REPUBLIC OF MACEDONIA
AGENCY FOR ELECTRONIC COMMUNICATIONS

Final Modelling Results Report

for a Bottom-Up LRIC Bitstream service in Republic of Macedonia

October 16, 2012

Submitted comments regarding published "Draft Modelling Results Report for a Bottom-Up LRIC Bitstream service in Republic of Macedonia" and AEC's answers.

Dear all,
Agency for electronic communications (AEC) on 27.07.2012 opened public hearing for Draft Model Reference Paper Wholesale Leased Lines, Duct Rental and Dark Fibre. Due date for submission of the views and comments about proposed subject of public hearing from the interested parties was 26.08.2012 on the operators request AEC have extended the due date till 15.09.2012 for submission of the comments where Makedonski Telekom, ONE operator and Neotel submitted their views on published document.

AEC is thanking to the interested parties for submitted comments on published document. Below are presented submitted comments and AEC answers.

Agency for Electronic Communications

Final Modelling Results Report for a Bottom-Up LRIC Bitstream service in Republic of Macedonia

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1 INTRODUCTION

1.1 This Report presents base case scenario and final results of BU LRIC modelling of bitstream services. Key assumptions and demand for base case scenario are presented first and LRIC estimates for select bitstream services second.

1.2 In preparing this Report, we have relied upon a number of third party reports (operator subscriber/traffic estimates, network/cost data, etc). We have not undertaken any form of investigation, verification, audit or other work in relation to such information. In particular, the scope of our work has not included validating subscriber, traffic, tariffs (revenues) and cost assumptions contained in third party source documents. Accordingly we express no view on the reasonableness of said third party source documents.

Makedonski telekom (Maktel/MKT) comment:
We believe that with this introduction the developer of this LRIC Bottom Up model wants to hedge against the responsibility of the accuracy of the data used as input data in the model and that it becomes obvious that the revision of this model by the independent auditor is more than needed. MKT considers that due to the obligation of all SMP operators should have revised LRIC Top Down model for the preparation of the accounting statements, and the AEC would have to have the same obligation to revise the model that governs almost all wholesale services on the Macedonian telecommunications market. The audit conducted by an independent auditor would mean the verification of the accuracy of the model.

AEC response:
AEC set forth a disclaimer about data investigation, verification, audit and other work related to data inputted to the model. The paragraph is not to say that AEC has not performed validation of data entered into the model but instead it is to say that the rigour and scope of these validations is limited to information available to AEC. As the model uses significant amount of data collected from the industry it would be unreasonable to expect, within the scope of this process, for AEC to verify and, in particular, trace the correctness of each input with rigour associated with a typical assurance process. This especially applies for subscriber habits related information which is specific to the geography subject to modelling. Instead, AEC assumed that data submitted by the industry (Maktel included) is valid and correct.

The model was developed in cooperation with the operators. AEC ensured meetings and workshops to discuss the provided materials (inception report, data collection, model referent paper and model results). Methodology was communicated to operators and models were developed using operator's data. Electronic communication act refers to the models developed by the operators which are developed independently by the operators and without public process or participation of the AEC. The audit of the model is the toll that enables AEC to ensure verification of the methodology and results.

1.3 The scope of our work has not involved us in performing tests necessary for the purpose of expressing an opinion on the accuracy of any subscriber/traffic forecasts and/or projections. Neither do we express any overall opinion on the reliability of the forecasts/projections nor the reasonableness of the underlying assumptions. Since any forecast and/or projection relates to the future and may be affected by unforeseen events, actual results after our Base Case date of July 24, 2012 are likely to be different from those forecast/projected because events and circumstances do not necessarily occur as expected. Such differences may or may not be material. Such prospective information is not susceptible to audit and Deloitte expresses no opinion as to whether the actual results achieved will *ex post* correspond to those forecast or projected.

1.4 Due to confidential information, some parts of the text are removed in the public version of the document. These parts are replaces by an ellipsis enclosed in square brackets – e.g. […].

Maktel comment:
We demand greater transparency and clarification of the model. We propose a closed discussion between MKT and AEC to open the entire model and for it to be able to submit comments. We propose MKT to have insight into the original text of the reference documents and calculations for LRIC, and to other operators, because of confidentiality can be made in a limited form. MTC should have an opportunity to comment on the modeling consultant AEC data as well as the use of the MKT.

AEC response:
AEC has presented Maktel with the model and Maktel has had the opportunity to comment on the model.

2 DEMAND PROJECTIONS

2.1 Demand used for modelling and preparation of LRIC estimates are best described in several parts:

- Number of subscribers of different services
- Aggregate throughput for different services in the core network
- Number of bitstream subscribers per different level of bitstream access

We address each one of these below in detail.

2.2 In preparation of base case scenario we have relied on a number of inputs from industry. Those inputs were available for year 2014 the latest, but due to expected dynamics and related unpredictability of market outcome, our base case refers to year 2013.

2.3 Number of subscribers of different services is divided into three main categories:

- Internet users over ADSL technology
- IPTV users
- VoIP users over ADSL lines

2.4 As the broadband penetration in Macedonia is relatively low compared to the EU27, there is still space for growth. In that sense, number of ADSL users is projected based on historical growth data (2011/2010). Number of users applied in the model is thus 165.577.

2.5 Similar to broadband penetration, IPTV penetration is relatively low compared to EU27 so assuming that IPTV penetration growth will continue with same CAGR is likely to be a conservative scenario. Number of IPTV users in the model is then 71.216.

2.6 It should be noted that although IPTV subscribers CAGR is relatively high – i.e. 33,22%, we believe that this scenario is realistic since the latest reports about IPTV subscribers suggest growth rates of 28% globally and even higher for Eastern Europe.

2.7 As it is common practice for IPTV service to include VoD services, VoD users were not estimated separately but instead all IPTV users are assumed to be VoD users as well.

2.8 […]. However, there are several developments that need to be taken into account to estimate the number of users:

a) In recent years, in Macedonia as well as in some surrounding countries, there was a noticeable trend of mobile-to-fixed substitution. However, in the last year this trend has reversed – see figure below.
b) Maktel's market share in terms of fixed lines has been constantly declining over the past several years. If this trend continues at the same rate, in the base case year Maktel would have approximately 56% of market share.

2.9 Applying CAGR for above trends (see table below), the number of VoIP users in applied in the base case is equal to […].

	CAGR	2008	2009	2010	2011	2012	2013
Fixed lines	-2,21%	451.299	437.301	415.144	422.053	412.732	403.616
Penetration	-2,33%	22,07	21,35	20,22	20,56	20,08	19,61
SMP's share	-9,72%	94%	84%	77%	69%	62%	56%

2.10 Last input to the model regarding subscribers is number of bitstream users. Estimates used in the model are again based on growth rates from 2011 over 2010. Resulting percentage of bitstream users is used for base case scenario is 15.34%.

2.11 Share of bitstream subscribers using VoIP/IPTV services is assumed to be the same as for retail subscribers.

Neotel comment:
We believe that cannot be compared to an equivalent number of subscribers using VoIP / IPTV, with the number of retail end-users because some of the operators do not offer IPTV service.

AEC response:
AEC developed a single model that does not differentiate users with respect to their ultimate service provider. AEC believes that this aggregate approach is the most appropriate to asses average cost incurred by Incumbent for providing Bitstream services. Distribution of bitstream VoIP/IPTV users across altnets will no doubt vary but AEC believes that on an aggregate level, with effective competition in place, percentage of VoIP/IPTV subscribers will most likely resemble that of the Incumbent since current Incumbent's subscribers represent the vast majority of market.

It important to notice that since cost of each service is priced separately, any alternative operator not providing IPTV/VoIP services will not participate in recovery of costs incurred by providing these services.

2.12 Summary of subscriber inputs is presented in the following tables.

Maktel's ADSL lines	CAGR	2010	2011	2013
Bitstream	13,07%	18.957	20.897	25.393
Retail lines	5,71%	130.127	137.563	140.184
Total lines	6,74%	151.218	161.410	165.577
Bitstream as % Internet	5,93%	14%	15%	15,34%
IPTV	33,22%	30.123	40.129	71.216

2.13 Basis for projections of aggregate throughput for different services at the core network level were obtained from Maktel.

2.14 Overview of traffic projections is presented in the following table.

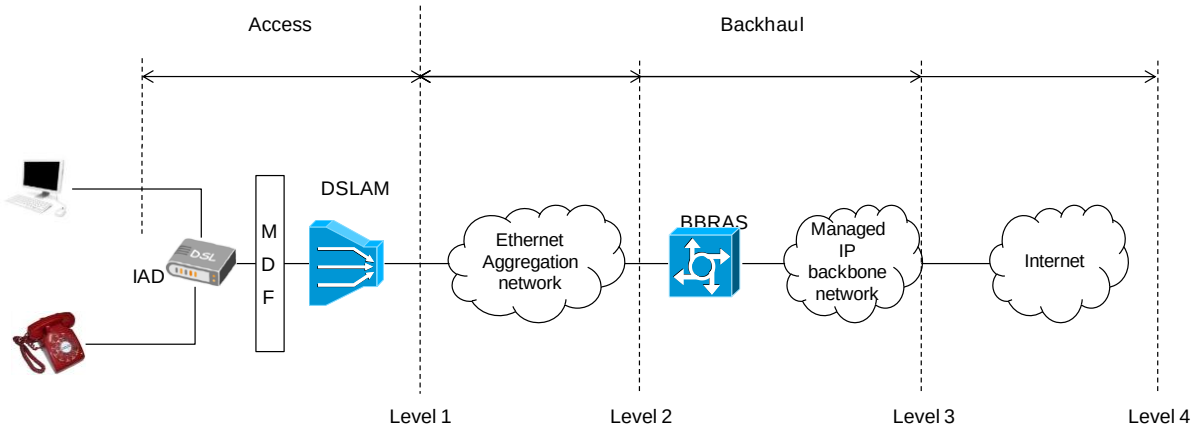
[…]

3 FINAL RESULTS

3.1 This chapter presents the results our Base Case analysis for selected profiles and services. All numbers refer to monthly rental fees.

3.2 The model supports LRIC and LRIC+ cost calculation for 4 (four) levels of bitstream as defined in ERG's common position (ERG (03) 33rev2). The levels are depicted and explained below.

Figure-1.1 Different levels of bitstream



Maktel comment:
By PSTN / IMS migration, in IP technology environment there is no splitter, all services are provided directly through IAD (Integrated Access Device) device .

AEC response:
The picture presented is an illustration. As agreed inter alia during model development splitters were not modelled, but IADs instead. AEC has updated the image.

For clarification, the splitter is not part of the services modelled on any level of bitstream access.

3.3 The ERG common position describes the following wholesale bitstream access levels:

1) Level 1: DSLAM[1] access – incumbent provides the DSL access link and hands over the bitstream to the new entrant directly after the DSLAM. In this option the new entrant is physically present at the DSLAM and is supplying the backhaul product. This enables him to differentiate himself through the backhaul product but requires large investments since due to presence at each DSLAM.

[1] Although the access node can also be an MSAN, for simplicity on DSLAM is used throughout this chapter.

2) Level 2: aggregation network – the new entrant connects to the incumbent network at an aggregation point behind DSLAM thus reducing the number of points at which the new entrant must be present. In this scenario the new entrant uses a bigger part of incumbent's network but can still control the quality of service since it operates its own BRAS server as well as part of the backhaul.

3) Level 3: IP level – in this scenario the demarcation point is at/after the managed IP core network. The traffic goes over managed IP network only and the incumbent controls the BRAS.

4) Level 4: unmanaged IP – in this scenario the new entrant only brands, sells and bills the product. It has no control over technical characteristics and in effect is providing only a resale.

Maktel comment:
Changing the way in providing a level 4 of bitstream access will cause additional investment by MKT which will depend on the number of subscribers, of the change in the billing system, but most will cause changes in the safety management of personal data.
Namely, to ensure identical process as in retail, alternative operator will need to provide management and over all user names and passwords of its users MKT. Possibly other data will be needed to manage the resale of bitstream access or level 4. This will be part of the comments on the new draft Regulation on bitstream access and resale of bitstream services.

AEC response:
Maktel argues that changing the way level 4 bitstream is provided will required additional investment. AEC sees no need to change the manner in which level 4 bitstream is provided compared to the way it is provided currently. However, Maktel may propose any changes it finds appropriate in the new Referent Bitstream Offer (RBO) and AEC will consider these changes during RBO approval process.

3.4 Before detailed explanation of modelled services, it is necessary to note that cable access network is not covered by this model. Instead, prices for cable access up to the DSLAM access node are determined by the referent unbundling offer (RUO).

3.5 Level 1 bitstream services are modelled in the following manner:

- Network access point for alternative operator is on DSLAM and bitstream service access link is based on Ethernet technology.
- Charges for end customer access in the local loop are taken from RUO.
- Customer premises equipment (CPE) is assumed to be provided by the alternative operator.

3.6 Level 1 bitstream includes the following network components:

- Bitstream access link from handover ODF to DSLAM
- DSLAM port card

- Access network in the local loop (charges taken form RUO) without CPE

3.7 Level 1 bitstream is modelled both with and without PSTN subscription ("standalone bitstream").

3.8 Level 2 bitstream is modelled in the following manner:

- Network access point for alternative operator is on the aggregation network and bitstream access link is based on Ethernet technology.
- Aggregation network is charged per capacity required to provide access to alternative operator's end users in the respective aggregation part of the network from network access point.
- Charges for end customer access in the local loop are not calculated but taken from RUO.
- CPE is assumed to be provided by the alternative operator.
- BRAS server (Broadband Remote Access Server) is provided by Alternative Operator.
- Capacity of the bitstream access link is assumed to be greater or equal to the capacity reserved in the backhaul. This provides the alternative operator with possibility to optimize cost with respect to planned expansion. No concentration ratio for Bitstream access link will be assumed, so AO is self-responsible for the quality of best effort internet services that are provided to end subscribers.

3.9 Level 2 bitstream is modelled both with and without PSTN subscription ("standalone bitstream").

3.10 Level 2 bitstream includes the following network components

- Bitstream access link from handover ODF to a port on aggregation network node
- Backhaul aggregation network capacity up to the DSLAM
- DSLAM (uplink and port cards)
- Access network in the local loop (charges taken form RUO) without CPE

3.11 Level 3 bitstream is modelled in the following manner:

- Network access point for alternative operator is on the core network and bitstream access link will be based on Ethernet technology.
- Backhaul network capacity network (core and aggregation) is charged per capacity required to provide the service to alternative operator's end users from network access.
- Optional BRAS node – see explanation in the following point.
- Charges for end customer access in the local loop are not calculated but taken from RUO.
- CPE is assumed to be provided by the alternative operator.
- Capacity of the bitstream access link is assumed to be greater or equal to the capacity reserved in the backhaul. This provides the alternative operator with possibility to optimize cost with respect to planned expansion. No concentration ratio for Bitstream access link is assumed, so AO is self-responsible for the quality of best effort internet services that are provided to end subscribers.

3.12 Level 3 is modelled with two variants: i) with BRAS node provided by the SMP; ii) with BRAS node provided by the alternative operator. This effectively means that level 3 bitstream will be provided as OSI stack Layer 2 service but on a core network level. Availability of this service is subject to technical and security requirements of the SMP operator.

MKT comment:
Level 3 in the second variant "ii) BRAS node of the alternative operator" will not be a problem to ensure if the BRAS equipment is fully managed and owned by the alternative operator.

AEC response:
BRAS that is fully managed by the alternative operator is the underlying assumptions in Level 3 variant that does not include BRAS.

3.13 Level 3 bitstream is modelled both with and without PSTN subscription ("standalone bitstream").

3.14 Level 3 bitstream includes the following network components

- Bitstream access link from handover ODF to a port on core network node
- Core and aggregation backhaul network capacity up to the DSLAM
- BRAS node (optionally – see above)
- DSLAM (uplink and port cards)
- Access network in the local loop (charges taken form RUO) without CPE

3.15 The model covers three basic classes of services: Internet access, VoIP and IPTV.

3.16 All of these services are modelled with the same QoS and overbooking factors used by the SMP to for its own end customers.

3.17 Results for basic internet service per selected profile are presented in the following table.

Profile (downlink/uplink)	Level 1	Level 2	Level3 without BRAS	Level3 with BRAS
1024/512 Kbps	**115,71 MKD**	**119,42 MKD**	**124,70 MKD**	**127,18 MKD**
2048/512 Kbps	**116,32 MKD**	**122,49 MKD**	**131,30 MKD**	**135,43 MKD**
3072/512 Kbps	**116,92 MKD**	**125,57 MKD**	**137,89 MKD**	**143,68 MKD**
4096/768 Kbps	**117,67 MKD**	**129,41 MKD**	**146,14 MKD**	**153,99 MKD**
5120/768 Kbps	**118,28 MKD**	**132,48 MKD**	**152,73 MKD**	**162,24 MKD**
6144/768 Kbps	**118,88 MKD**	**135,56 MKD**	**159,33 MKD**	**170,49 MKD**
7168/768 Kbps	**119,49 MKD**	**138,63 MKD**	**165,93 MKD**	**178,74 MKD**
8192/1024 Kbps	**120,24 MKD**	**142,48 MKD**	**174,17 MKD**	**189,05 MKD**
9216/1024 Kbps	**120,84 MKD**	**145,55 MKD**	**180,77 MKD**	**197,30 MKD**
10240/1024 Kbps	**121,45 MKD**	**148,62 MKD**	**187,36 MKD**	**205,55 MKD**
11264/1024 Kbps	**122,05 MKD**	**151,70 MKD**	**193,96 MKD**	**213,79 MKD**
12288/1024 Kbps	**122,66 MKD**	**154,77 MKD**	**200,56 MKD**	**222,04 MKD**
13312/1024 Kbps	**123,26 MKD**	**157,85 MKD**	**207,15 MKD**	**230,29 MKD**
14336/1024 Kbps	**123,86 MKD**	**160,92 MKD**	**213,75 MKD**	**238,54 MKD**
15360/1024 Kbps	**124,47 MKD**	**164,00 MKD**	**220,34 MKD**	**246,79 MKD**
16384/1024 Kbps	**125,07 MKD**	**167,07 MKD**	**226,94 MKD**	**255,04 MKD**

AEC note:
As a result of model adaptation – explained under point 3.33. – calculated cost estimates have changed compared to Draft version of this report. For further detail, please refer to comments under point 3.33.

3.18 Results for "standalone" basic internet service – i.e. when there is no active PSTN subscription associated with ADSL line - per selected profile are presented in the following table.

Profile (downlink/uplink)	Level 1	Level 2	Level3 without BRAS	Level3 with BRAS
1024/512 Kbps	**325,71 MKD**	**329,42 MKD**	**334,70 MKD**	**337,18 MKD**
2048/512 Kbps	**326,32 MKD**	**332,49 MKD**	**341,30 MKD**	**345,43 MKD**
3072/512 Kbps	**326,92 MKD**	**335,57 MKD**	**347,89 MKD**	**353,68 MKD**
4096/768 Kbps	**327,67 MKD**	**339,41 MKD**	**356,14 MKD**	**363,99 MKD**
5120/768 Kbps	**328,28 MKD**	**342,48 MKD**	**362,73 MKD**	**372,24 MKD**
6144/768 Kbps	**328,88 MKD**	**345,56 MKD**	**369,33 MKD**	**380,49 MKD**
7168/768 Kbps	**329,49 MKD**	**348,63 MKD**	**375,93 MKD**	**388,74 MKD**
8192/1024 Kbps	**330,24 MKD**	**352,48 MKD**	**384,17 MKD**	**399,05 MKD**
9216/1024 Kbps	**330,84 MKD**	**355,55 MKD**	**390,77 MKD**	**407,30 MKD**
10240/1024 Kbps	**331,45 MKD**	**358,62 MKD**	**397,36 MKD**	**415,55 MKD**
11264/1024 Kbps	**332,05 MKD**	**361,70 MKD**	**403,96 MKD**	**423,79 MKD**
12288/1024 Kbps	**332,66 MKD**	**364,77 MKD**	**410,56 MKD**	**432,04 MKD**
13312/1024 Kbps	**333,26 MKD**	**367,85 MKD**	**417,15 MKD**	**440,29 MKD**
14336/1024 Kbps	**333,86 MKD**	**370,92 MKD**	**423,75 MKD**	**448,54 MKD**
15360/1024 Kbps	**334,47 MKD**	**374,00 MKD**	**430,34 MKD**	**456,79 MKD**
16384/1024 Kbps	**335,07 MKD**	**377,07 MKD**	**436,94 MKD**	**465,04 MKD**

Maktel comment:
We propose to set eight profiles (downlink / uplink) for all wholesale operators, ie only 8 profiles to include in a reference offer for bitstream services. This will achieve better service provision and future maintenance and resolve obstacles, and effectively creating products. The introduction of multiple accounts will mean additional investment by the MTC (new control / management system) that is not an input in the calculation of these fees.
Monthly fees of this document should refer to the one-year contract, because incoming information which MKT provided most refers to perennials calculations. If these are prices for indefinitely, MKT will need to have the possibility of setting up a one-time fee for setting a particular service or package. Just like in the reference offer for unbundled local loop, the amount of MKD 1.109,00 denars is the cost for connecting one local loop.

Also, lowering prices and reduced price difference between different speeds will lead to new requirements for creating different profiles by alternative operators only for larger gears, which in turn will contribute to a reduction in the quality of the links and reduce the maximum

affordable speed per local loop. Each copper cable can withstand a certain load, after which starts a reduction of the quality of all services provided through this cable.

AEC response:
Maktel proposed that only 8 access profiles are regulated. However, during model development process the profiles listed above were agreed to be part of the model and therefore part of the modelling results. Profiles that will be present in the Referent Bitstream Offer (RBO) are to be agreed according to industry requirements during new RBO approval process.

Maktel argues that one-time fee connection fee should be introduced and that fees should refer to one-year contract. One-time connection fee is a common part of referent offers and Maktel may propose such a fee in its referent offer, however AEC will review the proposed fees. Results calculated from the model are for monthly fees only and are no related to any contract duration. Minimum contract duration, if any, will be determined in the referent offer.

Maktel argues that higher access speeds produce a higher load on the network and that each copper pair has a maximum speed that it can support. AEC agrees that there are technical limitations inherent to providing broadband in both access and backhaul network and AEC sees no need to address the comment further.

ONE comment:
ONE Telecommunication Services DOO thanks for given an opportunity to present their views, opinions and submit comments on the Draft Report of the Electronic Communications Agency of the results of the Bottom-Up LRIC modeling for bitstream services in the Republic of Macedonia.

In this occasion we would like to express our satisfaction with the decision of the Agency for Electronic Communications to change the methodology for calculating prices for bitstream services and replacement of the retail minus method with the implementation of the so-called Bottom-up LRIC model.

Regarding the manner of the modeling of the services we don`t have major objections except in the area of modeling the cost of a standalone bitstream access service.

We think that should be correct the manner of calculating the cost for the providing the service standalone bitstream access, respectively it can be calculated as the sum of the cost of the provision of bitstream access at the appropriate level of service plus the difference of the cost of providing full unbundled local loop and the cost of providing shared access to the local loop or by the following formula:

Price (Stand Alone BSA) = Cost (BSA) + (Cost (Full LLU) – Cost (Shared LLU)) = Cost (BSA) + (210 MKD – 99 MKD) = Cost (BSA) + 99 MKD

If one takes into account that the cost of providing the service for bitstream access at any level implies generally the cover of the cost of providing Internet service to the end user with included the maintenance costs of the so-called last mile then we can assume that exists and is valid the following equation Cost (BSA) = Cost (Internet).

According to your methodology the cost of the service for providing standalone bitstream access will be calculated by the following formula:

Price (Stand Alone BSA) = Cost (BSA) + Cost (Full LLU) = Cost (BSA) + 210 MKD

Full unbundled local loop by definition is a service that allows alternative operators to provide Internet and voice services for their users. The cost of providing the service fully unbundled access of the local loop is regulated by the Agency for Electronic Communications and the same we can assume that is the sum of the cost of providing its two constituent components, ie the sum of the cost of providing Internet segment plus the cost of providing the voice segment or Cost (Full LLU) = Cost (Internet) Cost (Voice).

If such separation is inserted in the methodology of the Agency for Electronic Communications the result is the following:

Price (Stand Alone BSA) = Cost (BSA) + Cost (Full LLU) = Cost (Internet) + (Cost (Internet) + Cost (Voice)) = 2*Cost (Internet) + Cost (Voice)

It follows that the price that alternative operators pay for the standalone bitstream access calculated in this way is unrealistic and is not based on the actual costs that has the SMP operator in providing the same.

If this line of reasoning is applied to the method of calculating the cost of service provision of the standalone bitstream access which we argue that this is correct then:

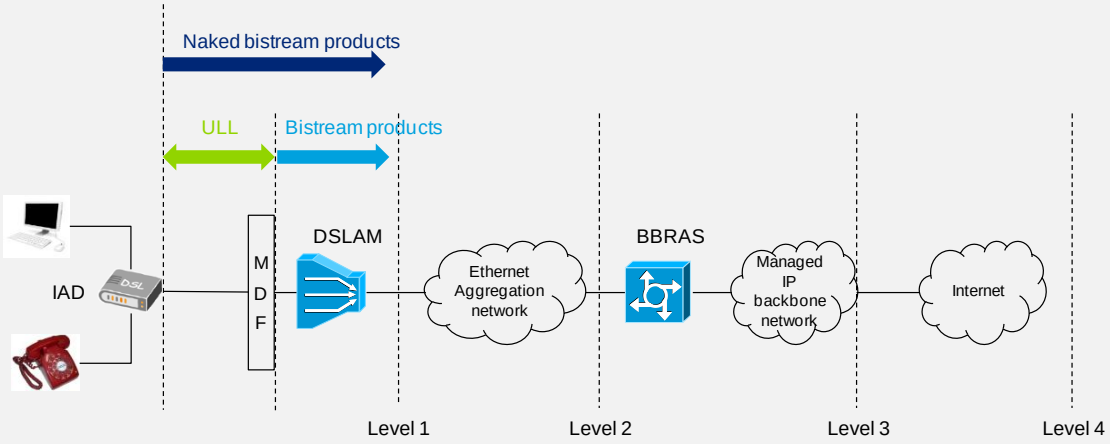
Price (Stand Alone BSA) = Cost (BSA) + (Cost (Full LLU) – Cost (Shared LLU)) = Cost (Internet) + ((Cost (Internet) + Cost (Voice) - Cost (Internet)) = Cost (Internet) + Cost (Voice)

The cost of providing the service standalone bitstream access obtained by this way corresponds and provides the cover of the actual costs that the SMP operator has in providing the same.

This calculation method was developed and applied by many regulators of the European countries.

ONE's reasoning for arguing that additional costs for standalone bitstream should equal to difference between ULL and SA costs is faulty. Cost of ULL reflects the cost of providing copper pair and not voice service. As a convention, cost is recovered trough PSTN subscription. Therefore, when this subscription does not exist, cost must be recovered through standalone bitstream service.

AEC response:
ONE's reasoning for arguing that additional costs for standalone bitstream should equal to difference between ULL and SA costs is faulty. Cost of ULL reflects the cost of providing copper access loop and not voice service. As a convention accepted by most European regulators, costs of providing copper access loop are recovered trough monthly subscription that is – due to historical reasons – in most cases the PSTN voice subscription. When no such subscription-based service is provided, costs of providing copper access loop have to be recovered through other services. In the naked Bitstream case, the minimum service provided is Internet access, and therefore, these costs have to be recovered through monthly fees for Internet access. This is presented in the picture below.



AEC note:
As a result of model adaptation – explained under point 3.33. – calculated cost estimates have changed compared to Draft version of this report. For further detail, please refer to comments under point 3.33.

3.19 VoIP service is modelled as an additional channel per user with guaranteed QoS in access, aggregation and core network. VoIP service will be modelled in the following manner:

- Terminal equipment will be provided by alternative operator (e.g. IP telephone, Softphone).

MKT comment:
Equipment must meet the technical requirements of the MKT. This should be taken into account in the reference offer for bitstream access.

AEC response:
Maktel argues that terminal equipment for VoIP services must conform to technical requirements of Maktel and that this should be taken into account in reference offer. AEC has no objections and therefore sees no need to address the comment further.

- Three bandwidth profiles are modelled (per bandwidth per user in backhaul - aggregation network and, on level 3 bitstream, core network):
  - 128kbps/128kbps (downlink/uplink)
  - 256kbps/256kbps (downlink/uplink)
  - 512kbps/512kbps (downlink/uplink)

- Bitstream access link for is modelled as a virtual link provided over the same physical bitstream access link used for best effort Internet service. VoIP bitstream access is modelled as a symmetrical link with capacity calculated as explained below. This capacity is an additional capacity to the capacity needed for Internet service.

Maktel comment:
This is a wrong conclusion, all capacities (speeds) are entering in the access speed of the table above, whereupon are performing prioritization of the VoIP traffic. If you have to provide 3 different profiles for the VoIP, the situation is even more complicated, because you will get more profiles and their management will be further complicated.
Our suggestion is to have only the one VoIP profile of the proposed 3 and be part of the reference offer.
In the case of Croatia, we have 7 access speed and two speeds for VoIP. That are total of 14 different user access profiles.

AEC response:
Maktel argues that bandwidth required for VoIP is part of the access profile. AEC's statement about the additional bandwidth however refers to the additional bandwidth capacity required in the backbone network.

Maktel states that there are too many access profiles and their management will be too complicated. However, during model development process the profiles listed above were agreed to be part of the model and therefore part of the modelling results. Profiles that will be present in the Referent Bitstream Offer (RBO) are to be agreed according to industry requirements when the new RBO is approved.

- Overbooking factor applied for backhaul bandwidth and VoIP Bitstream access link is 1:5. Thus, the capacity reserved for VoIP traffic in backhaul and over bitstream access link is calculated according to the following formula:

$$BW = (N_{128}*128kbps+N_{256}*256kbps+N_{512}*512kbps)/5$$

where N_{128},N_{256},N_{512} stands for the number of subscribers using VoIP services with 128kbps/128kbps, 256kbps/256kbps and 512kbps/512kbps profile, respectively.

Maktel comment:
This is already defined in 3.16, unjustifiably are set stricter criteria than for the PSTN services, although previously is stated that the SMP operator provides the same service parameters for alternative operators as for the own subscribers.
Also we demand to be described how is determined the ratio 1:5.

AEC response:
AEC has submitted several information requests to Maktel asking Maktel to describe the QoS parameters implemented in their network. Maktel has not provided any explicit information on QoS. To mitigate this issue AEC has extracted as much as possible implicit QoS information from other submitted data. The overbooking factor estimated in this manner is thus 5. In addition, current RBO version 2.2., paragraph 3.6.2., states that applied overbooking factor for VoIP is 5.

3.20 VoIP services are modelled for 2-nd and 3-rd level of bitstream.

Profile	Level 2	Level3 without BRAS	Level3 with BRAS
128/128 Kbps	**6,80 MKD**	**9,86 MKD**	**10,53 MKD**
256/256 Kbps	**13,61 MKD**	**19,71 MKD**	**21,06 MKD**
512/512 Kbps	**27,22 MKD**	**39,43 MKD**	**42,12 MKD**

AEC note:
As a result of model adaptation – explained under point 3.33. – calculated cost estimates have changed compared to Draft version of this report. For further detail, please refer to comments under point 3.33.

3.21 IPTV multicast services are modelled as an additional channel per user with guaranteed QoS in access, aggregation and core network. IPTV multicast service are modelled in the following manner:

- Terminal equipment will be provided by alternative operator (e.g. STB).
- Content and IPTV platform is provided by the alternative operator.
- Total bandwidth reserved in the backhaul network is calculated depending on the number of SD and HD channel the alternative operator wants to provide.
- Bandwidth capacity reserved per SD and HD channel is 2.7Mbps and 7Mbps, respectively.
- Bitstream access link for IPTV is modelled as a virtual link provided over the same physical bitstream access link used for best effort Internet service. Link capacity reserved for IPTV is

equal to the capacity reserved in backhaul for IPTV. This capacity is an additional capacity to the capacity needed for Internet service.

Maktel comment:
This is a wrong conclusion, all capacity are entering into the access speed of the table above, whereupon are performing prioritization of IPTV traffic.
Also, full bandwidth for the IPTV cannot be provided at any broadband connection.

AEC response:
Maktel argues that bandwidth required for IPTV traffic is part of the access profile. AEC's statement about the additional bandwidth however refers to the additional bandwidth capacity required in the backbone network.

Maktel argues that IPTV cannot be provided at any broadband connection. AEC agrees that there are technical limitations inherent to providing broadband in both access and backhaul network. Each copper pair can support only limited bandwidth and possibility of providing IPTV service over a particular copper pair has to be verified in practice on a case-by-case basis. Purpose of the model developed is not to provide insight into technical limitations but to estimate costs when service can be provided.

3.22 IPTV multicast services are modelled for the 2-nd and 3-rd level.

3.23 IPTV multicast SD channels are calculated per user in increment of 10 and HD channels in increment of 5 channels. Table below presents the results of the model.

Package	Level 2	Level3 without BRAS	Level3 with BRAS
10xSD	**17,47 MKD**	**25,28 MKD**	**25,49 MKD**
5xHD	**22,64 MKD**	**32,77 MKD**	**33,04 MKD**

Maktel comment:
We demand to be presented model of the calculations, a comment that is repeated many times, especially on how it is defined this cost (10 SD channels), which are the costs that can be allocated on the channels? Also, there is an unicast traffic and as such should be modeled.
We believe that a more appropriate definition of the fee would be per user, not by the number of channels. Additionally in our costs analysis we have different results for fees.
Because the traffic for VoD is impossible to measure by MKT, we propose to take into account that 10% of the users of the wholesale partner will generate VoD traffic, and consequently the prices for VoD service per MB of the item 3.27 to be deleted.

AEC response:
Maktel questions the possibility to allocate costs to channels. As with any other service using the backhaul network, multicast IPTV consumes part of the bandwidth of the network and therefore part of the cost is allocated to multicast IPTV services.

Maktel argues that unicast traffic, in the context of IPTV, should be modelled as well. Unicast IPTV service is modelled as VoD services and separately from multicast IPTV.

Maktel proposes to delete prices for VoD services arguing that VoD traffic cannot be measured and that VoD traffic should be priced per user. AEC addresses this comment is further in this document.

AEC note:
As a result of model adaptation – explained under point 3.33. – calculated cost estimates have changed compared to Draft version of this report. For further detail, please refer to comments under point 3.33.

3.24 Video on Demand (VoD) service is modelled as an additional channel per user and per channel with guaranteed QoS in access, aggregation and core network. VoD service is modelled in the following manner:

- Terminal equipment is assumed to be provided by alternative operator (e.g. STB).
- Content and VoD platform is provided by the alternative operator.
- Total bandwidth reserved in the backhaul network is calculated depending on the number of users and number of SD and HD channels the alternative operator wants to provide.
- Bandwidth reserved per SD and HD channel is the capacity required transfer of the TV channels with same quality as SMP provides to its own subscribers (2.7Mbps for SD, 7Mbps for HD).
- Bitstream access link for VoD is modelled as a virtual link provided over the same physical bitstream access link used for best effort Internet service. Link capacity reserved for VoD will be equal to the capacity reserved in backhaul for VoD. This capacity is an additional capacity to the capacity needed for Internet service.

Maktel comment:
This is a wrong conclusion, all facilities included in the access speed of the table above, whereupon are performing traffic prioritization VoD.

AEC response:
Maktel argues that bandwidth required for VoD is part of the access profile. AEC's statement about the additional bandwidth however refers to the additional bandwidth capacity required in the backbone network.

3.25 Overbooking factor applied for VoD service is 1:10. In that respect, required capacity of bitstream access link is calculated using the formula below:

$$BW = (N_{HD}*7Mbps + N_{SD}*2,7Mbps)/10$$

where N_{HD} and N_{SD} stand for the number of VoD users with HD and SD channels, respectively.

Maktel comment:
This is already defined in 3.16, unjustifiably are set stricter criteria than for the PSTN, although previously is stated that the SMP operator provides the same service parameters for alternative operators as for the own subscribers.

AEC response:
AEC has submitted several information requests to Maktel requesting Maktel to describe the QoS parameters implemented in their network. Maktel has not provided any data explicit information on QoS. To mitigate this issue AEC has extracted as much as possible implicit QoS information from other submitted data. The overbooking factor is estimated based on this data, experiences in the region (e.g. Croatia, Slovenia), QoS expectation for VoIP as a prioritized traffic and expectations of traffic growth.

3.26 VoD services are modelled for the 2-nd and 3-rd level.

3.27 VoD services are assumed to be charged per MB of usage. Results of modelling are presented in the following table.

	Level 2	Level3 without BRAS	Level3 with BRAS
Per MB	**0,0007 MKD**	**0,0012 MKD**	**0,0012 MKD**

Maktel comment:
We would like to know exactly how the cost is calculated for VoD services per MB? We consider that technically this is not possible, because it is impossible to measure this traffic. We require a description of how to perform this measurement procedure.

AEC response:
For the modelling purposes, AEC has assumed that VoD traffic can either be on a separate VLAN or identified via separate source IP address and therefore that it can be measured via NetFlow capability of Cisco routers. If Maktel is unable to implement these solutions then alternative pricing model may be agreed upon during new RBO approval process.
Price per MB is calculated according to the capacity needed to transfer the total VoD traffic volume.

AEC note:

As a result of model adaptation – explained under point 3.33. – calculated cost estimates have changed compared to Draft version of this report. For further detail, please refer to comments under point 3.33.

3.28 VoIP, IPTV and VoD services are modelled as add-on services to best effort Internet service. In this respect, additional channels for VoIP, IPTV and VoD services do not use additional physical network elements but only additional bandwidth with QoS guarantees.

Maktel comment:
What are the technical limitations for additional bandwidth? To be given a description which refers to the additional bandwidth?

AEC response:
Technical limitations for additional bandwidth have to be the same as assured for Maktel's users.

3.29 It should also be noted from previous points that the same physical bitstream access link will be used for all services (best effort internet services, VoIP, IPTV and VoD). This means that no additional charges are required for VoIP, IPTV and VoD Bitstream access link.

Maktel comment:
To be explained how to measure this traffic. The question is whether it is possible to measure the traffic or to be determined the cost of VoD on traffic level. When doing this, please specify whether there is such experience in other countries?

AEC response:
For the modelling purposes, AEC has assumed that VoD traffic can either be on a separate VLAN or identified via separate source IP address and therefore that it can be measured via NetFlow capability of Cisco routers. If Maktel is unable to implement these solutions then alternative pricing model may be agreed upon during new RBO approval process.

3.30 Bitstream access link for alternative operator is priced according to link speed and link length.

Maktel comment:
MKT requires transparency and insight of the model, need to know which expenses are entered in the calculation of bitstream access link, especially whether are taken into account the cost of increased capacity or the equipment that provides this link.

AEC response:
AEC has presented Maktel with the model and Maktel has had the opportunity to comment on the model.

3.31 Link speeds modelled are the following:

- 1Gbps
- 10Gbps

Maktel comment:
The providing of the 10Gbps is not technically possible to be provided through the entire bandwidth of the broadband network.
AEC response:
This section describes the access link and not the backhaul capacity which is priced differently and described in previous sections.

3.32 Link distances modelled are the following:

- Up to 60m – in the building link
- From 60m up to 2km
- From 2km up to 10km in increments of 1km
- From 10km to 150km in increments of 10km

3.33 Tables below present the results of modelling for bitstream access links for various speeds and distances and levels of access. The prices are for the length of the physical circuit.

	L2 - 1Gb	L2 - 10Gb	L3 - 1Gb	L3 - 10Gb
In building - up to 60m	3.801,55 MKD	33.805,57 MKD	4.409,57 MKD	40.228,51 MKD
Up to 2km	7.843,55 MKD	37.847,58 MKD	8.451,57 MKD	44.270,52 MKD
Up to 3km	9.864,55 MKD	39.868,58 MKD	10.472,57 MKD	46.291,52 MKD
Up to 4km	11.885,56 MKD	41.889,58 MKD	12.493,58 MKD	48.312,52 MKD
Up to 5km	13.906,56 MKD	43.910,58 MKD	14.514,58 MKD	50.333,52 MKD
Up to 6km	15.927,56 MKD	45.931,59 MKD	16.535,58 MKD	52.354,53 MKD
Up to 7km	17.948,56 MKD	47.952,59 MKD	18.556,58 MKD	54.375,53 MKD
Up to 8km	19.969,56 MKD	49.973,59 MKD	20.577,59 MKD	56.396,53 MKD
Up to 9km	21.990,57 MKD	51.994,59 MKD	22.598,59 MKD	58.417,53 MKD
Up to 10km	24.011,57 MKD	54.015,60 MKD	24.619,59 MKD	60.438,54 MKD
Up to 20km	44.221,59 MKD	74.225,62 MKD	44.829,61 MKD	80.648,56 MKD
Up to 30km	64.431,61 MKD	94.435,64 MKD	65.039,63 MKD	100.858,58 MKD
Up to 40km	84.641,63 MKD	114.645,66 MKD	85.249,66 MKD	121.068,60 MKD
Up to 50km	112.454,75 MKD	144.863,19 MKD	114.278,81 MKD	153.552,64 MKD
Up to 60km	132.664,77 MKD	165.073,21 MKD	134.488,84 MKD	173.762,67 MKD
Up to 70km	152.874,79 MKD	185.283,23 MKD	154.698,86 MKD	193.972,69 MKD
Up to 80km	173.084,82 MKD	205.493,25 MKD	174.908,88 MKD	214.182,71 MKD
Up to 90km	200.897,93 MKD	225.703,27 MKD	203.938,04 MKD	234.392,73 MKD
Up to 100km	221.107,95 MKD	245.913,30 MKD	224.148,06 MKD	254.602,75 MKD
Up to 110km	241.317,98 MKD	266.123,32 MKD	244.358,08 MKD	274.812,78 MKD
Up to 120km	261.528,00 MKD	286.333,34 MKD	264.568,10 MKD	295.022,80 MKD
Up to 130km	289.341,11 MKD	306.543,36 MKD	293.597,26 MKD	315.232,82 MKD
Up to 140km	309.551,13 MKD	326.753,39 MKD	313.807,28 MKD	335.442,84 MKD
Up to 150km	329.761,16 MKD	346.963,41 MKD	334.017,31 MKD	355.652,86 MKD

Maktel comment:
The offer of the bitstream access link is too complex and we believe that most of it would not be used. We demand the transparency of the model, the details of how it is calculated the cost of this link, because prices are too low, especially for 1Gbps for smaller distances (up to 5km).
We propose to reduce the combinations of bitstream access links in a way that will be offered only link in the collocation and another extended link for a primary zone.
Level 2 does not require extended links, MKT has a presence of over 30 locations, already presented in the reference offer for bitstream services.
It is not clear how it is possible 1Gbps prices to be more than 10 times smaller than the cost of 10Gbps. According to the experience of MKT of these kind of calculations, the prices between 1Gbps and 10Gbps should not vary more than 3 to 4 times.
How prices for L2 10 Gbit /s are more expensive than the prices for L3 10 Gbit /s?

AEC response:
AEC believes that flexibility in access link is required to enable effective competition in Macedonia. Access links that will be present in the Referent Bitstream Offer (RBO) are to be agreed according to industry requirements when the new RBO is approved.

AEC recognizes the validity of Maktel's comment that prices are somewhat distorted resulting from varying utilizations at different bistream levels and port capacities. In that respect, AEC has adapted the model to minimize the impacts of this effect in a manner that ensures consistent utilizations across bitstream levels and port capacities – utilization employed are now based on Maktel's network actual utilizations adjusted for inefficiency. Result of this model adaptation is an update in cost estimates with updated estimates presented in table above.

3.34 As noted before, none of the charges above include CPE equipment. However, as requested by interested parties, Home Gateway (HGW) device monthly rental charges were modelled as an addition to the above services.

3.35 Calculated monthly rental charge for HGW device, including operation, maintenance and fault repairs is presented in the table below.

HGW	**108,36 MKD**

Maktel comment:
We propose this monthly cost to be deleted of this draft document, as well as the opportunity to lease customer premises equipment with maintenance and repair work.
This should be the goal of the commercial offer and each operator to provide customer premises equipment for its customers.

AEC response:
View of AEC is that HGW renting will provide additional flexibility and support development of competition.

AEC note:
As a result of model adaptation – explained under point 3.33. – calculated cost estimates have changed compared to Draft version of this report. For further detail, please refer to comments under point 3.33.

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