INSTITUT LUXEMBOURGEOIS DE RÉGULATION

Projet de l'élaboration d'un modèle de coûts fixe NGA-NGN

Réponse aux contributions soumises à la demande d'avis menée du 31 octobre 2013 au 3 janvier 2014

Version publique

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Response to stakeholder comments

This note sets out the ILR's response to the comments provided by stakeholders in response to the call for inputs on the specification, methodology, input data and intermediate calculations of the ILR's bottom-up LRIC model in December 2013.

The tables below address the questions and comments provided by stakeholders.

This response is split into two sections:

(1) Comments on the model specification; and

(2) Comments on the model input data and intermediate calculations.

Comments on the model specification

Section		Stakeholder comment	ILR response
1	Lack of transparency	Stakeholders noted that they did not have access to the model itself as part of the consultation.	Given the large amount of detail contained within the model, the documentation provided in the call for inputs focussed on the most material areas for stakeholders to comment on. The ILR considers that the model specification and model methodology documents, provided as part of the public call for inputs contain sufficient transparency for stakeholders to be able to assess the methodology used and the main assumptions in the model. The "Input data and intermediate calculations" document contained information on the input data and assumptions used. It also provided stakeholders with the results of the sensitivity analysis to enable them to see the impact of changing key parameters (within reasonable bounds) on the model results.
		This makes it difficult to understand the model, the approach used and the results.	
		Stakeholders noted that they cannot provide views on some aspects of the model without the necessary transparency or having access to the model itself.	The model itself and the model results were not covered by this call for inputs. As noted in the stakeholder meeting on 9 October 2013, stakeholders will be granted access to the model on the ILR's premises as part of a separate consultation on the price setting for wholesale rates.

Section		Stakeholder comment	ILR response
2.1	Comparison with the model developed by a stakeholder in Luxembourg	One stakeholder stated that it would expect the outputs of its own model to be similar to the ones from the ILR's BU LRIC model.	There are a number of reasons why the results of the ILR's BU LRIC model and of the model developed by a stakeholder would not be expected to fully reconcile with each other. Additionally, the ILR's BU-LRIC model is of an efficient network operator in Luxembourg rather than of a stakeholder's current network. Furthermore, it seems that the approach followed by this stakeholder is not really in compliance with EC recommendation. Reference to EC Recommendation: Commission Recommendation of 7 May 2009 on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU, (2009/396/EC); available online http://eur-lex.europa.eu/
		Any inconsistencies in the results between a stakeholder model and the ILR model should be analysed.	Given the differences between the two methodologies, we do not intend to carry out a full reconciliation of the model results.
	Coverage assumption	One stakeholder commented that FTTH coverage of 60% (in 2017) of both P2P and GPON is not in line with the forward looking principle.	There is functionality within the model to consider a number of alternative scenarios in relation to coverage. We note that the actual coverage used in the cost calculations in specific regulatory decisions will be driven by policy issues and are therefore not covered in this call for inputs.

Section		Stakeholder comment	ILR response
		The coverage assumptions do not take account of the costs of an operator with a national footprint.	
		One operator noted that the model documentation does not describe how FTTH coverage has been modelled.	The rollout assumptions for superfast broadband lines are as set out in section 2.1 of the "Input data and intermediate calculations" document. Under the base case, the model assumes 25% GPON coverage (based on current levels) and this does not change over the period modelled. P2P coverage is modelled to start at 40% and to increase by 5 percentage points in each year modelled. As described above, the model contains the flexibility to consider other coverage and rollout scenarios.
		One operator commented that the model should not consider LLU copper and GPON in the access network but rather only a P2P fibre network.	The rollout assumptions for superfast broadband lines are as set out in section 2.1 of the "Input data and intermediate calculations" document. The model considers the current rollout of different access network technologies. It also contains the flexibility to cover other coverage and rollout scenarios. It will be a policy decision to determine what the relevant scenario would be in order to assess the prices of different regulated access products. Therefore this decision did not form part of this call for inputs.
		One operator commented that only the existing FTTC nodes do not allow full	We note that the 100% FTTC coverage is included as a sensitivity analysis and not as part of the base case assumption. Further, as described above, it will be a policy decision to determine what the relevant scenario would be in order to assess the prices of different regulated access products. Therefore,

Section		Stakeholder comment	ILR response
		coverage of the country with 30 Mbit/s copper.	this decision did not form part of this call for inputs. The ILR further notes that while making the comment about the level of existing nodes not being appropriate for the 100% FTTC network, the operator does not specify the number of nodes it would consider appropriate.
2.2	Scorched node approach	One operator requested clarification on whether the locations of lower level nodes (DPs in the copper network) in the model are the same as actual lower level nodes in his network.	The model follows the scorched node approach on the location of lower level nodes. The model uses the locations of the existing POP VDSL sites provided by the operator as the location of the distribution points in the copper network.
		The model has the option to vary the number of nodes. It seems that this is not in line with best practice as such an option is usually not implemented in BU LRAIC models.	The model follows the scorched node approach; however, the model has the functionality to model a different number of nodes. This does not feed into the model base case and is used only for sensitivity analysis.
		Where are new nodes located?	The sensitivity analysis considers the locations of the current MDF sites (scorched node approach).
		Is the MS Access calculation run again?	Yes, the model calculations are re-run for the sensitivity analysis. This is because the location of the POP sites is a main input into the model and has an impact on the results.

Section		Stakeholder comment	ILR response
		How are new nodes connected to existing nodes?	The model calculations are re-run and therefore the POPs are connected through the least cost routing algorithm described under Section 5.4.5 in the model specification and under Section 4.4 in the model methodology.
2.3	Network topology	A stakeholder commented that VDSL remote access nodes are not connected to OLTs.	The equipment used in the model for fibre access services is also able to provide aggregation. The type of equipment also ensures that this aggregation is done more cost effective compared to connecting VDSL nodes to the first aggregation layer. The ILR also notes that there is relatively limited impact on service costs if remote notes were connected to the first aggregation layer.
		The model should only be of P2P FTTH in order to be compliant with the EC recommendation.	The content of this comment is addressed above (see Coverage Assumptions, Section 2.1)
2.4	Core Network topology	The ILR was asked whether core sites are linked to a single core site or fully meshed.	The logical routes of the core sites are fully meshed. The model has also been updated to ensure no single point of failure between any two nodes (core sites are connected in a ring topology). This is described in section 5.5 in the specification and section 4.6 in the methodology.
		The core sites should be connected using a ring or fully meshed topology rather than a spanning tree.	

Section		Stakeholder comment	ILR response
		Resilience links should avoid SPOFs (single point of failures) - i.e. two resilience links should not cross anywhere.	
2.5	Access network dimensioning		
2.5.1			
		It was pointed out that road segments with no buildings should not be disregarded as this could lead to buildings being isolated from the rest of the network.	The model takes account of road segments even where there are no buildings. These road sections are examined to see whether they form part of the least cost route. However, road sections with no buildings are not required to be connected to the network and are therefore excluded from the network if they are not passed by the least cost route.
		It was argued that term "shortest routes" rather than "least cost routes" should be used to describe the routing algorithm as the most efficient route is not necessarily the shortest one.	Noted. Section 5.2 of the model specification has been updated to point out that the applied algorithm provides an approximation of "least cost routes".

Section		Stakeholder comment	ILR response
2.5.2.	Assets	The costs below should be accounted for in the model.	
		Network termination units (NTUs)	The model does not include the cost of the final drop because it is assumed to be covered as a connection charge to end customers (which is included in the stakeholder public price list). Additionally, in new housing developments, developers pay for their own final drop.
		Cable joints	The content of this comment is addressed below (see Section 2.5.3.2)
		Manholes/chambers	The content of this comment is addressed below (see Section 7.2.5)
		Final drop costs	The content of this comment is addressed above (see Network termination units, Section 2.5.2)
		Splicing/testing/planning costs	The content of this comment is addressed below (see Section 7.2.6)
2.5.3	Dimensioning rules		
2.5.3.1	Distribution points	A stakeholder commented that the FTTH P2P network should be modelled without a DP as the fibre goes directly from the customer premises to the POP.	In the FTTH network the location of the DPs are modelled to be the location of the splicing chambers (flexibility points). A comment has been added to the model specification (Section 5.4.1) to clarify this.

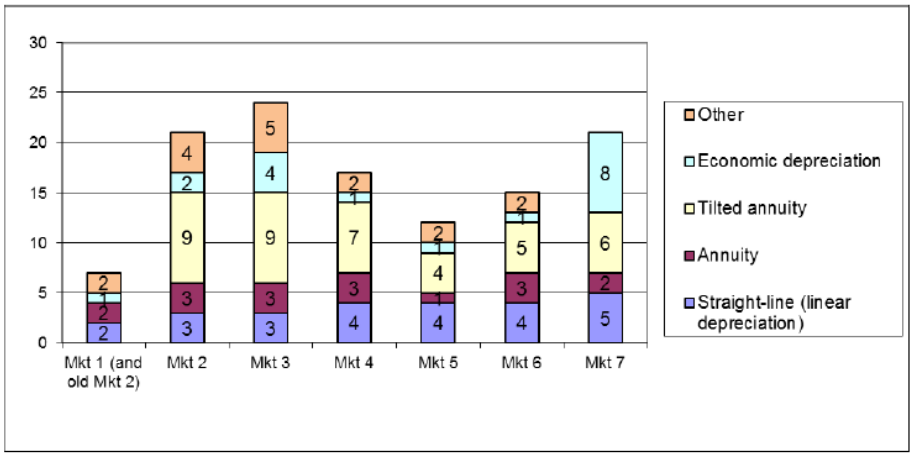
Section		Stakeholder comment	ILR response
		From each POP there will be 2 fibres per customer.	The model takes this into account. As described in section 3.1 in the input data document, the model assumes 2 fibres per customer in the D-side network.
		From the curb, 4 fibres will enter the customer's premises.	This relates to cost of the final drop which is not part of the model (as described above).
		An operator asked for a specification of the exact definition of DPs for each technology (FTTH P2P, GPON, FTTC and copper).	The model uses 1,258 FTTC sites. This provides a pragmatic approach and follows the scorched node approach. This is because it is typically easier and more efficient to re-use existing sites rather than adding new ones. The location of the DPs is therefore the same for all technologies.
		Are DPs splicing chambers in the case of FTTH?	The ILR confirms that in the FTTH network DPs would be the location of the splicing chambers (flexibility points).
		Are DP locations the same for the different scenarios?	The location of the DPs is the same for all technologies.
2.5.3.2	Cables	The ILR should ensure that the following rules are considered within the model:	
		1 joint per chamber	This is taken into account in the model.
		Maximum 144 fibres per joint (Flat Fist)	There is some simplification in the model so this is not explicitly modelled but implied in the quantities derived as a result of the network dimensioning.

Section		Stakeholder comment	ILR response
		Max 32 Micro- cable per joint (Flat Fist)	There is some simplification in the model so this is not explicitly modelled but implied in the quantities derived as a result of the network dimensioning.
		Max 32 customers per splicing chamber (average 20 customers per splicing chamber)	There is some simplification in the model so this is not explicitly modelled but implied in the quantities derived as a result of the network dimensioning.
		Number of fibres per duct is limited (security)	The model takes account of overcrowding in ducts and trenches. This is described in Section 4.7 of the model methodology.
		Number of fibres per trench is limited (security)	
		Have the differences between P2P and GPON topologies engineering rules been considered?	The ILR confirms that: - micro fibre cables are modelled in micro ducts and ducts. - The model uses micro fibres for GPON.
		The way copper pairs have been modelled should be specified: • One joint to connect final drop cables for 2 buildings? • One joint to connect the final drop cable for each building?	As described in Section 2.5.2 above, the model does not take into account joints for final drops to buildings, these costs are assumed to be covered as part of a customer or premise connection cost.
2.5.3.3	Duct / Trenches		

Section		Stakeholder comment	ILR response
		An operator pointed out that it is unclear if the model accounts for the trench connecting trenches on two sides of the road.	The model has been updated to include additional trench at road intersections, based on data provided by stakeholders,
		An operator pointed out that it is unclear if the model accounts for the trench connecting two street segments (i.e. at cross-roads).	
		Both of these types of links use more expensive trenches to resist the car traffic.	
		Even if buildings are only rolled out on one side, trench must sometimes be deployed for security reasons: Number of fibres per duct is limited Number of fibres per trench is limited A stakeholder deploys always at least one spare duct	
2.5.3.4	FTTO	The FTTO network should be modelled.	No evidence has been provided of how FTTO would be different from FTTH. The ILR understands that the difference between FTTO and FTTH is driven by demand factors (i.e. business subscribers value the fibre access more than residential subscribers) rather than underlying cost differences.

Section		Stakeholder comment	ILR response
			Therefore, we would not expect there to be a significant difference in terms of the network that would be modelled on a BU-LRIC basis.
2.5.3.5	Busy hour	The ILR should specify its busy hour calculation assumptions in more detail.	The model aggregates voice busy hour demand and the average busy hour requirement for broadband and other data services. There is currently no adjustment between service and network busy hour. However, the model contains the functionality to take account of such an adjustment.
		It is unclear how the traditional leased lines demand is accounted for in the model.	The ILR clarifies that all leased line capacities are modelled as modern equivalent taking account of the full busy hour capacity on the next generation network.
2.6	Costing		
2.6.1.1	Working capital	A comment was addressed on the working capital, so that the time to build should be taken into account (one year).	Working capital refers to the capital used by a business in its day to day trading operations. In the context of capital expenditure, it relates to costs incurred in purchasing and installing assets before those assets start to generate revenue. This is taken account in the model since the model dimensions the network based on the end of year requirements. Therefore, the tilted annuity formula implicitly takes account of a 6 month delay.

Section		Stakeholder comment	ILR response
		The tilted annuity formula should be adjusted for FTTH to reflect that demand is growing so that the cost recovery better reflects economic depreciation.	The tilted annuity formula is a well-understood and widely adopted approach to calculating depreciation charges. In principle, the adjustment proposed allows for closer approximation of true economic depreciation since it allows for the consideration of changing demand. However, in practice, such an approach would require detailed forecasts of demand over the full lifetime of the assets modelled. In some cases (e.g. duct) such asset lifetimes are very long - 40 years. It is therefore difficult in practice to estimate an adjustment for changing demand in a robust way. Moreover, the tilted annuity method is a best practice in other European jurisdictions (cf. Figure 3 of the BEREC Report on Regulatory Accounting in Practice 2013).

Section		Stakeholder comment	ILR response
			Figure 3 – Annualization methodologies used in 2013 in the markets listed in Recommendation 2007/879/EC when CCA is the cost base  *Source: BEREC RA database 2013*
2.6.2	Opex calculations		

Section		Stakeholder comment	ILR response
		A stakeholder commented that operating costs should be estimated using task times (i.e. on a bottom-up basis) or using an existing operator's actual costs (i.e. using a top-down approach).	Many bottom-up models estimate operating costs on the basis of operating cost to capital cost mark-ups. As described in the model specification (Section 7.1.3), using task times to estimate operating costs is a very resource intensive process since it requires a large amount of detailed information in order to identify the necessary tasks, the time required to complete them, and the hourly costs of labour. There are also other operating costs that are not related to individual tasks or labour costs (e.g. the materials required). In any case, typically top-down cost information would be used to cross-check and calibrate any estimates. Therefore, the result may be relatively close to the top-down estimate. The ILR also notes that, where available, the ILR took account of stakeholders' actual costs in order to cross-check the assumptions made.
		The ILR was invited to ensure that the model should take account of the higher wage costs in Luxembourg.	The access network operating costs were based on international benchmark data and consisted primarily of labour costs. The benchmark data was therefore adjusted to take account of differences in labour costs between different jurisdictions.
			The core operating costs were based on data provided to the ILR by stakeholders on their own costs.
2.6.3	Wholesale specific costs		

Section		Stakeholder comment	ILR response
		Wholesale specific costs should be included in the pure LRIC estimates of the model.	Wholesale specific costs include additional wholesale commercial costs directly related to the provision of the wholesale termination service to third parties. This definition is consistent with the EC recommendation. The consultation documents describe how “wholesale specific costs that were recovered by termination under the LRIC approach are re-allocated to on-net calls and call origination based on the volumes of those services.” This has now been changed in the model so that “wholesale specific costs” that are incremental to call termination are received from call termination under the pure LRIC approach. This revised approach is consistent with the EC Recommendation. Wholesale specific costs are calculated as a mark-up over other previously allocated costs based on network LRIC (excluding common costs). The ILR notes that this may overstate the true incremental (direct) wholesale specific costs of termination since the mark-up would contain some costs that are fixed and common between different wholesale products. However, it is not possible to split these out because sufficiently granular accounting data is not available to do so. Reference to EC Recommendation: Commission Recommendation of 7 May 2009 on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU, (2009/396/EC);

Section		Stakeholder comment	ILR response
			available online http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:124:0067:0074:EN:PDF
		It was stated that these costs could represent about 20% of fixed termination costs (based on benchmarks from Austria and EC decision). However, this may be higher in Luxembourg because of lower termination traffic (lower economies of scale) and high wage costs.	Wholesale specific costs are calculated as a mark-up over other previously allocated costs based on network LRIC (excluding common costs). This may overstate the true incremental (direct) wholesale specific costs of termination since the mark-up would contain some costs that are fixed and common between different wholesale products. However, it is not possible to split these out because sufficiently granular accounting data is not available to do so.

Section		Stakeholder comment	ILR response
2.6.4.	Re-allocation of common costs to origination	The ILR should seek stakeholder views on how common costs that would have been recovered from wholesale termination under a LRAIC approach should be recovered when termination rates are set at pure LRIC. Some examples of approaches adopted elsewhere in Europe where provided. These include allowing operators to recover these costs from retail services, from call origination, from wholesale line rental and from all other services.	The purpose of the October 2013 consultation was to seek stakeholder views and input into the specification, methodology and input data used in the development of a BU-LRIC model. Stakeholder Question 7 from this document invites stakeholders to indicate whether they agree with the described approach, and if not, the rationale for adopting an alternative approach. However, no stakeholder has stated whether it agrees or disagrees with the described approach, and what would be the most appropriate approach. Section 7.2.3 of the specification document describes how these costs are re-allocated to call origination and on-net calls based on the volume of these calls. In determining this approach, the ILR considered a range of different options including on-net calls, origination and other services. Recovering these costs from both on-net calls and call origination has the advantage that it results in the cost of an on-net call is related to the price an entrant would face to buy wholesale call origination and call termination. This means that it does not distort competition in the way that recovering these costs from either on-net call or origination only would. Such an approach is objective as it does not unduly favour one service over another. It is transparent since there are clear cost allocation keys (usage factors and volumes). It also provides results that are stable over time since the allocation keys are not overly sensitive to small variations in assumptions. Moreover, the ILR invites the stakeholders to refer to the European Commission's statement made to the regulation of markets 2/2007 and

Section		Stakeholder comment	ILR response
			3/2007: http://www.ilr.public.lu/communications_electroniques/avis_consultations/R__sultat_7_2007/Avis_de_la_Commission_europ__enne_M2_3_7.pdf.
2.7	Quality assurance		
		A number of cross-checks that should be carried out was listed:	The "Inputs and intermediate calculations" document contains the details of the data that was used to cross-check the intermediate model results (e.g. trench length, length of copper cable).

Section		Stakeholder comment	ILR response
		- Outputs of access network dimensioning with road section demand	The call for inputs requested evidence from stakeholders to support the comments, observations and requests that they make. However, no information on this issue has been provided. Further, this is a model of an efficient network and not of a current network specifically so we would not expect the numbers to reconcile.
		- Asset count with stakeholders' data (km of trenches, km of cables, number of joints).	The model is of an efficient network operator in Luxembourg. Therefore, we would not expect a full reconciliation of the assets modelled and those currently in other stakeholders' networks.
		- Costing results with stakeholders' accounts	As described above, we would not expect a full reconciliation of costs. In order to determine whether all material cost categories have been included, the consultation document provided details of the main cost categories (those that account for more than 90% of annualised capital costs). The revised documentation now includes a full list of the assets considered in the model.
		- Comparison with benchmark data	As part of the model development, input data was either based on benchmark data or cross-checked with benchmark data. Cross-checks of intermediate and final results were also considered where available. However, we note that the operating conditions in Luxembourg are different to those in other countries. Therefore, we would not expect the overall results of models from other jurisdictions to be directly comparable with the results from the BU-LRIC model. Therefore, comparison with benchmark data will provide a relatively limited picture of the robustness of the model itself.

Comments on the input data and intermediate calculations

Section		Stakeholder comment	ILR response
5.1	Fibre coverage	Further information have been required on how fibre coverage has been modelled. In particular:	The coverage increase is modelled on an aggregate level rather than on individual addresses. The passive network module models fibre roll-out across the network. The allocation is based on the sum of households and businesses in each node area. For example, if one DP has 5% of all households and businesses in Luxembourg, then 5% of all FTTC subscribers are allocated to that particular DP. The assumptions on the roll-out of fibre coverage are described in Section 2.1 of the Input data and intermediate calculations document. Further detail has been added to the documentation.
		- which addresses are passed by the fibre network	
		- Which ones with a GPON connection and which ones with a P2P connection?	
		- How does the model select which new addresses are passed by the fibre network as the coverage increases?	
		- How is this taken into account in the model? What algorithms are used?	

Section		Stakeholder comment	ILR response
		The model should include national copper coverage. Fibre coverage should be national and in line with the "ultra haut debit" strategy of the Luxembourg government. A sensitivity analysis should be provided.	The content of this comment is addressed above (see Coverage Assumptions, Section 2.1)
5.2	Broadband subscribers	The growth over the modelled period would be different over the next four years. This compares to the 32% forecast increased included in the model.	Comparison with more recent international benchmark data appears to support lower growth in the number of broadband lines than was previously forecast. This would also be consistent with the relatively high current penetration of broadband lines in Luxembourg. We therefore propose to revise the forecast for the growth in subscribers to be in line with operators' assumptions.

Section		Stakeholder comment	ILR response
5.3	Corporate subscribers	It was required the ILR should publish engineering rules for leased lines.	Legacy leased lines are modelled as modern equivalents and traverse the access and core network twice. The access dimensioning is outlined in the Model results and input data documentation (Section 2.3.4).
6.1	Voice traffic	Is the conversion from yearly traffic to Erlangs missing?	The ILR notes that limited information was provided to substantiate the claims.
		The network dimensioning is planned in order to support not only current demand but also future demand. The network is typically planned to support the growth over 2 or 3 years.	While the ILR accepts that network dimensioning may in practice involve longer planning periods, the model calculates the increase in equipment required if and growth in demand occurs. In addition, the ILR confirms that in the case of declining volumes, the maximum required equipment over the period is modelled even though lower demand in later years would result in lower equipment requirements.
		The yearly traffic shown in table 10 is the commercial traffic, i.e. the traffic billed to the customers. But the commercial traffic is not the traffic supported by the network which is the technical traffic.	The ILR considers the billed traffic as the relevant input to the model for two main reasons. First, the ILR considers that a general uplift of the billed traffic is inappropriate due to different capacity requirements. In particular, the payload of call setup and tear down should be significantly smaller compared with the capacity required during a call. And second, while there are some reasons that technical traffic may be higher than billed traffic, there are also factors which may lead to the opposite. In particular, depending on the way in which billed minutes are counted, the network minutes may actually be lower than billed minutes. Nevertheless, the ILR notes that the input data may be revised in the event of the model being used for the purpose of setting regulated rates.

Section		Stakeholder comment	ILR response
		These parameters only dimension the demand handled by the traffic. Other parameters are involved when dimensioning the network especially the utilisation rate, the churn, the spare capacities, the spare elements. These should be taken into account in the model.	The ILR notes that no particular reference was made to parameters used in the model or specific equipment to which these parameters should be applied. In light of this, no changes are made to the model.
6.2	Broadband bandwidth per subscriber	A stakeholder considers that the growth in broadband bandwidth per line has been overestimated.	Stakeholders did not provide a forecast for the growth in the broadband bandwidth per line in their response to the data request. Nor did they provide an alternative forecasts in their response to this call for inputs. Given this, the growth in average usage is based on international benchmark data. The forecast levels of growth are consistent with the rollout of fibre networks. That is a rational operator would not rollout a higher capacity network unless it demand to grow.
6.3	VoD and IPTV traffic	The calculation of VoD and IPTV traffic should be documented.	The model does currently not consider IPTV and VoD traffic. However, the model includes the functionality to have that traffic included in the model.

<table>
<tr><th>Section</th><th></th><th>Stakeholder comment</th><th>ILR response</th></tr>
<tr><td>6.4</td><td>Leased lines traffic</td><td>An operator commented that the assumptions on leased lines traffic should be justified and described in more detail.</td><td>The leased line traffic is calculated by multiplying the forecast number of lines by the forecast traffic per line.
The forecast traffic per line is based on stakeholders data provided in response to the ILR's data request. This includes actual data from 2011 and forecasts from 2012 onwards for total traffic and total lines. This is for different types of lines which are then categorised in the model into low speed traditional, high speed traditional and gigabit Ethernet. No adjustments were applied to the data provided.
However, we note that there was a slight error in our calculations. The table below reflects the revised estimate of bandwidth per line. The forecast for 2017 is based on growth in previous years.
Bandwidth per line (bhkbps) BASE CASE
<table>
<tr><th></th><th>2013</th><th>2014</th><th>2015</th><th>2016</th></tr>
<tr><td>Low speed traditional (< 2Mbit/s)</td><td>94</td><td>93</td><td>91</td><td>91</td></tr>
<tr><td>High speed traditional (>= 2 Mbit/s)</td><td>9,259</td><td>9,259</td><td>9,259</td><td>9,259</td></tr>
<tr><td>Gigabit Ethernet</td><td>2,981</td><td>2,981</td><td>2,981</td><td>2,981</td></tr>
</table>
</td></tr>
<tr><td>7.1.1</td><td>Road network data</td><td>Could the ILR provide the source of the Cadastre road network data?</td><td>For the dimensioning of the road network, the ILR considered data provided by the Cadastre. ("Données vectorielles de la BD-L-TC de l'Administration du cadastre et de la topographie")</td></tr>
</table>

Section		Stakeholder comment	ILR response
		One stakeholder requested the cross-checks that have been carried out to validate the database; e.g. by comparing it to satellite pictures.	The data have been provided by Cadastre (the public register) therefore a cross-check of validity is not required. Quality checks have been carried out such as ensuring that the road network had no isolated loops and the cross-roads had road intersections to connect them. This ensures that the road network is fully connected.
		The access part of the fixed network should not be rolled out along highways as no customers are located there; the core network may use highways.	The model does not distinguish between road types. The model would only calculate for the access network to be rolled out along highways if doing so provided the least cost route connecting up customers.
		Could the ILR explain the reason for excluding roads as the road network should not be modified?	The road network as provided by Cadastre has not been modified. The reason for the difference between the sources is that the Cadastre data does not include "chemins ruraux" (small, rural roads). These are often not connected to the rest of the network and do not have a significant impact on the overall road length. Additionally, the model considers all occupied buildings in Luxembourg as explained in section in 5.4.3 in the model specification and section 4.3 in the model methodology. Therefore, excluding the "chemins ruraux" does not result in excluding any buildings from the network.
7.1.2	Estimating the number of households	The number of households at each address should be an integer.	The ILR confirms that this is taken into account in the model. The number of households has been calculated using the population of Luxembourg (518,252); a single household threshold (4); and the number of people per household in multiple household properties (3). The number of households at each address is calculated using this threshold which ensures that the

Section		Stakeholder comment	ILR response
			number of households at each given address is an integer. The documentation has been updated with the above explanation.
		One stakeholder recommends that the calibration of the number of households should make sure that the total number of households in the model is in line with the actual number of households in Luxembourg.	Based on the calculation described above, the total number of households in the model is 200,721 and the average household size is 2.6. This is in line with the average household size in Luxembourg.
		Buildings with several entrances should have several final drop cables (typically buildings that have several street numbers).	This is not modelled as the model does not include drop cables. (see above)
7.2.1 7.2.2 7.2.3	Minimum number of copper pairs / fibres per potential subscriber	All households in Luxembourg should be passed, not only potential subscribers	The ILR confirms that this is taken into account in the model. The term "potential subscribers" refers to all occupied households or businesses in Luxembourg.
7.2.4	Duct fill factor		
		It seems that the 80% duct fill factor used in the model is overestimated.	The fill factor has been updated to take account of this.

Section		Stakeholder comment	ILR response
		Using the outside diameter instead of the inside diameter for a 110 mm duct leads to overestimate its capacity	The model has been updated to use the inner diameter of duct.
		One stakeholder considers that the number of micro-ducts per 125mm duct is limited to: o maximum 2 bundles of 7x14/1 0 micro-ducts; o maximum 1 bundle of 12x10/6 micro-ducts and 1 bundle of 7x14/10 micro-ducts; o maximum 2 bundles of 12x10/6 micro-ducts. NB: in a bundle of 7x14/1 0 micro-ducts, one micro-duct remains as reserve, in a bundle of 12x1 0/6 micro-ducts, two micro-ducts remain as reserve.	The model uses the assumption that each duct can contain two bundles of microducts.
7.2.5	Cable joints and jointing chambers	The model should use the following assumptions for copper and fibre joints: - Max distance between two underground copper joints: 250m - Max distance between two	The model assumes copper joints at the end of road segments which are on average significantly shorter than the 250m maximum distance between joints and hence we consider that the number of joints estimated is reasonable. We assume a fibre jointing chamber at the same location as the DPs in the copper network. As the average distance from premises to the DP location is significantly less than 2000 m, we consider that the resulting number of joints

Section		Stakeholder comment	ILR response
		underground fibre joints: 2000m Furthermore, jointing chambers are based on the number and location of copper and fibre joints	is reasonable. In the E-side and core networks we assume a fibre jointing chamber and joint every 1500 m.
7.2.6	Distance between road crossing with 2-sided duct network	At each road intersection, a trench is required to cross the road. These trenches have a higher cost as they must resist to car/truck traffic.	The content of this comment is addressed above (see Section 2.5.3.3)
		Splicing chambers should be installed on both sides of the road.	The ILR confirms that this is taken into account. Jointing chambers are assumed to be installed in the E-side and D-side network at the end of each road section. Splicing chambers are assumed to be installed at the location of DPs. In the core network splicing and jointing chambers are assumed to be installed every 1500m.
		On roads that have trenches on only one side, at least one road crossing is required per building located on the side of the street where there is no trench.	The content of this comment is addressed above (see Section 2.5.3.3)

Section		Stakeholder comment	ILR response
7.2.7	Missing parameters	The following number of cable dimensioning rules were submitted: - Curvature of cables (5% uplift) - Extra-length for splitting fibre cables - Extra-length due to wasted cables (end of drums) (10% uplift) - Extra length for splicing (work of the technicians not carried out in manholes or chambers)	The ILR confirms that the model takes into account a factor for excess cable requirements of 20% which is included as an uplift on the fibre unit costs.
7.2.7.5	Length of the final drop	One stakeholder commented that no information has been provided on how the length of the final drop has been calculated.	The content of this comment is addressed above (see Section 2.5.2)
8.1	Comparison with the data provided	An operator considers that the data in the comparison has been incorrectly represented.	The cross check is designed to demonstrate that the model results are plausible, rather than that the model of a hypothetical efficient operator directly corresponds to stakeholder's actual network.
		More explanations should be provided for the difference between the stakeholders' actual network and the results from the ILR's model.	More detail has been added to the documentation. Nevertheless, we note that the model considers the costs and network of a hypothetical efficient operator rather than the specific network of an operator. Therefore, we would not expect a full reconciliation of the intermediate model results and an operator's actual network.

Section		Stakeholder comment	ILR response
8.2	Missing elements	The ILR should consider further cross-checks of data (e.g. length of duct network, number of copper joints, number of street cabinets, and length of different types of cable).	As noted above, we would not consider a full reconciliation of the two models. In any case, no data has been provided in order to be able to carry out any further cross-checks.
8.3	Data aggregated	More detail should be added in the cross-check list for the copper network.	The content of this comment is addressed above (see Section 8.2)
8.4	Data per MDF and per POP	An operator commented that data is provided at the national level but should be provided at MDF / POP level.	It is not clear how checks at the POP/MDF level would provide the stakeholders with greater assurance in the model. Further, information has been provided in order to be able to carry out the more granular cross-checks that it has requested.
9	Trench sharing	Trench sharing should be based on current levels of sharing in the network. This is because historic levels were only achieved on the deployment of hybrid cables where it was possible to co-ordinate with other utility providers and municipalities.	The current base case assumption is that trench sharing is based on historic levels of sharing. In stakeholder meetings, a stakeholder indicated that its fibre network rollout has been on an ad hoc basis with it often installing cables while other works are being carried out We therefore intend to continue to use the current levels of sharing in the model. Further, using higher levels of sharing could lead a stakeholder to significantly over recovering its costs.

Section		Stakeholder comment	ILR response
10	Core network hierarchy and number of nodes	The core network should be based on a ring topology.	The content of this comment is addressed above.
11.1	Equipment cost / main cost categories	A full list of the cost categories and network elements included in the model is required.	The consultation document focussed on the most significant asset cost categories in order to focus the review of stakeholders on the most material issues. Therefore, the ILR considers that sufficient transparency was provided in order for stakeholders to do this. The updated documentation contains a full list of the assets included in the model. However, the updated documentation continues to contain only cost information for the largest asset categories (by annualised capital cost). This is because, as described above, we would not expect there to be full reconciliation between the BU-LRIC model and the costs that operators have incurred on an historic basis.

Section		Stakeholder comment	ILR response
11.2	Trench costs	The geotypes (rural, suburban, urban and urban high cable density) have not been defined in the documentation.	The model uses unit GRC for trench in the following different geotypes: • Rural • Suburban • Urban • Urban high cable density. In line with the request, we re-label the geotype “urban high cable density” as “dense urban”.
		The trench costs used are significantly lower than operators’ trench costs.	The unit costs are based on an operator in Luxemburg and have been compared with benchmarks in other countries. As described above (Section 2.5.3.3) the model has been modified to account for higher cost trench at road intersections in line with information provided by stakeholders.

Section		Stakeholder comment	ILR response
11.2.2	Underestimation of costs when assessing the trench unit costs	One stakeholder considers that the unit costs used by the ILR underestimate the cost of the trench network. An operator considers that this has meant that several cost elements may not have been included.	A number of inputs were used for the trench cost in the model. The unit costs are based on an operator in Luxemburg and have been compared with benchmarks in other countries. The average costs estimated in the model are very similar to those estimated in other jurisdictions. They are 57% more expensive than in one Western European model and 9% less expensive than in another Western European model. ILR believes that its current input costs best reflect the cost of an efficient operator. The model takes account of the higher cost of crossing roads though an uplift to the duct cost to take account of the higher costs of building ducts across roads at the end of road segments.
		Different unit costs are needed depending on where the trench is located: - A trench to cross a road is more expensive than a trench along a side walk; - Specific trenches are needed for the final drop;	
		- Larger trenches are mostly costly	
		- Planning, designing, registering in the inventory system and geodesy	
		- Water during construction	
		- Concrete construction for protection	

Section		Stakeholder comment	ILR response
		- Care when digging (e.g. for archaeological findings)	
11.3.1	Jointing chambers	The model underestimates the cost of jointing chambers and considers that the cost of jointing depends on the number of pairs being joined.	The types of jointing chambers considered in the model are those required for the modelled network equipment. The costs considered in the model are based on an operator in Luxemburg. The average costs of the jointing chambers are similar to those in other models and operators in Europe.
		Jointing equipment costs should be considered for both copper and fibre cables.	The cost of jointing equipment was included for copper. The cost of jointing equipment for fibre has now been added to the model.
		The cost of splitters should be added to the model.	The cost of splitters has now been added to the model. This is described in Section 5 of the Input data and intermediate calculations document.
11.4	Copper cables	Should include cost of ducts (table with costs)	This is now covered in section 5.4 of the Model results and input data documentation.
11.5	Fibre cables	A stakeholder states that in order to select the appropriate micro-ducts, the diameter of the cable should be compared to the inside diameter of the micro duct.	The model does not consider micro ducts.

Section		Stakeholder comment	ILR response
11.6.	ODF	Operating costs should be included for maintenance and floor cost. There should be a specific mark-up for different asset categories, as well as further breakdown of the mark-up into different categories of operating costs. The total operating costs included in the model should be compared to the operating costs that stakeholders have themselves incurred historically. All the benchmarks should be adjusted to reflect the higher wage costs in Luxembourg. As described above, and in the consultation document, the operating costs for the core network were based on operators' data. For the access network, the Opex per subscriber per month might be	As described in the input data document, the mark-up included in the model over GRC for operating costs for core network assets is based on operating costs and gross book value that operators provided. Further, no data has been provided in order to be able to perform this calculation. Further, it is unclear whether adding such granularity would result in a more accurate estimate of operating costs. As set out in the specification document included in the consultation, the BU-LRIC model is of an efficient network operator in Luxembourg. Therefore, we would not expect there to be a full reconciliation between the BU-LRIC model calculations and the costs that the stakeholder have actually incurred. The international benchmarks were used as cross-checks rather than as direct inputs to the calculation. Therefore, there is no need to adjust this figure for differences in operating costs. In any case, labour costs in the benchmark countries were not consistently lower than those in Luxembourg. Further, operators would need to provide evidence that a sufficiently important part of core access operating costs are labour costs. As described above, the model considers the real costs. As described in the WACC annex of the input data document, the model uses a 2% inflation forecast. Therefore, the real increase in Opex per subscriber per month for the access network would be zero.

Section		Stakeholder comment	ILR response
		uplifted by wage inflation (2% pa) so that this reflects the nominal costs.	
		One stakeholder advises that an ODF with around 2,000 ports uses approximately 240sqm.	The ILR assumes that this is a mistake as 240sqm is extremely large for any type of telecommunication equipment. Similar models in other jurisdictions suggest significantly lower space requirements, similar to those considered for other equipment in the modelled network. The ILR notes that the space only refers to that occupied by the actual equipment, not the space for the building typically associated with optical or copper distribution frames.
11.7	MDF	Opex should be included for maintenance and floor cost	The same response as outlined for Opex for the ODF above applies to this comment.
		An MDF with around 10,000 ports uses approximately 400sqm.	The same response outlined above for ODFs applies to the 400sqm indicated for MDFs.
11.8	Other assets part of the access network		

Section		Stakeholder comment	ILR response
11.8.1.	Copper joint for final drop	The following costs for the final drop should be included. In particular: 50.79 EUR per household and 76.78 EUR per joint	The content of this comment is addressed above (see Section 2.5.2)
11.8.2	LV	The full cost of the street cabinet should be taken into account. It provides a breakdown of these costs.	Street cabinets are taken into account to the extent that they are required for active remote equipment. The scorched node approach does not imply that nodes must have the same equipment or infrastructure installed but the node is considered for the structure of the network, e.g. no optimal placing of cabinets for customer connections. The ILR notes that the function of cabinets would replace what is currently modelled as manholes. The ILR will consider if the use of cabinets would be reasonable in the event that the model is used for determining access costs, particularly in the context of the new EC recommendation.
11.8.3	NTP	The model should include full cost of NTP (NTU) (list of costs).	The same response as earlier outlined for the costs of the final drop applies to this comment.
11.9	MSAN equipment	The footprint of the rack has been under-estimated and there are additional costs that have not been considered. Moreover the footprint of a rack is 1.8 sq m and includes approx. 35 rack units. According to this, modules have 80% utilisation rate, uplink ports 70% and spare equipment accounts for 5% of the	The operator's response in relation to space requirements appears inconsistent with its comment that the model calculating higher space requirements compared to its network. The ILR therefore considers the assumptions made in the model as reasonable. The ILR further confirms that the network dimensioning takes into account reasonable utilisation factors and spare equipment. Specific site costs are included in the overhead mark-up used in the model and power requirements are separately modelled on the basis of individual power requirements per equipment.

Section		Stakeholder comment	ILR response
		total MSAN. In addition, rental costs have been underestimated and the costs associated with each site should be included.	
11.10	NMS	The generic NMS used in the model under-estimates the true costs of an existing NMS. Breakdown of the costs that relate to the NMS have been provided. This includes technical IT, order handling, and work force costs.	The ILR finds that the NMS costs considered in the model are broadly consistent with those set out by the stakeholder's response excluding the last three items. The ILR considers that costs considered from these systems fall within the area of overhead costs.
11.11	MGW	Several types of gateways should be included in the model: PSTN GW PLMN GW International GW	The ILR confirms that the media gateway is dimensioned according to the information provided in a stakeholder's response to the data request. Information for a single type of media gateway and corresponding costs and capacity has been provided. This appears to be broadly consistent with the dimensioning rules now provided.
11.12	Other core network assets	The model should also include the costs of the following additional network elements and clear dimensioning rules should be provided for each:	

Section		Stakeholder comment	ILR response
		Intelligent network	The ILR considers any equipment associated with the IN as irrelevant for the provision of termination, access and wholesale broadband services. Any justification has not been provided why that the cost of the IN should be taken into account. The model will therefore not include cost related to the IN.
		IMS	The stakeholders did not explain now or as part of the response to the data requests how equipment information provided is related or replaced in light of the IMS. The ILR considers that the provision of voice services is sufficiently enabled using softswitches, media gateways and VoIP services according to the stakeholders' submission and that further equipment and costs would not be related to the provision of regulated services.
		Routers and switchers	All routers and switches relevant for the provision of access, wholesale broadband and interconnection services have been included in the model. The ILR regrets that no further evidence on this issue has been provided.
12	Asset lives and price trends	The cost of space should be considered as a yearly cost instead of as Capex.	The ILR considers the way in which the model considers accommodation as appropriate and consistent with bottom-up models in other jurisdictions. The ILR regrets that no further evidence on this issue has been provided.
		The price trend of space should be 2% not 2.5%.	No evidence for using a higher price trend for space costs has been provided. Therefore, we do not propose to revise the model based on this.
		The documentation should include data on asset lives for all network equipment.	A complete list of asset lives for all categories of assets is covered in section 6 of the Model results and input data documentation. The list of assets under each category has now been added to the documentation.

Section		Stakeholder comment	ILR response
13.1	OPEX	Will the documentation include all relevant operating costs? Could the ILR make sure that operating costs are calculated on a more granular basis, and cross-checked using top-down data? In the case benchmark data is used, the ILR should consider the upper range in order to account for higher relative costs in Luxembourg.	The content of this comment is addressed above (see Section 2.6.2)
13.2	Power and air conditioning costs	Power and air conditioning costs should be split in 2 categories.	With regard to the comment that power and air-conditioning costs should be estimated separately, reliable unit cost information was not available in order to be able take power and space requirements to estimate these costs separately. Therefore, as described in Section 7.2 of the input data document, the model uses “fully loaded” unit costs. This includes both capital and operating costs. Concerning a breakdown of the total power consumption and total air-conditioning requirement, total annual power consumption (in kw) can be calculated by dividing the total annual cost of power and air-conditioning by the unit cost of power and air-conditioning (as provided in Section 7.2 of the input data document). However, since the power and air-conditioning cost is fully loaded, it is not possible to calculate the air-conditioning requirement in watts per square metre. As described in the input data document (Section 7.2), the costs included for power and air-conditioning are “fully loaded”. That is, they already include

Section		Stakeholder comment	ILR response
			(among the other costs listed in the input data document) the on-going maintenance costs.
13.3	Wholesale specific costs	These costs should apply to all products.	The content of this comment is addressed above (see Section 2.6.3)
		It seems that this is not in line with the EC recommendation.	
13.4	Common costs	The common costs have been underestimated as they would be higher in Luxembourg compared to international benchmarks because of lower economies of scale, higher wages and lower bargaining power.	The estimate is based on data provided by stakeholders in response to clarifications and then cross-checked against benchmark data. It therefore reflects the operating environment in Luxembourg.
13.5	Cost of working capital	The cost of working capital should be included (12 months).	The content of this comment is addressed above (see Section 2.6.1.1)
14	Sensitivity analysis	The sensitivity with fewer nodes is not in line with the scorched node approach.	The content of this comment is addressed above (see Section 2.2)

Section		Stakeholder comment	ILR response
15	NGA risk premium / WACC	The estimation of WACC should include the French value (4.6%) which was calculated using real options. Further, the model should use nominal WACC.	The link provided does not appear to work and no further details of the document were provided. The French estimate, while cited in other publicly available documents, does not appear to be publicly available despite extensive searching of ARCEP's website. Therefore, in the absence of a document from ARCEP itself, the estimate was excluded from the benchmarking In Section 6 of the input document sets out the nominal price trends used in the model. However, these are adjusted in the model to account for inflation so that the price trends used in the annualisation formula are real (inflation is assumed to be 2% in line with the inflation forecast used in the WACC estimation, described in the annex to the input document). This has been added to the documentation. Therefore, the model uses correctly the real pre-tax WACC. Depending on how the model is used, final pricing decisions would need to take account of general price inflation since the model results are in 2013 prices. The previous version of the model applied the same WACC to all assets. However, it has now been revised so that the WACC including the NGA risk premium is only applied to NGA specific assets.