CONSULTATION DOCUMENT

METHODOLOGY FOR FIXED AND MOBILE BU-LRIC MODELS

OCTOBER 2015
INTRODUCTION

The Communications and Media Commission regulates termination rates. According to the following section from the mobile and WLL licenses, the termination rates should be cost based:

“Section IX. Interconnection, paragraph D i.:
Interconnection fees between the Licensee and other licensed Telecommunications Service Providers are to be cost-based and may be inclusive of both the cost to provide the interconnection for each individual service required (but not a “bundle” of services including costs not directly associated with the cost necessary to specifically provide the interconnection service), as well as a proportionate and reasonable share of the Licensee’s common costs of general operations.”

Therefore CMC has engaged a firm of consultants, WRAP International, to assist it with a calculation of cost based termination rates. According to international best practice the termination rates should be calculated using Bottom-up Long Run Incremental Cost (BU-LRIC) models. The consultants have produced a draft methodology for fixed and mobile BU-LRIC models and CMC wishes to obtain the views of interested individuals and organisations on this methodology before it is approved and implemented.

CMC now invites the public, operators and other interested organisations to provide it with their answers to the consultation questions or other comments on the draft methodology for fixed and mobile BU-LRIC models. Any answers or comments should be made in writing addressed to:

Iraq- Baghdad
Al-Masbah / Babel neighbourhood
District No.929 – Street No.32 – Building No.
or electronically to;
consultation@cmc.iq
by 29/12/2015

Submissions may be in English or Arabic; dual-language submissions will be extremely helpful.

In the interests of transparency, CMC expects to publish submissions. Stakeholders should indicate clearly any part of their submission that they would not wish to be included in a published version, explaining why this part should be treated as confidential.
# DRAFT METHODOLOGY FOR FIXED AND MOBILE BU-LRIC MODELS

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1 Methodology for fixed BU-LRIC model

1.1 Background

CMC set termination rates for WLL and mobile operators in 2014 in CMC communication number 6307 dated 2014/08/13. However these rates are not cost based.

International best practice in tariff regulation is that termination rates are cost based and calculated using bottom-up Long Run Incremental Cost models (BU-LRIC).

Top-down models take costs from financial accounting of the operator and split them into costs of individual services. Bottom-up models construct theoretical network, calculate costs of such network and split them into costs of individual services.

Bottom-up models are preferred for price setting for the following two reasons:

- Top-down models include inefficiencies of the operator and it is difficult to agree what the “correct” values should be.
- Bottom-up models are independent on the operator and objective discussion about the input parameters and outcomes of the calculation is possible.

1.2 Model principles and assumptions

The model should be based on the following principles:

- The bottom-up approach involves the construction of a modern and efficient network that is capable of handling the current traffic volumes (or forecasted traffic volumes if the model results are calculated for a future period) at the current grade of service.
- Use of LRIC requires a “long run” view of costs, meaning that the costing methodology should take all costs as being variable. In other words: the “long run” is defined as the time horizon within which capital investment or divestment to increase or decrease the capacity of existing productive assets can be undertaken.
- Incremental costs are defined as the increase (or decrease) in costs associated with the supply (or removal) of the service at the full volume of demand. Under this definition incremental fixed costs (i.e. costs that do not vary with output) that are specific to the service being considered are included in the incremental costs.
- The definition of incremental costs that should be used is the Total Service Long Run Incremental Cost (TSLRIC). In addition to incremental costs there are shared fixed costs associated with the supply of a group of services, and common fixed costs, which are shared by all services produced by the operator. Examples of the former are shared transmission links, while classic examples of common costs are the company's headquarters and the chairman's salary. Given that recovery of only incremental costs for termination
would lead to an under recovery of the total costs, the model should allow also for recovery of shared and common fixed costs.

- Relevant costs should be measured by the current costs of assets. Replacement costs as determined by the Modern Equivalent Asset (MEA) approach should be used to estimate current costs.

- A scorched node approach which is based on the operator’s existing node locations should be adopted. Type and size of equipment is then optimised depending on demand levels. This approach (scorched node) is preferable to scorched earth and has been used by other operators and regulators because assuming different network topology is extremely complex and introduces considerable arbitrariness. In addition, even if the current network topology may differ from the efficient network topology, it would be neither reasonable nor manageable to rearrange the operator’s network from the existing topology. Scorched earth would assume a level of efficiency in the network design that is not practically achievable and this would lead to an under-recovery of costs over time.

1.3 Services to be calculated

The focus shall be on providing cost estimates for the provision of wholesale call termination services. Because telecommunication networks are shared between multiple services, in order to properly dimension the network and calculate its total costs, the model has to include all services sharing the network with termination services.

The following services will be included in the model:

- On net calls
- Outgoing national calls
- Outgoing international calls
- Incoming national calls
- Incoming international calls
- National transit calls
- International transit calls
- Internet traffic (xDSL)
- Leased lines and data transmission services national traffic
- Leased lines and data transmission services international traffic.

The model will not include the access network and will not calculate the costs of access lines (copper line, fibre line or WLL). Costs of access lines are paid by the customers separately from calls as line rental services and thus the costs of calls include only the costs of core network and not the costs of access network. Therefore modelling access network and access line services is not necessary in order to calculate the costs of termination services.

**Question 1:** Do you agree with this list of services? If not, please describe which services you would like to add or remove and why.
1.4 Definition of increments

Incremental costs are equal to the increase (or decrease) in costs associated with the supply (or removal) of the increment. An increment can be a single service or a group of services.

Incremental costs of increments representing a single service are often zero or negligible, because adding (removing) a single service to (from) the network does not cause any change in the network, because the network has to exist in that size also in order to provide the other services. In such a case the incremental costs do not correspond to the share of capacity needed for the services and using them for pricing could lead to distorted values.

The bigger the increment, the higher is the chance that the network has to be modified when the increment is added (removed) and that the incremental costs will correspond to the share of capacity needed for the services.

Therefore we will use a single increment of core network traffic, which will represent all traffic services using core network.

Question 2: Do you agree with this definition of increments? If not, please describe the definition of increments which you would like to use and the reasons for your response.

1.5 Period to be modelled

The model will calculate the costs for period 2015 – 2018.

Question 3: Do you agree with this period to be modelled? If not, please provide reasons for your response.

1.6 Required steps in service cost calculation

This chapter provides the methodology for the calculation of service costs.

1.6.1 Traffic measurement

Details relating to traffic and call volumes are required for network dimensioning in the model. The network should be dimensioned so that it is capable of handling busy hour traffic.

For usage based call services (charged per minute or per second) the following traffic data should be obtained from the operators in order to calculate the busy hour traffic:

- number of call conversation minutes
- average call duration
- % of unanswered calls (unanswered calls are included in the model because the network must be dimensioned to handle all calls, not only the successful ones)
- average non conversation holding time - the time between the “phone ringing” and the call being answered or the calling party terminating the call. This data should be used in the model because the network is used also at times other than when a conversation is being held.
- % of traffic in busy hour - share of traffic in busy hour as % of total annual traffic.

The busy hour traffic for each call type will then be calculated in following way:

\[
\text{total busy hour traffic} = \frac{\text{number of call conversation minutes} + \text{number of call conversation minutes}}{\text{average call duration}} \times (1 - \% \text{ of unanswered calls}) \times \text{average non conversation holding time} \times \% \text{ of traffic in busy hour}
\]

The busy hour traffic for data transmission services will be calculated as the guaranteed Mbit/s in busy hour, which are used for network dimensioning. For example, for leased lines it may be 100% of their nominal Mbit/s while for ADSL it may be 5% of their nominal Mbit/s (contention ratio 1/20).

The busy hour considered in this case should be the overall network busy hour (peak of total traffic coming from all services in the network) not the busy hour of the individual services (different services can have different peak times during the day).

The busy hour traffic of different type (voice, data) will be converted to a common unit (Mbit/s).

**Question 4:** Do you agree that the busy hour traffic in the network should be calculated as described above? If not, please provide reasons for your response and describe the alternative method which you would like to be used.

### 1.6.2 Dimensioning the network

In order to calculate the cost of the network, it is first necessary to ascertain the size of the network and the number of components that are required to handle the traffic at a predetermined grade of service.

The same call/traffic type may take more than one route for passing across the network. Different network elements may be used in different routes and the probability of taking each route may also be different. The routing factor shows how many times the same type of a network element is used in each route. When we multiply the routing factors in each route with the route probability and summarize them for all possible routes for the considered service, we get the average routing factor.

To dimension the network elements which are required to handle the busy hour traffic calculated in the previous step, the busy hour traffic has to be multiplied by the average routing factor. The result is the busy hour traffic demand for each network element.
The model should then determine the quantity of the following core network elements:

- Multi Service Access Node core network card
- National softswitch
- International softswitch
- AAA server
- Broadband Remote Access Server
- National interconnection gateway
- International interconnection gateway
- Aggregation router
- Core router
- Dense Wavelength Division Multiplex
- Fibre optic cables
- Microwave transmission equipment
- Operational Support System
- Billing system
- Intelligent Network platform.

Additional network elements may be added based on the data received from operators during data collection.

Question 5: Do you agree with the list of network elements which will be included in the model? If not, please describe which network elements you would like to add or remove and why.

The efficient network created in the bottom-up model should employ the most efficient technology for meeting the capacity requirements. There is also the general requirement for the choice of technology and optimisation that the hypothetical network should as a minimum offer the same quality of service and functionality as the existing network.

The quantity of equipment will be calculated as the quantity of traffic that the equipment must handle divided by the design capacity per unit of that particular equipment. When calculating the quantity of equipment needed to handle the traffic, the busy hour design capacity of the equipment should be adjusted by an efficient loading factor for that equipment. The efficient loading factor reflects the level of use that can reasonably be achieved with efficient provisioning practice. The efficient loading factor can be developed by reference to international benchmarks, design rules recommended by vendors and statistical data on system loading.

A resilience factor should be applied to the quantity of core network equipment, which ensures that it can handle a proportion of traffic from another equipment of the same type should a network fault occur.

Question 6: Do you agree with the calculation of the quantity of network equipment as described above? If not, please provide reasons for your response and describe the alternative method which you would like to be used.
Transmission links are used for data transmission between nodes. The model will use fibre optic and microwave transmission links. The link has two dimensions: length and capacity. Length of each link depends on the location of nodes that are connected to it and on the network topology. Capacity of each link depends on the forecasted traffic between the nodes that are connected to it.

The model will use ring topology for the fibre transmission routes, with three types of ring:

- local rings
- aggregation rings
- core rings.

The model will dimension the transmission rings using the following assumptions:

- MSANs are located on local rings.
- Local rings connect MSANs to aggregation routers.
- Aggregation routers are located on aggregation rings.
- Aggregation rings connect aggregation routers to core routers.
- Core routers are located on core rings.
- Core rings connect core routers between each other.
- Softswitches and Media Gateways are located on core rings.
- If the number of MSANs would increase, additional local rings would be created.
- If additional local rings would be created, the number of aggregation routers would increase and additional aggregation rings would be created.
- Core rings would not change even if additional aggregation rings would be created, because the new aggregation rings would still connect to the same core nodes. Only the number of core routers in each location would be increased if required to handle the capacity.

The average traffic in one ring will be calculated as the busy hour traffic multiplied by the average routing factor for the ring type divided by the number of rings of this type.

The cost of cable per km should include not only the cable itself, but also the cost of ducts, trenches, optical fibre joints and manholes. Because the cost of trenches and the average use of ducts and manholes differ in individual area types, the length of cables will be split by these area types and the costs will be calculated separately in each area type.

**Question 7:** Do you agree with the proposed network topology as described above? If not, please provide reasons for your response and describe the alternative network topology which you would like to be used.
1.6.3 Capital costs of network equipment

Direct capital costs refer to those costs incurred for purchasing and installation of the relevant network equipment. The direct capital costs are calculated by multiplying the unit cost of each equipment by the number of that type of equipment in the network.

Capital costs can be measured either on current or historical basis. Generally, a current measure is preferable because it shows the true costs of providing network services based on today’s technology and costs.

Current cost measurement uses a modern equivalent asset approach (MEA) to estimate replacement costs. MEA is defined as the asset that can produce the same level of service / output as the existing asset by using the latest, most efficient technology. The unit costs should be equal to the current prices of the equipment achievable on the market. Equipment prices are likely to vary between operators for reasons including differences in specification and bargaining ability. The prices used in the model should reflect those that are faced by the operators in Iraq. They can be obtained from recent purchases made by the operators.

The purpose of the model is to calculate the service cost for a particular year and it is therefore necessary to annualise the direct capital costs. The annualised capital expenditure is added to the annual operational expenditure to find the total annual costs of network equipment.

An annuity approach should be used in the model to estimate the annualised capital costs, including the cost of capital. The use of annuities for determining annual capital costs has the merit of smoothing annual capital costs over the life of the asset. A simple or tilted approach to the calculation of annuities can be used.

A simple annuity is a constant annual payment received from an investment. It represents the partial repayment of the capital invested and a return on the investment. The annual payment continues until the end of the investment term.

The replacement cost of an asset may vary from year to year. The annuity is tilted in response to the projected changes in the replacement value of a particular asset. A tilted annuity calculates an annuity charge that changes between years at the same rate as the price of the asset is expected to change. By tilting the annuity, costs can be recovered earlier than if a simple annuity approach is used. In this way, the tilted annuity approach recognizes the issue of technical obsolescence.

The cost of capital is required for the calculation of the capital annuity. An appropriate return on capital, or cost of capital, should reflect two factors:

- the cost of equity and debt capital to the operator
- the level of risk faced by the operator.

Weighted Average Cost of Capital (WACC) approved by the CMC should be used as cost of capital in the model.
1.6.4 Operating expenses

Operating expenses which are directly related to the network equipment should also be included in the calculation of the costs of the network equipment. The model should only include the network operating expenses that would be incurred by an efficient operator using modern and commercially available technology. The network in the model should be constructed using modern equivalent assets. If the operating expenses of the modern equivalent assets differ from the operating expenses of the existing assets then this must be accounted for.

The network operating expenses in the model will include for example:
- maintenance and operation of network equipment
- power and other utility charges for network equipment
- insurance of network equipment.

1.6.5 Indirect costs

Indirect costs include indirect network costs and the share of common costs and working capital costs related to network.

Indirect network costs are costs of additional assets that belong to the network but are not included in the direct network costs. The indirect network costs include for example:
- costs of buildings or sections of buildings containing network equipment
- costs of vehicles used for maintenance and installation of network equipment
- costs of test equipment, spare parts and mechanical aids used for maintenance and installation of network equipment.

In addition to indirect network costs, a share of common costs and working capital costs that is related to the operation of network should also be taken into account. The common costs represent the costs of the support departments like HR, finance etc. Working capital costs will be calculated as working capital (current receivables - current liabilities + cash + inventories) multiplied by the WACC.

Direct relation between these indirect costs and the network equipment is usually not defined. The indirect costs can therefore be allocated to the direct network.
costs via mark-up, which can be obtained directly from operator’s accounts, if it is believed that the operator operates in an efficient manner, or from international benchmarks.

**Question 10:** Do you agree with adding the indirect costs to the total network costs as described above? If not, please provide reasons for your response and describe the alternative method which you would like to be used.

### 1.6.6 Calculating service costs

The total network costs will be allocated to services based on following principles:

- **Cost causality** - costs shall be attributed to services in accordance with the activities which cause the costs to be incurred.
- **Objectivity and non-discrimination** - the attribution shall be objective and not intended to benefit any operator, service or network component.
- **Consistency** - the same methodology should be used over different periods.
- **Transparency** - the attribution methods used should be transparent and verifiable.
- **Materiality** - the use of a detailed causal allocation basis may not be necessary if the effect of the allocation is not material to the outcome.

In accordance with these principles the costs of network equipment will be split to individual services based on the traffic of each service flowing through the particular network equipment (service volume multiplied by the average routing factor).

**Question 11:** Do you agree with the allocation of network equipment costs to services as described above? If not, please provide reasons for your response and describe the alternative method which you would like to be used.

### 1.7 Data needs and data collection

The following data will be required for the fixed BU-LRIC model.

Network demand data:

- service volume
- proportion of traffic in busy hour
- additional parameters of call services
  - average call duration
  - average non conversation time
  - percentage of unanswered calls
  - voice channel size
  - blocking probability
- number of subscribers.
Network topology data:
- number of access nodes
- average number of access nodes per local ring
- average number of aggregation nodes per local ring
- proportion of local rings using microwave
- average length of local ring section using fibre and split of the total length to area types
- average number of aggregation nodes per aggregation ring
- proportion of aggregation rings using microwave
- average length of aggregation ring section using fibre and split of the total length to area types
- number of core nodes
- number of core rings
- proportion of core rings using microwave
- total length of core ring sections using fibre and split of the total length to area types
- routing table.

Network equipment data:
- equipment capacity
- equipment prices and installation costs
- expected change of prices and installation costs in the modelled period
- equipment lifetime
- operational costs
- expected change of operational costs in the modelled period.

Operators’ accounting data:
- indirect network costs from operators’ accounts
- network, retail and common costs from operators’ accounts
- working capital from operators’ accounts
- share of equity and debt and the cost of equity and debt from operators’ accounts.

The data will be collected via Excel questionnaires, which will be sent to the operators. Data not available from the operators will be filled in based on international benchmarks and based on information available to CMC.

2 Methodology for mobile BU-LRIC model

2.1 Background

CMC set termination rates for WLL and mobile operators in 2014 in CMC communication number 6307 dated 2014/08/13. However these rates are not cost based.
International best practice in tariff regulation is that termination rates are cost based and calculated using bottom-up Long Run Incremental Cost models (BU-LRIC).

Top-down models take costs from financial accounting of the operator and split them into costs of individual services. Bottom-up models construct theoretical network, calculate costs of such network and split them into costs of individual services.

Bottom-up models are preferred for price setting for the following two reasons:

- Top-down models include inefficiencies of the operator and it is difficult to agree what the “correct” values should be.
- Bottom-up models are independent on the operator and objective discussion about the input parameters and outcomes of the calculation is possible.

### 2.2 Model principles and assumptions

The model should be based on the following principles:

- The bottom-up approach involves the construction of a modern and efficient network that is capable of handling the current traffic volumes (or forecasted traffic volumes if the model results are calculated for a future period) at the current grade of service.
- Use of LRIC requires a “long run” view of costs, meaning that the costing methodology should take all costs as being variable. In other words: the “long run” is defined as the time horizon within which capital investment or divestment to increase or decrease the capacity of existing productive assets can be undertaken.
- Incremental costs are defined as the increase (or decrease) in costs associated with the supply (or removal) of the service at the full volume of demand. Under this definition incremental fixed costs (i.e. costs that do not vary with output) that are specific to the service being considered are included in the incremental costs.
- The definition of incremental costs that should be used is the Total Service Long Run Incremental Cost (TSLRIC). In addition to incremental costs there are shared fixed costs associated with the supply of a group of services, and common fixed costs, which are shared by all services produced by the operator. Examples of the former are shared transmission links, while classic examples of common costs are the company's headquarters and the chairman's salary. Given that recovery of only incremental costs for termination would lead to an under recovery of the total costs, the model should allow also for recovery of shared and common fixed costs.
- Relevant costs should be measured by the current costs of assets. Replacement costs as determined by the Modern Equivalent Asset (MEA) approach should be used to estimate current costs.
- A scorched node approach which is based on the operator’s existing node locations should be adopted. Type and size of equipment is then
optimised depending on demand levels. This approach (scorched node) is preferable to scorched earth and has been used by other operators and regulators because assuming different network topology is extremely complex and introduces considerable arbitrariness. In addition, even if the current network topology may differ from the efficient network topology, it would be neither reasonable nor manageable to rearrange the operator's network from the existing topology. Scorched earth would assume a level of efficiency in the network design that is not practically achievable and this would lead to an under-recovery of costs over time.

2.3 Services to be calculated

The focus shall be on providing cost estimates for the provision of wholesale call termination services. Because telecommunication networks are shared between multiple services, in order to properly dimension the network and calculate its total costs, the model has to include all services sharing the network with termination services.

The following services will be included in the model:

- On net calls
- Outgoing national calls
- Outgoing international calls
- Incoming national calls
- Incoming international calls
- On net SMS
- Outgoing national SMS
- Outgoing international SMS
- Incoming national SMS
- Incoming international SMS
- On net MMS
- Outgoing national MMS
- Outgoing international MMS
- Incoming national MMS
- Incoming international MMS
- 2G data
- 3G data
- 4G data.

**Question 12:** Do you agree with this list of services? If not, please describe which services you would like to add or remove and why.

2.4 Definition of increments

Incremental costs are equal to the increase (or decrease) in costs associated with the supply (or removal) of the increment. An increment can be a single service or a group of services.
Incremental costs of increments representing a single service are often zero or negligible, because adding (removing) a single service to (from) the network does not cause any change in the network, because the network has to exist in that size also in order to provide the other services. In such a case the incremental costs do not correspond to the share of capacity needed for the services and using them for pricing could lead to distorted values.

The bigger the increment, the higher is the chance that the network has to be modified when the increment is added (removed) and that the incremental costs will correspond to the share of capacity needed for the services.

Therefore we will use a single increment of mobile network traffic, which will represent all traffic services using mobile network.

**Question 13:** Do you agree with this definition of increments? If not, please describe the definition of increments which you would like to use and the reasons for your response.

2.5 **Period to be modelled**

The model will calculate the costs for period 2015 – 2018.

**Question 14:** Do you agree with this period to be modelled? If not, please provide reasons for your response.

2.6 **Required steps in service cost calculation**

This chapter provides the methodology for the calculation of service costs.

2.6.1 **Traffic measurement**

Details relating to traffic and call volumes are required for network dimensioning in the model. The network should be dimensioned so that it is capable of handling busy hour traffic.

For usage based call services (charged per minute or per second) the following traffic data should be obtained from the operators in order to calculate the busy hour traffic:

- number of call conversation minutes
- average call duration
- % of unanswered calls (unanswered calls are included in the model because the network must be dimensioned to handle all calls, not only the successful ones)
- average non conversation holding time - the time between the “phone ringing” and the call being answered or the calling party terminating the call. This data should be used in the model because the network is used also at times other than when a conversation is being held.
The busy hour traffic for each call type will then be calculated in the following way:

\[
\text{total busy hour traffic} = (\text{number of call conversation minutes} + \text{number of call conversation minutes} / \text{average call duration} / (1 - \% \text{ of unanswered calls}) \times \text{average non conversation holding time}) \times \% \text{ of traffic in busy hour}
\]

The busy hour traffic for SMS, MMS and data will be calculated as total annual traffic volume multiplied by the percentage of traffic in busy hour.

The busy hour considered in this case should be the overall network busy hour (peak of total traffic coming from all services in the network) not the busy hour of the individual services (different services can have different peak times during the day).

The busy hour traffic of different type (voice, SMS, MMS, data) will be converted to a common unit. Several common units (BHE, Mbit/s) can be used dependent on the dimensioning parameters of network equipment.

**Question 15:** Do you agree that the busy hour traffic in the network should be calculated as described above? If not, please provide reasons for your response and describe the alternative method which you would like to be used.

### 2.6.2 Dimensioning the network

In order to calculate the cost of the network, it is first necessary to ascertain the size of the network and the number of components that are required to handle the traffic at a predetermined grade of service.

The same call/traffic type may take more than one route for passing across the network. Different network elements may be used in different routes and the probability of taking each route may also be different. The routing factor shows how many times the same type of a network element is used in each route. When we multiply the routing factors in each route with the route probability and summarize them for all possible routes for the considered service, we get the average routing factor.

To dimension the network elements which are required to handle the busy hour traffic calculated in the previous step, the busy hour traffic has to be multiplied by the average routing factor. The result is the busy hour traffic demand for each network element.

The model should then determine the quantity of the following mobile network elements:

- Base Transmission Station
- Node B
- eNode B
- Base Station Controller
Additional network elements may be added based on the data received from operators during data collection.

**Question 16:** Do you agree with the list of network elements which will be included in the model? If not, please describe which network elements you would like to add or remove and why.

The efficient network created in the bottom-up model should employ the most efficient technology for meeting the capacity requirements. There is also the general requirement for the choice of technology and optimisation that the hypothetical network should as a minimum offer the same quality of service and functionality as the existing network.

The quantity of equipment will be calculated as the quantity of traffic that the equipment must handle divided by the design capacity per unit of that particular equipment. When calculating the quantity of equipment needed to handle the traffic, the busy hour design capacity of the equipment should be adjusted by an efficient loading factor for that equipment. The efficient loading factor reflects the level of use that can reasonably be achieved with efficient provisioning practice. The efficient loading factor can be developed by reference to international benchmarks, design rules recommended by vendors and statistical data on system loading.

A resilience factor should be applied to the quantity of core network equipment, which ensures that it can handle a proportion of traffic from another equipment of the same type should a network fault occur.

**Question 17:** Do you agree with the calculation of the quantity of network equipment as described above? If not, please provide reasons for your response and describe the alternative method which you would like to be used.
The radio access network consists of a number of BTS/Node B/eNode B. The number of BTS/Node B/eNode B and the size of BTS/Node B/eNode B equipment depend on the coverage area of the BTS/Node B/eNode B and on the level of traffic within the BTS/Node B/eNode B area.

The model will assume the use of 2G, 3G and 4G technologies in the network. Therefore it will be necessary to enter following input parameters to the model:

- 2G coverage area
- 3G coverage area
- 4G coverage area
- split of total busy hour traffic between 2G, 3G and 4G traffic.

**Question 18:** Do you agree that the model should include 2G, 3G and 4G technologies? If not, please provide reasons for your response.

The model should calculate the number and type of BTS/Node B/eNode B required to provide both coverage and to carry the traffic load separately for different area types. These area types should be defined based on different parameters of coverage and traffic.

The number of BTS/Node B/eNode B in each area type will be calculated as the higher of the two:

- number of BTS/Node B/eNode B required to provide coverage
- number of BTS/Node B/eNode B required to carry the traffic load.

The number of BTS/Node B/eNode B required to provide coverage will be calculated as the covered area in each area type divided by the average area covered by one BTS/Node B/eNode B.

The number of BTS/Node B/eNode B required to carry the traffic load will be calculated as the total busy hour traffic in each area type divided by the maximum capacity of one BTS/Node B/eNode B.

Configuration of BTS/Node B/eNode B will be selected based on the traffic per one BTS/Node B/eNode B. If BTS/Node B/eNode B are constructed because of coverage requirement and not because of the traffic, the BTS/Node B/eNode B can have configuration with lower capacity than the maximum capacity of one BTS/Node B/eNode B.

BTS/Node B/eNode B are located on rooftops or on towers. The number of rooftop sites and towers will be calculated by multiplying the number of BTS/Node B/eNode B by the proportion of rooftops and towers. This will be done separately for each area type, because it can be expected, that the proportion of rooftops and towers and the height of towers (and therefore also their cost) will differ in each area type.

The model has also to take into account the sharing of rooftops and towers between BTS/Node B/eNode B.
**Question 19:** Do you agree with the dimensioning of radio access network as described above? If not, please provide reasons for your response and describe the alternative method which you would like to be used.

Transmission links are used for data transmission between nodes. In mobile network there are two types of transmission:

- wireless transmission using microwave equipment, which is used in the radio access network
- fixed transmission using fibre optic cables, which is used in the backbone network.

The topology used to build the microwave links in radio access network is of a tree structure. The network can be seen as a number of trees with the roots at the main hub sites (fibre nodes). The number of microwave links is given by the number of RAN sites connected by microwave (total number of RAN sites minus the RAN sites which are located in fibre nodes). The capacity of the microwave transmission equipment will be given by the traffic in the link, which will be calculated based on the average traffic per RAN site and the position of the link in the tree structure – links on the outside of the tree carry traffic only from one RAN site, links close to the root concentrate traffic from more RAN sites.

The fibre optic backbone has two dimensions: length and capacity. Length of each link depends on the location of nodes that are connected to it and on the network topology. Capacity of each link depends on the forecasted traffic between the nodes that are connected to it.

The model will dimension the fibre optic backbone using the following assumptions:

- If the number of RAN sites would increase, the length of the backbone would stay the same, because it would still connect the same locations.
- All core network equipment is located on the backbone.

The average traffic in backbone ring will be calculated as the busy hour traffic multiplied by the average routing factor for backbone ring divided by the number of backbone rings.

The cost of cable per km should include not only the cable itself, but also the cost of ducts, trenches, optical fibre joints and manholes. Because the cost of trenches and the average use of ducts and manholes differ in individual area types, the length of cables will be split by these area types and the costs will be calculated separately in each area type.

**Question 20:** Do you agree with the proposed network topology as described above? If not, please provide reasons for your response and describe the alternative network topology which you would like to be used.
2.6.3 Capital costs of network equipment

Direct capital costs refer to those costs incurred for purchasing and installation of the relevant network equipment. The direct capital costs are calculated by multiplying the unit cost of each equipment by the number of that type of equipment in the network.

Capital costs can be measured either on current or historical basis. Generally, a current measure is preferable because it shows the true costs of providing network services based on today’s technology and costs.

Current cost measurement uses a modern equivalent asset approach (MEA) to estimate replacement costs. MEA is defined as the asset that can produce the same level of service / output as the existing asset by using the latest, most efficient technology. The unit costs should be equal to the current prices of the equipment achievable on the market. Equipment prices are likely to vary between operators for reasons including differences in specification and bargaining ability. The prices used in the model should reflect those that are faced by the operators in Iraq. They can be obtained from recent purchases made by the operators.

The purpose of the model is to calculate the service cost for a particular year and it is therefore necessary to annualise the direct capital costs. The annualised capital expenditure is added to the annual operational expenditure to find the total annual costs of network equipment.

An annuity approach should be used in the model to estimate the annualised capital costs, including the cost of capital. The use of annuities for determining annual capital costs has the merit of smoothing annual capital costs over the life of the asset. A simple or tilted approach to the calculation of annuities can be used.

A simple annuity is a constant annual payment received from an investment. It represents the partial repayment of the capital invested and a return on the investment. The annual payment continues until the end of the investment term.

The replacement cost of an asset may vary from year to year. The annuity is tilted in response to the projected changes in the replacement value of a particular asset. A tilted annuity calculates an annuity charge that changes between years at the same rate as the price of the asset is expected to change. By tilting the annuity, costs can be recovered earlier than if a simple annuity approach is used. In this way, the tilted annuity approach recognizes the issue of technical obsolescence.

The cost of capital is required for the calculation of the capital annuity. An appropriate return on capital, or cost of capital, should reflect two factors:
- the cost of equity and debt capital to the operator
- the level of risk faced by the operator.

Weighted Average Cost of Capital (WACC) approved by the CMC should be used as cost of capital in the model.
**Question 21:** Do you agree with the calculation of annual capital costs as described above? Do you prefer to use simple or tilted annuity? If you do not agree with the use of annuities, please provide reasons for your response and describe the alternative method which you would like to be used.

2.6.4 Operating expenses

Operating expenses which are directly related to the network equipment should also be included in the calculation of the costs of the network equipment. The model should only include the network operating expenses that would be incurred by an efficient operator using modern and commercially available technology. The network in the model should be constructed using modern equivalent assets. If the operating expenses of the modern equivalent assets differ from the operating expenses of the existing assets then this must be accounted for.

The network operating expenses in the model will include for example:
- maintenance and operation of network equipment
- power and other utility charges for network equipment
- insurance of network equipment.

**Question 22:** Do you agree with adding the operating expenses to the total network costs as described above? If not, please provide reasons for your response and describe the alternative method which you would like to be used.

2.6.5 Indirect costs

Indirect costs include indirect network costs and the share of common costs and working capital costs related to network.

Indirect network costs are costs of additional assets that belong to the network but are not included in the direct network costs. The indirect network costs include for example:
- costs of buildings or sections of buildings containing network equipment
- costs of vehicles used for maintenance and installation of network equipment
- costs of test equipment, spare parts and mechanical aids used for maintenance and installation of network equipment.

In addition to indirect network costs, a share of common costs and working capital costs that is related to the operation of network should also be taken into account. The common costs represent the costs of the support departments like HR, finance etc. Working capital costs will be calculated as working capital (current receivables - current liabilities + cash + inventories) multiplied by the WACC.

Direct relation between these indirect costs and the network equipment is usually not defined. The indirect costs can therefore be allocated to the direct network.
costs via mark-up, which can be obtained directly from operator’s accounts, if it is believed that the operator operates in an efficient manner, or from international benchmarks.

**Question 23:** Do you agree with adding the indirect costs to the total network costs as described above? If not, please provide reasons for your response and describe the alternative method which you would like to be used.

2.6.6 Calculating service costs

The total network costs will be allocated to services based on following principles:

- **Cost causality** - costs shall be attributed to services in accordance with the activities which cause the costs to be incurred.
- **Objectivity and non-discrimination** - the attribution shall be objective and not intended to benefit any operator, service or network component.
- **Consistency** - the same methodology should be used over different periods.
- **Transparency** - the attribution methods used should be transparent and verifiable.
- **Materiality** - the use of a detailed causal allocation basis may not be necessary if the effect of the allocation is not material to the outcome.

In accordance with these principles the costs of network equipment will be split to individual services based on the traffic of each service flowing through the particular network equipment (service volume multiplied by the average routing factor).

**Question 24:** Do you agree with the allocation of network equipment costs to services as described above? If not, please provide reasons for your response and describe the alternative method which you would like to be used.

2.7 Data needs and data collection

The following data will be required for the mobile BU-LRIC model.

Network demand data:

- service volume
- proportion of traffic in busy hour
- additional parameters of call services
  - average call duration
  - average non-conversation time
  - percentage of unanswered calls
  - voice channel size
  - blocking probability
- average size of SMS, MMS, data session
- split of busy hour traffic between 2G, 3G and 4G
- covered area by 2G, 3G and 4G
- number of subscribers.

Network topology data:
- split of traffic and covered area between area types
- proportion of shared sites in each area type
- proportion of rooftop and tower sites in each area type
- proportion of sites connected by microwave and sites located in backbone nodes
- capacities used for connection of sites
- structure of microwave trees
- number of backbone nodes
- number of backbone rings
- total length of backbone rings and split of the total length to area types
- routing table.

Network equipment data:
- site coverage area
- equipment capacity
- equipment prices and installation costs
- expected change of prices and installation costs in the modelled period
- equipment lifetime
- operational costs
- expected change of operational costs in the modelled period.

Operators’ accounting data:
- indirect network costs from operators’ accounts
- network, retail and common costs from operators’ accounts
- working capital from operators’ accounts
- share of equity and debt and the cost of equity and debt from operators’ accounts.

The data will be collected via Excel questionnaires, which will be sent to the operators. Data not available from the operators will be filled in based on international benchmarks and based on information available to CMC.