3.30 Optus suggests that a large part of the discrepancy is likely to flow directly from the issues discussed above under base station deployment. Since WIK's hypothetical network has an unfeasibly low number of base stations and TRXs, it follows that it will also contain fewer BSCs than would in reality be deployed. The total number of TRXs reported by the model in the 25% scenario is 20,536, and the total number in the 31% scenario is 24,155. These figures are indeed substantially lower than the number of TRX in Australian MNOs networks.

3.31 We would also observe that the number of BSCs modelled in both these scenarios (twenty) have a collective capacity according to WIK's assumptions of only 16,000 TRX.

3.32 Differences in the number of TRXs are not the only issue with WIK's modelling of the aggregation network. The remainder of this section is concerned with issues related specifically to WIK's modelling of the aggregation network layer, rather than base station deployment.

3.33 First, the methodology employed by WIK to determine BSC locations and the configuration of the aggregation network bears little resemblance to best network modelling practice. The model selects BSC locations "at which most traffic is aggregated with the additional restriction that the distances between each pair of BSCs is larger than a predetermined threshold (which is an input in the WIK-MNCM)" (page 68). The basis of the minimum distance has not been justified, which means that the number of BSCs determined by the model is calculated using an arbitrary restriction on the minimum distance between BSCs. This can therefore lead to an arbitrary number and location of BSCs. Optus observes that the minimum distance between BSCs is one of the least important considerations in designing this layer of the mobile network.

3.34 Optus also observes that BSCs are not spread out in the manner advocated by WIK in Australian mobile networks. Rather, BSCs are often collocated with each other where possible for ease of maintenance and of infrastructure provision. WIK has attempted to justify its spread-out approach by reference to network resilience. This is a simplistic view as it ignores the tradeoff that with increased distance between network elements, there is an increased risk of transmission outage, which would tend to decrease resilience. This is particularly relevant as the star network topology assumed by WIK in this aggregation network is not realistic. Transmission between multiple base stations (and hubs) and their corresponding BSC is commonly and necessarily aggregated on the same transmission path. No MNO would operate a network based on the star topology considered by WIK. Additionally, such paths may be protected (i.e. diversity is provided) to improve network resilience.

3.35 Second, the model does not take into account practical constraints on BSC location. For example, BSC locations are restricted by the availability of infrastructure such as roads and power.

3.36 Third, the model does not take into account the difference in time zones between states (eg, due to daylight saving). Since some mobile services are dependent on the time/date of the call, this consideration makes it appropriate to group BSCs according to state, as is done in the Optus network. That is, any given BSC in the Optus mobile network is generally connected only to base stations within the state in which it is located. To the extent that state subscriber populations are not multiples of the maximum number of subscribers per BSC, this factor is likely to lead to an increased number of BSCs.

3.37 Fourth, the model's assumption about the parameter for BSC capacity (800 TRX) appears higher than the norm. WIK assumes that the capacity of BSCs is 800 TRX. Lower figures for TRX capacity are used in network modelling in other jurisdictions. For example, the Norwegian regulator NPT's model assumes the capacity of a BSC is 256 TRX. Further, we would observe that for reasons of network resilience BSCs are generally not used at greater than 80% capacity. This has not been explicitly recognised in the model. Finally, the choice of high capacity BSCs tends to reduce network resilience, since it means that the outage of a single BSC must result in a loss of coverage for a greater number of base stations and subscribers.

3.38 Fifth, the model makes unrealistic assumptions about network elements typically used in the aggregation network. For example, WIK assumes a combination of internal radio links and leased lines are used to connect base stations to BSCs. However, MNOs uses internal fibre optic links for this purpose combined with limited use of microwave links. MNOs also provide protected routes for these routes. It is worth noting that existing fibre links tend to follow highways, rather than take a direct route as WIK appears to assume.

3.39 Finally, WIK does not take into account the dynamic nature of subscriber demand, which is relevant to the degree of optimisation appropriate in network modelling. The location of MNOs' BSCs is a function of the history of network development. Optus' network contains many BSCs which are provisioned with less than maximum capacity. While this factor has contributed to the larger number of BSCs in Optus' network, it is not necessarily due to imprudent or inefficient network planning, since it is not possible to predict with complete accuracy future population growth and subscriber demand. Further, technology changes have resulted in improved capacity for BSCs and lengths for transmission lines. Decisions on the location of BSCs are likely to have been efficient at the time they were made, based on information and technology available at the time.

3.40 WIK's assumptions can dramatically affect the level of costs incurred. For example, in the standard scenario, changing the capacity of BSCs from 800 TRX to 512 TRX results in an increase in the capital investment in BSCs from $41.4 m to $61.7m. Changing the number of BSCs from 20 to 40 results in an increase in the capital investment in BSCs from $41.4m to $66.1m. Optus considers that a feasible network configuration for the aggregation network for a 25% or 31% mobile network operator would involve substantially more than 20 BSCs.

Backhaul network

3.41 WIK's approach to modelling the backhaul network raises a number of issues.

3.42 First, the methodology employed by WIK is not transparent. According to WIK, "the number of MSC locations depends upon the capacity of an MSC and on aspects of network resilience. The SNPT takes these values as input parameters" (see page 71). The method by which these parameters have been used to calculate the number of MSCs and their locations is not clear from the materials provided.

3.43 Second, the network topology employed by WIK is not realistic. WIK notes in the report section on the design and dimensioning of the backhaul network (page 71) that it "*... considers the best solution for the backhaul network is connecting BSC locations with their corresponding MSC locations by a star topology implemented only by leased DSGs.*" Star topologies are not used to connect BSCs to MSCs. Where the relevant BSC is not collocated with its MSC, the transmission would use fibre links which are likely to follow highways rather than direct routes. A combination of ring and meshed networks is common as it provides diversity for network resilience.

3.44 We would also observe that WIK's explanation of the modelling for this layer of the network is not clear. WIK state in relation to transmission paths that:

> *... network operators apply a combination of multi-path routing and stand by capacities. This requires in general a fully meshed transmission network or at least ring topologies excluding tree based topologies. As discussed in the sections on the backhaul and core networks, such topologies are implemented in the modelled network by the SNPT. (page 74)*

3.45 This statement is inconsistent with the section on the backhaul network at page 71 of the report (quoted above), in which WIK states that star topologies are the best solution.

3.46 Third, in the standard 25% market share scenario and also in the 31% scenario the WIK model produces a hypothetical network with five MSCs, fewer than the number deployed in Optus' mobile network. Optus considers that WIK's number of MSCs is likely to be too low, for a number of reasons.

3.47 The WIK model does not take into account the difference in time zones between states as discussed in the preceding section. MSCs, like BSCs, are grouped according to state by MNOs in Australia. To the extent that state subscriber populations are not exact multiples of the maximum number of subscribers per MSC, this factor may lead to an increased number of MSCs.

3.48 Further, it is possible that the capacity parameter for the number of users per MSC is overstated by vendors due to discrepancies between the theoretical and actual capacity of telecommunications equipment. Equipment vendors' statements about the capabilities of their equipment are likely to be based on a theoretical maximum value, which does not necessarily take practical considerations into account. For example, Nokia states that its DX200 MSC can support up to 1.5M subscribers however this maximum capacity estimate is too high for network planning. The figure of 1.5M subscribers is based on the vendor's estimate of average busy hour traffic usage profile per subscriber. Since Optus' estimate of average traffic usage in the Australian market is higher than the vendor's estimate, for practical network planning purposes Optus would assess the maximum capacity of this piece of equipment at [CiC] subscribers.

3.49 As a result, Optus considers that the WIK model may underestimate the number of MSCs required in the network. While the emergence of modern technology is likely to enable a reduction in the number of MSCs in a mobile network, WIK's assumptions appear to take this development to an unrealistic extreme. It would appear that WIK have assumed the use of technology which is not best in use in Australia, and deployed newly developed BSCs and MSCs with the largest possible capacities. For example, the maximum number of E1 ports per MSC is assumed by WIK to be 4,032 – a figure vastly greater than the maximum assumed by network planners in Australia. New entrants are considered likely to deploy tried and tested 'best in use' technology. Optus considers that WIK's technology assumptions are likely to exceed what can be considered 'best in use' technology.

3.50 This issue is related to the degree of optimisation appropriate in network modelling as discussed elsewhere. The higher number of MSCs in Optus' network is not necessarily due to inefficient network planning. The capacity limits of MSCs have increased over time with technology advances. Decisions on the number of MSCs are likely to have been efficient and prudent at the time they were made, based on the technology available. It is not clear in these circumstances whether optimisation is appropriate.

3.51 Even if it were possible with today's technology to build a new network with only five MSCs, to do so would require a major redesign of the mobile network. The costs of such a redesign are amplified by the need for integration with other existing systems such as retail and billing systems, and network management systems. Such a radical redesign may not be cost-effective. Broadly speaking, it is likely to be impractical for an existing operator to realise all efficiencies achievable by a new entrant. To scorch the entire network, as the WIK model does, is unrealistic and does not recognise the legitimate business interests of existing operators which have invested large sums in existing networks. WIK has recognised this point in the context of its review of the German fixed line model, observing: "*MDF locations will follow those of the existing network architecture, as the possibility of restructuring access networks, in particular, is limited, even in the long term.*"[23]

[23] WIK, *Analytical Cost Model for the Local Loop - Consultative Document 2.0*, 8 November 2000, page 1.

3.52 These issues can dramatically affect the level of costs incurred in network construction. For example, in the standard scenario, increasing the number of MSCs from five to nine results in an increase in capital investment in MSCs from $15.3m to $23.9m. These differences give rise to a large margin of uncertainty regarding the required level of costs.

3.53 Optus considers that a feasible configuration for the backhaul network for a 25% or 31% mobile network operator would involve more than five MSCs.

Core network

3.54 Optus has a number of concerns with WIK's modelling of the core network.

3.55 First, some parameters used in the model of the core network appear questionable. For example, the model applies a 10% traffic reduction factor to reduce busy hour traffic between WA and the eastern states due to time zone differences. It is not clear how this parameter was determined, and it appears likely to be an overstatement of the impact of time zones.

3.56 Second, WIK does not appear to have modelled all the key network elements in the core network. Two of the major network elements not included in the model are the core signalling transfer points (STP) and mobile number portability (MNP) platforms. There are [CiC] STPs in Optus network. The function of STPs is to serve as a hub for call setup signalling messages between core network elements (eg MSC, HLR, SMSC), the Optus fixed network and other carrier networks like Telstra. MNP functionalities are integrated into [CiC] of the STPs. When a call is made to a mobile, queries are sent to these platforms to find out which carriers the mobile belonged to. MNP provides the information to route the call to the correct carrier network. Optus observes that the STP system is a network element in its own right, which need to be modelled separately. The STP system goes beyond the signalling processors located at MSC sites (and modelled by WIK).

3.57 Third, the number of HLRs and other core network registers modelled by WIK is not clear from the materials provided. We note, however, that in the Optus network HLRs are utilised only to [CiC] of their theoretical maximum capacity, to allow for further activations of new SIMs. Also, one HLR is kept unused for redundancy purposes. It is unclear whether or not WIK has allowed for practicalities such as these in its modelling.

3.58 Finally, the model (see page 72) uses a traffic matrix to "distribute the traffic aggregated in a particular MSC to the users connected to other MSCs…" There is no justification of the levels of traffic contained in the matrix, and therefore it is not clear whether the traffic mix being applied correctly estimates the traffic flowing over the core network. The matrix appears to allocate traffic between MSCs (and thus routing factors) according to arbitrary rules of thumb. Consequently it is unlikely to accurately model real traffic patterns in Australia. This issue is discussed in the traffic demand section.

Transit layer

3.59 As noted above, a more feasible design of the core network may result in significantly more MSCs than are input into the WIK model. Additional

MSCs may require a transit layer to be installed in an efficient network design to provide resilience, redundancy and traffic concentration.

3.60 Optus submits that the minimal design for a transit layer would be two tandem switches. International cost models indicated that when the number of MSCs exceed eight a transit layer would be provisioned.[24]

3.61 As noted elsewhere, because of the WIK model's scorched earth nature it cannot capture the real world importance of building resilience and redundancy into a network. It also does not appear to capture the nature and location of interconnection points for the MTAS and other mobile interconnection arrangements in Australia.

[24] Analysys, *Final report for OPTA – Mobile BULRIC model*, June 2006, page 11

4. Traffic and Demand Issues

The busy hour

4.1 The busy hour (BH) is a critical parameter in network dimensioning both in the radio layer and in the core layers.

4.2 The WIK model uses a value of 0.0083 Erlang of demand for traffic by the average user in the BH. It bases this on its 'experience'. It also indicates a 'rough indicator' based on German fixed line network modelling which "uses a BH Erlang value of 0.05. Dividing 0.05 Erlang by 6 leads to a value of 0.0083 Erlang"[25].

4.3 The WIK model also applies a BH ratio (percent share of the BH traffic in a day's total traffic) of 8.5% to determine the total volume of traffic.

4.4 For an MNO, the BH traffic volumes depend upon the profile of customer traffic for that MNO. This means that a benchmark developed using data from customer and operator traffic in other countries cannot take account of the traffic profile generated by Australian customers. Failure to take customers' traffic profiles in Australia into account leads to a modelled network that is not able to accurately reflect the underlying traffic provisioning requirements and, therefore, the costs incurred.

4.5 The BH dimensioning is an empirical question for individual MNOs. Optus has available statistics for the busy hour on its network. It provides different values depending on the way it is calculated. If one observes the entire network, and the BH of the whole network, the ratio is lower than what is calculated for particular parts of the network. Further the peak may or may not be coincident and some areas are 'peakier' than others.

4.6 In this regard, the BH for entire network can be highly misleading, particularly in planning the radio layer of the network. This is because viewing the whole network as a single entity smooths and averages out the traffic to a large extent, and ignores the reality that carriers need to dimension individual sites to cater to local traffic peaks.

4.7 Calculating the BH on a cell-by-cell basis, the median figure for Optus' network is in excess of [CiC] which is significantly larger than that used by WIK. However even that masks the fact that half of the network is actually 'peakier' than that. Observing the 90th percentile, 90% of cells in the Optus network have a BH-to-day ratio of [CiC]. Both of these factors are likely to drive additional investment in the network above what is modelled by WIK.[26]

4.8 Using heuristics is common in determining the relationship between the BH and total traffic. In planning a mobile network, engineers will receive traffic forecasts from the business and plan the network based on the historic relationship between total traffic and the BH. It is Optus' experience that the

[25] WIK, *Mobile Termination Cost Model for Australia,* January 2007, page 107.
[26] In one of the output sheets WIK reports on a global BH to local BH ratio. It is unclear how this is modelled or the basis on which it is calculated.

relationship between billable minutes and the BH is localised and therefore radio planning is done at a more disaggregated level than that undertaken by the WIK model. This means that the WIK model is likely to be biased towards under provisioning network elements, particularly in the radio layer.

4.9 The cost of the mobile network is highly sensitive to this BH definition. However, due to the construction of the WIK model a sensitivity analysis involving changing the BH ratio may be misleading because it will change the total volume of traffic model as well as its distribution throughout the day. Optus finds this is a unique and perplexing feature of the WIK model. A simultaneous adjustment may be possible to the BH Erlang in order to hold the total traffic volume constant. For example, increasing the BH ratio to 12% appears to require the BH Erlang to be increased to hold total traffic constant. If this adjustment is undertaken the MTAS rate is modelled at 6.9 cents for the base-case (25 per cent market share) scenario.

4.10 The BH varies significantly from country to country. The observed estimates in overseas cost models have been as high as 15% across an entire mobile network. However international benchmarking cannot be relied upon to determine the rate for a new entrant in the Australian market or for existing MNOs. BH data is likely to be carrier specific and somewhat dependent on the marketing strategy of the MNO. The BH will also vary over the life cycle of the MNO.

4.11 The proportion of annual traffic in the BH in overseas cost models are generally above that indicated by the WIK model. According to overseas cost models up to 15 percent of daily traffic is likely in the BH.[27]. As such WIK's assumptions appear overly conservative.

4.12 When dimensioning the network the WIK model does not appear to cater for SMS traffic in the BH. Similarly a parameter is required to account for GPRS and other data traffic in the BH. Such allowances are typically applied in international cost models.

Traffic volumes and mix

4.13 As indicated above the total traffic per user is derived in the WIK model using a heuristic based on an assumed BH Erlang per user and an assumed relationship between that and total traffic volumes used. These assumptions are based on overseas bottom up cost models however WIK believes the result to be consistent with total volumes in the Australian mobile industry.

4.14 The total traffic carried by an MNO can be empirically verified. The BH traffic per subscriber estimates from other countries are derived from the BH traffic assumptions and the number of minutes per annum. The WIK model assumes BH traffic per subscriber based on this benchmark, and is therefore not based upon the traffic in Australia nor the BH traffic percent of Australian customers. Experience in the UK, Sweden and Norway demonstrates that estimates of BH traffic are best derived from country specific usage statistics.

[27] Post & Telestrelsen, *Mobile LRIC model specification – Final version for the industry working group*, 23 March 2004, page 178.

4.15 Traffic volumes and the mix of traffic will vary amongst existing MNOs. A new entrant's average subscriber's traffic volume and mix will vary depending on the marketing strategy of the entrant. For example, Optus historically had a high proportion of on-net traffic due to its 'yes time' promotion whereas Hutchison and Vodafone focussed on capped plans that increase total traffic.

4.16 The potential implication is that the cost attributed to MTAS (per unit) is higher or lower depending on the individual MNO's traffic mix.

4.17 There is a question as to whose traffic data should be used in the cost modelling. The traffic mix of a carrier (i.e. the relationship between on-net, outgoing and incoming minutes and data traffic) can materially affect the modelling. For example, if carriers are using handset or subscription subsidies to attract subscribers then they are likely to have a lower level of outgoing and on-net call minutes than a carrier which, for example, discounts those calls. This is due to the own-price elasticity of demand for those calling services.

4.18 On-net demand has been typically linked to market share in bottom up cost modelling and this basic view appears to be captured in the WIK model. However, carriers are able to influence these calling patterns through individual charging structures.

4.19 As only the MTAS is regulated, one may question whether it is appropriate to model the regulated MTAS using a particular MNO's traffic, some average of all MNOs traffic or some standardised traffic mix where the minutes used are be based on what is expected using cost based (unsubsidised) outgoing and on-net calling prices.

4.20 If actual MNO data is used to model MTAS costs then the larger volume of on-net and outgoing call minutes will have allocated to them a share of the annual cost of network element, reducing the unit cost of MTAS relative to the MNO.

4.21 It may be argued that this reflects 'market realities', however regulating in this way may lead to distortions in competition. For example, MNO's may avoid calling discounts in favour of handset subsidies.

Unbillable minutes

4.22 The WIK model does not take into account unbilled minutes. Optus submits that this is an important omission as the ringing time (and holding time) of successful and unsuccessful calls is a key consideration in dimensioning a mobile network.

4.23 It may be feasible to adjust the BH Erlang within the WIK model to reflect unbillable minutes and to dimension the network appropriately.

4.24 Overseas cost models include uplift factors of between 10 percent and 30 percent to account for these minutes and their effect on network dimension (see Norway and Netherlands). The absence of this factor makes WIK's model appear upwardly biased.

Routing factors

4.25 The routing factors are said to be endogenous to the WIK model. They are based on the number of network elements that are either derived by the model algorithms (eg base stations) or that are input into the model (e.g. BSCs and MSCs). It is therefore these inputs that determine the routing factors.

4.26 A particular distribution of traffic, termed the 'traffic matrix' is assumed by WIK the model, as is a particular call handover regime. This is described by WIK as follows:

> *Note that for an On-Net call the utilisation addressed here is the one of either the up-link or the down-link; for an On-Net call the network elements would be used twice (up-link and down-link). The utilisation of the MSCs is generally more than once for an average call because a call initiated by a network subscriber will in general not stay within the district of the originating MSC, in addition it is likely that any incoming call will not enter the network at the MSC which serves the receiving party. The WIK-MNCM determines a corresponding traffic distribution in the form of a traffic matrix among the MSC locations and provides the routing as part of the core network configuration. This will result in utilisation (routing) factors for On-Net and incoming calls, for MSCs of greater than one, and for MSC-MSC links of greater than zero. For an Off-Net outgoing call, in which case there are interconnection facilities at each MSC, the utilisation factors for MSCs are one and those for the core links (MSC-MSC) are zero.*[28]

4.27 Optus finds no justification for the levels or mix of traffic contained in the traffic matrix used by WIK and is not able to determine whether the traffic mix being applied correctly estimates the traffic flowing over the core network. It is therefore difficult to comment explicitly on its content or application.

4.28 It appears that the routing factors implied by this traffic matrix indicate that around 63 percent of on-net calls and around 63 percent of incoming calls 'touch' two MSCs. Under the assumed network configuration of one MSC per state, this may imply that 63 percent of those calls are interstate. The degree to which this occurs in practise is an empirical question for MNOs to clarify.

4.29 In international cost models the routing factors are determined using input from actual operator data on routing factors. This reflects the scorched node nature of international cost models and the greater consideration of practical resilience, redundancy and network concentration incorporated in those models but which is absent from the WIK model.

4.30 It is unclear whether the traffic matrix used by the WIK model assumes any call duration and if so, the extent to which this effects the modelling. If calls are of different length and there are different costs involved in setting up and then holding a call then the unit cost will be different. The lack of consideration of this issue may reflect the WIK model's apparent omission of a signalling network (STP).

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[28] WIK, *Mobile Termination Cost Model for Australia*, January 2007, page 72.

SMS conversion factor

4.31 The WIK model indicates that the relevant SMS conversion factor is at 432 messages per voice minute. Optus submits that WIK have chosen to take an unreasonably aggressive approach in estimating this parameter. Based on 125 bytes per message this would imply a channel rate in excess of what is best in use by MNOs and significantly greater than is used in international cost models.

4.32 International cost models use a figure of around 145 messages per voice minute based on a 40 bytes per message and a 768bps channel rate. For example, the mobile model produced for OPTA used an SMS conversion factor of approximately 143 messages per voice minute [29]. Optus contends the conversion factor used by WIK is upwardly biased and a more reasonable value should be used.

4.33 In Australia the average SMS is around [CiC] bytes with [CiC] bytes of overhead for enveloping the messages, yielding a higher SMS equivalent for messages per voice minute.

4.34 Similar issues apply to the WIK model's other data conversion factors.

[29] Post & Telestrelsen, *Mobile LRIC model specification – Final version for the industry working group*, 23 March 2004, page 126.

5. Financial Parameters

Asset values (equipment prices)

5.1 WIK has derived the equipment prices used in its model from international benchmarks. The benchmark values were sourced from the UK, the Netherlands, Sweden and Germany.

5.2 The table below indicates the wide variation in the cost of macrocell site acquisition and construction costs from other jurisdictions. We believe this is indicative of large variation that a benchmark estimate is subject to.

Table: Example Macrocell Site Acquisition and Construction Costs

	AUD (2006)	Local currency (2006)
UK	193,646	£77,784 GBP
Sweden	83,904	50,000

5.3 Optus considers that international benchmarks cannot be relied upon to produce an accurate estimate of the cost of investment in Australia. Equipment prices are determined in large part by local factors such as land prices and labour costs. Installation can be a significant share of cost. We would observe that the cost figures used in the model are in many cases substantially lower than actual prices faced by MNOs in Australia.

Cost trends (rates of annual price change)

5.4 WIK has based its annual rates of price change on information from bottom-up modelling exercises in other jurisdictions and in some cases from the ABS.

5.5 Optus has some concerns where the price trends are derived from international sources. Cost trends can be difficult to estimate accurately without taking into account local factors, such as increased demand for sites, saturation of readily available radio mast sites or increased environmental concern over radio installations.

5.6 The need to take into account specific known local factors has been recognised by other modellers. For example in its modelling for the Norwegian regulator NPT, Analysys has taken into account expected reductions in the price of GSM equipment due to the anticipated entry of Chinese equipment vendors into the West European market.[30]

Depreciation

5.7 The WIK model employs the tilted annuity depreciation method. WIK appears to have chosen this method without due consideration of alternative commonly applied depreciation methods such as economic depreciation or tilted straight line depreciation. Optus considers that the impact of alternative

[30] NPT's mobile LRIC model version 4, Analysys, 5 December 2006, p14

methods should have been assessed, considering the importance of depreciation for the final MTAS price determined.

5.8 In other jurisdictions including the UK, Norway and Sweden economic depreciation has been used rather than tilted annuity depreciation. The Norwegian Post and Telecommunications Authority (NPT) also applies straight line depreciation for comparative purposes. The primary factor the NPT considered when choosing its method of depreciation was whether network output changes over time. NPT believes tilted annuity depreciation would be suitable for a fixed network, where circuit switched traffic levels are generally stable but not in a mobile network cost model, where demand is varying over time.

5.9 Further, Optus considers that the tilted annuity depreciation method has been applied incorrectly in the model. WIK has incorporated an output "tilt" as well as a price tilt into its calculations. In principle, there is nothing wrong with this. However:

- WIK has used an output tilt that reflects the expected growth of service output. This is incorrect. What matters is output per piece of network equipment. If service output is growing, the volume of network equipment will also be growing although not necessarily at the same rate. By ignoring the growth of the asset base, WIK is assuming that existing assets are catering for all the increase in demand which is clearly not the case. By making this assumption, WIK is exaggerating the future rate of increase of equipment utilisation and hence understating depreciation;

- At the same time, if equipment utilisation (output per unit of equipment) is increasing over time, it is necessary for the utilisation factors in the model to reflect this. For example, if the maximum possible utilisation of a piece of equipment is 80% but the tilted annuity calculation assumes that utilisation is increasing by 2% per year, then for a piece of equipment with a 10 year asset life, the start year utilisation can only be 66%. WIK does not appear to have taken this into account and consequently has applied equipment utilisation and tilted annuity factors that are mutually inconsistent.

- If WIK is going to introduce an output tilt, it should also add a tilt to allow for the fact that the cost of operating existing equipment tends to increase over time thereby reducing the cash flows for recovering depreciation towards the end of an asset's life. The tilt to allow for rising operating costs of existing equipment will tend to increase the amount of depreciation and by ignoring this WIK may have again understated the required capital charge.

Lead times

5.10 The network planning horizon does not appear to have been adequately taken into account in the model. Networks are dimensioned to meet the level of demand for telecommunications services anticipated to be met by an operator, as well as providing capacity for anticipated growth to the extent that would be appropriate. There is an inherent lead time required in provisioning of network equipment (especially for base stations where planning permission is usually required), which means that the predicted future demand placed on a network element needs to be factored into its provisioning. This requires a forecast of network traffic which has not been made, nor factored into the derivation of network equipment.

5.11 While it could be argued that this factor is taken into account implicitly, for example in the working capital allowance, this treatment is not likely to be adequate. Models in other jurisdictions (UK, Norway, Sweden, Netherlands) have taken this factor into account explicitly, since equipment needs to be "purchased in advance, in order to allow provisioning, installation, configuration, testing before they are activated."[31] and it takes time "to make all the necessary preparations to bring new equipment online"[32] The table below shows some examples of the 'lead time' for network elements in the Norwegian model[33]:

Network elements	Months
Owned tower site acquisition, 3rd party site, civil and ancillary equipment	9
Remote BSC site and ancillary	18
BSC, MSC, TSC	9
MSC switching site	18
MSC software (per MSC port)	3
Licence fee	0

Site sharing

5.12 The model allows for cost savings due to site sharing between operators. In particular, it is assumed that 50% of macrocells and 30% of microcells are shared.[34]

5.13 Optus considers that the 50% sharing assumption for macrocells is too great. In the Optus network the proportion of macro base stations including antennas located on a tower owned by another carrier or a specialist tower provider is approximately [CiC]. Further, microcell sites are generally not shared with other carriers. They are typically positioned at busy street intersections, (to service that intersection alone), and are placed on street-lighting poles, or shop awning. Neither Optus nor Telstra own or otherwise use these structures.

5.14 Further, the extent of cost reductions may also be overstated, considering that carriers do not share all site facilities. Typically, carriers share only the antenna support structures. Usually each carrier must construct its own equipment shelter or hut (which contains the radios and other electronics) for reasons of operational flexibility, network security and expansion opportunities.

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[31] NPT mobile LRIC model version 4, Analysys, 5 December 2006, p43
[32] PTS Annex B Final model specifications (PTS format) 23 March 2004, p132
[33] LRIC_model_NPT_final_v4_public.xls, Analysys
[34] Section 4.3.1.1.1 BTS investment

Working capital

5.15 In the WIK model, working capital is assumed to form part of organisation level costs. Optus considers that this approach is unlikely to result in a meaningful estimate of MNO's working capital requirements. For example, these equipments may depend upon the level of redundancy required in practice and typical equipment operating limits.

5.16 To capture the full cost of working capital, the model should consider the actual time difference between cash payments for inputs and cash receipts for output on account of current operations, and calculate the opportunity cost based on a relevant interest rate. An accurate approach should be based upon the actual experience of MNOs in Australia.

Mark-ups for OPEX

5.17 The OPEX mark-ups used to determine the operational expenditure and common costs in the model are estimates, said to be based on WIK's previous experience in other jurisdictions. There is little justification presented for these estimates. Optus considers that these markups should incorporate information from the actual experience of MNOs in Australia. As discussed previously in the submission, a benchmark approach cannot take sufficient account of local factors such as Australian labour costs.

WACC (weighted average cost of capital)

5.18 Optus has not given substantial consideration to an appropriate value for the WACC at this stage.

5.19 However, we would observe that the WACC presented in the model, 11.68% (pre tax), appears low compared to values used in other jurisdictions, including:

- 13.5% (nominal)[35] in the PTS's model;
- 13.64% (nominal)[36] in the NPT's model; and
- 13.7% (nominal pre tax)[37] in OPTA's model.

5.20 We would also observe that in its decision on the appeal of the Commission's decision on Vodafone's MTAS undertaking, the Australian Competition Tribunal concluded that Vodafone's WACC was a reasonable figure.[38]

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[35] Model documentation for the PTS, Analysys, 29 March 2004, p14
[36] LRIC_model_NPT_final_v4_public, DiscFacs, Analysys, nominal discount rate for 2007.
[37] Conceptual design document, Analysys, 14 June 2006 A92
[38] ACT decision, Vodafone Network Pty Ltd & Vodafone Australia Limited [2007] ACompT 1, par 258-261

Licence fees (and universal service levy)

5.21 WIK has allocated the licence fee of A$1.944 million to network services (one third) and to retail (two thirds). Optus considers that this allocation is inappropriate.

5.22 A MNO would not be able to operate a network if it did not pay a licence fee. By contrast, it would still be able to offer retail services, which do not depend on possession of a network licence. Consequently, the entire licence fee should be allocated to network services.