

Volume forecasts in the Ofcom MCT Model.

A Report for BT

8 August 2014

This report has been prepared on the basis of the limitations set out in the engagement letter and the matters noted in the Important Notice From Deloitte on page 1.

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited (“DTTL”), a UK private company limited by guarantee, and its network of member firms, each of which is a legally separate and independent entity. Please see www.deloitte.co.uk/about for a detailed description of the legal structure of DTTL and its member firms. Deloitte LLP is a limited liability partnership registered in England and Wales with registered number OC303675 and its registered office at 2 New Street Square, London, EC4A 3BZ, United Kingdom. Deloitte LLP is the United Kingdom member firm of DTTL.

Contents

Important Notice from Deloitte	1
Executive Summary	2
1 Introduction	5
2 Voice and data traffic in the 2014 MCT Model	6
2.1 Total voice and data traffic in the 2014 MCT model	6
3 4G handset subscribers	11
3.1 Handset subscribers: comparison with 2011 MCT model	11
3.2 Handset subscribers by technology in the 2014 model	12
3.3 Assessment of 4G handset assumptions against evidence from the market	12
3.4 Scenario analysis: 4G subscribers	13
4 4G data usage per subscriber	17
4.1 Data usage per subscriber: comparison with 2011 MCT model	17
4.2 Assessment of 4G data usage assumptions compared to actual usage observed	18
4.3 Scenario analysis: 4G data usage per subscriber	19
5 Datacard subscribers	23
5.1 Datacard subscribers: comparison with 2011 model	23
5.2 Assessment of datacard penetration assumptions against evidence from the market	24
5.3 Scenario analysis: Datacard penetration	25
6 Combined scenario analysis	27
6.1 Scenario 6 – 4G subscribers, 4G data usage per subscriber and datacard penetration rate all higher	27
6.2 Scenario 7 – Adjustment to Scenario 6	27
6.3 Conclusion	28
Appendix A Additional Information	29
A.1 Calculation of volume parameters	29
A.2 Revisions in key parameters in 2014 MCT Model	29
A.3 Further updates to traffic input parameters	31
A.4 Further combined scenario results	31
A.5 Scenario 10 – Higher 4G subscriber levels and higher 4G data usage per subscriber	31

- A.6 Scenario 11 – Higher 4G subscriber levels and higher datacard penetration rate 32
- A.7 Scenario 12 – Higher 4G data usage per subscriber and higher datacard penetration rate 32

Important Notice from Deloitte

This final report (the "Final Report") has been prepared by Deloitte LLP ("Deloitte") for British Telecommunications plc ("BT") in accordance with the contract with them dated 31 July 2014 ("the Contract") and on the basis of the scope and limitations set out below.

The Final Report has been prepared solely for the purposes of providing BT with an assessment of the volume forecasts used by Ofcom in its draft 2014 Mobile Call Termination (MCT) model, as set out in the Contract. It should not be used for any other purpose or in any other context, and Deloitte accepts no responsibility for its use in either regard.

The Final Report is provided exclusively for BT's use under the terms of the Contract, however it may be made available to Ofcom solely for the purpose of evaluating their volume forecasts in the context of their MCT market review modelling. No party other than BT, including Ofcom, is entitled to rely on the Final Report for any purpose whatsoever and Deloitte accepts no responsibility or liability or duty of care to any party other than BT in respect of the Final Report or any of its contents. If Ofcom chooses to rely on the Final Report, it does so at its own risk and without recourse to Deloitte.

As set out in the Contract, the scope of our work has been limited by the time, information and explanations made available to us. The information contained in the Final Report has been obtained from BT and third party sources that are clearly referenced in the appropriate sections of the Final Report. Deloitte has neither sought to corroborate this information nor to review its overall reasonableness. Further, any results from the analysis contained in the Final Report are reliant on the information available at the time of writing the Final Report and should not be relied upon in subsequent periods.

Accordingly, no representation or warranty, express or implied, is given and no responsibility or liability is or will be accepted by or on behalf of Deloitte or by any of its partners, employees or agents or any other person as to the accuracy, completeness or correctness of the information contained in this document or any oral information made available and any such liability is expressly disclaimed.

All copyright and other proprietary rights in the Final Report remain the property of Deloitte LLP and any rights not expressly granted in these terms or in the Contract are reserved.

This Final Report and its contents do not constitute financial or other professional advice, and specific advice should be sought about your specific circumstances. In particular, the Final Report does not constitute a recommendation or endorsement by Deloitte to invest or participate in, exit, or otherwise use any of the markets or companies referred to in it. To the fullest extent possible, both Deloitte and BT disclaim any liability arising out of the use (or non-use) of the Final Report and its contents, including any action or decision taken as a result of such use (or non-use).

Executive Summary

Ofcom is currently in the process of consulting on the 2014 bottom-up cost model for the calculation of mobile termination rates (“MTRs”) as part of the review of the wholesale “mobile call termination” (“MCT”) market for the period of 1st April 2015 – 31st March 2018.

Deloitte has been engaged by BT to undertake a review of the changes made by Ofcom to service volume forecasts and other specific parameters related to the calculation of traffic load, compared to the model used by Ofcom in previous price controls.

This review has focused on the volume forecasts for the newly introduced modelling of a 4G network in the model, and other parameter revisions which appear to have a significant impact on MTRs. Forecasts were sense-checked and compared against publicly available information.

Overall, comparison with publicly available information suggests that data traffic, and in particular traffic on the 4G network, has been significantly underestimated by Ofcom. Adjusting for this shortfall results in a decrease in MTR by 2017/18 of between 16.6% and 25.5%.

4G handset subscribers

Ofcom’s forecasts regarding migration of handset subscribers to 4G appear to be too low in light of recent evidence from the market. Considering information on 4G handset subscribers from all operators in the UK for 2014, assumptions for 2013/14 Q4 should be revised upwards. For example EE reported that it had reached two million subscribers by January 2014, but Ofcom models only 420k 4G subscribers in 2013/14Q1.¹ Further, stronger migration can be predicted for the periods thereafter. Table 1 below illustrates the impact on the MTR from scenario analysis revising Ofcom’s forecasts upwards.

Table 1: Scenario analysis results: 4G handset subscribers - Summary

	Description	2014/15	2015/16	2016/17	2017/18
Ofcom's base case		0.5391	0.5147	0.4975	0.4764
Scenario 1	Mirrors EE's 4G subscriber numbers in 2013/14 Q3 – 2014/15 Q1, adjusted for market share	0.5106	0.4768	0.4462	0.4170
% change		-5.3%	-7.4%	-10.3%	-12.5%
Scenario 2	Mirrors average market data in 2013/14 Q4	0.5062	0.4670	0.4403	0.4009
% change		-6.1%	-9.3%	-11.5%	-15.8%

Source: Deloitte analysis, 2014 MCT Model

¹ EE (2014), EE reaches two million 4G customers as uptake accelerates, Accessed 24/07/2014, <http://explore.ee.co.uk/our-company/newsroom/ee-reaches-two-million-4g-customers-as-uptake-accelerates>

4G data usage per subscriber

Ofcom's forecasts underestimate the amount of data usage of both 4G handset and 4G datacard users according to usage patterns observed in the market. Operators' reports on data usage per subscribers indicate both usage levels for 2013/14 and future forecasts need to be revised upwards. For example, EE reports that the usage per 4G data subscriber was 1.4GB per month in 2012/13 Q4 (approximately four times higher than Ofcom's combined handset and datacard usage per subscriber in 2013/14 Q3), and O2 Germany reported that its 4G smartphones used three times as much data as its other handsets (which would suggest levels of 4G usage approximately six times higher than those in Ofcom's 2014 model in 2013/14 Q3).^{2 3}

Scenario analysis was conducted to take this into account, the results of which are shown in Table 2 below.

Table 2: Scenario analysis results: 4G data usage - Summary

	Description	2014/15	2015/16	2016/17	2017/18
Ofcom's base case		0.5391	0.5147	0.4975	0.4764
Scenario 3	Models EE's 4G data usage per subscriber and uplifts Ofcom's forecast by a ratio of 4:1	0.5020	0.4852	0.4679	0.4453
% change		-6.9%	-5.7%	-6.0%	-6.5%
Scenario 4	Uplifts Ofcom's 4G usage by a ratio of 6:1	0.4950	0.4788	0.4605	0.4362
% change		-8.2%	-7.0%	-7.4%	-8.4%

Source: Deloitte analysis, 2014 MCT Model

Datacard penetration

Ofcom has revised downwards significantly its assumption on datacard penetration compared to the forecasts made in the 2011 MCT model. However, market evidence suggests that possible reductions in the number of dongle users will be offset by growth in tablets with embedded SIMs. For example, Enders Analysis predicts a tablet penetration rate of 63% in 2020.⁴ Even keeping the current proportion of embedded SIM cards within tablets constant at 20%, this would imply a tablet datacard penetration of 12.6%. When considered with Mintel's prediction that the penetration rate of SIM-enabled tablets will increase, and the likelihood that there will remain other forms of datacard in the market, this suggests a datacard penetration rate closer to 20%.⁵

² Ofcom (2013): The Communications Market Report, Accessed on 10/07/2014, p. 316, http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr13/2013_UK_CMR.pdf

³ GSMA (2014): 4G driving data usage but not all markets reaping the rewards, para. 8, Accessed on 21/07/2014, <https://gsmaintelligence.com/files/analysis/?file=2014-01-20-4g-driving-data-usage-but-not-all-markets-reaping-the-rewards.pdf>

⁴ Enders Analysis (2014): UK internet device and consumption forecasts to 2020, p. 6

⁵ Mintel (2014): Rise of the 4G Tablet, Accessed 14/07/2014, <http://oxygen.mintel.com/display/699884>.

Considering this evidence would reduce the MTRs over the review period, as evidenced in Table 3 below.

Table 3: Scenario analysis results: Datacard penetration - Summary

	Description	2014/15	2015/16	2016/17	2017/18
Ofcom's base case	Assumes growth in penetration rate to 20% in 2019/20 Q4	0.5391	0.5147	0.4975	0.4764
Scenario 5		0.5312	0.5078	0.4889	0.4659
% change		-1.5%	-1.3%	-1.7%	-2.2%

Source: Deloitte analysis, 2014 MCT Model

Other changes to traffic related assumptions were also considered. However, these have a less significant impact on the MTR results.

Combined scenarios

Scenarios were run which present combinations of the most conservative cases of the various parameters discussed above. This resulted in a substantial reduction in the MTR of 25.5% in 2017/18. However, combining all scenarios above resulted in total projected data traffic at the market level which lies above the total forecast by Cisco in 2018.⁶ An additional scenario was run which calibrates the inputs to bring the forecasts in line with Cisco's forecasts. This predicts a reduction in the MTR in 2017/18 of 16.6%.

Table 4: Scenario analysis results: Combined scenarios- Summary

	Description	2014/15	2015/16	2016/17	2017/18
Ofcom's base case		0.5391	0.5147	0.4975	0.4764
Scenario 6	Combines scenarios 1, 3 and 5	0.4763	0.4544	0.4197	0.3549
% change		-11.7%	-11.7%	-15.6%	-25.5%
Scenario 7	Adjustment for total data traffic	0.4828	0.4598	0.4303	0.3974
% change		-10.4%	-10.7%	-13.5%	-16.6%

Source: Deloitte analysis, 2014 MCT Model

⁶ Cisco (2014): VNI Forecast Widget, Accessed 18/07/2014, <http://www.ciscovni.com/forecast-widget/advanced.html>

1 Introduction

As part of its periodic review of markets subject to ex ante regulation, on 4th June 2014, Ofcom issued a consultation document for the regulation of the wholesale mobile call termination (“MCT”) market for the period of 1st April 2015 – 31st March 2018.⁷ Responses to the consultation from stakeholders are to be submitted by 13th August 2014, and a final statement is expected to be published by Ofcom by March 2015.

As part of this consultation, Ofcom has also published the updated version of the bottom-up cost model, on the basis of which mobile termination rates (“MTRs”) are calculated. The model was originally developed by Ofcom with its consultants Analysys Mason as part of previous MCT market reviews, but several changes have been made by Ofcom in this latest version. In particular, Ofcom has introduced the modelling of a 4G network and updated several traffic related parameters.

In this context, Deloitte has been engaged by BT to undertake a review of the changes made by Ofcom to service volume forecasts and other specific parameters related to the calculation of traffic load. These are mostly contained in the “Traffic” module of the model. This is the first of the five modules of which the MTR bottom-up model is composed and calculates service volumes on the basis of which the network of the modelled operator is dimensioned (in the “Network” module).

The purpose of this report is to outline the results of the review of Ofcom’s specification of key parameters and comparisons of Ofcom’s forecasts with publicly available information. This report is structured as follows:

- Section 2 contains a discussion of the newly introduced variables related to the introduction of 4G technology into the model, as well as a discussion of the main changes that have been made by Ofcom in relation to other traffic forecasts;
- Section 3 discusses the assumptions and the results of the scenario analysis conducted in relation to the migration of subscribers onto 4G;
- Section 4 discusses the assumptions related to 4G data usage per subscriber and presents the results of the scenario analysis related to this assumption;
- Section 5 contains a discussion of the assumptions regarding datacard penetration and the results of the scenario analysis related to these assumptions; and
- Section 6 summarises the cumulative impact of combining the scenarios discussed in the previous sections.

⁷ Ofcom (2014), Mobile call termination market review 2015-18, henceforth referred to as “Ofcom Consultation documentation”

2 Voice and data traffic in the 2014 MCT Model

The first step in the calculation of termination rates is the calculation of service volumes that the hypothetical efficient operator modelled has to accommodate in its network. These are calculated in the “Traffic” module of the model. These traffic volume forecasts are used to determine the load on the network, according to which the network of the modelled operator is dimensioned in the Network module. This in turn drives the calculation of the total network’s cost (opex and capex), performed in the “Cost” module. Traffic forecasts for incremental voice services are then also used to calculate the incremental unit cost per minute of delivering termination services.

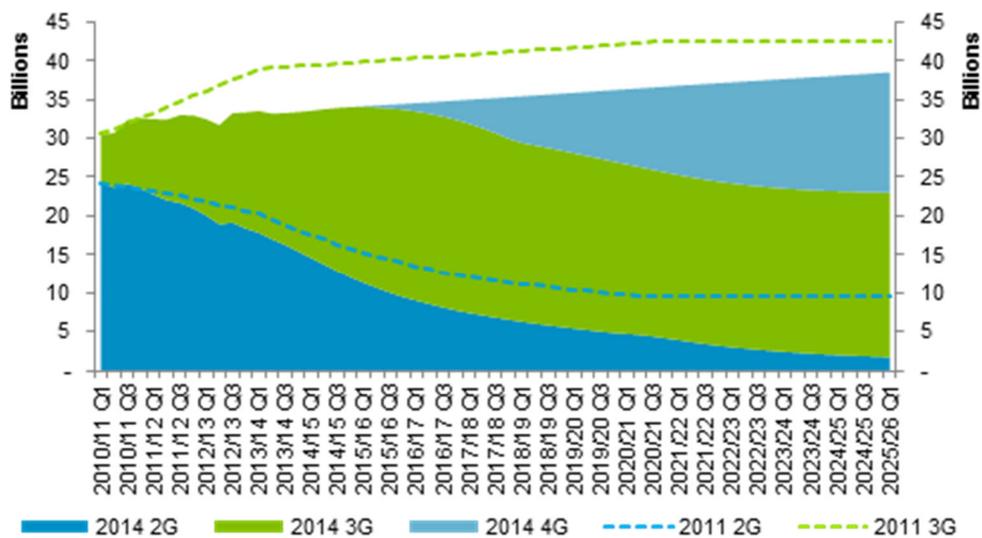
Given their importance in driving the results of the model, it is therefore important to ensure that traffic forecasts and assumptions for the hypothetically efficient operator are reflective of the reality of the UK market.

2.1 Total voice and data traffic in the 2014 MCT model

2.1.1 Voice traffic

Figure 1 below illustrates the total outgoing voice traffic in the 2014 MCT model in comparison with the 2011 MCT model.

Figure 1: Total outgoing voice traffic by technology

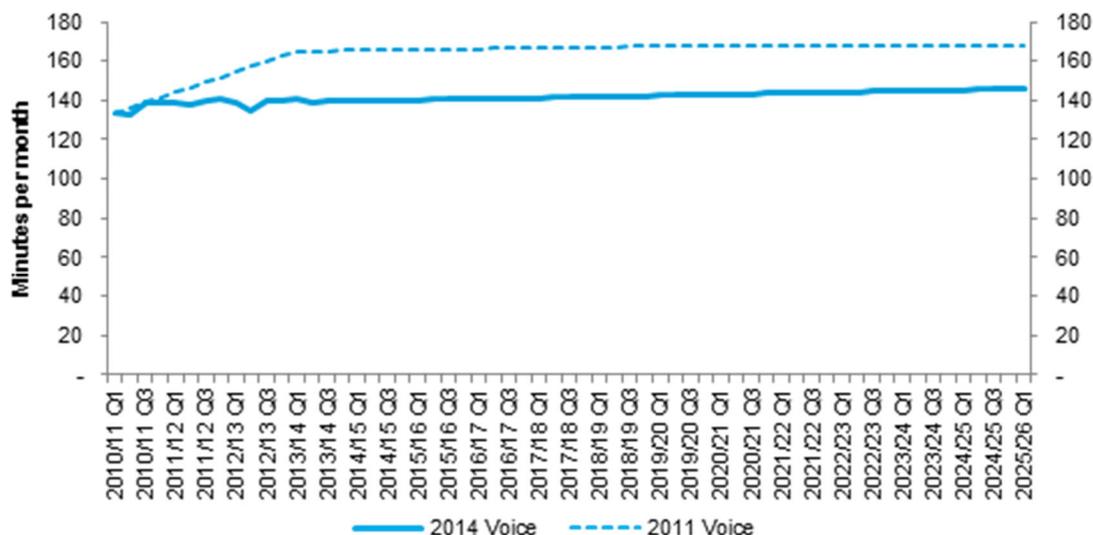


Source: MCT Model, Deloitte analysis

As can be seen from the figure above, total outgoing voice traffic at the market level is lower in the 2014 model than in the 2011 model. This is primarily due to a downward revision of the

assumptions regarding voice usage per subscriber in the new model.⁸ Ofcom’s analysis of historical usage per subscriber showed that the growth in voice minutes per subscriber that had been predicted did not materialise in practice. Therefore, Ofcom has now forecast that voice usage per subscriber will remain relatively flat for the rest of the period, as illustrated in Figure 2 below.

Figure 2: Voice usage per subscriber (minutes/month)



Source: MCT Model, Deloitte analysis

The 2014 MCT Model assumes that the hypothetically efficient operator operates a 4G network from 2012/13 onwards. 4G has been introduced in the model to reflect the fact that all four major Mobile Network Operators (MNOs) have already launched 4G services. Whilst the 4G network is mostly used for data services, the 2014 MCT Model also 4G voice services. This has implications for the proportion of voice traffic carried on the different technologies in the 2014 MCT model, which therefore vary from the 2011 MCT model, as Figure 1 above showed. 2G voice usage continues to decline (as in the 2011 model), but it is predicted to decline at a higher rate. Further, in the 2014 model, voice migrates increasingly to 4G devices as 4G voice technology develops from 2015/16. By 2025/26, 4G voice usage remains below 3G as the number of handsets that are 4G voice enabled lags behind the total number of 4G handsets.

Given the limited availability of alternative data and forecasts regarding voice traffic, no scenario on these inputs and assumptions has been performed.

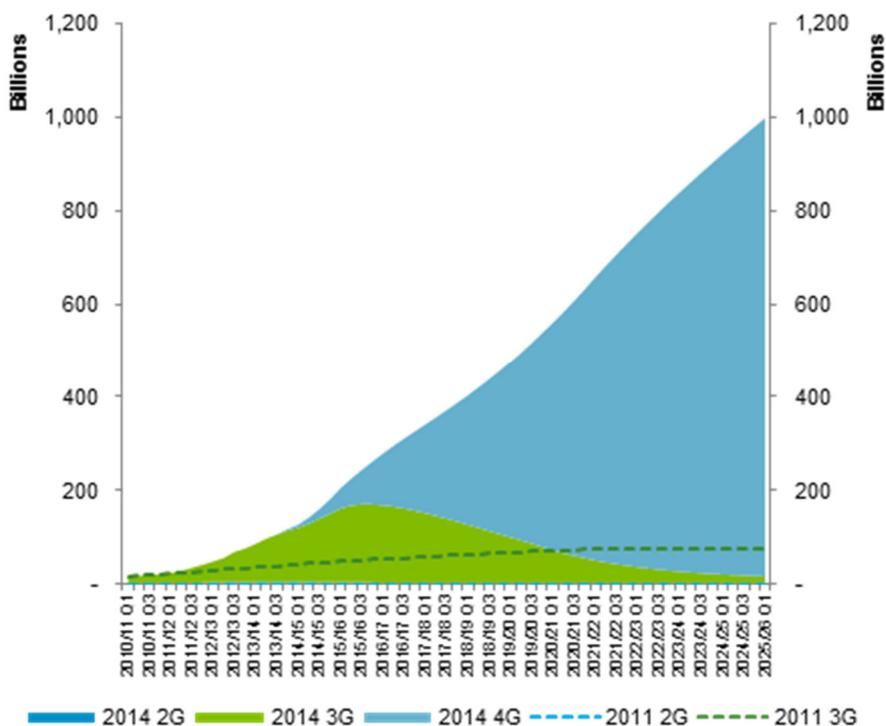
2.1.2 Data traffic

The introduction of 4G modelling into the model has significant implications for the amount of total traffic assumed. In particular, as 4G networks have been deployed by MNOs primarily to cater for increasing data traffic, it is to be expected that the introduction of 4G in the 2014 model would result in significant changes to data traffic forecasts compared to the 2011 MCT model.

⁸ Details on this assumption can be found in Table 13 in the appendix.

Total data traffic assumptions in the 2011 and 2014 models are displayed in Figure 3 below. Data traffic assumptions are presented at the market level so as to allow assessments of their reasonableness to be made at the aggregate, rather than operator level. Further, this allows comparisons to be made to the 2011 model outputs, independent of market share assumptions.

Figure 3: Data usage by technology (Mb)



Source: MCT Model, Deloitte analysis

As expected, the above figure shows significant increases in the total data traffic in the 2014 model in comparison with the 2011 MCT model as a result of subscriber migration to 4G combined with higher modelled data usage per subscriber for 4G customers. As can be seen from the figure above, however, Ofcom has assumed that as subscribers migrate to 4G devices, total data usage on 3G declines from 2015/16 onwards.

Despite the large upward revision in total data traffic forecasts between the 2011 MCT model and the 2014 MCT model, more recent evidence from the market seems to suggest that Ofcom is still underestimating data traffic in the current, as well as future periods. For example Cisco predicts that by 2018, mobile data traffic in the UK will reach 445 Petabyte (“PB”) per month, compared to approximately 120 PB predicted in the 2014 MCT model in 2017/18 Q4.⁹ Given this evidence and considering the rapid evolution of 4G deployment and service take up, as well as significant

⁹ Cisco (2014): VNI Forecast Widget, Accessed 18/07/2014, <http://www.ciscovni.com/forecast-widget/advanced.html>

developments in the market for data devices (tablets in particular), this review of the Ofcom's traffic forecasts and assumptions has therefore focused primarily on data traffic-related assumptions.

In particular, the analysis has focused on:

- 4G assumptions including speed of customers migration to 4G as well as assumed usage per subscriber; and
- Number of subscribers and usage of datacards.

2.1.3 4G volume assumptions

In order to allow a 4G network to be modelled, a number of new parameters and inputs had to be introduced in the model. These include:

- 1) **Number of 4G subscribers:** Ofcom assumes that handset migration occurs as a proportion of gross additions each year taking up 4G. 10% of gross additions take 4G in 2013/14 Q3; this proportion rises to 94.5% by 2021/22 Q1, after which it remains constant. 4G datacards are modelled through an assumption on the share of 4G datacards in total datacards. The proportion of datacards that are 4G is forecast to grow from 3.5% in 2013/14 Q3 to 94% in 2025/26 Q4.
- 2) **4G handset data usage per subscriber:** This is assumed to increase from 100 MB/month in 2013/14 Q2 to 3,833 MB/month in 2025/26 Q4.
- 3) **4G datacard usage per subscriber¹⁰:** Usage is forecast to rise from 250 MB/month in 2013/14 Q2 to 8,667 MB/month in 2025/26 Q4.

The assumptions on the number of 4G subscriber are further discussed in section 3. The assumptions regarding 4G handset and datacard usage are further discussed in section 4.

2.1.4 Changes to other volume forecasts and parameters

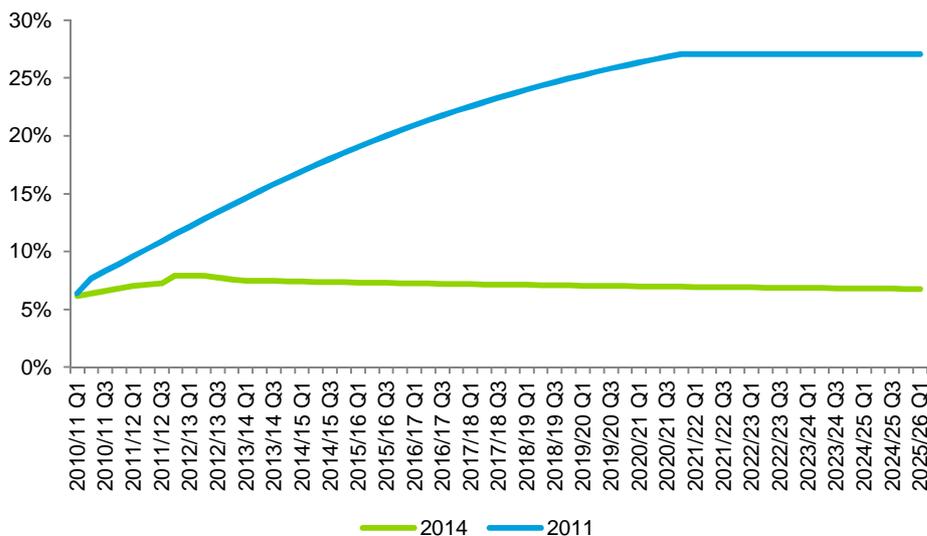
In addition to the changes to traffic assumptions due to the introduction of 4G discussed above, a number of other volume forecasts have been updated by Ofcom in the 2014 MCT model. Some of these changes appear to have limited impact on the model results, and therefore are not discussed in this report, although a summary of these changes is provided in Table 13 of Appendix A.

The assumptions regarding datacard penetration, however, appear to have been revised significantly, and this change has material implications for the model results. In particular, the assumptions regarding datacards have been changed as follows:

¹⁰ A more intuitive naming convention for this variable would be "data usage per 4G datacard subscriber", given that 4G datacard data is only used by 4G datacard subscribers. This variable is multiplied by 4G datacard subscribers, not total datacard subscribers, to derive the demand for 4G data traffic from handsets. We stick with Ofcom's naming convention here to avoid confusion.

- In the 2011 MCT model: Datacard penetration rises from 5.9% in 2009/10 Q4 to 15.2% in 2013/14 Q2 and 27.0% in 2020/21 Q4.
- In the 2014 MCT model: Datacard penetration rises from 5.9% in 2009/10 Q4 to a peak of 7.9% in 2011/12 Q4, then declines to 7.5% in 2013/14 Q2, and continues to decline to 6.7% in 2025/26 Q4.

Figure 4: Datacard penetration rates in 2011 and 2014 MCT models



Source: MCT Model, Deloitte analysis

The assumptions regarding datacard subscribers are further discussed in section 5 of this report.

The following sections focus on assessing the impact of these modelling assumptions on the outputs of the 2014 MCT model relevant to this charge control, i.e. the profile of MTRs across the period 2015-2018. First, parameter assumptions and forecasts are assessed against publicly available information. Then, scenario analysis is carried out to assess the impact on MTRs of amendments to Ofcom’s assumptions.

3 4G handset subscribers

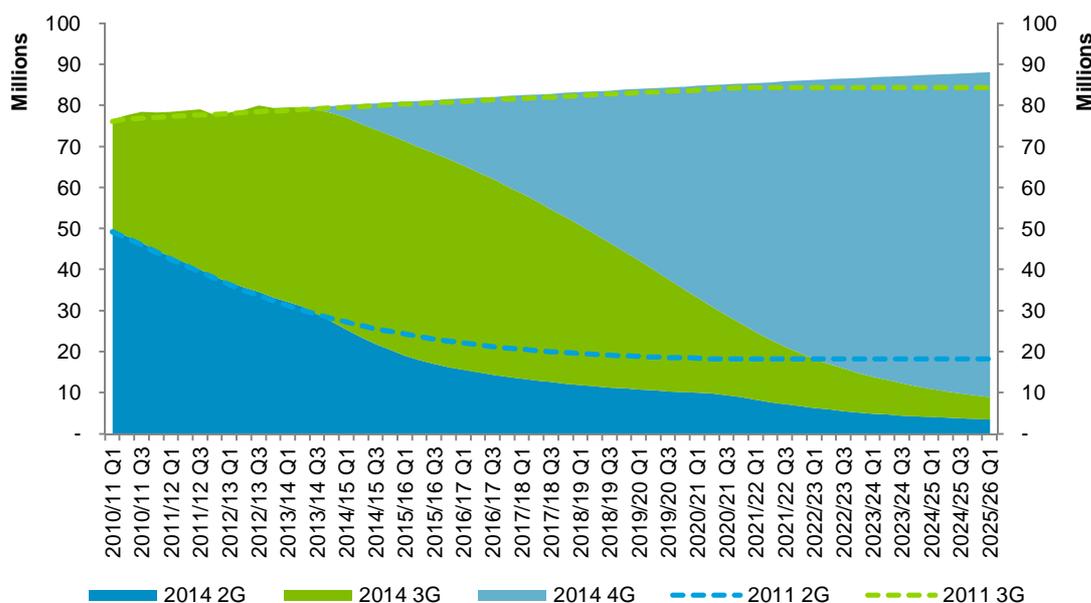
As explained in Section 2 above, the number of 4G handset subscribers is calculated in the model through assumptions regarding the proportion of churning subscribers taking up 4G services. These assumptions are discussed in this section.

3.1 Handset subscribers: comparison with 2011 MCT model

Forecasts regarding the total number of handset subscribers in the 2014 MCT model are largely consistent with the 2011 model. The number of handset subscribers is forecast to increase at an average growth rate of 0.9%. This forecast is marginally higher than the 2011 model predictions, which estimate growth at an average rate of 0.7%.

Figure 5 below illustrates total handset subscribers in the market.

Figure 5: Handset subscribers by technology



Source: MCT Model, Deloitte analysis

Two observations regarding the migration of subscribers across networks can be made:

- With the introduction of 4G in the 2014 model, much of the growth in the number of 3G subscribers predicted in 2011 has been replaced by growth in the number of 4G subscribers. This reflects the assumptions on handset migration.
- The uptake of 3G and then 4G handsets is more rapid in the 2014 model than originally predicted in the 2011 model, resulting in a quicker phasing-out of 2G (and then 3G) handset subscribers.

3.2 Handset subscribers by technology in the 2014 model

The following figure shows the breakdown of handset numbers by technology in the 2014 MCT model.

Figure 6: Handsets, shares by technology in the 2014 model



Technology	2017/18 Q1 (inner circle)	2025/26 Q1 (outer circle)
2G	16.3%	4.0%
3G	54.6%	6.3%
4G	29.1%	89.8%

Source: MCT Model, Deloitte analysis

3.3 Assessment of 4G handset assumptions against evidence from the market

The forecasts made by Ofcom regarding 4G handset subscribers have been compared with the most recent publicly available information to assess the extent to which such assumptions reflect the latest market developments.

In the 2014 MCT model, Ofcom assumes that users begin to take up 4G in 2013/14 Q3. In this quarter, the model assumes that 10% of new additions take up 4G. This then rises to 17% of new additions by 2014/15 Q1. This results in the modelled hypothetical efficient operator having approximately 182,000 4G subscribers in 2013/14 Q3, 419,000 subscribers in 2013/14 Q4, and 730,000 subscribers in 2014/15 Q1.

This is not reflected in the actual take-up of 4G observed by the mobile network operators. In particular,

- EE reported that it reached two million 4G subscribers by January 2014 (the beginning of 2013/14 Q4)¹¹; and
- 3, Vodafone and O2 reported that they reached 1.7 million, 500,000 and one million 4G subscribers respectively by February 2014.^{12, 13, 14}

¹¹ EE (2014), EE reaches two million 4G customers as uptake accelerates, Accessed 24/07/2014, <http://explore.ee.co.uk/our-company/newsroom/ee-reaches-two-million-4g-customers-as-uptake-accelerates>

This corresponds to a total of 5.2 million 4G subscribers in 2013/14 Q4, or a simple average of 1.3 million per operator across these four operators. Therefore, Ofcom appears to have underestimated the number of 4G subscribers in the period immediately after the launch of the service.

With respect to longer-term take-up of 4G, EE reported that it had reached 3.6 million 4G subscribers in May 2014 (2014/15 Q1 in the model) and predicts that 97% of its customer base will be 4G subscribers by 2018.^{15, 16} In Ofcom's model, the proportion of gross additions taking 4G handsets is predicted to only reach 60.5% in 2017/18 Q4.

It therefore appears to be the case that Ofcom has significantly underestimated the migration to 4G handsets, both in the short and longer term. Uptake of 4G handsets among the four largest operators has already been more rapid than predicted in the model until this date, and it is likely that this trend will continue.

These assumptions also seem to be inconsistent with other assumptions made by Ofcom in relation to the spectrum. For instance, Ofcom assumes that 2x10 megahertz (MHz) of 1,800MHz spectrum previously used for 2G is refarmed for 4G use in 2012/13, in line with Ofcom's decision to allow EE to refarm its 1,800MHz spectrum for 4G usage which took effect in September 2012.¹⁷ However, Ofcom then assumes that there are no 4G subscribers before Q3 of 2013/14, and take-up is slow as evidenced above. This appears counterintuitive; in order for the model to capture the most efficient roll-out of 4G, the modelled operator could be allowed to gain subscribers much more quickly, more in line with EE's experience.

3.4 Scenario analysis: 4G subscribers

This section presents the results of scenario analysis in which Ofcom's assumptions are replaced by alternative assumptions, consistent with the market evidence discussed above.

¹² O2 (2014), O2 4G reaches a third of the UK population as network modernisation programme is unveiled, para. 2, Accessed 21/07/2014, <http://news.o2.co.uk/?press-release=o2-4g-reaches-a-third-of-the-uk-population-as-network-modernisation-programme-is-unveiled>

¹³ Mobile Today (2014), Vodafone signs up 500,000 customers to 4G service, para. 1, Accessed 24/07/2014, <http://www.mobiletoday.co.uk/news/industry/28302/vodafone-signs-up-500000-customers-to-4g-service.aspx>

¹⁴ V3 (2014), Three reveals 1.7 million 4G users on network, Accessed 18/07/2014, <http://www.v3.co.uk/v3-uk/news/2331547/three-reveals-17-million-4g-users-on-network>

¹⁵ EE (2014), EE unveils plans to increase 4G accessibility and transform the user experience as 4G overtakes 3G, para. 1, Accessed 10/07/2014, <http://ee.co.uk/our-company/newsroom/ee-unveils-plans-to-increase-4g-accessibility-and-transform-the-user-experience-as-4g-overtakes-3g>

¹⁶ Juniper Network (2014), EE Completes Migration to National IP/MPLS Network With Juniper Networks, para. 7, Accessed 17/07/2014, <http://newsroom.juniper.net/press-releases/ee-completes-migration-to-national-ip-mpls-network-nyse-jnpr-1126085>

¹⁷ Ofcom Consultation documentation, Annex 11, Page 92

Overall, increasing the number of 4G subscribers causes the blended MTR to fall. This fall is driven by two main effects:

- First, the 4G incoming voice termination rate drops because 4G equipment can carry very high levels of capacity, and 4G subscribers use proportionately much more data than voice. Therefore as the number of 4G subscribers increases, the network becomes more loaded with data traffic and the marginal cost of incoming voice decreases.
- Second, the increased number of 4G subscribers means that the 4G termination rate has a higher weight when calculating the blended termination rate. Since the 4G termination rate is lower than the 2G and 3G termination rates, increasing its weight will decrease the blended rate.

3.4.1 Scenario 1 - EE 4G subscriber numbers

Scenario 1 models an efficient operator that has the same proportion of 4G subscribers as EE did between 2013/14 Q3 and 2014/15 Q1 (adjusted for market share), and follows EE's projected migration pattern thereafter.¹⁸

EE's reported number of 4G subscribers in September 2013, January 2014 and May 2014 are used to revise the number of 4G subscribers in 2013/14 Q3, 2013/14 Q4 and 2014/15 Q1 respectively. However, EE's reported numbers are revised downwards to allow for EE's larger market share than the hypothetical efficient operator (32.3% in 2013 vs approximately 23.7% in the 2014 MCT model).¹⁹ This results in 736,000 4G handset subscribers in 2013/14 Q3, rising to 2,654,000 in 2014/15 Q1 (instead of 182,000 in 2013/14 Q3 and 730,000 in 2014/15 Q1 as assumed in Ofcom's 2014 model).

From 2014/15 Q2, the proportion of gross additions taking 4G enabled handsets is assumed to grow at a constant growth rate of 3% per quarter to 97% in 2017/18 Q4, and to remain flat at 97% thereafter. This is slightly slower than EE's forecasts, which anticipate that 97% of its total subscriber base will be 4G by 2018. In Ofcom's model, the proportion of gross additions taking 4G handsets is predicted to only reach 60.5% in 2017/18 Q4, and rises to 94.5% by 2021/22 Q1, remaining flat at 94.5% thereafter.

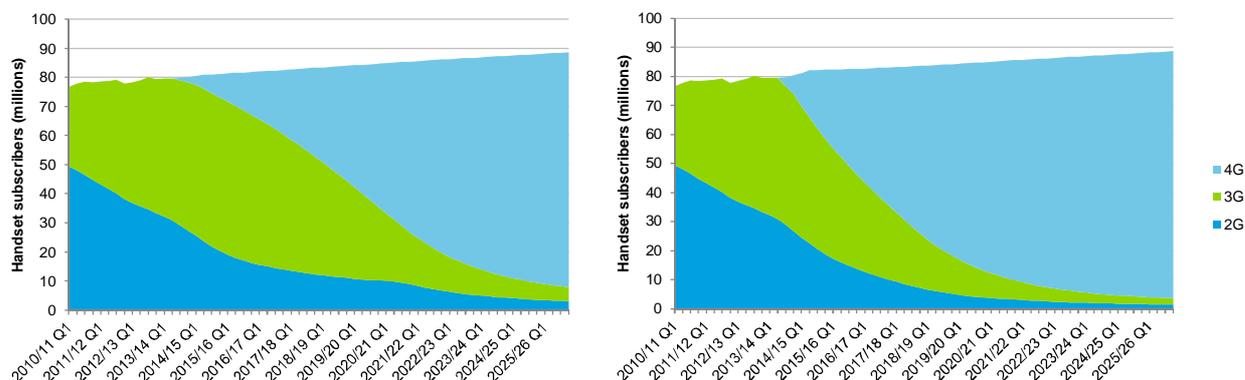
As the number of subscribers overall is kept the same as in the Ofcom's model, the higher 4G additions in this scenario are at the expense of 3G and 2G additions.

Figure 7 below illustrates the impact of these assumptions on the profile of handsets by technology over time.

¹⁸ As discussed in Section 3.3

¹⁹ Paul Budde Communication Pty Ltd (2014), United Kingdom - Mobile Market Insights, Statistics and Forecasts, p. 8

Figure 7: Original (left) and new (right) profile of handset subscribers by technology



Source: MCT Model, Deloitte analysis

Scenario 1 results in a blended termination rate that is 12.5% below Ofcom’s base case in 2017/18.

Table 5: Scenario 1 impact on MTR

	2014/15	2015/16	2016/17	2017/18
2G	0.5961	0.5834	0.5815	0.5851
3G	0.4591	0.4448	0.4432	0.4487
4G		0.2320	0.2296	0.2345
Blended	0.5106	0.4768	0.4462	0.4170
Ofcom’s base case	0.5391	0.5147	0.4975	0.4764
% change	-5.3%	-7.4%	-10.3%	-12.5%

Source: MCT Model, Deloitte analysis

3.4.2 Scenario 2 – Average subscriber uplift

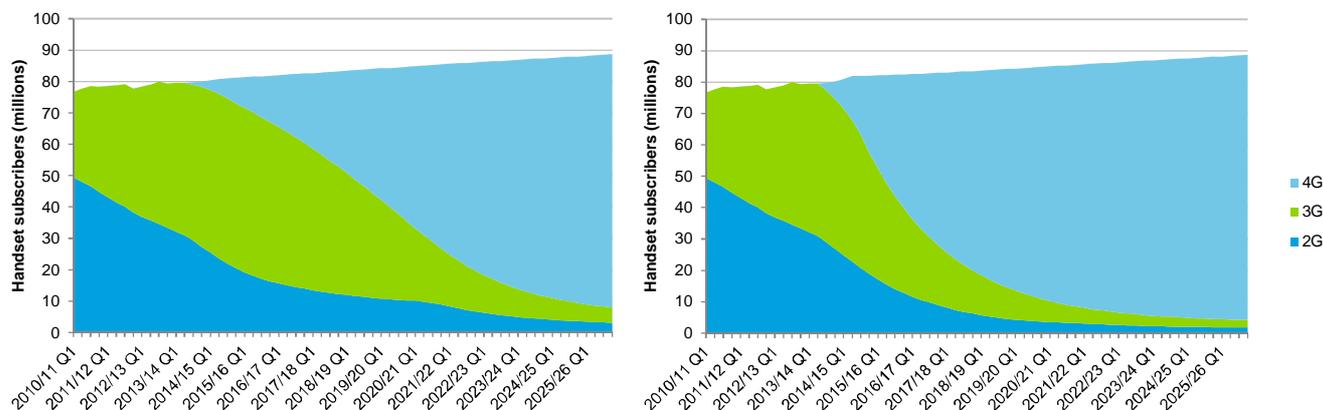
Scenario 2 is similar to scenario 1, but uses the average number of 4G subscribers that the four major operators reported in 2013/14 Q4 (1.3 million) to calculate 4G subscribers in the model.²⁰

Ofcom’s predicted level of 4G handset subscribers per operator in 2013/14 Q4 is less than a third of the average level reported by the operators. To correct for this, the proportion of gross additions taking 4G handsets is therefore increased by a factor of approximately 3 until 2014/15 Q4, in order to provide an uplift to the number of 4G subscribers. This translates into an assumed proportion of gross additions taking 4G handsets of 32% in 2013/14 Q3 (compared to 10% in Ofcom’s base case), rising to 96% from 2014/15 Q4 onwards (compared to 29% in Ofcom’s base case).

Figure 8 below illustrates the impact of changing these assumptions as described above. Comparing scenario 1 and 2, scenario 2 models faster migration of subscribers onto 4G than scenario 1.

²⁰ As discussed in Section 3.3

Figure 8: Original (left) and new (right) profile of handset subscribers by technology



Source: MCT Model, Deloitte analysis

The results of this scenario suggest an MTR in 2017/18 in a blended termination rate that is 15.3% below Ofcom’s base case.

Table 6: Scenario 2 impact on MTR

	2014/15	2015/16	2016/17	2017/18
2G	0.5896	0.5751	0.5802	0.5772
3G	0.4576	0.4384	0.4462	0.4443
4G		0.2246	0.2274	0.2299
Blended	0.5076	0.4682	0.4418	0.4037
Ofcom's base case	0.5391	0.5147	0.4975	0.4764
% change	-5.8%	-9.0%	-11.2%	-15.3%

Source: MCT Model, Deloitte analysis

As in scenario 1, this scenario results in a lower MTR throughout the period.

In summary, Ofcom’s assumption on 4G subscriber growth is below the experience of the UK market. Bringing the 2014 MCT model in line with the recent evidence from the market suggests that the MTR should be between 5.3% and 5.8% lower than that proposed by Ofcom for 2014/15 and between 12.5% and 15.3% lower in 2017/18.

4 4G data usage per subscriber

Section 2 described two additional parameters introduced in the 2014 MCT model; namely 4G handset data usage per subscriber and 4G datacard data usage per subscriber. This section reviews Ofcom's assumptions regarding these parameters.

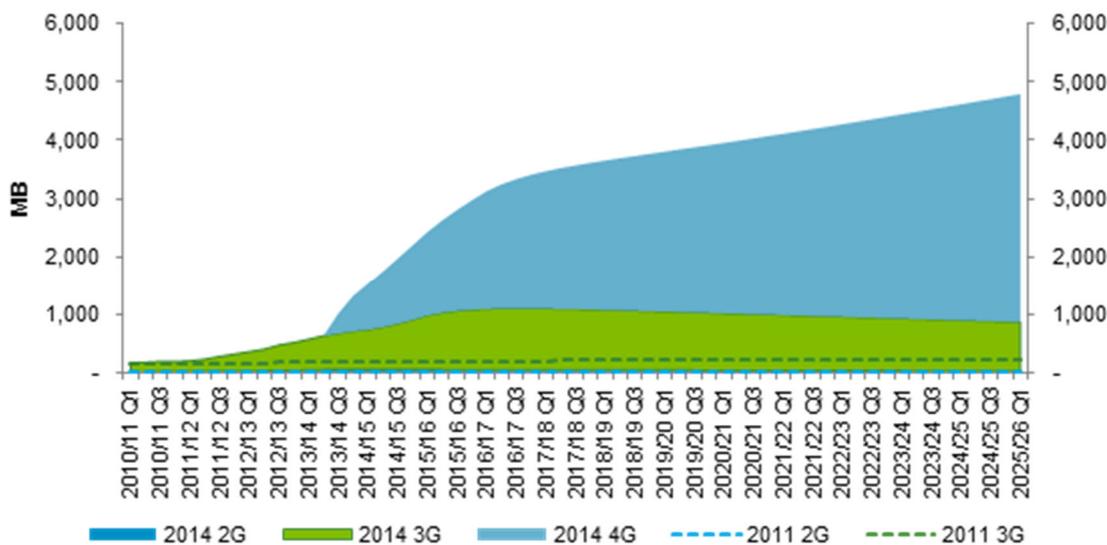
4.1 Data usage per subscriber: comparison with 2011 MCT model

Figure 9 below illustrates the weighted average data usage per subscriber across handsets and datacards in the 2014 model, compared to the corresponding 2011 assumptions. This comparison shows that:

1. 4G data use per subscriber is generally higher than 3G data usage per subscriber.²¹ 4G data usage per subscriber is forecast to be below 3G usage per subscriber between 2013/14 Q2 and 2013/14 Q4, but by 2014/15 Q1 4G handset data usage per subscriber is forecast to reach 676 MB/month compared to 638 MB/month for 3G handsets, while 4G datacard usage per subscriber is forecast to reach 1,689 MB/month compared to 1,298 MB/month for 3G datacards. This difference increases thereafter; by 2025/26 Q4, 4G handsets are forecast to use 3,833 MB/month Q4 compared to 823 MB/month for 3G handsets, and 4G datacards are forecast to use 8,667 MB/month compared to 796 MB/month for 3G datacards.
2. Increases in 4G data usage per subscriber drive overall increases in data usage per average subscriber. Although Ofcom significantly increased 3G data usage per subscriber in the 2014 model compared to the 2011 model, in line with the observed market trend in the past few years, it is not as significant as 4G data usage per subscriber in the later periods. In particular, in the 2014 model, whilst 3G data usage per subscriber increases until 2016/17 Q4, it is modelled to decrease thereafter as higher intensity users are assumed to migrate to 4G.

²¹ Recall from footnotes 3 and 4 above that "4G data usage per subscriber" refers to data used by 4G subscribers. Similarly, "3G data usage per subscriber" refers to data used by 3G subscribers.

Figure 9: Data usage per subscriber (MB)



Source: MCT Model, Deloitte analysis

4.2 Assessment of 4G data usage assumptions compared to actual usage observed

This section compares Ofcom’s assumptions regarding 4G data usage per subscriber with the most recent publicly available information, in order to assess how closely the model assumptions made by Ofcom reflect the latest trends observed and expected. This analysis suggests that Ofcom underestimates the 4G data usage for both handset and datacard subscribers.

In particular, Ofcom’s model assumes that 4G handset data usage per subscriber is 100 MB/month in 2013/14 Q2 (although in this quarter the model does not yet have any 4G subscribers), rising to 270 MB/month in 2013/14 Q3. 4G datacard usage per subscriber is assumed to be 250 MB/month and 675 MB/month in these quarters. However market data suggest significantly higher usage assumptions might better reflect current conditions.

For example, Ofcom’s Communication Market Report 2013 observes that EE was already seeing average usage per 4G subscriber of 1.4 GB/month in February 2013.²² This appears to include both handset and datacard subscribers, but even when taking the weighted average 4G usage per subscriber for handsets and datacards as modelled in the 2014 MCT model for this period, Ofcom’s modelled assumptions remain below this level of 4G data usage across handsets and datacards until 2015/16 Q1.

²² Ofcom (2013): The Communications Market Report, Accessed on 10/07/2014, p. 316, http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr13/2013_UK_CMV.pdf

Similarly, the GSMA has suggested that Vodafone's European 4G smartphone subscribers used twice as much data as their 3G counterparts in the first quarter of 2013, and that in Germany, O2's 4G smartphones users used on average three times as much data as those with non-4G smartphones.²³

On the basis of these figures, the model significantly underestimates the levels of 4G data usage, both for the historical period up to 2014/15 Q2, and in the forecast period thereafter. It can also be noted that actual data usage has consistently exceeded Ofcom's expectations modelled in previous versions of the model, which may suggest a systematic underestimation of data usage by Ofcom.

This conclusion seems to be also supported by other assumptions made by Ofcom in other sections of the 2014 model. For example, Ofcom has revised upwards the proportion of data traffic in busy days, from 72% to 100%, following, according to Ofcom's explanation, a calibration exercise²⁴. It seems counterintuitive that no data traffic is being generated in non-busy days. This could be interpreted to suggest that the estimates of total data traffic in busy days would, with a more realistic assumption on the proportion of data traffic in busy days, generate insufficient load on the network and therefore lead to a network dimensioning out of line with that observed for the MNOs.

4.3 Scenario analysis: 4G data usage per subscriber

This section presents the results of scenario analysis in which Ofcom's assumptions are replaced by alternative assumptions, more in line with the market evidence discussed above.

Overall, increasing 4G data usage per subscriber decreases the blended MTR. This is driven by the fact that, as 4G subscribers use proportionally more data, the marginal cost of incoming voice on 4G decreases. Given that 4G has a lower weighting in the blended MTR than the 2G and 3G MTRs, the blended MTR falls. Further, there is a knock-on effect on 2G and 3G MTRs, lowering them as well: as radio interface traffic becomes increasingly dominated by 4G data traffic, Shared Radio Access Network (S-RAN) costs attributed to 3G and 2G traffic fall, meaning that the marginal cost 2G and 3G incoming voice also decreases.

4.3.1 Scenario 3 – EE 4G data usage per subscriber

Scenario 3 models the experience of EE described above. It assumes that the weighted average of 4G handset and datacard usage per subscriber is 1.4GB in 2013/14 Q3. This is the level that EE reported in February 2013.²⁵

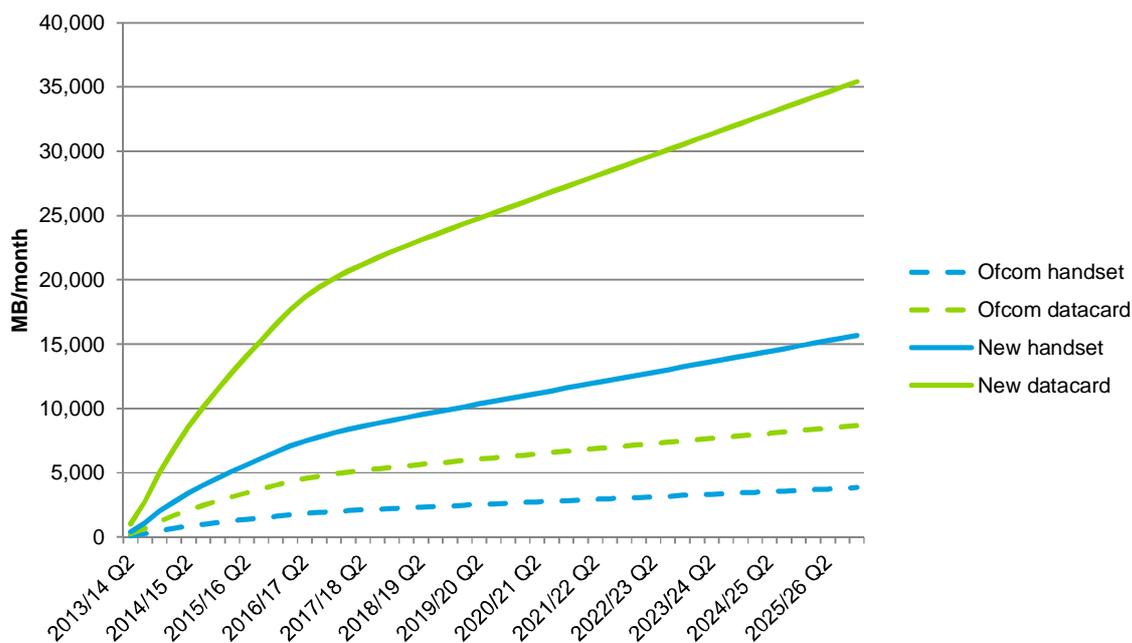
²³ GSMA (2014): 4G driving data usage but not all markets reaping the rewards, para. 8, Accessed on 21/07/2014, <https://gsmaintelligence.com/files/analysis/?file=2014-01-20-4g-driving-data-usage-but-not-all-markets-reaping-the-rewards.pdf>

²⁴ See Ofcom's 2014 MCT model, workbook "2 – Network", sheet "Cost drivers", cell J12.

²⁵ As discussed in Section 4.2. Whilst this figure was reported by EE in 2012/13 Q4, it is used in the model as a proxy for 2013/14 Q3, when 4G subscribers are introduced in the model.

The ratio between 1.4GB and data usage per subscriber in Ofcom's base case in 2013/14 Q3 (approximately 4:1) is used to forecast data usage for the rest of the modelling period. Figure 10 below illustrates the comparative profiles for 4G handset and datacard usage per subscriber.

Figure 10: Comparison of Scenario 3's 4G data usage per subscriber with Ofcom's base case



Source: MCT Model, Deloitte analysis

This scenario results in a blended MTR that is 6.5% below Ofcom's base case rate in 2017/18.

Table 7: Scenario 3 impact on MTR

	2014/15	2015/16	2016/17	2017/18
2G	0.5727	0.5693	0.5675	0.5660
3G	0.4564	0.4526	0.4512	0.4490
4G		0.2346	0.2295	0.2235
Blended	0.5020	0.4852	0.4679	0.4453
Ofcom's base case	0.5391	0.5147	0.4975	0.4764
% change	-6.9%	-5.7%	-6.0%	-6.5%

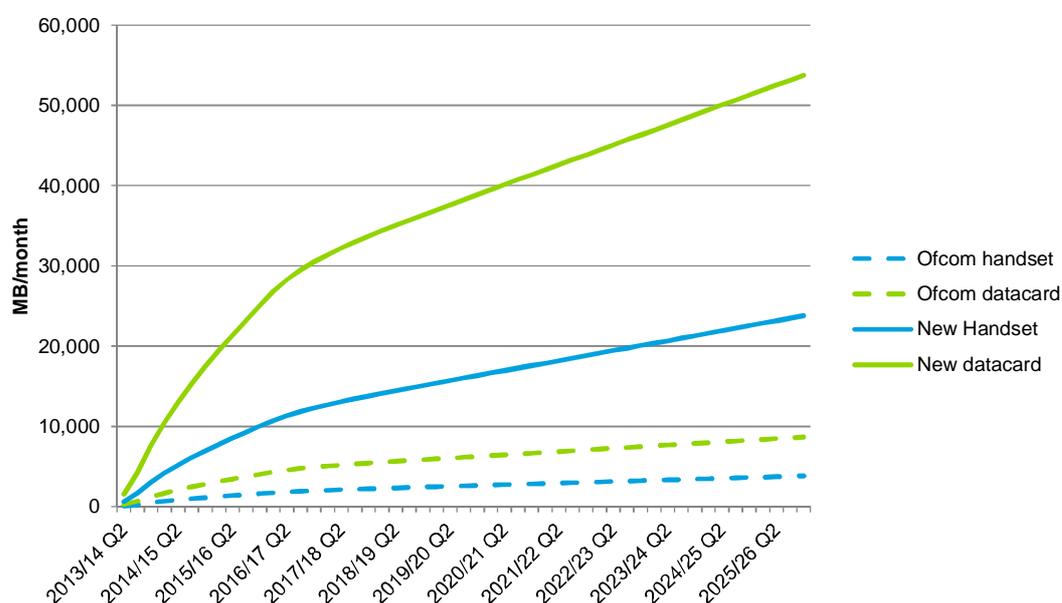
Source: MCT Model, Deloitte analysis

This scenario generates lower MTRs than in Ofcom's base case, throughout the charge control period. This occurs as the marginal cost of voice decreases because of the higher data usage. The lower MTR generated in this scenarios for periods before the introduction of 4G is due to the effect of the economic depreciation (as less costs are recovered overall in earlier years and more in future years, when usage is higher).

4.3.2 Scenario 4 – 4G data usage per subscriber 6x higher

Scenario 4 assumes that the 4G handset usage per subscriber is three times the level of 3G usage in 2013/14 Q3, in line with O2's estimated figures for handsets in Germany.²⁶ This is a ratio of approximately 6:1 above Ofcom's estimate for 4G handset usage in 2013/14 Q3. Assuming that datacard usage is similarly higher²⁷, this scenario uses an amended profile for both 4G handset and datacard usage per subscriber, based on multiplying Ofcom's forecasts for 4G datacard and handset usage per subscriber by a factor of approximately 6 across the entire period. The amended profile is illustrated in Figure 11 below.

Figure 11: Comparison of Scenario 4's 4G data usage per subscriber with Ofcom's base case



Source: MCT Model, Deloitte analysis

This scenario results in a blended MTR that is 8.4% below Ofcom's base case rate in 2017/18.

²⁶ As discussed in Section 4.2

²⁷ This assumption seems reasonable – 4G datacard usage per subscriber in Ofcom's base case appears to be a mark-up on 4G handset usage per subscriber. 4G datacard usage per subscriber is a factor of 2.5 times higher than 4G handset usage per subscriber until 2016/17 Q1; the mark-up then falls gradually and by 2025/26 Q4 4G datacard usage per subscriber is a factor of 2.26 times higher than 4G handset usage per subscriber.

Table 8: Scenario 4 impact on MTR

	2014/15	2015/16	2016/17	2017/18
2G	0.5644	0.5613	0.5593	0.5575
3G	0.4502	0.4471	0.4453	0.4426
4G		0.2125	0.2045	0.1985
Blended	0.4950	0.4788	0.4605	0.4362
Ofcom's base case	0.5391	0.5147	0.4975	0.4764
% change	-8.2%	-7.0%	-7.4%	-8.4%

Source: MCT Model, Deloitte analysis

This scenario results in a lower MTR than in Ofcom's base case, throughout the period. This occurs as the marginal cost of voice decreases because of the higher data usage, as explained in scenario 3 above.

In summary, the assumptions made by Ofcom in relation to 4G data usage per subscriber appear to be significantly below the experience of UK and European players. Bringing the 2014 MCT model more in line with the evidence from the market, suggests that the MTR should be between 6.9% and 8.2% lower than that proposed by Ofcom for 2014/15 and between 6.5% and 8.4% lower in 2017/18.

5 Datacard subscribers

This section discusses the forecasts made by Ofcom in relation to datacard penetration in the 2014 MCT Model. As discussed below, these have been substantially revised downwards compared to the 2011 MCT model.

5.1 Datacard subscribers: comparison with 2011 model

In the 2014 MCT model, datacard penetration rates are assumed to decline slightly during the forecast period, and are significantly lower than those in the 2011 MCT model.

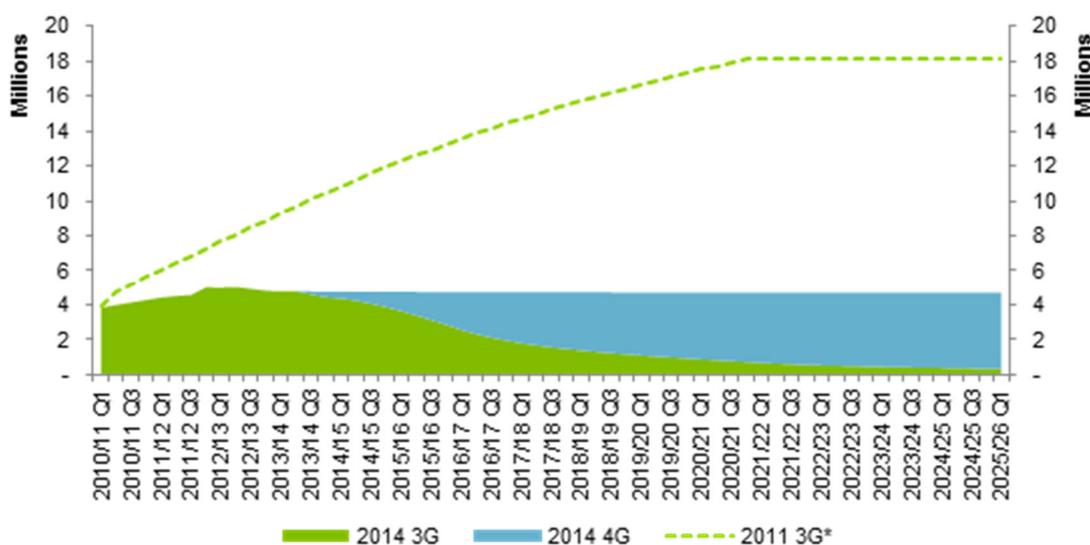
Table 9: Penetration rates in the 2011 and 2014 MCT models

	2009/10 Q4	2013/14 Q4	2017/18 Q4	2025/26 Q4
2011 model	5.9%	16.4%	23.7%	27.0%
2014 model	5.9%	7.4%	7.1%	6.7%

Combined with the assumed increase in population, these revised penetration assumptions result in the number of datacard subscribers staying approximately constant across time in the 2014 model.

This forecast differs substantially from that in the 2011 model, as evidence in Figure 12 below, showing datacard subscribers in the market by technology. In particular, the 2011 model forecasted a steady increase in the number of datacard subscribers to a peak of close to 18 million by 2020/21 (the end year of the 2011 model), whilst datacard subscribers in the 2014 model are assumed to stay at a level of around 4.7m for the remainder of the modelling period.

Figure 12: Datacard subscribers by technology (cumulative)



Source: MCT Model, Deloitte analysis. *Indicates all datacards in the 2011 model are assumed to use 3G technology.

5.2 Assessment of datacard penetration assumptions against evidence from the market

There is substantial evidence suggesting that the assumption of declining datacard penetration made by Ofcom significantly underestimates market trends.

Ofcom argues that the decline in datacard penetration rates recently observed will continue as a result of the introduction of 4G handsets. They argue that subscribers who might formerly have used a datacard will increasingly be able to meet their data needs by tethering other devices to their handset²⁸.

However, the decline in datacard penetration observed between 2010/11 and 2013/14 needs to be considered in the context of the rapid increase in penetration rates observed in the years prior to this date, and also in light of the significant potential for expansion in the tablet computer market.²⁹ Both of these factors suggest that recent decreases in penetration may only be short-lived.

In particular, rather than decreasing the proportion of subscribers who use datacards, the expansion of 4G take up can be expected to stimulate an increase in the use of SIM-enabled devices, in particular tablets. As the tablet market matures, tablet producers will increasingly compete on additional functionality like 4G connectivity. In its report "Rise of the 4G Tablet", Mintel predicts that US manufacturers will increasingly emphasise 4G tablets, possibly by decreasing pricing differentials to non-mobile broadband facilitated devices. Mobile operators in turn will also have an incentive to increase 4G tablet roll-out as they seek to expand their revenue streams and may thus contribute to a trend of increasing tablet penetration.³⁰

Even if the proportion of tablet owners making use of embedded SIMs does not increase with the roll-out of 4G, but instead remains at the current level of 20% of total owners (as reported in Ofcom's Communication Market Report 2013), this would still lead to a rise in the overall datacard penetration rate as the penetration of tablets in the population increases. Ofcom's Communication Market Report 2013 states that tablet computer ownership doubled in the 12 months up to Q1 2013, reaching 24% of UK households, while Enders Analysis predicts that tablet penetration will increase to 63% of the population by 2020.³¹ By this metric, tablet datacards alone will account for a datacard penetration rate of 12.6% by 2020.

²⁸ Ofcom (2014): Mobile call termination market review 2015-18, Annex 11, para. A11.96.

²⁹ According to Ofcom's consultation documentation, datacards include all devices capable of transmitting and receiving data excluding handsets and Machine to Machine (M2M) devices". Ofcom (2014): Mobile call termination market review 2015-18, Annex 11, footnote 31.

³⁰ Mintel (2014): Rise of the 4G Tablet, Accessed 14/07/2014, <http://oxygen.mintel.com/display/699884>, henceforth referred to as "Mintel (2014)".

³¹ Enders Analysis (2014): UK internet device and consumption forecasts to 2020, p. 6

5.3 Scenario analysis: Datacard penetration

This section presents the results of scenario analysis in which Ofcom's assumptions are replaced by alternative assumptions, more in line with the market evidence discussed above.

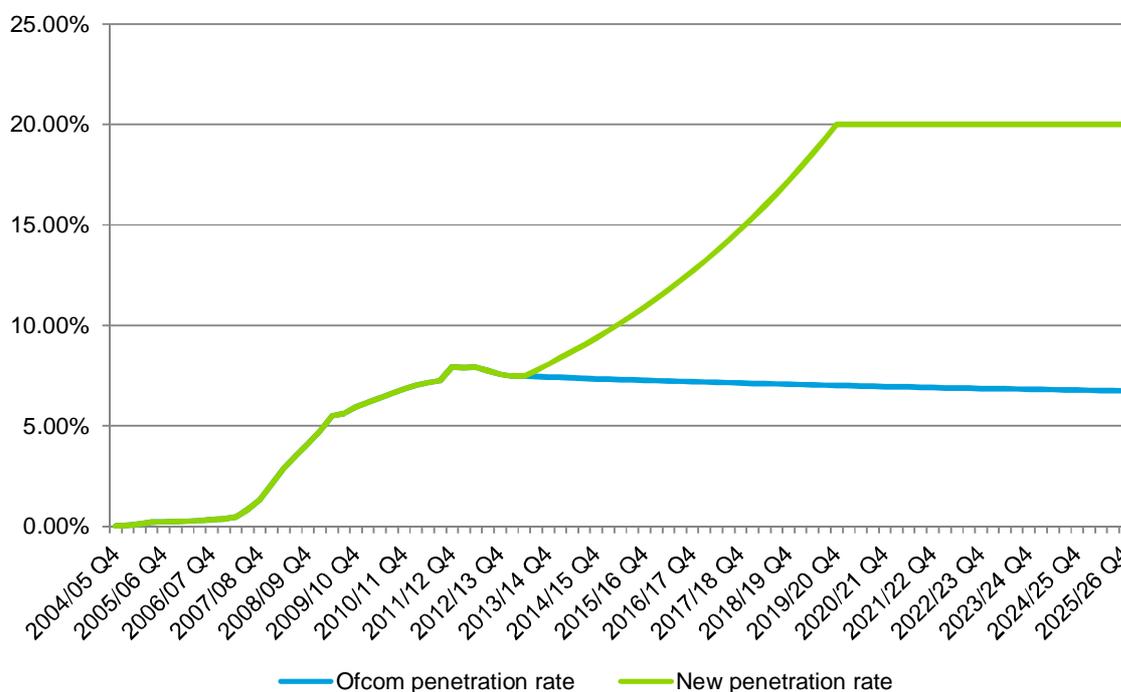
In general, decreasing the penetration rate of datacards has the effect of decreasing the blended MTR. This is because datacards only use data. Therefore, increasing datacard penetration rates increases the data traffic in the network (particularly 4G data) without a similar increase in voice traffic. As more data is used, the marginal cost of incoming voice decreases. However, the impacts observed are less significant than increases in handset penetration: the hypothetical efficient operator has a smaller datacard market share than handset market share in the price control period, and therefore increasing datacard penetration affects fewer of the operator's subscribers than a similar increase in handset penetration would.

5.3.1 Scenario 5 – High penetration, including tablets and dongles

Scenario 5 assumes that the tablet penetration rate will increase and that the proportion of tablets with embedded SIMs will also increase as producers and mobile operators increasingly market 4G tablet functionality, in line with Mintel's prediction for the US.³² It also assumes that there will remain other forms of datacards in the market, pushing up total datacard penetration rates to 20% (instead of 7.0% in Ofcom's base case) by 2019/20 Q4. Figure 13 below illustrates the amended profile assumed for datacard penetration.

³² Mintel (2014)

Figure 13: Comparison of new penetration rate with Ofcom’s base case penetration rate under Scenario 5



Source: MCT Model, Deloitte analysis

This scenario results in a blended MTR that is 2.2% below Ofcom’s base case rate in 2017/18, as evidenced in Table 10 below.

Table 10: Scenario 5 impact on MTR

	2014/15	2015/16	2016/17	2017/18
2G	0.6050	0.5970	0.5946	0.5931
3G	0.4837	0.4731	0.4705	0.4680
4G		0.2485	0.2458	0.2432
Blended	0.5312	0.5078	0.4889	0.4659
Ofcom’s base case	0.5391	0.5147	0.4975	0.4764
% change	-1.5%	-1.3%	-1.7%	-2.2%

Source: MCT Model, Deloitte analysis

In summary, the assumptions made by Ofcom in relation to datacard penetration do not appear to take into account the effect of tablet datacards and the potential expansion of this market, both as the penetration rate of tablets increases and as the prevalence of 4G SIMs in tablets rises. Bringing datacard assumptions in the 2014 MCT model more in line with what can be expected in the tablet market suggests that the MTR should be 1.5% lower than that proposed by Ofcom for 2014/15 and 2.2% lower in 2017/18.

6 Combined scenario analysis

The scenario analysis in the previous sections considered the effect on the MTR of amending the value of one parameter at the time. This section summarises the cumulative effect that changing these assumptions has on the MTR.

In running combined scenarios, a conservative approach was adopted, in which only the more conservative scenarios from the previous sections were considered for each variable. Nevertheless, substantial reductions in the MTR are estimated as a result of these combined scenarios, ranging to reductions of up to 26% in 2017/18. The sections below present the results to two scenarios, which amend the assumptions regarding all parameters discussed in this report simultaneously. The results to alternative combined scenarios can be found in Appendix A.

6.1 Scenario 6 – 4G subscribers, 4G data usage per subscriber and datacard penetration rate all higher

Scenario 6 combines the assumptions from scenarios 1, 3, and 5. Scenarios 1 and 3 respectively refer to the more conservative assumptions applied to 4G subscribers and 4G data usage per subscriber respectively.

Nevertheless, this scenario results in a blended termination rate in 2017/18 that is 25.5% below Ofcom's base case rate in 2017/18. This is a higher percentage reduction than the effect of the two individual scenarios combined. This can be explained by the fact that, in addition to higher data usage being applied to the same number of subscribers, the same data usage is being multiplied by higher subscriber numbers. This generates an additional cumulative effect from the change in data usage and the change in subscriber numbers.

Table 11: Scenario 6 impact on MTR

	2014/15	2015/16	2016/17	2017/18
2G	0.5511	0.5488	0.5444	0.5172
3G	0.4311	0.4284	0.4239	0.3917
4G		0.1826	0.1782	0.1621
Blended	0.4763	0.4544	0.4197	0.3549
Ofcom's base case	0.5391	0.5147	0.4975	0.4764
% change	-11.7%	-11.7%	-15.6%	-25.5%

Source: MCT Model, Deloitte analysis

6.2 Scenario 7 – Adjustment to Scenario 6

In Section 2, a prediction by Cisco was mentioned, that total mobile data usage per month will reach 445 PB by 2018. The combined effect of increasing the number of 4G subscribers and the 4G data usage per subscriber, results in a significant increase in the total data traffic per month on the network. In scenario 6, total data traffic at the market level reaches 647 PB by 2017/18 Q4, compared to approximately 120 PB in Ofcom's base case.

Whilst Cisco's forecasts are also likely to be conservative given the evidence presented earlier, an alternative scenario was run to assess the impact of adjusting the combined scenario assumptions above to match Cisco's forecasts of total data traffic at the market level in 2018. Therefore, this scenario adjusts the assumption in scenario 6 to demonstrate the effect on the MTR of data usage closer to Cisco's estimate.

To do so, the uplift factor on 4G data usage per subscriber versus Ofcom's forecast 4G data usage per subscriber is reduced from 4.1 to 3, and the point at which the proportion of gross additions taking 4G handsets reaches 97% is moved from 2017/18 Q4 to 2021/22 Q1. This reduces the total network data traffic per month to 444 PB in 2017/18 Q4, approximately 31% lower than the 647 PB in Scenario 6.

This results in a blended termination rate in 2017/18 that is 16.6% below Ofcom's base case rate in 2017/18.

Table 12: Scenario 7 impact on MTR

	2014/15	2015/16	2016/17	2017/18
2G	0.5609	0.5568	0.5542	0.5518
3G	0.4357	0.4316	0.4296	0.4279
4G		0.2025	0.1991	0.1967
Blended	0.4828	0.4598	0.4303	0.3974
Ofcom's base case	0.5391	0.5147	0.4975	0.4764
% change	-10.4%	-10.7%	-13.5%	-16.6%

Source: MCT Model, Deloitte analysis

6.3 Conclusion

In conclusion, evidence suggests that Ofcom has significantly underestimated data traffic forecasts in the 2014 MCT model. The result of this is an overestimate of the MTR for the period of the price control. Revising the assumptions on 4G take-up together with those on 4G data usage per subscriber and datacard penetration has a cumulative effect which reduces the MTR by 11.7% in 2014/15 and 25.5% in 2017/18.

The more conservative scenario 7, which adjusts downwards the revisions to bring total mobile data usage per month in line with Cisco's estimates for 2018, still results in an MTR that is 10.4% lower than Ofcom's base case in 2014/15 and 16.6% lower in 2017/18.

Appendix A Additional Information

A.1 Calculation of volume parameters

There are several parameters that feed into the calculation of total traffic that the operator manages in its network. The logic of the calculation is described below:

1. Total handset and datacard subscribers are calculated by applying a market share assumption to total market subscribers. These in turn are calculated by assuming a profile for the population handset and datacard penetration, and applying these to population forecasts.
2. To derive the split between handset subscribers by network technology, migration onto 3G and 4G is modelled through assuming that churned customers choose technologies in specific proportions when they re-enter the market. For voice services, it is assumed that only a proportion of 4G subscribers are able to use these services, the remainder become 3G voice subscribers but are still considered to be 4G data subscribers. For datacards, total operator datacard subscribers are simply split between 3G and 4G using an assumption.
3. An assumption of traffic per subscriber is made for data by technology and device and voice across all technologies. Voice usage per subscriber is converted into on-net calls, outgoing calls, and incoming calls using a number of parameters
4. Total traffic is derived as the product of subscribers by technology and their usage.
5. Traffic management assumptions are applied to calculate the actual load by service on each network.

A.2 Revisions in key parameters in 2014 MCT Model

This section discusses additional new parameters that were introduced in the 2014 MCT model as a result of the modelling of 4G, as well as a list of existing volume-related parameter revisions.

In addition to the newly introduced parameters discussed in Section 2, the following two parameters were introduced:

- 1) **Voice subscribers on the 4G network:** Although Ofcom forecasts that new 4G handsets will come to dominate the market, it does not forecast that these will all have capacity for carrying voice over the 4G network. It predicts that 4% of handsets will have 4G voice capability in 2015/16 Q1, rising to a peak of 45% in 2017/18 Q4, after which the proportion remains flat.
- 2) **4G voice usage per subscriber:** This follows the same profile as 2G and 3G voice usage per subscriber; these were revised as described below.

The table below summarises the changes in forecasts regarding all key volume parameters in the model.

Table 13: Changes in key volume parameter assumptions

Assumption	2011 MCT model	2014 MCT model	Justification
Datacard penetration	Rises from 5.9% in 2009/10 Q4 to 15.2% in 2013/14 Q2 and 27.0% in 2020/21 Q4	Rises from 5.9% in 2009/10 Q4 to a peak of 7.9% in 2011/12 Q4, then declines to 7.5% in 2013/14 Q2, and continues to decline to 6.7% in 2025/26 Q4	The historical datacard penetration rate increased much more slowly than expected, then began to decline. Ofcom predicts that this decline will continue.
Handset market share	Rises from 23% in 2010/11 Q1 to 25% in 2020/21 Q4	Rises from 23% in 2010/11 Q1 to 25% in 2025/26 Q4	A market share of 25% is a long run assumption and should therefore only be reached in the final modelled year.
Datacard market share	Rises from 15% in 2010/11 Q1 to 25% in 2020/21 Q4	Rises from 15% in 2010/11 Q1 to 25% in 2025/26 Q4	A market share of 25% is a long run assumption and should therefore only be reached in the final modelled year.
3G handset data usage per subscriber	Rises from 35 MB/month in 2010/11 to 49 MB/month in 2013/14 Q2, and to 100 MB/month in 2020/21 Q4	Rises from 35 MB/month in 2010/11 to 509 MB/month in 2013/14 Q2, and then to a peak of 1,055 MB/month in 2016/17 Q4. Declines thereafter, falling to 823 MB/month in 2025/26 Q4	Historical growth (up to 2013/14 Q2) was much higher than expected. Ofcom forecasts that this growth will continue, but decelerate until 2016/17 Q4, after which it will decline as the heaviest data users switch to 4G.
3G datacard usage per subscriber	Falls gradually from 1,099 MB/month in 2009/10 Q4 to 1,000 MB/month in 2020/21 Q4	Rises from 1,099 MB/month in 2009/10 Q4 to 1,335 MB/month in 2013/14 Q2, then falls to 796 MB/month in 2025/26 Q4.	Historical growth (up to 2013/14 Q2) was higher than expected (positive rather than negative). From 2013/14 Q3 Ofcom forecasts that usage per subscriber will decrease as heavy users will begin moving to 4G.

Assumption	2011 MCT model	2014 MCT model	Justification
Voice usage per subscriber	Rises from 134 min/month in 2009/10 Q4 to 165 min/month in 2013/14 Q2. Rises gradually thereafter, to 168 min/month in 2020/21 Q4.	Rises from 134 min/month in 2009/10 Q4 to 139 min/month in 2013/14 Q2. Rises gradually thereafter, to 146 min/month in 2025/26 Q4.	Voice usage grew much more slowly in the period 2010/11-2013/14 than Ofcom had expected. Ofcom expects future growth to be slow because of increased usage of Over The Top (OTT) services and other forms of communication.

Source: Deloitte analysis, Ofcom consultation documentation

A.3 Further updates to traffic input parameters

This section contains a list of further updates made to volume parameters.

- 1) Population forecasts have been updated using Office for National Statistics (ONS) data rather than data from the Economist Intelligence Unit. Population growth forecasts are slightly higher than in the 2011 model. This will affect subscriber numbers.
- 2) The weighting on incoming traffic from fixed lines has been updated so that it varies over time, instead of staying constant at 0.5 (as it did in the 2011 model). In the 2014 model it now falls from 0.5 in 2011/12 Q3 to 0.35 in 2025/26 Q4.
- 3) Handset penetration: Handset penetration was observed to be slightly above the forecast level between 2010/11 Q2 and 2013/14 Q3. Historic figures have been updated accordingly. Penetration is a forecast to continue to grow from 125% to 127% at the end of the forecast period (in 2025/26 Q4).
- 4) 2G data usage per subscriber: This was far higher in reality than forecast in the 2011 MCT model in the review period up to 2013/14 Q2. Ofcom has stated that this may in part be a result of fallback from 3G and 4G handsets. It has revised upwards the historical data between 2010/11 Q1 and 2013/14 Q2, with data usage per subscriber now at 46.9 MB/month in 2013/14 Q2 instead of the 1.5 MB/month forecast previously. However, Ofcom predicts that 2G data usage per subscriber will decrease after 2013/14 Q2, falling to 22.1 MB/month in 2025/26 Q4. This decrease is expected to be the result from better network coverage for 3G and 4G, resulting in less fallback, as well as less usage per 2G subscriber.

A.4 Further combined scenario results

A.5 Scenario 8 – Higher 4G subscriber levels and higher 4G data usage per subscriber

Scenario 8 combines the assumptions from scenarios 1 and 3. This results in a blended termination rate in 2017/18 that is 25.4% below Ofcom's base case rate in 2017/18.

Table 14: Scenario 8 impact on MTR

	2014/15	2015/16	2016/17	2017/18
2G	0.5534	0.5510	0.5466	0.5193
3G	0.4287	0.4260	0.4213	0.3894
4G		0.1907	0.1857	0.1694
Blended	0.4756	0.4536	0.4192	0.3554
Ofcom's base case	0.5391	0.5147	0.4975	0.4764
% change	-11.8%	-11.9%	-15.7%	-25.4%

Source: MCT Model, Deloitte analysis

A.6 Scenario 9 – Higher 4G subscriber levels and higher datacard penetration rate

Scenario 9 combines the assumptions from scenarios 1 and 5. This results in a blended termination rate in 2017/18 that is 13.1% below Ofcom's base case rate in 2017/18.

Table 15: Scenario 9 impact on MTR

	2014/15	2015/16	2016/17	2017/18
2G	0.5894	0.5759	0.5771	0.5782
3G	0.4579	0.4424	0.4446	0.4472
4G		0.2273	0.2258	0.2298
Blended	0.5074	0.4729	0.4458	0.4141
Ofcom's base case	0.5391	0.5147	0.4975	0.4764
% change	-5.9%	-8.1%	-10.4%	-13.1%

Source: MCT Model, Deloitte analysis

A.7 Scenario 10 – Higher 4G data usage per subscriber and higher datacard penetration rate

Scenario 10 combines the assumptions from scenarios 3 and 5. This results in a blended termination rate in 2017/18 that is 7.6% below Ofcom's base case rate in 2017/18.

Table 16: Scenario 10 impact on MTR

	2014/15	2015/16	2016/17	2017/18
2G	0.5705	0.5663	0.5651	0.5630
3G	0.4528	0.4479	0.4475	0.4446
4G		0.2256	0.2199	0.2133
Blended	0.4989	0.4810	0.4642	0.4404
Ofcom's base case	0.5391	0.5147	0.4975	0.4764
% change	-7.5%	-6.5%	-6.7%	-7.6%

Source: MCT Model, Deloitte analysis