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Costing of next generation communications networks (NGN)

– Manual for a sample CALDIVO DATA application –

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1 Subject of the model

The CALDIVO DATA application presented in this Manual attributes costs to communications services provided on a Next Generation Network (NGN). An NGN is an Ethernet-based network that is suitable to provide all kinds of communications services, including legacy telephone services, internet access and television (IPTV). Typical incumbent network operators do not build NGN from scratch, but gradually replace their legacy PSTN and ATM networks with a NGN. Therefore PSTN, ATM and Ethernet are included in the cost model.

2 Cost measure

The applied cost measure is TSLRIC. TSLRIC is the abbreviation for 'Total Service Long Run Incremental Costs'. The wording indicates that relevant increments are the total quantities of communications services or categories of communications services provided per year. The increments relevant to our cost model are 'access services' on the one hand and 'conveyance services' on the other hand (see table 1). These service categories are distinguished by their major cost drivers, namely the quantity of network accesses provided on average per year respectively the quantity of traffic conveyed over the network.

Access services	Conveyance services
access to public telephone network	public telephone services
+ xDSL access	+ interconnect calls
+ terminating ends of leased lines	+ bitstream access (conveyance element only)
+ unbundled access to local loops	+ trunk element of leased lines
= increment 'access services'	= increment 'conveyance services'

Table 1: Modelled service portfolio

The costs that could be hypothetically saved 'in the long-run' by stopping to provide network access are the LRIC of access services. Analogously, the amount of costs that could be hypothetically saved 'in the long-run' by stopping to convey traffic over the network are the LRIC of services. 'Long-run' means that relevant costs include CAPEX, i.e. the model compares the current state of the network with a hypothetical state in which the network assets necessary to provide access respectively conveyance services are not in place. The residual costs which cannot be assigned exclusively to one of these service categories are common costs with regard to access and conveyance. By definition, common costs can be attributed to increments only in an arbitrary manner.

The model's outputs are three different amounts of costs attributed to each service: a floor, a ceiling and a 'reasonable' amount. They all include a portion of relevant LRIC, but differ by the portion of common costs allocated to the relevant increment (see table 2).

	Access services	Conveyance services
floor	LRIC of access services	LRIC of conveyance services
ceiling	LRIC of access services + total amount of common costs = stand-alone costs of access services	LRIC of conveyance services + total amount of common costs = stand-alone costs of conveyance services
'reasonable' amount	LRIC of access services + mark-up for common costs	LRIC of conveyance services + mark-up for common costs

Table 2: Output of cost model

3 Structure of the model

Our sample model comprises the following modules:

- inputs (see section 4),
- assembly of costs (see section 5),
- allocation of costs to cost centres (see section 6), and
- allocation of costs to services (see section 7).

4 Inputs to the model

4.1 Service-related inputs

This section concerns tabpage '**Inputs (1): Services**'.

Quantities of services. These are metered as follows:

- access services (such as accesses to the telephone network, terminating ends of leased lines or DSL accesses) in terms of 'average amounts of accesses p.a.';

- quantities of telephone services (including interconnect calls) in terms of 'call minutes p.a.';
- quantities of all conveyance services including telephone services in terms of 'bandwidth required during an average peak hour'.

Routing factors. Routing factors reflect the average occupation of the so-called 'Main Cost Centres' (MCC) by the various kinds of communications services (see section 6.1 below). Correspondingly, there are as many routing factors as there are combinations of services and MCC. All MCC listed in the application are distinct network components. The dimensioning of these network components depends directly on the demand for access and/or conveyance services (see section 6.1). 'PSTN tandem switches' are an example for MCC. For instance, if a long-distance telephone call occupies on average 1.5 PSTN tandem switches, the corresponding routing factor for the combination of 'PSTN tandem switch' and 'long-distance telephone service' is 1.5.

Percussion factors. Packet-switched conveyance networks such as ATM-networks or Ethernets permit to define Quality of Service (QoS) levels. The QoS-level determines the priority with which a data package will be processed when queuing at a network node. Voice has to be transmitted in real-time, and hence telephone services are typically assigned the highest QoS-level. Bitstream used for surfing the internet is typically at the bottom end of the QoS-scale. A percussion factor equals the relation between the amount of capacity to be hold for the distinct service and the expected bandwidth occupied by the service during an average peak hour. The higher the percussion factor the higher is the QoS-level assigned to the respective service.

4.2 Network-related inputs

This section concerns tabpage **'Inputs (2): Network and activities'**.

Cost directly attributable to cost centres. Cost centres are either network components or activities. Costs that are directly attributable to a network component typically include depreciation and cost of capital. Costs that are direct attributable to an activity typically include wages, social insurance, and supplies and materials.

Cost driver volumes. In so far possible, costs shall be forwarded from one cost centre to another on the basis of cost-volume relationships (CVR). A CVR assigns to the volume of a cost driver (possibly also multiple cost drivers) the

amount of costs incurred. Such cost driver volumes are an input to the model. Examples for cost drivers are man-hours of maintenance work, the power consumption of a network component and the floorspace occupied by a network component.

5 Assembly of costs

This section concerns tabpage **'Assembly to costs'**. By adding up the costs that are directly attributable to the various cost centres (see section 4.2) a systematic list of all costs considered in the model is obtained.

6 Allocation of costs to cost centres

This section concerns tabpages **'Allocation to cost centres (1)'** and **'Allocation to cost centres (2)'** .

6.1 Hierarchy of cost centres

Cost centres are hierarchically organised. Costs get forwarded from an originating cost centre only to recipient cost centres further down the hierarchy of cost centres. The costs accounted to a cost centre are composed of:

- the costs that have been forwarded from other cost centres, and
- the costs that are directly attributable to the cost centre.

The latter are a user-defined input to the model (see section 4).

The model distinguishes three layers of cost centres:

- Layer 0 – There is a direct cost-volume relationship (CVR) between the demand for communications services on the one hand and the costs directly attributable to the cost centre on the other hand. Cost centres at this level are called 'Main Cost Centres' (MCC) (see section 4.1).
- Layer 1 – There is just an indirect CVR between the demand for communications services on the one hand and the costs directly attributable to the cost centre on the other hand.
- Layer 2 – There is no relationship whatsoever between the demand for communications services and the costs directly attributable to the cost centre.

Table 3 provides a list of cost centres respectively categories of cost centres used our sample model.

Layer	Cost centre or cost cost category	Cost centre subcategory		
		'LRIC of access services'	'LRIC of conveyance services'	'Common costs of access and conveyance services'
2	'general management'	×	×	×
2	'plant provision & network planning'	×	×	×
1	'maintenance indoor'	×	×	×
1	'maintenance outdoor'	×	×	×
1	category 'plant buildings'	×	×	×
1	category 'power supply and air condition'	×	×	×
1	category 'transmission equipment'		×	
1	category 'cables'	×	×	×
1	category 'ducts and trenches'	×	×	×
1	category 'distribution frames'	×		
0	category 'network nodes'	×	×	×
0	category 'customer-facing ports'	×		×
0	category 'local loops'	×		×
0	category 'core links'		×	×

Table 3: List of cost centres

6.2 Cost allocation by increment

All cost centres have got one or more of the following subcategories:

- 'incremental costs of access services'.
- 'incremental costs of conveyance services'.
- 'common costs of access and conveyance services'.

The cost centres categories 'ducts and trenches' and 'network nodes' play a special role. The subcategory 'common costs of access and conveyance services' are associated with concrete network components (see table 4). The common costs accounted to cost centres further up in the hierarchy of cost centres are the costs the get allocated to the ducts and trenches and network node components mutually used for the provision of access and conveyance services.

These cost centres represent network components, and the sub

	'LRIC of access services'	'LRIC of conveyance services'	'Common costs of access and conveyance services'
Ducts and trenches	Costs associated with ducts and trenches used exclusively for local loops.	Costs associated with ducts and trenches used exclusively for core links.	Costs associated with ducts and trenches used simultaneously for core links and local loops.
Network nodes	Costs associated with customer-facing ports. Each customer-facing port is dedicated to a distinct end-user or wholesale customer.	Costs associated with hypothetical minimum configuration of network nodes that have been deprived of all customer-facing ports while still having enough processing capacity to handle the traffic conveyed over the network.	Total costs associated with network nodes minus LRIC of access services minus LRIC of conveyance services.

Table 4: Network components mutually used for access and conveyance services

6.3 Forwarding of costs

The Annex to this Manual specifies how costs get forwarded from originating cost centres to recipient cost centres further down in the hierarchy of cost centres. In the case of 'layer 2' cost centres, the forwarding of costs is arbitrary, while in the case of the 'layer 1' cost centres the forwarding of costs is based done on the basis of cost drivers (i.e. in accordance with the principle of cost causation). When the cascade-like cost allocation process is completed, all costs have been allocated to MCC.

6.4 Amounts of costs attributed to MCC

Tabpage **'Allocation to cost centres (2)'** presents for each MCC three different amounts of costs allocated to the MCC, namely a 'floor', a 'ceiling' and a 'reasonable' amount (see table 5). Determination of the 'reasonable' amount requires a rule for the allocation of common costs to the increments. In our model, that rule is the 'Equal Proportionate Mark-Up'- (EPMU-) rule. According to the EPMU-rule, the mark-ups for common costs on the LRIC of access

services and the LRIC of conveyance services shall be identical:

$$\text{EPMU} = \frac{\text{total amount of common costs}}{\text{LRIC of access services} + \text{LRIC of conveyance services}}$$

	MCC occupied for the provision of access services	MCC occupied for the provision of access services
'floor'	portion of LRIC of access services attributed to distinct MCC	portion of LRIC of conveyance services attributed to distinct MCC
'ceiling'	portion of stand-alone cost of access services attributed to distinct MCC	portion of stand-alone costs of conveyance services attributed to distinct MCC
'reasonable' amount	portion of LRIC of services access attributed to distinct MCC · (1+EPMU)	portion of LRIC of conveyance services attributed to distinct MCC · (1+EPMU)

Table 5: 'Reasonable' amount attributed to MCC

7 Allocation of costs to services

This section relates to the tabpage **'Allocation to services'**.

For each individual service, the quantity of the service gets multiplied with the routing factor and – if applicable – with the percussion factor (see table 6 and section 4). The result is the occupation of the MCC by type of service. A service's contribution to the MCC's total occupation determines the portion of costs that gets forwarded from the MCC to the service. That forwarding of costs from MCC to services is done separately for the floors, the ceilings, and the 'reasonable amounts' that have been previously attributed to the MCC (see table 5).

	Access services	Conveyance services	
Relevant categories of MCC	■ Customer-facing ports ■ Local loops	■ PSTN nodes	■ ATM- and Ethernet nodes ■ Core links
Relevant subcategories of MCC	→ LRIC of access services → Common costs of access and conveyance services	→ LRIC of conveyance services → Common costs of access and conveyance services	
Relevant service quantities	average quantities of accesses p.a.	bn. call minuntes p.a.	bandwidth required during average peak hour
Usage factor	usage factor = routing factor	usage factor = routing factor	usage factor = routing factor · percussion factor

Table 6: Cost allocation to services