Technical Assistance for Achieving the Information Society and Stimulating High-speed Broadband Services to the Benefit of Consumers

Consultation Paper on Cost Models
Other Licensed Operator (OLO)

DATE: 05 November 2015
ALTUN/ICTA/TR2011/0740.26-2/SER/001
Technical Assistance for Achieving the Information Society and Stimulating High-speed Broadband Services to the Benefit of Consumers

Consultation Paper on Cost Models Methodology

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This publication which was prepared through European Union's financial aids includes the views and assessments of the consultant firm, and doesn't reflect necessarily the views of BTK.
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1. INTRODUCTION

1.1. CONTEXT AND PURPOSE

The Information and Communication Technologies Authority (ICTA) is currently engaged in developing measures for achieving the information society and stimulating high-speed broadband services to the benefit of consumers in Turkey. In the light of this overarching project, co-financed by the European Union and the Republic of Turkey, the consultant firm on behalf of ICTA is developing cost models for fixed and mobile telecommunication networks in Turkey. The Authority, in the context of the access and interconnection legislation (Electronic Communications Law Article 15-21, Ordinance on Access and Interconnection, Communique on Principles as to Colocation and Facility Sharing), intends to use the cost models to complement existing regulatory instruments in determining the cost of retail and wholesale telecommunications services, as well as to gain a better understanding of the cost structure and drivers of telecommunications networks.

The purpose of this paper issued by the Authority is to identify and communicate the key methodologies and parameters that support the development, implementation and use of the cost models of Other Licensed Operators (OLO), as well as to collect the opinions and views of the Industry on this respect. The results of the public consultation will be used to support ICTA’s decisions and discussions with the Industry as well as to be used in the refinement of the current access regime.

1.2. OVERVIEW OF FIXED NETWORK MARKET IN TURKEY

Türk Telekom is the incumbent in the fixed telephony (80% market share) and wholesale provider in the broadband (70% market share via its retail subsidiary TTNet) as well as the leased lines markets. The mobile incumbent Turkcell’s subsidiary Turkcell Superonline is also an active player in the broadband market and holds a market share of 15.4% there and a comparable market share in the fixed telephony market. The overall number of telephony wireline subscribers is still decreasing.

Other relevant players in the fixed telephony market are TTNet (10.5%) and Superonline (3.2%). Relevant players in the fixed broadband market are also Türksat (6.5% market share) and Doğan TV (4.1%). The number of wireline broadband subscribers is still growing: From 6.4 million in 2009 to 8.9 million in 2014. The fixed broadband household penetration rate rose from 33% to 44% in the last five years. In addition, the total length of fiber infrastructures of alternative operators is approximately 55,000 km, while the one for Türk Telekom is 203,000 km.

The Turkish government still owns 30% of Türk Telekom through the Undersecretariat of Treasury.

Because of the strong dominance – despite Türk Telekom’s decrease of market shares during the last years – and its subsidiary the level of competition in the fixed market is rather low and therefore the development of the Turkish telecommunications sector is limited.
1.3. SCOPE OF THE COST MODELS

The cost model will serve as basis for setting regulated prices. The EU recommends the use of bottom-up LRIC cost model (BU-LRIC) for calculation of unit service costs (e.g. Recommendation of 2009/396/EC, 2013/466/EU). The recommendation also states that forward looking efficient technologies should be used in the cost model. The Authority is in line with the precepts of the EU Acquis and applies the BU-LRIC approach.

The overall scope is to develop BU-LRIC models encompassing the following objectives:

- Collect input data from relevant mobile network operators (MNOs), the relevant fixed network operator (FNO) and Other Licensed Operators (OLOs)
- Design and implement BU-LRIC models per relevant operator based on gathered input data and applying international benchmark data where no data is available
- Provide forecasts from 2015 to 2019
- Calculate service unit costs for predefined services

The following network operators were considered within the data collection process:

- Türk Telekomünikasyon A.Ş. (FNO)
- Superonline İletişim Hizmetleri A.Ş. (OLO)
- Vodafone Net İletişim Hizmetleri A.Ş. (OLO)
- Turkcell İletişim Hizmetleri A.Ş. (MNO)
- Avea İletişim Hizmetleri A.Ş. (MNO)
- Vodafone Telekomünikasyon A.Ş. (MNO)

The present document focuses on the BU-LRIC model of Other Licensed Operators (OLO).

1 "It is recommended that the evaluation of efficient costs is based on current cost and the use of a bottom-up modelling approach using long-run incremental costs (LRIC) as the relevant cost methodology” (Recommendation of 2009/396/EC, p. 4).

2 Related programmes with ICTA’s involvement that helps to promote the EU Acquis and adjust to it are to date: “Technical Assistance for the Improvement of Access Regime in the Turkish Telecommunications Market” (EuropeAid/123810/D/SER/TR), supported by the European Commission (EC). The Project was carried out and completed in 2008. The first component of the Project was aiming at improving the implementation capacity of ICTA on the implementation guidelines of accounting separation and know-how on cost models in line with the EU Acquis. The second component focused on strengthening the implementation capacity of ICTA for local loop unbundling, being a prominent element of a sound access regime promoting competition in the sector as outlined by the EU Acquis for effective and efficient usage of resources and achieving workable competition. In addition, the project called “Technical Assistance for Prevention of Anti-competitive Behaviors in the Electronic Communications Sector” (EuropeAid: 133078/D/SER/TR) was carried out and completed in 2014.
The services included in the BU-LRIC models are the following (see Annex for complete list):

- Broadband access services (dark fibre)
- Infrastructure sharing services (co-location, duct sharing)

1.4. TIMELINE

The consultation process will be carried-out according to the timeline below.


The questions and comments need to be sent to following e-mail addresses (adarici@btk.gov.tr and sacar@btk.gov.tr) according to stipulated deadlines. The questions and comments need to be submitted in one single consolidated document.

2. PRINCIPLES OF LRIC COST MODELS

According to the EU Recommendation 2009/396/EC regulatory authorities should shift their cost modeling approaches to an LRIC approach and in the next step from LRIC+ to Pure LRIC. The recommendation specifies guidelines for cost models for setting regulatory prices. The cost models to be developed will be able to calculate Pure LRIC and LRIC+ costs.

BU-LRIC models consider that a cost of provisioning a service is equal to the change in total costs resulting from a discrete variation in output in the long-run (that is when all inputs are variable). This means that when the demand of a particular service changes, the cost structure of the analyzed operator will also change.

There are different variations of LRIC, as can be seen in figure 1.

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3 “Therefore, it is justified to apply a pure LRIC approach whereby the relevant increment is the wholesale call termination service and which includes only avoidable costs. A LRIC approach would also allow the recovery of all fixed and variable costs (as the fixed costs are assumed to become variable over the long run) which are incremental to the provision of the wholesale call termination service and would thereby facilitate efficient cost recovery” (Recommendation of 2009/396/EC, p. 3).
Pure LRIC is an incremental cost approach which allocates only efficiently incurred costs that would not be sustained if the service included in the increment was no longer produced, i.e. avoidable costs. This implies that the cost results are primarily based on network related costs.

Pure LRIC focuses on efficient markets (not operators). It is commonly used as a proxy for market efficiency based on cost reduction rather than revenue growth. One of its main characteristics is that it only includes direct volume-sensitive costs of the given service, excluding all cost categories that are not volume sensitive (e.g. joint and common costs). The pure LRIC cost model is based on the avoidable cost approach on increment level (traffic-related costs only). Therefore for the pure LRIC approach only costs should be considered that can be avoided if the service wouldn’t be provided.

The depreciation method for LRIC cost models is commonly based on the tilted annuities method, because it replicates best the economic value method. Because of the “efficient operator” idea, the models are not only based on the modern equivalent method (MEA) but also on the choice of the most efficient/modern technology in the economic/engineering model. The use of the MEA means that legacy costs or path dependency costs are ignored.

Pure LRIC only considers directly attributable avoidable costs based on the modern equivalent method in a theoretical efficient network. LRIC+ considers in addition to Pure LRIC an allocation of joint and common costs (referred to as “+”). These include cost categories such as license costs, marketing and sales costs, overhead costs, and other non-network related costs. LRIC+ approaches additionally consider shares of directly attributable costs, shared costs, fixed costs and common costs.
### 3. GENERAL COSTING ISSUES

#### 3.1. ASSETS, WORKING CAPITAL AND OPERATIONAL COSTS

The total amount of cash spent in assets required to provide services is the total investment. These assets can be tangible assets (hardware, buildings, land, etc.) and/or intangible assets (licenses, software, patents, etc.).

The BU-LRIC model will provide also a calculation of appropriate working capital levels and associated costs (cost of capital). Allowances will be made for working capital which preferably will be cross checked against international benchmark data to ensure that only working capital related to network activities is included. The levels should reflect efficient service provider practices and will not include retail and other business capital requirements. These costs will be allocated to the network services.

Considered operating costs shall only include costs to do with maintaining the network and providing service to customers. The BU-LRIC model will use cost estimates based on the best practice data from operators, as the basis for these costs.

The operational costs or expenses (OPEX) will be calculated and then allocated in the model to homogeneous cost categories (HCC) and services based on cost drivers. OPEX items will be estimated from the tasks and processes required to operate the network and will be estimated in some cases at a more aggregated level as a percentage of equipment capital costs. Operators provided data will assist in the estimation of operational expenses.
Question 1: Do you agree with the above views about treatment of assets, working capital and operational costs? In case of disagreement please elaborate your position.

3.2. ANNUALISATION METHODOLOGIES

Capital investments in telecommunication networks are significant and many items last long periods of use before they are replaced. The volume of the investment costs therefore could vary significantly from year to year as a result of changes in the inventory of assets.

The effective annual cost of the investment is required to define the revenue needed to provide for the replacement of the investment (asset) and to allow an adequate (fair) return on the investment (profit). This is termed annualisation of the capital investment.

Annualisation charges are calculated on capital investment as the sum of the cost of capital, and depreciation. The annual cost of capital is calculated as the mean capital employed in the equipment during the analyzed year multiplied by the Weighted Average Cost of Capital (WACC). The mean capital employed in the equipment during the reference accounting year will be calculated as the arithmetic average between the gross values of the fixed assets from the beginning and the end of the accounting year. For sensitivity purposes a geometric average between the gross values of the fixed assets from the beginning and the end of the accounting year will be also applied in the calculation.

The BU-LRIC model will include annualisation of capital including the current and forward looking prices for capital purchase, asset lifetimes and price trends.

Question 2: Do you agree with the above views on regards the annualisation methodology? In case of disagreement please elaborate your position.

3.3. DEPRECIATION METHODOLOGIES

The most ideal method to calculate depreciation for forward looking telecommunications models is economic depreciation, since it measures the period – by – period change in the market value of an asset. Also the method takes into account such factors as the rate of technological change and the extent of unanticipated demand changes, which affect an asset’s income generating ability.

The tilted annuity formula is the nearest proxy for economic depreciation and will therefore be the default method within the BU-LRIC model as it is best practice. It has the following advantages:

- Brings uniformity to different operator accounting policies and thus creates a level playing field;
- Allows all costs incurred over the lifetime to be considered;

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Allows operators’ expenditures which occurred in the past to be reflected in present and future charges, to the extent that they are still being (or can be) recovered.

The advantage of an annuity calculation is that it takes account of the discount rate (cost of capital). With this methodology, the sum of the depreciation charge and the return on capital employed declines over time consistent with the reduction in the replacement value of the asset. It adjusts the capital costs over time in line with the rate of increase or decrease of the replacement cost of the capital equipment.

Under a tilted annuity the capital cost in each year is given by:

\[
\text{Tilted Annuity} = \frac{V [1+a]^{-1} [r-a]}{1 - [(1 + a)/(1+r)]^n}
\]

Where:
- \( r \) is the rate of return on capital employed
- \( a \) is the rate of change of the replacement cost of the asset
- \( n \) is the economic life in years
- \( V \) is the current replacement cost of the asset
- \( t \) is the age (in years) of the asset

This approach is forward-looking [through the application of modern-equivalent asset (MEA) price trends] and takes into account the full time series of operation. It also requires forecasts of future equipment prices and demand. The BU-LRIC model developed by the consultant firm on behalf of the Authority will use the tilted annuity method as the default methodology to calculate depreciation charges. For sensitivity analysis the straight line depreciation method will be also considered in the model.

**Question 3:** Do you agree with the proposition above on the calculation method for depreciation charges within the BU-LRIC model? In case of disagreement please elaborate your position.

**3.4. WEIGHTED AVERAGE COST OF CAPITAL (WACC)**

In general the determination of the appropriate cost of capital is one of the key elements when defining or reviewing cost-based regulated prices. When the cost of capital is correctly defined, it allows sufficient return to account for the risks of the associated telecoms market.

The costs of capital calculated using the WACC rate are an integral and in fact one of the most relevant parts of LRIC based cost rates, hence its determination strongly impacts the result of any LRIC calculation.
The WACC represents the minimum costs a company needs to cover to be attractive for shareholders and creditors and to ensure the supply of capital. In the BU-LRIC model a pre-tax nominal WACC rate will be used.

This WACC will be a direct input from each modeled network operator. Operators are allowed to claim for appropriate cost of capital on investments when determining LRIC-cost based pricing. The WACC shall be derived by using the formula as shown below:

\[
WACC_{post-tax} = r_E \frac{E}{(E + D)} + r_D \frac{(1 - T)}{E + D}
\]

Where:
- \( r_E \) – Return on equity, i.e. rate of return expected by shareholders
- \( r_D \) – Cost of debt, i.e. rate of return requested by creditors
- \( E \) – Value of equity used by company
- \( D \) – Value of debt used by company
- \( T \) – Corporate income tax rate

As telecommunications operators need to cover their income tax obligations over and above the return expected by their shareholders and cost of debt requested by their creditors, pre-tax WACC is relevant for regulatory purposes.

The pre-tax WACC is derived from post-tax WACC using the following formula:

\[
WACC_{pre-tax} = \frac{WACC_{post-tax}}{1 - T}
\]

The use of this formula is common practice in the finance community and generally accepted by regulators. The return on equity (\( r_E \)) is normally calculated using the Capital Asset Price Model (CAPM) and assumes an efficient service provider in the relevant market (using the appropriate optimum debt/equity ratio).\(^5\)

The nominal pre-tax WACC is commonly used in the European Union and will therefore be the default option. For sensitivity purposes the model will also consider real pre-tax WACC rates.

\(^5\) The Capital Asset Price Model (CAPM) uses an unlevered beta factor (removing financial leverage effects). The unlevered beta is calculated as follows:

\[
\beta_u = \frac{\beta_l}{[1 + (1 - T) * (D / E)]}
\]

Where: \( \beta_u \) – Unlevered Beta (financial effects from leverage removed); \( \beta_l \) – Levered Beta (measure of relative volatility compared to market); \( T \) – Corporate Income Tax Rate, \( E \) – Value of equity used by company, \( D \) – Value of debt used by company.
Question 4: Do you agree with the above view to use a pre-tax nominal WACC rate which is a direct input from each modeled network operator and is based on CAPM model using unlevered beta factor? In case of disagreement please elaborate your position.

3.5. APLICABLE FEES

The model will take into account the following applicable fees:

- **Administrative Fee**: (A requirement through ‘Ordinance on Authorization as to Electronic Communication Sector, Article 16’)

- **Universal Service Fee**: (A requirement through ‘Law No. 5369’, Article 6)

Question 5: Do you agree with the application of described fees in the unit cost calculation? In case of disagreement please elaborate your position.

3.6. ASSET LIFETIMES

In order to send appropriate economic signals to the Industry, it is considered that it is favourable to use economic asset life times over accounting asset life times in developing the BU-LRIC model.

The reasoning is based on the fact that accounting asset lives in historical cost accounting tends to be shorter than economic asset lives, because of accounting prudence and uncertainty to set useful life times to an asset in advance. BU-LRIC models value costs using current cost accounting (CCA) and forward looking costs and tend to reflect the economic costs of service provisioning. For valuation of land and buildings the indexation valuation method based on historical costs will be used.

The useful life (or economic life) can be defined as the period of time the asset is being utilized by the operator or the period in which the asset’s revenues exceed its costs. The economic life of an asset cannot be longer than its physical life, but it can be shorter (e.g. due to technological obsolescence). International best practice typically avoids the use of accounting lives in developing BU-LRIC models as they do not reflect the true economic lifetimes of the assets.

The view adopted within this paper is that economic asset lives should be used. It may therefore be necessary to adjust accounting asset lives used by operators if they do not represent a good proxy for economic lives. Using asset lives that are too short (compared to true economic asset lives) can lead to significant over-recovery of costs in the BU-LRIC model and distort the resulting prices over time.

For those reasons, it is considered that economic asset lives should be used in the BU-LRIC model. Where accounting asset lives do not provide a good proxy for economic lives, the consultant firm on behalf of ICTA will make the adjustments that it considers necessary.
Question 6: Do you agree with the above proposed methodology? In case of disagreement please elaborate your position.

4. TECHNICAL MODELLING ASPECTS

4.1. SCORCHED NODE METHODOLOGY

Network operators deploy infrastructure following international and national standards and guidelines aiming at efficient use of resources while providing quality of service. At the same time they have to accommodate for different constraints that may arise due to a range of factors – urban planning and regulations, power availability, availability of land / building space, land leasing prices, environmental constrains, public activism and others. In that respect it is commonly accepted that the cost model is developed to consider the actual number and type of network locations (nodes) compared to a hypothetical (efficient) number and type of locations. This is referred to as scorched node methodology. At the same time the models are flexible to consider (estimate) the type and quantities of equipment and infrastructure situated in the network locations so that it can cover efficiently for the existing and future demand of services and related traffic volumes. This is referred to as modified scorched node methodology. It shall be understood that a network location refers typically to a civil engineering (civil works) structure as opposed to a network element (equipment or cables). For avoidance of doubt the models shall classify the following structures as network locations: street cabinets and manholes, exchange (central) offices, switch rooms (e.g. containing NGN elements, transmission equipment), data centres, and any other facility that hosts network related elements.

In the situation when OLO does not provide sufficient and reliable information on the number and type of network locations the cost model shall be able to estimate the required numbers based on efficient parameters.

It shall be noted that the models will support modified scorched node methodology.

4.2. MODERN EQUIVALENT ASSETS (MEA) AND EFFICIENT NETWORK ARCHITECTURE

The access network of the FNO consists of both copper and fibre access lines. It is expected that both type of access will co-exist in the short to medium term. On the other hand the own access network of OLO consists only of fibre access lines. Nevertheless developments in the Turkish and international markets have demonstrated that practically there are no new pure copper access network deployment. The European Commission has recommended\(^6\) that NRAs consider the adoption of the so-called Modern Equivalent Asset approach whereby fibre line is the modern equivalent of copper line arguing that by

so doing it will neutralize to extent the inflationary volume effect. The recommendation goes further to recommend that bottom-up cost models shall consider only fibre for estimating the costs of both copper and fibre wholesale access products. To reflect the cost difference between both products an adjustment can be applied.

However the recommendation also stipulates that under special cases such as very different topologies of the copper and fibre networks the NRA can model copper and fibre networks separately considering the extent of sharing of the civil engineering infrastructure (ducts, trenches, poles). In such setting fibre network will be modelled as overlay.

The cost model for FNO will consider both options – calculating copper access cost separately from fibre (overlay case) and calculating the access cost using fibre as MEA. In this way ICTA will have the flexibility to apply dynamically the necessary approach in relation to the market development and demand for copper and fibre access products. On the other hand the cost model for OLO will consider only fibre access.

Bottom-up cost models depend on the capability to reflect at the same time the OLO actual network topology (modified scorched node) while at the same time considering the latest commercially available and mature technology. According to the European Commission recommendation modern fixed networks shall be compliant with Next-Generation networks (NGN) architecture. NGN networks support simultaneously and efficiently both voice and data services. Therefore the cost model will be developed to support NGN architecture for all relevant network domains.

For OLO the model will support fibre based Next Generation Access (NGA) architecture. Specific accommodations can be made to align with relevant Turkish legislation if required.

### 4.3. RELEVANT TECHNOLOGIES

The relevant technologies for OLO can be grouped under the following domains:

- **Access**
  - Fibre access loops
- **Civil engineering**
  - Ducts
  - Trenches
  - Poles

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- Facilities
- Manholes, handholes, joint boxes

As a general principle mature, available and economically affordable technologies shall be modelled.

4.4. EQUIPMENT PRICES AND COST DATA

The bottom-up cost model methodology is based on current and forward looking prices for network equipment, infrastructure and services (e.g. network implementation, network maintenance). Therefore operators shall provide up-to-date pricing and also the expected price trends (erosion and/or increase) for the requested time period. Initial data was obtained in the data collection process between June and October 2015. Depending on future needs operators might be asked in the upcoming years. The consultant firm will consider the provided prices however it reserves the right to benchmark and challenge the provided prices should need arise.

The prices can be provided in three different currencies (TRY, EUR, USD). The output of the models will be in TRY respecting the relevant yearly average exchange rates as stipulated by the Central Bank (CBRT).

4.5. SERVICE ROUTING MATRIX AND COST VOLUME RELATIONSHIPS

In modern networks services share network elements, infrastructure and operational resources (staff, vehicles, etc.). Therefore there is a need to allocate in a fair and proportionate manner the incurred costs to services considering as a minimum the following aspects – frequency of usage and intensity of usage. In order to allow for dynamic response to changing market situation the allocation method will be dynamic – depending on the service volumes. In addition the principle will depend on the network architecture and appropriate service conversion factors. Hata! Başvuru kaynağı bulunamadı.

Network architecture: it provides the relevant information what kind of network elements, what protocols, codecs, etc. are used in the network

Service conversion table: some services need to be normalized to common units. Typical example is voice services converted to data volume (MB)

Service volumes: this is input from service demand module

Normalized service volumes: the service volumes are converted to normalized units, it shall be noted that more than one unit can be used. This shall be finalized after model development with respect to cater for all services in scope

Service routing matrix: for every service a mapping of all relevant cost categories (homogenous cost categories) is performed. Only relevant cost categories are used.
- **Service probability matrix**: for every service the probability of utilizing particular cost category is assigned. The probability can range from 0% (not used) to 100% (always used).

### Figure 3: Service Cost Allocation Flow

### 4.6. UTILIZATION AND DIMENSIONING RULES OF NETWORK ELEMENTS

Bottom up cost modelling applies engineering rules for network dimensioning. Every network element (e.g. active or passive equipment, cables) as well as civil engineering structures and facilities needs to be estimated according to predefined rules. Examples of dimensioning rules include:

- Length of cable per household (fibre)
- Detour factors
- Type of cables (fibre) and capacity per network segment (drop, distribution, feeder)
- Coverage range for exchange offices (per topology and technology)
- Type and capacity of copper and fibre distribution frames
- Type and capacity of street cabinets

Typically the network elements are dimensioned considering the expected households coverage (homes passed), subscribers and/or traffic on a yearly basis (year end). The initial coverage is achieved by deploying elements with standard configuration that
depending on subscriber and traffic increase are expanded. The expansion process is not fully elastic or in other words there is a time period from starting the process till the requested capacity is being installed and available. To prevent negative impact to subscribers (e.g. service unavailability due to overload of particular equipment) it is acceptable to dimension network elements with a predefined utilization threshold that will serve as a safety buffer. The exact value of the engineering threshold depends on the type of network element and its position in the network hierarchy. E.g. a network element in the access domain will typically have a higher utilization threshold than an element in the core network domain. This is logical since a core network element is typically responsible for thousands of subscribers while element in the access can be responsible for much lower number.

Following the principle that the network architecture shall follow an NGN and NGA architecture the cost model considers that different services share network elements. E.g. dark fibre can be carried over the same ducts that carry own FTTx services. The dimensioning of the shared elements will consider service dependent factors (typically utilization of elements or civil engineering) so that the shared elements are correctly dimensioned.

These rules have been requested from the OLO during the data collection phase. It shall be emphasized that ICTA reserves the right to apply different rules and utilization threshold should it consider that the provided values are significantly deviating from internationally accepted benchmarks.

4.7. GEOGRAPHICAL CONSIDERATION

The Republic of Turkey is geographically and demographically hugely diverse country. Important characteristics such as population, population density and household size differs significantly from province to province, and even within province. Bottom-up models mimic network engineering planning where it is mandatory to consider the underlying area characteristics. At the same time it is important to balance complexity and accuracy. Theoretically most accurate models will need to be done on the smallest administrative unit (urban district or village) to reflect its geographic and socio-demographic specifics. However it has been established and acknowledged that there are several challenges to operate on that smallest level. First of all historical data is largely unavailable, second - forecasts on such level are not available and third, model structure could become significantly complex to be handled in efficient way. Thus it has been suggested that the modelling framework will be developed on provincial level (81 provinces) considering the specifics of each one of the provinces.

The model will consider inputs on provincial level for most of the inputs and parameters however some could be on national level where it makes more sense – typical examples it shall be noted that while the BU-LRIC cost model will operate on provincial level its outputs – the service reference price will be calculated as a weighted average over all provinces. In so doing the model itself is not recommending a provincially differentiated price structure.

Question 7: Do you agree with the above view that modelling on provincial level will satisfy the requirements of BU-LRIC? In case of disagreement please elaborate your position.
4.8. QUALITY OF SERVICE

Quality of service is an important aspect of network planning and operations. It is related to network expenses (CAPEX and OPEX) since maintaining a certain level of quality requires investment and recurrent expenses.

Typical quality of service parameters are call blocking probability for voice service, speed class for data services, time to restore particular service after failure has occurred.

Quality of service parameters will be considered in relation to network dimensioning as well as estimating network costs.

5. BOTTOM-UP LRIC MODELS DESIGN

5.1. STRUCTURE OF THE MODEL

The cost model will be developed following international best practices applicable to the scope and objectives of ICTA. A generalized schematic can be seen in Figure 4.

![Figure 4: Structure of BU-LRIC Model](image)

The different modules are dynamically linked to share information as required. For this purpose, there are interfaces responsible to provide specific inputs and outputs as outlined:

1. “Service demand module” to “Non-technical cost module” and “Service cost module”
• Service volumes (including usage and subscribers)

2. “Service demand module” to “Technical cost module” and “Service cost module”
• Service volumes (including usage and subscribers)
• Traffic estimation and traffic profiles for different services

• Bill of quantity per network element
• CAPEX and OPEX provided per cost category
• Service cost allocation (technical) per cost category

4. “Non-Technical cost module” to “Service cost module”
• CAPEX and OPEX provided per cost category
• Service cost allocation (non-technical) per cost category

Figure 5: Technical Cost Module Structure
Figure 5 presents the structure of the Technical Cost Module.

5.2. ESTIMATION OF SERVICE DEMAND

The estimation of service demand follows the data, the consultant firm on behalf of the Authority received from the operators, cross-checked by experience and best practice examples and accompanied by estimations and forecasts, where data is missing.
Estimations and forecasts are always based on expert knowledge and where applicable by benchmarks.
Where in detail values are missing the experts are processing the total values and distributing them to the regions and/or to single services based on adequate distribution factors.

5.3. RELEVANT NETWORK ARCHITECTURE AND TOPOLOGY

The network architecture describes what components, protocols and interfaces are used for the creation and supply of the services offered by the OLO to its retail or wholesale customers. Several different architectures might be needed to cover the portfolio of services. These architectures need to be compliant with the guidelines specified in chapter 4.2.

The architectures are specified during the development of the model. They are semi static in nature, meaning that they can be adjusted to a certain extent by the modification of some parameters but cannot be and should not be altered significantly during the operation of the model. This is required to ensure consistency during the lifecycle of the model and that calculated results are comparable.

Within the scope of the OLO model the following architectures have been identified:

a. Fixed access fibre loop

The appropriate architectures as specified by ITU and ETSI will be used.

Network topology refers to the applied connectivity between network elements for each network architecture. Note that one architecture can have more than one applicable topology – e.g. access fibre loop can be deployed in point to point (P2P) or point to multipoint (P2MP) topology.

The bottom up cost model will consider the actual network topology as supplied by the OLO. Where data is missing it will be compensated by applying a reasonable and relevant benchmark. Important aspect of the network topology are the points of interconnection and traffic handover. Those shall be provided as precisely as possible by the OLO. Initial data was obtained in the data collection process between June and October 2015. Depending on future needs operators might be asked in the upcoming years.

5.4. NETWORK DIMENSIONING AND BILL OF QUANTITY

The network of the OLO is dimensioned considering all applicable inputs, parameters and guidelines.

There are two major parallel processes in the network dimensioning – coverage and capacity. The resulting network has to fulfil the requirements of both processes. An example of coverage dimensioning is the household reach for fibre service. For the same coverage dimensioning there must be a corresponding capacity dimensioning that will ensure that the service demand will be met without rejections (e.g. a potential customer is rejected to be connected in an area that is considered to be covered). Typically network coverage is done first and capacity closely follows the forecasted subscriber demand. In
overprovision of capacity is applied to cover the uncertainty in subscriber demand as well as to maintain network element load within the reasonable engineering limits (refer to utilization).

The access network dimensioning is done separately for each province however dimensioning for transmission and core network elements is done considering the total nationwide demand depending on the applicable topology. Also common is the dimensioning of OSS and BSS systems as they typically are deployed nationwide as opposed to separately per province.

The dimensioning of facilities is performed to ensure that current and future network elements demand can be met. It shall be noted that facilities are typically provided by the OLO as opposed to be calculated by the model (in relation to modified scorched node methodology). However if information from OLO is missing a calculation on facilities can be included in the model.

Once all network elements (equipment, links and cables) and facilities are estimated - commonly referred to as bill of quantity (BoQ) the next step is to estimate the related CAPEX and OPEX for the requested period in yearly periods.

5.5. DETERMINING NETWORK COSTS

The network costs are calculated using BoQ and the relevant price information. The costs have two components – CAPEX and OPEX. The CAPEX network component is computed as the multiplication of quantities with current prices (adjusted for erosion or increase) over all network elements within the time period.

It shall be noted that while CAPEX is directly related to the calculated BoQ, network OPEX can have a more complex structure.

The OPEX network component is the sum of yearly costs directly attributable to network elements as well as the costs for common technical expenses such as technical staff, vehicles (leasing and fuel), and facilities (rents, electricity, fuel, maintenance). Important inputs for network OPEX are network KPIs (MTBF, MTTR).

5.6. ANNUALISATION OF ASSETS COSTS

The total amount of investment required to model the network assets will be annualized by calculating yearly depreciation charges and the corresponding cost of capital per defined asset (tangible as well as intangible). The cost of capital is calculated as the return on the average capital employed. The applied return rate is the pre-tax WACC.

5.7. CALCULATION OF TOTAL COSTS

Total costs will be calculated as the sum of yearly technical and non-technical OPEX, depreciation charge of the year and the calculated cost of the average capital employed
(called “annualization”). This sum represents the total annual cost to provide the defined services.

5.8. CALCULATION OF UNIT LRIC COSTS

The calculation of the unit long-run incremental costs of each defined service will be carried-out using allocation factors. The allocation factors are multiplied by the volume of each service. The volume-weighted allocation factors, in turn, are used to allocate the total cost to each relevant homogeneous cost category. The unit costs per homogeneous cost category then need to be aggregated. Finally, a mark-up is added to take into account a share of common costs.
6. ANNEX

6.1. SERVICES

<table>
<thead>
<tr>
<th>Services</th>
<th>Unit</th>
<th>Additional Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadband access</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibre (FTTC)</td>
<td>line</td>
<td>FTTC fibre access (any technology)</td>
</tr>
<tr>
<td>thereof Dark fibre (FTTC)</td>
<td>line</td>
<td>Dark fibre within FTTC fibre access (unlit fibre, not shared with other users, services)</td>
</tr>
<tr>
<td>Fibre (FTTB)</td>
<td>line</td>
<td>FTTB fibre access (any technology)</td>
</tr>
<tr>
<td>thereof Dark fibre (FTTB)</td>
<td>line</td>
<td>Dark fibre within FTTB fibre access (unlit fibre, not shared with other users, services)</td>
</tr>
<tr>
<td>Fibre (FTTH)</td>
<td>line</td>
<td>FTTH fibre access (any technology)</td>
</tr>
<tr>
<td>thereof Dark fibre (FTTH)</td>
<td>line</td>
<td>Dark fibre within FTTH fibre access (unlit fibre, not shared with other users, services)</td>
</tr>
<tr>
<td>Infrastructure sharing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-location (CO)</td>
<td>space</td>
<td>The space (floor and rack) offered to other operators for collocation purpose</td>
</tr>
<tr>
<td>Co-location (CO)</td>
<td>energy</td>
<td>The energy (capacity and consumption volume) provisioned to other operators for collocation purpose</td>
</tr>
<tr>
<td>Co-location (Cabinet)</td>
<td>space</td>
<td>The space (in cabinet) offered to other operators for collocation purpose</td>
</tr>
<tr>
<td>Co-location (Cabinet)</td>
<td>energy</td>
<td>The energy (capacity and consumption volume) provisioned to other operators for collocation purpose</td>
</tr>
<tr>
<td>Duct sharing (underground) - access network</td>
<td>conduit per m</td>
<td>Sharing of underground ducts in the access network</td>
</tr>
<tr>
<td>Duct sharing (overhead) - access network</td>
<td>conduit per m</td>
<td>Sharing of overhead ducts</td>
</tr>
</tbody>
</table>
6.2. LIST OF ABBREVIATIONS

The following terms and abbreviations are used in the document:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>Activity Based Costing</td>
</tr>
<tr>
<td>ARPS</td>
<td>Average Revenue per Subscriber</td>
</tr>
<tr>
<td>ARPU</td>
<td>Average Revenue per User</td>
</tr>
<tr>
<td>BH</td>
<td>Busy Hour</td>
</tr>
<tr>
<td>BHCA</td>
<td>Busy Hour Call Attempt</td>
</tr>
<tr>
<td>BoQ</td>
<td>Bill of Quantity</td>
</tr>
<tr>
<td>BRAS</td>
<td>Broadband Access Server</td>
</tr>
<tr>
<td>BU-LRIC</td>
<td>Bottom Up – Long Run Incremental Costs</td>
</tr>
<tr>
<td>CAPM</td>
<td>Capital Asset Pricing Model</td>
</tr>
<tr>
<td>CCA</td>
<td>Current Cost Accounting</td>
</tr>
<tr>
<td>CO</td>
<td>Central Office</td>
</tr>
<tr>
<td>CPE</td>
<td>Customer Premises Equipment</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>ERG</td>
<td>European Regulators Group</td>
</tr>
<tr>
<td>ETH</td>
<td>Ethernet</td>
</tr>
<tr>
<td>ETSI</td>
<td>European Telecommunications Standards Institute</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EUR</td>
<td>Euro</td>
</tr>
<tr>
<td>FAC</td>
<td>Fully allocated Costs</td>
</tr>
<tr>
<td>FDC</td>
<td>Fully distributed Costs</td>
</tr>
<tr>
<td>FNO</td>
<td>Fixed Network Operator</td>
</tr>
<tr>
<td>FTE</td>
<td>Full Time Equivalent</td>
</tr>
<tr>
<td>Acronym</td>
<td>Definition</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------------------</td>
</tr>
<tr>
<td>FTTB</td>
<td>Fiber to the Building</td>
</tr>
<tr>
<td>FTTC</td>
<td>Fiber to the Curb</td>
</tr>
<tr>
<td>FTTH</td>
<td>Fiber to the Home</td>
</tr>
<tr>
<td>HCC</td>
<td>Homogeneous Cost Categories</td>
</tr>
<tr>
<td>ICTA</td>
<td>Information and Communication Technologies Authority</td>
</tr>
<tr>
<td>ISDN</td>
<td>Integrated Service Digital Network</td>
</tr>
<tr>
<td>IPA</td>
<td>Instrument for Pre-Accession Assistance</td>
</tr>
<tr>
<td>ITU</td>
<td>International Telecommunications Union</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>kW</td>
<td>kiloWatt</td>
</tr>
<tr>
<td>L2</td>
<td>Layer 2</td>
</tr>
<tr>
<td>L3</td>
<td>Layer 3</td>
</tr>
<tr>
<td>LLU</td>
<td>Local Loop Unbundling</td>
</tr>
<tr>
<td>LRIC</td>
<td>Long Run Incremental Costs</td>
</tr>
<tr>
<td>LRIC+</td>
<td>Long Run Incremental Costs Plus</td>
</tr>
<tr>
<td>MB</td>
<td>Megabyte</td>
</tr>
<tr>
<td>Mbytes</td>
<td>Megabytes</td>
</tr>
<tr>
<td>MEA</td>
<td>Modern Equivalent Asset</td>
</tr>
<tr>
<td>MGW</td>
<td>Media Gateway (NGN architecture, R4)</td>
</tr>
<tr>
<td>MNO</td>
<td>Mobile Network Operator</td>
</tr>
<tr>
<td>MoU</td>
<td>Minutes of Usage</td>
</tr>
<tr>
<td>MTBF</td>
<td>Mean Time Between Failure</td>
</tr>
<tr>
<td>MTTR</td>
<td>Mean Time to Repair/Restore</td>
</tr>
<tr>
<td>NGA</td>
<td>Next Generation Access</td>
</tr>
<tr>
<td>NGN</td>
<td>Next Generation Network</td>
</tr>
<tr>
<td>NRA</td>
<td>National Regulatory Authority</td>
</tr>
<tr>
<td>OLO</td>
<td>Other Licensed Operator</td>
</tr>
<tr>
<td>PoI</td>
<td>Point of Interconnection</td>
</tr>
<tr>
<td>PSTN</td>
<td>Public Switched Telephone Network</td>
</tr>
<tr>
<td>RO</td>
<td>Reference Offer</td>
</tr>
<tr>
<td>SLA</td>
<td>Service Level Agreement</td>
</tr>
<tr>
<td>TRY</td>
<td>Turkish Lira</td>
</tr>
</tbody>
</table>
Technical Assistance for Achieving the Information Society and Stimulating High-speed Broadband Services to the Benefit of Consumers

Consultation Paper on Cost Models Methodology

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD</td>
<td>US Dollar</td>
</tr>
<tr>
<td>VAT</td>
<td>Value Added Tax</td>
</tr>
<tr>
<td>WACC</td>
<td>Weighted Average Cost of Capital</td>
</tr>
<tr>
<td>xDSL</td>
<td>x Digital Subscriber Line</td>
</tr>
</tbody>
</table>