



Response to NPT's Decision on MTRs:  
**Analysis of LRIC Model  
and MTR Determination**

Submitted to:  
**Post-og teletilsynet**

Norwegian Post and Telecommunications Authority



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## 1. EXECUTIVE SUMMARY

This CSMG report has been prepared on behalf of Tele2 and Network Norway, in response to the recent decision on mobile termination rates (MTRs) by the Norwegian Post and Telecommunications Authority (NPT).

The report focuses on the cost model used by NPT to determine MTRs for mobile operators in Norway, and to estimate the investment cost required by Mobile Norway to build its network. The model was built by the Analysys Mason Group (AMG) and is referred to as the AMG model in this document. Following NPT's consultation on its proposed changes to MTRs in Norway, AMG revised the cost model and NPT reissued its draft determination.

In response, CSMG analysed the new model and investigated changes that AMG had implemented to the assumptions and model logic. Through our investigation, we have identified further inaccuracies in the model, mainly as a result of the changes made by AMG.

The first issue is that the model still underestimates the number of base stations included in Mobile Norway's investment cost calculation. The calculation includes 2G investment costs up to the end of 2009, and 3G costs to 2011. Inspecting the model output of the number of base stations existing in the network at those times shows that only 1696 base stations are included in the investment costs.

In comparison, Mobile Norway's network plans show that [CONFIDENTIAL: ] cell sites will be required in its network. These plans were developed in a design process involving in-depth radio access network simulation, physical site searches and a network planning tool. They were submitted to and approved by the Ministry of Transport and Communications, reviewed by NPT in 2008/2009, and should be used, in a 'hybrid model' approach, for a top-down reconciliation of the bottom-up model. The current shortfall between the model and network plan is of an unacceptably wide margin.

The second inaccuracy is in the 2G to 3G migration profile assumption, which sets the proportion of voice traffic carried over the operator's 2G network versus its 3G network. In the latest model revision, the third operator's migration profile was adjusted such that 13% of its voice traffic is carried over 2G in 2011, compared to 65% in the previous version, with similar reductions in other years. The rationale given for this change is that more spectrum and base stations will be available in Mobile Norway's network supporting 3G than 2G.

While Mobile Norway is indeed expected to have more capacity in its 3G network, this does not imply that calling behaviour will adapt as rapidly as suggested by the revised migration assumption. Rather, handset capabilities and available network coverage do directly influence usage, so should be used as a factual basis for this assumption. An analysis of a 2010 study by Statistics Norway on 3G handset ownership, as well as traffic and 3G handset ownership forecasts from Network Norway, show that any reduction from the migration profile in the previous model version is inconsistent with actual data. We therefore urge the NPT to revert this assumption back to its original values as in the previous version of the model.

We observe that revising this 2G to 3G migration profile as suggested increases the number of base stations to a level closer to Mobile Norway's network plan. This further supports the view that the assumption should be revised, as doing so makes both the model inputs and outputs more consistent with real-world data.

Correcting the 2G to 3G migration profile assumption increases the investment cost model output to NOK 2.04bn, the 2013 LRAIC termination cost to 0.18 NOK, and the 2013 LRAIC+++ termination cost to 0.28 NOK, as shown in the table below.

Effect of Assumption Revisions on Model Output			
	v7.1	Revised Outputs	
Investment Cost	NOK 1.99 bn	+ 2.5%	NOK 2.04 bn
2013 LRAIC Termination Cost	[REDACTED] NOK	[REDACTED]	[REDACTED] NOK
2013 LRAIC+++ Termination Cost	[REDACTED] NOK	[REDACTED]	[REDACTED] NOK

Given the significant difference caused by these inaccuracies to the termination cost model output, we recommend NPT revisits the model assumptions and corrects the model based on the issues we have raised.

## **2. INTRODUCTION**

CSMG was recently engaged by Tele2 and Network Norway to review NPT's proposed determination of MTRs in Norway, and the cost model used as the basis of this decision. This document sets out our views and findings.

CSMG has extensive telecom experience and qualifications in several areas that are of particular relevance to this engagement:

1. We have developed numerous mobile operator business case models with a granular focus on both demand drivers and network costs
2. We have worked with telecom regulators in the US, Europe, and Asia on a range of critical topics and decisions
3. We have analysed and developed detailed MTR LRIC models in a variety of different regulatory markets across the world
4. We have specific experience with the Norwegian MTR LRIC model and have previously submitted analysis of an earlier version of this model to the NPT

As a result of our past wireless and regulatory experience, CSMG is well positioned to provide an in-depth analysis and assessment of the present MTR regulatory decision, cost model methodologies and regulator intentions.

### 3. CONTEXT

Mobile termination rates in Norway are currently based on a Long Run Average Incremental Cost (LRAIC) model commissioned by the NPT and built by the Analysys Mason Group (AMG).

For the current regulation cycle ending December 2010, AMG developed a common industry cost model to determine long-run unit costs using a LRAIC+++ methodology. The model is populated with operator-specific data to determine the cost of termination on each network. The NPT then applies the MTR level of higher cost operator as the common MTR applied for incumbent operators.

For the next regulation cycle starting January 2011, the NPT commissioned a revision (v6) of the AMG model in 2009, and proposed moving to a lower cost LRAIC methodology after June 2012. NPT issued a draft decision based on this model on 25 March 2010<sup>1</sup> and opened a public consultation.

As part of this consultation, CSMG analysed v6 of the AMG model on behalf of Tele2 and Network Norway, and submitted a report to NPT<sup>2</sup> on 10 May 2010. Following the consultation, NPT and AMG updated the model, issuing a response to Tele2 and Network Norway<sup>3</sup> (referred to hereafter as Annex G), and a further revision (v7.1) of the model.

NPT then issued a decision based on the model v7.1 on 27 September 2010<sup>4</sup>, offering three weeks for affected operators to appeal.

In response, CSMG has analysed the new model (v7.1) and investigated the changes that AMG had implemented to the assumptions and model logic set out in Annex G. This report comprises a summary of our analysis and conclusions.

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<sup>1</sup> NPT, "Varsel om vedtak i markedene for terminering av tale i mobilnett", 26 March 2010

<sup>2</sup> CSMG, "Response to Consultation for Mobile Termination Rates in Norway", 10 May 2010

<sup>3</sup> AMG, "Discussion of CSMG report submitted by Tele2 in response to NPT's public consultation on termination rates in Norway, Annex G to model documentation", 24 August 2010

<sup>4</sup> NPT, "Decisions for designating undertakings with significant market power and imposing specific obligations in the markets for voice call termination on individual mobile networks (market 7)", 27 September 2010



## 4. LRIC MODEL VALIDATION

### 4.1 Overview

Following NPT's consultation on its proposed changes to MTRs in Norway, AMG issued version 7.1 of the cost model with the accompanying Annex G report, and NPT reissued its draft determination

Through our investigation, we have identified further inaccuracies in the model, mainly related to the assumption adjustments made by AMG. This section examines these inaccuracies, suggests an assumption revision to correct them, and provides supporting evidence for the change.

The effect of the revision we suggest is that the investment cost output is increased by 2.5% to NOK 2.04bn, the 2013 LRAIC termination cost is increased by [REDACTED] to [REDACTED] NOK, and the 2013 LRAIC+++ termination cost is increased by [REDACTED] to [REDACTED] NOK.

Effect of Assumption Revisions on Model Output			
	v7.1	Revised Outputs	
Investment Cost	NOK 1.99 bn	+ 2.5%	NOK 2.04 bn
2013 LRAIC Termination Cost	[REDACTED] NOK	[REDACTED]	[REDACTED] NOK
2013 LRAIC+++ Termination Cost	[REDACTED] NOK	[REDACTED]	[REDACTED] NOK

### 4.2 Investment Cost Calculation

**Description and Model Location:** When the model is set to calculate the investment cost required to build a third network in Norway, it does so by adding up capital expenditure of relevant assets during a specified time period.

The investment cost relevant to Mobile Norway can be seen by selecting 'Scenario 3: Remove capex for MVNO-MNO step' from the *Ctrl* worksheet. This modifies the *CapexAdj* sheet to set which assets are included in the investment cost calculation, for which years. A '-' in a cell indicates that the cost of the network element in that row, for the year in that column, will be included in the investment cost calculation.

It can be seen on the *CapexAdj* sheet that the costs of 2G assets are included up to and including 2009, and 3G assets up to 2011. No 2G costs are included in or beyond 2010, nor are 3G costs included in or beyond 2012.

The output of this investment cost calculation is used by NPT to estimate the costs incurred to Mobile Norway in its rollout of a network that covers 75% of Norway's population.

The number of base stations included in this calculation can be found by adding the number of 2G base stations built by the end of 2009 to the number of 3G base stations built by the end of 2011. These values can be found on the worksheet *NwDeploy*, where it can be seen that a total of 1696 base stations are included in the investment cost total.

Base Stations Included in Investment Cost Calculation		
	2009	2011
2G base stations	[REDACTED]	[REDACTED]
3G base stations	[REDACTED]	[REDACTED]
BTS included in investment cost calculation	[REDACTED] = 1696	

Although the AMG model calculates the investment cost based on 1696 base stations as illustrated above, AMG's report cites that [REDACTED] sites would be required for 75% coverage. That is, while the coverage target of 75% is used by AMG in setting model parameters, and [REDACTED] sites are quoted as achieving this, the model does not use this number in its investment cost calculation.

**CSMG Revision and Rationale:** As discussed in CSMG's previous submission to NPT, in the planning stage of the Mobile Norway venture, Mobile Norway developed a network design that would match and fulfil Tele2 and Network Norway's business plan. The design process involved in-depth radio access network simulation, physical site searches and a network planning tool. This analysis resulted in a network design that required [CONFIDENTIAL: [REDACTED]] cell sites to cover 75% of the population. These network plans were submitted to and approved by the Ministry of Transport and Communications. The NPT has also reviewed this plan in 2008. Consequently, Mobile Norway's network plan should be used as the key presumption, in a hybrid model approach, for the top-down reconciliation of the bottom-up model. The model should therefore be set to match these figures as closely as reasonably possible.

As shown above, the model still clearly underestimates the size of the radio access network as compared to the Mobile Norway network plan: the 1696 base stations included in the model investment cost calculation falls well short of the number actually required by Mobile Norway.

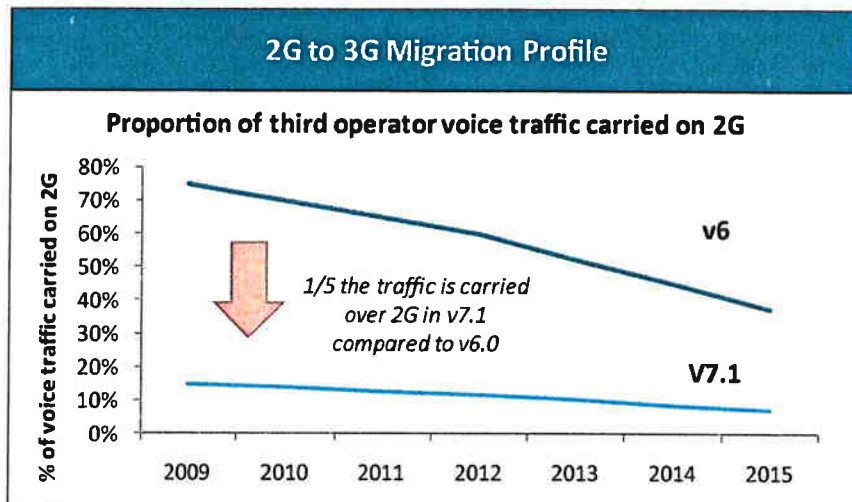
This understatement causes the model to give erroneous outputs in both the investment cost required to build such a network, and the LRIC termination rate.

In the following section, '2G to 3G Migration Profile', we explore an unrealistic assumption that is a probable cause for this error in the model.

### 4.3 2G to 3G Migration Profile

**Description and Model Location:** The 2G to 3G voice migration profile assumption sets the proportion of voice traffic carried over the operator's 2G network versus its 3G network, throughout the model period. This can be found on the worksheet *M6*.

In the model revision to v7.1, the third operator's migration profile was adjusted such that 13% of its voice traffic is carried over 2G, in 2011, compared to 65% in v6. The chart below shows the adjustments to the migration profile over the period 2009 to 2015.



AMG concludes in Annex G that because more spectrum and base stations are available for 3G than 2G, a 1/5 multiplier should be applied across the original v6 profile. In both v6 and v7.1, this decreases towards zero in 2020 as users move to 3G.

**CSMG Revision and Rationale:** While Mobile Norway is indeed expected to have more capacity in its 3G network than in its 2G one, this does not imply that customer calling behaviour will adapt as rapidly as suggested by the revised migration assumption. Indeed, the new migration profile proposed by AMG is not supported by operator or public data.

The mix of 2G and 3G usage, and the migration from one to the other will depend upon handset capabilities and available network coverage rather than network capacity. These factors should therefore be used as a factual basis for this assumption. Applicable data based on network coverage and 3G handset capabilities, sourced from Network Norway and Statistics Norway, does not support any reduction from the original profile in v6.

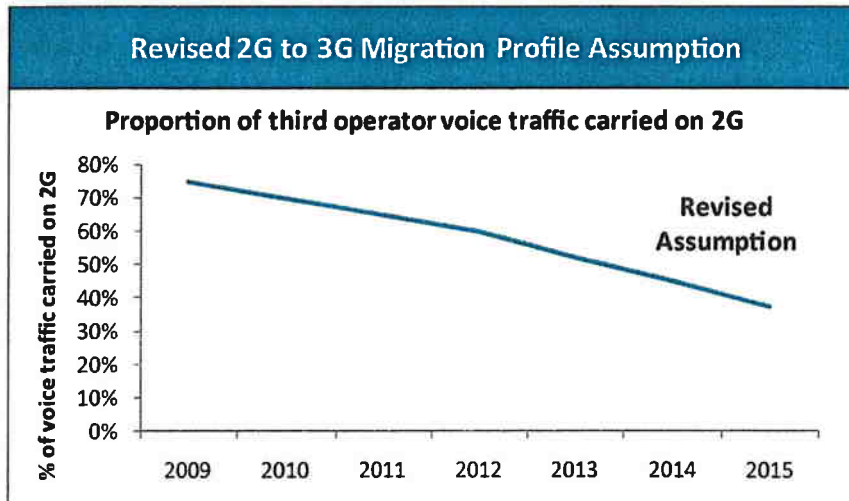
Network Norway's internal 2G vs. 3G traffic forecast is aligned with its current and expected network coverage and handset availability, and is thus representative of the traffic split that can be expected on Mobile Norway's network. This internal forecast shows that any reduction from the original migration profile in v6 is unjustified.

An internal analysis of 3G handset ownership in Network Norway's own customer base also does not support any reduction from the original migration profile. Finally, a 2010 study by Statistics Norway shows that 26% of adults in Norway own a 3G phone<sup>5</sup>, which is consistent with a view that

<sup>5</sup> Statistics Norway, "ICT usage in households", 24 September 2010

the majority of voice calls are still made on 2G networks, and gives further evidence that any reduction of the v6 migration profile would be unfounded.

Based on this data, we recommend that the third operator's 2G to 3G migration profile should be reverted to the original assumption as in the model v6.



As well as making the input assumption more consistent with real-world data, correcting the migration profile also makes the model output more consistent with Mobile Norway's actual network build.

As described previously in 'Investment Cost Calculation', the model v7.1 currently understates the number of base stations in Mobile Norway's Network. Revising the migration profile as suggested increases the number of base stations in the model, such that [redacted] are included in the investment cost calculation. This brings the number closer to that in the network plan.

Effect of Migration Profile Revision on Base Station Numbers		
	v7.1	Revised Output
2G base stations in 2009	[redacted]	[redacted]
3G base stations in 2011	[redacted]	[redacted]
BTS included in investment cost calculation	1696	[redacted]

This assumption revision is therefore an essential correction to the model if it is to be used as a viable representation of Mobile Norway's planned network.

**Impact to Investment Cost and Termination Cost:** Correcting the 2G to 3G migration profile increases the investment cost model output by 2.5% to NOK 2.04bn, the 2013 LRAIC termination cost by [redacted] to [redacted] NOK, and the 2013 LRAIC+++ termination cost by [redacted] to [redacted] NOK.

Effect of Assumption Revisions on Model Output			
	v7.1	Revised Outputs	
<b>Investment Cost</b>	NOK 1.99 bn	+ 2.5%	NOK 2.04 bn
<b>2013 LRAIC Termination Cost</b>	[redacted]	[redacted]	[redacted]
<b>2013 LRAIC+++ Termination Cost</b>	[redacted]	[redacted]	[redacted]

## 5. CONCLUSION

Our analysis of v7.1 of AMG's model has shown that, while a number of issues present in v6 have been corrected, the model still contains a number of inaccuracies.

The first issue is that the model still underestimates the number of base stations included in the third operator MVNO to MNO investment cost calculation. This is apparent when comparing the years in which the costs of 2G and 3G network assets are counted towards the investment cost, to the numbers of 2G and 3G base stations existing in the network in those years. The model includes 1696 base stations in the investment cost calculation, leaving an unacceptable shortfall compared to Mobile Norway's network plan.

Secondly, the 2G to 3G migration profile assumption now greatly underestimates the proportion of voice calls that will use the third operator's 2G network compared to its 3G network. After being set to a reasonable level in v6 of the model, this was cut by a factor of five in v7.1 such that 13% of voice calls are made using the 2G network in 2011. This reduction is inconsistent with traffic and 3G handset ownership forecasts from Network Norway, as well as a 2010 study on 3G handset ownership by Statistics Norway. We therefore urge the NPT to revert this assumption back to its original values as in v6 of the model.

We observe that revising this 2G to 3G migration profile as suggested increases the number of base stations to a level closer to Mobile Norway's network plan: following this revision, the model includes [REDACTED] base stations in the investment cost calculation. This further supports the view that the assumption should be revised, as doing so makes both the model inputs and outputs more consistent with real-world data.

Correcting the 2G to 3G migration profile assumption increases the investment cost model output to NOK 2.04bn, the 2013 LRAIC termination cost to [REDACTED] NOK, and the 2013 LRAIC+++ termination cost to [REDACTED] NOK. Given the significant difference caused by these inaccuracies to the termination cost model output, we recommend a re-calculation of the MTRs applied to operators in Norway and a revision of NPT's decision in the markets for voice call termination on mobile networks.