2012 update of OPTA's fixed and mobile BULRIC models

Response to the public consultation

27 June 2013 • 37097-262 PUBLIC VERSION

1 Amount of mobile spectrum

1.1 Comments received

Comments regarding the amount of mobile spectrum were included in the submissions received. These comments are paraphrased below:

- Ziggo: Additional 4G spectrum is available – leading to a larger-capacity network, and lower or zero pure LRIC MTR. KPN already has a 4G network.
- UPC: The efficient operator would use 900MHz for voice, and other frequency bands for data.

1.2 Analysys Mason response

As set out in original concept 6 in the 2 July 2012 Conceptual specification for the update of the fixed and mobile BULRIC models ('consultation paper'), the mobile model uses "*both 2G and 3G radio technology in the long term, with GSM deployed in 900MHz and 1800MHz bands, and 3G deployed as a 2100MHz overlay*". Both Ziggo and UPC's comments regarding this concept have already been addressed in Section 3.1.1 of the consultation paper.

With regard to the impact of 4G spectrum and its effect on the MTR, as raised by Ziggo, the consultation paper stated:

"*We observe that five operators acquired 2600MHz frequencies in the auction in 2010 (KPN, T-Mobile, Vodafone, Tele2 and the cable operator Ziggo/UPC). The first coverage obligation deadlines for LTE deployments expired in May 2012 and appear to have been satisfied by all five operators, although coverage and usage appear to be still very low*[1]*. Moreover, given the upcoming auction of lower frequency spectrum, it is unlikely that there is any significant growth in LTE coverage until operators know what spectrum holdings they have following this auction.*

There are economies of scope through deploying an LTE overlay with the 2G/3G networks, due to asset sharing. For example, LTE base stations can be co-located at existing radio network sites

[1] According to Vodafone's website, their LTE coverage is currently limited to the region of Eindhoven. According to T-Mobile's website, their LTE coverage is currently limited to 5 small areas in the Netherlands, including the Hague and Rotterdam. According to KPN's website, their LTE coverage is currently limited to parts of the Hague and Utrecht. This information was correct as of the end of June 2012.

and can also share the use of the core transmission networks. However, based on our experience in other jurisdictions, the inclusion of LTE technologies in a mobile cost model has little impact on the pure LRIC of wholesale mobile termination and only a relatively small downwards impact on the LRAIC of wholesale mobile termination, until such time as a significant proportion of voice termination might be carried as voice-over-LTE."

LTE is excluded in the v5 model, which reflects current 2G/3G spectrum usage and does not include 4G network assets. However, the v5 model does assumes migration to 4G according to a 2017–2019 timescale, and at that point it can be expected that the incremental cost of MT will be different from the current case (Ziggo submits it will be much lower).

UPC's comments on the efficient spectrum bands to use for the provision of different services differ from the approach taken in the v5 model (which used 900MHz and 1800MHz frequencies for the 2G network design, whilst the 3G network design was assumed to use 2100MHz frequencies). In the consultation paper we said:

"*As a result of the auction in late 2012, 2G/3G operators may have access to frequencies in the 800MHz, 900MHz, 1800MHz, 2100MHz and 2600MHz bands. Of these five bands, we do not believe that the 800MHz and 2600MHz frequencies are needed for an efficient use of 2G and 3G technologies (these are mainly intended for LTE). We still consider that the only frequencies relevant to 2G technologies are the 900MHz and 1800MHz frequencies.*

With respect to 3G technologies, the original BULRIC model assumed that the modelled mobile operator achieved 85% 3G population indoor coverage by 2012, and 90% in the long term, using only 2100MHz frequencies. The equipment specific to the 2G and 3G networks was shut down (and all costs recovered) by 2019.

Current levels of actual 3G coverage with 2100MHz frequencies in the Netherlands are high. Therefore, incremental coverage using 900MHz frequencies in the future (if any) would be small. It would also require an assumed reduction in the spectrum assumed for 2G 900MHz use, to allow frequencies to be used for 3G 900MHz. Although it could be the case that 3G 900MHz coverage is deployed in the Netherlands after the 2012 auction, it is an outcome within the control of actual operators and not obligated by any frequency package allocation. Therefore, our starting position will be to retain our existing assumption of using only 2100MHz frequencies for 3G deployments."

Consequently we conclude that all operators are using 900MHz spectrum for voice demand, but supplemented by 1800MHz for additional capacity, as we believe it is more efficient to overlay 900MHz sites with 1800MHz spectrum to provide additional capacity, rather than to rely solely on 900MHz frequencies.

2 Number of fixed operators

2.1 Comments received

Comments regarding the modelled number of operators were included in the submissions received. These comments are paraphrased below:

- Ziggo: N=2 is not consistent with the two cable companies, which are independent and not national operators. Therefore lower economies of scale should be reflected.
- UPC: Same as Ziggo.

2.2 Analysys Mason response

The operators' point regarding the number of operators active in the fixed market has already been addressed in the 20 April 2010 Conceptual approach for the fixed and mobile BULRIC models document ('conceptual approach document'). In Section 3.3 we said:

"*In the fixed telecoms market, there are primarily two competing national providers, KPN and the cable operators Ziggo or UPC".*

This sentence refers to 'access-network' providers, as there are numerous other national service providers relying on wholesale access to KPN's access network – however these wholesale providers do not own or comprise a third competing national fixed access network.

Section 3.3 also explains:

"Both KPN's and the combined cable networks have passed almost all residences, implying that a two-player fixed market is a reasonable proposition […] we consider that there is no evidence that a significant third national fixed network is likely in the short to medium term. Consequently, fixed traffic appearing at the first point of traffic concentration can be considered to be from one of two national access networks.

Therefore, we propose for the purposes of calculating the efficient fixed voice termination cost, that the market for fixed traffic should be shared between two full national infrastructure operators: N=2."

These comments have therefore already been addressed in previous consultation rounds.

3 Consistency with EC Recommendation

3.1 Comments received

Comments regarding the v5 model's consistency with the EC Recommendation were included in the submissions received. These comments are paraphrased below:

- T-Mobile: A new entrant (Tele2) obtained spectrum in the NL market, implying room for a fourth operator, and there are sufficient expectations that this operator will exist for the long term. The EC Recommendation says "minimum efficient scale […] 20%" and T-Mobile submits that it will probably never reach 33% market share.

3.2 Analysys Mason response

The operator's point regarding the consistency of the mobile operator market share with the EC Recommendation[2] has already been addressed in both the 20 April 2010 Discussion of operator responses on draft model document ('model finalisation document'), and the more recent 25 March 2013 Response to operator consultations ('response document'). In Section 2.2 of the model finalisation document we said:

"*The EC recommendation only indicates a* ***minimum*** *market share, and therefore leaves the option open for a higher efficient scale.*
Recent market consolidation in The Netherlands demonstrates that the efficient scale for mobile voice services is higher than 20%. This is also confirmed by the model which shows a significant decreasing cost price up to a market share of at least 33%."

In Section 3.1.2 of the response document we added additional information to this, saying:

"*We believe that a 33% market share (N=3) continues to be reasonable and efficient since there is currently no evidence that a fourth* ***independent 2G or 3G mobile network*** *will establish itself as a long-term operation in the Dutch mobile voice market. In any case, a fourth operator, by stimulating competition, should aim to stimulate higher levels of traffic consumption in the market, rather than simply diluting the existing (forecast) usage across another infrastructure operator. Therefore, even if N was increased to 4, this would need to be accompanied by a commensurate increase in the demand forecasts. Therefore, the assumption of N=3 will be retained.*"

T-Mobile claims not to be expecting to obtain a 33% share of the 2G/3G voice market and the associated 2G/3G mobile data market. This is inconsistent with the outcome of the recent spectrum auction, where T-Mobile acquired more than 33% of the GSM/UMTS spectrum available. However, the position set out in the extract above is that the efficient operator appropriate for setting cost-based mobile termination rates should achieve an equal (1/3) share of the national market. There are no strong arguments for reflecting T-Mobile's weak aspirations to improve its market share towards equal terms in the cost model used to calculate efficient costs.

Therefore, the comment raised is not accepted.

[2] Commission of the European Communities, *COMMISSION RECOMMENDATION of 7.5.2009 on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU*, 7 May 2009.

4 Below-cost recovery

4.1 Comments received

Comments regarding below-cost charges were included in the submissions received. These comments are paraphrased below:

- T-Mobile: T-Mobile will be forced to charge below its pure LRIC MTR. Total incremental costs in the model are divided by the hypothetical operator's (33% market share) traffic volumes, but total incremental costs are divided by a 23% share of traffic in T-Mobile's network.

4.2 Analysys Mason response

In its assertion, T-Mobile may be misinterpreting the way in which the pure LRIC calculation works, as some parts of the pure LRIC calculation are scale dependent (as opposed to simply a fixed cost divided by a market-share amount of traffic).

T-Mobile's submission is speculative as it has not submitted cost-based evidence that the proposed rate is below its own corresponding cost, nor submitted evidence that its own pure LRIC and LRIC+ unit costs of traffic are efficient. Furthermore, the relevant market share percentage against which to assess the pure LRIC cost is T-Mobile's share of traffic (rather than its share of subscribers), which we have assessed as being closer to 30% and higher than the submitted 23%.

The v5 model is set up to produce termination costs for an efficient hypothetical existing operator defined with characteristics similar to, or derived from, the actual operators in the market, except for specific hypothetical aspects that are adjusted. As a result of this hypothetical operator structure of the model, it does not produce operator-specific results.

The resulting costs for the hypothetical efficient 33% market share mobile operator may be higher, or lower, than the corresponding *pure BULRIC* and *plus BULRAIC* values for each actual operator. The choice of modelling this hypothetical (efficient) operator was defined and concluded at the outset of the process, and therefore actual operators' *pure BULRIC* or *plus BULRAIC* results are not an input to ACM's approach to setting prices. In Section 2.1 of the Conceptual specification for the update of the fixed and mobile BULRIC models, 15 October 2012, it was concluded that:

"We shall develop a model based on a hypothetical existing operator. The modelled operator is "hypothetical" because no actual operator has the same launch and market share characteristics, and it will have a hypothetical equal share of the relevant market, designated by 1/N."

Therefore the assumption of a 33% market share for our hypothetical operator will be maintained (N=3) and higher, or lower, cost results of actual operators will not be considered.

5 Fixed voice traffic

5.1 Comments received

Comments regarding fixed voice traffic were included in the submissions received. These comments are paraphrased below:

- Ziggo: An NGN using VoIP does not reflect the current market – more than half of customers use traditional PSTN.
- UPC: Fixed voice traffic will decline further as OTT applications in the fixed network grow.

5.2 Analysys Mason response

With regard to the Ziggo comment discussing the fixed network choice, the EC Recommendation[2] states the efficient technological choice on which the cost models should be based in principle:

- NGN-based core network for fixed operations.

In Section 2.1 of the consultation paper, in our discussions of concept 1 we said that:

"*Where possible, this operator can be set up as a typical operator [...] In the fixed market, there is no typical operator. As a result, a modelling choice was made as to an efficient mix of the technologies to be used by the operator."* Therefore we consider an NGN using VoIP to be the efficient technology for the fixed network.

In Section 2.3 of the consultation paper we said that:

"*Loading curves are used to define how legacy subscribers and traffic are migrated onto the NGN […]. In particular, the loading curves for fixed business services are relatively slow. This is to allow for the transition time for business customers to migrate to NGN services, as well as for the necessary service support and customer equipment (such as PABX) to be developed.*"

The loading curves used for the fixed NGN network in the v5 model are shown in Figure 1 below.

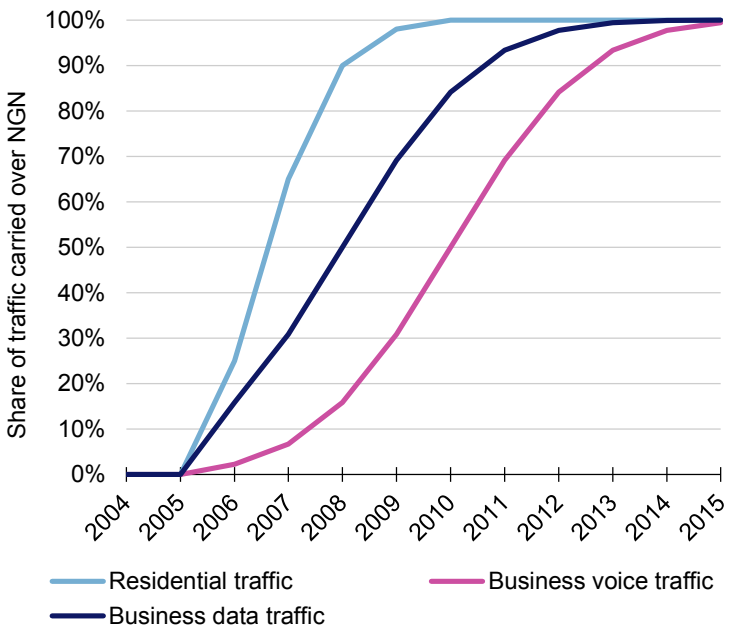


Figure 1: Loading curves used in the v5 model [Source: v5 model, 2013]

These loading curves reflect the fact that it takes some time for all traffic to be moved across to the NGN, however it may be that KPN or the cable operators have chosen to migrate more slowly in order to utilise existing assets for longer, or for other (e.g. retail) reasons.

Consequently, we consider that an all-IP NGN model for the fixed core network is an efficient choice, and the application of load-up curves acting over a number of years reflects the situation where customers move across from the legacy to the new technology over time, but in an overall efficient manner.

UPC's comment suggests that a further decline in modelled fixed voice traffic is required to reflect the increasing popularity of over-the-top (OTT) applications. As discussed in Section 2.1.2 of the response document, the fixed voice forecasts for the period to 2016 were taken from Analysys Mason Research forecasts[3]. Beyond 2016 "*we observe that the rate of traffic decline is reducing at approximately 0.3% per annum and we have extended this trend out to 2030, where the fixed traffic growth rate reaches zero. Therefore, traffic will only stabilise at that point.*"

As seen in Figure 2, the fixed traffic in the v5 model already declines significantly. Therefore we believe any potential future increase in the popularity of OTT applications is adequately taken into consideration in our forecasts and it is not necessary to further reduce the fixed voice traffic to reflect potential adoption of OTT applications.

[3] Source: Analysys Mason Research, *Fixed and mobile voice services in Western Europe: forecasts and analysis 2011–2016*.

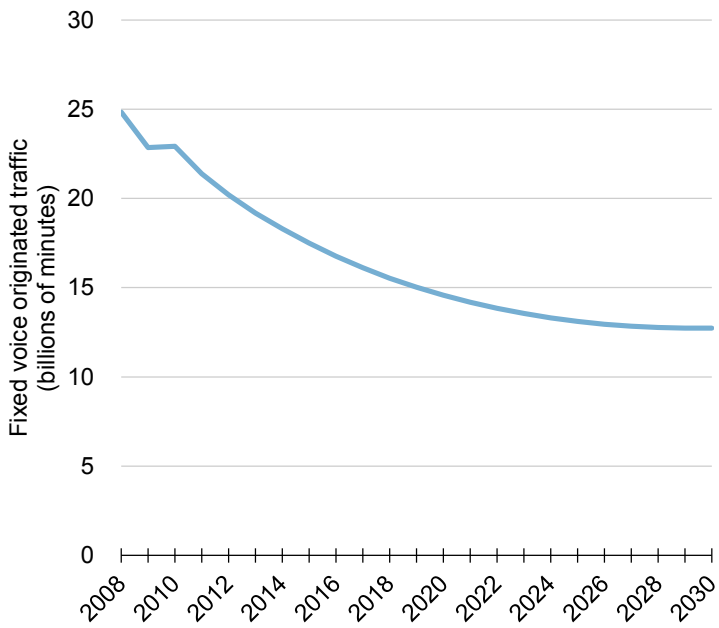


Figure 2: Assumptions for fixed voice traffic in the v5 model [Source: v5 model, 2013]

6 Interconnect protocol

6.1 Comments received

Comments regarding interconnect protocol were included in the submissions received. These comments are paraphrased below:

- Ziggo: Assuming both PSTN and IP interconnection is inconsistent with an NGN.

6.2 Analysys Mason response

We clarify that the v5 model considers only PSTN interconnection, as previously addressed in the conceptual approach document. In Section 5.3 we said:

"*The costs of circuit-switched (64kbit/s) interconnection using a TDM gateway will be applied*."

This was based on the understanding that an IP interconnect network was not in existence at the time when v3 model was finalised.

However, within Section 4.1.2 of the conceptual approach document there was an acknowledgement that "*E1/STM1 interconnect is relevant for the next regulatory period. Session control and other platforms required to deliver the services will be incorporated.*"

At the time of preparing the v4 and v5 cost models, we understood that all major operators in the market (two cable operators, three mobile operators, one copper-based incumbent, and a small number of major altnets and MVNOs) had not deployed an IP interconnection facility. Therefore, we conclude that PSTN interconnection using TDM gateway equipment for interconnecting

copper, cable, mobile and alternative network operators, attached to the modelled fixed operator's all-IP core network is reasonably efficient for the purposes of the next price control period.

7 Voice platform

7.1 Comments received

Comments regarding the voice platform were included in the submissions received. These comments are paraphrased below:

- Ziggo: It is not clear why subscriber-driven and fixed costs in the voice platform are excluded.
- KPN: It seems incorrect to model VoIP hardware and software in a separate model then to change only the software costs used in the model.

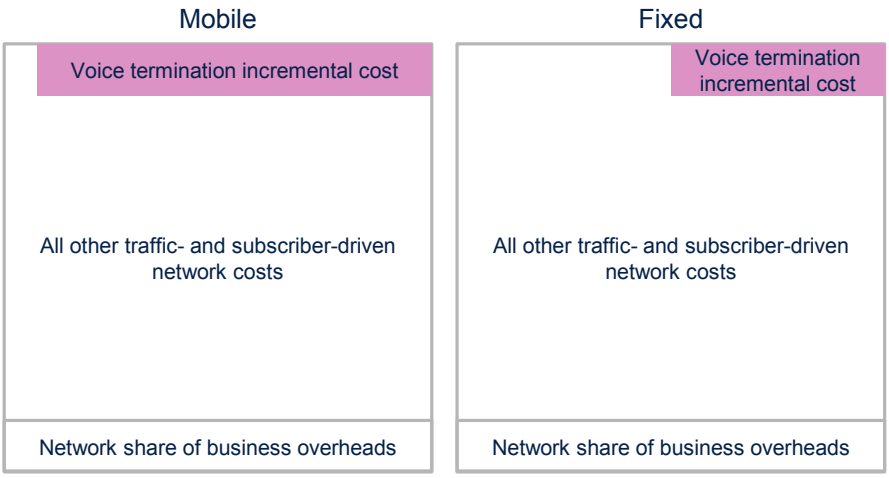
7.2 Analysys Mason response

The operators' points regarding the voice platform have already been addressed in the conceptual approach document's discussion of Pure BULRIC. That document said "*the **Pure BULRIC** approach will be consistent with the recent EC Recommendation, which specifies the following approach for the calculation of the incremental costs of wholesale mobile termination service:*

- *The relevant increment is the wholesale termination service, which includes only avoidable costs. Its costs are determined by calculating the difference between total long-run costs of an operator providing full services and total long-run costs of an operator providing full services except voice termination.*
- *Non-traffic related costs, such as subscriber-related costs, should be disregarded.*
- *Costs that are common such as network common costs and business overheads should not be allocated to the wholesale terminating increment.*"

The diagrams in Figure 3 below illustrate the costs included in the unit cost of terminated traffic in both the mobile and fixed pure BULRIC calculations.

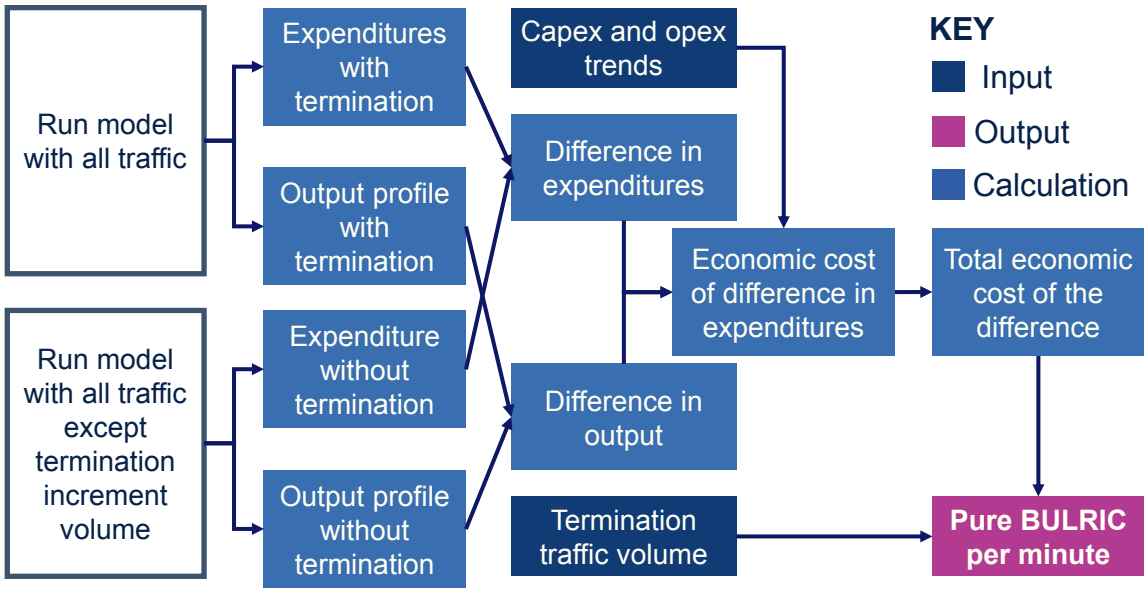
Figure 3: Pure BULRIC cost allocation [Source: Analysys Mason, 2013]



As the fixed and subscriber-driven voice platform costs would not be affected by the removal of fixed termination traffic, these do not fit into the relevant increment and are therefore not part of the pure BULRIC cost of fixed termination.

The outcome of the cost model is set to give the answer obtained from a detailed analysis, as illustrated for pure BULRIC in Figure 4 below.

Figure 4: Overview of pure BULRIC calculation in the v5 fixed/mobile models [Source: Analysys Mason, 2013]



KPN has commented that it seems incorrect to model both hardware and software in a separate model then to adjust only SW costs in the BULRIC model. This claim is incorrect:

- The reason for modelling both HW and SW in the separate VoIP model is because each of the operators included in the VoIP benchmark (Dutch and other benchmarks) has a different (specific) mix of HW and SW components, and it is necessary to combine both parts in order to prepare a comparable total cost benchmark for the efficient LRAIC+ and pure LRIC of fixed termination traffic.

- The adjustment to VoIP costs in the model (a 75% multiplier to the unit costs) is applied to all relevant assets[4] (HW and SW), as shown in the *Asset_Inputs* sheet of the fixed model.

8 Mobile voice traffic

8.1 Comments received

Comments regarding mobile voice traffic were included in the submissions received. These comments are paraphrased below:

- T-Mobile: Mobile voice traffic is expected to decline further, e.g. due to OTT mobile voice.

8.2 Analysys Mason response

The mobile voice traffic forecast used in the v5 model has already been discussed in Section 2.1.2 of the response document. The historical mobile voice minutes used in the v5 model are sourced from OPTA historical market data to 2011. From the OPTA market data[5] we observe that mobile voice minutes were already relatively static over the period December 2009–June 2012, and as a result have forecast total voice traffic so that mobile-originated traffic remains static, as shown in Figure 5 below.

4 SBC, SBC cards, call server, VoIP software, VMS.

5 Source: http://www.opta.nl/en/download/bijlage/?id=879

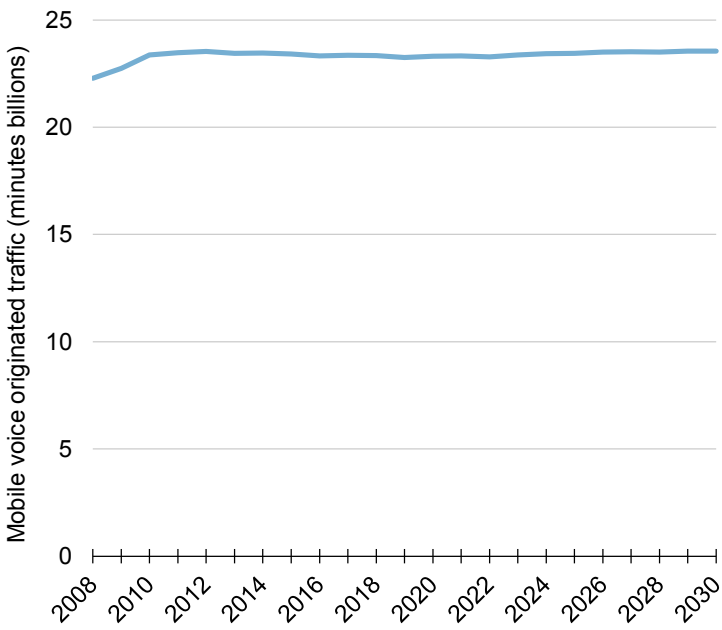


Figure 5: Assumptions for mobile voice traffic in the v5 model [Source: v5 model, 2013]

As discussed in Section 5.2 earlier, we believe any potential future increase in the popularity of OTT applications is adequately taken into consideration in our voice traffic forecasts.

9 Mobile SMS traffic

9.1 Comments received

Comments regarding mobile SMS traffic were included in the submissions received. These comments are paraphrased below:

- T-Mobile: The decrease in SMS will be much larger than modelled, e.g. due to OTT messaging.

9.2 Analysys Mason response

The mobile SMS traffic forecast used in the v5 model has already been discussed in Section 2.1.2 of the response document. The forecasts were updated using OPTA Market Monitor data[5] on historical SMS traffic. We said "*This data showed that between year-end 2010 and half-year 2012 SMS volumes have decreased at a compound annual growth rate (CAGR) of -19%. We have assumed this is the decline experienced between 2011 and 2012. We have then assumed the year-on-year decline reduces to zero by 2019.*"

These SMS traffic forecasts are shown in Figure 6 below, where it can be seen that there is a significant reduction in the traffic. As for voice traffic (see Sections 5.2 and 8.2 above), we believe that this forecast reduction is sufficient to take into account any reduction in SMS traffic from the adoption of OTT messaging. The overall influence of the SMS forecast on the results of the model

is relatively limited therefore we believe that the reduction adopted already is reasonable for the purposes of the next regulatory period.

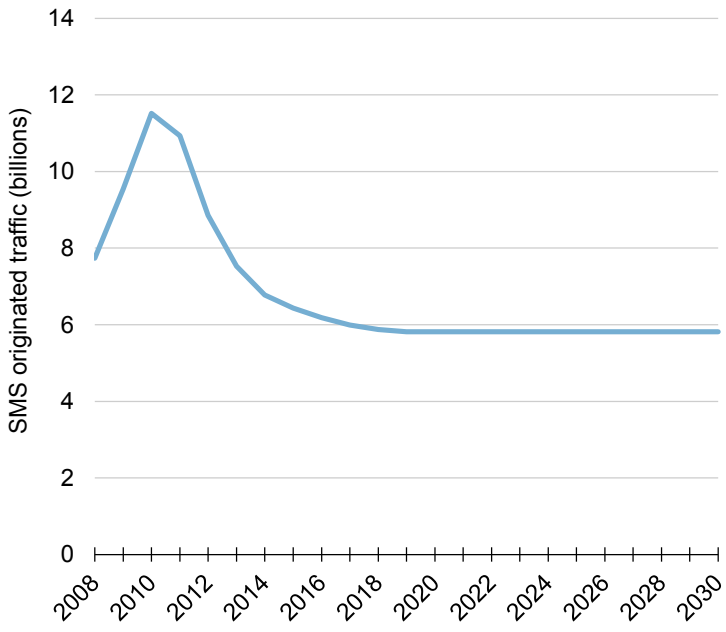


Figure 6: Forecast for SMS traffic in the v5 model [Source: v5 model, 2012]

10 Mobile data traffic

10.1 Comments received

Comments regarding mobile data traffic were included in the submissions received. These comments are paraphrased below:

- UPC: Too conservative data traffic forecasts are applied, given the increased availability of 2G and 3G network capacity.

10.2 Analysys Mason response

The mobile data traffic forecast used in the v5 model has already been discussed in Section 2.1.2 of the response document:

"As noted in the responses, mobile data growth is slowing, with a continued reduction in growth rate expected. Our historical mobile data traffic inputs to the v5 model are based on data from the OPTA Market Monitor. For the purposes of comparison, we have estimated mobile data traffic for 2012 as double the first-half 2012 volumes, and compared this value with the forecast in the v4 model. As can be seen (Figure 2.7), our estimates and the forecasts in the v4 model are almost identical. We believe that this demonstrates that our modelled growth rate is appropriate."

While the forecast used in the model does include some data growth, we expect that 4G networks (not modelled) will carry much higher data volumes in the future, and thus the 2G/3G traffic forecast in the coming years is not overly conservative.

As a result we believe that the mobile data traffic reasonably takes into consideration expectations for 2G/3G mobile broadband services in the coming years.

11 Spectrum valuation

11.1 Comments received

Comments regarding spectrum valuation were included in the submissions received. These comments are paraphrased below:

- KPN: Value of spectrum in the model should reflect the value of spectrum paid for in the market, not the value for the services modelled.
- T-Mobile: Same as KPN.

11.2 Analysys Mason response

On 27 December 2012, a Supplementary note for OPTA – consultation questions for the Dutch industry parties following the multi-band spectrum auction document ('spectrum note') was released to industry which discussed using both bottom-up and top-down methodologies in order to calculate the value of the spectrum.

In response to the spectrum note, UPC and KPN were agreeable to the bottom-up approach. BCPA suggested using the v4 model value and Vodafone stated that the bottom-up approach could be acceptable for 2100MHz spectrum since such a small proportion of the band was auctioned in 2012.

This bottom-up approach as set out in the spectrum note "*relies upon deciding 'fundamental underlying spectrum values' for the purposes for which the spectrum could be used (e.g. GSM900, UMTS900, GSM1800, LTE1800, etc.) and then adding up and multiplying these values by the overall amount of spectrum available.*

This method must be 'reconciled' with the actual outcome of the auction in order to confirm whether the bottom-up valuation meets the observed outcome, and/or to explain any discrepancy in reconciliation (e.g. scarce or excess spectrum, lot restrictions, tactical bidding)."

On the other hand, Tele2 took the view that the outcome of the auction is too high for the purposes of 900MHz and 1800MHz spectrum used for voice services.

The views expressed by KPN in its public consultation response, and of Tele2 in the spectrum consultation highlight the two approaches to this issue, summarised in Figure 7 below.

Figure 7: Spectrum valuation approach [Source: Analysys Mason, 2013]

KPN suggestion (full opportunity cost)	Tele2 suggestion and v5 model (fair valuation for relevant services)
• The total amount paid by the operators reflects the value of spectrum to any purchaser • The opportunity cost of using that spectrum for any purpose, irrespective of the value of the service, is the amount paid for the spectrum • The hypothetical operator would be required to occupy spectrum for its services and would therefore need to incur the cost of purchasing that spectrum at current prices Spectrum values for this method: **900MHz / 1800MHz value: EUR0.85 / EUR0.45 per MHz per pop**	• Operators incurred higher spectrum payments based on the expectation of future additional use and extracting higher value from future services (e.g. LTE and UMTS900 mobile broadband usage) rather than from immediately including higher spectrum costs in the voice service and voice termination service prices • It is fair for interconnecting operators to be charged for the usage of spectrum on the basis of its value to provide the purchased services (hypothetically, if it had been auctioned for that purpose only) • Mobile network operators (MNOs) will be required to recover higher spectrum costs from the longer-term expectation of cost recovery from mobile broadband services, as MNOs choose to move spectrum from legacy (low-value) 2G/3G voice usage across to UMTS900 and/or LTE (high-value) usage Spectrum values for this method : **900MHz / 1800MHz value: EUR0.70 / EUR0.30 per MHz per pop**

We have considered these two options for including a spectrum value in the cost of mobile termination paid to the MNOs by third parties (such as fixed operators). We conclude that, on balance for the situation in the Dutch market and for the recent Dutch spectrum auction, the second approach (fair valuation for the relevant services) is most appropriate for cost-based mobile termination charges for the next three-year period. This is because we believe that the higher amounts paid by the MNOs was due to the future long-term expectations gained by the three large operators for supporting the majority of the next generation (mobile broadband) demand over the next 17 years on new technologies (UMTS900 and LTE) and these new technologies are not expected to be materially used for delivering voice termination in the coming regulatory period.

12 Reconciliation

12.1 Comments received

Comments regarding the reconciliation were included in the submissions received. These comments are paraphrased below:

- T-Mobile: Reconciliation was only carried out for a small number of assets; and was not carried out on asset values / GBV. This leads to a low accuracy for the model.

- Vodafone: The v5 model contains a less discounted cumulative capex and opex compared to the v4 model and therefore cannot be considered to still be reconciled to actual operator expenditures.

12.2 Analysys Mason response

The final v5 model is based upon a series of model refinements, checks, improvements and validation, including the work carried out in 2010 to prepare the previous version of the model (v3). The preparation of the final v5 model relied upon a number of cost-related changes to the v4 model, summarised below (and taken directly from Section 3.6.2 of the response document):

"We have then undertaken a similar exercise in terms of comparison of the modelled and actual operating expenditures.

We have been able to consider opex for both the KPN-like calculation and the Vodafone-like calculation, so as to get closer agreement with both the KPN-like calculation and the Vodafone-like calculation. We have included an additional mark-up on the opex assumptions for all radio network assets and all core network assets of 60% and 45% respectively. We have reduced the level of business overheads, as described in Section [...]. We have also introduced negative year-on-year opex cost trends for radio network assets, core network assets and site assets. These trends are required since operator data indicates that total opex, in real terms, is either static or falling year-on-year.

The outcome of the revision of the modelled opex and the operator data is shown in Figure [...] below. The difference in opex levels for KPN and Vodafone has made it difficult to obtain close agreement for both calculations. The model currently slightly over-estimates the opex in the Vodafone-like calculation and slightly under-estimates the opex in the KPN-like calculation [...]

Due to the lack of cumulative capex data from operators, we have been unable to construct a comparison similar to that for opex [...]"

Slide 52 of the October 2012 IG2 presentation[6] shows that the cost model is at the lower (efficient) end of the scale of opex and capex for 2011. Based on the work undertaken in completing the v5 model we reject T-Mobile's submission that the model is inaccurate.

Furthermore, Vodafone's submitted comparison is spurious, and therefore rejected, for three reasons:

- It is focusing on **discounted cumulative expenditure** values from the **hypothetical operator model**. These values are not related to the reconciliation of the model.
- It is comparing the draft model with the final model and placing greater reliance on the draft model as the correct reconciliation target.

[6] Annex C.3, available at https://www.acm.nl/nl/publicaties/publicatie/11321/Ontwerpbesluit-marktanalyse-vaste-en-mobiele-gespreksafgifte-2013-2015/

- It is not demonstrating any (lack of) comparison with actual operator costs (e.g. Vodafone's actual costs in any particular or recent year).

As a result of the comments raised by Vodafone (section 15 below) the radio network opex mark-up has been adjusted from 60% to 45% (consistent with the core network opex adjustment) in order to maintain the opex reconciliation applied in the model.

13 Coverage

13.1 Comments received

Comments regarding coverage were included in the submissions received. These comments are paraphrased below:

- T-Mobile: Common costs are set too high in the model. Growth in 3G, mobile data traffic and network capacity means that common costs will be a much lower proportion of cost.

13.2 Analysys Mason response

Common costs in the model arise from the requirement to deploy coverage (and the associated connecting infrastructure such as basic transmission links and switching nodes) for both 2G and 3G services. 3G coverage is not considered a traffic-driven cost for two reasons:

- firstly, all operators have coverage obligations in 3G (and 3G coverage maps)
- secondly, operators have deployed 3G networks to a high percentage of the population prior to the emergence of sufficient voice and data load to fill up the network capacity.

We disagree that 'growth in mobile data traffic and network capacity has caused large increases in costs'. This is because the additional costs required to support higher-rate mobile data and to increase the network capacity benefit significantly from the existing network deployment (e.g. existing 2G/3G sites are used to host HSPA upgrades). This means that the incremental costs necessary to support additional (data and voice) traffic are relatively small compared to the overall total costs of the network. This can be seen in the results of the model: the Plus BULRAIC is approximately EUR2 cents per minute, while the pure BULRIC is approximately EUR1 cent per minute. In any case, if a large proportion of today's costs have been caused by explosive growth in data traffic then these costs will not be relevant to the (implied) small incremental cost associated with wholesale voice termination.

Consequently, we reject the view that the MTR is set too low.

14 Treatment of spectrum

14.1 Comments received

An extensive set of comments on spectrum were received. These comments are paraphrased below:

- Vodafone: No spectrum is considered incremental to the termination service and this is an error: either an amount of spectrum should be considered incremental, or the value of spectrum should change with the level of traffic carried.
- Vodafone: A rational operator would seek to avoid more expensive 900MHz spectrum first.

14.2 Analysys Mason response

In Section 3.4.4 of the response document we presented a 'surface' chart (Figure 3.12) showing that the v5 model was sensitive to the amount of paired 900MHz spectrum and the amount of paired 1800MHz spectrum applied in the model, such that in all cases:

- a reduction in the amount of 1800MHz spectrum causes an increase in GSM base stations
- a reduction in the amount of 900MHz spectrum causes an increase in GSM base stations
- a reduction in the amount of both spectrum bands causes an increase in GSM base stations.

The same chart is reproduced below for the current model.

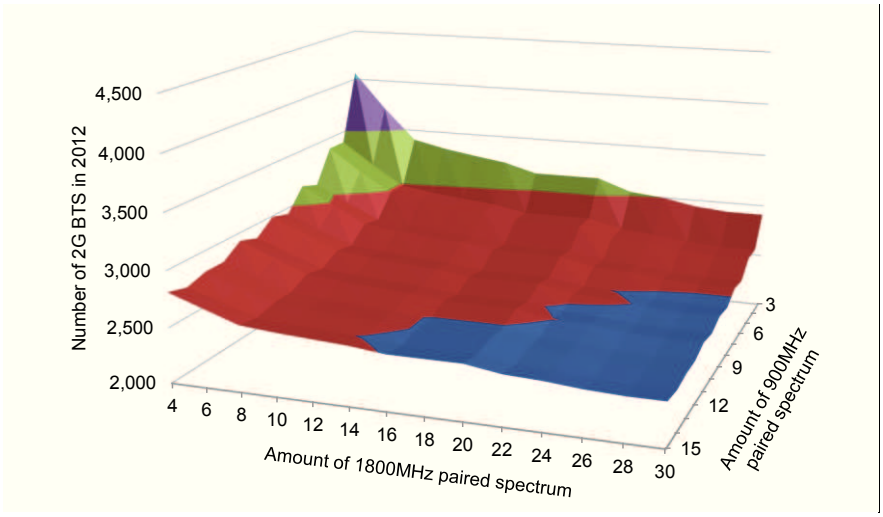


Figure 8: Number of BTSs versus spectrum [Source: Analysys Mason, 2013]

This chart confirms our conclusion, and the behaviour of the model, that reducing the spectrum allocation in the network requires more sites to serve the traffic load. This chart also shows that the trend is always in the same direction – reducing the spectrum available always causes an increase in the requirement for sites.

The trade-off between sites and spectrum can also be observed in a different way. Figure 9 below shows the total present value of capex and opex in the mobile model as a function of the selected

spectrum allocation. This surface does not show any significant tilts, meaning that the network versus investment trade-off between sites and spectrum, using our v5 spectrum valuations, is reasonably balanced.

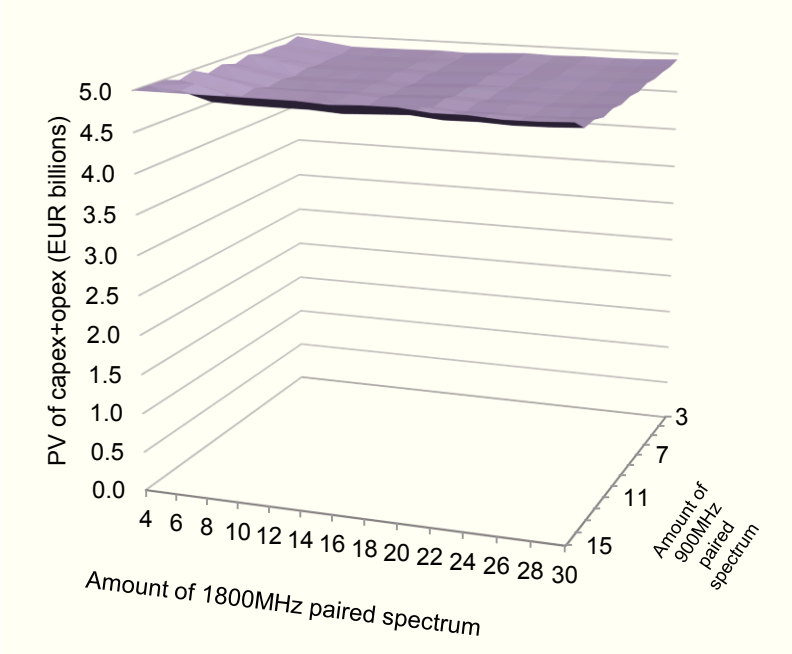


Figure 9: Total cost versus spectrum [Source: Analysys Mason, 2013]

This surface can be looked at more closely, rotated slightly for clarity. Figure 10 shows that the total cost surface is not perfectly flat.

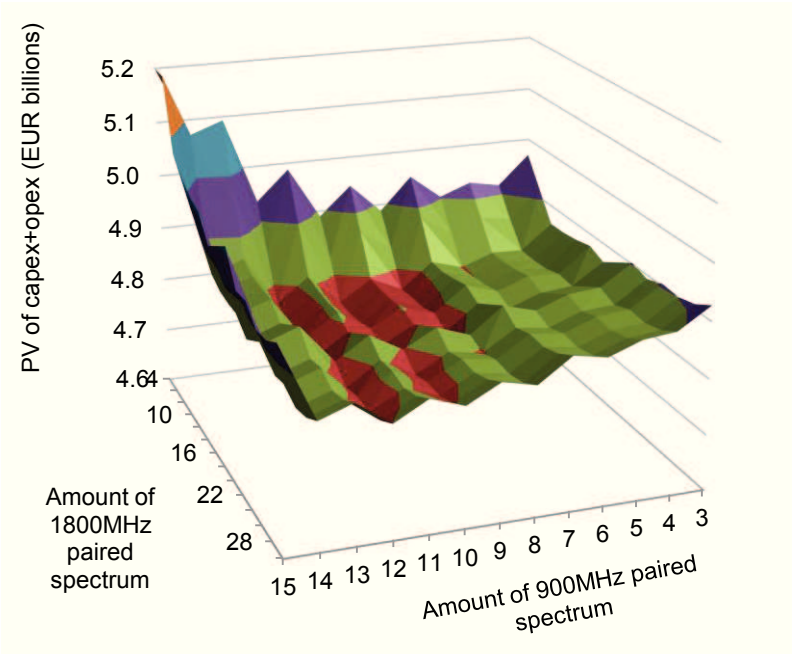


Figure 10: More detailed view of total cost versus spectrum [Source: Analysys Mason, 2013]

The lowest overall cost results are seen in the troughs (shown on the chart in red), occurring broadly in the range of 8–12MHz of paired 900MHz spectrum and 8–16MHz of paired 1800MHz spectrum. However, this surface highlights that the uniform average price per MHz applied in the model does not perfectly reflect the incremental price of each additional MHz for each spectrum

band. Hence, Vodafone's own investigations, illustrating that an operator would reduce its 1800MHz spectrum to 2×8.2MHz in the absence of termination traffic are misleading because they do not show that an operator would also seek to reduce 1800MHz spectrum to around 2×8 or 2×10MHz of spectrum even ***with*** termination traffic. (This efficient amount of spectrum was one of the issues discussed in the supplementary spectrum consultation in late 2012/early 2013, but has not been raised by Vodafone in the public consultation). The detail of this surface therefore shows that marginal spectrum value is a non-uniform function. Vodafone's own investigations may also show that the marginal value of 1800MHz spectrum is practically zero above 2×16MHz of spectrum (i.e. that there is excess spectrum for the 2G voice demand in the market).

However, the fact that spectrum value is a non-uniform function or marginally valued at zero does not change our conclusion on the approach in the final model: that either spectrum or sites should be avoided, but not both; and that the incremental cost calculated by the model is accurate and correctly calculated. Vodafone's suggestion that spectrum should also be incremental to the voice termination service is therefore rejected.

The relationship between the reduction in spectrum and the reduction in sites can be seen more clearly in Figure 11.

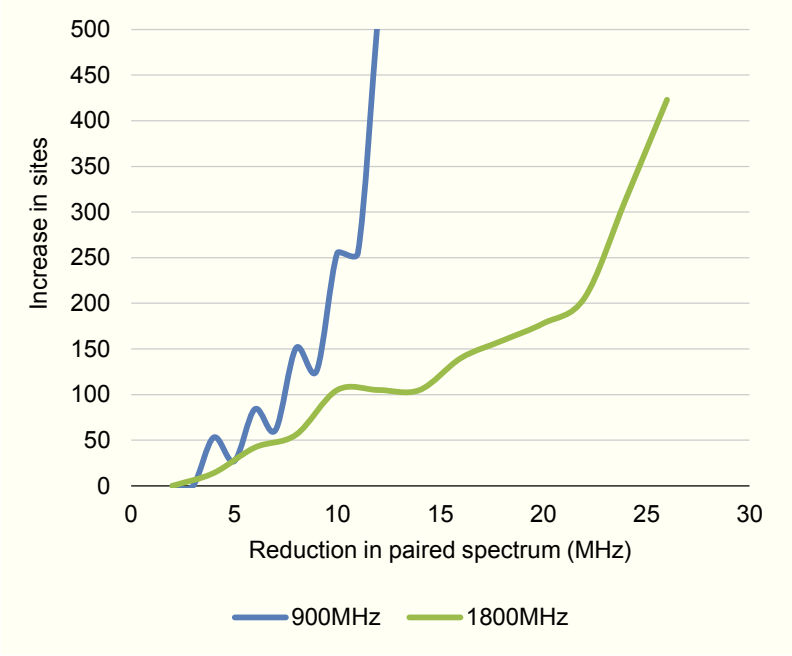


Figure 11: Spectrum and site changes [Source: Analysys Mason, 2013]

This shows that each MHz of 900MHz frequency is not the same as a MHz of 1800MHz frequency, in terms of the impact it has on network site requirements. It can be observed that the relationship has approximately a ratio of 2:1. This means that an operator which chooses to reduce 900MHz spectrum must consider the site impact more carefully, because site effects (site increases) are twice as significant in the 900MHz (coverage) layer. This evidence also broadly confirms our underlying spectrum valuations of EUR0.70 per MHz per pop for 900MHz and EUR0.30 per MHz per pop for 1800MHz spectrum – a ratio of approximately 2:1. These points mean that Vodafone's claim that it would be rational to reduce 900MHz spectrum is false:

900MHz spectrum has more significant impacts within the network design and available capacity and consequently is more valuable to the MNOs. 900MHz spectrum also offers better indoor coverage possibilities (though we do not rely on this fact to reject Vodafone's point).

15 Network deployments for coverage and capacity, and calibration of sites

15.1 Comments received

Comments on the radio network inputs, calculations and calibration were received. These comments are paraphrased below:

- Vodafone: Evidence was provided of the need to increase the busy-hour factor to reflect cell-by-cell and seasonal variability over the network average. This adjustment should be applied without also applying further 'compensating adjustments not supported by evidence'.
- Vodafone: Vodafone's site count [✂] is around [✂] higher than the number of sites in the hypothetical 33% operator model, despite Vodafone carrying [✂] of the market traffic.

15.2 Analysys Mason response

In Section 3.4.2 of the response document we summarised the parametric evidence presented by the same operator:

- *"Recognising peak demand on a cell-by-cell basis, as opposed to the network average, would require an increase in the modelled "busy hour percentage" from [✂].*
- *Accounting for monthly variability results in an increase in peak demand on a cell-by-cell basis such that the "busy hour percentage" increases further, from [✂]."*

The operator then notes that:

"in applying these amendments the modelled equipment quantities change materially; for example the modelled quantities of sites in the "full capacity" network reduces by c40% and, further, that the equipment quantities in the original model, adjusted for volumes provided by us [✂], are materially different to those deployed by the operator in reality. <u>These results are therefore prior to any necessary recalibration exercise, and we recommend that such an exercise is conducted</u> to ensure that the modelled equipment quantities are consistent with those which would be deployed by an efficient operator for a given level and mix of demand." [Emphasis added by Analysys Mason and referred to below].

In Section 3.4.4 of the response document we responded that:

"The proposed mark-ups to the busy-hour inputs could be included in the model either by applying an explicit mark-up to the busy-hour proportion input, or by scaling the TRX utilisation factors. Since the effect described by the operator is related to the radio network only, and the mark-ups

are not especially relevant to the calculation of the transmission network, we have followed the second approach and have included functionality to allow the inclusion of scaling factors to the TRX utilisation inputs. We have included two factors: (a) a factor to take into consideration cell busy-hour and seasonal variability (100%/150% = 67%), and (b) a factor of 80% to capture the effects referred to by the operator as "daily variability, busy-hour variability, unforeseen peaks and spare capacity for traffic growth"."

Therefore, we reject the operator's suggestion that the busy-hour effects have not been properly applied in the model. The adjustments we have applied were based on the evidence presented by the operator (that the average busy hour does not reflect the peak busy hour in the radio network and therefore a lower average utilisation is obtained in the radio layer).

Furthermore, as suggested by this operator during the draft model consultation (in the underlined text above) it is necessary to check whether the adjusted model still 'calibrates' to a reasonable site count for an (efficient) operator. The operator's comments to the public consultation (that no compensating adjustments should be applied) are inconsistent with its previous suggestion that a recalibration exercise should be performed. The calibration of the model is discussed in more detail below.

The operator's point regarding asset reconciliation in the v5 model was discussed in Section 3.4.4 of the response document in which we detailed the recalibration of the radio network asset counts for all three operator-specific calculations. Specifically, the model was adjusted such that the model outputs for 2G asset volumes (BTSs and TRXs) and 3G NodeBs, when run with 'operator-specific' adjustments, correspond to actual operator asset counts.

The operator-specific configurations were set up by replacing certain hypothetical inputs with operator-specific values when recalibrating the operator-specific calculations. The inputs that we adjusted were set out in the response document as follows:

- "*Market share of voice minutes – this is calculated from a combination of data on total network minutes supplied by the operators, and market-level data available in OPTA's Market Monitor*
- *Indoor population coverage – taken from operators' responses to our earlier data request*
- *Paired spectrum allocation – taken from the ECO report on the licensing of 'mobile bands'*
- *Number of 2100MHz carriers for voice – this is assumed to be 1 for Vodafone and 2 for KPN*
- *BTS sectorisation, network busy-hour percentage and migration profile – based on data from operators' responses to our earlier data request.*"

However, based on this operator's responses to the public consultation we have re-investigated the calibration exercise to identify whether further calibration adjustments are required, particularly in relation to the numbers of sites (as well as BTSs, TRXs and NodeBs). This has resulted in a small number of additional changes to the v5 model, discussed below:

- operator-specific data indicates that a larger number of sites and BTSs are deployed by the actual operators with comparable demand volumes to the number of sites modelled in the

bottom-up model; there are also outdoor macro and indoor micro BTSs and sites which need to be considered. In order to calibrate the number of sites, a further adjustment to TRX utilisation[7] has been applied, along with an increase in the number of UMTS-only sites deployed[8]. The effects of adjusting the number of BTSs and sites are to increase the level of opex incurred in the model. In order to re-reconcile radio network opex to the data provided by the mobile operators, the additional opex adjustment factor applied in the v5 model has been reduced[9].

- the operator-specific 2G–3G migration profiles used in the calibration tests show a slightly stronger migration from 2G to 3G traffic than applied in the hypothetical operator model. This average migration profile is now applied in the hypothetical operator case and thereafter projected from around 40% in 2012 to 50% in the long term, as shown in Figure 12.

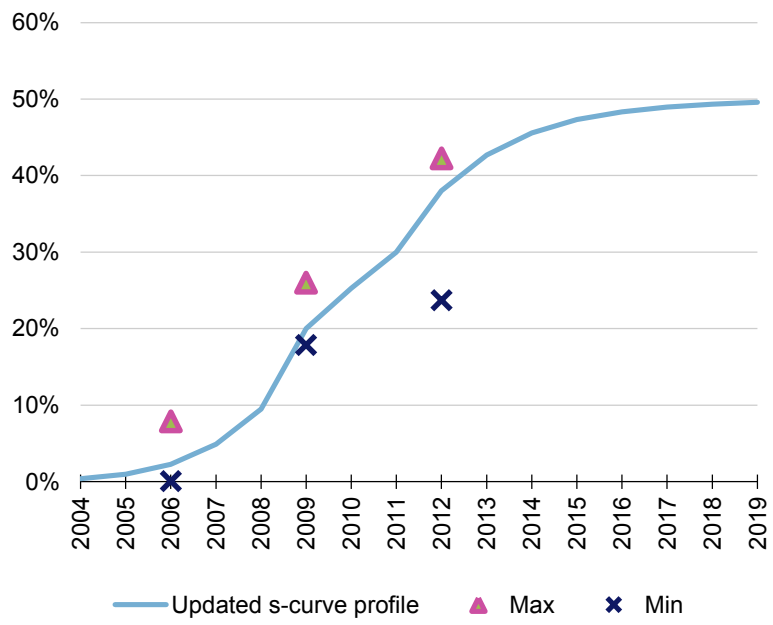


Figure 12: Updated migration profile showing actual and forecast values [Source: Analysys Mason, 2013]

Data was submitted by Vodafone in its public consultation response [✂]. For comparison, the updated hypothetical operator model now contains 4463 macro sites and 425 micro sites in 2011.

16 Cost causality

Comments regarding the existence of a subscriber increment were received. These are paraphrased below:

- Vodafone: A 'subscriber' service does not exist; all common network costs should be distributed across traffic rather than also to a subscriber service.

7 The calibration adjustment is reduced from 75% to 62%

8 The UMTS-only percentage is increased from 20% to 55%

9 The radio network opex adjustment has been reduced from 60% to 45%, consistent with the opex adjustment applied for core network assets.

16.1 Analysys Mason response

In addition to the comments referred to in Section 4.4.2 of the response document, we add two further facts.

- In order for a customer to subscribe to Vodafone's mobile network, and to have the ability to make and receive calls (but not to actually do so), Vodafone must deploy a nationwide mobile network capable of tracking and contacting all subscribers at their present location.

- Vodafone NL does not permit subscribers of KPN NL or T-Mobile NL to select the Vodafone NL network on a call-by-call basis, nor does it permit customers of KPN NL and T-Mobile NL to voluntarily receive calls to their mobile subscriber numbers via the Vodafone network, on a call-by-call basis. Therefore, Vodafone's claim that it "does sell traffic to customers of competing networks" is false.

Consequently, we conclude that the model properly reflects common, subscriber and traffic cost causality and reject Vodafone's suggestion.

17 Dimensioning of 3G coverage network

Comments regarding the modelling of the 3G network were provided. These are paraphrased below:

- Vodafone: Nearly 4000 sites are required for 3G coverage in the model; Vodafone's experience from other countries is that the number of sites is correlated with traffic. If no changes are made to the coverage calculation, at least the minimum number of NodeB channels should be reduced in the absence of termination traffic.

17.1 Analysys Mason response

It may be true that a correlation can be observed between the number of 3G sites and the amount of traffic carried. This is unsurprising. However, a correlation does not prove that the deployment of sites is driven by traffic. In particular, UMTS licence holders in the Netherlands have a coverage obligation, which would need to be met even if less traffic was carried. In this respect, the model already reflects the cell-breathing impact on UMTS coverage in the absence of termination traffic.

In our experience, modern UMTS equipment is increasingly supplied with large(r) complements of channel elements, in particular to cater for R99 data usage and upload for HSDPA. We repeat our conclusion from S4.1.2 of the response document:

"[…] the 2G and 3G radio network designs in the v5 model are more traffic-sensitive for network capacity, but taking into account the inverse relationship between spectrum and capacity means that the revised model is now sensitive to both levels of traffic in the network and spectrum holdings. As a result, we have removed the adjustments related to the minimum TRXs per sector

and minimum channel elements per NodeB from the Pure BULRIC calculation. As a result of the spectrum sensitivity in the v5 model described in Section 3.4, we have removed the adjustment to the 1800MHz spectrum allocation. The remaining adjustments have been retained, i.e.:

- *UMTS cell loading (for cell breathing relaxation)*
- *proportion of GSM special sites deployed."*

Therefore, we reject Vodafone's request to accommodate the suggested channel element change.