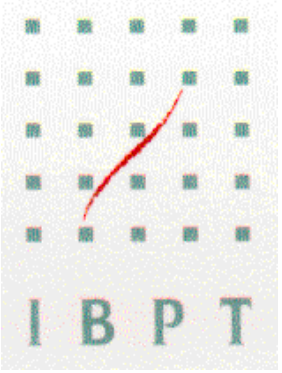


LRIC Bottom-up model for interconnection

Consultation Document 2.0

Summary of the comments

Decisions taken by the BIPT

Prepared by BIPT

In collaboration with Bureau van Dijk Management Consultants

29th june 2002

Table of contents

1. INTRODUCTION

1.1 Objective and structure of the document

This document summarizes the different responses that the BIPT has received as a reaction to its second consultation document regarding the development of a bottom-up model for interconnection. The Institute would like to thank all operators that responded to the questions in this second consultation document and found the operators' input most helpful.

This document is structured in the same way as the second consultation document. For each question, the different answers are summarized. Some questions will however be grouped in order to better reflect general remarks made by the operators. Moreover, where appropriate, the decision of the Institute is motivated.

In a first annex to this document, a detailed description of the structure of the network that is going to be dimensioned in the bottom-up model is presented. In a second annex, a list of relations is illustrated between the parameters that are identified for the dimensioning of the network. The dimensioning algorithms of these relations will be treated in the third consultation document.

1.2 Next steps

The initial planning of the bottom-up model envisaged the availability of the final results by the end of 2001. However, due to an unforeseen amount of work concerning local loop unbundling issues, this deadline could not be kept. Earlier this month, a new planning was presented. This planning has to enable the BIPT to take into account the results of the bottom-up model when verifying the cost-orientation of the BRIO 2003 tariffs.

As indicated in the new planning for the bottom-up model, a meeting will be organised to explain in more detail to the market to provide further clarifications to the market on the decisions in the second consultation round and on the next steps. This meeting will most probably take place during the second week of April.

A third consultation document will be issued on Monday April 22, 2002. This document will address in greater detail the values of the parameters that will be used for modelling the network, as well as methodologies for modelling OPEX-costs, the cost of capital, …

2. MODELLING THE NETWORK

2.1 Level of aggregation with regard to the input-information of the switching nodes

Question 2.1.1: The BIPT wishes to invite the industry to give its opinion on the different options considered above.

Summary of the comments

There seems to be a general consensus that option 3: *the use of detailed node information*, guarantees the best mix of model accuracy and the ease of modelling. However, the following remarks were made:

- For costing purposes: several operators are in favour of taking into account geo-types, under option 3, to reflect different site costs and transmission costs for the individual facilities;
- For dimensioning purposes: some operators also argued to take into account the evolution of call profiles and the type of services offered over the SMP-network;
- For modelling purposes: some operators asked the BIPT to construct a simpler, more general and aggregate model, in parallel.

Decisions taken by the BIPT

The BIPT and its consultant will dimension the Belgacom network using detailed node information.

The BIPT is considering using geo-type data for determining the site costs. The outcome of the 3rd consultation document will be decisive when evaluating to what extend geo-type data *can* be introduced into the model. However, with regard to transmission costs, it is not clear how geotypes can be properly introduced since these links may cross several demographic areas. As a consequence, the BIPT is more in favour of working with average transmission costs (see also Question 2.2.19).

The BIPT is not planning to take into account the evolution of call profiles or a change in services offered on the SMP-network since the evolution of call profiles and changes in services offered is highly uncertain. Moreover, the BIPT prefers to initially construct a robust bottom-up model whereby actual demand is correctly translated into the required equipment quantities before launching a broad range of hypothetical scenarios.

The use of detailed information however will not prevent the use of aggregate data in the model. It is the BIPT's intention to have a clear view on aggregate information in the model as well. This will allow OLOs to better audit and assess the results of the different parts of the model.

Question 2.1.2: The BIPT wishes to invite the industry to give comments on the data structure as proposed under option 3. The BIPT welcomes any alternative approach that may lead to an increase in the quality of the bottom-up model and the data used in it.

Summary of the comments

The majority of the operators believe that the data structure proposed by the Institute provides a robust design. There are however several remarks made by different operators:

- The majority of operators share the opinion that the amount of confidential information that is used within the model should be kept to a strict minimum. The use of the confidential data reduces the ability of interested parties to audit the assumptions used in the cost model, and may impact their ability to assess the manner in which model algorithms operate upon the input data;

- These operators also ask for cautiousness with regard to data objectivity from the SMP operator, which could be hampered by confidentiality issues;

- One operator stresses the importance of the optimisation rules in the model and the fact that these have to be compatible with international standards and with specific criteria imposed on the SMP operator.

Decisions taken by the BIPT

The data structure will further be developed based on the data structure proposed in the second consultation document, whilst taking into account the remarks of the operators.

Concerning data confidentiality, it is clear that the BIPT wants to build a cost model that has a maximum degree of transparency towards third parties. However, it cannot be denied that, under option 3, there is a specific amount of data that is confidential. Examples of this are the number of users connected to each individual switching node, the exact capacities of individual transmission links,... This detail information on the demand volumes will under no circumstances be made available to the market. The data structure, optimisation and decision rules will be completely transparent for all parties.

With regard to data objectivity, the BIPT would like to stress that this is always one of its most important areas of concern, as well for data that is provided by the incumbent operator as for data provided by other operators. The Institute therefore guarantees that all data will be double-checked and compared to all other available information sources. All operators can play an important role in this process by providing input in the information gathering process and by assessing the information that is indicated by the BIPT as non-confidential.

Finally, the Institute will certainly take into account in its dimensioning algorithms (cf. 3rd consultation document) the remarks made by the different parties with regard to optimisation restrictions imposed by international standards and specific SMP-criteria.

2.2 Infrastructure to be modelled

2.2.1 Modelling assumptions

Question 2.2.1: The BIPT wishes to invite the industry to comment on the assumptions made above.

Summary of the comments

All operators have commented extensively on this topic. Most comments concerned transmission technology and network integration.

Transmission technology:

- All parties mention that PDH-technology is still used and that it might be the most cost efficient technology in some cases. On the other hand, some operators acknowledge, that for the purpose of bottom-up modelling, the exclusive use of SDH is commonly accepted;

- Some operators draw the attention to the fact that the consultation document does not mention the use of DWDM-technology in order to provide further economies of traffic density on high volume rates;

- Some operators mention that ring structures are not necessarily the most cost-effective solution at all levels of the network. There may be some parts of the network, notably on 'thinner' routes such as within the concentrator to local switch where point-to-point links might provide a more efficient solution.

Network Integration:

- All parties utter their concern that demand for broadband services will not be taken into account in the model since they often use some of the same facilities as the PSTN/ISDN-services and they definitely have common costs;

- Several operators share the opinion that in the long term, voice and data will be conveyed over integrated networks;

- A final remark concerns the provision of the incumbent's narrowband internet services; these services still use the classical PSTN/ISDN switch before being routed to a Remote Access Server and thus this kind of traffic has to be taken into account.

Decisions taken by the BIPT

With regard to the transmission technology, the BIPT acknowledges that PDH technology is still quite common. However, within the time horizon of the model, it is expected that the use of PDH will continuously decrease. Therefore, the BIPT prefers not to include any PDH technology.

The operators' remarks with regard to the use of DWDM technology are correct if traffic volume of data services will be taken into account. Under a forward-looking approach, the use of DWDM technology should definitely be concerned. Therefore, the BIPT has decided to

take DWDM technology into account in the bottom-up model where it can be economically justified.

The BIPT agrees that on thinner routes, point-to-point links might be more cost effective. The BIPT is therefore considering the use of point-to-point fibre links, using TMUX technology, where appropriate.

With regard to the level of network integration, there seems to be a great deal of confusion about the extent to which common costs of broadband services will be taken into account. It has to be clear that the model will definitely recognize these economies of scope. In particular, the shared use of infrastructure will be taken into account. However, this does not mean that the model will include detailed information about every node and transmission link that is required to provide these broadband services. The existence of these shared costs will be taken into account by applying specific ratios that will probably be calculated by applying the results of distribution samples taken on the Belgacom network. This topic will be further addressed in the third consultation document.

With regard to the integration of voice and data, the Institute is not convinced that the results of a completely integrated voice and data network, where voice transport has also become packet-switched, would be representative. It is therefore, that for the initial modelling of the bottom-up model, the Institute wishes to model voice services using a circuit-switched network.

With regard to the internet-traffic, the Institute confirms that the volume of Internet traffic that still passes the PSTN/ISDN switch will be taken into account in the costs calculations of the model.

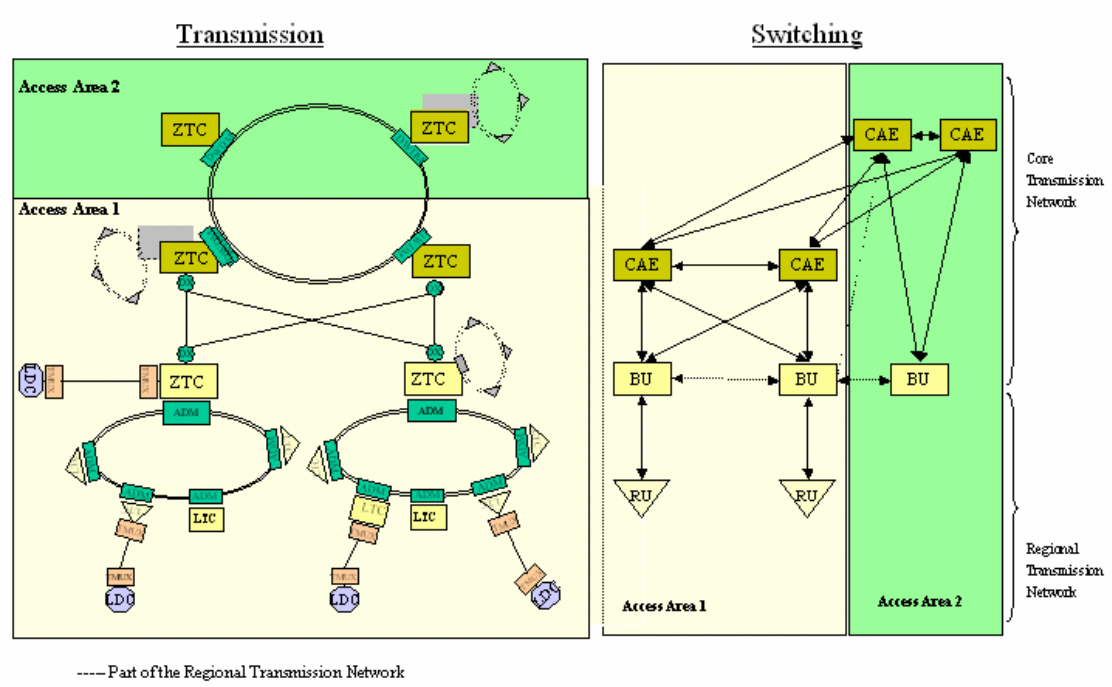
2.2.2 Structure of the logical network

Preliminary remark

During the last few weeks, there have been several discussions between the BIPT/its consultant and Belgacom on the actual structure of the Belgacom network and on the structure of the network that will be modelled under the modified scorched node approach. There has been a lot of confusion about the structure of the existing network, due to the use of different terminology between the parties.

Therefore, the BIPT and its consultants have drafted a new schematic overview, resuming the mapping between the logical switching structure and the physical transmission structure of the network that is going to be modelled. This overview, as well as the text that is commenting the scheme, has been presented to Belgacom for validation. The terminology used in the illustration will from now on be considered as the uniform and standard terminology that is going to be used during the further development of the bottom-up model.

The figure below replaces all previous schematic presentations of the network to be modelled. A detailed description of the network to be modelled is given in Annex 1 of this document.



For a detailed description of the above figure, please see Annex 1.

Question 2.2.2: The BIPT wishes to invite the industry to comment on the use of a three layer-network.

Summary of the comments

Most operators agree that the use of a three-layer network in the bottom-up model is appropriate. Some remarks are made concerning:

- the integration of the BU-level and the RU-level into one single layer: in combination with the integration of voice and data services over packet switched technologies could lead to significant efficiencies in the network;
- the collocation of BU and CAE switching functionalities, with cost savings for site accommodation and transmission as a consequence.

Decisions taken by the BIPT

Three layers will be distinguished in the logical structure of the switching network. There seems to be some confusion concerning the relation between Level 0 (RUs) and Level 1 (BUs). However, the RUs at Level 0 have no switching functionalities; this means that the actual switching only takes place at Level 1 and Level 2. Therefore, the three-layer network could be considered as a two-layered network[1].

[1] Cf. Belgacom document dd. 15/10/2001, "Belgacom Switched Network Architecture – An overview"; describing the migration from a 3-layer to the new 2-layer CAE network architecture.

Moreover, the BIPT confirms that the CAEs and BUs will be mainly collocated in order to minimize housing costs. More detail about collocation of transmission equipment and sharing of transmission paths are given in Annex 1.

Question 2.2.3: The BIPT wishes the industry to give its point of view on the principles proposed by the BIPT of redesigning the switching network but initially keeping the design of the transmission paths.

Summary of the comments

Remarks are made concerning to:

- the Core SDH meshed point-to-point connections between the CAEs (cf. Document of 14 November, 2001 – response to Question 2) are considered to be in conflict with the TELRIC principles;

- the fact that point-to-point connections could be justified where there is less traffic and inter-meshing (e.g. between BUs and RUs).

Most operators are proposing to create one or more rings that link all switching nodes in one covering area. One operator is stressing the importance of the possible sharing of infrastructure (between the regional and the backbone network) when deciding the configuration of the physical network.

Decisions taken by the BIPT

The BIPT has evaluated the comments of the market, whilst taking into account the new information it has obtained on the exact structure of the incumbent's network. The schematic overview in paragraph 2.2.2, shows that in the regional transmission network, a combination of point- to-point SDH links (connecting LDCs to LTC or ZTC) and regional SDH rings will be used. The point-to-point SDH connections will be modelled since they represent to most cost effective solutions for some more distant areas. The regional SDH rings will also provide connection to the core network.

With regard to the physical connections of the BUs, they will mainly be linked to the CAEs and to each other (where appropriate) by means of the existing SDH-rings. For some connections however, a meshed structure will be maintained. For high traffic routes, DWDM technology might be used. Possible future extensions of the bottom-up may include the possibility of simulating the impact of a migration to a core transmission network that is completely based on a ring topology.

The BIPT is convinced that the network structure that is going to be modelled responds to all comments made on the previously published illustrations of the network.

2.2.3 Modelling the switching network

Preliminary comments by the operators

Comments on the visibility of demand and its translation in network requirements

One operator draws the attention to the fact that in the second consultation document, no information was provided on whether the basic external demand input information would be visible and on how this external demand would be translated into network capacity requirements. The operator urges the BIPT to confirm the level of detail that will be visible in the model.

Comments on Figure 4: Basic functions of an exchange

Some operators are surprised that Figure 4 shows a direct connection of the 2Mbit/s customer lines into the switch ports. They stress that a concentrator is always needed (either co-located or remote) to connect a 2 Mbit/s customer line to the port and switching matrix.

Comments on the comparability of Input Data

Some operators explain that different switch manufacturers may have defined different switching modules and price structures, which makes it very hard to conclude on the "best practice" unit cost for each equipment category. Moreover, commercial deals between manufacturers and operators can be quite different. Therefore, it can be necessary to collect cost data on network equipment on a more aggregated level.

Comments on cost behaviour and scale differences

One operator focuses our attention to the fact that there are important differences in switch configurations and loading between new entrants and the incumbents. These can have a major impact on the global cost of the switching equipment, considering that some cost categories may have high fixed costs, or are characterised by step increases.

Reaction of the BIPT

The BIPT would like to thank the market for the general comments it has made on several important aspects concerning the modelling of the switching network. The comments contain a lot of useful information on how to avoid pitfalls when calculating the cost of the switching network and they will certainly be taken into account.

With regard to the translation of the visibility of the external demand input and its translation into network capacity, the BIPT would like to specify that:

- the external demand input will be made available to the market at a more aggregate level than the node level;
- the translation in network capacity will be done by means of the algorithms presented in the Annex 2. In the 3rd consultation document, the market will have the opportunity to the react on the relations expressed in the algorithms (e.g. to calculate the number of concentrators needed) and to quantify the different parameters.

With regard to the cost of the network components, the BIPT will try to obtain as much detailed information as possible on the different cost parameters. Furthermore, the Institute will provide the possibility to the market to provide cost information on a more aggregate level. The combination of detailed and aggregated information should give the best guarantee that the appropriate network costs are derived from different cost structures.

Question 2.2.4: The BIPT invites the industry to give its point of view with regard to the possibility of isolating the line card costs

Summary of the comments

There is a general consensus that the idea of isolating line card costs is a good approach. However, many operators point out that it is quite uncommon to have prices of line card separated from port, central processor and other equipment prices. List prices of individual items may not necessarily be readily available to operators. Moreover, different operators will receive different discounts. Two alternative approaches have been suggested. The first approach starts from suppliers' list prices that can be used to show the relative cost of individual equipment items and these relative costs can then be applied to the total cost tendered by the manufacturer. The second approach starts from different purchasing data (different mixes of line cards and call carrying capacity). It should be possible to estimate the cost of traffic sensitive and non-traffic sensitive elements of the switch by regression analysis.

Finally most operators reminded the BIPT to the fact that the cost of the line card should not be taken into account for interconnection purposes as it is entirely covered by the subscription fee paid by the end users that are connected to the Belgacom network.

Decisions taken by the BIPT

The BIPT agrees that obtaining separate line card costs will not be easy. The BIPT will therefore try to collect as much useful information as possible. The objective of the BIPT is to obtain the line card cost information on the most detailed degree available. However, operators will be requested to submit aggregate data as well, so that when necessary, the BIPT will have enough data to calculate separate line card costs following the approaches described above.

The BIPT confirms that the cost of the line card itself will not be taken into account when calculating the interconnect tariffs, since the cost of the line card is supposed to be covered by the Belgacom subscription fees.

Question 2.2.5: The BIPT invites the industry to give its point of view with regard to the possibility of providing concentrator costs per E1 group.

Summary of the comments

Most operators agree that the above approach is not unreasonable, however constituting a simplification of the true cost drivers. The majority of the operators propose the BIPT to ask operators to provide total costs for a concentrator unit, together with its capacities in both customer lines and E1s.

Decisions taken by the BIPT

The BIPT agrees to follow the proposal of the operators. Costs for concentrator units will be asked together their capacity in both customer lines and number of E1s. To determine cost causality, regression methods can be used.

Question 2.2.6: The BIPT invites the industry to give its point of view with regard to the possibility of providing port costs per E1 group.

Summary of the comments

All operators agree that the number of E1 groups is driving port costs since ports are provided on the 2 Mb level. However, as with the previous components, isolation of these costs may not always be straightforward.

Decisions taken by the BIPT

The objective of the BIPT is to isolate port costs. Isolation of port costs will not only be useful to determine interconnection tariffs, but also for possible future extensions of the model. For those operators that cannot provide separate port costs, aggregate costs with different capacities will be asked for and statistical analysis will be used to determine separate port costs.

Question 2.2.7: The BIPT invites the industry to give its point of view with regard to the possibility of providing switching matrix costs per E1 group.

Summary of the comments

All operators agree that switching matrices are dimensioned on the basis of the number of E1s that are required to be switched. Therefore, requesting information on switch matrix costs per E1 group is considered to be appropriate. Moreover, most operators agree that it should also possible to identify these costs separately. Some operators notice that this possibility may be manufacturer-dependent and that it may not always be possible to isolate switching matrix costs.

Decisions taken by the BIPT

The objective of the BIPT is to isolate switching matrix costs per E1 group. For those operators that cannot provide separate switching matrix costs, aggregate costs with different capacities will be asked for and statistical analysis will be used to determine separate switching matrix costs.

Question 2.2.8: The BIPT invites the industry to give its point of view with regard to the possibility of providing central processor costs per 1.000 BHCA.

Summary of the comments

There is a general concern amongst most operators that processor costs shall include processing capacity for value added services such as call divert/forwarding, call barring, voice mail, … Since these services are not relevant to interconnection traffic conveyance, they should not be included in the interconnection tariffs. A similar reasoning can be followed concerning switch software that is often used to implement new service functionality. Therefore, some operators have proposed that processor costs per BHCA be reduced in proportion to the estimated capacity required for these additional services. With regard to BHCA, there seems to be a general consensus that this is the appropriate cost driver.

Decisions taken by the BIPT

The BIPT will ask for processor costs per BHCA. These costs will include all processing costs. The BIPT acknowledges that part of the processor costs are to be attributed to value added services. Therefore, a ratio will have to be determined that takes into account the fact that the processor is needed to provide other services as well.

Question 2.2.9: The BIPT invites the industry to give its point of view with regard to the possibility of providing investment costs for accommodation assets per switch.

Summary of the comments

Most operators remark that accommodation assets should not be measured on a per switch basis. The correct cost driver to calculate accommodation costs would be area or square meters.

Decisions taken by the BIPT

The BIPT acknowledges that square meters used is a better-cost driver to model accommodation costs and will adopt it in the bottom-up cost model. However, it is not clear yet at which level of detail and in what structure this data should be asked for. The BIPT will therefore consult all operators concerned on this topic during one of its following meetings.

Question 2.2.10: The BIPT invites the industry to give its point of view with regard to the possibility of providing investment costs for miscellaneous investments per switch.

Summary of the comments

The BIPT has received no specific information with regard to this question. One operator mentioned charging and taxation costs. All operators would like to have more information about the exact nature of these costs.

Decisions taken by the BIPT

At this point, the BIPT has not defined any additional costs that should be taken into account in this category. Billing and charging costs will be part of the general overhead costs in the bottom-up model.

Question 2.2.11: Is it appropriate to have different cost parameters (but same classification) for remote concentrator units and transit switches compared to local exchanges

Summary of the comments

Most operators believe that it is appropriate to use the same parameterisation for remote concentrators and transit switches, compared to local exchanges. This is because typically, the same underlying equipment components will be used. It is however obvious that not all components will be present everywhere (e.g. no switching matrix in remote concentrators) and that only relevant equipment will be taken into consideration.

Decisions taken by the BIPT

The BIPT will use the same parameterisation for the remote units, base units and transit units, taking into account the technical presence of each component. With regard to site costs, we would like to refer to the answer in paragraph 2.2.9.

Question 2.2.12: The BIPT wishes to invite the industry to comment on the above parameterisation that will be used to model the switching network. Comments on following topics are very welcome:

- **completeness of the switching functions;**
- **correctness of the cost driver (e.g. E1 group, 1.000 BHCA, switch, …);**
- **ability to provide disaggregated costing information.**

If you will not be capable of providing cost information at this level of detail, please specify an alternative classification, which could be used to collect switching cost information.

Summary of the comments

Most of the remarks have already been specified in the above summaries. Some additional comments were related to the need to take great care in ensuring that input costs in the parameterisation avoid all double counting.

Decisions taken by the BIPT

The avoidance of double counting issues is always one of the important challenges the BIPT faces when setting tariffs. As a consequence, a great deal of effort is put in the elimination of double counting. In the third consultation document, the definition of the cost parameters will be formulated in order to avoid any double counting. If however any confusion about the exact nature of the costs should arise, the BIPT will contact all operators concerned to analyse the input data in more detail.

2.2.4 Modelling the transmission network

As already stated under section 2.2.2., the structure of the transmission model that is going to be modelled, is different than what was presented in the figures of the second consultation document. With regard to transmission, this means that the split between 'Access level of the Core Network' and 'Backbone level of the Core Network' is no longer valid. Furthermore, due to these changes in the transmission structure, there is some equipment not mentioned in the consultation document that will be modelled as well (e.g. TMUX between the LDCs and the ZTCs or LTCs). In spite of this, the BIPT has noticed that almost all relevant information for the modelling of the network is included in the answers on the question 2.2.13 to 2.2.23.

Preliminary comments of the operators

Comments on the shared use of fibres by narrowband and broadband services

Several operators draw the attention to the fact that, when using SDH and DWDM technology, it is possible to use the same fibre for narrowband services and broadband services, as the transmission medium is transparent to the nature of the information transmitted.

Comments on the availability of the information

All operators agree that the cost elements needed for determining the cost of the transmission network, should be readily available.

Comments on the source of the cost information

One operator suggests that the cost information should not only be provided by the incumbent operator and the competitive carriers, but also from independent contractors that supply installation and construction services to carriers.

Comments on the dimensioning of the transmission network

One operator is concerned that the modelling of the transmission network will be limited to the assessment of the efficient provision of transmission equipment and that efficient provision of the fibre/cable line plant will not be optimised.

Comment on the link between the cost structure and the rate structure

One operator is concerned that the cost drivers identified for the transmission network will be reflected in the rate structure.

Reaction of the BIPT

The shared use of fibres: when modelling the bottom-up model, the assumption will be made that narrowband and broadband services can be offered on a single fibre.

The availability and source of the information: the BIPT is pleased to read that most cost information should be readily available at both the incumbent and the new entrants. At this moment, no contacts have been established with suppliers, contractors,.. in order to obtain or to check information on the investment and cost drivers. However, the BIPT will look at the possibility of getting more input from third parties such as network equipment suppliers and network contractors. Moreover, the BIPT will address its IRG contacts to obtain additional benchmarking information.

The dimensioning of the transmission network and link between cost structure and rate structure: at the end of section 2.2.4., the BIPT will present a number of algorithms that will be used in the bottom-up model in order to dimension the transmission network. The BIPT would like to stress that there is no direct link between the cost structure presented in these algorithms and the rate structure, as the rates will be element based and not e.g. distance-dependent.

Question 2.2.13: The BIPT invites the industry to give its point of view with regard to the possibility of providing investing costs for the E1 connection to the ADM.

Summary of the comments

Most operators agree with the approach outlined by the BIPT. One operator remarks that a tributary card is typically able to insert/extract 32 E1s, which means that the first tributary E1-card will cost the whole tributary card while the 31 next E1s will have a very limited incremental cost. In other words, it is important to take the occupancy rate into account when calculating the incremental investment cost in E1s.

Decisions taken by the BIPT

The BIPT will consider the investment in E1 connections as an investment driver (and cost driver) for the ADM. When enquiring after the costs of the E1 connection in the 3rd consultation document, the BIPT will take into account that a tributary card is able to insert/extract more than one E1.

Question 2.2.14: The BIPT invites the industry to give its point of view with regard to the possibility of providing investing costs for the ADM for the different STM-x rings.

Summary of the comments

Most operators agree with the approach outlined by the BIPT. Some operators raise the concern that the BIPT has to ensure that the cost coverage of each component is unique. Another operator notes that the ADM investment costs should include the cost of the line cards. These line cards define the capacity on which the ADM is connected. Finally, one operator remarks that, where a number of nodes are co-located in the same site, sharing opportunities should be taken into account.

Decisions taken by the BIPT

The BIPT will consider the investment in ADMs as a distinct cost driver at the nodes of the different STM x-rings. This will include investment cost in the STM-x line card. The co-location of nodes will be mapped and sharing opportunities will be quantified.

Question 2.2.15: The BIPT invites the industry to give its point of view with regard to the possibility of providing investing costs for fibre per kilometre.

Question 2.2.16: The BIPT invites the industry to give its point of view with regard to the possibility of providing investing costs for cable per kilometre.

Summary of the comments

All operators agree that the separate categorisation of fibre and cable is not meaningful, as the average fibre cost per kilometre depends largely on the cable type and as network operators will invest in "fibre cable assets". The cost information of different "fibre cables" should be readily available on a per kilometre basis.

One operator remarks that the model has to take into account that in a lot of cases, it is required to dig and lay several cables at different times for the same transmission route.

In order to solve the issues related to the cable and fibre modelling, one operator proposes to model the fibre cable with the following formula:

Fibre Cable Cost = A X L+ B X L X N + C X L X N + D X N

Where:

- L is the link length
- N is the number of fibres in the cable

And:

- A is the cable cost per km representing minimum cable material and insulation costs, as well as the cable installation costs per km.
- B is the incremental cable cost per km due to the number of fibre inside the cable (the more fibre in the cable, the larger the cable will be for a given length).
- C is the fibre cost per km that includes material costs and splicing costs.
- D is the connector costs and is proportional to the number of fibres in the cable.

Decisions taken by the BIPT

The BIPT will ask operators to provide cost data on different sizes of cable, with the size depending on the number of fibres in the cable.

Taking into consideration whether reactions on the 3rd consultation document, the BIPT will evaluate if the formula proposed by one operator is useful for the determination of the fibre cable investment cost.

Question 2.2.17: The BIPT invites the industry to give its point of view with regard to the possibility of providing investing costs for infrastructure *per kilometre*.

Summary of the comments

Most operators agree that the investing costs for infrastructure can be provided per kilometre.

Another operator remarks that, due to technological developments, fewer fibres are now required than under e.g. PDH technology, which can imply fewer duct bores and smaller – and therefore cheaper – trenches.

Decisions taken by the BIPT

The BIPT will ask for investing cost for infrastructure on a *per kilometre* basis.

Question 2.2.18: The BIPT invites the industry to comment on the above categorisation of investment costs in the access level of the core network. Differing views or comments on the feasibility are highly welcomed. If there should be cost categories that are not mentioned above, but that are relevant in the Belgian situation (e.g. should there be a category that includes the investment costs of SDH regenerators), the BIPT would like to receive a description of these.

Summary of the comments

SDH-regenerators

Most operators clarify that no SDH-regenerators are needed since the distance between any two consecutive ADMs is unlikely to exceed the distance for which an unregenerated SDH signal can be transmitted.

Synchronisation network

Next, some operators remark that consideration should be given to the inclusion of synchronisation network costs (i.e. 4 primary clocks and secondary clocks for switching and transmission systems and minimal transmission capacity). The costs of network synchronisation however are not very significant.

DWDM-equipment

One operator is convinced that the growth in data networks may give opportunities for sharing line plant infrastructure (fibre cables) through the use of different wavelengths to carry both narrowband and broadband traffic on the same system.

Decisions taken by the BIPT

The BIPT will not include costs for SDH-regenerators in the bottom-up model for interconnection; neither will the costs for network synchronisation be modelled separately. Finally, DWDM-equipment will be modelled where economically justified.

Question 2.2.19: The BIPT invites the industry to comment on the use of *average* investment costs in ducts and trenches.

Summary of the comments

All operators agree that there are some significant dangers in modelling infrastructure costs on an average basis as geographical differences can result in differing contractor rates or

differences in installation time (e.g. city centres), logistical overhead, trench specifications. Therefore, the input data on investment costs in ducts and trenches has to be handled with great care, all the more because new entrants are likely to focus more on major cities, which involves higher duct costs than those for the incumbent operator.

Some operators remark that the appropriate geo-type can be determined by the location of local exchange or remote concentrator unit. They add that geo-type variation will be less important for the core network transmission cost as these inter-city routes are running through either rural areas, or as they are built at low cost on road or motorway verges, or along railways.

One operator is concerned that the use of de-average infrastructure costs is going to increase model complexity, without an equivalent added value for the interconnection cost calculation.

One operator indicates that infrastructure costs can vary highly by soil type and geo-type and therefore propose to provide both de-average data (per geo-type) and aggregate data.

Decisions taken by the BIPT

The BIPT acknowledges that there can be great differences in investing in ducts and trenches depending on the geographical characteristics of different areas. However, the BIPT is convinced that these differences are especially important when modelling the access network. The investment costs of the local access network depending on a certain LEX (BU or RU) can then be categorised depending on the location of this LEX. Since the aim of the bottom-up model is to model the core network, the impact of geographical difference will be much less important. Therefore, the BIPT will use average investment costs for ducts and trenches. However, when evaluating the costs information in the 3rd consultation round, the BIPT will ensure that no relatively high urban investment costs will be extrapolated to the rest of the transmission network.

Question 2.2.20: The BIPT invites the industry to give its point of view with regard to the possibility of providing investing costs of providing the cross-connection of an E1 (port costs excl. digital cross connect investment).

Question 2.2.21: The BIPT invites the industry to give its point of view with regard to the possibility of providing investing costs of providing the cross-connection of an STM-1 (port costs excl. digital cross connect investment).

Question 2.2.22: The BIPT invites the industry to give its point of view with regard to the possibility of providing investing costs of digital cross-connects. If more technical details should be provided, please clarify.

Summary of the comments

Most operators remark that it is quite common that separate cross connect equipment is provided for cross connecting E1s on the one hand and STM-1s on the other hand. Moreover, for some operators/manufacturers, it could be more appropriate to seek the cost of complete "E1 cross connects" and "STM-1 cross connects" (i.e. of the distinct equipment and not only of the separate ports). They are convinced however, that – where possible - the investing costs of providing cross connection of an E1 (port costs excl. digital cross connect) should be provided.

One operator remarks that the investment granularity of a E1-cross connects is not the E1, but the line card (e.g. an STM-1 card for connecting two STM-1 rings). Therefore, it is important to take the occupancy rate into account when calculating the incremental investment cost in E1s.

With regard to the cross connects for STM-1 traffic streams, the operators believe that STM cross connects should be provided at a number of capacities (i.e. capable of handling multiple STM-1 streams). Depending on the manufacturer, it can be possible to provide the separate cost of an STM-port cost excl. the investment in equipment.

One operator is specifying that for the cross connection of 1 STM-1, there are two STM-1 cards needed: one card is required for the input STM-1 and another for the output STM-1.

Most operators believe that cross connects cannot be considered distinct from the E1 and STM-1 ports. Moreover, it is very unlikely that equipment is common to E1 and STM-1 cross connects.

Decisions taken by the BIPT

The BIPT acknowledges that there is not always a clear distinction between a fixed cross connect cost and a variable connect cost depending on the number of E1 and STM-1 ports. As already stated for the modelling of other network components, the BIPT will try to obtain information on the most detailed level possible. In its 3^{d} consultation document, the BIPT will formulate its questions on the cost drivers of the cross connects in such a way that all capacities needed can be modelled.

With regard to the occupancy rate, the BIPT will take into account the remarks made by the sector and questions will be asked on the granularity of cross connect capacity.

Question 2.2.23: The BIPT invites the industry to give its point of view with regard to the possibility of providing the (de)multiplexing investment costs.

Summary of the comments

Most operator remarks that it is appropriate to use ADM 4, ADM 16, … equipment for STM 4, STM 16 transmission equipment. They specify that, in order to insert or extract STM 1 traffic streams, appropriate ports (tributary cards) are required.

Decisions taken by the BIPT

The BIPT will model separate ports for inserting/extracting STM1 traffic streams in/out of higher SDH-systems. These ports will be part of the algorithms that translate the external demand into the network component quantities needed.

2.2.5 Modelling the signalling network

Question 2.2.24: The BIPT wishes to invite the industry to give its view on how the signalling network should be modelled and which investment parameters should be determined.

Question 2.2.25: The BIPT wishes to invite the industry to give its point of view on the possibility of providing investment costs for the signalling network following the above classification. If other fixed investment should be modelled separately (e.g. part of an IN-platform), please specify.

Summary of the comments

The majority of the operators agree that under a simplified approach, signalling point (SP) costs and signalling transfer point (STP) costs are best modelled by BHCA volumes. Some operators however pointed out that signalling processor costs have to be identified within the (local or tandem) switch processor. This might not be an easy task. One operator suggests that the BIPT preserves some flexibility for the purpose of modelling the signalling network.

One operator disagrees with the suggestion to use BHCA as a cost driver for investment in the signalling network. The operator argues that signalling links are usually under-used, that there is a great variance in the signalling volume per call and that there is also circuit depending signalling. Moreover, the operator noted that a star network (2 x 2 x n links for n nodes) with a redundant STP-function in the hub is a better solution compared to a meshed network.

Finally, one operator reminded the BIPT to the fact that, in order to calculate tariffs for IN calls, the model should be extended to include Service Control Points (SCP) and one or more Service Management System (SMS) nodes, with associated transmission paths.

Decisions taken by the BIPT

The BIPT has opted to model initially only the cost of a basic call set-up. These basic calls require the transmission of identical amounts of information over the signalling network. Therefore, the BIPT will develop the signalling model based on the methodology proposed in the 2nd consultation document. The investment cost "other fixed investment for the signalling network" will be further specified in the next consultation document.

The signalling network will be a separate logical network. However, equipment will be collocated with normal switching equipment and signalling transmission links will be physically shared with the rest of the transmission network. The BIPT has not yet decided on the logical transmission structure of the signalling network (meshed vs. star).

2.3 Node consolidation rules

Question 2.3.1: The BIPT wishes to consult the industry to determine the minimum size, measured in PSTN/ISDN connections that a Belgian local switch should have.

Question 2.3.2: The BIPT wishes to consult the industry to determine an 'optimal' ratio between the number of remote units and the sum of the total number of local switches and remote switches, for the incumbent. E.g. a ratio of 40 % would mean that out of a total of 100 nodes (local + remote), there would be 40 remote units and 60 local switches

Summary of the comments

A general conclusion is that none of the operators involved in the consultation process has any experience with the use of node consolidation rules in bottom-up modelling. Some operators questioned the importance of node consolidation issues as compared to the need of initially developing a robust structure for the rest of the model.

Should the BIPT however choose to implement node optimisation procedures, several approaches have been proposed. The first approach constitutes of determining the trade off between transmission costs and switching costs for each node. A second approach combines the two simple heuristic rules that were presented in the second consultation document. Under this combination, BUs could be turned in RUs (starting from the smallest BU) until a specific ratio of BU/RU is obtained.

A final remark concerns the fact that the BIPT only addresses optimisation of the BU/RU structure and that it does not mention any optimisation of the tandem layer.

Decisions taken by the BIPT

The development of a well-specified and robust bottom-up model that converts end-user demand into network requirements is the main priority of the BIPT. When this will be achieved, node optimisation issues will become important. The BIPT therefore proposes to handle this into more detail when the model will be in a further development phase and when the impact of node optimisation rules on the final results will become clearer.

With regard to the tandem layer, it is the BIPT's point of view that there is not much room for efficiency improvement left. The actual ratio of transit exchanges (16) versus local exchanges (245) is still fairly small when compared to international benchmarks. Therefore, the BIPT will not model any optimisation in the transit layer.

2.4 Network support investments

Question 2.4.1: The BIPT wishes to invite the industry to give its view on the above classification of indirectly attributable network investment costs and their ability to provide data on these.

Summary of the comments

All operators agree that the BIPT's approach to model indirect network investments is reasonable. Indirect investments are driven by direct network investments. One operator however notes that it may be difficult for some operators to provide the split between

switching costs, transmission costs and outside plant costs and that percentages should be given relative to total direct investment costs (not yearly).

Most operators agree that different sources of cost input should be used. These include existing SMP operator accounting data, benchmark data from overseas operators (taking into account the specific situation of these operators) and data submitted by operators in Belgium.

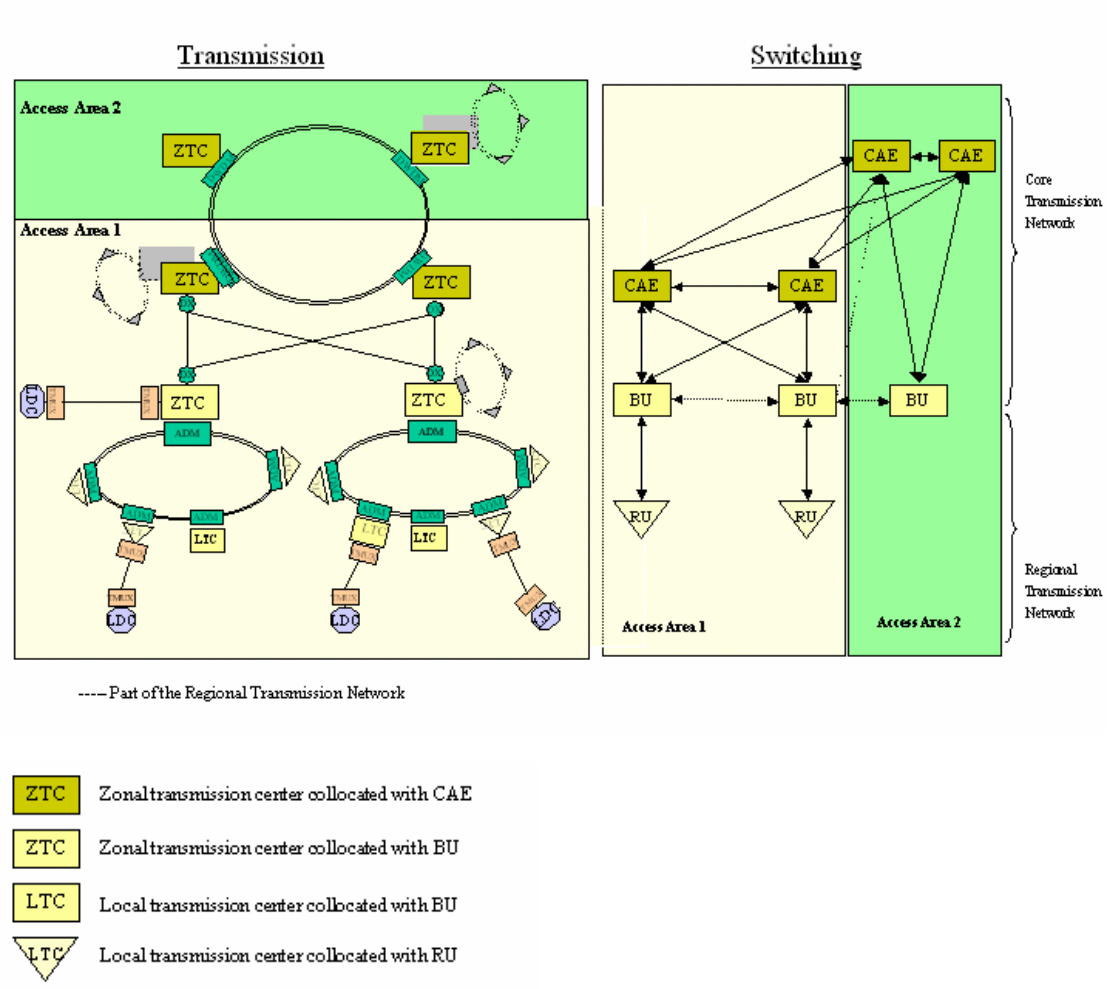
Decisions taken by the BIPT

The BIPT will adopt the indirect investment categories as proposed in the second consultation document. Percentages will be asked for relative to total indirect investment costs (not yearly). Whenever operators will not be able to provide data on a disaggregate level, aggregate data will be asked for.

Annex 1: Structure of the logical and physical network

Schematic overview of the transmission and switching network

The figure below illustrates schematically how the switching and transmission network will initially be modelled in the bottom-up model.



Structure of the transmission network

The physical transmission network will be divided into a regional transmission network and a core transmission network. The regional network is constructed by means of SDH-rings.

The core network links together the Zonal Transmission Centres (ZTCs). Its transmission paths may be partly collocated with the physical rings of the regional network. A part of SDH connections in the core transmission network are point-to-point, but the larger ZTCs will be connected with SDH rings built over a DWDM infrastructure- if it is economically justified.. The part of the core network made of point-to-point SDH connections is called the "normal core transmission layer" or "normal layer". The other part made of SDH rings over DWDM infrastructure is called the "express core transmission network" – or "express layer".

Two kinds of transmission centres are located on the regional rings: the Zonal Transmission Centres (ZTCs) and the Local Transmission Centres (LTCs). The ZTCs provide the connections of the regional rings with the core network. On top of this transmission function, a ZTC is almost always co-located with a BU.

All the CAEs are co-located with a ZTC. The BUs are co-located with a ZTC or a LTC. The RUs are co-located with a LTC or a LDC.

A LEX is always co-located with a ZTC or a LTC and can be made of RU(s) or BU.

Next to LEX-BUs and LEX-RUs, there are RUs installed in Local Distribution Centres (LDC) that are not located on a regional ring. However a point-to-point fibre connection is installed between the LDC and a LTC or a ZTC.[2] The transmission equipment necessary to provide the connection is called a TMUX.

The interconnection of the regional SDH rings and the core SDH network is done in the ZTCs by means of Digital Cross Connects (DX).

Structure of the switching network

The switching network has a two-layer logical hierarchy (= 2 switching levels). Remote Units (RUs) do not have switching capacity and depend logically on the Base Units (BU). Each BU is logically connected to at least the two Covering Area Exchanges (CAE) of its own area. A BU can be logically connected to another BU if this is justified by the traffic amount between them. On the physical level however, the connection will still be made using the existing transmission paths. A direct unidirectional connection between a BU and a CAE of a different access area can be installed (on the logical level) whenever this can be justified by the amount of traffic. The CAE includes the Access Gateway Exchange.

Collocation issues

Collocation of transmission and switching equipment

The CAEs are mostly collocated with BUs. All transmission centers are collocated with switching nodes (CAEs / BUs) or concentration nodes (RUs).

Collocation of transmission links of different network parts

The regional rings are common to the regional core and the backbone core network. The DWDM-rings use the existing infrastructure in the regional rings and in the meshed core network connections. Some trenches of the core network will be partially shared with trenches of the local access network.

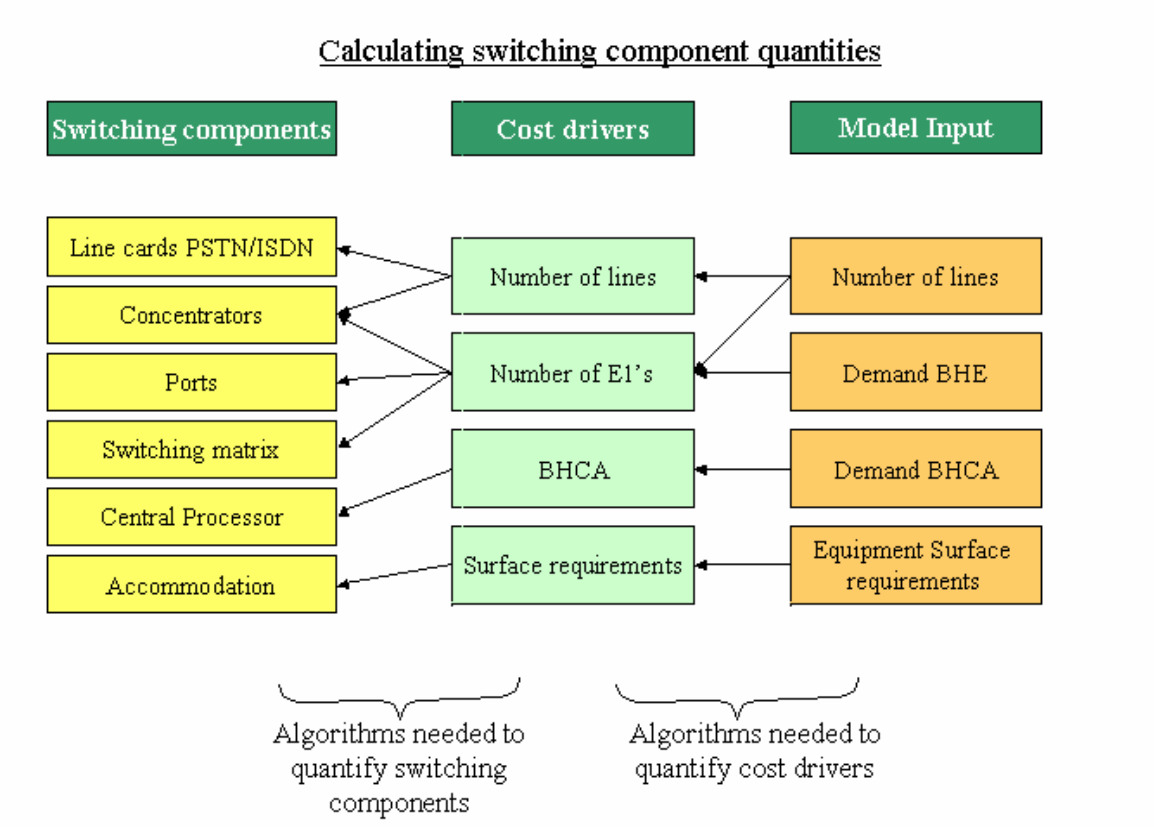
[2] This connection is called the 'junction network' and is fully part of the regional transmission network.

ANNEX 2: Network dimensioning algortihms

Calculating switching component quantities

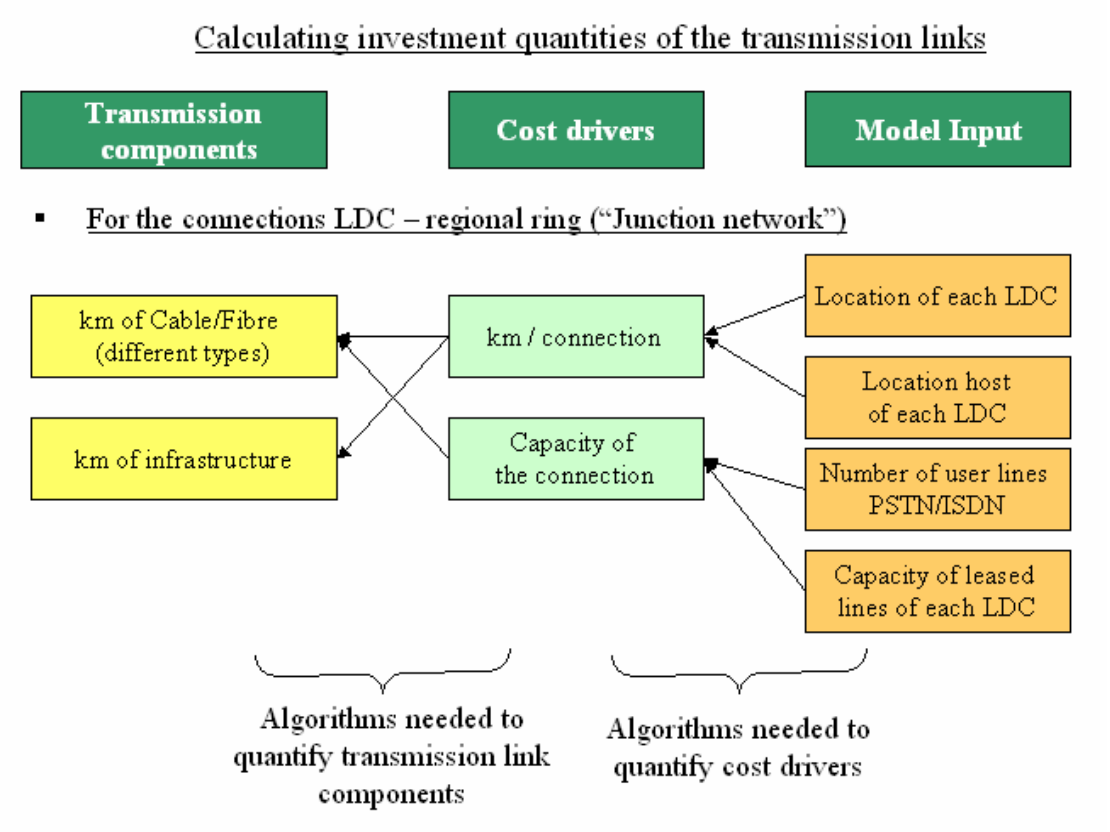
The figure below illustrates the logic of the switching dimensioning of the BIPT bottom-up model schematically. The figure should be read from the right to the left side. The right column illustrates the different input values that are needed to dimension the network. Based on these, cost drivers can be calculated (middle column). These cost drivers determine the amount of equipment that is needed for each component.

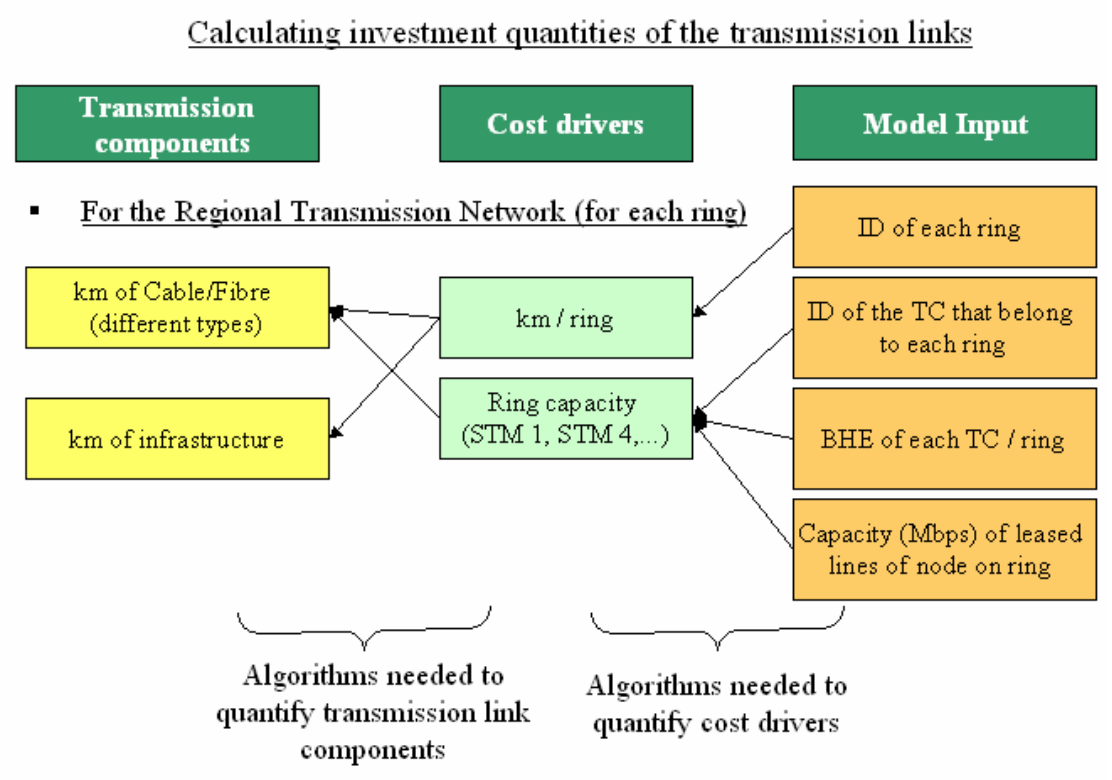
The arrows between the different columns represent decision rules or decision algorithms that are needed to calculate the exact quantities. These will contain several parameters such as utilisation factors, blocking ratios etc. These algorithms will be presented in the third consultation document for approvalby the operators.

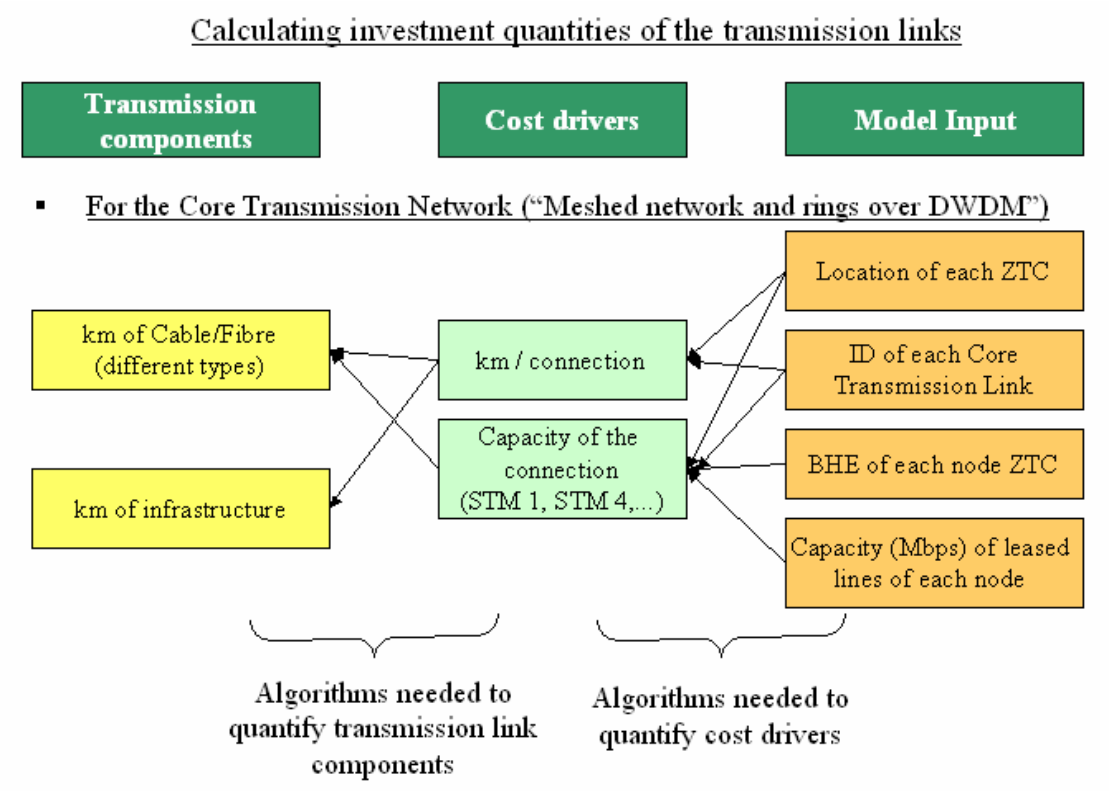


Calculating transmission component quantities

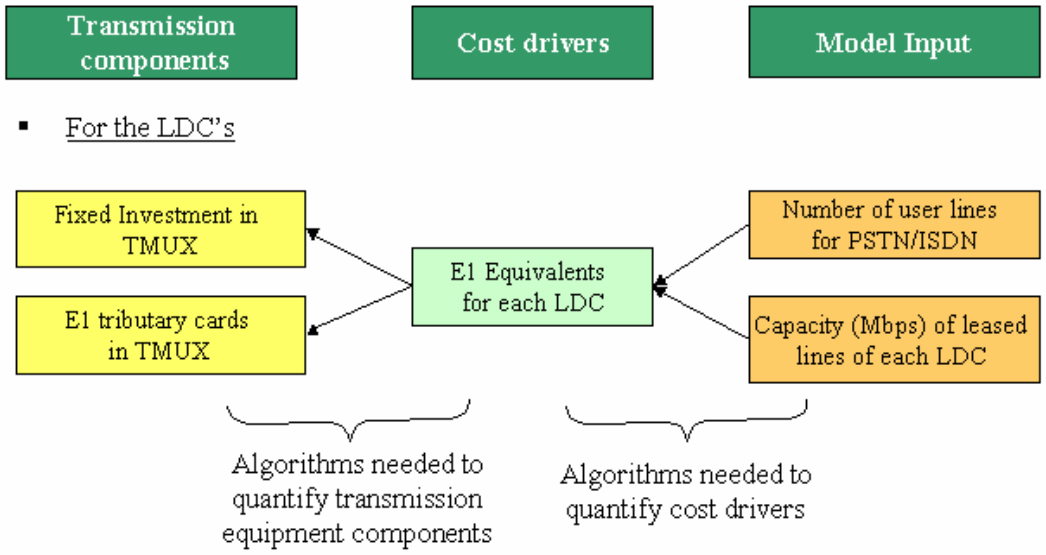
The figures below illustrate the logic of the transmission dimensioning of the BIPT bottom-up model schematically. The first three diagrams represent the algorithm flow to calculate the investment in transmission links. The next three diagrams specify how investment in transmission equipment will be conceptually calculated. The investment parameters for DWDM equipment may still be revised in the near future



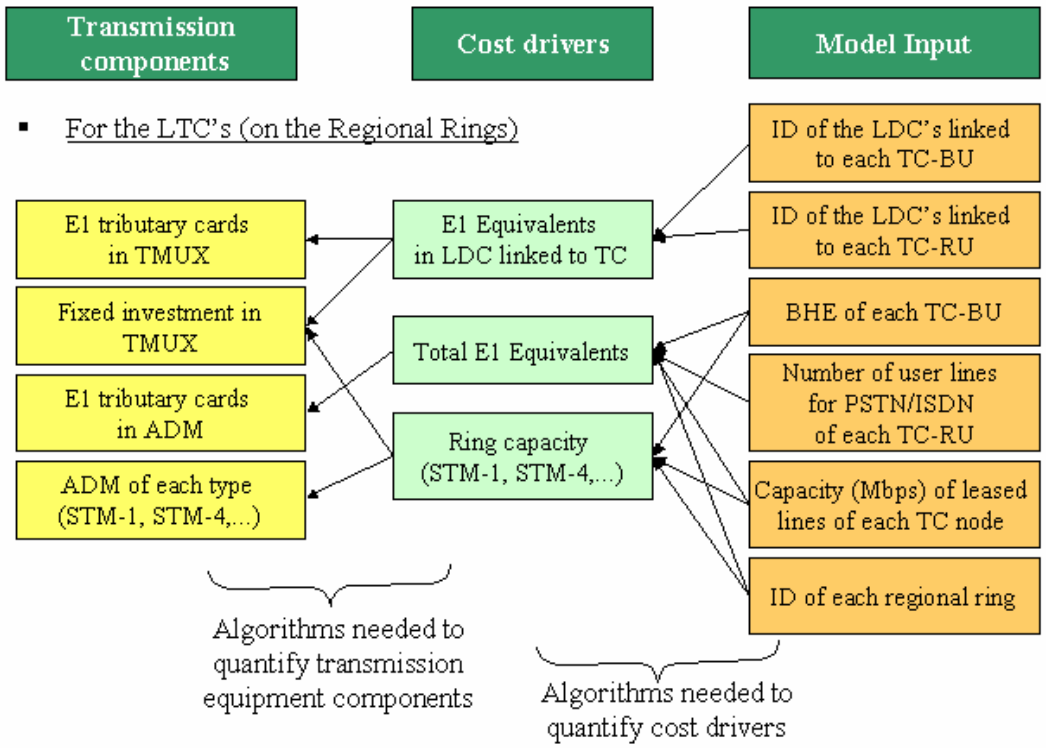

Calculating investment quantities of the transmission links
Transmission components
Cost drivers
Model Input
For the Regional Transmission Network (for each ring)
km of Cable/Fibre (different types)
km of infrastructure
km / ring
Ring capacity (STM 1, STM 4,...)
ID of each ring
ID of the TC that belong to each ring
BHE of each TC / ring
Capacity (Mbps) of leased lines of node on ring
Algorithms needed to quantify transmission link components
Algorithms needed to quantify cost drivers

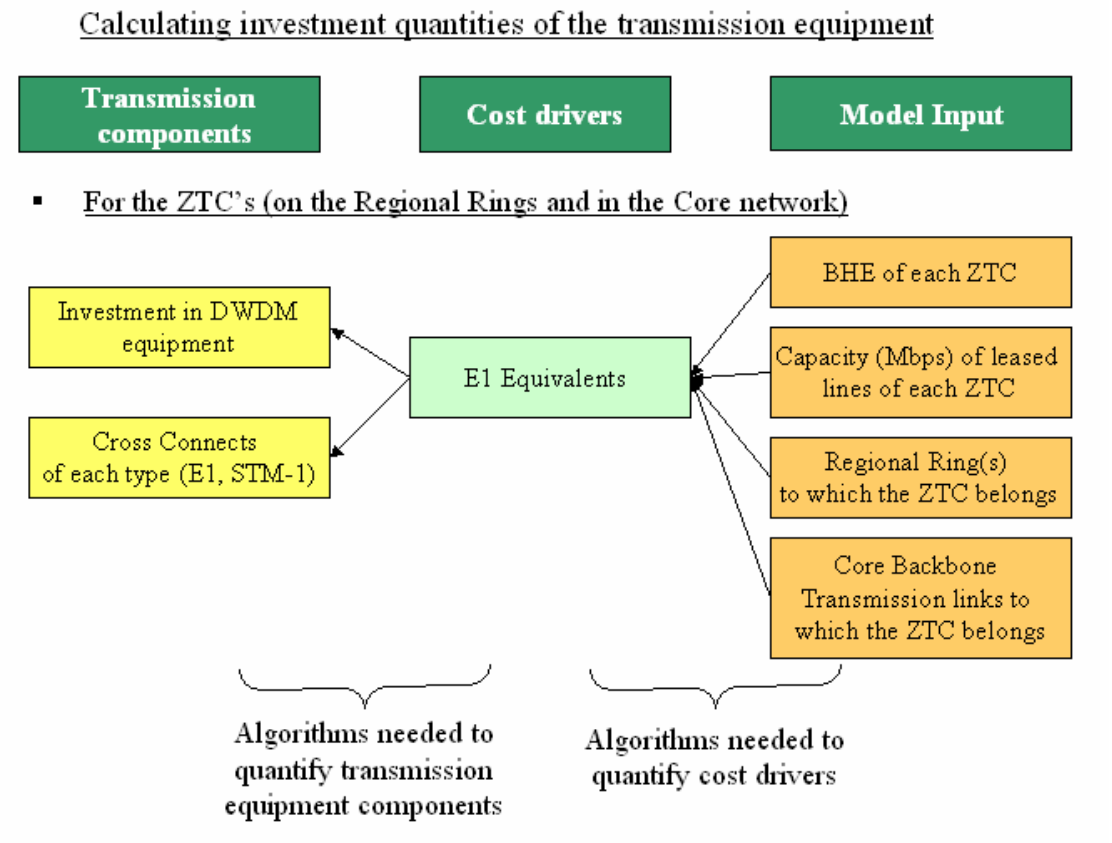

Calculating investment quantities of the transmission links
Transmission components
Cost drivers
Model Input
For the Core Transmission Network ("Meshed network and rings over DWDM")
km of Cable/Fibre (different types)
km of infrastructure
km / connection
Capacity of the connection (STM 1, STM 4,...)
Location of each ZTC
ID of each Core Transmission Link
BHE of each node ZTC
Capacity (Mbps) of leased lines of each node
Algorithms needed to quantify transmission link components
Algorithms needed to quantify cost drivers

Calculating investment quantities of the transmission equipment



Calculating investment quantities of the transmission equipment




Calculating investment quantities of the transmission equipment
Transmission components
Cost drivers
Model Input
For the ZTC's (on the Regional Rings and in the Core network)
Investment in DWDM equipment
Cross Connects of each type (E1, STM-1)
E1 Equivalents
BHE of each ZTC
Capacity (Mbps) of leased lines of each ZTC
Regional Ring(s) to which the ZTC belongs
Core Backbone Transmission links to which the ZTC belongs
Algorithms needed to quantify transmission equipment components
Algorithms needed to quantify cost drivers