



Excellence in Business



**Assessment of the cost of providing
wholesale voice call termination services
on fixed networks in the EU/EEA
countries – SMART 2018/0014**

User manual

Axon Partners Group

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1. Introduction

The European Commission (hereinafter “EC”) commissioned Axon Partners Group Consulting S.L.U. (hereinafter “Axon Consulting” or “Axon”) for the “Assessment of the cost of providing wholesale voice call termination services on fixed networks in the EU/EEA countries¹” (‘the Project’).

As described during Workshop 1 held on 23 October 2018 at the EC’s premises², the EC deemed relevant to develop a cost study to understand the costs of providing fixed termination voice services in EU/EEA countries. With such objective in mind, the EC/Axon team has developed a Bottom-Up Long Run Incremental Cost (hereinafter ‘BULRIC’) model that calculates the costs of providing wholesale voice call termination services on fixed networks in the EU/EEA countries.

This report describes how to use the costing model (‘the model’) for fixed networks commissioned by the EC and is split in the following sections:

- ▶ **General overview of the model**, which describes the structure of the costing model.
- ▶ **Getting started**, which outlines the main considerations and specifications to run the model.
- ▶ **Understanding the control panel**, describes the Control Panel of the model, which is the main user interface where the main options and scenarios are selected. Additionally, this worksheet contains a ‘RUN’ button to execute the model.

¹ SMART 2018/0014

² A video version of the workshop is available at:

<https://webcast.ec.europa.eu/fixed-termination-rates-workshop-23-10-2018>



2. General overview of the model

The model file is comprised of worksheets grouped in the following blocks or calculation steps:

- ▶ Support and control worksheet
- ▶ Step 0: Parameters
- ▶ Step 1: Main inputs
- ▶ Step 2: Advanced inputs
- ▶ Step 3: Drivers mappings
- ▶ Step 4: Unit costs and drivers consolidation
- ▶ Step 5: Network dimensioning
- ▶ Step 6: Costing of resources
- ▶ Step 7: Consolidated results

The model has been developed based on a linear architecture to improve the execution performance and to reproduce the calculation flow logic. The exhibit below shows the model calculation flow.

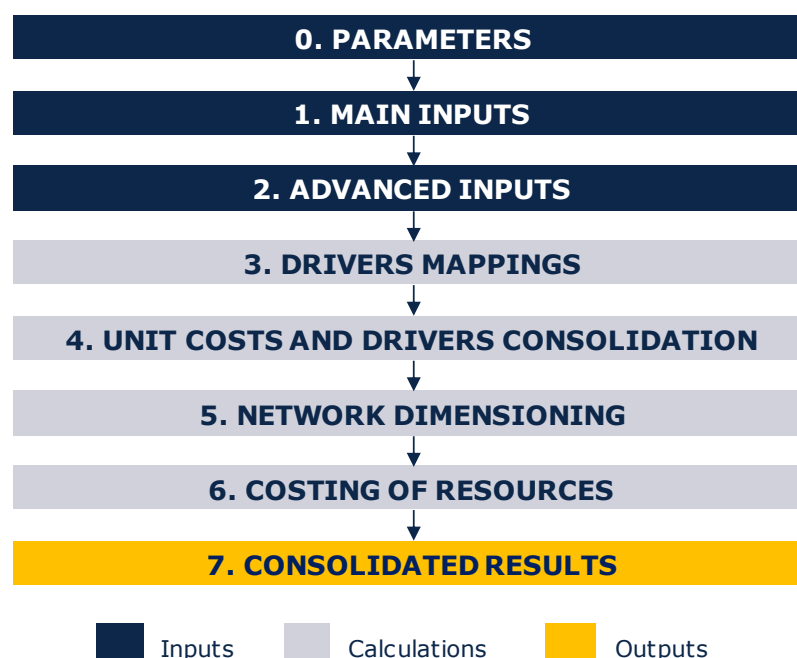


Exhibit 2.1: Calculation flow of the model [Source: Axon Consulting]



The block “Support and Control Worksheets” has not been represented in the previous exhibit for clarity purposes.

The worksheets of the model have been labelled according to the following structure (not applicable to the “Support and Control Worksheets” block):

- ▶ Step number and ordinal: It is composed of the number of the step (i.e. 0, 1, 2...) and the order of the worksheet in alphabetical format (i.e. A, B ...)
- ▶ Type of worksheet indicators:
 - *PAR*: Definition of parameters
 - *INP*: Input worksheet
 - *MAT*: Matrix obtaining the relationship between two dimensions
 - *MAP*: Mapping between two dimensions
 - *CALC*: Other Calculations
 - *OUT*: Results worksheet
- ▶ Name of the worksheet

As an example, the worksheet ‘1B INP DEMAND’ is the second (B) worksheet of the Step 1. It represents an input (INP) related with the demand (DEMAND).

2.1. Relationship between the model calculation flow and its worksheets

This section describes the calculation blocks of the model, including a detailed description of the worksheets contained in each block. Note that sub-section 2.1.1 does not strictly describe a block of the calculation flow, but it describes the support and control worksheets used within the model.



2.1.1 Support and control worksheet

In the model there are four (4) worksheets that provide general information and support the calculation process.

| Worksheet name | Description |
|--------------------|---|
| COVER | <ul style="list-style-type: none">▶ This worksheet is the cover page of the model. It allows the user to run the model and have access to the main controls of the model (Worksheets "CONTENTS", "MAP").▶ It provides a graphical overview of the results for the wholesale voice call termination services on fixed networks. |
| CONTENTS | <ul style="list-style-type: none">▶ Provides high-level information about the model (i.e. version, status and contacts).▶ Provides a list and brief descriptions of the model's worksheets. |
| MAP | <ul style="list-style-type: none">▶ Map that presents the relationship between worksheet blocks and the calculation flow of the model.▶ Colours have no meaning and have been selected to ease the identification of the blocks through the model. |
| COLOUR CODE | <ul style="list-style-type: none">▶ It contains the colour code used throughout the model. |

Exhibit 2.2: Support and Control Worksheets. [Source: Axon Consulting]

2.1.2 Step 0: Parameters

The four (4) worksheets concerning the parameterisations taken into consideration in the model are defined in the table below:

| Worksheet name | Description |
|------------------------|---|
| OA PAR SERVICES | <ul style="list-style-type: none">▶ The list of services considered in the model is introduced in this worksheet. Additionally, certain services' details are input in it, such as the units in which services are measured and to which increment each service is associated.▶ The demand traffic, obtained from the operators, is entered in the model for these services (Worksheet-"1B INP DEMAND"). |



| Worksheet name | Description |
|-------------------------|--|
| OB PAR RESOURCES | <ul style="list-style-type: none">▶ The core network resources used in the cost model are parameterised in this worksheet. Other parameters related to the resources and cost items are also defined here.▶ The main aspects of the resource parameterisation are listed below:<ul style="list-style-type: none">• <i>Category</i>: Main classification of the resource.• <i>Name</i>: Complete name of the resource• <i>Short Name</i>: Shorter version of the name for abbreviation purposes throughout the model• <i>Unit</i>: Unit in which the resource is measured• <i>Resource Code</i>: Code reserved for the resource▶ The dimensioning of the resources is performed in block 5 of the model. |
| OC PAR DRIVERS | <ul style="list-style-type: none">▶ Drivers are network entities used to dimension the network in terms of Subscribers, Sessions, Channels, etc. The drivers considered in the model are parameterised in this worksheet.▶ The rationale of the dimensioning drivers is to express traffic and demand (at service level) in a way that facilitates the dimensioning of network resources.▶ The explicit recognition of a dimensioning "Driver" in the model aims at simplifying and maximising the transparency of the network dimensioning process. Dimensioning drivers represent, among others, the following requirements:<ul style="list-style-type: none">• Subscribers• CDR/hour• Concurrent Sessions• Concurrent Voice Channels▶ The mapping between services and drivers is presented in the block 3 of the model, more specifically in worksheet "3A MAP SERV2DRIV". |



| Worksheet name | Description |
|--------------------------------|---|
| 0D PAR OTHER PARAMETERS | <ul style="list-style-type: none">▶ This worksheet includes other parameters employed across the model. These include, but are not limited to, the parameterisation of increments, time, currency, wholesale specific cost categories, countries etc. |

Exhibit 2.3: Parameters worksheets. [Source: Axon Consulting]

2.1.3 Step 1: Main inputs

The main inputs are those which need to be regularly updated to better represent the characteristics of the operator modelled at any specific moment in time. A total of five (5) worksheets have been introduced in this calculation block, which are defined below:

| Worksheet name | Description |
|--|---|
| 1A INP MARKET SHARE | <ul style="list-style-type: none">▶ The size of the reference operator (% of market share) is defined in this worksheet. |
| 1B INP DEMAND | <ul style="list-style-type: none">▶ The overall demand (subscribers and traffic) generated in each EU/EEA country is introduced in this worksheet. This represents the total market demand and is afterwards adjusted according to the market share of the reference operator.▶ The demand is introduced for each of the services defined in worksheet "0A PAR SERVICES".▶ The demand of the three scenarios available is included in this sheet. |
| 1C INP NW STATISTICS | <ul style="list-style-type: none">▶ The call statistics registered in the operator's network are introduced in this worksheet. |
| 1D INP CORE PLATF UNITARY COSTS | <ul style="list-style-type: none">▶ Unitary costs (both CapEx and OpEx) are defined in this worksheet for each core network resource introduced in worksheet "0B PAR RESOURCES", differentiating between Hardware and Software. Cost values are presented in Euros for the year 2018.▶ CapEx trends are also included in this worksheet. These trends are used to estimate the costs of the core equipment for each of the years considered in the model (calculations performed in block 4 of the model). |



| Worksheet name | Description |
|--|--|
| 1E INP ACTIVE TRANSMISSION COST | <ul style="list-style-type: none">▶ Active transmission and switching costs considered in the model are defined in this worksheet by means of a mark-up applied over core network costs. |

Exhibit 2.4: Main inputs worksheets. [Source: Axon Consulting]

2.1.4 Step 2: Advanced inputs

The second type of inputs, named Advanced Inputs, are not expected to be updated regularly by the user, as they refer to information that will generally remain unchanged over a prolonged number of years (e.g. number of nodes, useful lives). Six (6) worksheets have been defined in this step, and they are described in the table below:

| Worksheet name | Description |
|----------------------------------|---|
| 2A INP NW | <ul style="list-style-type: none">▶ Network parameters required for the dimensioning of the network (e.g. equipment's load, network unit conversions, constants) are introduced in this worksheet. |
| 2B INP CORE NODES | <ul style="list-style-type: none">▶ The information related to the number of core nodes is introduced in this worksheet. |
| 2C INP BUSY HOUR | <ul style="list-style-type: none">▶ The busy hour distribution profile in each EU/EEA country is defined in this worksheet. The outcome generated in this worksheet constitutes the percentage of traffic in the busy hour of a normal day over the traffic carried over one year for the voice services.▶ The information from this worksheet is used in the calculation of drivers in block 4. |
| 2D INP RESOURCES LIFE | <ul style="list-style-type: none">▶ Useful lives for the annualisation of resources costs are introduced in this worksheet and applied in block 6. |
| 2E INP WACC | <ul style="list-style-type: none">▶ The nominal pre-tax Weighted Average Cost of Capital (WACC) for each EEA country is defined in this worksheet.▶ The WACC is used to calculate the economic depreciation of the assets in block 6. |
| 2F INP SERVICE SPEC COSTS | <ul style="list-style-type: none">▶ The wholesale specific costs incurred in the provision of voice termination services are introduced in this worksheet. |

Exhibit 2.5: Advanced inputs worksheets. [Source: Axon Consulting]



2.1.5 Step 3: Drivers mappings

The two (2) worksheets contained in this block are used to map the services with the drivers used for the dimensioning process of the core network. These worksheets are defined in the table below:

| Worksheet name | Description |
|-------------------------|---|
| 3A MAP SERV2DRIV | <ul style="list-style-type: none">▶ This worksheet defines the relationships between services and dimensioning drivers based on the conversion factors and the usage of the drivers by each service.▶ It should also be noted that a service is generally assigned to more than one driver, as drivers represent traffic in a particular point of the network.▶ The relationships introduced in this worksheet, presented in tabular format, are restructured in a matrix format in sheet "3B MAT SERV2DRIV". |
| 3B MAT SERV2DRIV | <ul style="list-style-type: none">▶ This worksheet re-organises the relationships between services and drivers previously defined in worksheet "3A MAP SERV2DRIV".▶ This information is used to estimate the volume of dimensioning drivers in block 4. |

Exhibit 2.6: Drivers mappings worksheets. [Source: Axon Consulting]

2.1.6 Step 4: Unit costs and drivers consolidation

The two (2) worksheets included in this section are responsible for calculating the unitary costs of the core network resources for the years considered in the model, and consolidate the drivers' volumes to ease the network dimensioning process. These worksheets are described below:



| Worksheet name | Description |
|---------------------------------------|---|
| 4A CALC PLAT UNITARY COSTS | <ul style="list-style-type: none">▶ This worksheet consolidates the unit costs of the resources (CapEx) in the format required by the model for the network dimensioning process.▶ CapEx unitary costs are calculated by taking into consideration the 2018 reference CapEx defined in the inputs section and applying the CapEx trends to it.▶ The values obtained are later used to calculate the total costs of the network in blocks 5 and 6. |
| 4B CALC DRIVERS | <ul style="list-style-type: none">▶ The dimensioning drivers' volume is calculated in this worksheet. The first table (on the left) calculates the drivers' volume assuming the demand of all services, while the second table (on the right) calculates the drivers' volume after removing the voice increment.▶ This information is used to dimension the core network in block 5. |

Exhibit 2.7: Unit costs and drivers consolidation worksheets. [Source: Axon Consulting]



2.1.7 Step 5: Network dimensioning

This block includes a single (1) worksheet responsible for the core network platforms dimensioning:

| Worksheet name | Description |
|-------------------------|---|
| 5A CALC DIM CORE | <ul style="list-style-type: none">▶ Core network platforms are dimensioned in this worksheet, calculating the equipment required to support the traffic for each increment.▶ Calculations are presented for the two different increments (when moving towards the right of the sheet). Finally, at the lower end, results are consolidated.▶ The dimensioning of the core network takes as starting point the drivers obtained in block 4 as well as the inputs extracted from blocks 1 and 2. Results of this worksheet are used to calculate the total costs of the network in block 6. |

Exhibit 2.8: Network dimensioning worksheet. [Source: Axon Consulting]

2.1.8 Step 6: Costing of resources

This step contains four (4) worksheets related with the costing of resources. A description of each of these worksheets is provided in the table below:



| Worksheet name | Description |
|--------------------------------------|---|
| 6A CALC RES OPEX | <ul style="list-style-type: none">▶ The OpEx generated by the resources installed in the network is calculated in this worksheet for each increment. The information for the different increments is presented towards the right of the worksheet.▶ The calculation takes into account the Total CapEx Cost calculated in worksheet "5A CALC DIM CORE" and the OpEx over CapEx percentages defined in worksheet "1D INP CORE PLATF UNITARY COSTS".▶ Finally, the incremental OpEx cost associated with the voice termination increment is calculated. |
| 6B CALC RES CAPEX | <ul style="list-style-type: none">▶ Resources' CapEx is annualised in this worksheet using the economic depreciation method for each increment. The information for the different increments is presented towards the right of the worksheet.▶ The calculation takes into account the Total CapEx Cost calculated in worksheet "5A CALC DIM CORE" and the useful lives defined in worksheet "2D INP RESOURCES LIFE".▶ Finally, the incremental CapEx cost associated with the voice termination increment is calculated. |
| 6C CALC RES ACTIVE EQUIP COST | <ul style="list-style-type: none">▶ The active switching/transmission equipment cost is calculated in this worksheet.▶ The calculation consists of multiplying the active switching/transmission equipment mark-up from worksheet "1E INP ACTIVE TRANSMISSION COST", by the incremental network cost of the resources (CapEx and OpEx) from the two previous worksheets "6A CALC RES OPEX" and "6B CALC RES CAPEX". |



| Worksheet name | Description |
|-----------------------------------|--|
| 6D CALC SERVICE SPEC COSTS | <ul style="list-style-type: none">▶ The wholesale specific costs incurred in the provision of wholesale voice termination services are calculated in this worksheet. |

Exhibit 2.9: Costing of resources worksheets. [Source: Axon Consulting]

2.1.9 Step 7: Consolidated results

Worksheets included in this block show the main results of the model. A description of the six (6) worksheets presented in this block is provided below:

| Worksheet name | Description |
|-----------------------------------|---|
| 7A OUT SERV LRIC TOT COST | <ul style="list-style-type: none">▶ This worksheet consolidates the total incremental costs of wholesale voice call termination services on fixed networks.▶ Costs are disaggregated per cost category and cost type. |
| 7B OUT SERV LRIC UNIT COST | <ul style="list-style-type: none">▶ This worksheet consolidates the unitary incremental cost of wholesale voice call termination services on fixed networks.▶ The unit cost is disaggregated per cost category and cost type. |
| 7C SERV LRIC TOT CONS | <ul style="list-style-type: none">▶ This worksheet consolidates the total incremental costs of wholesale voice call termination services on fixed networks calculated in each EEA country.▶ These are extracted from worksheet "7A OUT SERV LRIC TOT COST". |
| 7D OUT SERV LRIC UNIT CONS | <ul style="list-style-type: none">▶ This worksheet consolidates the unitary incremental cost of wholesale voice call termination services on fixed networks calculated in each EEA country.▶ These are extracted from worksheet "7B OUT SERV LRIC UNIT COST" |



| Worksheet name | Description |
|-------------------------|--|
| 7E OUT RES COSTS | ▶ This worksheet consolidates the total costs of the core resources calculated in each EEA country (without considering incrementality). These are extracted from worksheets "6A CALC RES OPEX" and "6B CALC RES CAPEX". |
| 7F OUT RESULTS | ▶ This worksheet summarises and illustrates the main results obtained in the model. |

Exhibit 2.10: Consolidated results worksheets [Source: Axon Consulting]



3. Getting started

Computer requirements

The costing model is an Excel file. To run the model, a computer with at least 1 GB of RAM memory and with Microsoft Excel version 2010 (or a newer version) is required. For enhanced performance, it is recommended to run the model on computers with at least 2 GB of RAM Memory.

Opening the model

The execution of the model is based on Macros (embedded programs in Visual Basic). Therefore, they need to be enabled to run the model. If Macros are not enabled when opening the model, the following warning message will appear³:

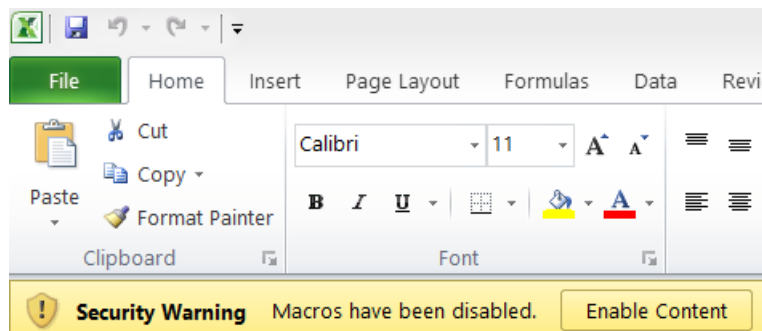


Exhibit 3.1: Warning appearing in Microsoft Excel 2010 when the model is open and Macros are not enabled. [Source: Axon Consulting]

If the warning shown above appears, click the “Enable Content” button to enable Macros and be able to execute the model.

³ If the warning shown in Exhibit 3.1 does not appear, disregard further steps described in this section.



4. Understanding the control panel

The control panel (or COVER) represents the main interface of the model to the user. This worksheet is used to select the model’s main available options, configure the execution mode and run the model. The following figure shows a snapshot of the control panel.



Assessment of the cost of providing wholesale voice call termination services on fixed networks in the EU/EEA countries

SMART 2018/0014

| Quick controls | | |
|---|--|--|
| Execution mode | All countries | <input type="button" value="RUN"/> <input type="button" value="CONTENTS"/> <input type="button" value="MAP"/> <input type="button" value="General check"/> <input type="button" value="OK"/> |
| | <i>execution.mode</i> | |
| Selected Country | Hungary | |
| | <i>selected.country</i> | |
| Core Platforms Dimensioning scenario | Based on Continuous Functions (Curves) | |
| | <i>dimensioning.scenario</i> | |
| Market Share scenario | Market share of an hypothetical operator | |
| | <i>market.share.scenario</i> | |
| Market Share input (only applicable if Market Share scenario "Market share of an hypothetical operator" is selected) | 50% | |
| | <i>input.market.share</i> | |
| Demand Forecast scenario | Base Case | |
| | <i>selected.demand.scenario</i> | |

Exhibit 4.1: Snapshot of the control panel [Source: Axon Consulting]

Important warning: the model needs to be run in order to see the impact on the results of any change made in the control panel.

The main options available to the user in the “Quick controls” section are described below:

- ▶ **Execution mode:** This option allows the user to select between the execution modes described below:
 - “Selected country” mode: The model will be executed for the selected country in the *Selected Country* panel (estimated execution time: 15 seconds).



- "All countries": The model will be executed for all the 31 EU/EEA countries (estimated execution time: 8-10 minutes). In this case, each country is executed in order and its results are stored in block 7 worksheets.
- ▶ **Selected country:** Selection of the country to be executed when the "Selected country" mode is enabled. The user can select any of the 31 EU/EEA countries.
- ▶ **Core Platforms Dimensioning scenario:** This selection enables the user to choose the scenario employed for the dimensioning of the core network platforms. The two available scenarios are listed below:
 - "Based on Prices Catalogues": Only a set of configurations/capacities for each core network element is available (discrete points). In the dimensioning module, if the capacity required falls between two configurations, the higher one is selected.
 - "Based on Continuous Functions (Curves)": The set of configurations/capacities of the 'Prices Catalogues' option is connected by means of straight lines to produce a continuous function for each core network element. In the dimensioning module, the cost of the core network element is selected as the intersection of the corresponding capacity with this continuous function.
- ▶ **Market Share scenario:** This option allows the user to select between the scenarios described below:
 - "Market share of the incumbent operator": Under this scenario, the market share of the incumbent operator in each country is used for the size of the reference operator.
 - "Market share of a hypothetical operator": In this case, the market share is set as a theoretical figure, which must be included by the user in the *Market Share input* panel located below.
- ▶ **Market Share input (only applicable if Market Share scenario "Market share of a hypothetical operator" is selected).** Cell reserved for the inclusion of the market share of the hypothetical operator when the "Market share of a hypothetical operator" scenario is enabled. The user can introduce any value between 0% and 100%.
- ▶ **Demand forecast scenario:** This selectable allows stakeholders to assess the results produced by the model under different voice traffic forecasts. The three alternative scenarios defined are described below:
 - "Base Case". This is the base-case scenario, where growth rates observed in the historical period (2015-2018) has been directly used to estimate the future demands of voice services.



- "*Conservative*". This scenario assumes a more pessimistic than the originally expected growth of the voice services. Particularly, we have defined this scenario by adjusting the historical growth rate, deducting 5 percentage points from it.
- "*Aggressive*". This scenario assumes a more optimistic than the originally expected growth of voice services. In a similar manner, we have defined this scenario by adjusting the historical growth rate, adding 5 percentage points to it.

Important: For further information about the definition of these scenarios, please refer to the methodological approach document.

MADRID (HQ)

Sagasta, 18, 3
28004, Madrid
Tel: +34 91 310 2894

BOGOTA

Carrera 13 No. 93 - 40
Of 301-304, Bogotá D.C.
Tel: +57 1 732 2122

DELHI

Level 12, Building No. 8,
Tower C, DLF Cybercity Phase II,
Gurgaon 122002
Tel: +91 981 9704732

ISTANBUL

Buyukdere Cad. No 255, NuroI Plaza
B 04 Maslak 34450
Tel: +90 212 277 70 47

SEVILLE

Fernández de Rivera, 32
41005, Seville
Tel: +34 671548201

MIAMI

801 Brickell Avenue, 9th floor, 33131
Miami, Florida
Tel: +1 786 600 1462

MEXICO D.F.

Lamartine 711, Chapultepec
Morales-Polanco-
México, D.F. 11580
Tel: +52 55 52034430



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