LRIC Bottom-up model for interconnection

Consultation Document 2.0

Prepared by BIPT

In collaboration with Bureau van Dijk Management Consultants

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1. INTRODUCTION

On April 27 this year, the BIPT issued a consultation document in order to define the methodology to develop a bottom-up model for interconnection. On June 4, the BIPT published a summary of the answers that it had received with regard to the consultation, as well as the methodological decisions it had taken. These decisions were commented in further detail for the platform of telecom operators on June 24, by the BIPT's consultant, *Bureau van Dijk Management Consultants*.

This document constitutes the second consultation document. It addresses questions regarding the structure of the bottom-up model, the definition of the network elements and some decision rules that will be used to model a modified SMP operator's network. The BIPT is seeking view on several issues regarding these subjects.

For the majority of the questions in this consultation document, on which the BIPT is consulting the industry, the BIPT is not yet seeking numerical values for the parameters. Most of the questions concern issues related to the determination of the different network elements that will be modelled in the bottom-up model. The goal of these questions is to strictly define a classification and to check whether the relevant information could be provided by the different market players. Moreover, it is of crucial importance that all questions are understood clearly, as only standardised answers are useful. The third consultation document will address issues related to the actual values of the input parameters of the model.

The first chapter of this document – modelling the network – will discuss the structure of the bottom-up model as proposed by the BIPT. Topics concerning the required level of aggregation, the infrastructure to be modelled, node consolidation rules and network investment parameters will be addressed. The second chapter – cost of capital and operating costs – will briefly deal with some other parametrical issues. The last chapter – planning - contains practical information about the planning of the responses and the name of the contact person.

The BIPT asks that reference be made to the relevant question numbers from the consultation document. Comments that do not relate to a specific question can be added in a separate section. To facilitate the task of analysing the comments, the BIPT invites the industry to group their comments as much as possible.

The BIPT also asks that it is clearly indicated what part of the comments is considered as being confidential business information. The BIPT will not include confidential business information in the summary of the comments.

2. MODELLING THE NETWORK

There are several possible ways of structuring the relevant elements in a bottom-up model for interconnection. One of the most important choices that hast to be made concerns the level of detail that is used to construct the cost-model. This chapter first takes a closer look at the level of aggregation of the technical input-information (and the structure of the model). Next, the proposed degree of detail with regard to the network components will be presented. Finally, we will discuss node consolidation issues.

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

When choosing a level of aggregation for modelling the network nodes and the transmission channels between these nodes, several possible options can be considered. The first option only uses general aggregated data. The second option takes into account some specific geographic characteristics and the third option uses detailed information as a starting point to model the network.

2.1.1 Option 1 : use of aggregated data

The first option models a telecom network starting from average traffic and topologic data. This option starts from the actual number of nodes of the network and optimises the network by shifting local switching to remote switching. However, there is no individual information available on which local switch has become a remote switch since the aggregated data is the starting point. The decision with regard to the shift from local to remote switches is mostly based on an 'acceptable ratio' between local and remote switches. Costs are then calculated on average cost assumptions with regard to prices and the geographic distribution of the network nodes and traffic. The determination of the transmission investment is also based on average figures. No information regarding the actual transmission paths and their capacities is used.

The main advantage of this approach lies in its simplicity. Only aggregated data on the switches, the traffic and demand is required, which results in a relatively simple model structure. However, the results of these kind of models are very difficult to reconcile with the financial figures, used in the top-down model. The main reason for this is that an aggregated model does not take into account specific market characteristics such as demand profiles that may vary according to their geographic location. Next to this, the results of these models are highly criticizable given the large number of assumptions taken and the poor concordance with the actual network of the operator.

2.1.2 Option 2 : use of geo-types

One way to take into account, i.e. to a certain extent, the existence of several demand types and different geographic profiles, is to work with geo-types. This implies a subdivision of the network and demand data into several profiles that are defined by their geographic characteristics. This counters some of the disadvantages that are inherent to 'Option 1'.

This option already acknowledges that the existence of different geographic profiles has an impact on the topology and the cost structure of the network. In practice, three different geo-types are often used: metropolitan, urban and rural. E.g., housing costs will typically be higher in metropolitan areas than in urban and rural areas. However, the number of customers connected to local and remote switches in metropolitan areas will also be higher than elsewhere, resulting possibly in a lower per subscriber cost. The use of geo-types results in a model that is closer to the real (cost) structure of the network of the SMP operator than the model of ‘Option 1’.

There are however also considerable disadvantages to this approach. When shifting the functionality of the local switches to remote switches, one still has to make use of certain ratios. They can be different for each geo-type, but they will not take into account specific characteristics of the individual nodes. Again, this approach remains very theoretical. Especially with regards to the demand in the nodes, the aggregated date (possibly per geo-type) results in a distorted image of the real network situation, which weakens the credibility of the model. Moreover, larger cities such as Brussels might require a separate approach.

2.1.3 Option 3 : use of detailed node information

Option 3 uses the actual network configuration of the SMP operator as a starting point. It requires information regarding all the separate nodes with regard to the number of lines connected, the identification of the transmission links between the nodes, the lengths of the cables, etc.

With this approach, almost no aggregate network information is used. Every single node will be introduced in the model and demand will be established on a per node basis. When modelled like this, network optimisation can happen at the node level. This means that once the optimisation has been finished, the model will show exactly which local switch has become a remote switch. With regard to the costs of transmission, an aggregated approach that uses geo-types can still be used to estimate transmission costs when detailed information is not available.

Option 3 has several advantages. First of all it creates a realistic and detailed view of the network to be modelled and the improvements that can be made at the node level. The availability of information at node level makes a lot of hypotheses, that would be needed in an aggregated model, redundant. This may have a positive impact on the general acceptance of the model. Next to this, the transparency and concordance with a modified ‘real’ situation will improve the quality of the results. Finally, a suchlike approach facilitates a transparent reconciliation process with the top-down model for interconnection since the impact of the optimisation process can be isolated more easily. This provides the regulator with an excellent tool to simulate realistic efficiency gains at the network infrastructure level. Any small additional effort in this approach would be more than offset by the improved value of the model.

The main disadvantage of a model that uses detailed node and transmission information is often the difficulty to obtain the high quality information needed to feed the model. Moreover, a model that contains confidential information of the SMP operator’s network, especially with regard to demand in every node, requires special attention to separate the confidential with the non-confidential information. This will slightly increase the complexity of the cost model.

2.1.4 BIPT proposal for a data structure

The BIPT proposes to construct a cost model that is based on the detailed node information provided by the SMP operator. The BIPT has already verified that this information is available and useable in order to construct a bottom-up model. A possible data structure of the bottom-up model is presented in **Figure 1**.

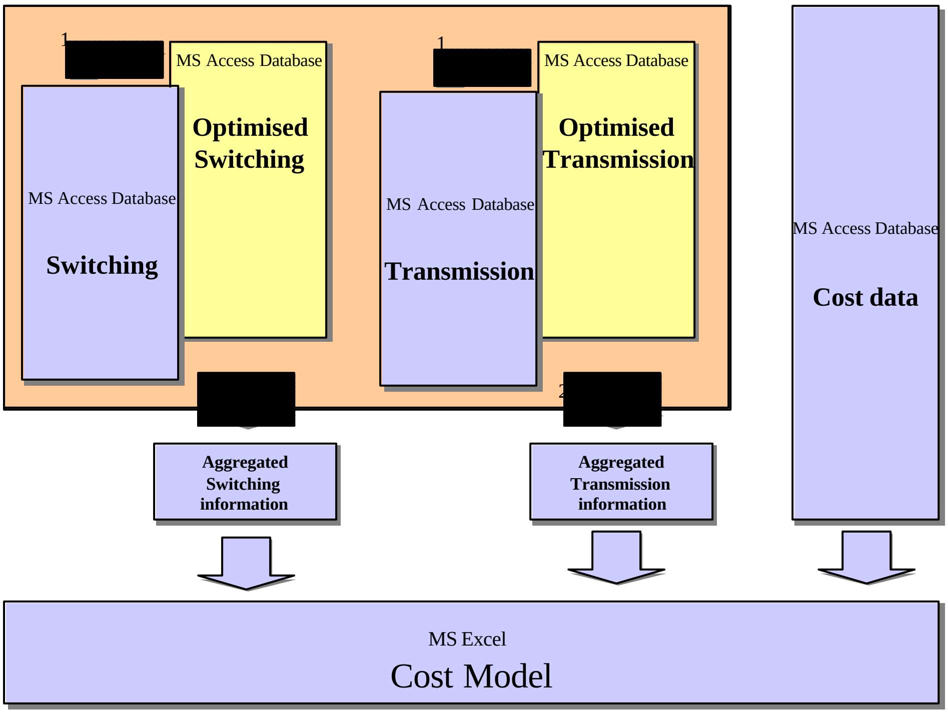

Figure 1: possible data structure

The figure shows that the network data will be stored in a Microsoft Access Database. This database will contain detailed information about the actual switching nodes and transmission links. Starting from this database, a second database will be created that contains the information about the switching nodes and the transmission links after they have been optimised to reflect the 'modified scorched node' approach for which the BIPT has opted. This optimisation will also take into account future growth provisions.

Using this approach, at all times, it will be clear for the BIPT and the SMP operator which switches have been consolidated and there will be a perfect view on the optimised structure of the SMP operator's network. Moreover, the impact of the modified scorched node approach on the cost structure of the network will be relatively easy to isolate. This will facilitate the reconciliation process.

Starting from the optimised network database, forms with aggregated data about the number and capacity of nodes and transmission lines can be generated and can then be used for the actual cost calculations. The difference between this aggregated information and the aggregated information used in option 1 and option 2 is significant. Under option 1 and 2, the aggregation is made on the basis of global figures, such as the total number of nodes and total demand etc. The aggregated data in option 3 is constructed on the basis of the unaggregated network data (individual node and transmission data). This results in information that is much more reliable because it guarantees a viable technical situation that can be attained by the SMP operator.

Because of confidentiality issues, the BIPT proposes to work with this kind of aggregated data. It has to be clear that the actual node and transmission databases remain confidential, since they contain market sensitive information. The cost database will not be confidential, provided that the responses to the BIPT's consultation with regard to costing issues (consultation document 3.0) and the format of these responses will ensure the construction of a cost database that will guarantee the anonymity of its sources. The aggregated data, based on the individual node and transmission information will thus be the input in the actual cost model, which will probably be constructed using Microsoft Excel software.

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

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.

2.2 Infrastructure to be modelled

These paragraphs look in further detail into the physical network parts that need to be modelled. First of all, we will propose some technological assumptions that will be made while constructing the model. Next, we will discuss the general structure of the network as it will be modelled. Finally, we will define the components that are needed to model the switching network and the transmission network.

In this consultation document, the BIPT is not asking for any quantitative data with regard to prices and volumes. These topics will be addressed in the third consultation document. However, one of the goals of this document is to acquire a thorough understanding of the network components that need to be modelled and to counter problems that might arise when filling up the model with actual figures.

2.2.1 Modelling assumptions

When constructing a bottom-up model, numerous assumptions have to be made. The basic methodological issues have been addressed in the first consultation document. However, there are also a variety of technological choices that have to be made which can have a significant impact on the design and the results of the model. We will discuss these elements in the following paragraphs.

a) Location of the main distribution frames (MDF)

The BIPT has opted, after consultation of the market, for a *'modified scorched node'* approach to model initially, the core network. This implies that the MDF-locations will follow those of the existing network architecture, as the possibility of restructuring the local access network, which is beyond the scope of the initial model, is very limited. Moreover, restructuring the local access network will be a very complex and lengthy process. This does not mean that there will be no optimisation at the node level, since node consolidation will take place by replacing local exchanges with remote concentrator units.

b) Use of digital technology

A bottom-up LRIC model must be forward looking and take account of likely improvements in technology in the next 3 to 4 years. The network that will be modelled will be completely digital. This means that in every exchange, digital technology will be used for switching. The public telephone network will still use circuit switching. No packet-switched voice telephony will be modelled at this stage of the model as it is not expected that voice over IP will be in general use in the period covered by the model. Packet-switched data services such as X.25, frame relay and ATM have their own network nodes.

c) Transmission technology

With regard to transmission systems, SDH technology will completely replace the older PDH technology where still used by the SMP operator during the period covered by the LRIC approach. In the local junction network[1], connection is established by fibre rings from which the circuit demand of the individual access areas is extracted by means of add-drop

[1] Regional and local links

multiplexers. At the upper levels of the transport network, digital cross-connects are used as nodes. Demand for circuits is integrated up to STM-1 level and above. If appropriate the use of STME-64 systems will be included.

d) Network integration

Today's rapid technological evolution has enabled the provision of, integrated voice and data switches combined with cross-connecting capabilities. At some point in the future, circuit switching may be entirely replaced by integrated packet switching technologies. However, discussions about the maturity and cost effective nature of these technologies for voice traffic are still just discussions and it is therefor that the BIPT has opted not to develop an entirely integrated voice and data network. This implies that the model will assume that the ATM-network, at the switching layer, is provided solely for special services. In other words, there is no network integration at the switching layer with the data network. At the transmission level, the model will take into account the existence of network integration. Figure 2 illustrates this schematically.

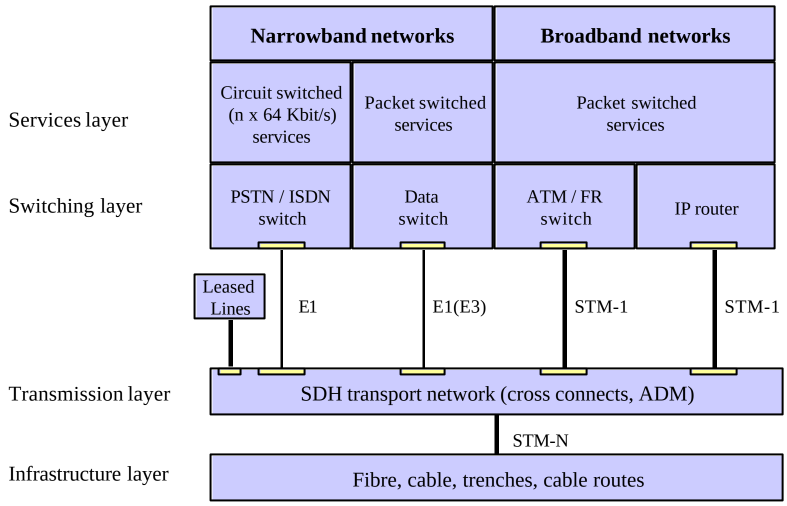

Figure 2: network layers and degree of integration, source WIK

A final remark concerns the sharing of the infrastructure layer with the local access network. When optimising the model, partially shared infrastructure with regards to trenches and ducts will be taken into account. The exact allocation of these costs to local access and core network will be addressed in the third consultation document.

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

2.2.2 Structure of the logical network

The logical network in the model will be decomposed into three hierarchical levels. The lower level will be constituted of remote exchanges, also called remote concentrator units (RU's). The second level will consist of the local exchanges or base units (BU's). The third level will be the transit level which is constituted of covering area exchanges (CAE's). The BIPT has opted for this network structure since it reflects best the optimal situation that the SMP operator should be able to obtain within the next few years. Figure 3 summarises this structure schematically.

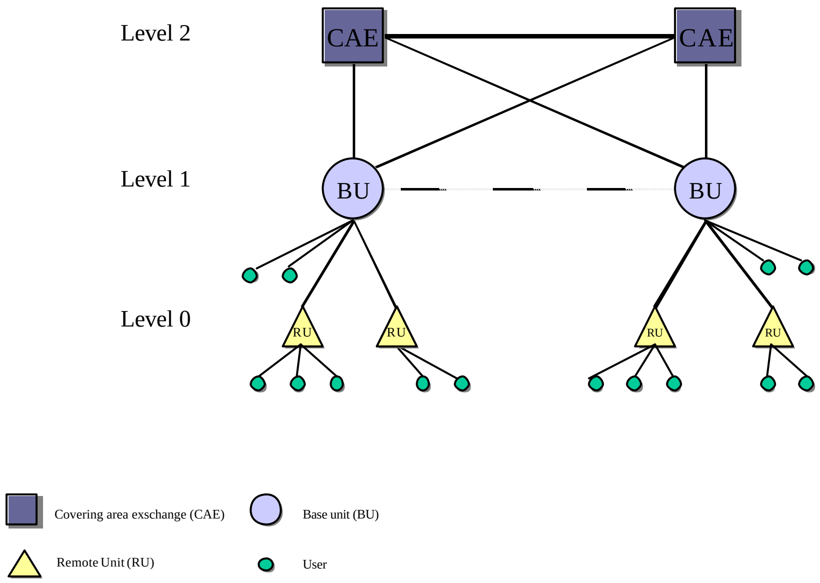

Figure 3: network architecture used in the model

As already mentioned in paragraph 2.1.4 'BIPT proposal for a data structure', the model will first optimise the switching structure by replacing several base units by remote units. The rules for this optimisation process will be discussed in further detail under paragraph 2.3.

With regard to the transmission structure, the BIPT proposes in a first approach to model the existing transmission paths. Reconfiguring the transmission paths would be a complex and lengthy process that would delay considerably the outcome of the results. Modelling the existing paths will significantly speed up the modelling process. Moreover, this will also facilitate the reconciliation process.

This does not mean however that the capacities of the transmission paths that will be modelled, are those that are actually installed by the SMP operator. The model will calculate, taking into account desaggregated demand data and growth provisions, the optimal capacity that is needed for a specific transmission path. In a next phase, an evaluation can be made whether a redesign of the transmission paths is considered necessary.

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

2.2.3 Modelling the switching network

This paragraph will try to define the elements of the switching network that will be taken into account in the model. Starting from the demand volumes in a specific node, the investment cost for all of these elements will be established. Only elements that are necessary to perform the core task of the exchange, i.e. the on demand, end-to-end provision of 64 Kbit/s channels between two subscribers, a subscriber and a trunk or two trunks[2], are to be considered.

FUNCTIONS OF THE SWITCHING NETWORK

The investment in the switching network is a function of the number of subscribers directly or indirectly connected to the exchange, the number of call attempts derived from the traffic (in Erlang) carried by the exchange, and the number of E1 groups from the exchange to the core network. In defining the investment parameters, it is important to keep in mind that only those features are taken into account that are necessary to provide interconnection services to interconnected operators.

It is of crucial importance for the acceptance of the model that an aggregated manner of representing the different switching functions is defined. Figure 4 illustrates the basic functions of an exchange schematically.

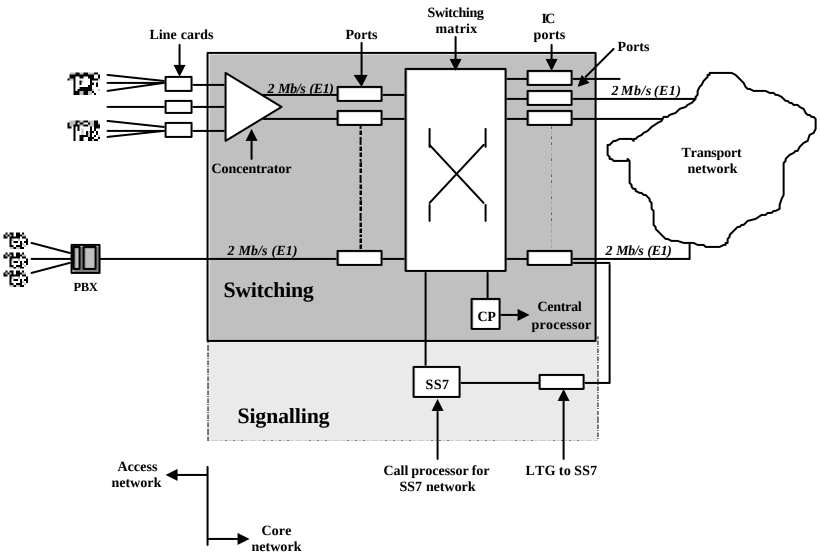

Figure 4: basic functions of an exchange, source WIK

Once the different switching functions have been defined, the gathering of cost information for each of these functions can start. This cost information will be the subject of the third consultation document. However, before this cost information gathering, all parties should have a clear understanding of the different switching functions that will be modelled and the

2 *Wissenschaftliches Institut für Kommunikationsdienste (WIK)*, Analytical Cost Model National Core Network, Consultative Document 2.0, 30 june 2000

format in which this will be done. The BIPT proposes the classification below, based on previous research of WIK[3].

Investment parameters for remote concentrator units (RU's)

- Investment in the connection of an analogue subscriber line (per user);
- Investment in the connection of an ISDN basic rate access (per user);
- Investment in concentrators per E1 group;
- Investment in ports to the switching matrix per E1 group;
- Investment in processor capacity (software and hardware) per 1.000 BHCAs (busy hour call attempts);
- Investment in switching matrix capacity per E1 group;
- Investment in accommodation assets (floor space) including air conditioning, power supply, etc… per switch;
- Other fixed investment in switching components and functions not covered by the above parameters per switch.

a) Line cards

The line card is the interface between the physical connection to the subscriber, mostly copper pair, and the exchange. The line card transfers the line signal, tests the line and supplies power to the connected terminal equipment. Since the investment in line cards is determined by the number of users and not determined by traffic, the cost of the line card should be fully allocated to the subscriber line network. The cost of the line card should thus not be taken into account for interconnection purposes.

However, there are some difficulties with this approach. The BIPT has understood that in some cases, the SMP operator does not know the exact supplier price of a line card, because of the fact that the list prices for line cards include other costs, such as switching costs, concentrating costs, etc.. This would make it very difficult to obtain a correct view of the cost of a line card and would require allocation rules which take this effect into consideration.

There is a second important reason to gather information about line card costs. There are several costs that are shared between the subscriber line network and the core network, e.g. power supply, air conditioning, etc.. The directly attributable costs (such as the line card investments) can be an acceptable yardstick for splitting the common costs. These cost drivers will be discussed in the last consultation document. It thus make sense to include the cost of the line cards into the bottom-up model.

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.

[3] *WIK*, Analytical Cost Model National Core Network, Consultative Document 2.0, 30 june 2000

b) Concentrators

The main function of a concentrator is to bundle the subscriber traffic. This traffic is then converted into E1 groups before is goes to the 2 Mbit/s ports. The BIPT proposes to include the investment cost of concentrators per E1 group.

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.

c) Ports for E1 groups

A port is the common interface between an E1 group from the core network or a customer-facing concentrator and a switching matrix.[4] The BIPT proposes to calculate the investment cost of ports per E1 group.

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.

d) Switching matrices

The task of a telephone switching matrix is the establishment on demand, of an individual connection from a desired inlet to a desired outlet user for as long as is required for the transfer of the information.[5] In other words, the switching matrix provides 64 Kbit/s user information channels between incoming and outgoing lines. The BIPT proposes to calculate the investment of switching matrix capacity per E1 group.

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.

e) Central processor

The central processor controls the switching matrix. It consists of one or more micro-processors. The central processor has several tasks. Its mains tasks are to configure the switching matrix according to the signalling information and to monitor the matrix for the duration of the call. The central processor also contains routing and charging functionality. Since the processor is used, irrespective of the completion of the call attempt, the BIPT proposes to calculate the investment in the central processor per 1.000 BHCA (busy hour call attempts).

[4] WIK, ibid.

[5] ITU definition

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.

f) Accommodation assets

Accommodation assets comprises several investments. It includes investments in buildings, false floors or cable racks, air conditioning, lighting, power supply, fire and lightning prevention. These investments are also common to the access and core network. Moreover, a split of these costs to the switching network and transmission network has to be made. This will be addressed in more detail in the final consultation document. The BIPT proposes to provide these costs on a per LEX basis.

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.*

g) Miscellaneous

Finally, all other costs that have not been explicitly specified in the above categories have to be determined. These include e.g. investments in control terminals, traffic meters, data storage systems, etc. The BIPT proposes to add an additional cost per exchange to take into account all other unspecified costs that are necessary for the provision of interconnection services.

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.

The BIPT realises that it is a difficult task to separate the costs of the different functions of an exchange. Subject to the comments made by the different market players on this parameterisation, a different list will be used. However, the above classification seems to be an appropriate trade-off between the benefits of working in detail and the difficulty in gathering and modelling detailed information.

The BIPT wishes, if appropriate, to use the same parameterisation for the remote concentrator units, the local switches and transit switches (AGE's).

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.

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 desaggregated 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.

2.2.4 Modelling the transmission network

This paragraph will try to define the elements of the transmission network that will be taken into account in the model. Starting from the traffic data on a specific route, the investment cost for all of the elements will be established. The BIPT would like to repeat that, in this version of the model, the existing transmission paths between the different 'optimised' nodes will be modelled. A complete redesign of the transmission network is at this stage of the model not feasible within the strict time schedule that the BIPT wishes to maintain. However, the capacities of the different transmission paths will be adapted to reflect the cost structure of an efficient operator.

In the following paragraphs, a parameterisation of the different investment costs in the core network is presented. First we will look at local junction transmission in the access level of the network. Next we will discuss transmission in the backbone level of the core network. The BIPT is seeking comments on this classification. The values of the cost parameters will be the subject of the third consultation document.

ACCESS LEVEL OF THE CORE NETWORK

The access level of the local junction network comprises the remote concentrator units, the add-drop multiplexers and the SDH-rings. We are making the assumption that in a specific area, all users are connected either to a local exchange or to a remote concentrator unit and that no switching is performed at the remote locations. This implies that all the traffic in this specific access area goes to the local exchange covering this area.

All line termination units and all concentrating units are installed in the main distribution frames of the remote access areas. The connection of the concentrators to the fibre rings is established by the add-drop multiplexers (ADM). The fibre rings are self-healing, which implies that the rings will have to be dimensioned to carry the traffic of all the nodes connected to this specific ring. Specific issues on dimensioning the rings will be dealt with in the third consultation document.

Using the investment parameters, determination of the cost of interconnection for the access level of the core network should be possible. The list below, based on previous work of the WIK in Germany[6], proposes a classification for the investment parameters for the ADM and the outside plant.

<u>Investment parameters for ADM and outside plant</u>

- Investment for inserting/extracting one E1 to/from an ADM-x [7];

[6] WIK, ibid.

[7] The 'x' will take several values. We will thus seek investment values for ADM-1, ADM-4, ADM-16, ADM-64

- Fixed investment in an ADM-x;
- Investment in one kilometre of fibre (excl. other costs such as duct, cable, trench, …);
- Investment in one kilometre of cable[8] (excl. other costs such as fibres, duct, trench, …);
- Investment in one kilometre of infrastructure including tubes, ducts and trenches.

a) Insertion / extraction of E1 to/from ADM

Subscribers are connected to the SDH-ring by means of add-drop multiplexers (ADM) at each access node site. The ADM provides the insertion/extraction of the 2 Mbit/s streams into/from the STM-signal. To provide this connection there are investments that have to be made in 2 Mbit/s interfaces. These may vary according to the STM-signal used in the ring.

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.

b) Fixed investment in ADM

The ADM provides the connection of the E1 with the SDH-ring. Depending on the hierarchical level of the SDH-ring, e.g. STM-1, STM-4, …, fixed investments are incurred with the provisioning of the ADM material.

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.

c) Investment in fibre

Since the BIPT bottom-up model will calculate cost for self-healing SDH rings, two fibres will always be necessary per access ring. The costs of these fibres can be fully allocated to the E1 groups for narrow band services, which may include leased lines. Other fibres can be used for broadband services. The BIPT has opted to model fibre costs separately from cable costs, since cable costs could be allocated partially to switched services, leased lines and broadband services.

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.

[8] One cable can contain several fibres

d) Investment in cable

One cable can contain several fibres. Some of these fibres may be used solely for narrow band services while others may be used for broadband services. The BIPT therefor wants to model cable investment separately from fibre investment.

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.

e) Investment in infrastructure

Apart from investment in cables and fibres, the investment in infrastructure has to be modelled as well. This comprises investment in trenches, ducts, access points and tubes.

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.*

The BIPT realises that it might not be possible to provide all costs separately. However, the proposed classification seems to be an appropriate approach. Depending on the Industry's' responses, alterations to the above list of investment categories might be made.

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 STM regenerators), the BIPT would like to receive a description of these.

A final remark concerns the use of geo-types for infrastructure costs. The BIPT would prefer to model an average cost for trenches and ducts since there is no geo-data available on the different transmission paths. However, the BIPT would like to have the point of view of the industry on this. The problem of the shared use of the local junction network with the copper access network will be addressed in the third consultation document.

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

BACKBONE LEVEL OF THE CORE NETWORK

The backbone level of the core transmission network comprises the digital cross connects that are linked to each other with optical fibre and the associated infrastructure such as conduits, trenches etc.. Investment in backbone transmission is largely shared with other services such as broadband data services and leased lines. In the following paragraphs we will try to define the different components that are relevant for interconnection services in the backbone level of the core network. The BIPT is, at this stage of the modelling, not interested in specific values for the investment categories, as these will be determined on the basis of the third consultation document.

The list of investment parameters below constitutes the BIPT's proposal for a classification of the investment parameters in the backbone level of the core transmission network.

Investment parameters for backbone level of the core transmission network

- Investment in cross-connecting an E1 in a digital cross-connect;
- Investment in cross-connecting an STM-1 in a digital cross-connect;
- Investment cost of digital cross connect.;
- Investment in multiplexing and electro-optical conversion of N STM-1.

a) Cross-connection of an E1 in a digital cross-connect

The transport nodes in the network consist of digital cross connects. These digital cross connects route E1 groups to switch units or they crossconnect these lines between incoming and outgoing STM-1 frames. In practice, this means that there is some kind of 'switching' that takes place on a permanent basis controlled by network management.

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).

b) Cross-connection of an STM-1 in a digital cross-connect

STM-1 connections are digitally cross-connects to provide routing from one node to another in the transmission network. The BIPT wishes to determine the investment cost of cross-connecting an STM-1 in the backbone network.

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).

c) Investment cost of a digital cross-connect

The BIPT wishes to determine the fixed cost of the provision of a digital cross-connect, without the provision of any ports, since these costs are calculated separately.

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.

d) Investment in multiplexing and electro-optical conversion of N STM-1

Higher levels of the synchronous hierarchy in SDH are formed by byte-interleaving the payloads from a number N of STM-1 signals, then adding a transport overhead of size N times that of an STM-1 and filling it with new management data and pointer values as appropriate. This results in STMs integer multiples of four (STM-4, STM-16, …). However, when cross-connecting these signals, equipment is needed to provide this conversion.

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.

With regard of the infrastructure costs, the BIPT proposes to use the same fibre, cable and duct cost categories and values as determined in the local junction level of the network. If any other relevant costs would not have been mentioned above, the BIPT welcomes a description of these costs.

2.2.5 Modelling the signalling network

The signalling system transfers dialling information between the different exchanges. It initiates the charging systems and processes call control information. The switching system facilitates thus the connection and disconnection of the 64 kbit/s user-information channels. The signalling information uses separate channels for its transmission. On average, several hundred user-information channels can be transmitted on a single 64 kbit/s signalling channel.

The signalling network is logically an independent network with its own nodes. It is an integrated network at the information transfer level into the SDH transport level. The information is mostly conveyed via one channel within an E1 group. At the logical level, the signalling information is thus completely separated from the 64 kbit/s user information channel.

It is the intention of the BIPT to model the signalling network separately as this would increase the transparency of the signalling costs to the market. Therefor, it is necessary to define all the important switching components, based on the ITU Signalling System No 7 (SS7) standards.

ARCHITECTURE OF THE SIGNALLING NETWORK

The switching nodes in a signalling network can be divided in two main categories. The first category comprises the signalling points (SP). These are nodes in which the signalling information is processed. All local and transit switches hold this functionality that is provided by their call processor.

The second category comprises the signalling transfer points (STP). These nodes do not provide processing functionality. Their task is to provide signalling channel switching. The STP's will often be located in transit exchanges.

Figure 5 illustrates a simplified basic structure of the signalling network schematically where the STP's are located in de transit exchanges. Every SP is connected to two STP's to ensure quality of service by avoiding single points of failure. This is the structure that the BIPT would like to adopt in the bottom-up model.

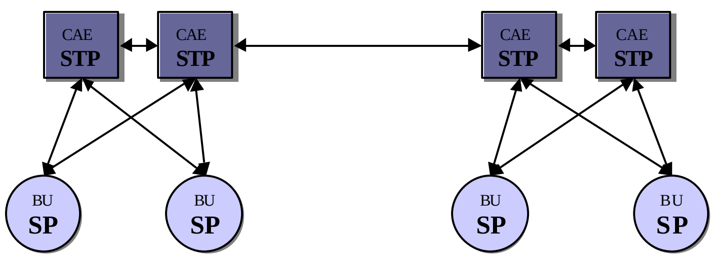

Figure 5: architecture of the switching network

The exact SS7 procedures are rather complex given its variety of parameters. The BIPT proposes therefor to model a 'simplified' investment calculation in which the number of call attempts is taken as the key cost driver for investment in the signalling network. Even with this simplification, the model should be able to provide a fairly accurate picture of the cost of an efficient signalling network. The BIPT assumes that it is possible to determine an investment figure per BHCA and proposes the classification below to determine the investment costs in the signalling network.

Investment parameters for the signalling network

- Investment in a signalling point per 1.000 BHCA;
- Investment in a signalling transfer point per 1.000 BHCA;
- Other fixed investment for 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 (ex. part of an IN-platform), please specify.

2.3 Node consolidation rules

The modified scorched node approach for which the BIPT has opted requires a 'node modification' or 'node consolidation'. Node consolidation is the process under which for each local switch, a consideration has to be made whether it would not be more cost effective to transform it into a remote concentrator unit. If a local switch becomes a remote unit, this means that processor and switching capacities of the switch would be removed and that the remote unit would become dependant on another base unit (local switch). Figure 6 illustrates this schematically.

The decision of whether or not a specific local switch should become a remote unit is, for an existing network operator, a rather complex analysis, given the large number of parameters. A comparison between switching costs and transmission costs has to be made. The determination of the switching costs however involves an analysis of supplier contracts, new technologies and the current technical and accounting status of the switching material. The BIPT wishes not to analyse all the decision rules in such detail, given the limited time schedule it has to adhere. Therefor it is seeking simple decision rules that can be used to determine when a local switch should become a remote unit.

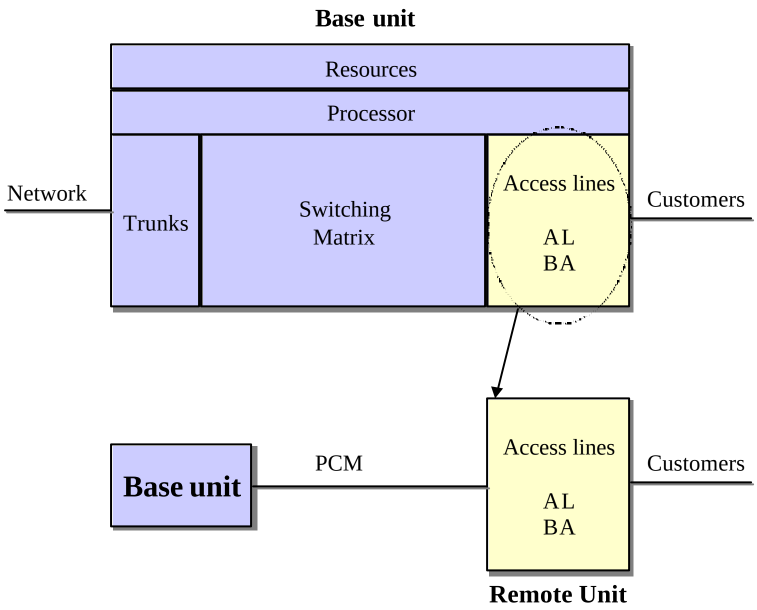

Figure 6: node consolidation principle, source Belgacom

The approach that is taken with regard to these decision rules in other bottom-up models is often simple. Two main methodologies are being used.

The first method determines a minimal size that a local switch should have. This size is measured in the number of PSTN/ISDN-subscribers that are connected directly or indirectly (via remote units) to the switch. The second method tries to define an optimal ratio between the total number of remote units and the sum of the total number of local switches and remote units. The BIPT is seeking the industry's point of view with regard to these or other decision 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 SMP operator. 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

.

If other rules could be used to make the node consolidation process more realistic, the BIPT would appreciate to receive more information on these rules.

2.4 Network support investments

In the previous sections, we have tried to define the different cost categories that constitute investment costs directly attributable to the exchanges, the transport and the signalling function of the core network. There are however a large number of indirectly attributable investment costs that need to be taken into account. These costs are also indispensable for network operation but cannot be determined easily by the use of cost drivers. At this moment, we would like to limit the classification to the CAPEX costs. The OPEX costs will be addressed further on. The BIPT identifies the following categories:

- Motor vehicles;
- Network management systems;
- Office and general ICT-equipment;
- Workshop facilities and spare parts;
- Land and buildings that are not already accounted for in the directly attributable investments;
- Other network support and equipment.

Given the limited level of detail of a bottom-up model, the above costs cannot be determined by the use of the direct cost drivers such as BHCA or BHE. As a consequence, an alternative method of modelling these costs has to be defined. The BIPT proposes to model these costs as a percentage of the direct attributable costs. If useful, each of these costs can be separately calculated for three main categories, i.e. switching, transmission and the outside plant. Figure 7 below illustrates this schematically.

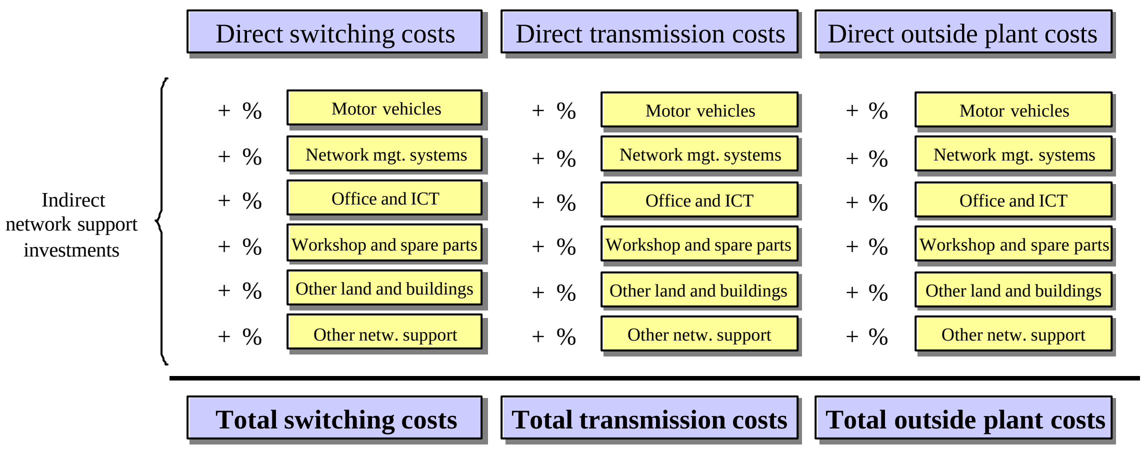

Figure 7: Allocation of indirect network support investment costs

There are different sources of information that can be used to determine these percentages. First of all, existing accounting data of the SMP operator can be used to get a first approximation of what these costs can be. Next, benchmarks with other (foreign) operators can be used. In addition to this, existing public information that is used in other bottom-up models can be used as a source of information. Finally, the BIPT will ask the different market players, in the third consultation documents, to provide their quantitative point of view on these parameters.

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.

3. COST OF CAPITAL AND OPERATING COSTS

In the previous chapter, the BIPT has proposed a classification for all network related investment costs. The model will also take into account cost of capital and operating costs that are necessary to operate the assets modelled in the previous chapter. The BIPT has however not decided yet under which form these costs will be implemented in the model. As a consequence, the topic of capital and operating costs will be addressed in the third consultation document.

4. PLANNING

Comments to this second consultation document should be submitted in writing before Friday, November 9, 2001 at 17.00 p.m. to:

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