Final report for OPTA

Conceptual design document

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Conceptual design document

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Analysys

0 Introduction

The purpose of this document is to present a final position on all the conceptual issues raised and discussed with the Industry Group (IG) and submitted during OPTA's public consultation period regarding the development of the bottom-up long-run incremental cost (BULRIC) model for mobile termination.

Previous drafts of this document have been presented to the IG on the following dates:

- first version: published 28 September 2005
- second version: published 2 December 2005
- third version: published 23 January 2006
- fourth version: published 31 March 2006
- public consultation version: published 21 June 2006.

At each stage, IG members have been able to respond to draft positions on conceptual issues in bilateral operator meetings, at IG workshops (held on 27 September 2005, 14 December 2005 and 6 April 2006), and by submitting written comments to OPTA.

This document incorporates responses to IG members' submissions received up to 10 May 2006 and translated comments submitted by 3 August 2006 in response to OPTA's public consultation, and therefore can be considered to be the revised, complete and final Conceptual Design document.

The feedback by the IG is summarised in this document; specific issues are not attributed to specific IG members. The following IG members provided written responses to the draft and/or public Conceptual Design documents:

- BT, Colt, MCI, Versatel (joint response)
- KPN Mobile
- Orange
- Tele2
- Telfort
- T-Mobile
- Vodafone.

This document is structured according to the recommendations made in the first version of the Conceptual Design document, with each section structured in the following manner:

- description of issue from the Conceptual Design
- recommendation from the Conceptual Design
- summary of feedback from IG
- Analysys's response
- conclusion.

In addition to the main body of this report, an annex has been included to provide additional quantification to the conceptual design aspects of the model. These annexes do not discuss **all** model parameters, but rather focus on those specific conceptual issues that need this additional quantification for the purpose of better understanding the model.

0.1 Timeline for review of issues during IG process

The period during which operators reviewed each issue, and the point at which OPTA communicated its viewpoint on each issue is shown in Exhibit 1, below:

Issue	*Operator review period*	*Communication of OPTA viewpoint*
1. Market share	28 Sep–21 Oct 2005	Jan 2006
2. Rate of subscriber acquisition	16 Dec 2005–27 Jan 2006	Mar 2006
3. Profile of traffic	16 Dec 2005–27 Jan 2006	Mar 2006
4. Network coverage	16 Dec 2005–27 Jan 2006	Mar 2006
5. Transmission network	16 Dec 2005–27 Jan 2006	Mar 2006
6. Network nodes	16 Dec 2005–27 Jan 2006	Mar 2006
7. Input costs	31 Mar 2006–10 May 2006	June 2006
8. Stand-alone network	28 Sep–21 Oct 2005	Jan 2006
9. Spectrum situation	31 Mar 2006–10 May 2006	June 2006
10. Service set	28 Sep–21 Oct 2005	Jan 2006
11. Wholesale or retail	28 Sep–21 Oct 2005	Jan 2006
12. WACC	28 Sep–21 Oct 2005 and 31 Mar–10 May	June 2006
13. Increments	31 Mar 2006–10 May 2006	June 2006
14. Other issues[1]	28 Sep–21 Oct 2005	Jan 2006

Exhibit 1: *Classification of issues [Source: Analysys]*

Exhibit 2 below shows the three stages of issue closure, and how open issues were presented in the models to facilitate operator responses and OPTA's viewpoint.

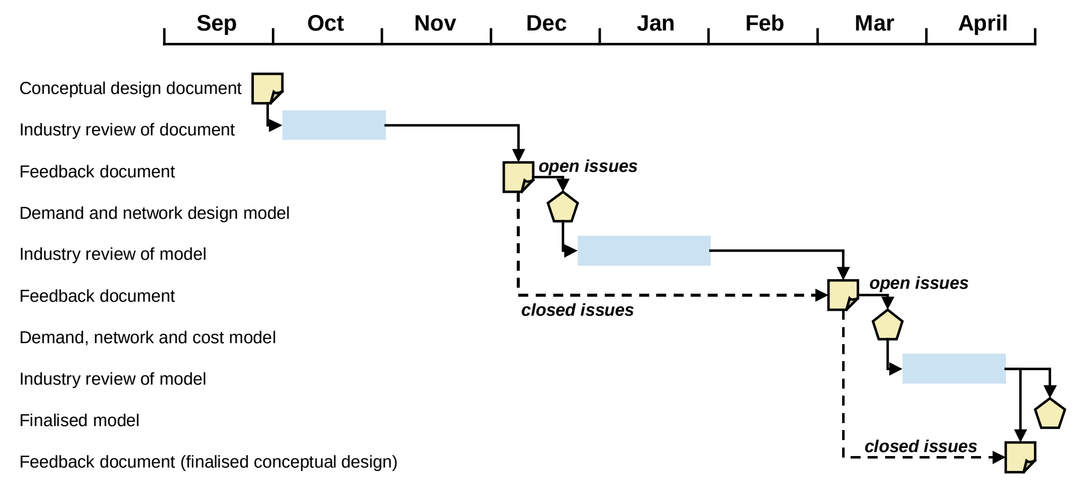

Exhibit 2: *Model and feedback document interaction [Source: Analysys]*

1 We did not receive any issues outside of Numbers 1–13.

1 Market share

Description of the issue

One of the major parameters that defines the cost (per unit) of a hypothetical operator is its market share. It is therefore important to determine the evolution of the market share of the hypothetical new entrant and the period over which this takes place.

Costing implications

The parameters chosen for defining the operator's market share over time influence the overall level of economic costs calculated by the model. These costs can change if short-term economies of scale (such as network roll out in the early years) and long-term economies of scale (such as spectrum fees) are fully exploited. The more quickly the operator grows,[2] the lower the eventual cost will be.

Recommended approach

The scale of the model's hypothetical new entrant is determined by the number of actual players in the mobile market in the long run. Since 1998 there have been five mobile network operators in the Dutch market.[3] KPN Mobile's recent take-over of Telfort will reduce the number of operators to four, and we understand that Telfort's spectrum will remain in the possession of KPN. We also understand that no further GSM or UMTS licences are currently planned to be issued in the Netherlands during the relevant regulatory period. The likely number of players in the long run therefore appears to be four.

Recommendation 1: The long-run market share modelled should be 25%.

2 Strictly, the net present value of demand – therefore reflecting the discounted combination of eventual share and rate of acquiring share.

3 Tele2 is not considered to be a player in this market as it is not an infrastructure player. It is considered as a retail MVNO, which re-sells its host network's services (including termination).

1.1 Summary of feedback from IG

There were a number of different issues raised by IG members, some of which were conceptual and some of which were practical. All of the practical issues suggest that the appropriate market share for the hypothetical operator should be lower than the proposed 25%, thus reducing the economies of scale and resulting in a higher-cost operator. The rationale for this lower market share falls broadly into three categories:

- the hypothetical new entrant constitutes an $(n+1)^{th}$ player
- uncertainty over the future of the market
- differences between existing operators.

IG members also submitted comments on a number of other issues related to market share.

The hypothetical new entrant constitutes an $(n+1)^{th}$ player

One party suggests that the market share of the modelled operator should equate to *1/(n+1)* since a new entrant to the market is being modelled.

Uncertainty over the future of the market

Two parties raise the issue of the lack of certainty over the timing, degree and costs of the integration of Telfort and KPN's networks, and accordingly question the appropriateness of the assumption of a 25% market share.

Three parties raise the issue that Tele2, with a partly owned network, should be treated as a separate network operator. This fact, combined with the uncertainty over the integration of KPN and Telfort's networks, should result in an assumed six-player market with a 16.7% market share. This position was again submitted by one party in its response to OPTA's public consultation.

Two parties raise the issue of further frequencies in the 2.5–2.6GHz range becoming available for mobile services in 2008 and that this should call into question the appropriateness of the 25% market share assumption.

One party raises the issue that, assuming there are four network operators in the long run, the market in the Netherlands is likely to be characterised by fluctuating market shares between 20% and 30%. The market price being set is on the basis of the costs of the smallest (and therefore highest cost) operator at any given time, and thus a long-run market share of 20% would be appropriate for the hypothetical operator. Another industry party suggests in its response to OPTA's public consultation that the realistically achievable market share of a new entrant is 20%, making reference to the Dutch DCS operators.

Differences between existing operators

One party raises the issue that early entrants to the market have a higher market share, which is sustainable due to their higher volumes of on-net traffic. This higher market share (and associated lower cost per minute) cannot be replicated by later entrants because of the barriers resulting from the higher volume of on-net traffic and the associated price discrimination flexibility that this grants the larger operators.

One party suggests that differences in cost between operators arise because of factors that are outside of the control of the operators themselves. The major sources of such differences are spectrum allocation (frequency, bandwidth and price) and start dates (which affect 'first-mover advantages' such as cheaper site acquisition and a typically higher-spending subscriber base). These differences cover multiple areas: scale, network, unit costs and spectrum. Therefore we only deal with the scale-related issue in this section. Unit cost issues are covered in Section 7 and network issues are covered in Sections 4, 5 and 6.

One party raises the issue that mobile operators which only use 1800MHz spectrum are not practically able to support a 25% market share since they cannot provide a service that is equivalent (in terms of indoor coverage) to those operators which use 900MHz spectrum. The party asserts that its lower coverage quality prevents it from competing effectively for the business market segment and that the investment levels required to replicate the indoor coverage of 900MHz operators would be prohibitively high. The relationship between quality of coverage and spectrum is not considered to be directly related to the market share of the hypothetical operator. Therefore, this is further discussed as a coverage issue in Section 4.

Other issues

One party suggests that competition is hindered by symmetrical termination pricing as smaller (higher cost) operators would not be recovering their whole cost of termination through the regulated termination charges, leading to higher retail prices for the smaller operators and diminishing their ability to compete effectively with the larger operators. Accordingly, price controls should be based on the actual costs of each operator based on its actual market share. This view is restated in the party's response to OPTA's public consultation.

Furthermore, one party suggests that setting the long-run market share to 25% would require existing operators to reach a market share level of 25% within the charge control period, and that this is not a realistic goal. This suggestion is reiterated in the party's response to OPTA's public consultation. Another party suggests that by adopting a 25% share, the model assumes existing market parties are able to acquire 25% of the market "straight away".

One party emphasises the requirement for the model to be sufficiently flexible to explore different scenarios for market share.

One party suggests that the prevalence of mobile service providers and their ability to migrate their customer base from one network to another leads to periods of overcapacity in operators' networks.

One IG member submits that the choice of *actual and asymmetric* or *hypothetical and symmetric* scale costing and regulation is determined by OPTA's objectives for the mobile market. Finally, some IG members request a precise definition of what market is being modelled and the modelled operator within that market.

1.2 Analysys's response

The hypothetical new entrant constitutes an (n+1)th player

The modelling of the hypothetical new entrant is by definition hypothetical: it is the threat of a new-entrant operator (with a lower cost base) coming into the market and pricing below existing operators' prices that is the primary mechanism that constrains the prices charged by existing operators. Thus, the new entrant is not an actual *n+1* entrant to the mobile market, but is rather an operator that would take *1/n* of the market in the long term if any of the existing *n* operators were pricing above the long-run cost of such an entrant.

Uncertainty over the future of the market

There is some degree of uncertainty over the long-term number of national cellular infrastructure-based operators in the Netherlands. The recommendation of a four-player market is a judgement based on the current circumstances in the Netherlands, specifically the integration of KPN and Telfort's networks.

OPTA is aware that events that happen in the future may influence the ability of operators to under- or over-recover their costs relative to the proposed 25% benchmark costs. However, OPTA is of the opinion that it should not currently allow mobile operators the direct benefit of all such unknowns in the model, nor should it prejudice the outcome of future licensing or similar future processes.

Network integration alone would not affect the judgement on the long-term market share

The integration of KPN and Telfort's networks is likely to result in a degree of uncertainty in the market as well as requiring some costs associated with the integration to be incurred. It is also likely to require the disposal of duplicated assets. The duplication of assets (and the associated cost of disposal) and all other integration costs are factors that are incorporated in the price paid for the acquisition and are, therefore, not something that should be recovered again through higher termination charges, paid for by other operators.

MVNO infrastructure is accounted for in the modelling

The cost of Tele2's switching infrastructure is included in the model **only to the extent** that it saves capacity on Telfort's core network beyond what Telfort would have had to provide in order to support Tele2's subscribers.

Tele2 and Telfort also incur additional costs from not being able to reach the economies of scale that would be available if Telfort supported both Tele2 and its own subscribers on one set of core infrastructure. The decision to have two sets of core infrastructure was a commercial decision taken by both Tele2 and Telfort: to enable Tele2 to provide value-added services to its subscribers and to enable Telfort to receive transfer charges from Tele2 for radio network capacity. This additional cost should, therefore, be reflected in their commercial agreements and should not be funded through termination payments by other operators.

It is not known whether additional licensed spectrum will result in additional national infrastructure

The additional spectrum that will become available in 2008 provides an opportunity for additional sets of national network infrastructure to be deployed, or for existing national infrastructure operators to increase their network capacity. However, given that the outcome is unknown at this point in time, we maintain our current projection of a four-player market.

Modelling a partially competitive market is a regulatory judgement

The model upon which the 25% market share recommendation is proposed is that of a hypothetical new-entrant operator in a fully competitive market. In a fully competitive market with four operators, each operator will have a 25% market share in the long term. An alternative would be to model a partially competitive market in which an operator could exist with a lower market share, and to base the regulated price on this higher-cost operator. However, basing a regulated price on an operator in a market which is less than fully competitive is not consistent with OPTA's desire to reflect a competitive, efficient, cost-based market for the regulated supply of mobile termination.

Differences between existing operators

As stated in OPTA's market analysis decision, the only differences between operators' cost bases that are suitable for inclusion in an argument on differential pricing are those differences that are due to spectrum availability.

Market share differences associated with first-mover advantage will not be reflected the regulated price

As suggested by an IG member, operators with a larger market share, and hence higher volumes of on-net traffic, can maintain their market dominance by setting the prices of on-net calls substantially below those for off-net calls, leading to cost savings due to their scale that is potentially beyond the commercial control of the smaller operators. OPTA sees no reason to differentiate for the higher market share of earlier entrants because:

- All incumbents would be disciplined by the threat of entry of the same hypothetical new entrant, from the perspective of that entrant's hypothetical market share.
- At the time, those earlier entrants took a greater risk in the mobile market (for example, higher cost of capital, higher prices for equipment and greater uncertainty over demand).

Insufficient spectral capacity to support a 25% market share is considered in Section 9 (Spectrum situation) and Section 4 (Coverage)

An IG member suggests that an operator which purchases less than 25% of the available spectrum will not be able to support 25% of the traffic with as efficient a network as an operator with 25% of the available spectrum. Furthermore, it is suggested that an operator that uses only 1800MHz spectrum will not be able to compete effectively for business users who are highly sensitive to indoor coverage quality.

Both of these assertions would lead to the smaller operator being unable to recover its costs through a termination charge based on an operator with 25% market share.

However, an operator with less than 25% of the available spectrum does have two cost advantages Firstly, it paid less for its spectrum than it would have had to in order to acquire 25% of the spectrum. Secondly, if it is regulated with a termination rate based on an operator which purchases 25% of the available spectrum, the operator which purchased less spectrum will receive termination revenues based on a greater cost of spectrum acquisition than it incurred historically. Furthermore, information provided by the mobile operators suggests that while there is an in-building disadvantage from 1800MHz frequencies, it is possible for an operator to support a 25% share of market demand with less than 25% of available market spectrum. This issue is discussed more fully in Section 4.

The amount, type and price paid for spectrum is considered further in Section 9.

Reference to the 20% share of DCS operators is not consistent with the hypothetical new-entrant approach

One industry party suggests that a 20% share for the new entrant – making reference to the Dutch DCS operators – should be the basis for the hypothetical cost calculation. This suggestion is inconsistent with the approach taken in the model. Specifically, measures have been adopted in the model to ensure that the hypothetical new entrant can effectively match the necessary high quality of coverage demanded by the Dutch market. There is no reason therefore to assume that an equal share of the market cannot be achieved.

Other issues

The issue of symmetry of termination pricing has already been covered in OPTA’s market analysis decision. Expanding on this, with specific regard to market share (all other factors remaining unchanged), operators of a smaller scale are likely to face higher costs per unit of traffic than those of a larger scale, due to economies of scale. However, these may be balanced by lower equipment prices faced by later entrants (which are likely to be smaller-scale operators), which arise from the lower cost of capacity of modern equipment and potentially more efficient network deployment. The issue raised by the IG is whether these cost differences should be reflected in the wholesale termination rate charged by different networks.

As already covered in OPTA's market analysis decision, beyond such considerations as scarcity of input resources, the scale of a mobile network is a function of commercial strategic decisions on coverage, quality of service and the traffic that the network has to support. Therefore, there is to be no differentiation of tariffs on these grounds.

Setting the long-run market share to 25% does not imply that the existing operators should be able to reach a 25% market share either immediately or within the charge control period. Indeed, the modelled hypothetical new entrant takes ten full years from licensing to reach a 25% market share. The aim of controlling the price of termination is to set it to the level that would be incurred in the termination market, if it were competitive. The charge control period is simply the period over which the price of termination will be controlled, and is unrelated to the market shares that have been, or will be, achieved by the actual operators over that period.

According to one IG member, the existence of mobile service providers could potentially lead to large-scale migrations of customers from one network to another, leading to a period of over-capacity in some networks. It is debatable whether this risk posed by service providers is significantly greater than the migration of individual customers and whether there is a counter-balancing risk of under-capacity. However, the model is calibrated against actual operators' networks, so if redundant network capacity as a result of the effect of service providers is a systematic feature of networks in the Netherlands, then the hypothetical new-entrant operator will deploy its network with similar levels of redundancy.

With regard to definitions, the market being modelled is a fully competitive and contestable market for wholesale voice termination on mobile networks. By definition, an actual mobile termination market is non-competitive and not accessible to new entrants. Accordingly, the market being modelled is hypothetical and is used to determine the costs (and accordingly prices) that would arise if it were possible to have a competitive and contestable market for mobile termination.

In order to determine the cost of providing a termination service for an operator, it is necessary to define the volume of traffic that this operator would carry (in order to determine the economies of scale that the operator is able to achieve). In a competitive and contestable mobile market (including origination and termination of traffic), the modelled operator is assumed to acquire 25% of the total traffic in the market.

This 25% assumption assumes a four-player market the long run, where a player is defined as an operator with a network roll-out obligation, commensurate with the acquisition of a piece of spectrum that has been licensed for cellular telephony services. The modelled operator is defined as a new-entrant operator: it is the threat of a new-entrant operator (with a lower cost base) coming into the market and pricing below existing operators' prices that is the primary mechanism that constrains the prices charged by existing operators. Thus, the new entrant is not a fifth entrant to the mobile market, but is rather an operator that would take 25% of the market in the long term if one of the existing four operators was pricing above its long-run costs.

The date of entry of the modelled operator is immaterial to the prices charged in any given year. This is because the prices charged by an operator in a competitive and contestable market will be in line with the modern-equivalent asset value of the underlying network (as determined by the economic depreciation calculation).

1.3 Conclusion

The modelled operator shall achieve a 25% market share of traffic and subscribers in the long run, consistent with the assumption of a four-player market in the long run.

2 Rate of subscriber acquisition

Description of the issue

In the context of modelling a hypothetical constraint on the termination market, the level of contestability[4] considered need not necessarily be linked to the operator's historical performance. Indeed, an efficient operator offering call termination at cost might expect to be in a position to compete effectively with the incumbent's call termination services in each market as soon as it has deployed its network and established its brand.

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4 By contestability we mean the rate of acquiring subscribers and traffic.

Recommended approach

Recommendation 2: In a manner consistent with the hypothetical market definition adopted, we shall explore key parameters influencing the rate of subscriber acquisition, possibly using a simple subscriber model or other wholesale market proxy.[5] The appropriate level of contestability within the market will therefore be refined as the modelling progresses.

2.1 Summary of feedback from IG

One party states that it will take a number of years for the new entrant to acquire its long-term market share due to network investment required to meet coverage and quality requirements. Another party suggests that the time taken to build a brand exerts an influence on the hypothetical new entrant's rate of subscriber acquisition. In making this suggestion, the party refers to H3G as an actual new entrant in a number of European markets. Another party supplies information on the rate of market share acquisition of recent GSM entrants in a number of European markets. One party suggests that actual operators' market shares should be used and thus their rate of subscriber acquisition should be based on their actual values.

One IG member submits that modelling a 2004 entrant does not allow actual operators to bring cost recovery from the past into the current regulatory period (when asset utilisations are higher).

A number of parties note the linkage between the rate of coverage roll out and the rate of subscriber acquisition. In making this linkage, these parties submit that the hypothetical new entrant must immediately match the level of coverage of existing operators (i.e. a rapid roll out) and only then would the entrant be capable of steadily acquiring mobile subscribers.

5 For example, the average handset, subscription or tariff plan lifetime of subscribers.

2.2 Analysys's response

The rate of subscriber acquisition of the new entrant is a function of the competitiveness of the modelled market and the extent to which a new entrant can deploy a network capable of deploying a competitive level of coverage and quality of service.

The model is of a competitive market, and it is assumed that in order to compete effectively with existing operators, the new-entrant operator will deploy a network capable of supporting 25% of the market, at a level of quality and coverage similar to the existing operators.

At IG-II, Analysys presented two options for the rate of acquisition of market share, linked to the rate of coverage roll out. It is accepted that there is a linkage between the rate of network roll out and subscriber acquisition: roll-out rate is discussed in Section 4, market share acquisition in the remainder of this section.

The rate of acquisition of 3G entrants such as H3G in other European markets is not relevant to the consideration of Dutch GSM players' regulated mobile termination rates, since the regulation of Dutch mobile termination is based upon a hypothetical new (2G) entrant, rather than a real (3G) entrant.

Since IG-II, Analysys has explored with OPTA the parameters and principles of adopting rapid or steady market share acquisition profiles. OPTA considers it most appropriate to reflect a **steady** profile for the growth in market share, as this accommodates the need for the hypothetical new entrant to roll out a realistic but high-quality network, develop its brand, and steadily acquire market share (in regions of the country where it offers sufficient coverage for customers).

Following IG-III, this steady profile for the growth in market share has been set by OPTA with reference to the exact historical performance of five historical Dutch market players. Therefore, the growth in demand experienced by the hypothetical new entrant is exactly the same as the average level of demand experienced by the actual operators in their first, second, third, etc. years of operation. Further details of this market share are shown in Annex A.

Adoption of this market share profile means that the *historical lower utilisation of the network*, as experienced by actual market entrants developing the market, is also reflected in the carried volume of the hypothetical modelled entrant. Since the modelled calculation of costs based upon economic depreciation allows the costs of lower utilisation to be recovered in all years, the costs calculated for the hypothetical new entrant effectively **do** allow the recovery of costs of low historical utilisation in current periods. In addition, the model's approach ensures that the hypothetical new entrant is reflective of the growth rates of actual Dutch operators, and hence comparisons to 3G players in other European nations are not pertinent.

2.3 Conclusion

The modelled operator will acquire subscribers and traffic steadily over time, to reach a 25% market share ten full years after its licence is purchased. The size of the modelled operator over time will exactly match the average rate of growth of the Dutch mobile network operators in their historical years of operation.

3 Profile of traffic

Description of the issue

In defining the hypothetical operator, it is necessary to define the volume and profile[6] of traffic that the operator is carrying. Since the definition of the hypothetical operator incorporates a view on ongoing market share, it is necessary to define traffic volumes and profile for an average subscriber.

6 By profile we mean proportions of calls to/from various mobile and fixed destinations, and time-of day profile.

Costing implications

The volume of traffic associated with the subscribers acquired by the modelled operator is the main driver of costs in the mobile network, and the measure by which economies of scale will be exploited. The implications of this are therefore identical to those described in Section 1 on market share.

Recommended approach

In the hypothetical competitive market being modelled, the subscriber base of each operator will have the same profile, in the long run. In addition, we do not believe there to be any strong reasons why in this situation the modelled operator cannot compete equally for subscribers.[7] Therefore, the traffic profile of the modelled operator should be as per the market average, calculated to be consistent with the scale of that operator.[8]

Recommendation 3: The forecast traffic profile for the hypothetical operator should be based on an evolving market-average profile. How this profile changes over time should be included dynamically as a function of market share.

3.1 Summary of feedback from IG

Two parties raise the difficulties associated with averaging time-of-day traffic profiles across different geographies and different customer types, which would lead to a 'smoothing' of the traffic profile and under-deployment of network elements. It is suggested that this effect causes a large difference between the actual busy hour and the averaged busy hour.

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7 The converse of this would be that *the hypothetical new entrant can only initially acquire poor quality low-volume subscribers because it is initially seen as a weak competitor in the market.*

8 For example, the proportion of originated calls that are on-net can be expected, all other factors being equal, to be related to the size of the operator's subscriber base. Clearly, as the size of the modelled operator changes over time, a dynamically changing proportion of traffic would be estimated as on-net.

One party suggests that the traffic profile should reflect migration to other technologies such as 3G, WiFi and VoIP.

One party suggests that the traffic profile should be linked to the market share of the modelled operator.

3.2 Analysys's response

The data request assumes the same distribution of traffic across all geographies and takes no explicit account of different traffic profiles in different areas. However, the model **does** implicitly take account of this effect through the calibration process where the model results are calibrated to match the actual network deployment by the different operators for their given level of demand. This calibration process remains valid even where the difference between average network and individual cell busy hours is large. Therefore, the risk of under-estimating the number of network elements deployed is small.

Migration to 3G is covered in Section 8. Pessimistic scenarios cover migration to competing technologies such as WiFi or VoIP, which is viewed as a known and systemic risk affecting all mobile operators. This is reflected in the risk-discounting of expenditures – and therefore in the discount rate applied. Commercial decisions by mobile operators to develop their own or joint-venture WiFi-based (or similar) services are not considered relevant to the efficient costing of mobile (cellular) voice termination.

The current traffic profile of the hypothetical operator is based on the current market average. The forecast of the traffic profile of the hypothetical operator is based on forecast usage of an average subscriber, performed at a market level. We agree that market share affects traffic profile (i.e. proportion of on-net traffic) and that the rate of subscriber growth for the modelled operator will control the rate of growth in on-net traffic – this interaction is evident in the model.

3.3 Conclusion

The forecast traffic profile for the hypothetical operator is based on an evolving market-average profile. The overall market for mobile voice is forecast to grow from 2004 levels as penetration saturates and usage levels per subscriber stabilise. The modelled operator will eventually receive a 25% share of this market, as identified in the first and second conceptual issues. The modelled operator's on-net traffic proportion will increase as its subscriber base grows, reflecting closed user group calling effects.

4 Network coverage

Description of the issue

Coverage is a central aspect of network deployment, and of the radio network in particular. The question of what coverage assumptions to apply to the hypothetical operator can be understood as follows:

- How far should geographical coverage extend in the long run?
- How rapidly should the long-run coverage level be attained?
- What quality[9] of coverage should be provided, at each point in time?

Costing implications

The definitions of coverage parameters have two important implications for the cost calculation:

9 By quality of coverage we specifically mean the density of the radio signal – within buildings, in hard-to-reach places and in special locations (e.g. airports, subways, etc.).

Level of unit costs due to present value of expenditures

The rate, extent and quality of coverage achieved over time determine the present value of associated network investments and operating costs. The degree to which these costs are incurred prior to demand materialising represents the size of the 'cost overhang'. The larger this overhang, the higher the eventual unit costs of traffic will be. The concept of a cost overhang is illustrated in Exhibit 3 below.

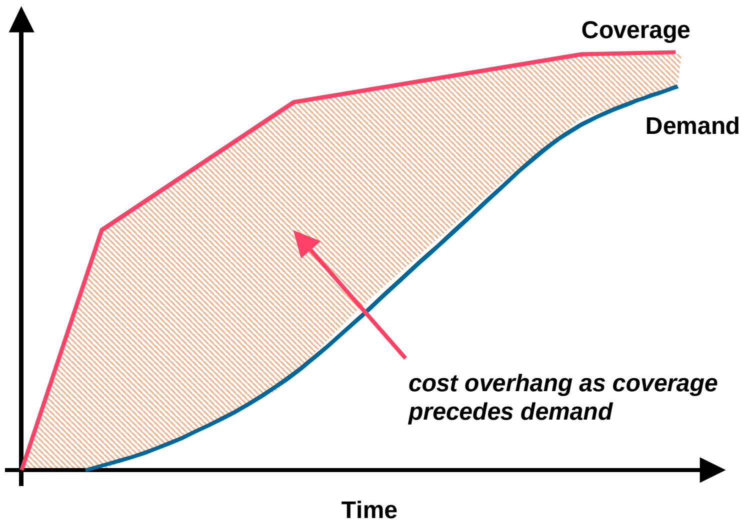

Exhibit 3:
Cost overhang
[Source: Analysys]

Identification of network elements and common costs that are driven by traffic

In a situation where coverage parameters are relatively large, fewer network elements are likely to be dependent on traffic. This decreases the sensitivity of the results to assumed traffic algorithms, particularly if the information submitted by operators does not allow conclusive traffic algorithms to be developed.

Furthermore, common costs are generally incurred when costs remain fixed in the long run. With larger coverage parameters specified for the hypothetical new entrant, increasing proportions of network costs are invariant with demand and hence likely to be common costs. In the worst-case situation, it is possible to arrive at zero incremental costs where all radio network costs are driven by coverage. This outcome can be viewed as potentially (and significantly) misleading if the driver of coverage was, in fact, the provision of traffic capacity rather than providing coverage in its own right.

Recommended approach

The benchmark for coverage provided by a hypothetical new entrant is related to whether more stringent coverage obligations would be placed on a hypothetical new GSM network today, and the level of coverage that today's mobile market would demand in order to consider it an effective proposition. Quality of coverage may be a contentious issue as operators have been directly and indirectly improving quality of coverage over time.

Targeted questioning and investigation of operator data should yield useful information with which to quantify the base case or scenarios for coverage parameters.

Recommendation 4: A reasonable and efficient level of network coverage to be achieved over time will be applied to the modelled operator, this will be explored further during the investigation of operator data. Our starting point for this investigation will be the actual range, rate and quality of coverage achieved by the Dutch operators. Our expert knowledge will be applied to validate operators' data in this area.

4.1 Summary of feedback from IG

Two parties emphasise the importance of indoor coverage in the Netherlands to be competitive and that complete coverage from the first day of operation will be necessary for a new entrant. When questioned further in subsequent bilateral meetings, each of these parties stated that immediate roll out was effectively unachievable.[10] Given that the cost base of the hypothetical new entrant will be derived from actual (efficient) levels of operators' network costs and staffing levels, the parties stated that a steady roll out which maximised the quality of the network to be deployed was in their view appropriate.

Two parties suggest that the costs incurred by the hypothetical new entrant should be based on the quality and coverage requirements that the actual operators faced in the past, rather than those that a new entrant would face today.

10 For example, the network design and deployment team required would be prohibitively expensive and difficult to manage.

One party suggests that the scarcity of good quality locations for antenna sites means that the costs of a new entrant will be in excess of those faced by existing operators.

One party suggests that if callers to mobiles benefit from greater quality, the costs of this should be reflected in higher termination charges: operators have no incentive to over-supply quality (e.g. in-building coverage).

4.2 Analysys's response

In order to compete effectively with the existing operators, the hypothetical new entrant will have to match the network coverage and quality of the existing operators. Historically, operators in the Netherlands have taken different commercial decisions as to how quickly and where to develop coverage, and differences still remain in terms of the extent of areas covered by each operator. The incentive for the new entrant would be to roll out its network as quickly as is possible in order to acquire customers and thus allow it to recover the cost of the network. A steady roll-out profile which maximises quality of coverage while remaining within realistic roll-out constraints is therefore considered appropriate to this principle and the views of industry parties:

- Once the hypothetical new entrant has achieved similar coverage in regions of the Netherlands (e.g. the Randstad) it will be in a position to compete effectively for subscribers who value that coverage.

- The network operations costs will be based on actual operators' levels, therefore the hypothetical new entrant should be capable of rolling out a network approximately as quickly as actual operators.

- We propose a five-year period to reach full coverage as an appropriate and efficient roll out.

In order to achieve a 25% share of the market, it is assumed that the hypothetical new-entrant operator must roll out to match the area coverage of the widest coverage operator in the Netherlands. This equates to 99.1% area coverage.

The hypothetical new-entrant operator offers the same level of coverage quality (in-building penetration) as the average 900MHz operator. This level of coverage quality is also applied to a DCS-only operator, which has cell radii set according to our estimate of the number of sites for coverage needed to achieve a 99.1% area with the same level of coverage quality as the benchmark stated above. This is also discussed in Section 9 and further in Annex A.

By matching both the area coverage and coverage quality of a DCS-only network with that of a GSM network, the hypothetical DCS-only operator is able to reach an equal (25%) share of the market in the long run.

While it is true that there may be a scarcity of good-quality antenna sites today, the hypothetical new-entrant model does not reflect the costs of another actual network provider entering the Dutch market (as suggested by one party that was struggling to find suitable antenna sites). In essence, the hypothetical new-entrant operator has access to the average site base of existing operators, *at MEA prices*, and subject to the scorched-node calibration condition which therefore reflects any differences in site requirements depending on the spectrum allocation of the modelled operator.

4.3 Conclusion

The modelled operator will deploy a network that covers 99.1% of the land area of the Netherlands, equivalent to the level of area coverage provided by the largest coverage operator. The modelled operator will deploy its coverage network to the high level of in-building coverage (signal strength) demanded by the Dutch market – the level of in-building penetration that can be achieved with 900MHz frequencies.

5 Transmission network

Description of the issue

A large number of factors affect the choice of transmission network used by an operator. These include:

- historical demand and network evolution
- forecast demand and network evolution
- build or buy preference of individual mobile operators
- availability of new generations of transmission technology from alternative providers
- range and price of wholesale transmission services.

During the development of the model it will be necessary to analyse differences in network transmission to carry traffic from the base stations, and to connect switching sites with backbone capacity.

Costing implications

Primarily, the modelling of a hypothetical new entrant requires an efficient choice of transmission network. All differences between the modelled network and operators' actual networks will be accompanied by cost differences. Therefore, it will be necessary to clearly articulate the method and rationale for selecting the chosen network transmission. Crucial to this decision is the degree to which actual operators' networks differ from this efficient benchmark.

Targeted questions and investigation of submitted data should yield information to support this aspect of the model. Alternatively (in the absence of such information), it is possible for an efficient transmission network to be designed 'on paper'.

Recommended approach

Recommendation 5: Adopt a reasonable and efficient transmission network design – to be specified further during the model development. Our starting point for defining such a transmission network will be submitted data on operators' actual networks, which we shall validate with our expert opinion.

5.1 Summary of feedback from IG

One party suggests that the model should have sufficient flexibility to model different possible transmission network layouts. Two parties suggest that the transmission network for the hypothetical operator should be based on actual operators' transmission networks because of the numerous factors that influence specific transmission network layouts.

One party suggests that KPN Mobile might be able to realise lower transmission costs by co-locating equipment with KPN Fixed.

5.2 Analysys's response

It is not necessary to include the flexibility to model each operator's individual transmission layouts, since the purpose of the model is to capture an efficient forward-looking new entrant's costs: such an network operator would adopt just one transmission network design. OPTA has chosen to base the cost calculation on an efficient hypothetical new entrant, therefore it would be inconsistent to apply each actual operator's transmission design.

A transmission network design was presented to the IG at IG-II. This network is defined as that of a stand-alone, new-entrant 2G operator. It does not include any cost advantages that KPN Mobile might realise from co-locating equipment with KPN Fixed as this would not be consistent with modelling a stand-alone mobile network. The transmission network design was based on information regarding the existing operators' networks: we examined each operator's high-level transmission layout, identified common factors between operators, and used this information to develop a simplified algorithm of transmission network deployment.

5.3 Conclusion

The modelled operator will deploy an efficient transmission network consisting of a mixture of microwave backhaul, E1 leased line backhaul and 155Mbit/s leased backbone links.

6 Network nodes

Description of the issue

A mobile network can be considered as a series of nodes with different functions and links between them. Of these node types, the most important are radio sites, RSO and MSOs. In developing algorithms for these nodes, it is necessary to consider whether the algorithm accurately reflects the actual number of nodes deployed. Allowing the model to deviate from the operators' actual number of nodes may be allowed in the instance where the operators' network is not viewed as efficient or modern in design.

Specification of the degree of network efficiency is a crucial regulatory costing issue, and one which is sometimes circumvented by the application of a 'scorched-node' principle. This ensures that the number of nodes modelled is the same (exactly or effectively as required) as in reality albeit with modern equivalent equipment deployed at those nodes. This is coupled with the commonly held view that mobile networks are generally efficiently deployed and operated due to infrastructure competition. The main alternative is the **scorched-earth** principle, which allows the number and nature of nodes modelled to be based on a hypothetical, efficient network even if it deviates from operational reality.

Costing implications

Adopting a scorched-node principle requires an appropriate calibration of the model, to ensure node counts correspond with reality. This ensures that the level of assets in the model is not under-estimated due to factors that are not explicitly modelled. The application of network node adjustments indicates the network efficiency standards above which excess cost recovery is not allowed. This can be assessed by analysing the actual design of the operators' networks.

Recommended approach

Prior to assessing the operators' actual networks and deconstructing their evolution in terms of cost drivers, it is difficult to assess the extent of differences between operators with respect to network nodes.

Recommendation 6: Adopt a reasonably efficient network design in terms of numbers of network nodes. The starting point for this will be submitted data on the number and nature of nodes in operators' actual networks, which we shall validate with our expert view. In the radio network, we suggest applying a scorched-node calibration to ensure that the model can replicate operators' efficiently deployed site counts; this effectively ensures that the radio network design parameters which are not modelled explicitly are implicitly captured in the model.

6.1 Summary of feedback from IG

One party suggests that a scorched-node approach might not properly reflect the deployment of the operators in the Netherlands, as strategic issues would not be captured – for example, an operator deploying fewer sites, charging commensurately less for its service and accepting lower indoor coverage.

One party suggests that the model should reflect the actual number of nodes of each operator, in order to ensure the full recovery of costs by each operator. This argument is based on the idea of cost advantages that cannot be replicated by other operators.

One party suggests that a radio-planning tool should be used in order to determine the most efficient network design for the Netherlands, and that since efficiency will vary between operators, a scorched-node calibration based on averages will result in an inefficient network. The party suggests that scorched-node calibration should be applied on the most efficient network, which is identified through detailed efficiency testing. The same party also suggests that Analysys's experience from building similar models in other European jurisdictions should be applied to the Dutch model to confirm the best-practice efficiency level applied to the modelled hypothetical new entrant.

One party notes that Tele2 has its own infrastructure that should be taken into account in the model.

One party suggests that, due the scarce nature of high-quality sites, later entrants have to deploy a greater number of lower-quality sites in order to achieve the same levels of quality and coverage, calling into question the validity of the scorched-node calibration. By the same token, one party suggests that the new entrant's unit costs will be higher still and that the model should reflect this.

One party submits, with the PwC report annex in its response to OPTA's final consultation, that the modelled geotypes do not account for border frequency planning issues and suggests consequently that it cannot be confirmed whether the scorched-node calibration sufficiently accommodates for this effect.

6.2 Analysys's response

The scorched-node approach is the best way to ensure full recovery of efficient network costs by the operators in the Netherlands. The underlying assumption behind this approach is that the deployment by operators in the Netherlands is as efficient as it could be given the constraints that the operators face as their networks develop over time. From the data available to us, differences in operators' networks can readily be ascribed to strategic decisions – below we describe how such differences have been averaged into scorched-node calibration. The data available to us does not illustrate major differences in efficiency which cannot be explained by strategic decisions or scale. A comparison of OPTA's model with those developed in other jurisdictions is within the scope of model development; however, we note that geographic factors (e.g. topology, building densities, mobility requirements, state of market development, etc.) vary considerably between countries and make cross-comparison less revealing than finding consistency between the actual Dutch operators.

The use of radio-planning tools, while potentially valuable, runs the risk of under-estimating what a reasonably efficient network deployment would be, and thus not allowing the existing operators to recover their efficiently incurred costs. 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. The scorched-node approach mitigates this risk.

Analysys believes the scorched-node calibration in the model accommodates a number of issues raised by industry parties as relevant:

- *average* availability of sites for PGSM versus DCS operators separately (reflecting the function of availability for earlier compared to later entrants)
- *average* border restrictions on spectral frequencies
- *average* strategic decision to deploy different quality networks is reflected in the use of coverage cell radii for PGSM and DCS operators separately (see discussion of coverage in Section 4)
- we have developed a network model of a full service operator – i.e. one which supports its entire demand with its own network infrastructure, without third-party MVNOs. This means that the costs of network equipment to support all subscribers are included, even though in reality these are shared between the MVNO (Tele2) and its host network.

The model should not reflect the ability of an *actual* new entrant to find further suitable sites, since the aim of the model is to cost a *hypothetical* new entrant (with access to the cost base of existing operators, at MEA prices) rather than an actual new entrant (which would face a multitude of actual constraints beyond those that are faced by actual market players).

6.3 Conclusion

The model has been scorched-node calibrated against the actual number of radio and switching sites deployed by the operators.

7 Input costs

Description of the issue

In order to calculate the costs of a mobile network using a BULRIC model, the unit cost of different equipment is a required input. There are three general approaches, discussed below, that could be taken in defining input costs:

- lowest cost
- highest cost
- average cost.

Lowest-cost operator

The definition of the hypothetical operator as a reasonably efficient new-entrant operator means that it should purchase equipment in an efficient way, i.e. that it would buy equipment for the lowest cost per unit of output.

Using the lowest unit costs carries the risk of under-estimation of costs because:

- some operators might have access to lower unit cost that cannot be replicated by other operators
- a lower unit cost in one category might be balanced by a higher unit cost in another
- the efficient unit cost might not necessarily be the lowest as there are other considerations that go into a real purchasing decision (e.g. reduce reliance on a single equipment vendor or bulk purchasing at international group level).

Highest-cost operator

Mobile operators in the Netherlands operate in a competitive environment and therefore have strong incentives to purchase and operate their network equipment at the lowest possible cost. Therefore, the price paid by any operator for a given unit of equipment will be the lowest possible price that the operator could pay and using any lower value will result in the operator being unable to recover their full costs.

Using the highest unit costs has the same potential problems as using the lowest unit costs, leading to a risk of over-estimating cost.

Average cost of operators

Given the staggered nature of network deployment, the price paid for any given unit of equipment by any given operator at any given time will naturally vary. However, the discipline of competition in the retail market means that all operators will aim to minimise their costs over the long term. Therefore, using averaged unit costs would produce an efficient overall network cost. It is the case that any particular efficient operator might choose to spend less on certain items and more on others, but this is unlikely to have a material effect on the result, especially with the use of equal-proportionate mark-up (EPMU) for allocating common cost.

The main advantage of using average costs is that it avoids adhering dogmatically to a particular principle (e.g. lowest or highest cost), which can be demonstrated to be unreasonable under certain circumstances and instead provides a reasonable, practicable alternative.

Recommended approach

Recommendation 7: Given the practical and regulatory difficulties of accurately and unambiguously defining the lowest cost base for an operator, we recommend an approach based on average costs. Our starting point for assessing the level of input costs will be the actual costs incurred by the operators – informed by data submitted by the operators – and subjected to our expert validation. High or low outliers of unit cost will be excluded where it can reasonably be shown that such an outlier represents cost advantages that cannot be replicated, or unusual operator behaviour.

7.1 Summary of feedback from IG

One party emphasises the importance of modelling a consistent network to ensure that unit costs and unit capacities are reflective of the real situation. Similarly, another party suggests that outlying data points should not be excluded on the grounds that they are likely to be a product of different network architectures or vendors.

One party suggests that no efficiency adjustments should be made in the unit costs of the new entrant because the mobile operators in the Netherlands have deployed their networks in a highly competitive environment. Similarly, one party requests an explanation of any outlying results that have been excluded.

Two parties suggest that the model should be able to be reconciled with actual operator costs to ensure the realism of the results. Similarly, one party emphasises the importance of ensuring that unit costs include procurement, fitting, installation, testing and commissioning.

One party emphasises the importance of being able to run alternative scenarios for unit costs within the model.

One party suggests that KPN Mobile derives unit cost advantages from transmission and co-location due to the economies of scale that are shared with the KPN fixed line business. On the other hand, one mobile operator submits that major multi-national operators such as Vodafone, Orange and T-Mobile enjoy significant purchasing scale economies.

One party raises the issue that later-entry DCS operators have higher unit costs due to the better sites being unavailable to them, resulting in inefficient network deployment. Similarly, one party suggests that the price paid for sites by later operators is higher than the prices paid by older operators, which should be reflected in the unit cost inputs.

Finally, one party suggests that the set of unit costs which gives the lowest (i.e. most efficient) cost result should be chosen, once trade-offs between higher/lower asset prices have been assessed and isolated.

7.2 Analysys's response

The process of deriving the unit costs for the hypothetical operator from actual operators' data is based on averaging the values from different operators. This averaging process requires a detailed understanding of the unit costs submitted by the IG members in order that they can be compared appropriately. Considerations as part of this averaging process include:

- whether the unit costs from each operator correspond to the same functional unit, with the same capacity per unit
- whether the low costs associated with one unit of equipment are tied to higher costs of another unit of equipment
- whether higher (or lower) unit costs are being incurred in a manner that would not be replicated by a new-entrant operator.

The values that have been used in this process are confidential to the operators providing the information and, as such, cannot be disclosed. Given the complexity and confidentiality of the population process we do not think it is beneficial to detail the consideration of each bottom-up or top-down data point in the context of setting up the cost model. Indicative outlier information is provided in Annex A.

The need for consistency across the selected unit costs, such that the hypothetical new entrant's network is achievable in practice, is recognised. Furthermore, the model has been validated against operators' actual top-down costs with no efficiency adjustments assumed. As such, the level of expenditure in the model reflects the average position that the Dutch operators have in purchasing scale economies: information available to us suggests that no operator is materially disadvantaged (i.e. outlying costs) in this regard. We believe it is appropriate to apply this average position to the hypothetical new entrant, rather than to assume a higher expenditure network based on single-country operation, in order that Dutch mobile termination consumers benefit from the level of purchasing economies achieved on average by operators in their home market (since mobile origination consumers receive this benefit also). All Dutch operators can in practice exploit purchasing scale economies on a national scale (by being a major national player), or on an international scale (by being part of a multi-national company or joint equipment purchasing agreement).

The issues of cost advantages due to KPN Mobile co-locating equipment with KPN Fixed have been commented on in Section 5.2.

7.3 Conclusion

The unit cost inputs used to populate the model have been derived by averaging across operator provided data, and taking into account both bottom-up and top-down estimates of the unit cost of network elements.

8 Stand-alone network

Description of the issue

This conceptual issue affects KPN Mobile, for which various network or non-network functions may be shared with KPN Fixed. However, it is also relevant to other mobile operators as they move from 2G onto 3G technology. Operators providing both 2G and 3G services will share economies of scope between the two networks. For instance, modern network switches may be dual compatible, and modern network software may be able to control both 2G and 3G, allowing network management and business functions to be pooled. Many sites will also probably be shared between 2G and 3G.

It is therefore necessary to decide whether the hypothetical operator being modelled is treated as a stand-alone mobile network operator, or whether it benefits from economies of scope with non-2G services (i.e. fixed or 3G).

Costing implications

Clearly, the choice between stand-alone and shared networks affects the overall costs incurred by the operator to deliver its GSM services – modelling stand-alone costs will result in a higher[11] unit cost. However, clear and accurate specification of data gathering in particular, and also subsequent model development, will be important to ensure that stand-alone network costs are correctly determined:

- Dedicated 3G costs should be excluded. These include various costs which would be avoided if 3G was not on the operators' roadmap (such as advanced software upgrades in anticipation of 3G).
- For KPN Mobile, costs should be assessed on a stand-alone basis. Where fixed-line and mobile network and business activities share the same cost elements, the stand-alone mobile network proportion must be assessed. In some areas, we would expect that KPN Mobile's stand-alone cost should be similar to the equivalent cost incurred by the three (four including Telfort) actual stand-alone mobile network operators – for example in business overheads.

Recommended approach

According to OPTA's market analysis decision, operators deciding to deploy 3G before the end of the price control will be allowed to keep any benefit arising from 3G costs being lower than the termination rate (which is based upon 2G costs). It therefore seems appropriate to allow operators to keep any potential economies of scope arising from the sharing of costs between 2G and 3G by modelling stand-alone 2G networks which carry all forecast voice traffic volumes.[12] By not modelling migration, the model result should represent the ceiling of efficient long-run termination costs in the Netherlands: any lower long-run costs arising from migration will be of direct benefit to the mobile operators until at least the length of the regulatory period; any activity which results in higher long-run costs of termination shall be considered inefficient from a voice termination perspective.

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11 Strictly, the **same** or higher unit cost, since if there were no economies of scope, costs would be identical.

12 It should be noted that our forecast of all voice traffic will be, in this situation, 2G-evolutionary rather than 3G-revolutionary in growth.

Recommendation 8: A 2G stand-alone operation should be modelled. Accordingly, operators should be asked to provide cost information as if they were only operating a 2G network.

8.1 Summary of feedback from IG

Mobile parties (and PwC in its report annexed to one party's response to OPTA's public consultation) disagree with the exclusion of 3G costs but agree that a stand-alone operation is the relevant scope to model. One party interprets stand-alone 2G operations as including the effects of traffic migrating off the 2G network. A second mobile party raises a number of particular points with regards to the exclusion of 3G:

- There will be cost savings associated with moving from 2G to 3G (e.g. transmission, sites) but there will also be additional costs arising from under-utilisation of both 2G and 3G networks in their respective lifetimes.

- Forward-looking costs are based on a projection of expected volumes: "this is acceptable when modelling a predictable 2G environment, it is not practical when applied to the very uncertain future volumes of 3G traffic". In its response to OPTA's public consultation, the party suggests (with its PwC report annex) that a lower long-run cost for 3G is reliant on extensive take-up of new services.

- 2G is no longer the 'modern equivalent asset' for a mobile network.

- Migration to 3G will be due to efficiencies for the portfolio of services offered, rather than for any one service in particular (i.e. termination).

- There is a risk asymmetry for regulation based on 2G, if demand for 3G does not materialise as planned (thereby 3G costs are higher than modelled 2G costs). Imposing the 2G-based termination rate will leave a large proportion of 3G investments un-recovered.

One party suggests that modelling a 2G operator with diminishing volumes would be an alternative way of accounting for the costs of migration and that this method has been applied by Ofcom in the UK.

Members of the IG also emphasise the importance of separation of the costs of KPN Fixed and Mobile, and the differential charge control treatment of KPN as a result of fixed–mobile integration. One party qualifies this assertion by suggesting that mobile costs for KPN should exclude any costs allocated to KPN Fixed, i.e. no double counting of shared costs.

Members of the IG point out that, when 3G licences were bid upon in 2000, the expectation was that the 2G licence would expire in 2010. This makes the purchase of the 3G licence a necessity for continued provision of mobile services and, since this places the purchase beyond the operators' control, the associated costs should be included in the BULRIC model.

Furthermore, the requirement in the 3G licences to provide a certain degree of coverage by 2007 and to migrate all 2G traffic by 2010 would result in stranded 2G assets.

Following IG-III and the subsequent bilateral operator meetings, industry parties submitted further comments specific to the 2G migration-based cost calculation which was adopted at IG-III:

One industry party suggests that OPTA's approach (as the party illustrated in Exhibit 4A) neglects the real-world cost recovery requirements faced by the mobile operators (as the party illustrated in Exhibit 4B).

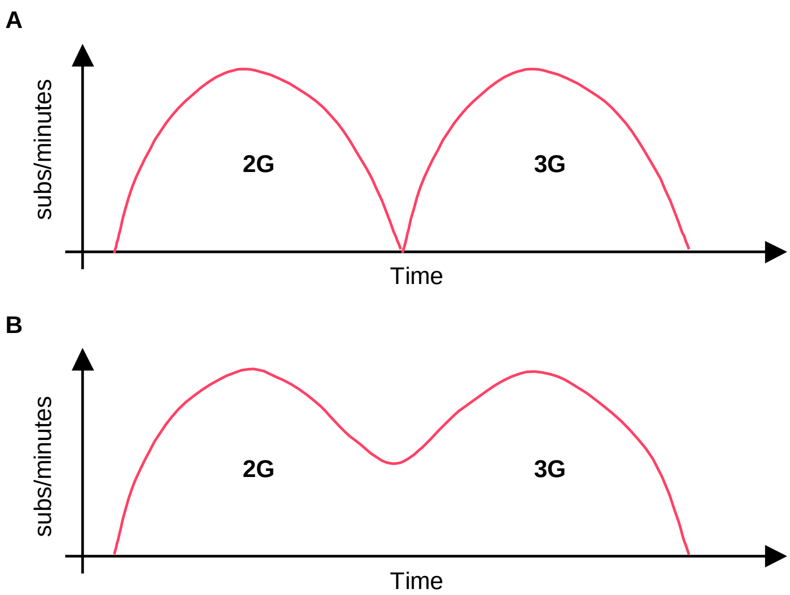

Exhibit 4:

2G and 3G recovery profiles [Source: Industry party]

The party also suggests that it is inconsistent with the real world to have an operator that receives a 2G licence in 2004 which is valid until 2019 (a period of 15 years). Instead, the party suggests that OPTA should model an operator that receives a GSM licence in 1999 then commences migration to 3G in 2009. Finally, it suggests that if OPTA wishes to apply a 2004 start date, then migration to 3G should commence five years after 2009 (i.e. in 2014).

One IG member submits that simultaneous operation of a 2G and 3G network results in extra costs. It also submits that the modelled hypothetical new entrant will not be subject to the 3G costs facing actual market parties. One industry party believes that OPTA has neglected decommissioning costs that should be added to the cost calculation – it estimates these at [confidential].

One party suggests (through the PwC report annexed to its response to OPTA's public consultation) that the costs of the 3G licence are incurred to obtain/retain a position in the 2G market, and therefore part of the 3G licence costs should be allocated to 2G, including mobile termination.

In its response to OPTA's public consultation, one IG member makes the assertion that, as a result of OPTA's specified approach, it cannot recover any costs of 3G licence fees or network roll out until 1 July 2008, and as a result it is highly likely that mobile termination tariffs will rise at that point.

Another industry party notes that, as a 1998 entrant, it is migrating traffic to 3G earlier in its lifetime than the PGSM entrants. It further notes that the modelled migration profile bears little relationship to reality, and suggests that the small rate of migration in the early years will leave a largely under-utilised network. The industry party also suggests that the rate of migration should be based upon data provided by the mobile operators (in which it also refers to various forecasts made by itself and other industry analysts).

One industry party (through the PwC report annexed to its response to OPTA's public consultation) notes that 3G licence obligations require operators to roll out a 3G network to 60% of the population by 2007, and therefore that migration to 3G should commence in 2007. Consequently, PwC recognises that 2G entry in 2004 followed by 3G migration from 2007 would reflect a rather strange situation to model.

Finally, one IG member submits that the costs of operating an "empty" 3G network in the early years should also be included.

8.2 Analysys's response

The principle of modelling a stand-alone operator is maintained. Reasons for the exclusion of 3G are discussed further in OPTA's market analysis decision; however, OPTA's decision in this area is consistent with its overall approach to regulation of the mobile termination market:

- The proposed cost base and regulation is technology-neutral.
- Sufficient uncertainty exists today over the eventual demand, costs and network structure of 3G networks that basing impending mobile termination regulation on 3G-only is likely to be subject to greater uncertainty than the calculation of 2G costs using current 2G equipment.
- The proposed approach ensures that regulation does not extract the benefits of migrating to 3G from the operators (they are able to retain these benefits internally for **at least** the duration of the price control) – this includes all benefits which could be derived from 3G usage: higher spectral efficiency, lower long-run costs, greater economies of scope between voice and data services, and greater network traffic volumes.

- In the UK, Ofcom has not taken a position on the inclusion of costs associated with the migration of traffic from 2G to 3G as part of the mobile termination rate. Ofcom has recognised that there are valid arguments for the exclusion of these costs from mobile termination, as well as for their inclusion, and has accordingly maintained the current termination rates until April 2007 at which time it intends to address this issue as part of a separate consultation.[13]

At the time of the purchase of a 3G licence, the operator concerned would have valued that spectrum on the basis of the expected 3G revenues and the costs associated with the risk of not being able to renew the 2G licence at the end of its life. If the risk of not being able to renew the 2G licence was negligible, then the decision to purchase the 3G licence would be an entirely commercial decision and it would not be appropriate to recover these costs through the 2G termination rate. If the risk of not being able to renew the 2G licence were substantial, this would require the operator to recover its 2G costs within its 2G licence period. Both of these scenarios were considered as part of the investigation into the costs of the modelled operator.

In the model, any cost associated with the 2G network that is also used for 3G is effectively shared between 2G and 3G by assuming perpetual service volumes for that asset. These costs include significant network economies of scope: site acquisition, transmission and business overheads. In the event that operating a combined 2G and 3G network results in higher costs than a separate operation, it would be economically efficient to structurally separate 2G and 3G networks into separate and more efficient (i.e. lower cost) businesses. The fact that 3G licences were purchased by existing players highlights the expected economies of scope, and therefore we believe modelling dedicated GSM costs on a migrating traffic profile and shared costs in perpetuity closely matches the expectations of actual operators.

The approach of the model does not assume that the hypothetical new entrant will not be subject to 3G costs – rather it assumes that these costs are incurred and recovered from 3G services only, including from mobile termination to a 3G subscriber (where, as defined by OPTA, the regulated mobile termination rate applied is based upon the older generation of technology – 2G – **and** which includes the costs of migration off that generation). In

13 Wholesale mobile voice call termination markets – a proposal to modify the charge control conditions, Section 4.27 www.ofcom.org.uk/consult/condocs/wholesale/wholesale.pdf.

addition, the approach taken by the model does not require that 3G cost recovery is delayed until 1 July 2008. Instead, the Dutch mobile operators are free to recover any of their 3G costs at any point in time, including during the price control duration, simply by migrating subscribers and traffic to 3G and charging retail users accordingly. In choosing their migration to 3G, mobile operators can be certain that they will be able to retain the same price for regulated mobile termination to their 3G customers – meaning that their strategic approach to migration can rely on one certain (regulated) component, even if other components of the 3G network are uncertain (such as usage of new data services).

We make the following observations about traffic migration:

Sharing of many network costs is independent of migration

A large number of costly network assets will be utilised identically by traffic that is migrated to the 3G network. These include: site rental and acquisition costs, site ancillary services, backhaul transmission, switching sites, backbone transmission, network indirect costs such as equipment maintenance teams, and **all** network and business overheads. Therefore, assuming a similar volume of traffic is carried on 3G in the future (as on 2G today) would result in identical unit costs independent of the rate of migration. If it were assumed that 3G would actually carry higher traffic volumes than 2G (which is certainly expected by Analysys to be the case in the long-run) then the unit cost of traffic due to shared costs would in fact be lower than that modelled by a 2G-only situation.

It is highly unlikely that overall service volumes will be insufficient to reduce the cost of 3G below that of 2G

One mobile party has argued that uncertainty over 3G volumes means that, if insufficient 3G volumes arise, 3G costs will be higher than 2G. While this relationship between cost and volume undoubtedly exists, it is obvious that a large and proven volume of mobile voice traffic can be (practically) relied upon by mobile operators. It is therefore the data services aspects of 3G which are, we agree, uncertain. However, if consumer demand for 3G data services evaporates, mobile operators are unlikely to resign themselves to an under-utilised 3G network: voice services will be offered in order to maximise the utilisation of the 3G network. Even only offering voice services, a 3G network will have a lower unit cost of traffic due to the significantly higher capacity of a 3G network (e.g. 60 voice channels per 3G sector,[14] compared to 30 TCH[15] per 2G sector).

In its submission, an operator suggests it is acceptable to model forward-looking costs using a projection of volume in a predictable 2G environment. We contend that this is indeed the approach proposed: Firstly, our projection of service volumes is predictable:

- levels of voice usage is based on evolution of the current, proven, 2G voice market (i.e. not revolution to 3G-anticipated levels)
- levels of non-voice usage are based on evolution of the current SMS and GPRS markets (i.e. not revolution to some data-centric 3G world).

Secondly, the capacity and costs of 2G networks are predictable going forwards: capacity of network elements is likely to remain static, equipment prices are known, and expected to decline further as GSM continues to mature.

By modelling 2G only, operators retain the benefits of migration

For the period that OPTA regulates mobile termination on the basis of a 2G-only cost, operators will retain any benefits they accrue from migrating voice traffic to the planned lower long-run cost 3G network. In migrating to 3G, operators will take into account all the costs associated with carrying traffic on 3G rather than 2G, including the licence fee and any additional network costs.

In developing the model, Analysys has explored with OPTA a number of options for migration between technologies, in particular concerning the validity and effects of finite technology lifetimes and the necessity of migration. OPTA is aware that its regulatory measures influence the technology generation, investment and efficiency choices of the mobile operators.

14 Assuming 2x5MHz carriers per sector.

15 Assuming four TRXs per sector.

Therefore OPTA has chosen to apply a costing scenario that recognises the fact that operators must face future technology generations and the inevitable migration off a fully functional network towards the end of a technology cycle. OPTA accepts that this migration is not cost-less from a network perspective, even when conducted efficiently, and also recognises that migration cannot be carried out with the seemingly perfect foresight of a predictive cost model. OPTA therefore accepts a number of the parties' submissions and accommodates the corresponding higher service costs in the output of the cost model:

- The costs of equipment **dedicated** to 2G, **including** GSM licence fees, are recovered from traffic carried over the lifetime of the licence,[16] GSM-specific costs are **not** recovered from subsequent licence generations.

- Traffic carried over the lifetime of the GSM licence is migrated off the GSM-specific network during the last **five** years of the 15-year technology lifetime.

- For the latter stages of the duration of the GSM licence, OPTA has adopted the position that all dedicated 2G network assets, including those deployed for capacity, remain in place in the network until the date the network is closed down (i.e. at the end of the 15-year period). This allowance is made in order that complete ongoing asset replacements and operating expenditures fully accommodate for any additional decommissioning costs – which are therefore not modelled[17] – and also the degree of uncertainty operators face in decommissioning a network following a less-than-predictable migration rate. In 2018, the modelled operator expends around EUR35 million replacing dedicated GSM assets that have reached the end of their estimated economic lifetime. In reality, these replacement expenditures would not be incurred when the GSM network only has one more year before shut-down. Instead, the operator would operate assets for one more year, or remove those reaching the end of their life without replacement, on the basis that an estimated 58% of 2G traffic had already left the network. The model also ignores any resale value of the GSM equipment removed from the network, or the fact that dual-technology equipment (3G switches supporting GSM traffic) is available today. We believe the modelled EUR35 million investment in 2018 is equivalent compensation for the amount of decommissioning costs that one party estimates at [confidential].

16 The lifetime of the licence is equal to 15 years. No licence extensions are assumed.

17 Since decommissioning costs cannot be larger than the complete operation, maintenance **and replacement** of all assets in the entire network until the end of the 15-year period.

- The costs of equipment which are shared between 2G and 3G (and future mobile cellular technologies) are recovered from traffic occurring in perpetuity (including all necessary replacements of these assets).

Further details are presented in Annex A to this document.

In responding to industry parties' comments on this migration-based approach, following IG-III, we make the following points.

The industry party's view, as captured by Exhibit 4A is an incorrect interpretation of the cost recovery approach adopted by the model. The modelled cost recovery profile is correctly shown schematically in Exhibit 5.

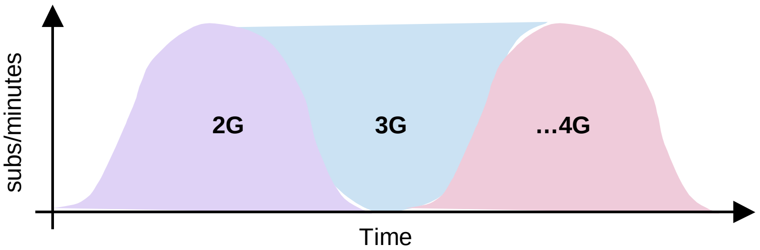

Exhibit 5:

Schematic of cost recovery

[Source: Analysys]

The industry party also suggests that modelling a 2004 date of entry is inconsistent with reality and reflects operation of GSM beyond the date actual operators will utilise GSM. As the purpose of the model is to calculate the costs of a hypothetical new entrant, the threat of entry of this hypothetical player is not linked to actual historical dates of entry, but present as a continual disciplining force in the (hypothetically competitive and contestable) market for mobile termination. The application of economic depreciation ensures that the cost recovery profile of this operator follows the underlying costs of production, therefore the exact date of entry is not relevant, since there exists one economic cost path for any vintage of hypothetical new entrant (that is subject to the criteria of achieving the stated coverage roll out and volume growth). As the cost calculation proposed by OPTA is based on a 2G network cost up to 2019 **and** includes the costs of migration off such a network, the calculated cost represents the ceiling to efficient traffic costs in the future. It is highly unlikely that GSM will still represent the *lowest long-run cost per unit of output* mobile network technology by 2019. By this date, actual mobile operators will be utilising vastly more modern, and we believe significantly more cost efficient technologies for producing a minute of voice traffic. Finally, the industry party suggests that OPTA should consider a 2014 migration date if it applies a 2004 start date. Examination of the migration profile applied in the model reveals exactly this migration date.

The fact that one mobile operator is choosing to migrate its traffic to 3G earlier in its lifecycle is a commercial decision. The operator is not required to migrate traffic at any date – in particular mobile terminated traffic – and it is therefore choosing to adopt a migration profile which meets its strategic aims for the Dutch mobile market. In doing so, the mobile operator will carry more traffic on its 3G network than is assumed in the cost model – this will result in a lower unit cost of traffic on the future technology which will at least counterbalance any higher costs of migrating more rapidly off its GSM network.

The rate of migration off 2G is naturally a forecast assumption, and is subject to uncertainty. Other industry analysts have made projections for 3G-handset usage or subscriptions, which does not identically relate to 2G traffic migrated to 3G.[18] We note that operators have not submitted their own detailed network/traffic data as part of their responses to OPTA's public consultation, in order to enable us to refine our assumed 3G-migration profile.

We note that the hypothetical new entrant's network achieves 72.1% population (43.8%) area coverage in its fourth year of licensing (second year of service). The level of 3G coverage required by the operators' 3G licence commitments is therefore less than that included in the modelled 2G network.

The model includes a steady acquisition of market share; therefore, we believe that the model effectively incorporates the costs of operating an empty 2G network in the early years. Due to the *finite and migrating* 15-year 2G technology lifetime modelled, the costs of operating an empty network are actually included twice in every 15-year cycle, for each successive generation of network: once at the beginning and once at the end of the 15-year period.

8.3 Conclusion

A stand-alone 2G network has been modelled, in which the recovery of all costs relating to dedicated 2G equipment (rather than equipment which would identically support 3G infrastructure) has been confined to the first 15-year lifetime. 15 years has been chosen as it matches the licence lifetime of both PGSM and DCS operators. The cost recovery profile

18 For example, because a 3G handset will still receive mobile termination on the 2G network when it is outside of 3G coverage. In the case of in-building coverage (which will be lower for 3G networks in the early years) a significant proportion a Dutch mobile subscribers usage occurs indoors.

that is applied to dedicated 2G equipment also includes migration off the 2G network, but retains all dedicated assets in the network for the full 15 years. Thus, the calculated cost of termination includes the higher costs of having to migrate all traffic from one technology to the next every 15 years, and accommodates the uncertainty in achievable migration rate.

9 Spectrum situation

Description of the issue

It is evident from the actual mobile operators that their respective positions with regard to spectrum differ significantly. Where such differences are outside of the control of the mobile operators, and where they give rise to material differences in unit costs, it would be appropriate to consider setting differential termination rates. OPTA has therefore indicated that further investigation of the materiality of this factor is important. There are three key dimensions to an operator's spectrum situation:

- **amount** of spectrum (which affects the trade-off between sites deployed and radio re-engineering costs in areas of dense traffic)
- access to **900MHz** spectrum (which allows lower-cost rural coverage from launch)
- **fees** paid for spectrum, and timing of the payment (which affects the present value of spectrum fees, which must be recovered from network traffic services).

Costing implications

It is not possible to assess the extent of spectrum-related differences prior to model development; however, we would expect the **amount** of spectrum to be an issue of less significance in the BULRIC model: since the modelled operator is a hypothetical new entrant that acquires an equal share of the market, an equal share of the amount of spectrum available appears to be an appropriate option.

In order to allow a reliable investigation of spectrum parameters, the model must be designed in such a way as to be capable of exploring the associated cost implications. This will require targeted questions for mobile operators, and a reasonable amount of available modelling effort.

Recommended approach

The spectrum situation is a key factor affecting each mobile operator. Therefore, careful investigation of the implications of the spectrum situation is foreseen.

Recommendation 9: The cost implications of an operator's spectrum allocation will be investigated in order to assess the materiality of potential differential service costs.

9.1 Summary of feedback from IG

Members of the IG raise a wide range of issues related to spectrum. In some areas, mobile operators submit diametrically opposing views.

In their responses to OPTA's public consultation, industry parties reiterate their views as stated in the earlier IG conceptual consultation stages.

Broadly, they can be grouped as follows:

Allowable reasons for differential prices

Two IG members disagree with the proposed investigations on spectrum differences, saying that cost differences on this basis have no place in a forward-looking BULRIC model. They go further and state that, under economic principles, only one price is relevant for a competitive market, because any differences in the quality of frequencies would be perfectly balanced by the (modern equivalent) amount paid for spectrum. This view is supported by the PwC report, which is annexed to one party's submission to OPTA's public consultation. The PwC report also submits that OPTA's divergence from a purely forward-looking hypothetical basis should not be limited to frequency bands (suggesting that the amount of frequencies, for example, should also be considered).

Other IG parties agree with the proposed investigations and submit that they represent valid reasons for differential prices – in their submissions to OPTA's public consultation, these parties suggest that the proposed differential in costs is understated and should be larger. Another party suggests that proposed groupings should be based upon different criteria: that all operators have access to 1800MHz spectrum, and all but one operator has 900MHz spectrum (PGSM or EGSM). It also mentions court decisions in 2001 and 2002, which "ruled that 1800 operators no longer had a valid argument to question a 'level playing field' in the Dutch market". Two parties suggest, in their responses to OPTA's public consultation, that the average spectrum allocation (of the four actual operators) should have been adopted.

One party suggests that all Dutch operators will have access to 900MHz spectrum in the near future, referring specifically to T-Mobile's attempts to acquire such spectrum from an existing market party.

Linkage to market share and date of entry

Two members submit that early access to spectrum for KPN and Vodafone, as determined by the Ministry's issuance of licences, has provided them with first-mover advantages – therefore, availability of market entry influences market share and should be included. One member submits that this first-mover advantage extends to radio site acquisition (at lower cost, in better locations and with fewer planning constraints).

The views above are repeated in the parties' responses to OPTA's public consultation.

Networks based on DCS 1800MHz coverage are disadvantaged / advantaged

One IG member submits that use of 1800MHz spectrum demands around twice as many sites to provide the same level of coverage (wide area and in-building quality). A second IG member makes the same point, and quantifies the differential as 1.5–2 times as many sites. In its response to OPTA's public consultation, one party suggests that OPTA has ignored independent international publications, which it submits to support the need for twice as many coverage sites for 900MHz compared to 1800MHz. One party submits, in its response to OPTA's public consultation, that the model also under-estimates the number of sites required for a 25% operator with 900MHz spectrum – it suggests that Vodafone (with an approximately 25% market share) must have at least 3966 sites.

However, another industry party cites that today's difference in actual site numbers of GSM compared to DCS-only operators is so small that it does not justify a difference in the cost model. It suggests that the model overstates the sites required by a DCS operator to achieve similar coverage – suggesting that the current number of approximately 3300 sites is now sufficient. The party questions whether DCS operators will actually deploy up to the modelled 4089 base stations (which it states is *significantly* higher than actual site numbers for DCS operators). A further industry party suggests that lower cost micro site solutions should be deployed by a DCS 1800MHz operator seeking to provide equivalent in-building coverage.

In conjunction with this view, one of the IG members contends that EGSM 900MHz spectrum was not suitable for deployment in the early years due to lack of dual-band handsets and limited vendor support for EGSM equipment. We note that the other EGSM operator is, today, using the EGSM spectrum to improve its coverage, and another industry party has quantified the benefit of exchanging a small amount of DCS spectrum for EGSM spectrum as a [confidential] increase in coverage quality. Another IG member suggests that OPTA has ignored EGSM spectrum, and instead OPTA should have considered that Orange has access to EGSM, and T-Mobile will obtain 900MHz spectrum.

One IG member suggests that later entrants to the market would have had lower equipment expenditures due to declining GSM list prices, and this effect should be included in the model. It also suggests that 1800MHz operators actually have cost advantages in high-traffic areas, though it does not describe this further in a GSM context.[19]

19 Though it does in a 3G context: having more 2G sites means a lower cost 3G overlay.

Amount of spectrum varies between operators

Two IG members indicate that parties do not hold an equal share of market spectrum or PGSM 900MHz spectrum. One member submits that its spectrum allocation is insufficient to service even 20% of the market, let alone the 25% proposed. Another IG member suggests in its response to OPTA's public consultation that differential spectrum amounts should be reflected in calculated costs.

One IG member submits that the allocation of 25% of the spectrum to the modelled hypothetical operator is in excess of the amount of spectrum actually required to support a 25% market demand, and costs should be based upon the efficient level of spectrum required to serve 25% of the market demand. This position is reiterated in its response to OPTA's public consultation.

Price paid for spectrum

One IG member submits that historical spectrum fees are not relevant for the forward-looking costing of a hypothetical new entrant, and instead the MEA price of spectrum should be reflected in the model.

Other industry parties submit that prices paid for spectrum differ greatly and this differential should be reflected in the model (nothing for PGSM compared to hundreds of millions of euros for later entrants).

Also, one IG member submits that the value per MHz of DCS spectrum should be set for **all** operators at the level paid by PGSM operators (which is less than our valuation of DCS operators' payments for DCS spectrum). It describes the higher payment by DCS operators as "an inefficiency".

Forward-looking spectrum issues

One IG member raises the point that more spectrum will become available in 2008: 2.5–2.6GHz spectrum. Another member suggests that 1800MHz licence lifetimes will be four years shorter than earlier entrants, due to the fact that 3G will replace GSM in the future. It also raises the issue that GSM licence reorganisation is planned by the Ministry in 2010 anyway.

Timing of DCS spectrum access and use

Two IG members submit that their DCS spectrum purchased in the 1998 auction was not released until two years later (2000), and the model should reflect this delayed access to spectrum. In its response to OPTA's public consultation, one party qualifies this position further. It states that the position set out in the final model incorrectly reflects the capacity constraints faced by PGSM operators prior to the release of their DCS frequencies, and the model should reflect earlier access to DCS frequencies so it relieves the same constraints as those faced by actual PGSM operators. The same industry party continues to suggest (similarly to its earlier submissions) that the **lifetime** of the PGSM operator's DCS fee should be set in order that full recovery is ensured before 2019.

Another IG member suggests that PGSM operators are inefficiently using their DCS spectrum, as they appear (from the model) to utilise a DCS frequency overlay at a small number of sites. As a result, the model should reflect a more efficient use of spectrum, or a PGSM operator should not be allowed to recover the full historical cost of the DCS fees in mobile termination rates. This view is repeated in the party's response to OPTA's public consultation.

Valuation of DCS per MHz fee paid by DCS operators

Two IG members submit their view that, in deriving a price per MHz for DCS spectrum as paid by DCS operators, two effects are ignored by OPTA. It is submitted that:

- the value ascribed to EGSM is excessive (referring also to the July 1999 paper of Eric van Damme of CentER, Tilburg University)
- the value ascribed to T-Mobile's piecemeal DCS licence is excessive.

These claims are re-iterated in these two parties' responses to OPTA's public consultation. In addition, one party suggests that the value of EGSM is still zero in 2005.

One party suggests that the value of EGSM is lower than we apply in the model, and it suggests that the actual price per MHz of T-Mobile's licence is suppressed because it reflects a need to develop more complex radio-planning solutions to build a network with a piecemeal licence.

Another party suggests that EGSM should be included to ensure the calculated cost levels are efficient. Finally, one party notes that the value of national roaming rights has not been included in the valuation of spectrum fees.

Non-spectrum costs

One mobile party asserts that the model neglects the costs of beauty-contest obligations made by players who were awarded their spectrum. These obligations focus around providing immediate nationwide coverage, using equipment that later became redundant in a higher-quality, higher-traffic mobile network; and in a higher-risk immature mobile market.

9.2 Analysys's response

OPTA stated its intention that the model should enable spectrum effects to be investigated. The following issues have been examined:

- spectrum band/number of sites required for coverage and coverage quality
- amount of spectrum
- amount paid for the spectrum (actual, MEA or some hypothetical amount)
- sufficiency of spectrum for supporting a given level of demand
- MEA price of site acquisition and GSM equipment.

OPTA's final position on these issues is presented below:

Spectrum band/number of sites for coverage

It is evident from the information available to us that 900MHz frequencies are better than 1800MHz for providing both wide-area and in-building coverage. The number of sites modelled for coverage reflects this fact, in conjunction with the position presented in the model that the hypothetical new entrant will roll out to a 99.1% area coverage – the area coverage of the operator in the Netherlands with the highest level of coverage.

EGSM spectrum also provides a coverage benefit in wide-areas and is better at penetrating buildings than 1800MHz signals, although limited 5MHz allocations do not facilitate a significant capacity ability for EGSM sites (therefore reliance in cities is not proposed due to spectrum re-use limitations). EGSM spectrum can therefore satisfy two supplementary aspects of a DCS operators' network: provide wider coverage in rural areas, and provide deeper building penetration with limited capacity in other areas.

The suggestion of one industry party that "today's difference in actual site numbers of GSM compared to DCS-only operators is so small that is does not justify a difference in the cost model" neglects two facts:

- the number of sites required to provide the same level of coverage differs significantly depending on the use of 900MHz or 1800MHz frequencies. This view is also submitted by other industry parties who make their own calculations and/or refer to independent bodies such as ETSI (referring to TR 43.030).
- GSM operators carry more traffic than DCS-only operators today.

We believe that the model accurately specifies the relationship between high-quality in-building coverage, capacity and network frequency.

With regards to the use of lower-cost micro cell deployments for providing in-building coverage, we suggest that micro cell deployments are only possible **after** heavy indoor subscribers (e.g. businesses) have been signed up. In order to attract such businesses a mobile operator must demonstrate sufficient existing coverage in the businesses' locale (as is also suggested by one industry party). This cannot be achieved nationally with micro cell deployments, but only with a high-quality national network – which is one reason for assuming a high-quality macro cell coverage network coupled with an equal share of the market.

Amount of spectrum

In determining the amount of spectrum available to the hypothetical new entrant, we have made one initial distinction: between spectrum used in the market for both coverage and capacity, and spectrum used in the market for coverage only:

- In our view, both PGSM and DCS spectrum is used for coverage and capacity – operators with access to PGSM only use DCS for capacity, DCS-only operators naturally use DCS for both coverage and capacity.

- EGSM spectrum is used for coverage only. Having access to EGSM confers a benefit to that operator in terms of coverage, although this spectrum does not confer significant capacity-carrying capability. EGSM spectrum has an associated value, commensurate with the coverage cost-savings. Therefore, the economic costs of a network with EGSM spectrum (and its associated fee) and the economic costs of a network without EGSM spectrum (and no fee) should be comparable.

The hypothetical new entrant obtains one-quarter of the total spectrum available for capacity – 23.95MHz. The two spectrum options modelled are therefore whether the hypothetical new entrant has some of this capacity provided by PGSM or not:

- **Option 1**: 11.9MHz of PGSM, 12.05 MHz of DCS
- **Option 2**: 23.95MHz of DCS spectrum.

Option 1 applies to Vodafone and KPN Mobile, and Option 2 applies to Orange and T-Mobile.

Under Option 2 (DCS-only), the hypothetical new entrant may also have 5MHz of EGSM spectrum. However, the fee attached to this spectrum is estimated to be broadly equivalent to the cost savings that can be achieved in network terms, and the resulting unit cost of traffic considered is independent of EGSM. Therefore, EGSM spectrum usage and fees are not modelled under the calculation for Option 2. The suggestion of one industry party that we have ignored EGSM spectrum is incorrect: for the reasons stated above, the model excludes EGSM spectrum and a significant associated spectrum fee.

EGSM spectrum and usage is of course not modelled under Option 1 either, since no PGSM operator in the Netherlands has, or would need, access to EGSM frequencies.

Amount paid for the spectrum

With regard to the fees paid for access to spectrum, two options have been discussed: actual price or an MEA price.

OPTA does not consider it appropriate to value spectrum allocations on an MEA basis, since this effectively allows a PGSM operator to charge for PGSM spectrum fees in its mobile termination rate, when those spectrum fees were not incurred in reality. OPTA is of the view that allowing PGSM operators to charge mobile termination inclusive of a material spectrum fee that was not incurred in reality (a ‘virtual’ spectrum fee), will be detrimental to effective competition in the mobile market. As a result, and also because of the fact that consumers will have to fund this ‘virtual’ spectrum fee, consumer welfare will be lower than with OPTA’s proposed approach.

This approach diverges from the MEA principles applied to other network assets because ongoing access to, and payments for, spectrum is restricted by the Ministry (unlike access to the modern equivalent network assets such as base stations or MSCs), and according to the special position of spectrum taken by OPTA in its market analysis decision.

Therefore, OPTA believes that actual spectrum fees should be applied in this instance, as detailed in Exhibit 6 and further in Annex A to this document.

	Option 1: PGSM+DCS	*Option 2: DCS only*
PGSM	Zero cost per MHz	not applicable
DCS	Fee per MHz based on average paid by KPN Mobile and Vodafone	Fee per MHz based on average paid by T-Mobile
EGSM	not applicable	Discounted from DCS fees where present

Exhibit 6: *Spectrum fees [Source: Analysys]*

In this context, it is not considered appropriate by OPTA to diverge from actual spectrum fees to account for other exogenous factors, such as the duration of the licence before the advent of 3G. It is also not considered appropriate by OPTA to assume that T-Mobile has access to 900MHz frequencies, since there is little certainty that this situation is imminent.

The reason that the cost per MHz for DCS spectrum is assessed separately for PGSM compared to DCS operators (which is asserted by one industry party as incorrect) is that value of the spectrum, and therefore the historical price paid, for additional frequencies added to existing PGSM spectrum is likely to be different from the average price for a total DCS spectrum allocation.

As seen in Annex A, we have discounted the extra payments made by Orange and Telfort over and above the amount paid by T-Mobile (per MHz) and ascribed these to the EGSM licence. This allocation effectively includes the value of national roaming rights, which were included in the licence. This is consistent with the cost model, which does not use national roaming to achieve national coverage. We believe the view submitted by an industry party, that the value of EGSM frequencies is zero (or much less than a DCS frequency), to be incorrect. EGSM spectrum confers benefits of wide-area and in-building coverage that are greater than for DCS spectrum, and these benefits were not taken into account in the report of Eric van Damme (p. 14, second paragraph). Furthermore, the same industry party defeats its own argument by the earlier submission of its own radio-planning team. It submits "[operator] radio department has previously undertaken a cost study to assess the impact of swapping 4MHz of DCS spectrum for 2MHz of PGSM and 2MHz of EGSM. The study found that such a swap would improve indoor coverage by [confidential] with the existing sites, enabling more calls or alternatively the same number of calls to be carried with fewer sites." This suggests that EGSM spectrum is in fact more valuable than DCS spectrum per MHz – a fact that is consistent with the model.

The suggestion of one operator that the value of EGSM today is zero is in conflict with its recent decision to deploy such frequencies in its network.

Sufficiency of spectrum for supporting the given level of demand

We have investigated the amount of spectrum required to support 25% of the market demand in the Netherlands. Information from the operators confirms that it is possible to serve 25% of the market demand with less than 25% of the available capacity spectrum (i.e. excluding EGSM frequencies). The 1998 auction created five mobile operators, one of which was subsequently acquired by KPN. As a result, it is necessary to consider whether the model should exclude Telfort's spectrum allocation (and associated fees). OPTA is of the view that Telfort's spectrum should be included in the cost calculation, because if the auction had closed down to four players, Telfort's spectrum would still have been shared between the four operators (i.e. it would not have remained un-auctioned) and it would have been priced at the actual fee per MHz.

MEA price of site acquisition and GSM equipment

The MEA price for site acquisition and GSM equipment reflects data provided by operators. In addition, equipment costs are assumed to be the same for GSM and DCS operators.[20] The mobile operators, on average, estimate a slight negative price trend for site acquisition, while equipment prices are forecast to have a slightly steeper negative decline.

Timing of access to spectrum

We recognise that PGSM operators did not get access to their DCS spectrum until two years after auction, and therefore may have faced capacity constraints earlier. Therefore, the PGSM cost model has been adjusted to reflect the timing of DCS spectrum for PGSM operators to ensure that these capacity constraints are mitigated by the availability of DCS spectrum:

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20 Apart from a minor different in site costs for a PGSM operator with fewer, larger sites.

- release of spectrum in Year 2
- payment for DCS spectrum in Year 0.

The lifetime of this spectrum fee is set at 15 years in the model. This is to ensure that the spectrum is not re-purchased before the end of the 15-year 2G technology cycle. Full recovery of the spectrum fee from dedicated 2G demand is ensured through the depreciation calculations in the model, and not through the assumed lifetime (which only controls when the asset might be repurchased).

With regards to the suggested inefficient use of DCS spectrum by PGSM operators, we note that there is an operational trade-off between:

- using DCS spectrum and the higher costs of deploying additional DCS BTSs and TRXs on an existing site
- the costs of deploying a new site using existing PGSM and higher frequency re-use
- availability of new sites
- the additional coverage which may be provided by an additional PGSM site, compared to no increase in coverage for a DCS overlay.

We believe that the usage of DCS frequencies by PGSM operators in some, but not all, areas reflects this trade-off: site densities in some areas (generally urban) are sufficient to provide good in-building coverage and high-capacity densities, whereas traffic-constrained sites in (generally) suburban areas can be relieved by deploying a nearby PGSM BTS. This also benefits coverage quality in the same locality whereas a DCS overlay may be unable to reach indoors to satisfy any cell overloading. Thus, we reject the contention that PGSM operators should use DCS frequencies throughout the network as being inconsistent with the approach defined by OPTA to model the costs of an efficient high-quality network, and inconsistent with the scorched-node calibration.

T-Mobile piecemeal licence

It is possible that the piecemeal licence acquired by T-Mobile necessitates a more costly radio solution. For example, more of T-Mobile's frequencies have no priority over Belgian and German frequencies in border regions compared to Orange's priorities. However, we believe this difference is likely to be marginal:

- 35% of Orange frequencies are unprioritised
- 45% of T-Mobile frequencies are unprioritised.

Therefore, 55% of T-Mobile's frequencies are prioritised with respect to at least one Dutch neighbour, and with a DCS network we believe that dual priority is only required in a minority of locations (e.g. Maastricht region).

Furthermore, the DCS coverage model has been calibrated against the level of coverage of Orange and T-Mobile – which therefore means that any higher site density (lower site utilisation) as a result of piecemeal frequencies is accommodated in the model.

Beauty contest or Auction?

The cost model is set up in an auction-based approach. This means that the licence is purchased (at the zero or non-zero modelled fee), quality coverage roll out commences and two years later service is launched. This auction-based approach is consistent with that undertaken by later DCS entrants. A further reason why DCS entrants were not able to launch nationwide service immediately is because the poorer propagation characteristics of DCS spectrum make it unsuitable to a nationwide thin umbrella of wide-area coverage. PGSM 900MHz frequencies are suitable for an umbrella of nationwide, wide-area coverage, and it was by this method we believe Vodafone and KPN provided their immediate nationwide coverage obligations from launch.

We recognise that the model does not capture such an immediate, nationwide umbrella coverage deployment, and therefore neglects any higher costs arising from such a deployment (such as redundant umbrella equipment, temporary sites, etc.). However, the model also does not capture any benefits of offering immediate nationwide coverage – in particular, the ability to serve demand by the end of Year 0. We believe that the benefits of serving demand from Year 0 onwards, rather than from Year 2 in the modelled auction-based approach, outweigh the costs of ending up with redundant umbrella coverage equipment. We also believe that the higher risk of the more immature mobile market in 1994 was balanced by the lower investment requirements of a low-capacity umbrella coverage network – which eventually became redundant, as discussed above, because the mobile network matured into a high-capacity, deep-indoor, small cell network. These benefits are most readily modelled with an earlier growth in market share compounded with an upfront cost of redundant nationwide coverage. Further details are presented in Annex A.

9.3 Conclusion

The modelled operator is allocated 25% of the total of DCS and PGSM spectrum in the Dutch market (including Telfort's acquired spectrum), in one of two configurations: DCS-only or PGSM+DCS. EGSM spectrum and an associated historical spectrum fee associated with EGSM has been excluded from the model, since the value ascribed to the EGSM spectrum is matched by its commensurate network coverage savings.

The fee per MHz attached to PGSM and DCS frequencies is obtained directly from the historical licence fees paid by the Dutch operators, adjusted for 1998–2004 inflation and discounting an EGSM fee. Historical licence fees have been applied by OPTA because applying a current cost valuation to spectrum within the regulated mobile termination rates is deemed to be detrimental to effective competition in the mobile market.

The model includes the later access to DCS spectrum that was imposed by the Ministry upon the actual PGSM operators, Vodafone and KPN Mobile. The model also reflects the costs that would be incurred in a licensing-based spectrum release and network roll out: this means that the model excludes the costs and revenues of deploying a coverage network in a beauty contest manner.

10 Service set

Description of the issue

The modelling of a hypothetical new entrant using modern 2G technology is intended to reflect the price constraint that would occur in the hypothetical competitive market for voice termination. Whether the modelled hypothetical operator also offers non-voice SMS and GPRS services to its subscribers determines the treatment of economies of scope achieved by the actual voice and data operators. Economies of scope arising from the provision of these services across a shared infrastructure will result in a lower unit cost for voice services. Also, the stand-alone 2G network costs (e.g. hardware and software) incurred by the operators – and therefore to be reflected in the model – implicitly include the support for non-voice services.

Costing implications

Assessing both voice and data services in the model increases the complexity of the calculation and the supporting data required, and will result in a lower unit cost for voice services due to economies of scope. Conversely, however, excluding costs that are relevant to non-voice GSM services (and developing a stand-alone voice cost) is complex. The majority of non-voice services (i.e. SMS) are proven services rather than emerging services that might be undermined by the inclusion in regulated prices for voice or require operators' cross-subsidy by the profits of scope economies. However, in the case of GPRS, traffic volumes may currently be limited. A conservative approach to forecasting GPRS may therefore be appropriate if suggested economies of scope are significant (therefore, strongly reducing the economic cost of voice on the basis of an uncertain and aggressive GPRS traffic forecast).

Recommended approach

Recommendation 10: The modelled operator should provide SMS and GPRS alongside voice services. The associated economies of scope will be shared across all services, although care will be taken where uncertain growth forecasts significantly influence the economic cost of voice.

10.1 Summary of feedback from IG

Two IG members disagree with the recommendation and suggest a voice-only operator should be modelled. Two reasons are given:

- the model will exclude 3G costs and therefore it should also exclude SMS and GPRS
- SMS and GPRS services do not significantly drive network capacity and related costs.

A third IG member suggests that the inclusion of SMS and GPRS represents additional modelling complexity, which is unnecessary in the context of costing voice termination.

Other IG members indicate support for SMS and GPRS service inclusion, noting that economies of scope will result in a lower voice cost. They add, however, that satisfactory costing for SMS will require detailed signalling modelling, and identification of TRX allocations for GPRS.

10.2 Analysys's response

The suggested comparison of 3G with SMS and GPRS services is misleading in the context of the BULRIC model for supporting mobile voice termination regulation. It is misleading for a number of reasons:

- 3G is the next technology for mobile voice termination, as well as other voice and non-voice services, while SMS and GPRS do not support voice termination – they are additional services offered by the same modern GSM equipment
- 3G utilises a different spectrum licence, while SMS and GPRS use the PGSM/DCS spectrum licence and frequency allocations

- SMS and GPRS services are proven services (at least at current volumes of consumption), while levels of demand for 3G services over and above that of existing 2G mobile services is unproven in the long-run – both the extra volumes of voice that might be carried on 3G networks, and the volume and nature of subscribers' non-voice usage.

Therefore, we reject the contention that SMS and GPRS must be excluded because 3G is also not being considered.

The inclusion of SMS and GPRS as part of the service set of the hypothetical operator is in accordance with the reality of a new-entrant GSM operator, who would be very likely to offer these services, and whose equipment would certainly be able to support them. Equipment prices derived from all the actual operators' current price lists or historical expenditures also mean that SMS and GPRS-compliant equipment is being purchased – and it would be inefficient to pay for compliant equipment without benefiting from economies of scope from the voice and data services offered.

With regards to the network impacts and dimensioning for SMS and GPRS volumes, we agree with the suggestion that SMS and GPRS volumes do not significantly drive network costs – full details of our implementation of SMS and GPRS drivers are presented in the model. We believe the separate modelling of signalling channels is overly detailed for the purposes of primarily costing voice traffic, and would place excessive engineering information demands upon the mobile operators to model satisfactorily in the time available. In addition, given the allocation of location update signalling resources to received calls, the effect of a separate signalling channel in the radio layer for SMSs is broadly cancelled out by the higher cost of location updates.

10.3 Conclusion

The modelled operator carries voice, SMS and data traffic. Costs are allocated to these non-voice services according to the dedicated network elements and the proportion of shared network elements utilised. In addition, these services attract an equal-proportionate share of network and non-network common costs such as licence fees and business overheads. Forecast growth for SMS and GPRS traffic is conservative to reduce the risk of under-estimating voice termination costs if actual SMS and GPRS volumes turn out to be smaller than forecasted volumes.

11 Wholesale or retail

Description of the issue

This issue is described by Exhibit 7 below.

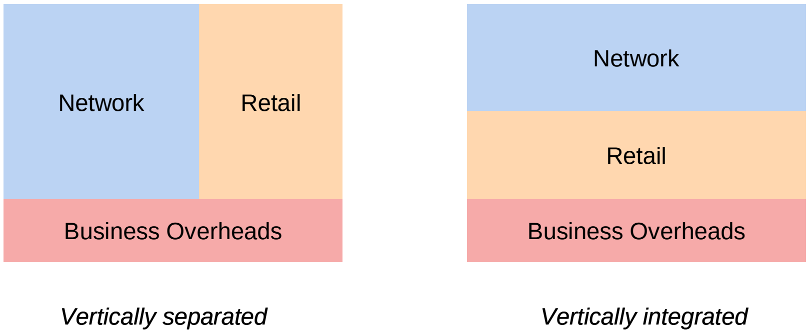

Exhibit 7:
Wholesale or retail
[Source: Analysys]

To date, OPTA has identified in its market analysis that there is no retail market directly corresponding to the wholesale call termination market. As such, OPTA intends to consider only those costs that are relevant to the provision of the network termination service. However, costs that are common to network and retail activities will be recovered from wholesale network services and retail services. This will be treated as a mark-up on the LRIC.

Costing implications

A vertically separated approach results in the exclusion of many non-network costs from the cost of termination. However, it brings with it the need to assess the relative size of the economic costs of retail activities in order to determine the magnitude of the business overheads to be added to the incremental network costs.

Recommended approach

Recommendation 11: Retail costs will be excluded from the calculation of the efficient cost of termination, as this is consistent with OPTA's definition. Business overheads that are common to retail and network operations should be recovered through a mark-up on all services.

11.1 Summary of feedback from IG

Three IG members state their agreement with the approach of considering business overheads as a mark-up within the cost calculation.

One IG member adds further to its submission in this area:

- Retail costs should also be included, through the application of a network externality mark-up since these are costs incurred to acquire subscribers which result in a welfare benefit for all users. A hypothetical new entrant would also be required to incur such costs.

The PwC report annexed to one party's response to OPTA's public consultation also supports this view: "OPTA should estimate the value of mobile externalities and include the result in their calculation of the mobile termination charge".

One member provides an extensive submission on the matter of retail costs. It submits the following comments (which have been paraphrased for brevity):

- subscriber acquisition and retention costs (handsets and retail costs) "are incurred not to gain subscribers, but to drive both outgoing and incoming traffic to these subscribers". Non-active subscribers are of no value so these costs equally relate to outgoing and incoming traffic
- it is necessary to understand the incremental costs of subscribers including retail costs, since operators "subsidise entry … in order to generate conveyance revenues"
- some retail costs are not incremental to subscription but are incurred to support all subscribers' activities (e.g. customer care)

- efficient pricing for all services requires knowledge of retail costs and related service demand characteristics
- the Dutch mobile market is characterised by four competing mobile network providers and multiple retail service providers, therefore the full vertically integrated costs of mobile providers should be recovered with an optimal pricing consideration.

IG members argue that the basic handset functionality of the handset and SIM card is required to support all traffic services, including termination, and should therefore be considered as a network common cost. One IG member goes further, stating that all costs involved in acquiring and retaining clients should be included in the cost calculation; another member states that these costs should be included because the hypothetical new entrant is entering a penetrated market.

One IG member suggests that wholesaling costs (such as the interconnection department) and other costs that only support wholesale network services should be modelled as network costs rather than business overheads.

These views are repeated in the IG members' responses to OPTA's public consultation, and are also stated within the PwC report annexed to one party's submission. The PwC report states that it is an oversight of the model that an estimation of customer acquisition, retention and support costs have not been included, as they are relevant for setting the charges for all services including mobile termination.

11.2 Analysys's response

The choice of wholesale market regulation, and the exclusion of retail costs through a network externality mark-up is the subject of OPTA's market analysis decision. Business overheads are defined as those costs that are common to both network and retail activities – therefore we expect that wholesaling costs (such as an interconnection department) would not be classified as business overheads, since a retail-only provider would not be concerned with network interconnection.

As this is part of OPTA's market analysis decision, we do not discuss the inclusion of retail costs as business overheads, or the addition of a network externality surcharge here, other than to raise the following points:

- We expect that the proportion of customer care and related call centre costs that are related to the receipt of incoming calls is likely to be minimal. The majority of customer care costs are likely to be due to retail servicing issues. We expect the same situation applies to the majority of marketing costs that relate to retail or service-specific products unrelated to calls from other networks. For this reason, OPTA is of the view that no marketing costs should be included in the cost for mobile termination.
- In its market analysis decision, OPTA rejected Ramsey pricing for the cost of termination.

With regard to the inclusion of basic handset costs in network common costs, it remains Analysys's opinion that these costs should be excluded from the wholesale cost of mobile termination for the following reasons:

- Handset costs and SIM card costs are incremental to subscribers, not to traffic services. It would, therefore, be better to recover these costs through a subscriber-based charge, rather than a traffic-based charge. Of course, with regard to its retail services a mobile operator is free to choose whichever tariff structure it deems best suited from a commercial point of view. However, this does not mean that a regulated tariff for call termination should then also 'automatically' be set in such a way that it partly recovers these costs.
- The delivery of incoming calls to subscribers is independent of the retention or churn of a subscriber, unless that subscriber chooses not to re-subscribe to any mobile service. As mobile penetration is saturating in the Netherlands, and the only remaining non-subscribers are likely to be old, young or poor, we believe that **both** the retention and 'acquisition' of mobile subscribers today is primarily focused on subscribers of 'high value' (i.e. contract customers) and little connection subsidy is provided to lower value users (i.e. prepaid customers).

- Acquisition and retention costs bear little relevance to maintaining the ability to deliver incoming calls, and are mainly incurred between mobile subscribers to bid/secure high-value subscribers. Incoming callers to these subscribers do not benefit from the retention subsidies incurred either on retention or on inter-operator churn. Subsidies paid when a handset reaches the end of its useful life[21] would be considered relevant to incoming callers only to the extent that this subsidy generated the network externality – the inclusion of which OPTA has rejected.

- The basic handset functionality need not necessarily be provided by the network operator that is providing the termination. For example, a handset (which is not locked to a particular network) could be acquired and just the SIM purchased from the network, or a handset could be provided by a service provider who receives no termination revenue from its host network. Providing the mobile network operator with a surcharge on top of termination for handset subsidy would, in this situation, lead to an over-recovery of costs for the mobile network operator at the expense of the incoming callers.

- In the analogous market for international roaming, network operators in the Netherlands allow inbound roamers to utilise the network without any requirement to purchase a Dutch handset or even SIM card. In this activity, the network operators are acting as a vertically separate network provider, where the retailing costs of services (e.g. including handset costs) are borne by the retail provider (in this case, an overseas party).

- The modelled operator is not actually going to enter the Dutch market: it is a hypothetical constraint to existing players which assumes that by pricing mobile termination at cost it can steady acquire 25% of the mobile market (conceptually with one hypothetical player replacing each existing player which prices mobile termination above cost). The hypothetical operator incurs acquisition costs but recovers them from services other than mobile termination.

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21 The useful life of a handset to deliver incoming and outgoing calls is significantly longer than the lifetime of handsets seen in the market, which are marketed to customers on the basis of fashion, non-voice features such as colour screens and advanced ring tones prior to the retention or churn event.

Finally, the method adopted by the model is consistent with OPTA’s treatment of subscriber and line-related costs in OPTA’s fixed network wholesale price cap regulation – namely that such costs are excluded from regulated traffic interconnection rates.

11.3 Conclusion

The costs of the modelled operator include only network costs plus business overhead costs. Business overhead costs are marked-up between network and retail services. No retail services are therefore included in the calculated cost of termination.

12 WACC

Description of the issue

The appropriate level of return to be allowed on regulated services is a standard aspect of regulatory cost modelling.

Costing implications

The level of WACC has a direct and material effect on the calculated cost of termination, however, it does not need to be resolved until final costing stages.

Recommended approach

The WACC can be calculated using a variety of methods, the most common being the capital asset pricing model (CAPM) to determine the cost of equity. In particular, the definition of mobile-specific parameters such as gearing and equity beta will need to be undertaken.

Recommendation 12: The WACC calculation does not need to be finalised early in the process. Our recommendation is to apply the capital asset pricing model, focusing on sector-specific parameters such as beta and the optimal gearing ratio.

12.1 Summary of feedback from IG

Members of the IG are in agreement with the use of the CAPM approach to determine the cost of capital. In addition, two parties also raise the point that the CAPM approach does not deal with project-specific risks (separate from 'undiversifiable' risks) and advocates the use of real option theory in this regard.

One member also suggests that the disadvantages of stimulating under-investment are worse than the benefits of stimulating over-investment (suggesting that there are significant knock-on benefits to wide areas of the economy).

Some members of the IG suggest that the parallel application of a Nera-calculated WACC value to KPN for the purposes of controlling prices for fixed network services (captured specifically by a beta for KPN as a whole) means, in our interpretation, one of two options:

- the same WACC value is used for regulating KPN's prices for mobile services (distinct from that applied to mobile-only operators)
- separate fixed and mobile betas should be applied for the separate regulatory streams.

One member of the IG asserts that, if the equity premium used in the model is based on the value asserted in the Nera report for KPN as a whole, then the beta used in the model should also be consistent with the Nera report.

One IG member suggests that in order to enter the mobile market, an operator must exceed its return on capital and that modelling cost recovery to the value of the cost of capital alone will result in an under-recovery of costs.

One IG member submits that the higher risks of a DCS-only operator should be reflected in a higher WACC.

Some IG members suggest that the risk-free rate should be the average value across the regulation period; one specifically suggesting a risk-free rate based on a three-year average of the yield on a government bond issued in the Netherlands with a ten-year maturity. Other IG members note that the rate applied was derived by Nera at a historical low point.

One IG member suggests that the beta used in the calculation should reflect the beta of a mobile operator in the Netherlands and not the beta of the holding companies of those operators.

Finally, one IG member suggests that a fully nominal model should be constructed since this would then be consistent with (more commonly quoted) nominal WACCs, suggesting also that a real-term model plus inflation does not give the same result as a nominal model without inflation.

12.2 Analysys's response

The use of CAPM for determining the cost of capital is consistent with previous regulation applied to fixed networks in the Netherlands, where the issue of real option pricing has been discussed and rejected. Differences between the fixed and mobile markets (greater infrastructure competition, greater future demand uncertainty and less well established technology) could all contribute to a set of alternative input parameters for the CAPM model, and do not invalidate the CAPM approach.

Real option theory is an, as yet, unproven methodology and the arguments presented for its consideration are not sufficiently compelling to justify a move away from the established CAPM approach. It is therefore deemed appropriate to continue the use of CAPM for this study.

OPTA is of the view, as communicated in the discussions on other conceptual issues (namely market share), that constraint of the operators' mobile termination rates should be set by the hypothetical competitive supply of mobile termination with threat of an efficient new **mobile** entrant. Therefore, specific treatment of KPN Mobile as a result of its historical structural relationship is not consistent with OPTA's view.

The hypothetical new mobile entrant would choose to enter the market if it expected the returns to meet its cost on capital. Supernormal profits (i.e. in excess of the return on capital) are not something that should be subsidised by subscribers to other networks in the long term.

The risk-free rate should be based on the risk-free return available to investors at the point at which the investment decision is made, rather than averaged across the period. The decision to purchase a bond with a long maturity (as a proxy for the risk-free asset) is made on the basis of the yield of that bond across its lifetime. See Annex A.12 for details on what risk-free value is used in the model.

The parameters used by Nera in its determination of the WACC for KPN Fixed and Mobile in combination can be selectively used in assessing the WACC of a stand-alone mobile operator in the Netherlands. For example, the equity risk premium is associated with the Dutch equity market as a whole (and consequently applies equally to combined fixed and mobile operators and to stand-alone mobile operators), whereas the beta applies specifically to the specific type of company in question (and therefore there might be a different value for a stand-alone operator as compared to a combined fixed and mobile operator).

The additional cost that is required to be incurred by DCS-only operators to effectively compete with 900MHz operators is dealt with in Section 9. This additional cost is supported by a higher termination rate for DCS-only operators. The cost of capital associated with DCS-only operators in the modelled market for mobile termination will therefore be the same as for PGSM operators.

The beta used in the model is, indeed, reflective of that which is faced by a stand-alone new-entrant mobile operator in the Netherlands.

We have undertaken a test with the model to investigate whether a real-term model plus inflation gives the same result as a nominal-term model without inflation.[22] Results for the unit cost of termination in 2008, expressed in nominal 2008 currency are within 0.5% of each other. This demonstrates that a real-term model, which is inflated at the final stage, produces a tolerable result compared to a fully nominal cashflow model.

22 The models we have compared are: 1. real expenditures, real price trends, real WACC, producing a real result which is then inflated to nominal currency; and 2. nominal expenditures, nominal price trends, nominal WACC, producing a nominal result.

Proposed WACC parameters and the resulting cost of capital are provided in the annex to this document.

12.3 Conclusion

A single WACC value has been defined for the modelled operator, based upon adopting reasonable inputs for the parameters that go into the CAPM and cost of capital weights. Real option theory has not been included.

13 Increments

Description of the issue

Increments in the BULRIC model take the form of a service, or set of services, to which costs are allocated, either directly (for incremental costs) or via a mark-up mechanism (for common costs). Specifically, the model constructed is used to gain an understanding of how costs vary, or are fixed, in response to different services. This enables costs to be identified as either common or incremental. In final costing stages, common costs are marked up onto the relevant increments.

The size and number of increments adopted affects the complexity[23] of results and the magnitude[24] of the marked-up incremental costs. Where increments combine one or more services, rules will need to be specified to allocate the incremental costs to the various component services. These allocation rules could be on the basis of average loading, peak loading or other method. Larger increments, which combine distinguishable services such as voice traffic, SMS traffic and GPRS traffic, will need carefully assessed routeing factors for allocating costs to the services – since in this large increment approach it is through routeing factors, rather than network algorithms, that non-voice service incremental costs are identified.

23 More increments = more calculations required of the model and more common costs to deal with in the mark-up.

24 With the EPMU defined by OPTA, the magnitude of service results are not significantly affected.

By considering coverage deployments in mobile networks, it is evident that a significant amount of traffic-carrying capacity[25] can be associated with the coverage deployment. With increasing traffic levels, upgrades to coverage sites will occur: additional TRXs, additional sectors, and eventually additional sites through cell splitting. Applying smaller increments will capture the effect of these deployment upgrades on the long-run cost at the margin – and importantly, this long-run cost function gradient at the margin will include a proportion of coverage capacity deployed in that network area. This is illustrated in Exhibit 8 below, along with the associated conclusion that, depending on the assumed long-run traffic volume, only long-run fixed coverage costs are considered common while short-run coverage capacity is treated along with other incremental costs.

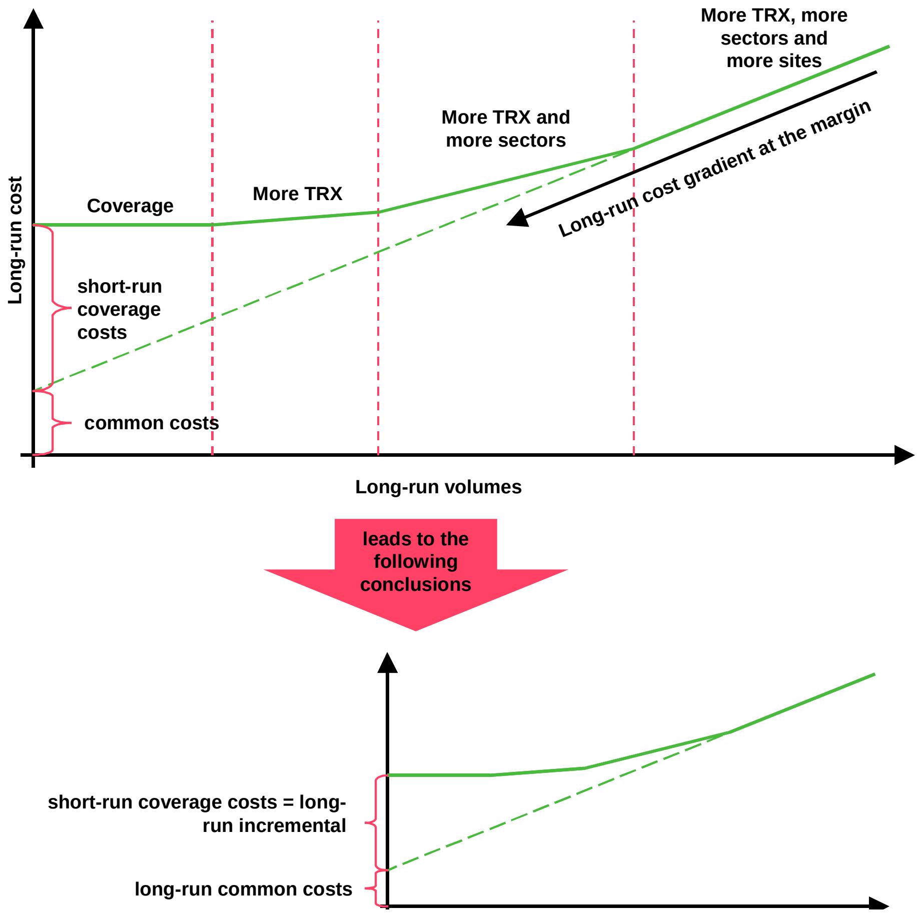

Exhibit 8: *Identification of long-run common costs and short-run coverage costs [Source: Analysys]*

25 For example, deployment of a tri-sectored site with two TRXs per sector (for redundancy) can support 90 traffic channels.

Most of the costs associated with a mobile network are driven by traffic (i.e. it is the marginal increase in traffic that drives the marginal increase in cost). However, this is not the case for a subset of network costs that are driven by the number of subscribers. These costs typically include the visitor location register (VLR) and home location register (HLR), which principally function as databases of subscribers and their locations. They also include the switching costs associated with periodical location updates for all active subscribers.

While the network cost of updating the HLR and reporting the location of handsets is driven by subscriber numbers, there is an emerging precedent in Europe for recovering these costs through received calls (which should therefore include on-net voice and also SMS delivery). This is because location updates and interrogating the VLR/HLR for subscriber location is only required for terminating traffic.

Costing implications

The magnitude of incremental costs, and costs common to increments, depends on the interaction of the number and nature of increments with the cost functions of network elements. More complex increments will require network design algorithms that are cognisant of relevant volume components.

Applying a large traffic increment implies focus on the routeing factors which share out traffic costs – particularly the degree to which SMS and GPRS traffic load the network. Assessing what proportion of the coverage network capacity is part of the long-run cost function indicates the importance of the modelled long-run traffic volumes on the magnitude of common costs.

Recommended approach

Recommendation 13: Only long-run fixed costs (rather than the entirety of the coverage network) are to be identified as common to network services. Therefore, elements of the coverage network which contribute capacity to traffic-driven parts of the network will be considered as part of a large average traffic incremental cost. Large traffic incremental costs should be shared out according to average traffic routeing factors, since this approach ensures that all traffic services pay a fair share of traffic costs – this includes data services which will be assessed on a voice-equivalence basis. Network subscriber incremental costs should be separately identified and recovered through relevant traffic services.

13.1 Summary of feedback from IG

In Exhibit 5 of the paper *Conceptual design issues and recommendations for the development of a mobile BULRIC model in the Netherlands*, we set out diagrammatically the proposed identification of common and incremental costs (the long-run average cost of traffic at the margin). Responses from the IG consider two main issues:

- magnitude of common costs
- identification of specific-service incremental costs (service routeing factors).

Magnitude of common costs

Two IG members have disagreed with this definition, instead suggesting that the entire, or **stand-alone**, cost of the mobile coverage network should be considered common to traffic and subscriber services. One IG member suggests that the incorrect approach currently adopted results in a considerable under-estimation of the costs of mobile termination. One party notes that the proposed incremental cost varies with volume – the gradient of the cost function is lower when examined at lower volumes – and instead the following definitions should be applied:

- Common costs are the costs that are incurred in the provision of two or more increments and are not incremental to any one product or service;

- Incremental costs are the costs caused by the provision of the defined increment of output (e.g. a minute) given that some level of output (i.e. for different increments) is already being produced.

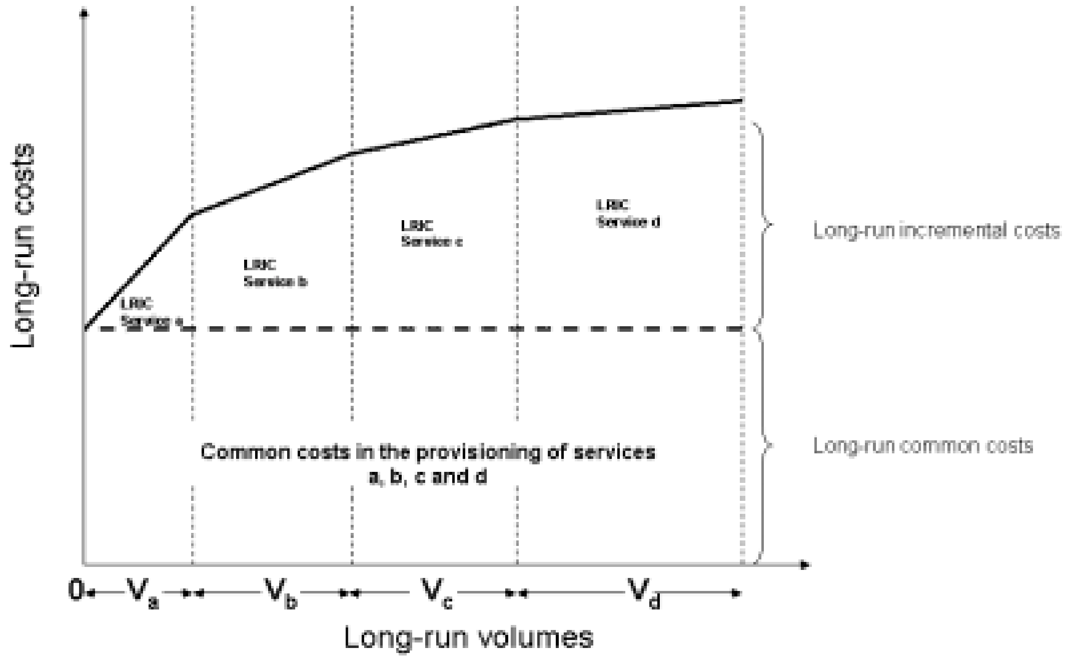

Exhibit 9: *Alternative definition of incremental and common costs [Source: IG member]*

The second party references the report by Europe Economics,[26] which considers coverage increments, and explores the difference between incremental and average incremental costs.

Another IG member appears to support our proposed approach, citing the importance of identifying marginal costs: "it is important that Analysys seeks to model the expansion cost of supplying termination rather than the average cost of supplying all termination traffic so as to approximate the marginal cost of the service".

26 *Cost Structures in Mobile Networks and their Relationship to Prices*, 28 November 2001.

A second IG member also agrees with the proposed approach, though highlights the importance of measuring the gradient of the cost function at current volumes, rather than some hypothetical effectively ‘infinite’ volume.

One IG member suggests that because common costs are large, OPTA should identify an access service to which these costs are allocated.

Identification of service-specific incremental costs (service routeing factors)

Two parties highlight the importance of accurately determining service costs by identifying routeing factors which capture specific network load differences between incoming minutes, outgoing minutes and other services. One of these parties raises the need to disaggregate conveyance and signalling aspects in order to accurately cost voice and non-voice services.

One member also explicitly states agreement with the proposed location update treatment. Another IG member disagrees – submitting that Analysys is responsible for the European precedent of recovering such costs from termination, and that it diverges from incremental costing principles.

Finally, an IG member submits that the allocation of costs to GPRS is excessively simplistic: there should be a reservation of channels for GPRS, and simultaneous channels would be used to convey data.

13.2 Analysys’s response

Magnitude of common costs

We note that the description applied in the Conceptual Design document (large average traffic increment) is better described as the long-run marginal traffic increment – thereby being consistent with our approach to identifying only long-run fixed costs as common.

The stand-alone cost (SAC) of coverage comprises a significant volume of equipment:

- a certain number of base station sites to provide geographic signal (given quality of signal criteria)
- BTS equipment for each sector deployed
- TRX equipment for each sector deployed (depending on design criteria, this could be two TRX per sector to provide redundancy)
- backhaul capacity (likely to be a minimum of 2Mbit/s)
- BSCs sufficient to control the TRX and BTS areas configured in the radio network
- at least two MSCs to provide switching redundancy
- HLR capacity.

However, the stand-alone cost of coverage is a misleading term – because the significant traffic-handling capacity provided is not needed for coverage purposes. Instead, it reflects the modularity of items which can be purchased from vendors and strategic decisions on the coverage quality of network deployed. A network designed to provide coverage in a stand-alone fashion would not incur these significant capacity costs.

The defined stand-alone cost of coverage also brings with it the complication that the definition of coverage (in the view of the mobile operators) is an increasing target: the quality of coverage has increased as the mobile market has developed. The density of the coverage network that is deployed is a function of the expected traffic to be carried (or the overall size of the market), and the quality of coverage today is higher than anticipated or stipulated by licence obligations, and higher than the level needed to satisfy coverage requirements in the past.

In order to provide some clarity, it is beneficial to divide the modelled network components into four classifications:

- costs that are fixed in nature and common to all network services
- costs that are fixed in nature and support network services excluding incoming calls
- costs that are incurred to support traffic levels
- costs that are incurred to provide coverage but also provide support for traffic.

The first classification of costs will evidently be common to all services, and the second classification is relevant only to an individual (non-voice termination) service.

The third and fourth of these classifications will provide the most contentious area of discussion – namely *the definition of coverage vs. traffic capacity*. Firstly, we describe the cost components of the modelled hypothetical network operator, distinguishing between a PGSM- or DCS-only hypothetical network operator; secondly we interpret this definition for the modelled and actual operators.

	PGSM operator	*DCS-only operator*
Fixed common costs	• VMS • NMS • Billing system • Business overheads	• VMS • NMS • Billing system • Business overheads • Licence fee
Fixed costs, non-mobile termination increment specific	• IN (origination only) • SMSC[27] • SGSN and GGSN[28]	• IN (origination only) • SMSC • SGSN and GGSN
Costs incurred to support traffic levels	• Urban 1800MHz overlay BTS • Suburban 900MHz capacity sites • DCS licence fee • TRX in excess of coverage deployment • Transmission links in excess of 1 per BTS • BSC in excess of coverage deployment • MSC in excess of coverage deployment	• TRX in excess of coverage deployment • Transmission links in excess of 1 per BTS • BSC in excess of coverage deployment • MSC in excess of coverage deployment

27 Only two SMSCs are required since they have a 300SMS/second throughput capacity.

28 Only two of each GSNs are required since they have a large capacity and limited GPRS demand is applied to the model.

	• HLR in excess of minimum deployment • TSC • Backbone transmission in excess of coverage deployment	• HLR in excess of minimum deployment • TSC • Backbone transmission in excess of coverage deployment
Costs incurred for coverage which also support traffic	• Coverage sites, sectors and TRX • Basic transmission link per BTS • BSC for coverage network • MSC for coverage network • HLR for coverage network • Backbone transmission for coverage network	• Coverage sites, sectors and TRX • Basic transmission link per BTS • BSC for coverage network • MSC for coverage network • HLR for coverage network • Backbone transmission for coverage network

The definition of coverage applied to the hypothetical network operator is of a high-quality coverage network, necessary to satisfy the current requirements of consumers in the Netherlands. With a DCS-only deployment, this high-quality network deployment provides sufficient macro sites to handle all the expected traffic of an operator with a 25% market share – i.e. no further base stations are required to be deployed in the long-run, although traffic handling capacity by TRX is increased on all sites. With PGSM spectrum, the high-quality coverage network can be achieved with fewer sites, hence some additional deployments in suburban areas are required to support the level of traffic at a 25% market share. This leads to the conclusion that, for a hypothetical new entrant with a high-quality coverage network achieving 25% of the market, the incremental costs of traffic are low (or practically zero in parts of a DCS-only deployment). The same conclusion is not valid for the actual operators though: coverage has been increasing steadily from licence requirements to today's high-quality network, yet few sites can be removed from today's networks without reducing the absolute quality of network coverage. In reality, the network deployment required to achieve licensed coverage is significantly smaller than the hypothetical new entrant's modelled high-quality network, and it is this benchmark of coverage quality below which actual operators would not fall.[29]

In the current hypothetical new-entrant model implementation, only fixed common costs are classed as common and included through an equi-proportional mark-up (39% for a PGSM operator, 52% for a DCS-only network). This is due to the distorting effects on service costing of placing large amounts of the network into a mark-up, leaving disproportional service incremental costs that are not reflective of the overall service structure of the business. This approach does not result in a considerable under-estimation of the costs of mobile termination: all network costs, whether common or incremental, are recovered from all network services; the application of an EPMU ensures that the magnitude of common costs only has a second-order impact on the marked-up cost of termination.

The definition of an access service to which major costs such as network coverage are allocated would mean that mobile termination services would not recover a fair share of network common costs (they instead would recover only a share of traffic incremental costs). The costs of network coverage would then need to be recovered from mobile access and origination services and as a result the benefit that inbound callers gain from being able to reach a mobile phone within coverage would not be reflected in the deployed networks or the regulated price. Operators would then have lower incentives to supply high-quality mobile termination (instead, incoming calls would likely be satisfied with the lowest cost solution – a voicemail server – and delivered later when the network was not congested).

Identification of service-specific incremental costs (routeing factors)

Analysys recognises the importance of accurately capturing differences between incoming, outgoing and on-net voice traffic in the identification of service costs – for example near- versus far-end handover. Routeing table data was requested from the operators to support this part of the model.

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29 Licensed national coverage can be achieved with around 1200 sites for PGSM operator, 1500–2000 for a DCS operator (for example T-Mobile claimed national coverage in April 2000 with around 1500 base stations).

With regard to separate signalling modelling, we believe this is likely to represent a level of detail **beyond** which:

- is necessary for the costing of voice services from a regulatory perspective (we note that OPTA is currently not concerned with the regulation of SMS charges)
- suitable data can be obtained by the mobile operators with manageable effort and within reasonable timescales.

At this stage, however, we can add three further clarifications:

- we have disaggregated certain network elements into subcomponents where possible (e.g. MSC processors vs. ports)
- we have explored with the operators the loading of SMS and GPRS traffic on significant aspects of the network (e.g. radio) in order to better understand the way in which these services load the network
- the application of a traffic increment, rather than service specific increments, means that SMS and GPRS traffic are considered with some form of equivalence even in the event that they may not drive certain network costs – e.g. through the amount of channel capacity utilised by an SMS message or a GPRS Mbyte.

The recovery of location update costs from received mobile voice calls was applied by the UK Competition Commission in 2002 – in its review of UK mobile voice call termination – and not by Analysys. It is Analysys's view that this approach should be extended to include received messages.

Finally, we explored the issue of dedicated GPRS channels with the Dutch mobile operators during model development. At that time, no operator in the Netherlands used dedicated GPRS channels (typically one channel per sector across the whole network) – instead, dynamically allocated channels were available for GPRS. We note that whether GPRS data is carried by one channel for one minute, or two channels for 30 seconds, is irrelevant to the (first order) cost of one Mbyte of GPRS traffic.

13.3 Conclusion

A material proportion of the modelled operators' costs are true fixed common costs – these include PGSM and DCS-only licence fees, business overheads and various centralised network functions such as the NMS.

The modelled operator deploys a high-quality coverage network irrespective of the level of traffic volumes assumed in the model. Consequently, a large proportion of its network cost base also exhibits long-run fixed cost behaviour. In reality, such high-quality network costs are incurred only because of the traffic levels prevailing in the mobile market today, and such costs were not incurred in the past in the absence of traffic.

Given this, the identification of common costs in the model is concentrated on true fixed costs, and an equal-proportionate mark-up applied thereafter. Because of the adoption of an EPMU, the exact magnitude of common costs does not have a major bearing on the level of marked-up unit cost of mobile termination.

Annex A: Model parameters relating to conceptual design

A.1 Market share

No additional quantification required.

A.2 Rate of subscriber acquisition

OPTA has adopted a steady profile for the growth of the hypothetical new entrant's market share which has been matched identically to the historical average performance of operators in the Dutch mobile market. This profile is shown in Exhibit 10, and is based upon the following features:

- licence purchased in 2004
- service launched in 2006
- market share by end 2006 is 2%
- 25% market share is reached after eight full years of operation (ten years after licensing), at the end of 2013.

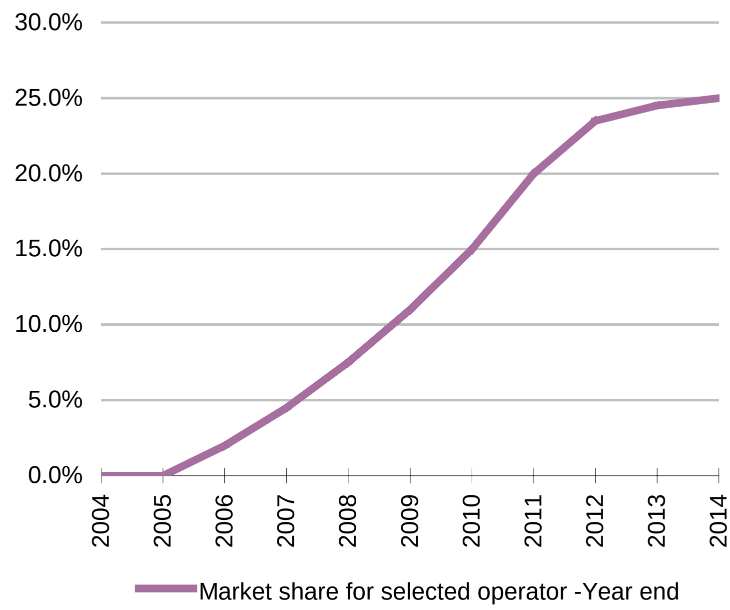

Exhibit 10:
Market share profile [Source: Analysys]

This market share profile enables the hypothetical new entrant to carry exactly the same volumes of traffic as the average that the five historical network operators have carried over their same relative period of operation. This is shown in Exhibit 11.

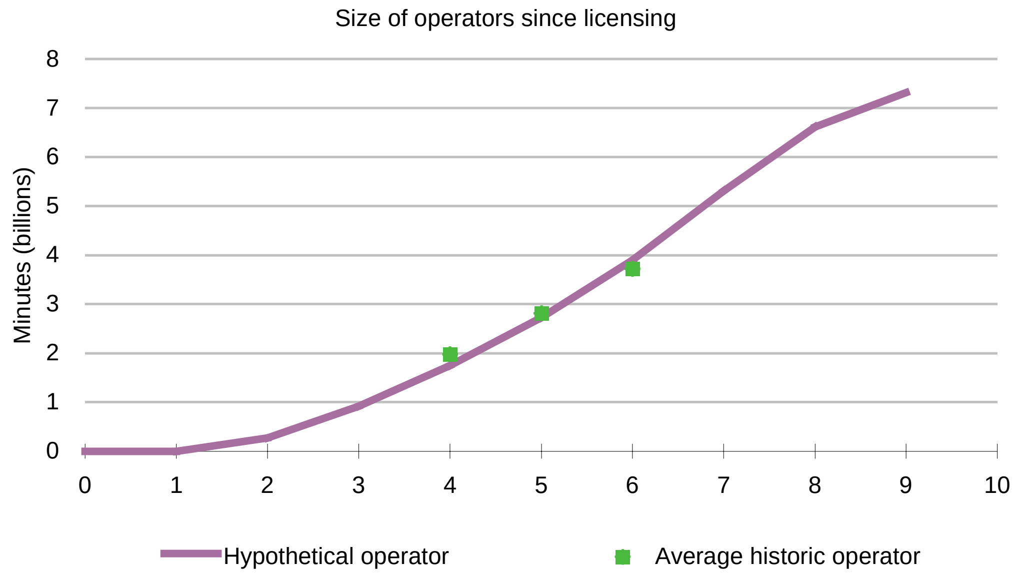

Exhibit 11: *Size of operators over time [Source: Analysys, operator data]*

A.3 Profile of traffic

No additional quantification required.

A.4 Network coverage

Following discussions with operators following IG-III and associated submissions from IG members, Analysys re-examined network coverage issues for OPTA. These issues were discussed in detail with OPTA, in order to prepare OPTA's final viewpoint in its draft national consultation. OPTA's position on network coverage has been parameterised as follows:

- The hypothetical new entrant rolls out its network to match the population coverage of the **best** operator in the market (which is estimated in the model as approximately 99.1% land area coverage of the Netherlands).
- Coverage roll out has been specified on a geotype basis, over time, to reach the maximum area coverage in each geotype.
- The level of in-building coverage applied to the hypothetical new entrant is set according to the level of in-building coverage quality achieved by the average PGSM operator. This level of coverage quality is parameterised in the cell radii applied for each operator type.

The network coverage profile, rising to 99.1% area coverage in each geotype is shown in Exhibit 12.

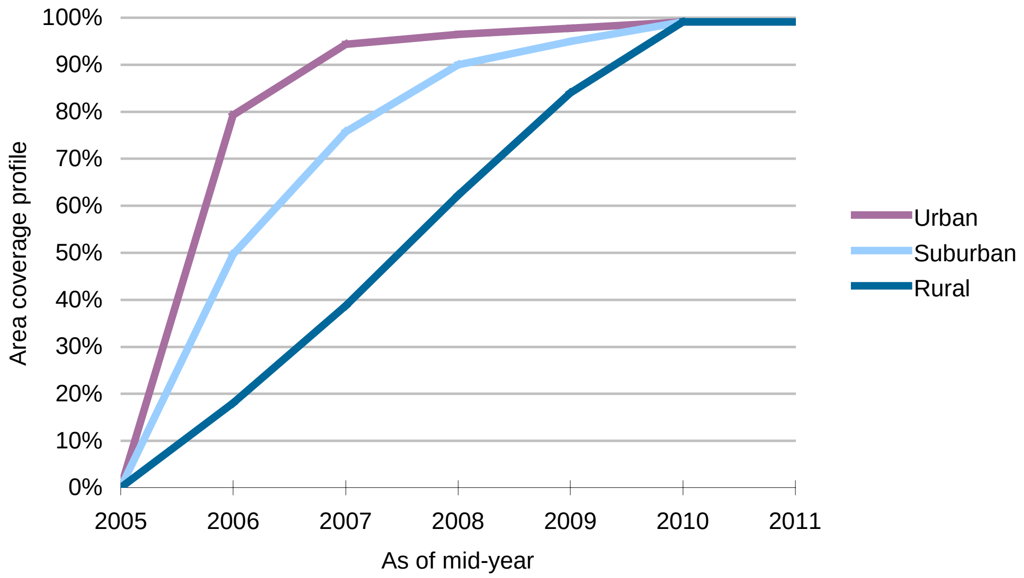

Exhibit 12: *Roll-out profile [Source: Analysys]*

It was discussed at IG-III that in order for a DCS-only operator to *exactly* match the signal strength of a GSM network, it might need approximately 6000 base stations. Two IG members submitted their own estimates of this site count: One IG member suggests around 6000 base stations, another suggests around 4400 DCS base stations to obtain equivalent coverage to 3750 GSM sites, but in its response to OPTA's public consultation this figure is revised to be 6000 DCS sites equivalent to at least 3966 GSM sites.

We believe it would be inefficient to deploy around 6000 base stations for coverage in the Netherlands, since this would represent an excessive and costly deployment to achieve identical signal strength, and the resulting network would become uneconomic due to a 25% increase in unit prices. We estimate that around 4100 base stations for coverage represents the number of base stations required by a DCS-only operator to effectively match the quality of coverage achieved by around 2000 PGSM sites for coverage (the PGSM operator requires an additional 1000 in traffic-driven areas that are already covered as its market share increases to 25%). In our opinion, the ratio of coverage sites of 4100:2000 is fully consistent with the submissions of some industry parties and independent bodies that the number of sites required to achieve similar coverage signal strength is a factor of two different. The additional 1000 traffic-driven sites for PGSM operators are considered to be deployed in areas that are already covered (since if the area was not sufficiently covered with the required level of in-building signals, the operator would not be able to access its 25% share of the market). Therefore the level of coverage necessary to achieve an equal share of the available market is 2000 PGSM sites, not the full complement of 2000 coverage plus 1000 traffic-driven sites.

Regarding our calculation of PGSM sites, according to the data available to us, we have not under-estimated the number of sites required for a 25% operator with 900MHz spectrum.

A.5 Transmission network

No additional quantification required.

A.6 Network nodes

No additional quantification required.

A.7 Input costs

The unit costs and overall cost levels in the model have been validated against submitted top-down data. However, a detailed operator-by-operator reconciliation has not been undertaken, since the model does not aim to reproduce each operator's cost base. Top-down validation has been carried out by examining each operator's expenditures to date (cumulative capex to the end of 2004 and opex in 2004) and, in the case of capital expenditure, applying a current-cost revaluation historical MEA trend. This re-valued cost base (gross replacement cost, or GRC) was then used to estimate the total cost per unit element purchased (i.e. including all indirect and other costs incurred in reality) compared to bottom-up estimates supplied, and as an overall cost check (to ensure the total level of expenditures assumed by the model is comparable with operators' estimated GRC).

Historical price trends used to derive a network GRC are shown in Exhibit 13.

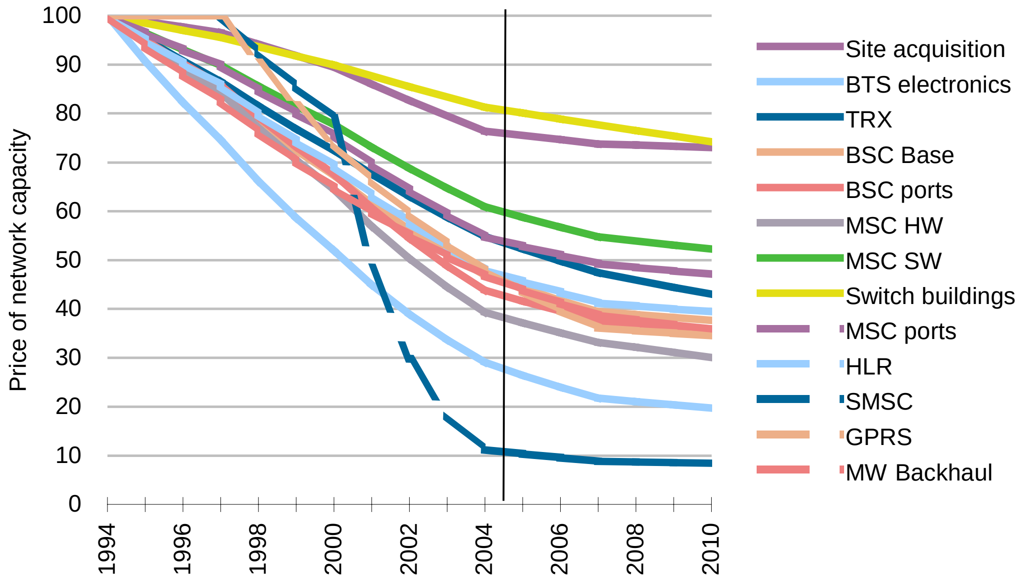

Exhibit 13: *Price trends [Source: Analysys, derived from operator data]*

The impact of these price trends in determining the network GRC cannot be shown on an operator-by-operator basis. However, we estimated the GRC of the operators' networks,[30] expressed as a percentage of cumulative capital expenditure to date, to lie in the range of 67–75%[31] (depending on the age of their network equipment, amount of recent replacement, etc.).

In developing a network GRC for each operator, the following 'outlying' effects were excluded:

- one operator's capex includes a material amount of replacement expenditure
- costs associated with KPN's i-mode services
- KPN's low level of business overheads

30 i.e. excluding licence fees and business overhead capex.

31 i.e. the total modern equivalent replacement cost of the entire 2004 network, in 2004 EUR, is estimated to be 67–75% of the operators' total expenditures including replacement expenditures to the end of 2004.

- one operator's capex data only covered part of its operational period, therefore we were unable to estimate a complete network GRC
- one operator's capex data included a material investment for self-provided national transmission, which is used for services other than domestic mobile origination and termination.

In exploring bottom-up data on unit costs submitted by a number of operators, the following 'outlying' effects were excluded:

- one operator did not submit any bottom-up data and was therefore excluded
- one operator derived various bottom-up unit costs from its own top-down data.

A.8 Stand-alone network

The model classifies assets into GSM-specific assets and technology non-specific mobile network assets.

GSM-specific assets	*Non-specific assets*
Macro cell equipment and TRX	Site acquisition, preparation and lease
Micro cell equipment and TRX	BTS-BSC backhaul transmission
Pico cell equipment and TRX	Remote BSC-MSC backhaul transmission
Repeater site	MSC switch buildings
BSC, BSC ports and remote buildings	Backbone transmission
MSC processor, software and ports	GGSN and SGSN
TSC	Network management systems
HLR	Business overheads
SMSC	
GPRS-PCU	
PGSM and DCS licence fees	
VMS	
IN	
Billing system	

Exhibit 14: *Technology specific assets [Source: Analysys]*

The cost recovery for dedicated GSM assets is carried out according to a migrating demand profile. This profile is shown in Exhibit 15.

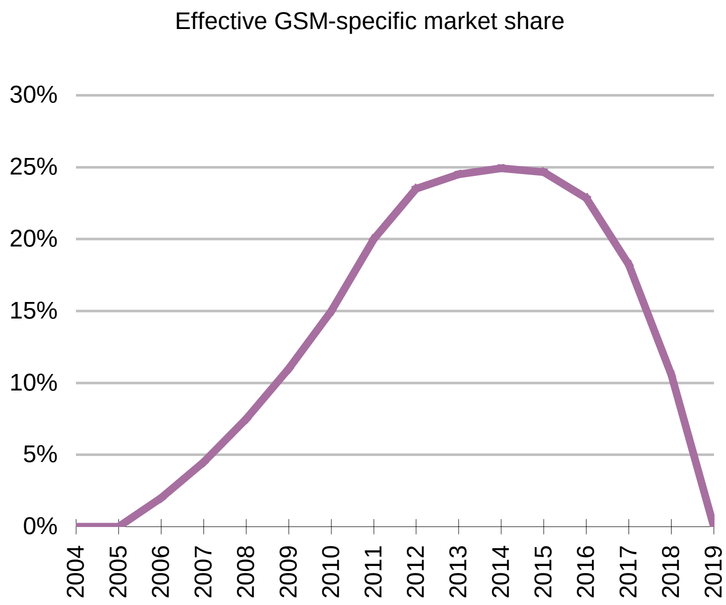

Exhibit 15:

Migration profile

[Source: Analysys]

A.9 Spectrum situation

Amount of spectrum

	KPN	*Vodafone*	*Orange*	*T-Mobile*	*Telfort*
PGSM	12.4	11.4			
EGSM			5		5
DCS	17.6	5.2	15	16.8	17.4

Exhibit 16: *Spectrum amounts (MHz) [Source: Operator data]*

As can be seen in Exhibit 16, the total of spectrum used for capacity (DCS + PGSM) is 95.8MHz, plus 10MHz of EGSM used for coverage.

Price per MHz of spectrum (nominal 1998 EUR)

- Actual PGSM fees were EUR0 per MHz.

- Actual DCS spectrum fees for operators already with PGSM amounted to EUR169 million for 22.8MHz of spectrum = EUR7.4 million per MHz.

- Actual spectrum fees for A & B licence holders include a contribution for EGSM. We have estimated the value of the EGSM by taking the value of DCS spectrum as that of T-Mobile (EUR126 million for 15.8MHz of spectrum = EUR7.5 million per MHz). This values an EGSM allocation at around EUR150 million.

Price per MHz of spectrum (in real 2004 EUR)

The per-MHz spectrum fees calculated above have been multiplied by 116% to reflect cumulative inflation from 1998 to 2004.

Licence auction versus beauty contest

We estimate the additional costs of launching with a beauty contest as potentially up to EUR70 million, based upon:

- deployment of up to 300 radio sites, 300 omni-sectored BTS and 300 TRX, which later become redundant
- cost of redundant equipment at 2004 equipment prices = EUR35 million
- cost of redundant equipment at 1994 equipment prices = EUR68 million (in 2004 real term EUR).

We estimate the benefits of an earlier market launch (bringing the market share profile forward by one year) to be around EUR78 million in 2004 present value terms.

The net present value of an earlier market launch combined with additional costs is positive, and therefore we conclude that the costs of a beauty contest model of deployment are outweighed by the benefits. Note in this comparison that we believe the estimated beauty contest cost to be generous, and the estimated benefit of earlier launch to be cautious.

A.10 Service set

No additional quantification required.

A.11 Wholesale or retail

Business overhead costs consist of (some) capital expenditures and (mainly) operating expenditures. Information submitted by the mobile operators varied according to general classifications, and a number of queries regarding the definition of submitted costs were explored with the mobile operators.

Based on the data we have available, we have estimated:

- business overhead costs to amount to a capital investment of EUR18 million and an annual operating expenditure of EUR110 million
- a 50:50 share of business overheads between network and retail activities.

A.12 WACC

The following values have been used in the parameters of the WACC calculation:

Input parameter	*Value*
Risk-free rate	3.33%
Equity premium over risk-free rate	6.00%
Beta	1.27
Debt-premium over risk-free rate	2.28%
Degree of financial leverage[32]	20.00%
Marginal corporate tax rate	30.20%

Exhibit 17: *WACC input parameters [Source: Analysys]*

Risk-free rate

The risk-free rate is the return on an asset that bears no systematic risk. It is thus a feature of the market rather than any specific industry sector or company. The asset that most closely approximates this criteria is a government bond with a long maturity. The Economist Intelligence Unit records the most recent[33] year's value for a ten-year government bond yield in the Netherlands to be 3.4%.

Nera's study on the cost of capital for KPN[34] concludes that the risk-free rate for the Netherlands is 1.4% in real terms, based on the average yield-to-maturity of Eurozone index-linked government bonds. Adjusted using Nera's value for inflation of 1.9% this gives a nominal return of 3.33% in nominal terms.

Values submitted by IG members vary from 3.24–5.07%, with an average of 4.07%. Nera's study is based on a broad set of cross-checked primary data sources, and has been successfully used for telecoms service price regulation in the Netherlands previously. It is very close to the ten-year government bond yield and falls within the range suggested by IG members. This value of 3.33% is therefore the most appropriate value to use. This value ensures consistency between OPTA's regulation of both fixed and mobile wholesale price caps.

32 Defined as debt as a proportion of total capital value.

33 2005.

34 The Cost of Capital for KPN's wholesale activities, Nera 12 December 2005.

Equity premium over risk-free rate

The equity risk premium over the risk-free rate is the difference between the expected return on a fully diversified portfolio of equity investments and the return on the risk-free asset. As for the risk-free rate, this is a feature of the Dutch market and not of a specific industry sector or company. OPTA has previously used a value of 6% for regulating the price of KPN's fixed services, a value supported by Nera's study in 2005. Estimates of the equity risk-premium vary widely between academic studies, with the 2005 study by London Business School and ABN Amro (based on 103 years worth of data) estimating the arithmetic average equity risk premium for the Eurozone at 5.9% and the Netherlands at 5.8%.

Values submitted by IG members are consistent at 6%, with only one IG member suggesting 7%. With the consistency between the majority of the IG member submissions and the Nera study, and the precedent of successfully applying 6% in regulating the prices of KPN's fixed services, the value of 6% is the most appropriate value to use.

Beta

The beta coefficient measures the risk of the individual company relative to a fully diversified portfolio of equity investments. The value, therefore, is a function of the individual company, hence the appropriate beta for this calculation is that of a mobile operator in the Netherlands. Using empirical evidence (measuring the volatility of particular stocks) to estimate the beta will produce results that vary depending upon the stock chosen, the gearing of the company, the period over which the measurement is taken and the frequency of the measurement.

In the UK, Ofcom and the Competition Commission concluded that, given the wide range of results that it is possible to generate using regression analysis of historical data, the beta for 2G termination provided by a mobile operator lies within the range of 1 to 1.6, with a mid-point of 1.3. At the same time, Ofcom estimated the beta of the UK fixed incumbent operator to be 1.0.

One operator submitted the same range as Ofcom: 1.0 to 1.6, suggesting that the highest value beta is appropriate for its operations. The submissions from the other IG members vary from 1.14 to 1.37, with an average value of 1.27. By comparison, the value determined by Nera for KPN in 2005 for fixed services was 1.0 (based on an unlevered beta value of 0.6), although it is expected that the beta for a mobile operator will be higher than for a fixed incumbent operator, due to the higher risk associated with the returns to a mobile operator due to the competitive environment.

We see no reason to adopt the highest value of the Ofcom range, when the mid-point of the same range was considered by Ofcom to be appropriate, and as the mid-point is also correspondingly relative to the UK fixed operator beta of 1.0. The other IG members' submissions fall within a reasonably tight range (using the highest or lowest value for beta produces a maximum deviation from the average WACC value of 0.9%), is close to the mid-point of the range of mobile betas determined by Ofcom and the Competition Commission in the UK, and is reasonable relative to the beta used for regulating KPN's fixed services. The average of the operators' submissions values, excluding the outlier of 1.6, is used at 1.27.

Debt-premium over risk-free rate

The cost of debt is the interest expenditure made on long-term debt as a proportion of the capital value of the debt. The debt-premium over the risk-free rate is the difference between this interest rate and the risk-free rate. The debt-premium that is appropriate for this calculation is that which a stand-alone mobile-only operator in the Netherlands would face. Since the operators in the Netherlands are all part of larger organisations that operate in other countries and/or in other sectors, direct empirical measurement of this value is unlikely to be entirely representative of the desired value and thus some judgement must be exercised in determining this value.

The submissions from the IG members vary from 0.6–2.3%. It should be noted that the 0.6% figure was based on an assumption of a debt-free operator, which is not in line with the assumption of the degree of financial leverage used in this calculation (as explained below), and as such is not considered appropriate for this calculation.

Nera's 2005 work on the cost of capital for KPN's fixed services determined a debt-premium of 1.87%. Although the default risk of a fixed incumbent is likely to be lower than for a mobile operator, so it would be expected that the value for this calculation would be somewhat higher.

In the UK, Ofcom concluded that a reasonable range for the debt-premium is from 1–1.75%, with the Competition Commission increasing the upper bound to 4% based on UK operator's actual cost of debt, with a mid-point of 2.5%.

Given that the actual operators' submissions are within a 0.25% range, for those operators submissions which included debt as part of their capital base, and that the average value of 2.28% is reasonable in comparison with Nera's determination for KPN Fixed, and is close to the mid-point of the range used for regulating mobile operators in the UK, the most appropriate value is 2.28%.

Degree of financial leverage

The degree of financial leverage is the proportion of the total capital base of the operator (debt and equity) that is debt. As for the debt-premium, the appropriate value for this calculation is the optimal level for a stand-alone mobile-only operator in the Netherlands, which is not represented by the actual operators, and again judgement is required in determining this value.

The operators' submissions range from 0–25%. The 0% debt-funded operator is inconsistent with the relative values of the cost of debt and equity used in this calculation: with the cost of debt being so much lower than the cost of equity, the optimal level of debt (i.e. the level that produces the lowest overall cost of capital) will be in excess of 0%.

In the UK, Ofcom and the Competition Commission determined a range of 10–30% to be the appropriate optimal gearing for mobile operators, eventually settling on a value of 10% for the cost of capital calculation.

The Nera report on KPN's costs of capital for fixed services based its 38% estimate for gearing on KPN's actual gearing.

A degree of financial leverage of 20% is used in this calculation as it sits in the mid-range of the values suggested as reasonable by Ofcom. IG members' submissions also fall within this reasonable range (specifically excluding submissions below 10%, which are inconsistent with the low cost of debt used in the model).

Marginal corporate tax rate

The marginal corporate tax rate is the tax paid on the last Euro of taxable income. The Nera report on the cost of capital of KPN's fixed services uses a weighted average value of expected corporate future tax rates over the regulated period (from 1 January 2006 up to 31 December 2008) which yields a result of 30.2%. For consistency of approach, this value is also used in the calculation.

These parameters lead to the following results:

Calculated result	*Value*
Nominal post-tax cost of equity	10.95%
Nominal cost of debt	5.60%
Nominal pre-tax WACC	13.7%
Real pre-tax WACC	11.55%

Exhibit 18: *WACC Cost of capital results [Source: Analysys]*

A.13 Increments

Voice network costs (excluding licence fees, business overheads and non-mobile termination costs such as SMSC) can be observed in the model as a function of demand. These cost functions are shown in Exhibit 19.

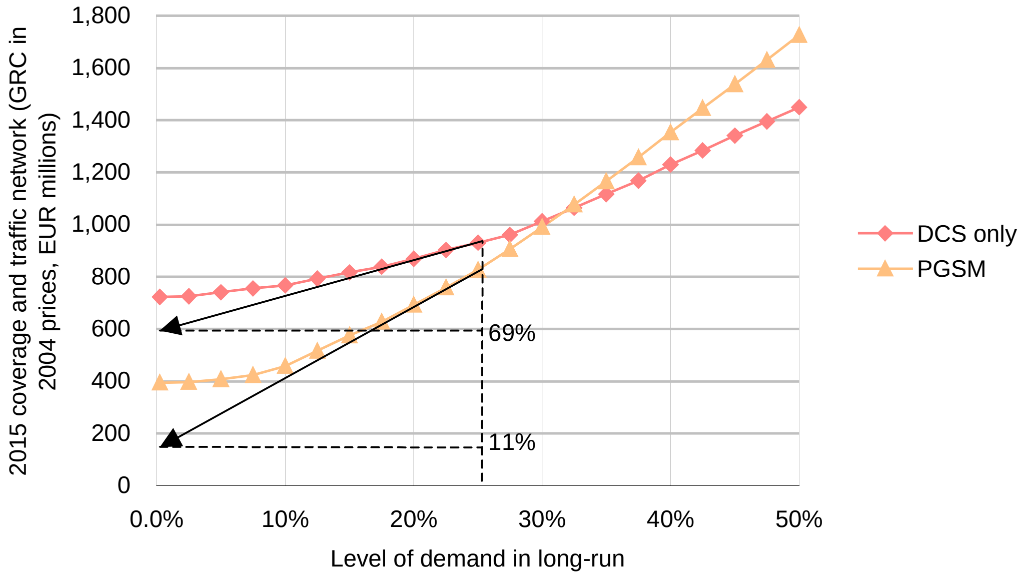

Exhibit 19: *Size of voice network as a function of demand [Source: Analysys]*

These cost functions illustrate the greater coverage network for DCS-only networks, and at high volumes, the higher BTS costs of having dual spectrum. The percentages indicated on the chart above illustrate the proportion of voice traffic and coverage costs that do not vary with volume at 25% of the market traffic (i.e. are described as long-run fixed costs). Comparing these alongside other costs results in the identification shown in Exhibit 20.

	PGSM operator	*DCS-only operator*
Fixed common costs	28%	34%
Fixed costs, non-mobile termination	5%	4%
Long-run coverage	7%	43%
Traffic driven costs	60%	19%

Exhibit 20: *Proportion of costs by common or incremental [Source: Analysys]*

For the hypothetical network operator, this amounts to a significant proportion of costs that could be marked-up (shown diagrammatically in Exhibit 21).

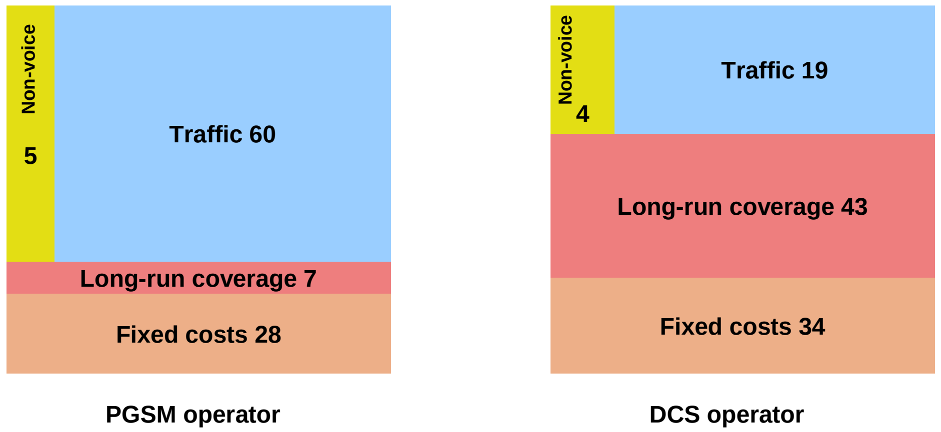

Exhibit 21: *Cost components of high-quality coverage hypothetical new entrant [Source: Analysys]*