



Study to estimate the market value of 800MHz and 2.6GHz spectrum: User guide for the business model estimating the value of the spectrum

Prepared for Ofcom

Draft

11 April 2012

Project Team:

Amit Nagpal
Peter Eckley
Andrew Wright

Copyright © 2012. All Rights Reserved. No part of this document may be used or reproduced in any manner whatsoever without written permission.

Aetha Consulting Limited
Coton Hall, 10 Brookfield Road
Coton, Cambridge
CB23 7PT
UK

Phone: +44 (0)1223 755 575
Fax: +44 (0)20 7183 3716
Email: enquiries@aethaconsulting.com
www.aethaconsulting.com

Contents

1	Introduction.....	4
1.1	Background.....	4
1.2	Structure of this document.....	4
2	Overview of model structure.....	5
2.1	Scenario and parameter control sheets.....	5
2.1.1	The SCEN sheet.....	6
2.1.2	The SENS sheet.....	6
2.1.3	The OP sheet.....	7
2.1.4	The PARAM sheet.....	7
2.2	Market model – the MKT sheet.....	8
2.3	Results summary sheets.....	8
2.3.1	The Summary VF, Summary TF, Summary EE, Summary H3G sheets.....	8
2.3.2	The Summary NE1 sheet.....	9
2.4	Special valuation cases for H3G and a potential new entrant.....	9
2.5	Results charts.....	10
2.6	Calculation sheets by scenario.....	10
2.6.1	Calculation sheets for existing national wholesalers.....	11
2.6.2	Calculation sheets for potential new entrant.....	11
3	How to use the model.....	13
3.1	Running the model and locating results for an existing national wholesaler.....	13
3.2	Running the model and locating results for the potential new entrant.....	14
3.3	Changing the amount of unpaired 2.6GHz spectrum won.....	14
3.4	Changing the long-run market share of an existing national wholesaler.....	14
3.5	Changing the long-run market share of the new entrant.....	15
3.6	Changing the basecase spectrum scenario for a given national wholesaler.....	15
3.7	Locating and changing key parameters.....	15
3.8	Adding a new spectrum scenario.....	15

1 Introduction

1.1 Background

This document has been prepared by Aetha Consulting Limited (Aetha) as part of a study undertaken by DotEcon Limited (DotEcon) and Aetha on behalf of the Office of Communications (Ofcom) in the UK to assess the market value of 800MHz, 1800MHz and 2.6GHz spectrum.

As part of the overall project, Aetha has developed detailed bottom-up business models to value different amounts and combinations of spectrum to the existing national wholesalers and potential new market entrants. This assessment is being used in conjunction with benchmarks of the value of the spectrum from international auctions to provide Ofcom with recommendations on the setting of the reserve prices for the 800MHz, 1800MHz and 2.6GHz (paired and unpaired) spectrum in the case that Ofcom were to seek to adopt a market-value approach for the setting of the reserve prices. Throughout our work, Aetha has drawn on our general experience of supporting mobile operators with the value of spectrum in numerous recent/on-going auction award processes.

This document provides a user guide for the bottom-up business models developed as part of the study. The purpose of this guide is to describe the functional structure of this model as implemented in Excel, and provide instructions on how to use the model, including adding and selecting scenarios, locating key parameters, and locating the model results. For further details about the overall modelling approach, parameters and assumptions please refer to Annex D of the main project report¹.

1.2 Structure of this document

The remainder of this document is structured as follows:

- Section 2 describes the functional structure of the model
- Section 3 explains how to use the model including step-by-step instructions for a wide range of tasks from running the model and locating results through to adding new scenarios.

¹ See Aetha Consulting Limited ‘*Confidential Annex D: Business modelling of the value of spectrum*’, April 2012.

2 Overview of model structure

In this section we provide an overview of the functional structure of the model.

The model is implemented in a single Excel workbook. This workbook includes bottom-up business models to value different spectrum scenarios (amounts and combinations of spectrum) to each of the existing national wholesalers (Vodafone, Telefonica, Everything Everywhere and Hutchison 3G) and a potential new market entrant (both an MVNO and a data-only mobile broadband operator).

The following abbreviations are used to refer to national wholesalers throughout the model:

- VF = Vodafone
- TF = Telefonica O2
- EE = Everything Everywhere
- H3G = Hutchison 3G
- NE1 = potential new entrant.

The workbook contain a large number of worksheets, but most of these are of very similar or identical structure, and simply replicate the same calculations for different spectrum scenarios for different national wholesalers or the potential new entrant. The model is thus able to calculate results for all operators and spectrum scenarios in one run (a single press of the F9 key) without the need for macros or manually repetitive changing of parameters and rerunning of the model.

The functions of the various worksheets are best explained in the following groups of worksheets, going from left to right in the ordering of worksheets in the workbook:

1. Scenario and parameter control sheets – scenario selection and key model parameter inputs
2. Market model – basecase forecast for the evolution of revenues and traffic in the UK mobile market
3. Results summary sheets
4. Special valuation cases for H3G and a potential new entrant
5. Results charts
6. Calculation sheets by scenario – the detailed business modelling calculations.

The calculation flow in the model is to take scenario and parameter inputs (1) and feed these into the market model (2). The results of the market model are fed into the calculation sheets (6) along with other scenario and parameter inputs that come directly from (1) rather than via the market model. The results of the calculation sheets (6) are then gathered up in the results summary sheets (3) along with some special valuation cases (4), and displayed in results charts (5).

The model is designed so that the user should not normally need to interact directly with the market model (2) or the calculation sheets (6) but only with inputs (1) and results (3) and (5). The special valuation cases (4) are somewhat separate from the rest of the model calculation flow.

Each group of sheets is now explained in turn.

2.1 Scenario and parameter control sheets

The sheets whose functions are described in this section are summarised in Figure 2-1. These are some of the sheets that the user is most likely to interact with when using the model.

Figure 2-1: Functions of sheets

Sheet name	Function of sheet
INDEX	Front-page of the model used to present the model title, version date and any notes, but no functionality relevant to the business modelling
SCEN	Definition of spectrum scenarios for all four existing national wholesalers and a potential new entrant, and selection of the amount of unpaired 2.6GHz spectrum included in those scenarios
SENS	Definition and selection of settings for key model parameters, for the purpose of analysing the sensitivity of results to these parameters
OP	Operator-specific parameters that act as inputs to the business models
PARAM	Parameters, that do not vary by either spectrum scenario or operator, and that act as inputs to the business models

2.1.1 The SCEN sheet

Each row in the SCEN sheet defines a different model scenario. A model scenario is the combination of the choice of national wholesaler (or potential new entrant) and a spectrum scenario (800MHz, 1800MHz and 2.6GHz paired spectrum).

Each model scenario is designated a name in a standardised format using the ‘|’ character as a separator. This name is used to refer to the model scenario in calculations elsewhere in the workbook, hence this format should be strictly adhered to. For example, VF|10|0|20 refers to the scenario where Vodafone (shortname VF) obtains, in the auction, 2x10MHz of 800MHz spectrum, no 1800MHz spectrum, and 2x20MHz of paired 2.6GHz spectrum. Note that for brevity the spectrum already assigned to a particular operator, independently of the auction (e.g. in the 900MHz and 2.1GHz bands) is not referenced here.

The SCEN sheet contains every possible combination of 800MHz, 1800MHz and 2.6GHz paired spectrum that a bidder could win at the auction, for completeness. Many of the spectrum scenarios that are included in the complete list may be ruled out in practice due to spectrum caps or other rules imposed by Ofcom. Many also reflect auction outcomes that are extremely unlikely in practice. Therefore model results are only calculated for the subset of these spectrum scenarios of interest as highlighted in green.

To keep the number of spectrum scenarios manageable, the amount of unpaired 2.6GHz spectrum won by the operator is implemented as a parameter for the user to select, in cell R1. The user’s selection is then automatically copied into each row upon calculation of the worksheet. The user should take care to ensure that this parameter is set to the number desired before calculating results.

Two more parameters are necessary for any model scenario for which results are to be calculated. These are the years in which GSM and UMTS are decommissioned / switched off. Both must be set to a year later than or equal to 2012, or the model will not calculate results for that model scenario, as a safeguard against generating non-sensical results. In addition, the model is not designed to calculate results for scenarios where the UMTS switch-off year is earlier than the GSM switch-off year, hence setting the parameters in this way, while possible, is not recommended.

Note that there is no place to select a particular model scenario (apart from the choice of unpaired 2.6GHz spectrum amount and GSM/UMTS switch-off years) because the model calculates results for all implemented scenarios in parallel.

2.1.2 The SENS sheet

At the top of this sheet are drop-down selection menus for four key sets of model parameters:

- LTE take-up – the curve from 2013 to 2029
- the Network Multiplier
- 1800MHz coverage
- 2.6GHz coverage.

The parameter values corresponding to the various settings for each of these four drop-down menus are defined below in the remainder of the sheet. These act as inputs to other sheets later in the calculation flow of the model, namely the MKT sheet (for LTE take-up), the OP sheet (for 1800MHz coverage and 2.6GHz coverage) and the calculation sheets (for the Network Multiplier).

2.1.3 The OP sheet

This sheet contains operator-specific input parameters that do not vary with the spectrum scenario. These parameters are grouped in named ranges in a table of cells in the top left of the sheet. The Excel names (e.g. op.name) of the ranges are given in the left hand column of that table. The parameter values for all national wholesalers and the potential new entrant are set out in a column each. The first three rows specify the national wholesale (op.name, op.nameshort) and the identification number (op.id) which is used in various model calculations to identify the operator and extract operator-specific parameters or results. The remaining rows are grouped as follows:

- **Mobile spectrum held before the auction:** the amount of spectrum held in the 900MHz, 1800MHz and 2.1GHz bands
- **Start sites:** the number of physical sites that each national wholesaler is estimated to have in its radio access network (RAN) in 2012, at the start of the modelling period
- **Coverage sites and coverage level:** assumptions about the number of sites that a given national wholesaler would roll out in order to provide LTE coverage in a given band, and the percentage of the ‘premium segment’ market that could be addressed using this coverage
- **LTE launch-date constraints:** these could vary by operator where, for example, one operator such as EE might be able to launch LTE using its existing spectrum holdings, even before the auction
- **Basecase spectrum scenario:** the scenario selected is assumed to correspond to the basecase outcomes in the market model (MKT sheet, see below). The variation in revenues under different spectrum scenarios is expressed as percentage deviations from the revenues secured in the basecase, hence the choice of basecase spectrum scenario is an important input to the valuation model.

The tables further down the sheet are simply side calculations used to estimate the coverage sites and coverage level figures in the main table described above. These smaller tables do not drive the model directly, but only via the main table in the top left.

Finally, there is a small table in the top-right of the sheet that simply lists the traffic growth scenarios (different levels of traffic loading).

2.1.4 The PARAM sheet

This sheet contains the model parameter inputs that are constant across all model scenarios. The discount rate used to convert free cash flow (FCF) results into net present value (NPV) figures is defined at the top of the sheet. Next come several parameters related to the revenue side of the business models. Finally, there are several technical parameters related to the network costs side of the model. For more details on particular parameters and their values, please refer to Confidential Annex detailing the model methodology and assumptions.

2.2 Market model – the MKT sheet

The market model is contained in a single sheet labelled MKT. The outputs of the market model are clearly marked in green highlighted cells. They are, for each existing national wholesaler, and for each year from 2012 to 2033, the following:

- Premium segment retail revenue
- Premium segment wholesale revenue
- Total data usage, for each of the three traffic growths scenarios (low, medium, high).

The rationale behind these forecasts is explained in detail in the Confidential Annex.

Key assumptions used in the derivation of these forecasts are indicated by yellow highlighting of the cells. The MKT sheet draws model parameter inputs from other sheets in only two places. The first is the LTE take-up curve in rows 42-43, which affects the size of the LTE market in each year, and is drawn from the SENS sheet (see Section 2.1.2). The second is the market share of Hutchison 3G by 2033, in cell AH82, drawn from the ‘Summary H3G’ sheet (see Section 2.3.1).

2.3 Results summary sheets

There are five summary results sheets: one for each existing national wholesaler (e.g. ‘Summary VF’ for Vodafone) and one for the potential new entrant (‘Summary NE1’). The four sheets for the existing national wholesalers are almost identical and we describe these first.

2.3.1 The Summary VF, Summary TF, Summary EE, Summary H3G sheets

The function of these sheets is to pull in results from the calculation sheets that are described in Section 2.6. No substantive calculations are done in these sheets.

There is a single and important input parameter among these sheets, which can be found in the top-right of the Summary H3G sheet, highlighted in yellow: the market share of Hutchison 3G by 2033. This market share assumption feeds into the MKT sheet (see Section 2.2) and automatically affects not only the market share of H3G in 2033, but also the market share of H3G in the years running up to that (on a glide path) and the market share of the other three existing national wholesalers (since in the basecase market forecast of the MKT sheet, the market share not taken by H3G is assumed to be split between the other three existing national wholesalers). Hence the Summary sheets for VF, TF and EE do not contain a similar parameter, and it is important that this parameter in the Summary H3G sheet is set to the appropriate value when calculating results for other national wholesalers and not just for H3G.

For example, to calculate results for VF with a 25% market share by 2033, the market share of H3G in 2033 must be set to 25%. If the latter is instead set to, for example, 18% (as might be done to produce valuation results for H3G) then the market share of VF in 2033 will automatically be calculated as one-third of 82% (100% minus 18%) which is 27.33%, not the desired 25% for VF.

At the top of each sheet is a warning in red text. This explains that the Summary sheets use a built-in Excel function called INDIRECT() in order to extract results from the appropriate calculation sheets, without having to manually create a formula pointing to each of the (many) calculation sheets. The user should be aware that Excel’s built-in formula tool called ‘Trace Precedents’ will not work in cells that use the INDIRECT formula. In addition, in the event that structural changes are made to the calculation sheets (this is not recommended) that change the cell in which a given calculation takes place – for example, inserting rows or columns -- Excel will not automatically update links to cells referred to in the

INDIRECT() function. Therefore if any structural changes are made to the calculation sheets, then the cell references used in the INDIRECT() functions should be checked and manually updated if necessary.

The content of each Summary sheet follows an identical structure. First, absolute valuations and valuations relative to the basecase are presented. The results are shown for low, medium and high traffic growth scenarios and are updated automatically upon initiating Calculate (pressing the F9 key). Some copy-pasted values, clearly marked as such, and formatted ready pasting into Powerpoint or Word, can be found to the right. Note that these do not automatically update when the model is recalculated.

Further down the sheet are more detailed tables of intermediate results for the same model scenarios, all of which are automatically updated on Calculate.

2.3.2 The Summary NE1 sheet

The Summary NE1 sheet is similar to the other Summary sheets described in Section 2.3.1. There are two key differences.

First, the potential new entrant model has its own market share input in cell M6. Unlike with Summary H3G sheet, this market share input does **not** affect the market shares of the existing national wholesalers in the model. This is because the calculations for the potential new entrant model are separate from the calculations for the existing national wholesalers.

Second, the potential new entrant model does not automatically calculate results for all three traffic-growth scenarios. Instead, to keep the model size manageable, it calculates results for a single traffic-growth scenario at a time. The user must select the traffic-growth scenario in cell M5. On pressing F9 the model then automatically updates the valuation results in the table at the top-left, and the various intermediate results shown below but to the left of the black line between columns X and Y. However, the model does **not** automatically update the results in the other valuation tables, as clearly marked by red text such as 'PASTED VALUES' or 'BASED ON PASTED VALUES'. Similarly, the results further down the sheet and from column Y rightwards are not automatically updated. The procedure for updating the results for the potential new entrant is described in Section 3.2.

2.4 Special valuation cases for H3G and a potential new entrant

This group of sheets comprises a collection of miscellaneous calculations in support of the valuations for H3G, the potential new entrant, and alternative uses of the unpaired 2.6GHz spectrum. The function of each sheet is summarised in Figure 2-2.

Figure 2-2: Functions of sheets

Sheet name	Function of sheet
2.6unpaired.NWs	Summary of valuation results given different amounts of unpaired 2.6GHz spectrum, for selected spectrum scenarios, and for each of the four existing national wholesalers. No new model calculations are done in this sheet
H3G abs	High level cash-flow model of H3G's whole business, under the assumption that H3G continues to operate as a going concern through to 2033. The structure of this model is similar to the new entrant model calculation sheets described in Section 2.6.2.
H3G sale	Benchmark-based estimates of Enterprise Value (EV) of H3G in a trade-sale scenario
NE1	New entrant basecase and parameters. The basecase model in the top half of the sheet forecasts the following inputs, for the basecase spectrum scenario, that act as inputs to the calculation sheets for the potential new entrant: revenues (premium / non-premium segments), subscribers, gross adds, traffic volumes (low, medium, high growth scenarios). The bottom half of the sheet comprises other non-network and network related parameter inputs for the new entrant model.
2.6unpaired.NE	A standalone model that estimates the value of the unpaired 2.6GHz spectrum to a potential new entrant who launches an LTE2600TDD mobile broadband data-only offering in urban areas only, in 2014, with network build starting in 2013. Some parameters are direct inputs in this sheet, highlighted in yellow. Some other inputs are borrowed from the PARAM sheet, which contains input parameters for the model of the existing national wholesalers. Apart from these links, there is no other connection between this standalone model and the main model of existing national wholesalers or the potential new entrant (NE1). This sheet is included in the same workbook as those models merely for convenience.
2.6unpaired.BACKHAUL	Another standalone model that estimates the value of the unpaired 2.6GHz spectrum to a national wholesaler who would use that spectrum to provide a backhaul alternative to microwave links or fibre connections.

2.5 Results charts

A large collection of charts is provided to help visualise key inputs and data. The first letter in the chart name corresponds to the sheet whose inputs/results are displayed, as follows:

- s = sensitivities inputs in the SENS sheet
- p = parameter inputs in the PARAM sheet
- m = market forecasts from the MKT sheet
- vf, tf, ee, h3g, ne1 = results for the corresponding operator.

2.6 Calculation sheets by scenario

All sheets to the right of the charts² are model calculation sheets where the detailed calculations of the bottom-up business modelling are implemented.

It is not envisaged that the user will need to interact with this group of sheets. The model has been designed to isolate inputs in the separate sheets described in Sections 2.1 and 2.2, and the outputs in summary sheets described in Sections 2.3 and 2.5. Nevertheless this Section will describe the structure of these sheets, in case the user should wish to audit the underlying calculations.

² The exception is the last two sheets in the workbook, A and Q. These contain potentially useful historic data on an annual basis and a quarterly basis respectively. Neither of these sheets is used to drive the model calculations.

Despite the large multiplicity of sheets here, there are only two different types of sheets: one for existing national wholesalers and one for the potential new entrant. These two sheets are then replicated for each model scenario (e.g. VF|10|0|20 or NE1|0|15|10) with the replicated sheets being absolutely identical in their layout and formulae. The only difference between, for example sheet VF|10|0|20 and EE|0|15|20, is the name of the sheet. The formula in D6 of each sheet picks up the sheet name as a text string and parses this to identify the national wholesaler and spectrum scenario to be modelled. The sheet then automatically links to the corresponding parameter input values and proceeds to calculate revenues, costs, free cash flow and NPV.

The detailed calculation flows are explained in the Confidential Annex detailing the modelling methodology. The following sub-sections provide an overview of how this is implemented in the structural flow of the worksheet.

2.6.1 Calculation sheets for existing national wholesalers

Rows 5-9 identify, from the sheet name, national wholesaler and spectrum scenario is to be modelled in this sheet.

Rows 11-167 apply rules to allocate the available spectrum to use by technologies, starting with GSM – based on a minimum spectrum requirement for coverage and a capacity requirement. This leaves a certain amount of 900MHz and 1800MHz spectrum available for refarming. The usage of 900MHz and 2100MHz spectrum for UMTS/HSPA(+) is decided next, based on a minimum reservation of 2100MHz spectrum, and refarming of 900MHz. Any spectrum not allocated to GSM or UMTS/HSPA(+) is considered available for LTE, starting from the date that LTE technology is considered to be commercially available in a given band. The final allocation of UMTS/HSPA(+) and LTE spectrum is an input to both the revenue and the cost calculations further down the sheet.

Rows 168-317 calculate the difference in revenues between this model scenario and the basecase scenario for the selected national wholesaler. Note the INDIRECT() function is used here. This carries the cautions discussed in Section 2.3.1 and hence cells using the INDIRECT() function are clearly highlighted in blue and accompanied by a warning in red text.

Rows 318-1559 calculate the network costs for this model scenario. Most of the calculations concern the radio access network (RAN) – involving network dimensioning calculations for sites and equipment. A coverage calculation comes first. Then capacity-driven network deployment is calculated under the three different traffic-growth scenarios (hence the length of the sheet which replicates this part of the calculations three times). Unit costs are applied towards the bottom of each of these three sections, along with addition of core and backhaul costs.

2.6.2 Calculation sheets for potential new entrant

The calculations for the potential new entrant, in the sheets named NE1|... are similar to those in the calculation sheets for existing national wholesalers.

The main difference is that these sheets model the cash flows of the whole business for a potential new entrant, whereas the existing national wholesaler sheets focussed on incremental cash flows. As a result, the top of the sheet consists of a financial overview and non-network costs. However, once the network cost calculations are reached further down the sheet, the calculations are virtually identical to those used for the existing national wholesalers, with the caveat that only one traffic growth scenario is modelled at a time.

The one sheet that is distinct from the rest is NE1|0|0|0. This models a potential new entrant in the event that they fail to win any spectrum in the auction and revert to being an MVNO, with cash flows modelled as a simple margin on revenue. Revenue is drawn from the NE1 sheet described in Section 2.4.

3 How to use the model

This section explains how to use the model including the following key tasks:

- Running the model and locating results for an existing national wholesaler
- Running the model and locating results for the potential new entrant
- Changing the amount of unpaired 2.6GHz spectrum won
- Changing the long-run market share of an existing national wholesaler
- Changing the long-run market share of the new entrant
- Changing the basecase spectrum scenario for a given national wholesaler
- Locating and changing key parameters
- Adding a new spectrum scenario.

The instructions for performing all of these tasks assume that the user has opened the workbook in Excel. The model was designed in Excel 2010, but is expected to work in Excel 2007 also. Correct operation in earlier versions of Excel cannot be guaranteed.

3.1 Running the model and locating results for an existing national wholesaler

As a preliminary step to running the model, the user should check that the following inputs are set to the values that are required:

- **Unpaired 2.6GHz spectrum:** the amount assumed to be won in the auction should be selected from the drop-down menu in cell R1 of sheet SCEN
- **Sensitivity inputs:** the drop-down selection menus in cells D7:D10 of sheet SENS. Unless a sensitivity analysis is being performed, the setting should be 'Default' for all four inputs
- **Basecase spectrum scenario:** the spectrum scenario associated with the basecase as found in row 33 of sheet OP
- **Long-run market share:** this is controlled by a long-run market share assumption for H3G in cell M4 of sheet Summary H3G. If results are required for H3G then the setting of this parameter should match the long-run market share forecast for H3G. If results are required for VF, TF or EE, then the setting of this parameter should be such that an equal (one-third) share of the market share remaining after subtracting H3G's market share, would give the value desired for VF, TF or EE. For example, if the user wants results for VF with 25% long-run market share, then the cell M4 in sheet Summary H3G should be set to 25%. It is not possible to simultaneously calculate results for combinations of H3G market share and the market share of other operators that do not sum to 100%.

The model can then be run by pressing F9.

The results for the existing national wholesalers can be found in the following sheets and charts corresponding to each operator:

- Vodafone – see 'Summary VF' sheet and charts whose names begin 'vf'
- Telefonica O2 – see 'Summary TF' sheet and charts whose names begin 'tf'
- Everything Everywhere – see 'Summary EE' sheet and charts whose names begin 'ee'
- Hutchison 3G – see 'Summary H3G' sheet and charts whose names begin 'h3g'.

The main valuation results (in GBP million) are shown in the tables at the top of each sheet, for the spectrum scenarios specified in cells B11:B31. From left to right the tables show results under low, medium and high traffic growth scenarios.

More detailed results from intermediate steps in the modelling, including revenues, market share, costs, and network dimensioning, can be found further down the sheet.

3.2 Running the model and locating results for the potential new entrant

As a preliminary step to running the model, the user should check that the following inputs are set to the values that they require:

- **Unpaired 2.6GHz spectrum:** the amount assumed to be won in the auction should be selected from the drop-down menu in cell R1 of sheet SCEN
- **Sensitivity inputs:** the drop-down selection menus in cells D7 and D8 of sheet SENS. Unless a sensitivity analysis is being performed, the setting should be 'Default'
- **Basecase spectrum scenario:** the spectrum scenario associated with the basecase as found in cell G33 of sheet OP
- **Long-run market share:** cell M6 of sheet Summary NE1
- **Traffic growth scenario:** cell M5 of sheet Summary NE1.

The model can then be run by pressing F9.

The results can be found in the 'Summary NE1' sheet and charts whose names begin 'ne1'. Note that some results on the 'Summary NE1' sheet are not automatically updated, but rather based on pasted values where indicated with a warning in red text. Results that are automatically updated on this sheet, based on the settings made above, are in cells B11:E88 and in B39:X350.

If the user wishes to view results for all traffic growth scenarios side by side, this can be done by running the model repeatedly, with cell M5 of sheet Summary NE1 set to each different setting. After each run, copy the values of cells B39:X350 across to the corresponding block of pasted results to the right of this range. The tables in G9:Q88 will then automatically refresh based on the pasted results in rows 39 to 350.

3.3 Changing the amount of unpaired 2.6GHz spectrum won

Select the amount of unpaired 2.6GHz spectrum to be included in the valuation, from cell R1 of sheet SCEN. Rerun the model according to the instructions in Sections 3.1 and/or 3.2.

3.4 Changing the long-run market share of an existing national wholesaler

If the existing national wholesaler of interest is H3G, then set the desired long-run (in 2033) market share directly in cell M3 of sheet Summary H3G.

If the existing national wholesaler of interest is one of VF, TF or EE, then calculate the parameter X according to the following formula:

$$X = 100\% - 3 * (\text{long-run market share of VF, TF or EE})$$

Enter the value of X in cell M3 of sheet Summary H3G.

Rerun the model according to the instructions in Sections 3.1 and/or 3.2.

3.5 Changing the long-run market share of the new entrant

Set the desired long-run (in 2033) market share directly in cell M6 of sheet Summary NE1.

Rerun the model according to the instructions in Sections 3.1 and/or 3.2.

3.6 Changing the basecase spectrum scenario for a given national wholesaler

In the OP sheet, row 33, select the column corresponding to the national wholesaler of interest. Enter the basecase spectrum scenario in the format AA|x|y|z where AA is that national wholesaler's short name in the model (VF or TF or EE or H3G or NE1), x,y, and z are the amounts in paired MHz of 800MHz, 1800MHz and 2.6GHz spectrum won at the auction respectively.

Rerun the model according to the instructions in Sections 3.1 and/or 3.2.

Note that by design, the basecase spectrum scenario corresponds to the basecase revenue and traffic forecasts derived in the MKT sheet. These forecasts assume that all the existing national wholesalers each secure enough spectrum in the auction such that they are all in relatively strong competitive positions as regards their spectrum holdings. The combination of basecase spectrum scenarios among the four existing national wholesalers has also been selected such that all the paired spectrum available in the auction is divided among these four operators. The user is strongly advised to account for these factors if/when changing the basecase spectrum scenario(s).

3.7 Locating and changing key parameters

In the SENS sheet, select preferred parameter settings using the drop-down menus in cells D7:D10.

Rerun the model according to the instructions in Sections 3.1 and/or 3.2.

3.8 Adding a new spectrum scenario

All possible combinations of spectrum that could be won at the auction have been listed in the SCEN sheet. However, calculations are only implemented for a subset of these as highlighted in green in the SCEN sheet. To add a spectrum scenario that has not yet been implemented for a particular national wholesaler, do the following:

- Locate the row for that scenario in the SCEN sheet
- Specify switch-off years for GSM and UMTS/HSPA(+) in columns T and U. These years must be no earlier than 2012 or the model will block calculation of this scenario as a safeguard to prevent accidental display of spurious results
- Highlight the cells in this row of columns O:R and T:U in green to indicate that this scenario is (about to be) implemented
- Go to any calculation sheet for an existing national wholesaler – e.g. VF|10|0|20
- Make a copy of this sheet
- Rename the sheet with the name of the scenario that you wish to add (e.g. EE|10|0|25). The sheet will automatically detect the scenario from the sheet name, and implement the calculations for that scenario
- Now to make the results for that scenario appear in the Summary results sheets, go to the Summary sheet for the operator considered in the just-added scenario (e.g. Summary EE). Overtyping one of the existing spectrum scenarios in cells B11:B31 with the new scenario name
- Press F9 to recalculate the model

- The results in the overtyped row, and in the corresponding rows of all results tables further down the sheet, should automatically be updated to reflect the results from your just-added calculation sheet. The graphs that are based on this Summary sheet will also be automatically updated.

Please note that whilst the functionality of the model supports the valuation of different amounts of paired 2.6GHz spectrum without any 800MHz or 1800MHz paired spectrum, in practice the model parameters have been set assuming that a national wholesaler would always secure some 800MHz or 1800MHz spectrum. Caution is therefore advised in the use of any scenarios to calculate the value of 2.6GHz paired spectrum only.

If the user wants to implement a new spectrum scenario for the potential new entrant, the procedure is essentially the same, except that the calculation sheet to be copied must be one of the potential new entrant calculation sheets with a naming starting NE1|... and excluding NE1|0|0|0 which is a special case and has different calculations to the other NE1|... sheets.