Final report for OPTA

Model implementation document

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Analysys

0 Introduction

The purpose of this document is to respond to feedback from members of the Industry Group (IG) on the Draft Demand and Network Model distributed on 16 December 2005, and the Draft Cost Model distributed on 31 March 2006. Feedback has been received from operators in three stages: initially following the release of the draft model on 16 December 2005, secondly as a result of bilateral meetings with operators on 22–24 February 2006, and finally following IG-III and further bilateral meetings completed by 10 May 2006. The feedback from the IG is summarised in this document, although specific issues are not attributed to specific IG members. The following IG members provided written responses to the draft model:

- BT, Colt, MCI and Versatel (joint response)
- T-Mobile
- Orange
- KPN Mobile
- Vodafone.

This document is structured according to six major sections:

- general approach
- demand
- network design and deployment
- economic depreciation
- unit costs and trends
- routeing factors and cost allocations.

IG members' submissions are paraphrased for brevity, and are numbered sequentially. Where IG members have submitted opposing or differing views, these are described in a single numbered statement where possible. Analysys's response to each numbered statement is provided below in roman text.

1 Issues raised regarding the general approach

1) *There is an asymmetry of information: mobile operators having access to significant information with which to identify favourable cost underestimates in the model, whilst ignoring overestimates.*

It is difficult for Analysys and OPTA to adjust fully for this effect, although the use of more complex model algorithms (e.g. radio planning tool) might have reduced the scale of this potential problem.

The aim of the model development process is to maximise the possibility for information transparency in the context of data confidentiality and pragmatism. Less complex algorithms have been developed for several reasons, including:

- low materiality in the context of scorched-node calibration and top-down data
- increased magnitude of effort, industry involvement and model development duration as the complexity of the model increases.

2) *The model lacks meaningful unit cost data, and this limits the ability of the model to undertake sensitivity testing, trade-off analyses and holistic evaluation at this stage.*

The benefit of early visibility of a partial model was deemed to be better for the overall model development process than delaying IG commentary until after a complete model had been developed.

2 Demand

In this section we discuss:

- subscribers
- voice traffic
- data traffic.

2.1 Subscribers

3) *It is extraordinary to consider a 2006 date of entry for the modelled operator, and the model should instead reflect the actual operators' entry dates*

A 2006 launch date (2004 licence date) was deemed to be appropriate for the most accurate costing of the hypothetical new entrant with which OPTA would constrain existing operators' termination rates from 2006 onwards – using the latest available 2004 unit costs, network and market data as the starting point. The choice of actual or hypothetical operator costing is outside of the scope of this document.

4) *The rate of market share acquisition should be investigated with respect to coverage and market share of actual entrants in comparable markets.*

We do not respond to this point here – this issue is covered by the conceptual approach document, R1 and R2.

5) *The population figures used in the model differ from those of the Centraal Bureau voor de Statisteik (CBS)*

Population figures (and associated historical penetration) have been adjusted to take account of the CBS data.

6) *One IG member notes that the mobile penetration figure adopted by Analysys (90.18% at end 2005) is inconsistent with OPTA's 14 November 2005 final decision on mobile termination tariff regulation (which states that one-quarter of the Dutch population does not own a mobile telephone). Another IG member states that the market forecast should be based upon the number of SIMs rather than subscribers, since the network is dimensioned to support SIM numbers.*

The forecast penetration figure provided in the model is an estimate of active SIMs per 100 registered[1] persons. This estimate is based on active SIM data provided by the mobile

1 i.e. registered by CBS.

operators; although one party did not present an inactive SIM percentage. Over the past four years, average subscriber inactivity has been around 12%,[2] but this has varied from 3–26%.

OPTA's reference to 25% of the Dutch population is applicable for May 2004. According to submitted operator information, active SIM penetration increased from 76% to 87% during 2004 – a penetration of approximately 81% at May 2004, assuming linear growth. Based on updated demand information, active SIM penetration was over 96% at the end of 2005. We have not attempted to measure active SIMs per subscriber for the Netherlands, which we estimate could be 1.05 or higher; however, in our opinion the model does not appear inconsistent with OPTA's May 2004 statement. In addition to active SIMs, we have dimensioned HLR elements to support an additional 12% of inactive (but registered) SIM cards.

7) *What is the source of the subscriber inactivity percentage, and why does this not vary over time?*

Operators submitted active and registered subscriber numbers reflecting their own, current inactivity percentage. It is evident that inactivity varies over time (e.g. as operators periodically purge the subscriber base). However, we believe it is unnecessary to reflect specific inactivity time variance in the model. The figure adopted in the model represents the average of four operators' data over the last four years and is therefore assumed to reflect the average level of inactivity carried by operators in their subscriber bases.

8) *What is meant by 'other fixed line numbers' in the market demand sheet?*

This input should be identified as 'fixed line numbers' and represents the approximate number of distinct fixed-line telephone numbers in the Netherlands (for calculating call proportions).

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2 This is the average percentage of inactive subscribers for the four mobile operators who supplied relevant data.

9) *The proportion of calls that are on-net should be higher than 27% in an equally shared four-player market. On-net call weighting should be calculated according to Dutch data rather than Analysys estimates.*

The on-net call weightings, incorrectly attributed to Analysys estimates, have been estimated by analysing the call patterns of Dutch mobile subscribers (based on volume data submitted by the mobile operators), and therefore do represent appropriate Dutch subscriber behaviour. The fact that the proportion of calls that are on-net is slightly higher than 27% in the UK is not relevant – the behaviour of subscribers in any particular country is affected by the prevalence of on-net pricing plans (which were significant in the UK in 2002), consumer preferences, peer pressure and closed user groups.

2.2 Voice traffic

10) *One member submits that the level of volume growth, which is higher in 2003–2004, and lower for 2004–2005 and 2005–2006, is plausible. Another IG member agrees.*

No response required.

11) *There is a significant risk that the number of minutes per subscriber will decline, due to an array of technological developments (e.g. VoWiFi, VoIP, etc.). This risk should be incorporated into the model through alternative volume forecasts, or by expanding the volume forecast to include probability-weighted scenarios (rather than just the most likely outcome). Demand risks constitute project-specific risks which should be (but are not) incorporated in the cost of capital. This is recognised by the UK process where forecasts are applied for high, low and base-case demand.*

As this effect is a known and systemic risk affecting all mobile operators, we believe it is reflected in the risk-discounting of expenditures.

12) *It should be clarified whether the volume forecast of the model is internally consistent with the sum of five/four operators' own forecasts, as supplied by the operators.*

The draft model released to IG members contained a forecast that had not been verified against operators' own forecasts, since not all forecast data had been received by that point. We can now confirm that the model's forecast appears **conservative** compared to the sum of operators' own forecasts. A comparison of active mobile subscribers is shown in Exhibit 1.

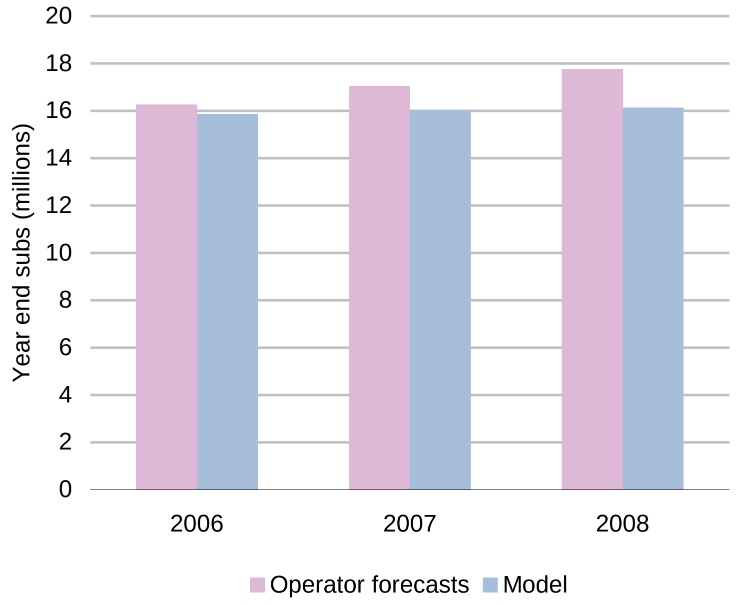

Exhibit 1:
Active mobile subscribers [Source: Operator forecasts, Analysys]

However, it is likely that operators' forecasts overstate the total market size, since we believe operators will forecast >100% total market share. Therefore, we have calculated a *market scalar* to downgrade forecast volumes to account for subscriber over-projection. A comparison of operator and model forecasts for mobile origination and termination is shown in Exhibit 2 and Exhibit 3, illustrating the conservatism of the model forecast.

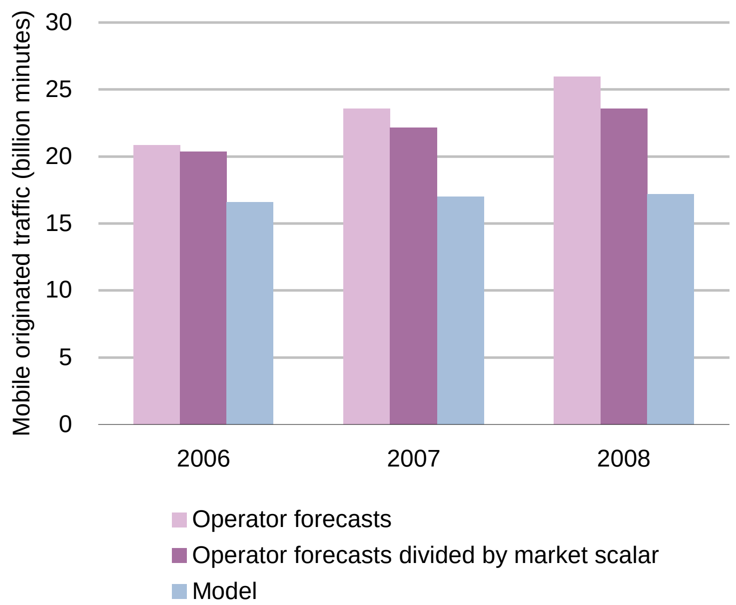

Exhibit 2: *Total mobile originated volumes [Source: Operator forecasts, Analysys]*

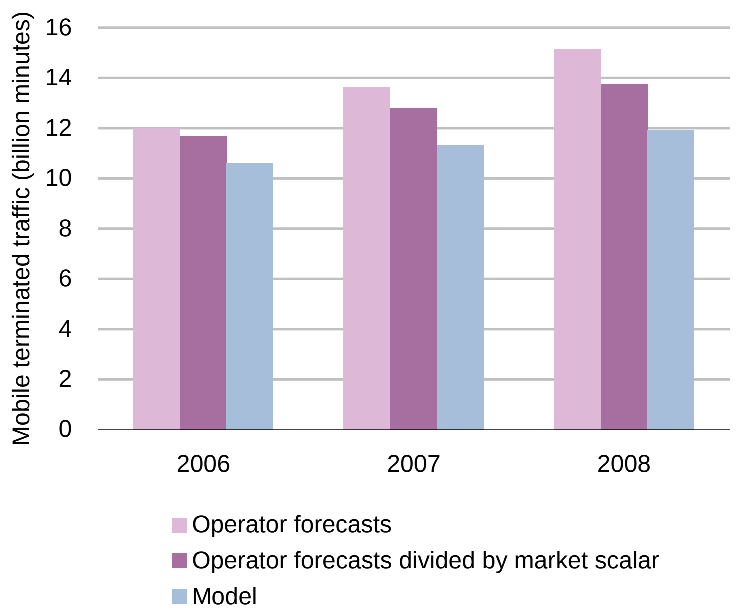

Exhibit 3: *Total mobile terminated volumes [Source: Operator forecasts, Analysys]*

13) The proportion of minutes that are incoming calls declines over time – the basis for this assumption is unclear.

We note that this decline is relatively small, from 39.6% to 38.3%. Further discussion on this aspect is presented with Statement 14 below.

14) *The market forecast – in particular outgoing minutes per subscriber and incoming minutes per subscriber, but also overall penetration levels – does not take into account the fact that in future (as a result of OPTA's mobile termination price controls) the retail cost of incoming calls will decrease, and retail cost of mobile services will increase. This will bring about a reduction in MO volumes* ***and*** *MT volumes, and consequently redundant network capacity.*

The market forecast in the draft model was based upon persistence of the 2004 origination-termination ratio for mobile traffic. It is recognised that as a result of OPTA's mobile termination price controls, the balance of origination and termination is likely to change. Therefore, the final model contains a market forecast that reflects our estimate of this rebalancing effect. However, we think it is unlikely that mobile termination volumes will be lower than currently forecast as a result of a reduction in mobile termination rates. We believe that the number of Dutch mobile subscriptions is unlikely to fall materially if mobile prices are increased as a result of the 'waterbed effect' following OPTA's mobile termination price controls. Dutch consumers and businesses are sufficiently dependent on mobile communications and mobile operators have the opportunity to accommodate the rising waterbed in a range of retail charges – including monthly fees, handset replacement costs and mobile-mobile call prices.

15) *The demand forecast for 2005 should be based upon real data available to date.*

During bilateral meetings in February 2006, we requested updated demand data for 2005. The comparison of actual market volumes with forecast market volumes is shown in Exhibit 4.

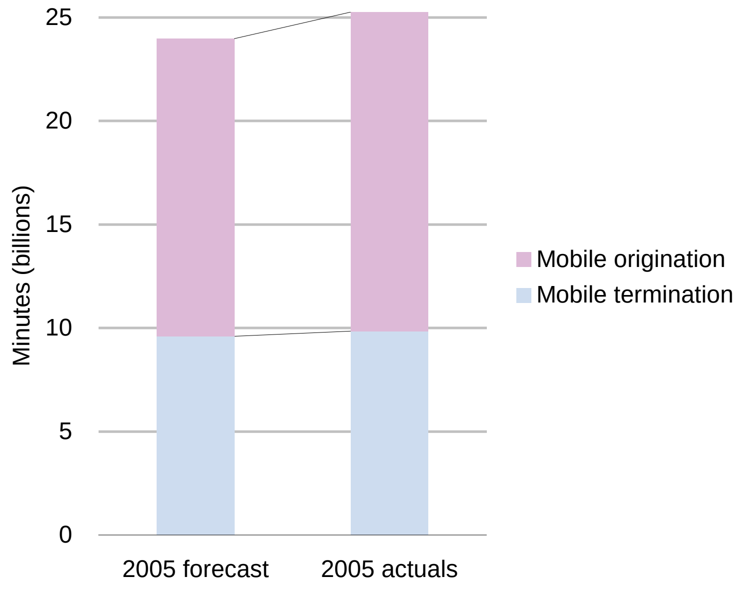

Exhibit 4:
Mobile market for 2005 [Source: Final model and operator data]

As can be seen, the draft model underestimated market volumes by around 5%. Mobile subscriptions are also underestimated by around 5%. The model demand forecast was therefore updated to reflect higher 2005 demand levels.[3]

16) One operator submits that "it plans to ensure it will meet busy-hour (BH) traffic even if the BH load is 10% greater than the average". Another operator claims its BH load is [confidential] % and weekday proportion of traffic is [confidential] %.

Given that the first operator already provides this 10% allowance (as a network dimensioning rule), and assuming this allowance is efficient and replicated by other operators, then it is already incorporated in the model by virtue of the scorched-node allowance: it is unnecessary to factor in an additional 10% and then recalibrate the radio network, as the result after a scorched-node calibration would be identical.

The data provided by the second operator, which claims its BH load is [confidential] %, differs significantly from the same operator's data provided in October 2005. The operator's data provided in October 2005 detailed the hour-by-hour proportion of weekday

3 Higher demand levels have been factored into the forecast by projecting growth in traffic per active SIM card, using the same forecast growth levels as in the draft model.

traffic which occurs in each hour. Other operators submitted the same information, and all operators' BH proportions were close, or similar, to 8.3%. Therefore, we believe the new data submitted by the operator represents a different measurement method, and given the inconsistency with the original data, we have rejected the new information provided as an outlier. This rejection ignores the fact that after the scorched-node calibration, any effect on the model would be negated.

17) *Call attempts per call for incoming calls should be greater than 1.00 since not all subscribers have their voicemail or divert functions on at all times. Other IG members refer to the numerical data >1.00 that was submitted.*

We recognise that 1.00 represents an unlikely lower bound to this parameter. Data submitted by operators suggests an average call attempt per call value of 1.25. Therefore, call attempts per call for received calls (inbound and on-net) has been increased to 1.20 to reach an average data value.

18) *The distinction between 'minutes' and 'radio minutes' is not clear.*

Radio minutes are calculated as a sum of minute volumes with on-net minutes multiplied by two.

2.3 Data traffic

19) *Calculation of SMS peak load refers to voice BH proportion rather than SMS BH proportion.*

This error has been corrected.

3 Network design and deployment

This section covers a significant proportion of the model's calculation, therefore IG statements have been arranged sequentially according to the calculation flow.

3.1 Area

20) The 498 segments for the area-population distribution of the Netherlands is too coarse to enable an accurate roll-out calculation, and consequently cell radii should be adjusted to fit a more detailed data set (e.g. postal sectors). Certain cities are missing from the classification, and the classification should be adjusted to match city borders rather that than municipalities.

We recognise the limitations of a coarse data set, but have been unable to obtain a more detailed data set. In our view, the discrepancies in the data (that certain named cities are missing from the list or that it is a list of municipalities) only have a minor effect on the outcome of the model. This is because the purpose of the area-population distribution is to determine the shape of the roll out over time and to assess **overall** population and area coverage, rather than to define the specific named cities that are covered or not covered.

21) The area data should include inland seas and lakes (e.g. Frisian), plus inshore waters (e.g. beaches), since operators aim to cover these areas.

Three mobile operators suggested that the relevant area to model was the land area (approximately 34 000km^2), while one operator suggested the area should include Dutch water areas. We have applied the land area in the model and calibrated the number of coverage sites accordingly; therefore various water areas will implicitly be covered by virtue of 'spill-over' from land-based radio sites.

22) How were population density thresholds determined?

Population density thresholds were determined by comparing the sequence of postal sectors against the information provided by the mobile operators on the classification of the Netherlands into various urban, suburban and rural (or similar) areas. For example, a broad consensus between operators suggested that the average rural area recognised by the operators was around 86% of the Dutch landmass. The threshold of suburban and rural areas was then selected from the postal sector data to ensure the least populated 86% area of postal sectors was classified as rural.

23) *The split of the country into geotypes does not correspond with the data submitted by one operator, and should be corrected to an approximation of the percentage area splits that operators submitted.*

As explained to the IG during the development of the model, model parameters, including the estimated split of the country into geotypes, do not exactly match every individual operator's data. However, there was a reasonable degree of consistency across the geotype area data submitted by all operators, and subsequently applied in the model. It is incorrect to suggest that the model should be adjusted to take account of all operators' data just because one operator's data is not exactly matched by the model parameters.

24) *The proportion of traffic in a geotype should be different from the proportion of the population – since network capacity distribution is shifted more towards urban and suburban areas than population.*

This effect has been reflected and parameterised in the model since its inception (released in draft form to industry parties on 16 December 2005), as illustrated in Exhibit 5 below.

	Proportion of population	*Proportion of traffic*	*Ratio of traffic to population*
Urban	9.7%	19%	1.9
Suburban	44%	51%	1.2
Rural	46.3%	30%	0.6

***Exhibit 5**:* *Geotype characteristics [Source: OPTA draft BULRIC model 16 December 2005 and OPTA draft BULRIC model v3]*

3.2 Radio network parameters – general points

25) *One operator submits the view of TNO Informatie- en Communicatietechnologie that: the calibration of the final version (v3) of the model was different from previous versions of the model, and that there are four possible explanations for this – 1. the reference set of sites and TRXs changed between versions; 2. the calibration of v1 and v2 was not performed properly; 3. the calibration of v3 was not performed properly; 4. the calibration of all versions was not performed properly.*

It is true that the calibration of the final version of the model (v3) was different from the calibration in the v1 and v2 versions of the model. However, this was due to the first explanation suggested above, rather than any incorrect calibration between model versions. Specifically, in moving from v1 to v2 to v3 a number of significant issues were sequentially refined and then set definitively in the process to v3, including:

- the level of geographic area coverage for PGSM versus DCS operators, which was known to be differential (but not stated as such) in earlier versions, and which was set to 99.1% in v3
- the way in which geographic coverage extended across urban, suburban and rural areas was set to 99.1% coverage
- the deployment and traffic loading of micro and pico cells
- the level of in-building signal strength offered *as coverage* by the modelled operator (“coverage quality”)
- specification of the reference set of sites and TRX numbers, based upon the actual data points from the mobile operators and their relativity to 99.1% area coverage and high-quality indoor signal strength coverage.

26) *The lack of pico cells in urban areas, and the chosen cell-traffic mix is questionable. A lack of pico cells is likely to overstate the unit costs of traffic.*

Information available to us suggests that some operators use few, if any, pico cells in their networks. For those that do use pico cells, they are deployed in the ratio of approximately 1:2 with respect to micro cells. Therefore, in order not to overstate the unit costs of traffic, 2% of the 8.5% microcellular traffic has been moved to pico cells.

27) *One party states that the lack of micro cell usage by 1800MHz operators is contrary to expectation – such operators are at a greater disadvantage than 900MHz operators when it comes to in-building coverage, therefore they should deploy as many if not more micro cells for such purposes. Another party states that the modelling of micro cells should be adjusted, since one IG member believes that these cells are used by 900MHz operators* ***only*** *to support capacity-constrained hotspots. These cells should only be deployed when the coverage network has run out of capacity, rather than steadily as coverage rolls out.*

Information available to us suggests that some operators use fewer micro cells in their networks. However, in order to be consistent with the hypothetical equal share of all market demand (some of which must be serviced in-building), the same proportion of traffic (6.5% + 2%) has been allocated to micro and pico layers for both 900MHz and 1800MHz operators. Dutch operators' micro and pico cellular roll outs have in reality been undertaken steadily since launch, according to the data available to us. This suggests that certain areas (e.g. Schiphol concourse) are more effectively covered with micro or pico structures from the time of the network launch, rather than simply as an addition when the local macro site becomes capacity-constrained.

28) *900MHz sites are more expensive than 1800MHz sites for civil and installation costs because the site equipment is physically larger. Another industry party disagrees, suggesting the opposite: cables and feeders in 1800MHz deployments are thicker (and therefore heavier).*

The limited amount of data that has been made available to us by two mobile operators suggests that civil costs for 900MHz sites could be 6% higher than for 1800MHz sites. The experience of Mason Communications Ltd also suggests that there may be some minor reasons for the higher cost of 900MHz sites (e.g. larger antennas requiring larger or stronger structures, preference for higher towers to achieve better coverage for a larger cell, structure of 1800MHz overlay equipment, more TRX per site); estimates by our experts put this effect at no more than 10% of civil costs. We have implemented a minor adjustment to the model – adding 5% to the macro site acquisition cost. The effect of this cost difference in the model is small (less than 1%).

3.3 Radio network parameters – cell radii

29) The source of cell radii ('actual deployment patterns of operators') is not attributed to Dutch or international benchmark operators. Furthermore, it is not clear how they have been determined.

The cell radii are developed from model calibration to the Dutch mobile operators, and by averaging the GSM and DCS cell radius data and other information provided by the mobile operators.

30) The model does not take into account various radio-planning factors such as topology and buildings, and therefore the model is deficient compared to a radio-planning tool. Scorched-node calibration does not take into account spectral constraints in border areas. Cell radii are too large.

We maintain that, through scorched-node calibration, the model implicitly reflects all radio-planning factors affecting Dutch mobile operators. This includes the magnitude of the cell radii for coverage sites, which we believe to closely reflect those required by operators at the defined level of coverage quality.

31) One operator submits the view of PwC in its response to OPTA's public consultation: The cell radii used in the model are significantly lower than those adopted by Ofcom in its GSM cost model – with no apparent reason. The cell radii used in the model should be larger, particularly for DCS operators. "It is unlikely that all sites are for coverage purposes" – instead it is suggested that networks have grown from national coverage in response to traffic levels.

The rationale behind the cell radii used in the Dutch model has clearly been stated as relevant to providing high-quality in-building coverage. The Dutch mobile market today demands particularly high levels of deep-indoor mobile signal penetration across large parts of the landmass of the Netherlands, a level of **coverage** greater than that generally provided **as a minimum** by UK mobile operators in the past. In addition, Ofcom's cell radii are specifically based on providing outdoor coverage – with little associated in-building coverage. In the UK model, in-building coverage is supplied by traffic-driven cells.

We would agree that it is unlikely that all sites **of the actual operators** are for coverage purposes, and also agree that actual networks will have grown subsequently from each operator's decision on acceptable national coverage in response to traffic levels. This is exactly the discussion presented in the Conceptual Design document, in the second paragraph of Section 13.3. However, the modelled hypothetical new entrant aims to achieve a high quality of coverage **from launch**, where it rolls out, on the basis that it must provide this level of coverage to compete equally for 25% of the market. Therefore, in these circumstances the size of the network deployed (and corresponding small cell radius) is sufficient for expected 25% share traffic volumes.

32) Network load should be broken down into seven or eight areas for each major conurbation or the listed geographical areas, to facilitate an accurate demand calculation.

This approach would yield a significantly more detailed model. In our experience the effort and processing requirements that are needed for operators' radio network planning staff to collate the necessary data to populate such a model, and the complexity and uncertainty in the resulting model, is excessive and undesirable for a LRIC exercise. A suitably accurate model can be achieved, in our view, by a less detailed scorched-node calibrated model.

33) Cell radii should reduce over time due to increases in site numbers.

When an operator deploys sites for traffic purposes, the effective radius of all cells would indeed fall. When an operator increases the quality of its coverage network (e.g. in-building signal strength) by deploying more macro sites, then the effective cell radius also falls. Both these effects will have occurred in practice during the historical evolution of operators' networks. However, the hypothetical new-entrant model is based upon deploying a high-quality coverage network consistent with operators' networks **today**, therefore we do not think that further reducing the **coverage** cell radius is appropriate. Where an operator deploys more sites for traffic purposes (when the model is traffic-driven) then the effective cell radius will indeed fall as site numbers increase.

34) *The cell radii do not reflect realities of 900MHz versus 1800MHz spectrum; in particular the model currently has a reducing difference in cell radii in going from rural to urban areas. This reducing difference should in fact be an increasing difference as 900MHz operators benefit significantly from being able to cover urban areas with larger cells than an 1800MHz operator. Furthermore, at the same cell radius, 900MHz operators have a significant in-building penetration benefit over 1800MHz operators.*

Information submitted by the mobile operators supports the view that:

- coverage cell radius is linked to the quality of coverage deployed, and it seems clear which operators offer a higher or lower quality of coverage
- cell radii for 900MHz are higher than those for 1800MHz in each geotype
- the difference in 900/1800MHz cell radii for the same level of coverage does indeed increase when moving from rural to urban areas
- the provision of sites for traffic increases the perceived coverage of an area, and increases the actual quality of coverage – leading to some uncertainty regarding the definition of a coverage site
- the ability of 900MHz frequencies to penetrate into buildings is greater in urban and suburban geotypes.

We have recalibrated the coverage and capacity algorithms of the model to more closely reflect the cell radii data and network coverage quality provided by the operators (in absolute and relative form), and also to be consistent with OPTA's conceptual decision on coverage quality. This has resulted in the revised parameters shown in Exhibit 6.

	900MHz cell radius (km)	*1800MHz cell radius (km)*
Urban	0.56	0.33
Suburban	1.60	1.10
Rural	3.30	2.60

***Exhibit 6**: Revised cell radii [Source: Analysys]*

35) *The model uses a simplified coverage model of a hexagon per site, and perfectly fitting hexagons to cover the required geographical area. The model would be improved by modelling a hexagon per sector (which has a lower area for a given cell radius) and modelling a cell-overlap margin (which accounts for imperfect site positioning) of 50% for rural areas, and 25% elsewhere. This means that the number of sites required for coverage is [confidential].*

We do not believe these revisions are necessary. The effect of a different hexagonal model and any extensive cell overlap has effectively been accommodated in the model through scorched-node calibration. The urban and suburban cell radii proposed by the operator in its example are lower than those in the revised model recalibration. It appears clear in the data available to us that this operator offers a higher quality of coverage and has deployed more sites to support traffic than other operators in the Netherlands with the same geographical area coverage. The resulting cell over-lap margin in our view is misleadingly compounded by the deployment of these sites for traffic – since these will naturally overlap in areas where existing sites were deployed. Therefore, the model does not reach the same [confidential] number of sites for coverage since it is calibrated on average operator data for coverage deployments.

3.4 Radio network parameters – spectrum

36) *It would be useful to know how the actual spectrum of each operator should be implemented into the model, in order to better understand the unit costs of each operator.*

We recognise that it is not evident how Analysys has parameterised each operator's spectrum allocation in the model. We would be willing to furnish the IG with a table of spectrum parameters; however, some IG members view this information (e.g. exactly how they are using their given spectrum allocations) as confidential.

37) Spectrum amounts do not reflect border restrictions on frequencies.

Spectrum has been modelled only in aggregate allocation. However, the effect of border restrictions on the network is accommodated in the scorched-node calibration of sites and TRXs through the BTS capacity, BTS utilisation and spectrum re-use parameters.

38) It is not clear how spectrum quantities influence the number of TRXs per sector that an operator may deploy.

Rules for the deployment of TRXs per sector are as follows:

- The maximum number of TRXs that can be deployed in each sector is calculated by either the physical BTS or spectrum TRXs per sector constraint.
- In the situation where an operator has both 900MHz and 1800MHz spectrum, deployment parameters can be set to use ‘both’ spectrum types on each urban macro site (i.e. two co-located BTSs).
- The maximum re-use factor for both PGSM and DCS spectrum is set at 16. In the final model this results in a spectral limit to TRX per sector of 3 × PGSM TRX plus 3 × DCS TRX per sector for a PGSM operator, or 7 TRXs per sector for a DCS-only operator. Therefore, the physical capacity of a sector is the binding constraint for DCS-only operators, whereas spectrum limitations are the constraint to PGSM operators’ TRX deployments.

39) No clear rationale for spectrum re-use factors has been provided; greater re-use should reduce the number of transceivers required in the network.

We requested information from the operators on their spectrum re-use patterns. Some operators said that they did not recognise a ‘classical’ re-use pattern, other operators submitted values in the range of 12–24. We expect that a greater re-use factor would allow operators to deploy a similar number of TRXs (for a given level of traffic) on fewer base station sites. However, given the need to provide high-quality coverage and support nationwide traffic without extensive use of very high radio towers, operators have undertaken a detailed radio plan that will have traded off tighter re-use with improved coverage levels, subject to frequency restrictions such as guard-bands and border interference. As defined in the conceptual approach, a scorched-node calibration has therefore been applied to arrive at a comparable number of sites and TRXs as in reality.

3.5 Radio network parameters – capacity calculations

40) The Erlang TRX utilisation of 30% is implausible, and this results in significant under-utilised capacity in the network. It is suggested that under-utilisation should only apply to the last TRX in a sector, as all other TRXs in a sector should be fully utilised. Finally, if TRX utilisation were disaggregated by geotype, it might reveal >30% utilisation in urban areas, and <30% utilisation in rural areas – and this would therefore improve the accuracy of the model. The view of PwC (as submitted by one party in its response to OPTA's public consultation) is that a TRX utilisation of 32% is too far removed from reality and casts doubt on the predictive quality of the model.

We believe that a TRX utilisation factor of around 30% *on average* is necessary to reflect the TRX requirements of the mobile operators, given their traffic loads and network deployments. It is likely that this utilisation factor does vary by geotype although we have not explored operators' TRX requirements on a detailed disaggregated basis. One radio-loading factor that is implicit in the modelled TRX utilisation parameter is the variance of cell BH to network BH, which we believe could be around 50%. This loading effect would apply to all TRXs and not just the last TRX.

41) The 80% (i.e. less than 100%) macro cell utilisation of TRXs should be explained.

While every BTS has available the maximum physical or spectral capacity, not every BTS is augmented up to the maximum available. This is for the same reason as discussed in Statement 39: the trade-off between fewer high capacity sites, and more lower capacity sites (providing better coverage availability).

42) *The minimum number of TRXs per sector is two, not one as modelled in rural, micro and pico cells.*

Information provided by the Dutch operators suggested the minimum number of TRXs per sector is either one or two. One operator submitted that one TRX would be sufficient if traffic levels in an area were low, and that it would be inefficient to maintain two TRXs per sector in such areas. Therefore, one TRX per sector was deemed to be the efficient minimum deployment.

43) *The definition of 'spectrum overlay' is not clear.*

Spectrum overlay refers to the use of DCS1800MHz spectrum by a PGSM operator. In such situations, we have modelled the deployment of a second BTS on existing urban base stations.

44) *The mobile network supports CS2 (13.4kbit/s) GPRS coding, and will eventually support up to CS4. The network can support multiple timeslots for GPRS (if available).*

The conversion of GPRS Mbytes to a network traffic load is carried out with reference to the BH. Therefore, signal-to-noise levels are likely to limit the network's ability to support higher coding rates in the BH. Irrespective of this, the effective load of GPRS traffic on the network is immaterial (less than 0.5%), therefore adjustments to GPRS are unlikely to significantly influence the cost of voice. The use of multiple time-slots for data is (to a first order) negligible on the model: the radio load of transmitting GPRS data in one channel for 60 seconds or two channels for 30 seconds is identical.

45) *Analysys should supply an overview of scaling, spectrum data, number of TRXs, etc. for all operators.*

We note that this information is considered confidential by some, or all, mobile operators.

3.6 Backhaul network

46) It would be beneficial for the model to be able to examine the costs of alternative backhaul configurations.

We believe that the model is capable of examining alternative backhaul configurations – subject to the broad constraints of leased E1 point-point links, or microwave multi-site chains. Backhaul configurations based predominantly on some other topology or technology are unlikely to be efficient and would be far removed from the realities observed in the Dutch market.

47) Backhaul should be dimensioned on TRXs (i.e. channels) rather than minutes.

Backhaul capacity is dimensioned on TRXs (channels per TRX). See worksheet *NwDes* rows 396 onwards.

48) Analysys should verify the need for microwave chains in the backhaul configuration, rather than universal BTS-BSC links.

The use of microwave chains for BTS backhaul is common practice in mobile networks across the world, particularly where long, line-of-sight distances must be covered (e.g. in rural areas of the Netherlands). The choice of microwave self-management and self-configuration are considered by Analysys to be efficient choices in the microwave deployment contexts presented by the model of a Dutch mobile operator.

49) The rationale for the resulting microwave backhaul chaining capacities is not clear (e.g. use of 2x2E1 when only 1x2E1 is required). This should be investigated alongside the compounding situation of 30% TRX utilisation.

Our investigations with operator data presented a large amount of broadly consistent information regarding the way in which operators deploy microwave in their backhaul networks. Two effects were apparent: firstly, due to marginal cost differences, microwave capacity was deployed in at least 2xE1 units and the cost of increasing microwave capacity was small once the basic antenna and link had been set up; and secondly, channels were not usually multiplexed within the microwave chain. Given the small differences in the costs of microwave capacities, more detailed modelling would be unlikely to result in a significantly different overall unit cost. As discussed above, the low TRX utilisation is a result of the global average for this parameter. More than 30% of TRX channels need to be supplied with backhaul capacity on a site-by-site basis due to variance of demand on the basis of time and geographical location.

50) One IG member notes that its backhaul network uses microwave and leased lines to a different degree than modelled. Another states that the modelled proportion of microwave transmission is unachievable in practice due to line-of-sight and planning constraints.

The modelled backhaul network has been developed with visibility of all operators' network decisions, and will therefore not match any particular operator's choices exactly. We believe the modelled network is reasonably efficient, forward-looking, achievable and in aggregate reflective of the level of total backhaul costs experienced by an efficient, modern mobile operator in the Netherlands.

3.7 BSC

51) BTS-facing BSC ports should be driven by total throughput requirements rather than the total of E1s.

Given we have modelled separate logical E1 links for all backhaul links, we have deployed associated E1 ports directly. While this aspect of the model could be improved through more detailed interrogation of operator information, and more detailed modelling, we consider that such a step would be extraneous in the context of available cost and network data, and the required time and resource demands.

52) The simplistic calculation of BSC requirements neglects two factors: distinct locations of BSCs, and trigger level utilisation of the last BSC in each location.

Given scorched-node calibration, the utilisation factor applied to the BSC TRX capacity in the model reflects both these factors in the operators' BSC deployments.

3.8 BSC-MSC transmission

53) The utilisation factor for BSC-MSC links applies to BHE, rather than circuits, and it would be more transparent to have a separate Erlang calculation and circuit utilisation factor.

We do not think this improvement will significantly affect the calculation of remote BSC-MSC transmission, nor will it materially affect the overall network costs, in the context of the network averaged approach to this network element.

54) The calculation of links when traffic is between 72 and 288 BHE in rows 697 and 722 is incorrect.

This calculation has been corrected.

55) The number of links calculated in worksheet NwDes rows 694-697 and 719-722 should not be fractional (i.e. should be rounded up).

We believe the model is correct in this respect since the calculation is of the *average* number of links per unit – which of course can be fractional. The actual number of links is rounded up in the subsequent calculation.

3.9 MSC

56) A 600-port MSC does not accord with our knowledge of fixed network switches where the increment on which ports are purchased is much lower.

The MSCs that have most recently been purchased by the Dutch mobile operators have port capacities in the region of 600 ports (vendor-dependent). The increment in which ports are purchased (up to the theoretical maximum of 600 ports per MSC) is an individual E1 port – therefore the model dimensions the required E1 ports in E1 units and purchases the required number of ports (subject to maximum utilisation allowances).

57) *The calculation of MSC ports would benefit from two improvements: location-specific calculations (rather than global average), and separation of the utilisation factor into scorched-node (i.e. geographical under-utilisation), a BHE calculation and a circuit utilisation allowance.*

We do not think this improvement will significantly affect the calculation of MSC ports, nor will it materially affect the overall network costs given scorched-node calibration.

58) *An MSC processor utilisation of 80% is too high – 70% should be used instead. Another IG member suggests 50% is more appropriate. A third IG member suggests that a peak processor utilisation of 80% is only achieved on one day of the year (New Year's Eve) and for the remainder of the year, utilisation is 40%.*

Data received from four mobile operators supports an average MSC utilisation of around 80%, rather than the 70%, 50% or 40% suggested. Furthermore, adjustment of this utilisation percentage will result in a corresponding routeing factor adjustment to return to a calibrated model state – therefore the effect of undertaking this utilisation adjustment will be negated. Regarding the effect of New Year's Eve, we note that we have not explored the cause of the significant peak load at this time. If it were due to SMS messaging, it would be necessary to determine whether half of the installed MSC processing capacity was present only to serve that SMS peak, and would therefore be unnecessary for voice traffic. This peak may also be caused by the processing of significant call volumes that are blocked at the radio layer.

59) *MSC dimensioning is not carried out on the basis of BHms per BHCA.*

While we recognise that MSCs are deployed to serve a range of network functions and according to complex drivers, we believe that BH processor load is a good proxy driver for the number of MSCs required in the network. This necessitates a BH load calculation, which we estimate in terms of milliseconds processing per event.

60) *It is more efficient to have a lower level of utilisation for interconnect ports (suggest 50–70% compared to 80% as modelled). This is because the mobile operator needs to have sufficient port capacity available in order to obtain competitive transit services. In addition, the number of inter-switch E1 ports is five times too low compared to our network. Another party suggests: MSC port utilisation should be at least 75%, particularly as 600 port MSCs are being purchased.*

We have adjusted the utilisation of MSC ports to obtain a higher port count (utilisation reduced to 50%) and more closely matched the level of port deployments actual operators face. However, it should be noted that only a minor proportion of capital and operating costs are associated with MSC port-driven elements.

MSCs are unable to utilise their port capacity up to the maximum capacity of 600 ports because there is a network design trade-off on the number of MSC locations and the amount of transmission to/from BSCs and between MSCs. It is efficient in the Netherlands to deploy MSCs in more locations than would be suggested by port requirements in order to minimise the costs of backhaul and delivering mobile traffic to outgoing POI or on-net mobiles. Therefore, the port capacity of a switch is generally not reached.

61) *A large number of access points for inter-switch traffic are required – this can sometimes result in additional MSCs.*

While this may be the case, scorched-node calibration of the number of MSCs ensures that this effect is sufficiently accommodated in the model.

3.10 Inter-switch transmission

62) *The model of core transmission is unclear.*

The core transmission network is based upon modelling only distant links – i.e. co-located links inside switch buildings are not modelled, due to the relatively low cost of co-located links.

The model initially deploys a fully meshed site-to-site inter-switch transmission link layout, in which the capacity per link (in STM-1 units) is calculated from total inter-switch traffic divided (equally) between the number of links.

When a transit layer is present, the model deploys a fully meshed TSC-TSC link layout, where the capacity per link (in STM-1 units) is calculated from the total inter-switch traffic divided (equally) between the number of links. Each MSC site is connected to two transit switches, via MSC-TSC links that are also dimensioned on total inter-switch traffic per link (although sites that also contain a TSC do not have a distant MSC-TSC link dimensioned).

3.11 Technical deployment and evolution

63) *The cost element for assets with a long planning period (e.g. radio sites and switch buildings, both with 18-month periods) should be divided more accurately into timed constituent parts. For example,*[4] *a radio site acquisition should be split into: T-18 planning; T-12 securing lease; T-6 civil works; and T-3 BTS.*

This statement appears to be broadly valid, though we note that operators have not submitted any detailed cost scheduling information with which to confirm the likely timing of deployment costs. Based on the information available to us, we estimate that around 20% of the site acquisition cost would be incurred at T-18, and 80% incurred during civil works. This suggests that the 18-month planning period may be too long on average, and that a nine-month period for expenditure is more appropriate. The model has been adjusted to reflect this.

64) *The deployment of equipment in the model follows the level of demand (subject to planning periods) too idealistically – in reality demand levels are uncertain therefore it is efficient to have a certain amount of over-capacity. Our network engineers are currently trying to determine the typical margin that is used to account for this effect.*

We do not believe that further allowances should be included in the model, over and above those already reflected by scorched-node calibration and deployment planning periods. We do not believe it is efficient for operators to systematically over-provision capacity, and in

4 This example is an Analysys interpretation.

the context of modelled planning periods (3–18 months depending on equipment) there is sufficient allowance and accommodation for network change due to the **symmetric** risk of demand diverging from forecasts.

65) The model assumes that demand grows uniformly in each geotype. In reality it grows unpredictably, therefore additional capacity should be allowed for this effect.

The amount of radio equipment deployed in the network has been subjected to scorched-node calibration against the data provided by the operators. This results in capacity utilisation factors of less than 100%. Therefore, we believe the model already accommodates this effect to the extent that it affects actual operators.

66) The model does not consider future technical changes: e.g. new switching topologies, or continual decisions to change between direct and indirect interconnection.

While the model does not consider technological evolution, we confirmed with the mobile operators during our network data gathering what plans are available for network evolution. Other than 3G deployments, some operators noted plans to reduce the number of switching locations – this particular efficiency drive has already been reflected in the forward-looking efficient modelling of switching locations and MSC capacity. It is not possible to model unplanned changes to network architecture, and further allowances to the overall risk-discount of expenditure should not be included.

The model adopts an efficient, forward-looking architecture for interconnection. The effect of historical changes in interconnection will most likely have resulted in some redundant elements and associated costs. We would expect that this cost effect is small in the context of overall top-down data, and it is likely to be effectively included in the cost model due to estimation of unit price for various transmission elements (including interconnection links and ports).

67) *One IG member notes that the asset lifetimes used in the model do not reflect its submitted lifetime data, and that the lifetimes are probably slightly too long. Another IG member questions the MSC software lifetime of eight years. Another IG member has submitted its view that the economic lifetimes of MSC and HLR are seven and six years respectively.*

Due to the consideration of multiple sets of data, economic lifetimes may not exactly match each operator's choice of accounting lifetimes. However, at the time of release, the draft demand and network model had not been populated with operators' data on asset lifetimes (since not all data had been received in time). We have now considered all the lifetime data submitted by operators and adjusted the modelled lifetimes, as shown in Exhibit 7.

Asset class	*Draft model lifetime*	*Revised lifetime*
Macro cell: site acquisition and preparation and lease	15	14
Macro cell: equipment	8	8
Pico cell: site acquisition and preparation and lease	15	13
Backhaul transmission	8	8
BSC	10	7
MSC: processor	10	8 (7[5])
MSC: software	8	5
MSC: buildings (switch building preparation)	15	17
HLR	10	8 (6[6])
Backbone transmission	10	8
SMSC	8	6
PCU	8	6
Network management system	10	6
DCS licence fee	15	15 (see caveat)
VMS	8	6

***Exhibit 7**:* *Asset lifetimes [Source: Analysys and operator data]*

5 In the final model, the lifetime of MSC hardware has been reduced to seven years, consistent with the economic lifetime data supplied by one IG member.

6 In the final model, the lifetime of an HLR has been reduced to six years, consistent with the economic lifetime data supplied by one IG member.

The following caveats should be recognised in association with this model revision.

Lifetime caveats:

- Data submitted by all mobile operators was strictly for accounting lifetimes. Alternative economic lifetimes were submitted only for MSC and HLR, and some mobile operators also asserted that the accounting lifetime was the economic lifetime.

- While we would agree that, in some instances, the accounting and economic lifetimes of an asset are likely to be broadly equivalent – particularly for vendor-supplied technology-specific equipment – in other instances we believe this assumption to be debateable. No information has been supplied to justify the economical nature of certain accounting lifetimes, in particular longer-lived assets: site acquisition costs, ancillary equipment (supports, towers, etc.), and switch buildings. There is also a wide range of suggested values for certain long-lived assets.

- The revised lifetime figures presented above are straight averages of the data provided by the operators (except MSC and HLR economic lives) – no outliers have currently been excluded. Wide ranges of lifetimes exist for a number of categories: MSC hardware (6–10 years); MSC software (2–7 years); NMS (3–8 years); transmission (5–11 years); macro site acquisition (10–18 years); and switch buildings (6–30 years).

- The average DCS licence fee lifetime submitted by the operators is 14 years, due to the decision of a number of mobile operators to delay depreciation. We have retained a 15-year economic lifetime for licence assets in the model, although cost recovery does not occur until the licence generates output. The cost recovery lifetime is therefore implicitly 13 years.

3.12 Elements not modelled

68) Handset equipment is not included in the model.

This point is discussed in the Conceptual Design document in Section 11.2. The effect of aggregate handset costs on the business overhead mark-up is visible in the final version of the model.

69) Prepaid platform, billing and IT provisioning capital cost elements are not present. Number portability signalling transit points (STP) and SCCP are not present. All these elements are required to receive an incoming call. Is the cost of STP and MNP devices included in the cost of MSCs?

The implementation of relatively minor network components has been explored in the context of top-down data. Explicit assets for IN (prepaid), billing and network management systems have been added. We have not explicitly identified signalling network elements, which have been incorporated implicitly through the top-down estimate of the MSC cost category. Therefore, we believe the model reflects the costs of these elements fully and furthermore, due to MSC routeing factors, allocates a corresponding proportion of network cost to incoming minutes.

The cost of STP and MNP devices is included in the cost of MSCs.

70) Transmission elements and costs for VC12, VC4, DXX, synchronisation, management systems and microwave hubs have not been included.

It is not practical to model every single network element explicitly in a regulatory cost model. As we have taken operators' top-down costs into account when developing the unit prices for switches and transmission elements, the model should accommodate all the costs for supplementary network elements such as those listed.

71) *Modelling of network elements (e.g. BSC, MSC) are too simplified compared to detailed network planning carried out by operators.*

We recognise that operators undertake detailed planning to deploy network elements. However, the purpose of the model is not to replicate this planning, but to capture the relationship between costs and their drivers for the purpose of regulatory service costing.

72) *Other cost elements listed in the top-down cost data are not present, as well as indirect costs such as engineers, vehicles, etc.*

The implementation of relevant indirect costs has been explored for the final version of the model, now cost data has been analysed. We have incorporated a number of additional annual fixed costs (e.g. network management) and captured all incurred indirect costs by comparing the output of the model against the total top-down expenditure incurred by the actual mobile operators to date.

73) *Non-network and business overhead costs are not present in the model.*

A cost line for business overhead costs has been included in the final version of the model, including an estimate of the proportion of business overheads that are marked-up onto network services.

4 Economic depreciation

This section is structured slightly differently due to the nature of the statements from the IG members. Firstly, we describe IG members' submissions on the method and profile of cost recovery; then we provide Analysys's response on these points. Finally, we deal with minor statements on economic depreciation.

4.1 The method and profile of cost recovery

IG members' submissions

74) One IG member states it is questionable whether the calculation properly reflects economic depreciation, though more important is the choice of price trends that feed into the calculation: thus, price trends should be fully documented and supported by operator evidence. Another IG member states that there are many different ways of calculating depreciation subject to the NPV=0 constraint, and therefore the choice of specific method should be justified.

75) The economic depreciation approach is simplistic, in that service unit costs vary only with changes in equipment unit costs. Instead, unit costs should reflect not only price trends, but the change in asset productivity (utilisation) which can be achieved at each point in time. In effect, existing networks will need to write down their own asset values to allow for both the fact that historical equipment prices differ from current price, and also the fact that the historical asset utilisation rates were lower than those that could be achieved by the hypothetical new entrant going forward. This amounts to modelling successive generations of new entrants in each year and solving previous entrants' cost recovery requirements (i.e. that of the existing players) in reverse. This effect can be included in the model by tilting the cost recovery profile as a function of growing market demand, where the growth in market demand is factored by a cost-volume relationship between 1.0 and 0.0 (estimated at 0.5, but which can be calibrated)[7]. Another IG member suggests that the applied economic depreciation method does not allow costs incurred in the past (when asset utilisations were low) to be recovered during current periods (when asset utilisations are higher).

76) Conversely, another IG member suggests that the depreciation calculation should not be made more complex, instead relying on a general error-correcting mechanism which can be used to correct for any mis-forecast on the price trend tilt factor.

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7 An adjusted model has been supplied with this calculation implemented.

77) *The model does not contain a revenue line to ensure "costs are recovered in line with revenues generated by the business".*

Analysys's response on the method and profile of cost recovery

Analysys has considerable experience of developing and refining economic depreciation algorithms over the past five years. It is true that the calculation applied in the Dutch model is somewhat simpler than that applied in other jurisdictions (e.g. the UK and Sweden). However, we believe that the relatively simple approach proposed still embodies the correct economic principles and calculates correctly, in order to arrive at the right cost-path that will by applied by OPTA as the constraint on existing players' mobile termination rates.

The calculation ensures that service unit costs follow the aggregate price trend of all inputs prices in each year exactly

For example, if the MEA price of mobile network elements falls by 5% from one year to the next, resulting service unit costs will also fall by the same amount. This ensures that existing players recover their costs according to the levels of the MEA price which (hypothetical) new entrants could access at every point in time. In this calculation we agree that the choice of price trend is crucial, and should be supported by available evidence. The price trends applied in the model are based upon an average of the price trend data submitted by the mobile operators.

Economic depreciation should reflect changes in asset productivity

As is correctly pointed out by one operator, the economic depreciation of assets can take into account any changes in the asset productivity from year to year. The operator goes on to suggest that historical asset utilisation rates were lower than those which could be achieved by hypothetical new entrants today and onwards. This therefore results in higher cost recovery in earlier years (as later entrants are at a cost advantage). In our view, the assertion of lower asset utilisation rates is questionable. Historical asset utilisation rates may be **higher or lower** than those of a new entrant, since it is effectively the lag between deployment and demand that determines this effect. Some assets may indeed have lower utilisation rates (e.g.

a GSM licence fee), while other assets may have higher utilisation rates (e.g. base station sites that are rolled out more steadily across the country for initial coverage purposes). The principles embodied in the final model and its implementation are:

- The hypothetical new entrant in 2004 is subject to an asset utilisation rate that is effectively determined by the magnitude of the cost-overhang attributed to its roll-out and demand growth profiles. This overhang is assessed in the 2004 entry model available to the IG.

- Every successive generation of hypothetical new entrants beyond 2004 is subject to the same asset utilisation rate, since the GSM market is assumed to be effectively mature. The suggestion of the IG member, and accompanying revised model, does not take this position – instead tilting the cost recovery profile to reflect the annual market growth (albeit relatively limited) subject to an estimated aggregate cost-volume relationship.

The level of overall market growth from 2006 onwards (the year in which the hypothetical new entrant starts recovering revenues) is limited, as shown in Exhibit 8. The effect of tilting the cost recovery profile according to this market growth level, subject to a cost-volume relationship of less than 1.0, is limited in reality. The tilt slightly increases costs in the early years, and marginally reduces costs in later years. This tilting effect occurs approximately around 2008 and is therefore distinctly marginal.

Hence, although relevant in theory, it is unnecessary to implement a more complex calculation that is capable of varying asset productivity from year to year[8] by virtue of market growth. All

[8] We note that Oftel's (now Ofcom) initial versions of economic depreciation (Sept 2001 model) included a series that reflected this asset utilisation change over time. The value of this parameter was set to 100% in all years – i.e. no assumed productivity variation for future entrants over time.

generations of hypothetical entrants are therefore assumed to be subject to the same costs of the 2004-entrant's asset productivity series, in all years.

Finally, we note that because the modelled hypothetical new entrant's volumes grow at the same (average) rate as actual operators have in the past, the same costs of similarly lower utilisation in the early years are recovered across from all units of demand occurring during the lifetime of the network.

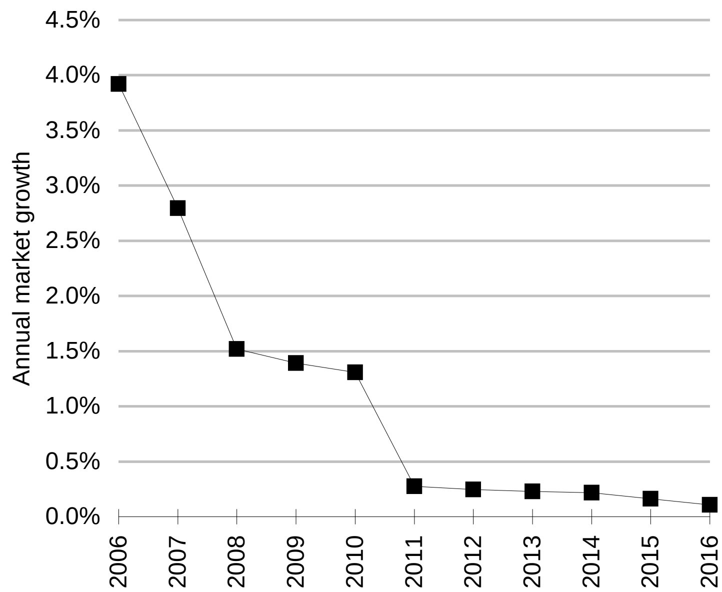

Exhibit 8: *Market growth from 2006 onwards [Source: Analysys]*

The revenue line recovery

The recovery of costs in line with revenues should more accurately have been stated as "recovery of costs in line with cost-based revenues" – i.e. aggregate network output. In the context of OPTA's cost-based examination of mobile termination, we therefore assume a cost-basis for all aggregate service revenues.

In addition, the method we have applied in the model avoids the need for spurious and unnecessarily complex calculations, such as:

- projecting theoretical operating cost trends over the lifetime of an asset (e.g. “bathtub” maintenance shapes)
- endogenously calculated asset lifetimes
- emphasis on a terminal value calculation for perpetuity which is discounted heavily and subject to phasing errors when the number of lifetimes of an asset in the modelled period is not an integer.

4.2 Other submissions relating to economic depreciation

78) *It is believed by one IG member that the price trend for 2G equipment will be rather modest in the future. Another IG member suggests that price trends for network equipment should be based upon future access to low-cost suppliers from Asia – which in a 2G-only world will result in continued equipment price declines. This view of an impending dramatic reduction in equipment prices is repeated by PwC in its annex to one party’s response to OPTA’s public consultation.*

Forward-looking price trends have been implemented in the final version of the model, alongside 2004 MEA unit prices. Price trends have been derived by averaging trend data for forecast unit costs as submitted by the operators. Most data points submitted by operators suggest that GSM equipment prices will remain broadly flat in nominal terms beyond 2007 – this implies a continued decline in price in real terms at the rate of inflation (approximately 2% per annum). Continued real-term price declines for GSM equipment, which are small in magnitude (up to –3% per annum for certain network elements), are consistent with the slower growth in the GSM market forecast from 2007 onwards. Given that the Dutch mobile operators do not intend to rely on GSM equipment for more than 15 years, we believe it is less likely that there will be intense vendor competition for the supply of GSM equipment to Dutch operators in the coming years – therefore the MEA trend for GSM equipment in the Netherlands may not reflect the full extent of lowest-cost supply from emerging Asian GSM vendors. The modelled hypothetical new entrant is also intending to rely on GSM equipment for only 15 years, in anticipation of moving **entirely** to 3G by the end of its first licence period. In developing markets where GSM could be the main mobile telephony standard for a number of decades, affordability is low, and demand for advanced data services practically non-existent, ultra-low cost and basic functionality GSM equipment may indeed become the benchmark.

79) *The description of operating cost "depreciation" is misleading – and would be better described as "smoothing". However, such a smoothing is considered by the IG member to be appropriate for an entrant operator.*

This descriptive point is recognised.

80) *One IG member has commented on the recovery of GSM-specific assets and non-specific assets over time. It suggests that dedicated 2G costs should not be recovered from the 2G lifetime; instead a set of 3G costs thereafter should be assumed. In addition, it believes that it is illogical that all non-2G expenditures are incurred after 2018.*

We note that the IG member has misinterpreted the way in which the model is recovering incurred expenditures. In summary we respond as follows:

- The costs of equipment dedicated to supplying 2G services should be recovered from the demand that they support: 2G service demand, which according to OPTA's conceptual decision also declines in the final years of GSM service. It would be incorrect to recover such costs from 2G and all future service demand when future service demand will be supported by next-generation assets, and the costs of next-generation assets is also not recovered from prior-generation 2G services.

- The model effectively assumes that a set of 3G costs does exist, as soon as migration from 2G begins – the assumed cost level of these 3G services is the logical projection of the economic cost calculated for the GSM-specific assets.

- Expenditure that is not specific to 2G is recovered from all demand occurring in perpetuity, including GSM volumes, and without the higher costs of underutilisation effects due to periodic migration.

5 Unit costs and trends

81) Unit opex values are incorrectly linked to capex cost trends.

This error has been corrected.

82) Unit capex values are incorrectly linked to the wrong capex trend row.

This error has been corrected.

6 Routeing factors and cost allocations

83) The allocation of BTS, backhaul and BSC costs neglects any GPRS service loading.

The model has been adjusted to include BTS and backhaul routeing factors for GPRS volumes. We do not believe it is appropriate to include a GPRS routeing factor for BSCs as the packet control unit (PCU) acts to groom GPRS traffic at the BSC layer of the network, delivering it to the SGSN and dedicated IP transmission.

84) If a call is diverted to voicemail, a traffic channel is reserved. Calls diverted to voicemail must be transited across the network to a VMS. The SMSC is also used to send the voicemail notification.

It is not clear to us that it is efficient to reserve a traffic channel while an incoming call is being answered by the VMS. We do not explicitly model calls to/from voicemail systems. It is assumed that the additional transit costs required for VMS traffic are captured by scorched-node calibration and unit cost data. The costs of SMSC used to deliver the voicemail notification are not added to the cost of an incoming call – these costs are recovered from SMS message volumes. Excluding this (small) SMSC cost from mobile termination is reasonable, since the incoming call per minute cost already includes the cost of the radio network leg used in the onward voicemail delivery.

85) *The allocation of network elements that contain conveyance and signalling components – e.g. TRX and transmission – should be separated into these two parts, then allocated accordingly. This means that the SMS service should receive significant signalling costs, whereas currently it is only allocated a voice-equivalent volume share of costs. At a minimum, this conveyance-signalling disaggregation should be carried out for radio network elements.*

We have explored the sensitivity of the cost results to the separation of radio equipment into conveyance and signalling channel proportions, and allocated the conveyance proportion to minutes, and the signalling proportion to call attempt, LU and SMS events. The proportion of radio costs allocated to signalling was 2/24 (8.3%), based on approximately two signalling channels for three TRXs per sector. The outcome of this sensitivity test was interesting: by allocating 8.3% of radio network costs to signalling, two effects were observed:

- SMS unit costs increased by more than 40%
- the cost of location updates (which includes control channel signalling) more than doubled.

After the mark-up of location update costs to received calls, the effect of this sensitivity was to increase the cost of termination by less than 2%. The calculations for this test have been retained in the model, although our base case remains a zero allocation to signalling because the method by which we assessed this sensitivity has not been validated against any detailed operator data on the precise loading of signalling channels by location update activities.

86) *The MSC processor load in the BH was measured by engineers, showing that there were two to three times as many call attempts than location updates. Therefore, the model substantially overstates the proportion of MSC cost that is allocated to subscribers (location updates).*

The final[9] model allocates 25% of MSC costs to LU, 59% to call attempts and 16% to SMS attempts. Routeing information from mobile operators was based upon switch counting rather

9 Revised for SMS BH proportion and call attempts per received call.

than processor loading – using switch counting routeing factors derived from operator data, the cost mobile termination falls by around 4% (by virtue of the lower location update mark-up and different distribution of MSC costs). The calculations for this test have been retained in the model, although our base case remains a processor load cost allocation.

87) *The MSC load due to location updates should be allocated to received calls rather than subscribers. The cost of the HLR should be allocated to received calls in line with international precedent.*

The model has been revised to include an exogenous final step in the calculation which adds an LU event cost per incoming minute. The cost per LU event is calculated by taking the total costs of LUs (a proportion of MSC plus all HLR costs) and dividing this by the number of relevant received events (the sum of incoming plus on-net voice calls and SMSs).

88) *Licence fees should be treated as a common cost, rather than incremental to service volumes.*

The treatment of common and incremental costs is described in Section 13 of the Conceptual Design document.

89) *The model applies the GSM-specific ramp-down to capital and operating expenditures, when the approach stated in the Conceptual Design indicates that such expenditures will be maintained until the end of the GSM licence period (15 years).*

The error in the model has been corrected for the final version: GSM-specific expenditures are fully maintained until the end of the GSM lifetime.

90) *The model identifies only fixed common costs; it should also identify network common costs from within radio, transmission and switching categories in order to identify the appropriate proportion of common costs that is applicable to the modelled operator.*

We have included a sensitivity in the model in which various numbers of network assets (including coverage sites, TRX and backhaul) are included in the common-cost allocation and subsequently equi-proportionally marked-up to incremental service costs. The output of the model when including this sensitivity test is slightly different.

In the final model we have applied only fixed common costs as the mark-up. This is because removing a significant proportion of the radio network and classifying it as common distorts the level of service costs for the network since a greater proportion of the resulting service costs are influenced by core network costs.

91) *Model calculations are performed in real terms, which is surprising given OPTA seems to advocate a nominal-term price control mechanism.*

Final results from the model have been re-inflated from real 2004 EUR terms to the appropriate nominal figures for OPTA’s chosen price control mechanism. The inflation forecast used for this step is visible in the model.

92) *VMS and SMSC elements are required for incoming calls, since if there is a diversion to voicemail, these network elements become involved. The costs of diversions related to incoming calls should therefore be added to the cost of mobile termination.*

The final model includes explicit modelling of a VMS, the costs of which are recovered from both incoming and on-net traffic. The operator submitting this statement does not mention that a call diverted to voicemail **does not** utilise the radio conveyance channel. The effect of removing the avoided radio costs of a diverted call is likely to significantly outweigh the additional costs of SMS notification. In the final model, every incoming call is charged for the full use of a radio channel, even if that a call is diverted to voicemail. This takes the view that the incoming caller benefits from leaving the voicemail, and is therefore content to pay for the message’s onward radio leg, whereas the mobile party supports the costs of voicemail notification (e.g. an SMS).

93) *The expenditure for Core+Tranmission should be equal to the expenditure for Radio, since this is already the case for [operator]*

Examination of the final model reveals that these two expenditure categories are similar for a PGSM operator of approximately ten years’ maturity (see Exhibit 9). For a DCS operator, radio costs are notably higher than PGSM costs, particularly in the early years. In this comparison it is worth noting that the modelled radio network has been increased in area coverage (to 99.1% area) and increased in quality (compared to less-than-average quality operators).

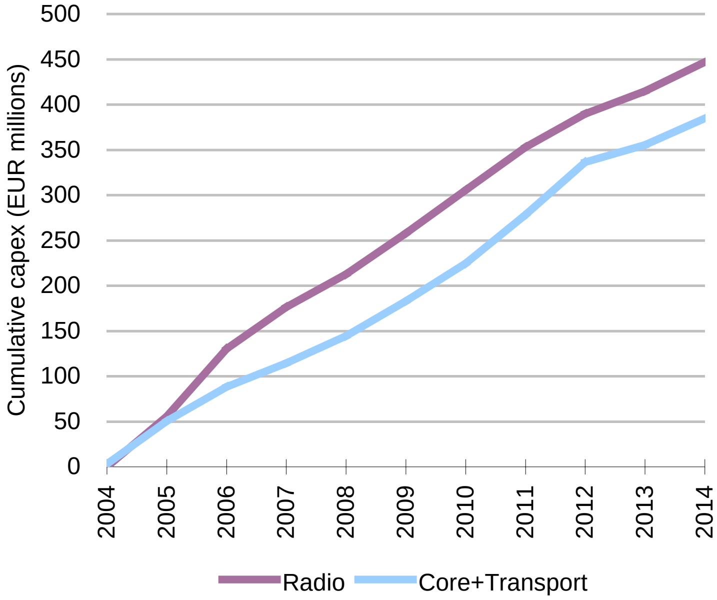

Exhibit 9:

Radio and other expenditures

[Source: Analysys]