MTN COMMENTS ON THE METHODOLOGIES OF THE PROPOSED TOP-DOWN (TD) AND BOTTOM-UP (BU) SHELL COST MODELS, IN RESPECT OF ICASA REVIEW OF THE COST MODELLING PHASE TO THE PRO-COMPETITIVE CONDITIONS IMPOSED ON RELEVANT LICENSEES IN TERMS OF THE CALL TERMINATION REGULATIONS, 2014 (AS AMENDED)

24 JULY 2023

1. INTRODUCTION

1.1 Mobile Telephone Networks Proprietary Limited ("MTN") would like to thank the Independent Communications Authority of South Africa ("the Authority") for the opportunity to provide comments on the methodologies of the Top-Down (TD) and Bottom-Up (BT) shell cost models following the Authority's request for comments as per the Updated Stakeholder Plan published on 29 June 2023.

1.2 MTN's commentary is based on a review of the following documents uploaded on the Authority's website:

- "**The Shell Models**" published on 22 June 2023:
  - BU-mobile-FWA-cost-model-v1.5
  - TD-mobile-FWA-cost-model-v0.4

- "**The Modelling Guide**": Guide on bottom-up and top-down shell models for the determination of mobile and fixed-line wholesale voice call termination rates – dated 2 June 2023. MTN notes this document was not updated following the 7 June 2023 submissions; and

- **"The Authority's Clarification Responses"**: Responses to stakeholder requests for clarification on bottom-up and top-down shell models for the determination of mobile and fixed-line wholesale voice call termination rates, dated 22 June 2023.

1.3 While MTN understands that the Authority is not seeking new submissions on the questionnaires at this stage of the regulatory process, we note that both the TD and BU questionnaires were updated following industry submissions on 7 June 2023. Most notably, the Authority has reduced the time horizon of the request to 20 years (2018-2037) for the BU model, and FY 2022/23 for the TD model which MTN understands to be the last available financial year, or 2022 in its case.

1.4 MTN welcomes the reduced time horizon, and notes that some of the data MTN highlighted as wholly unnecessary for MTR modelling was removed (e.g., wholesale revenues). However, the scope of the data remains essentially similar, and we stand by the arguments of our previous submission, namely that a) this represents an extremely onerous data request for the purpose of MTR modelling, and b) it is not clear how much and how this voluminous data request in fact flows into the shell models. Notwithstanding this, MTN takes comfort from the Authority's clarification that this data request is effectively to be produced on a best effort basis, and that "the Authority will not take any information not provided 'adversely'".

1.5 Critically, however, the main issue highlighted in MTN's previous submission remains. The updated questionnaire and BU model shell continue to enshrine a specific modelling approach (pure-LRIC) and depreciation method (economic depreciation). This in turn informs the scope of the data requests, in terms of both the time horizon and the granularity sought. It is not clear why the industry continues to be asked to comment on very specific modelling shells and depreciation algorithms *before* the consultation and decision to adopt a specific cost standard and modelling approach has taken place.

1.6 If, for example, the Authority decided to change its modelling approach to LRAIC (as proposed below), and/or tilted annuities, much of the below submissions would be unwarranted and unnecessary. A new round of consultation would likely be required on new model shells and questionnaires reflecting this updated approach.

1.7 The Authority's insistence in putting the proverbial cart before the horse leads us to believe that the Authority has in fact already made up its mind on the use of a pure LRIC cost standard (with or without mark-up), and this after-the-fact "consultation process" is a consultation only in name. It does not appear to be the intention of the Authority to consider the use of the previously adopted LRAIC modelling methodology. In fact, the Authority does not even discuss this possibility in the documentation issued to date, in that the Authority only ever discusses whether a mark-up should be applied to pure LRIC, but not why LRAIC, (which was deemed appropriate in 2014 and 2018) should now be jettisoned. MTN submits that the rationale identified in favour of a LRAIC methodology in the Authority's previous determinations remains relevant in light of issues identified in the BU shell model.

1.8 MTN's submission is structured as follows:

- Part 1 this introduction;
- Part 2 addresses the issues of cost standards;
- Part 3 comments on the BU LRIC shell model and modelling guide, and
- Part 4 comments on the TD shell model.

2.THE ISSUE OF BU COSTING STANDARDS: LRIC VS LRAIC

2.1 The modelling approach embedded in the BU shell model is pure LRIC[1]. This is confirmed in the modelling guide, where Acacia defends the use of the costing

[1] In its documentation we note the Authority refers to "LRIC" and "pure LRIC" interchangeably.

standard using four broad criteria[2]. In its Clarification Responses, the Authority suggests it may decide to move to a "LRIC +" approach by applying a mark-up on the pure LRIC model output (on some unspecified basis) to recover joint and common costs that are shared between different service increments. The proposed costing standard is thus pure LRIC with, or without a joint and common cost mark-up: LRIC, or LRIC +.

2.2 The Authority appears to ignore previous costing determinations (2014, 2018) were made on a different basis: LRAIC+. As a modelling methodology LRAIC is different from pure LRIC (or LRIC +). The fundamental difference is the definition of the increment that is being modelled: in pure LRIC / LRIC+ the increment is voice call termination traffic. In LRAIC, the modelled increment is *all* traffic (voice termination then gets allocated a share of this incremental cost using a cost-driver e.g., BH traffic). These are different modelling methodologies, which could potentially derive very different outcomes. The methodology also significantly impacts the precision and granularity of both the required data and modelling.

2.3 It is still not clear why and how the Authority suddenly decided to change its modelling approach. The LRAIC approach was deemed to be adequate for MTR price setting in 2014 and 2018. In 2018, the Authority, through its Consultant (Aetha) stated LRAIC was preferred to pure LRIC because *"[The] characteristics of the customary 'Pure' LRIC calculation make it extremely difficult to understand and follow, and hence to have confidence in the results. The results can also be sensitive to assumptions about demand, technology and costs a long way into the future."*[3]

2.5 Aetha, when proposing LRAIC further stated that: *"The calculation will be far more transparent. The calculation will be far more stable/consistent over time and forecast scenarios. The model will not have to look a long way into the future. It will not be necessary to use the highly complex economic depreciation method"*[4]. The consultants also previously highlighted the resource intensive nature of the data requirements and modelling required to derive accurate pure LRIC outcomes.

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[2] MTN already commented on the dubious application and/or relevance of these four criteria in its previous submission. In order to avoid repeating this submission, MTN directs the Authority to paragraph 2.23 of its 7 June submission.

[3] Development of top-down and bottom-up cost models for mobile and fixed line voice termination, Industry workshop, Aetha, Mazars and Africa Analysis on behalf of ICASA 13 November 2017. Slide 35.

[4] Development of top-down and bottom-up cost models for mobile and fixed line voice termination, Industry workshop, Aetha, Mazars and Africa Analysis on behalf of ICASA 13 November 2017. Slide 32.

2.6 The issues highlighted by Aetha during the previous MTR price setting round appear to be very relevant to the difficulties identified with the Acacia model, as highlighted in the next section below.

3. BU-LRIC SHELL MODEL CRITIQUE

3.1 Issues with the model structure

3.1.1 Pure LRIC requires highly granular modelling across space and time to detect the impact of a relatively small traffic increment, whereas LRAIC unit costs are substantially less sensitive to simplification and averaging of inputs.

3.1.2 The following sections define some of the key structural issues, every one of which may lead to materially inaccurate cost estimates. Due to the highly sensitive nature of the modelling and assumptions, these inaccuracies are much larger for the pure LRIC cost standard than for LRAIC.

3.1.3 This section does not criticise specific input values (MTN understands this will be consulted upon once the populated models are published) and focuses exclusively on the model structure and algorithms. In other words, the issues identified below cannot be fixed by changing input parameter values but require changes to the model code / structure.

3.2 Simplistic modelling of spectrum availability and use

3.2.1 The model assumes the following regarding spectrum availability and use in the downlink:

Source sheet:			"Summary"	"Summary"	"Dimensioning"
Spectrum assignments	**Unit**	**Usage**	**Assignments**	**Total MHz**	**Downlink %**
GSM sub-1GHz	MHz	FDD	2x5	10	50.00%
GSM above 1GHz	MHz	FDD	2x12	24	50.00%
UMTS sub-1GHz	MHz	FDD	2x5	10	50.00%
UMTS above-1GHz	MHz	FDD	2x15	30	50.00%
LTE sub-1 GHz	MHz	FDD	2x10	20	50.00%
LTE above-1 GHz	MHz	TDD	1x80	80	50.00%

Whilst in reality, spectrum availability varies over time as operators acquire new spectrum, the model maintains spectrum availability constant. Similarly, the proportion of spectrum used in the downlink in existing networks varies over time as e.g., FDD spectrum is migrated to TDD. The model structure does not reflect this.

3.2.2 Furthermore, the model does not allow for the possibility of spectrum refarming, e.g., migrating spectrum used for one technology to another. In reality, spectrum refarming is one of the most important cost drivers for network operators and it occurs frequently.

3.2.3 Spectrum is also used differently across clusters: For example, sub 1GHz spectrum may be used more extensively for GSM in areas with low traffic densities than in areas with high traffic densities.

3.2.4 Spectrum is the most basic production means used in a mobile network and the extremely simplistic modelling of its availability and use across technologies, geo-types, duplex technologies, and time inevitably leads to substantial dimensioning and costing errors affecting virtually every element of the radio and backhaul network.

3.2.5 While MTN does not intend to provide detailed comments on model inputs at this stage (it will do so when it receives a fully populated model), it notes that previous issues highlighted in its 7 June 2023 submission remain in the updated version of the model shell. For example, the Authority is proposing to model an operator with 174MHz of spectrum. Such a holding was unavailable until the conclusion of the recent spectrum auction and contains substantial 5G spectrum (a technology not modelled in BU shell). Without deploying 5G the proposed spectrum holding appear to be overstated.

3.2.6 It is also unclear how coverage is defined in the BU model. What QoS, spectrum type and spectrum quantity will be used for the coverage layer in each technology? Finally, the engineering rules that will be used to determine the type and quantum of spectrum necessary to achieve adequate coverage vs capacity from 2018 to 2037 remain also unclear.

3.3 Simplistic modelling across geo-types and sectors

3.3.1 The model tries to calculate the necessary network elements to meet demand as specified in sheet “1 Volumes”. However, its basic structural assumption for doing so is that all sites within a geo-type behave in exactly the same way. In reality, the busiest sites carry several times more traffic than the least busy sites and the average site. As a result of such averaging, the model is structurally unable to capture pure incremental cost with a reasonable margin of error. It also leads to lumpy model behaviour.

3.3.2 The issue of averaging is further aggravated by the embedded model assumption that all sectors of a site carry the same amount of traffic.

3.4 Static modelling of equipment types

3.4.1 The model assumes a single type of equipment for each network element as shown in the table below.

Core MGW Capacity	Erlang	Capacity of a Media Gateway (MGW) measured in Erlangs	44,318
Core SGSN Capacity	SAU	Number of Simultaneous Active Users supported by a SGSN (Service GPRS Support Node)	2,089,889
Core SMSC Capacity	#BHSMS	Number of SMS supported by a SMSC (Short Message Service Centre) in one hour	12,250,800
Core HLR Capacity	#subscribers	Number of subscribers supported by a HLR (Home Location Register)	4,266,667
Core MSCS Capacity - 3	Erlang	Capacity of a MSCS measured in Erlangs	67,000
Core GGSN Capacity	Mbps	Capacity in Mbps supported by a GGSN (Gateway GPRS Support Node)	41,779
Core GGSN Capacity - 2	SAU	Number of SAU (Simultaneous Active Users) supported by a GGSN (Gateway GPRS Support Node)	1,122,500
Core MME Capacity	SAU	Number of SAU supported by a MME (Mobility Management Entity)	5,548,750
Core SGW Capacity	Mbps	Capacity in Mbps supported by a SGW	68,456
Core PGW Capacity	Mbps	Capacity in Mbps supported by a PGW	78,848
Core HSS Capacity	#subscribers	Number of Subscribers supported by a HSS (Home Subscriber Server)	3,818,421
Core PCRF Capacity	#subscribers	Number of Subscribers supported by a HPCRF (Policy and Charging Rules Function)	2,633,333
Core SBC Capacity	Mbps	Capacity in Mbps supported by a SBC (Session Border Controller)	780

Source: Sheet "2 Dimensioning"

3.4.2 In the model, the 2018 equipment looks exactly the same as the 2037 equipment. In reality there are different types of equipment deployed over time, with different capacities, functionalities, and costs. Failing to capture such changes over time is likely to lead to significant inaccuracies.

3.5 Static modelling of demand dimensioning

3.5.1 The key variable driving dimensioning demand is the busy hour proportion of traffic. The model assumption is static across time.

		% of daily traffic in busy hour	% of annual traffic in busy hour	
2G data traffic	% of total	7.70%	0.021%	*bh_data_2g_perc*
3G data traffic	% of total	6.10%	0.017%	*bh_data_3g_perc*
4G data traffic	% of total	9.70%	0.027%	*bh_data_4g_perc*
2G voice traffic	% of total	11.80%	0.032%	*bh_voice_2g_perc*
3G voice traffic	% of total	11.00%	0.030%	*bh_voice_3g_perc*
4G voice traffic	% of total	7.00%	0.019%	*bh_voice_4g_perc*
2G SMS traffic	% of total	11.70%	0.032%	*bh_sms_2g_perc*
3G SMS traffic	% of total	11.00%	0.030%	*bh_sms_3g_perc*
4G SMS traffic	% of total	10.00%	0.027%	*bh_sms_4g_perc*

Source: Sheet "2 Dimensioning"

3.5.2 In reality, demand varies substantially over time. Assuming a static distribution of traffic will likely lead to significant output inaccuracies.

3.6 Seemingly incorrectly processed key assumptions

3.6.1 The following assumptions are expected to have a significant impact on the model output.

Data channel rate at which data is carried	Mbps	Used for calculation of conversion factor from MB to minutes	0.16	channel_rate_data_3g
Conversion factor from MB to minutes	min/MB	Conversion factor from MB to minutes	0.818	mb_min_3g
Conversion factor from SMS to minutes	min/SMS	Conversion factor from SMS to minutes	0.00104	sms_min_3g
Spectral Efficiency - 5 MHz	bps/Hz		1.06	
Spectral Efficiency - 20 MHz	bps/Hz		1.24	
Data channel rate at which data is carried	Mbps	Used for calculation of conversion factor from MB to minutes	0.50625	channel_rate_data_4g
Conversion factor from MB to minutes	min/MB	Conversion factor from MB to minutes	0.270	mb_min_4g
Conversion factor from SMS to minutes	min/SMS	Conversion factor from SMS to minutes	0.00104	sms_min_4g

Source: Sheet “2 Dimensioning”

3.6.2 However, varying these inputs does not have any impact on the model outputs. Similarly, changing the Currency scenario in sheet “Summary” should have an impact on model outputs but does not. This appears to highlight significant issues with the coding of the BU model.

3.7 Error in RAN modelling

3.7.1 According to the model, the vast majority of termination costs are driven by equipment calculations in sheet “4a Network demand – RAN”. Yet, there seems to be a material error in this sheet leading to increases in network costs with increases in coverage cell radii.

3.7.2 For instance, increasing cell radii for GSM sub-1GHz- Cities or GSM sub-1GHz- Towns and semi-dense substantially increase overall cost as well as pure incremental costs calculated by the model. If the cell radius for GSM sub-1GHz-Cities is set to that of GSM sub-1GHz- Towns and semi-dense areas, the incremental unit cost increases by 16%. This increase in both total and incremental costs suggest the presence of a material issue with the outputs and some calculations in the sheet.

3.7.3 One of the issues seems to be the calculation of total sites required as sites needed in addition to coverage sites (which is equal to total sites needed minus coverage sites) minus coverage sites. This calculation deducts coverage capacity twice, which explains the incorrect cost increase resulting from cell radius increases.

3.8 Cost recovery profile

3.8.1 As previously highlighted, in its cost modelling best practice document the GSMA states: *“In our opinion,* ***there is no single method of capital cost recovery that can be considered best practice in all circumstance****. In principle, a proper articulation of economic depreciation taking into account, inter alia, output levels over time, capital input price in(de)flation, operating cost expenditure over time is* *to be preferred.* ***However, the associated informational difficulties may argue for the application of a simpler proxy"*** [5] *(our emphasis).*

3.8.2 During the 2018 determination, the Authority, via its consultant stated that: *"Calculating economic depreciation therefore requires coverage, demand, network deployment and unit costs to be forecast a long way into the future – typically at least 20 years – and also for the full history of the business up to the present time to be included in the model. The calculation of economic depreciation is therefore highly complex, difficult to understand and validate, and the results can be sensitive to uncertain forecasts of demand and network deployment a long way into the future".* In contrast, the Authority stated that *"A tilted annuity approach to depreciation is a lot simpler to implement and a lot easier to understand than economic depreciation"*[6]

3.8.3 MTN agrees with these positions. Although economic depreciation (ED) is acceptable in principle, the practical issues with its implementation in a highly dynamic industry (both in terms of information requirements, modelling implementation and traceability) may advocate for a simpler method (tilted annuities). In any case, should the Authority wish to pursue ED, it is essential to understand the starting date chosen by the Authority for the modelling process. For example, why is the HEO assumed to be starting business in 2018, and not for example in 1994, as MTN?

3.9 Conclusions on BU shell model

3.9.1 The proposed modelling approach appears to be "falling between two chairs": it is extremely ambitious in terms of the granularity of what it seeks to model (pure LRIC of a voice termination increment over a 20-year time horizon), and at the same time fatally simplistic in the assumptions around critical network dimensioning and engineering rules needed to derive an appropriate view of network scaling and costs (e.g., spectrum, refarm, demand distribution across space and time, technology evolution). The latter negates the modelling objective. It is simply incongruous to pretend to model with any precision the network and cost impact of a very narrowly defined increment using sledgehammer assumptions around network dimensioning, spectrum, and demand distribution. These issues were identified in previous rounds by the Authority's network

[5] The setting of mobile termination rates: Best practice in cost modelling, p. 16. https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2014/10/settingofmobileterminationrates.pdf

[6] Development of top-down and bottom-up cost models for mobile and fixed line voice termination, Industry workshop, Aetha, Mazars and Africa Analysis on behalf of ICASA 13 November 2017. Slide 37.

modellers (Aetha) and led to the recommendation of using LRAIC as the modelling methodology, as LRAIC unit costs are substantially less sensitive to simplification and averaging of inputs.

3.9.2 Accordingly, MTN respectfully submit that the network modelling and engineering skills demonstrated in the BU shell model would strongly advocate for a less error-prone and assumption-sensitive modelling approach. An update of LRAIC models developed in the previous cost modelling would seem to be a much more appropriate and time-efficient approach. Alternatively, the current modelling approach could reasonably be adapted to calculate LRAIC, so outputs are more stable and less assumption sensitive.

3.9.3 Notwithstanding the above, should the Authority wish to continue with this complex modelling approach, the significant issues and modelling errors highlighted in this section will require fixing as the current model is not fit for purpose to derive a LRIC unit cost with any degree of confidence.

4.TD-LRIC SHELL MODEL CRITIQUE

4.1 Purpose of the TD model

4.1.1 In previous determinations, the FAC / TD model was used to inform the MTR glidepath (for the starting point [7]) and the BU modelling for the endpoint. Now, the Authority plans to use TD models as a "sanity check" for BU model outputs. It is not clear how a different costing method and standard can be used as a sanity check. The development of a TD cost model for sanity-checking appears to be a wasteful use of industry and regulatory resources, when readily available annual financial statements could perhaps be used for the same, high-level purpose.

4.2 Modelling methodology

4.2.1 The TD model applies a historic cost, fully allocated cost standard. It is extremely simple as it relies on inputs which are typically outputs of top-down models, such as costs by network element and activity. Put differently, the TD model only deals with the final of several allocation steps of typical TD modelling.

4.2.2 The TD model carries out only a couple of actions:

- It converts gross book value (GBV) or "Historic cost of assets in FAR" to economic cost; and

[7] See BRIEFING NOTE ON ISSUES RAISED DURING THE 2017 WHOLESALE VOICE CALL TERMINATION COST MODELLING WORKSHOP HELD ON 13 NOVEMBER 2017 AND ONE-ON-ONE MEETING WITH LICENSEES FROM 15-16 NOVEMBER 2017), the Authority suggested "*Cost / minute outputs will not be exactly the same for BU and TD models. The outputs will be taken into consideration, along with other factors, that will result in the final numbers. ICASA may follow the same methodology as in 2014 – TD model results used for Year 1, and BU model results for Years 2 and 3.*

- It converts traffic into Mbps by applying a conversion factor (which is a direct input) and allocates economic cost to services based on Mbps.

The following sub-sections provide some comments on each action and the embedded choice of cost standard.

4.3 Economic cost calculation

4.3.1 The model calculates economic cost as Opex + Depreciation + Cost of Capital. All components of economic costs by network element or activity are inputs to the model. Cost by network element, e.g., personnel opex for GSM access is typically an intermediate output of a TD model, not an input. In fact, most of the complexity of TD models is typically in the activity-based, causal allocation of cost to network elements and activity groups such as those defined in the TD model (e.g., retail-specific activities, head-office activities). Different operators are likely to use different allocation methodologies, making results of individual TD models difficult to compare.

4.4 Allocation based on Mbps

4.4.1 Network elements defined in the model are in general too aggregated to lend themselves to a causal allocation. For instance, network element "switches and routers" combines elements which are used only for voice services with elements that are used only for data services. As a result, there cannot be a single driver allocating costs in a causal manner. In the shell model, virtually the entire voice switches are allocated to data services owing to this structural issue.

4.4.2 A further issue with allocations is the disparity of criteria between the TD and BU model regarding cost drivers of the GSM network: whereas the BU model dimensions the GSM access network based on channels, the TD model uses Mbps for cost allocation purposes. Both cost allocation and dimensioning should use the same driver.

4.4.3 The TD model allocates retail specific costs, wholesale specific costs, working capital and head office costs based on traffic. However, there is no causal link whatsoever between significant portions of these costs and traffic. To align with the causality principle in cost allocation, the aforementioned cost blocks should be carefully analysed and allocated in a more nuanced manner.

4.5 Cost standard and cost base

4.5.1 The TD model applies a historic cost, fully allocated cost standard. This is diametrically opposed to the pure incremental current cost standard applied in the BU-LRIC model. Both cost standard and cost base are inconsistent with the BU model's cost standard and base. As a result, model outputs will not be comparable.