Report for Chorus to provide to the Commerce Commission

Model user guide for UBA model

28 November 2014

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Contents

1 Introduction

Analysys Mason has been commissioned by Chorus to provide modelling and consulting services related to Unbundled Local Loop (UCLL) Final Pricing Principle (FPP) and Unbundled Bitstream Access (UBA) FPP review.

This report is the model user guide for the UBA model, which combines a bottom-up model for electronics with actual asset counts for civil works (km of digging/km of fibre) and actual numbers of nodes (number of customer sites, cabinets and exchanges). We call this "bottom-up with actual asset count for civil works". The model calculates the element based TSLRIC of UBA.

The remainder of this document is laid out as follows:

- Section 2 summarises the results of the cost model
- Section 3 presents an overview of the model
- Section 4 explains how to install and run the model

The report includes an annex containing supplementary material:

- Annex A provides a description of the content of the UBA model file
- Annex B provides a list of terms and their definitions.

2   Results

The model calculates the following results.

2.1   Five-year constant nominal unit cost

The Commission has indicated that it intends to set a constant price in nominal terms for a period of five years. Accordingly, we have set up the model to calculate the 5-year flat nominal unit cost on a similar basis, recovering the same NPV as the calculated unit cost over this period. The result is as follows:

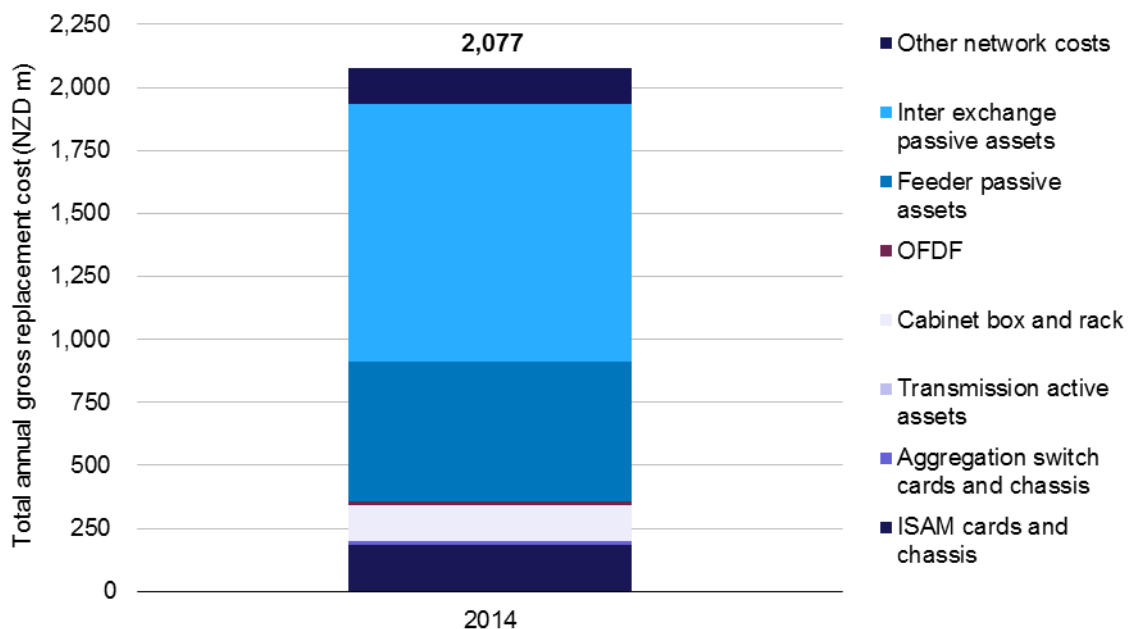| Service	Unit cost (NZD/month)
EUBA0	16.57

Figure 2.1: Five year flat nominal results for model [Source: Analysys Mason, 2014]

2.2   Network valuation

The Gross-Replacement Cost of the modelled core network is NZD 2 077M in 2013 real terms.

Figure 2.2: Network Gross Replacement Cost in the model [Source: Analysys Mason, 2014]

3 Model overview

This section describes the basic structure and operation of the UBA model in the following order:

- Section 3.1 provides an overview of the flow of the calculations
- Section 3.2 describes the calculations, including calculation of the numbers of assets and the costing methods applied.

In addition, Annex A provides a detailed description of the contents of the UBA model.

3.1 Overview of the flow of the calculation

The model consists of a single Excel workbook that uses various inputs.

Figure 3.1: Overview of model structure highlighting key calculation flows [Source: Analysys Mason, 2014]
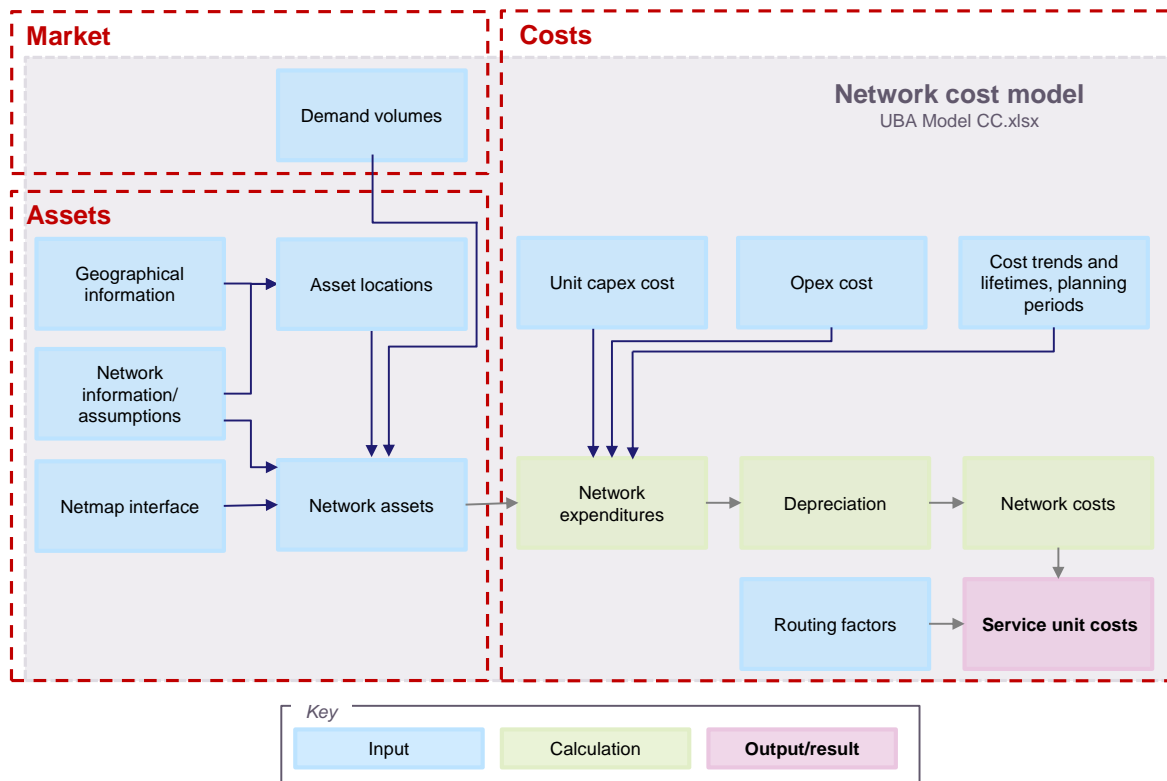
3.2 How the cost model works

The UBA cost model assumes a hypothetical new entrant utilising Chorus' actual copper local loop network and offering a service similar to Chorus' UBA service. We model the network necessary to deliver UCLL-based UBA services with a full share of the current market demand for such services, deployed over timescales representative of the modelled operator.

The network cost model uses five areas of inputs.

3.2.1 The demand forecast

We have used a top down approach based on Chorus forecasts to calculate the penetration rate for each of four service types:

- Residential voice
- Residential data
- Business voice
- Business data

This market share considers the competition provided by the coverage of non-Chorus networks, i.e. the HFC network, the non-Chorus LFC networks and mobile networks. Market share is calculated for each of the four service types above.

The forecast then allocates the active lines from the four service types across two stages of product allocation:

- *Product groups* are defined, such as copper unbundling, copper voice access, broadband access and business data services. This allows migration trends to be modelled between product groups.

- Active lines are then modelled by individual *product* (such as UCLL, UBA and HSNS) based on the forecast of their relevant product group. This allows migration trends to be modelled between products.

The distribution of active lines between product groups and products is guided by the data from the Chorus internal forecast.

3.2.2 NetMap data and asset counts

An extract from the Chorus NetMap system provides asset counts for some of the assets used in the UBA network cost model, specifically cabinets and feeder related items. The NetMap data provides a snapshot in time of the number of assets deployed. The UBA network cost model assumes these to be the necessary assets to provide coverage throughout the network, and deploys the full count of these assets from the start of service provision by the modelled operator.

3.2.3 The asset locations calculations

The asset locations calculations categorise the locations of active electronics into defined geotypes. The network coverage of the geotype is an input; the network assets required are then calculated for each geotype. Figure 3.2 presents an overview of the data inputs and calculation steps taken to determine coverage of unique DSLAM locations classified into DSLAM geotypes.

Figure 3.2: Overview of the approach taken to determine coverage of unique DSLAM locations classified into DSLAM geotypes [Source: Analysys Mason, 2014]
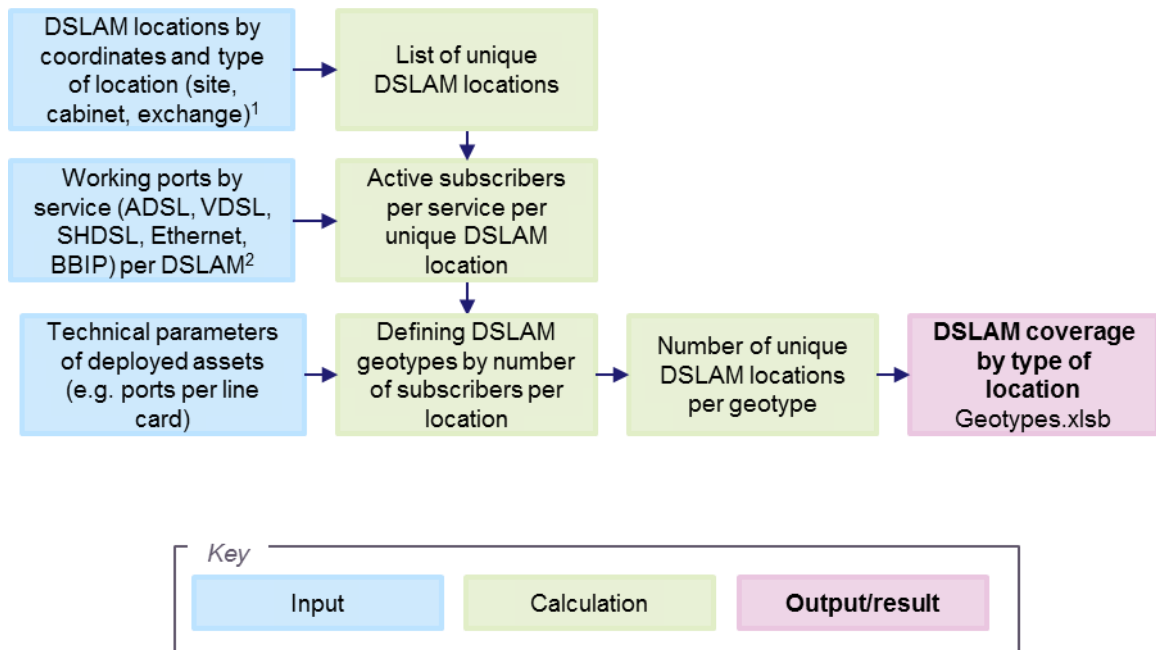
The DSLAM Geotypes are defined by grouping together DSLAM locations with similar demand characteristics, specifically the number of active lines across all services (Ethernet, SHDSL, voice, ADSL, VDSL and VDSL2) at that location. The total number of active lines, in turn, determines the technical capabilities required and the level of traffic to be supported at each location.

Analysis of network data provided by Chorus, as detailed in Figure 3.2, led to the definition of the five DSLAM geotypes for each type of DSLAM location (customer site, cabinet, exchange) as shown in Figure 3.3.

Figure 3.3: Definition of DSLAM geotypes in terms of the upper boundary of active lines served by each type of location [Source: Analysys Mason, 2014]

Geotype name	Maximum number of active lines served at:		
	Sites	Cabinets	Exchanges
Geotype 1	48	48	144
Geotype 2	96	96	480
Geotype 3	192	192	960
Geotype 4	240	240	1,920
Geotype 5	288	624	10,992

Each DSLAM is parented on a defined Ethernet switch. Figure 3.4 shows the key data inputs and calculation steps to allocate each DSLAM location from each geotype to its matching Ethernet switch. This allocation is then used in the network cost model to determine the ports required at

switches in terms of both number of lines coming from DSLAMs (DSLAM-facing ports) and the resultant traffic flow from the switch to the core network (core-facing ports), as discussed in Section 3.2.5.

Figure 3.4: Overview of the approach taken to allocate unique DSLAM locations for each geotype to the matching Ethernet switches [Source: Analysys Mason, 2014]
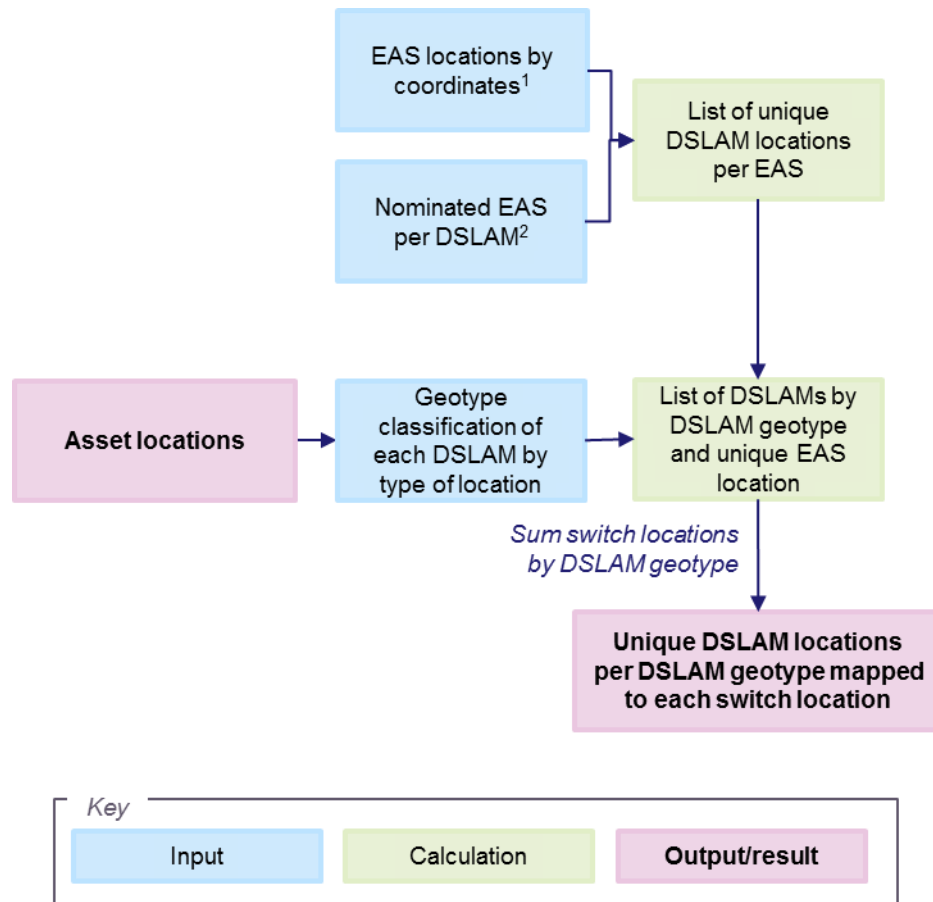

The asset location calculation includes another topology related input for the main network cost model, the distance of inter-exchange links. This is used to dimension inter-exchange assets in the UBA costing model. Figure 3.5 shows Chorus' inter-exchange network and the approach taken to identify routes allocable to UBA costing. The network is made up of logical links called bearers, which are carried via multiple fibre cable sheaths. Each fibre cable can be utilised by more than one bearer. The inter-exchange network shown in Figure 3.5 contains all the inter-exchange links throughout Chorus's network. We select only the links attributable to UBA services from the total network distance. The definition of the UBA product is up to the first data switch. Therefore, inter-exchange distances for bearers between switches have been removed, which results in an inter-exchange distance relevant to UBA which is significantly lower than the total.[1]

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[1]   Where a sheath is shared by "to first data switch" and "inter-switch" bearers, the sheath distance is shared in proportion to the number of bearers of each type.

We have used MapInfo software to explore whether it would be more efficient to remove cables running in parallel to each other, which would be a closer representation of a modern equivalent network. However, it was found that such optimisation only reduced the total route distance by an immaterial 1-2% and, thus, no further reduction was applied.

The portion of the inter-exchange distance assumed to be shared with the feeder was calculated separately.[2] The net inter-exchange distance allocable to UBA services was then used to determine inter-exchange assets based on knowledge of route types in the network.[3]

Figure 3.5: Visualising the inter-exchange network and the approach taken to identify routes allocable to UBA costing [Source: Analysys Mason, 2014]
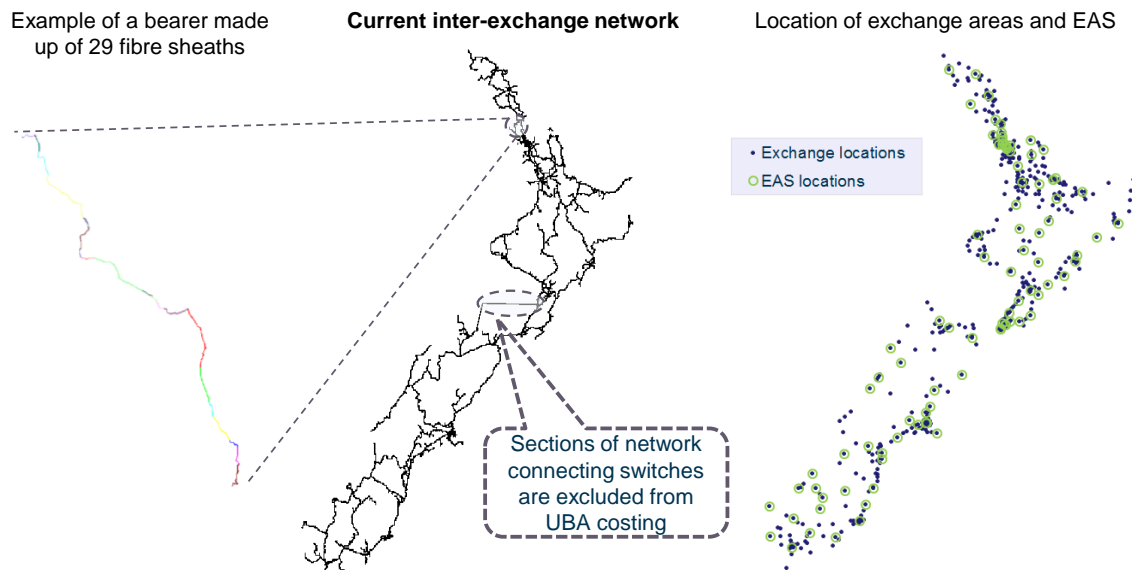
3.2.4 Calculating costs inputs

Asset capital unit costs

Direct capital unit costs are taken from the following sources:

- DSLAM (and other ISAM related equipment), Ethernet switch equipment and SFP direct unit capex are taken from vendor price lists

- OFDF direct unit capex is taken from Chorus vendor price lists

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[2]   The inter-exchange distance that is both shared and not shared with the feeder was calculated via the NetMap analysis for the UBA model. The total distance calculated to be not shared with the feeder was approximately 3300 km. The total distance allocated to UBA from the distance shared with the feeder was approximately 6500 km.

[3]   Cable route was set equal to the net inter-exchange distance. Directly ploughed, ducted and ploughed routes were set to 63, 33 and 3%, respectively, of the net inter-exchange distance. It was found that aerial routes made up a negligible 0.5% of the total inter-exchange network and were, therefore, not considered. Cable joints and UUBs were estimated to be needed every 10 km of route. The proportion of inter-exchange routes by route types was determined by matching network data to the route types from the NetMap data. Fibre cable assets were set equal to total inter-exchange distance allocable to UBA (excluding inter-switch distances). It was assumed that fibre cables are not shared between access and core services.

- Cabinet, feeder and inter-exchange direct unit capex are taken from the UCLL model

- Service management system material costs are based on vendor price lists.

Indirect capex unit costs are taken from the following sources:

- DSLAM (and other ISAM related equipment), Ethernet switch equipment and SFP indirect unit capex as advised by Chorus

- OFDF indirect unit capex is also as advised by Chorus

- Cabinet, feeder and inter-exchange indirect unit capex is taken from the UCLL model

- Service management system indirect costs were advised by Chorus.

In addition, the UBA model includes explicitly modelled costs for two network IT systems, namely the Element Management System and the Service Management System costs.

- The Element Management System is related to the ISAM assets. We have included an indirect capex recurring every 2 years to represent the cost of ongoing upgrades to the EMS system. We have also included a 10% uplift in the asset installation costs to represent the design and test costs.
- The Service Management System is related to the Switch assets. We have included an SMS asset. This has a 2 year lifetime, so the costs are incurred every 2 years. The line card software costs are included as separate assets and also with a lifetime of 2 years. The associated opex with both of these assets has also been included as described in the next section.

Allowance for spares inventory

We carried out an analysis of Chorus' inventory of spare assets. By comparing the gross replacement cost of the total asset base by category to the gross replacement cost of the spares held in that category we were able to calculate a mark-up to the unit cost of deployed assets. This mark-up is applied to the unit costs used in the model to account for the spares required to be held in inventory to meet Chorus' network reliability requirements.

Operating costs (opex)

The opex analysis combines top-down and bottom-up data.

The operating costs of Chorus can conceptually be separated into four main categories:

- *Network opex* which is the costs of operating the network e.g. the non-capitalised cost of cost centres such as Field Services or Network Engineering and can be further divided into
    - Network labour costs
    - Customer services costs (including network provisioning)
    - Network maintenance

- Network IT
- Network accommodation
- Network electricity
- Network other

- *Marketing and sales opex* which is the costs associated with the management of Chorus wholesale products e.g. the non-capitalised cost of cost centres such as Market and Product Development or Product Management and Capability
- *Business support opex* which is the costs associated with business overhead and non-network common costs e.g. the non-capitalised cost of cost centres such as Corporate Property or Human Resources[4]
- *Regulatory levies* which are the costs associated with payments to the Government for the TDL and Commerce Commission fees[4].

We used information from several sources[5] to calculate the total annual opex for each of the above opex categories. Those total opex by categories are then allocated to each service type (e.g. copper, UBA etc.)

The model has the following key opex inputs:

- Direct opex inputs (in 2013 terms), *AssetIn* sheet, column AV
  — Route assets have a direct input cost per metre per annum representing the annual cost of non-exchange rent, rates and similar costs
  — Chorus annual business overhead relevant to UBA and relevant to other services (in 2013) are input in this column. All such costs are allocated to all services in the model on the basis of an equi-proportional markup (EPMU) (ie both apply to all services, despite their notional labels as "UBA" and "other").
  — Product and customer IT relevant to copper services relevant to UBA and relevant to other services (in 2013) are input in this column. This is allocated to services in the model on the basis of an EPMU
  — UBA customer services costs per line per annum is input in this column
  — Non-UBA customer services costs per line per annum is input in this column
  — UBA marketing and sales costs per line per annum is input in this column
  — Non-UBA marketing and sales costs per line per annum is input in this column
  — UBA Network operations cost per line per annum is input in this column
  — Non-UBA Network operations cost per line per annum is input in this column
- Accommodation cost in terms of floorspace is inserted in column BB. The cost, expressed in NZD per sqm per year, accounts for common space and the level of utilisation.
- Power consumption costs are input in columns BF:BJ. This includes the annual consumption and the cost of electricity.

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[4] This is represented as a UBA component and non-UBA component in terms of assets. As both are allocated to services through an equi-proportional mark-up both the UBA and non-UBA component have an impact on the calculated cost of UBA.

[5] Primarily the Chorus General Ledger

— The cost of electricity is based on Chorus actual 2013 consumption and expenditure. The cost per kWh accounts for the cost of accommodating power plant. We apply an uplift of 23% (based on 1/(90%*90%)) to account for a 10% reduction in the usable energy supplied due to DC power plant losses and the reduction in usable energy due to other site operational requirements such as lighting, cable losses etc.

— Total electricity consumption is based on bottom-up estimates

— We assume that assets that consume electricity require cooling. We apply a 40% uplift to electricity consumption requirements to account for the power required for cooling.

- Regulatory levies are represented as an asset in the model with a direct opex charge. This is based on the amount of levy charged to chorus in FY2013 and is recovered as an equi-proportional mark-up (EPMU) across all services

Whilst not an opex cost, the IT capex costs are also calculated in the opex model as the source data is common.

Cost trends, asset lives and planning periods

Other cost inputs are taken from the following sources:

- Cost trends in real terms for unit direct capex are taken from the average of multiple international benchmarks from publicly available network cost models
- Cost trends for unit indirect capex are assumed to be zero in real terms except for labour costs where a small negative cost trend was applied[6]
- Cost trends for unit opex are calculated as a weighted average of the trends in the various opex components (e.g. accommodation, power, air conditioning, supplier support)
- Asset lives are taken from the Chorus fixed asset register, and checked against benchmarks
- Similarly, planning periods are taken from the average of multiple benchmarks from publicly available network cost models and previous modelling work.

3.2.5 The network cost calculation

The network cost calculation consists of three sub-sections: model inputs, asset calculations and the resulting cost calculations. Each is described in the following section, with a detailed description of the contents provided in Annex A.

Network cost inputs

Figure *3.1* gave an overview of the key inputs flowing into the network cost model. In addition to the supporting calculations described above, other inputs based on technical data and network assumptions are as follows:

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[6] An average real labour cost trend of -0.6% was calculated based on the average year-on-year change in New Zealand's labour cost index for New Zealand technicians and trade workers in the period 2009 to 2014 expressed in real terms by using the average year-on-year change in the price index for the same period. Data were sourced from Statistics New Zealand and the EIU in 2014.

- allocation of demand from wholesale services to volume for the relevant technical services[7],
- apportionment of technical services to network assets for the purpose of cost allocation and sharing, referred to as the routeing table[7, 8], and
- technical specifications per asset, including utilisation factors, and technical configurations of assets by modelled geotype[9].

These inputs are used to calculate the assets required to meet forecast demand volumes and the resulting network costs drive the costs for the UBA service.

Network asset calculations

This part of the network cost model calculates the active and passive network assets required to provide UBA services. Calculations assume the modelled operator to serve a share of the total wholesale market deployed over a timescale as defined in the model[10].

There are three main groups of assets calculated on a bottom-up basis, and each discussed in turn below:

- digital subscriber line access multiplexers (DSLAMs) and related assets,

- Ethernet switches and related assets, and

- optical fibre distribution frames (OFDFs) and related assets.

The deployment of DSLAMs follows the profile of deployment of services for the modelled operator. The deployment of DSLAMs in turn determines the rate of deployment of assets higher up in the network, namely Ethernet switches and OFDFs, with assets required as soon as one or more DSLAMs are deployed parented on each switch location.

The calculation of DSLAM related assets based on subscriber demand consists of two steps as shown in Figure 3.6. First, the demand at each DSLAM location is calculated. Second, the required assets at each DSLAM location are calculated.
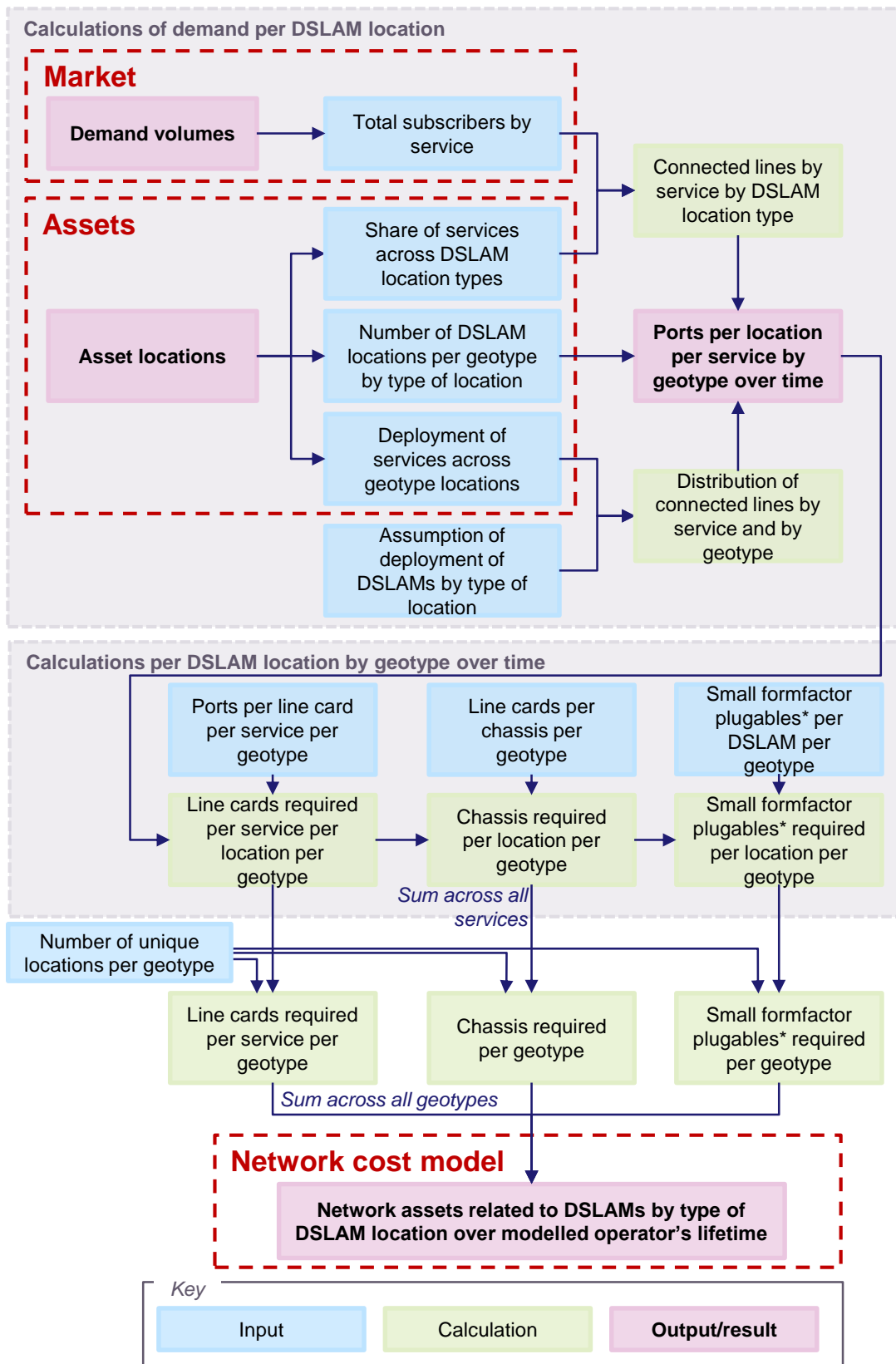
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7   See sheet "DmdSubCalc" in the network cost model

8   See sheet "RF" in the network cost model

9   See sheet "NwDesIn" in the network cost model

10   See sheet "Output" in the network cost model

Figure 3.6: Overview of the approach to calculate subscriber-based assets required in DSLAM locations [Source: Analysys Mason, 2014]


* Note that small formfactor plugables are dimensioned on the basis of 1GE and 10GE ports required to meet traffic demand as shown in the next figure.

Calculating requirements for assets in each geotype is also broken down into sub-sections, as shown in Figure 3.6. First, the necessary number of ports is calculated to meet the coverage and capacity requirements at each DSLAM location per each geotype. Next, active ports are summed across all services provisioned at DSLAMs to calculate the total number of DSLAM line cards and chassis to meet demand volumes by geotype across the network.

Calculation of the required small form factor pluggable (SFP) transmission assets depends on the number of EAS-facing 1 GE and 10 GE ports deployed in DSLAMs to meet the traffic demand, as discussed below, and the topology of the network. Calculations deploy an SFP based link for each 1GE and 10GE port, with one SFP needed at each end of the link. More SFPs are deployed should the number of ports (driven by traffic level) require this. The distribution of SFPs by transmission range is equivalent to the current distribution of SFPs by transmission range on the assumption that the network topology will remain unchanged for the modelled operator and will be independent of the share of the market it serves.

The calculation of DSLAM related assets based on traffic demand is carried out alongside the asset calculations based on subscriber demand. The main DSLAM assets based on traffic demand are EAS-facing 1GE and 10GE ports, which in turn determine the requirement for small form factor pluggable assets in DSLAMs (discussed above) and DSLAM-facing connections in Ethernet switches (discussed below). Figure 3.7 shows the approach taken to calculate DSLAM assets based on traffic demand. First, the total traffic demand for DSLAM services is calculated at each location, determining the required 1GE and 10GE ports per location. Then, total requirements of 1GE and 10GE ports are summed up across all locations per each geotype and by location type. A costing threshold of 2.5 1GE ports is assumed, whereby if traffic requirements per DSLAM chassis exceed 2.5GE, a 10GE port is deployed instead, allowing for capacity for future growth in demand. In addition, a minimum of 1GE port per every 384 connections per DSLAM is included. This deployment criterion overrides the traffic-based calculations in a small number of the exchange-based DSLAMs, as for the majority of DSLAMs, the traffic requirements mean that this deployment rule is already met.

Figure 3.7: Overview of the approach to calculate data traffic-based assets required in DSLAM locations [Source: Analysys Mason, 2014]
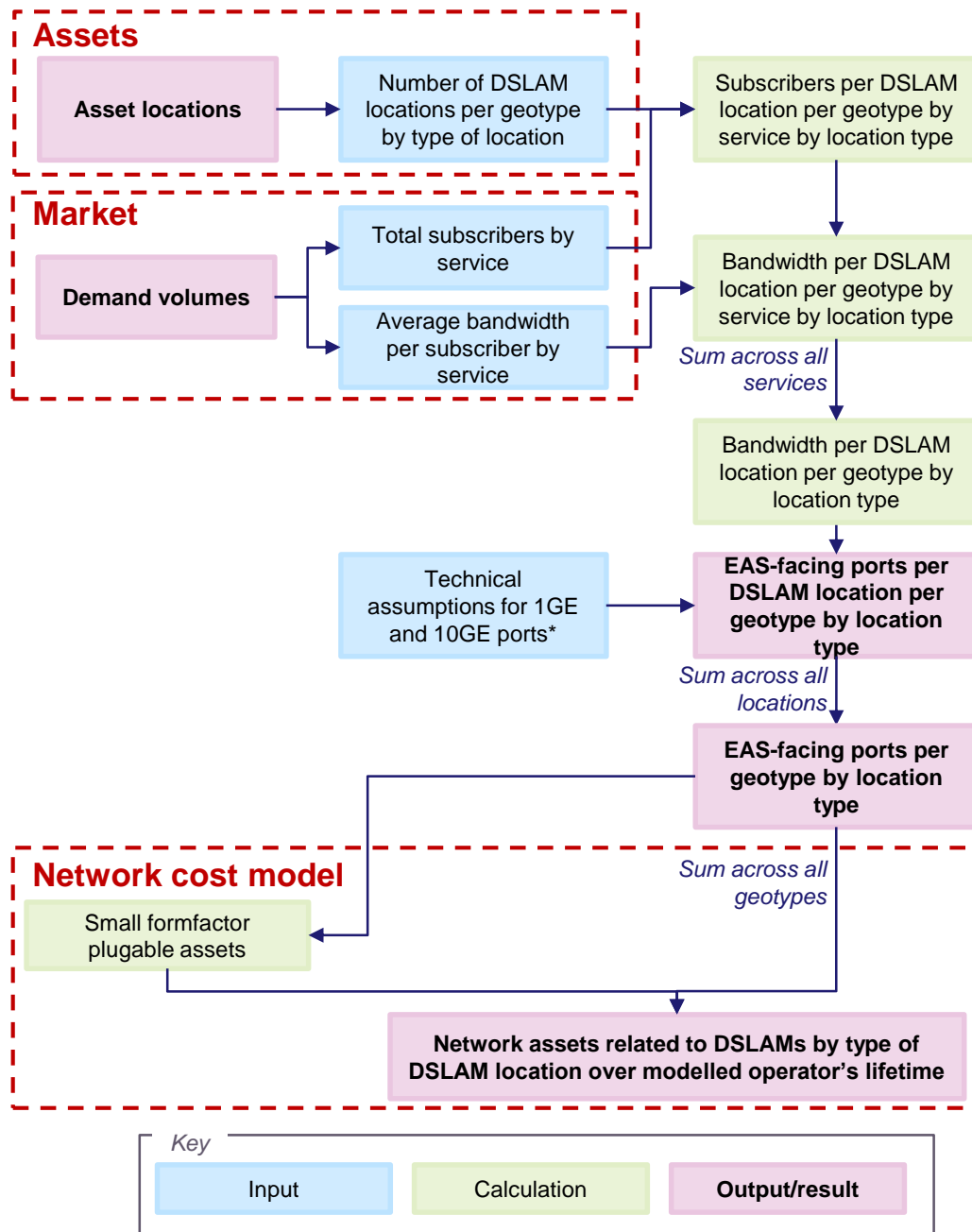
* A utilisation of 80% per port is assumed, and a costing threshold on 2.5 1GE ports is used, as described in the main text.

Similar to the DSLAM calculations, the calculation of Ethernet switch related assets also consists of two steps, as shown in Figure 3.8. First, the demand at each switch location is calculated. Second the required assets at each switch location are calculated to meet coverage and capacity requirements throughout the network.

Figure 3.8: Overview of the approach to calculate assets required in Ethernet switch locations based on subscriber and traffic demand [Source: Analysys Mason, 2014]
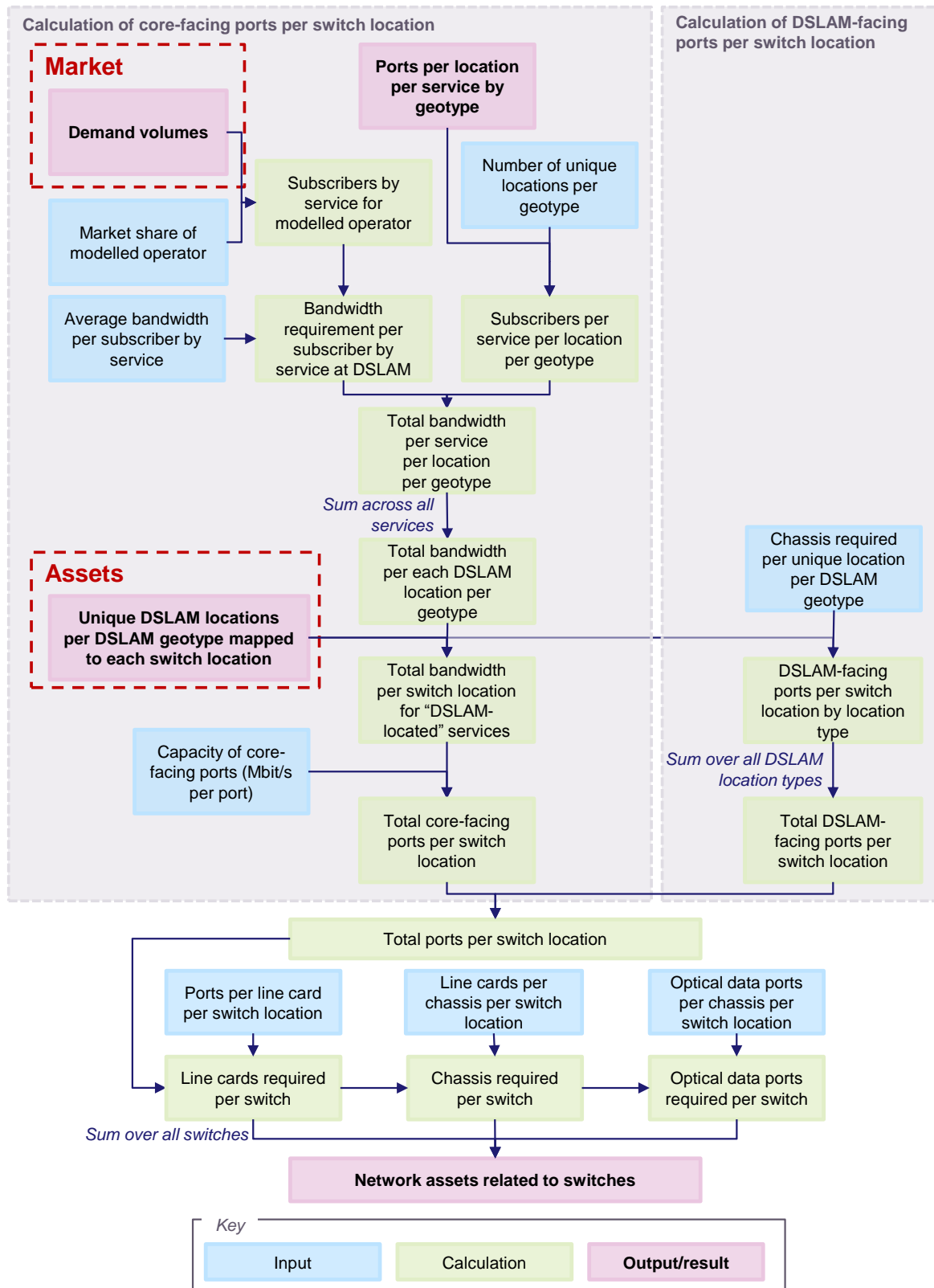
In the first calculation step shown in Figure 3.8, the requirement for active ports at each switch location takes into account the demand for DSLAM connections (the DSLAM-facing ports) and out-flowing traffic volumes to the next level in the network (the core-facing ports). The calculation of the latter is based on the average bandwidth requirement per subscriber across the range of services available at DSLAMs. Both 1GE and 10GE options are considered in the calculation of Ethernet ports and associated line cards.

The calculation of OFDFs distinguishes between OFDFs collocated with Ethernet switches (co-located OFDFs) and OFDFs required in exchange areas without a co-located switch (pass-through OFDFs). Figure 3.9 provides an overview of the definition of OFDFs as either co-located or pass-through dependant on whether there is an Ethernet switch in the exchange areas or not.

Figure 3.9: Overview of the definition of pass-through and co-located OFDFs [Source: Analysys Mason, 2014]
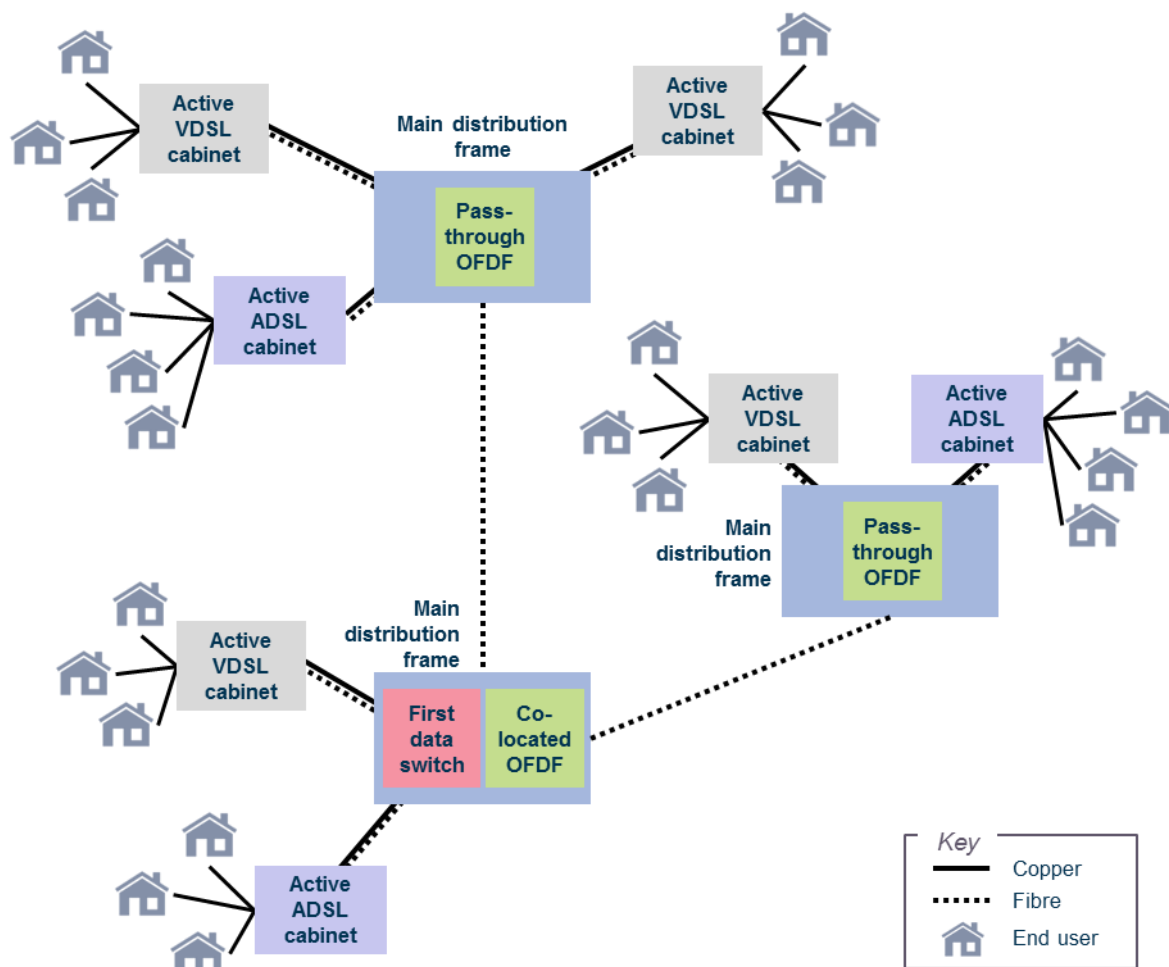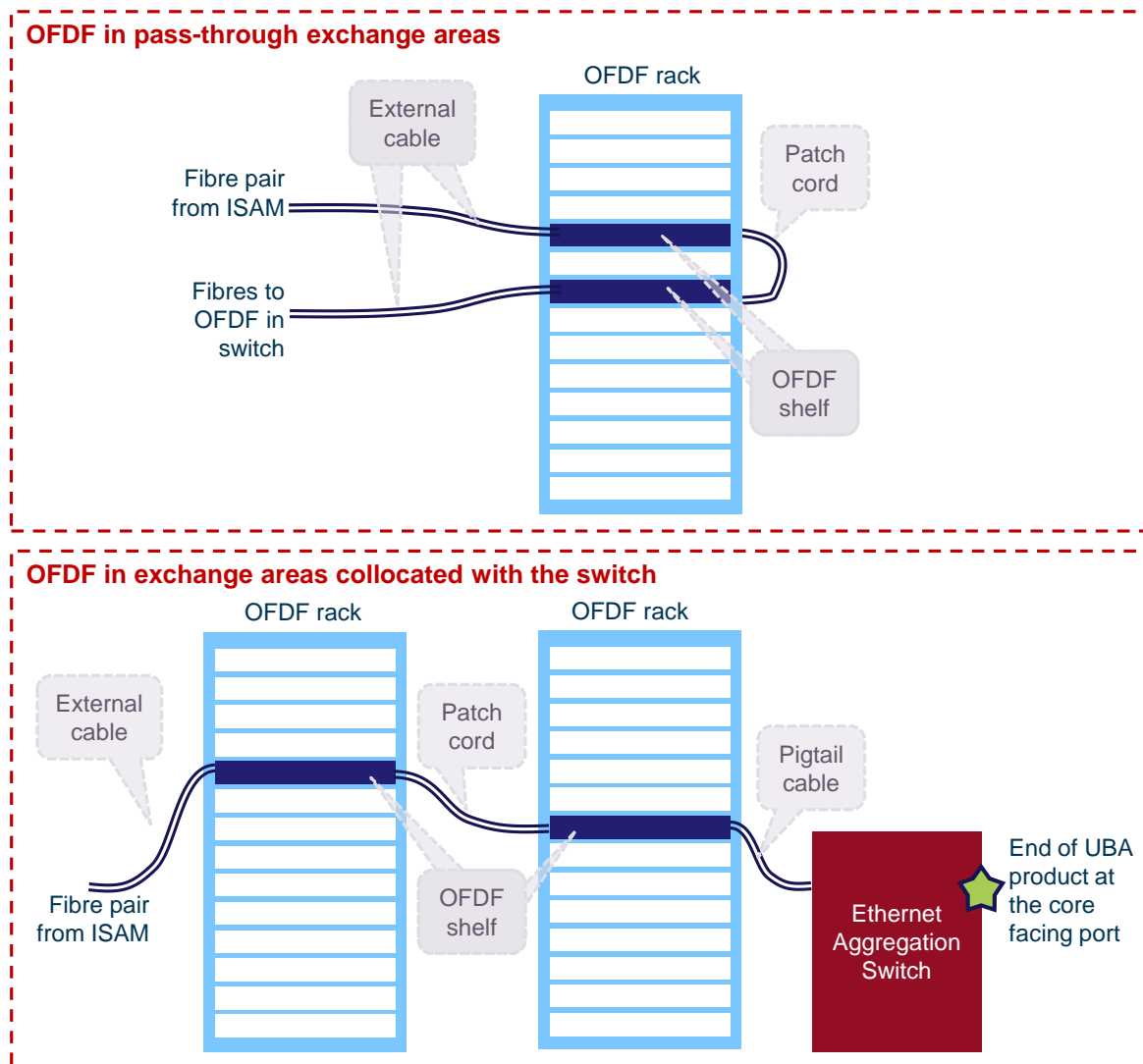

Figure 3.10 shows the configuration of OFDFs in pass-through and co-located exchange areas.

Figure 3.10: Overview of the configuration of OFDF racks and related assets in pass-through exchanges and in switch locations [Source: Analysys Mason, 2014]

By definition, the UBA product ends at the core facing ports in the Ethernet aggregation switch. As such, the number of OFDF assets required is directly dependent on the number of active DSLAM-facing ports to be connected in the pass-through and co-located exchange areas. Each active port requires a duplex fibre connection into the OFDF. A double-rack and a single-rack configuration are assumed in co-located and pass-through OFDFs, respectively. The number of fibre pairs to be connected and the rack configuration allows calculation of shelves, racks and related assets. The number of pass-through OFDF locations that is needed to be served is taken into account as a minimum when calculating the total required number of shelves and racks in pass-through OFDFs. Overall, calculations are carried out for each switch location, distinguishing between assets required in pass-through and collocated OFDFs separately; summation gives the total requirements for OFDF assets across the network.

In addition to the active assets discussed above, there are four main groups of passive assets, each discussed in turn below:

- cabinet and site related assets,
- feeder related assets,
- inter-exchange assets, and
- wireless assets.

Cabinet and feeder related assets are obtained from the current asset count through the NetMap data. It is assumed that no cabinet-type assets are deployed at site locations. Calculations assume that the total number of cabinet and feeder related assets deployed is in proportion to the network roll-out, independent of the share of the market served by the modelled operator.

Inter-exchange assets are calculated alongside the asset locations as discussed in section 3.2.3.

Wireless links are not currently considered in the UBA model for the following reasons:

- Analysis of the available data for wirelessly fed cabinets suggest that these feeder links connect an immaterial number of DSLAMs and subscribers

- We have modelled a fibre-only network for the inter-exchange links.

Total network investment

Combining the calculations and inputs above enables the total assets *required* to be determined in each year of the model.

Using estimated asset lifetimes it is possible to calculate the number of assets of each type that are *deployed* in each year using an asset deployment calculation with a retirement algorithm (*NwDeploy* sheet). The drivers for this algorithm are defined in this workbook and may be altered. The retirement algorithm, which also includes a planning period, also covers the costs of maintenance spares without necessitating the inefficient mark-up of in-year assets required.

Capex in each modelled year is then calculated (assets deployed in each year and unit cost information for each year, in the *Capex* sheet) and opex in each year is then calculated (number of active assets in each year and unit operating expenditures by asset calculated in a bottom-up way in the *UnitOpex* sheet).

The exact timing of network investment is not important given that we are using a modified tilted annuity. The calculation exists in this form because we were interested in other depreciation methods.

Depreciation

The cost model uses a modified tilted annuity depreciation. This approach tilts the cost recovery based on the forecast price change of the assets and demand served by those assets. An overview of service unit cost calculation using modified tilted annuity is shown below in Figure 3.11.

Figure 3.11: Service unit cost calculation using modified tilted annuity [Source: Analysys Mason, 2014]
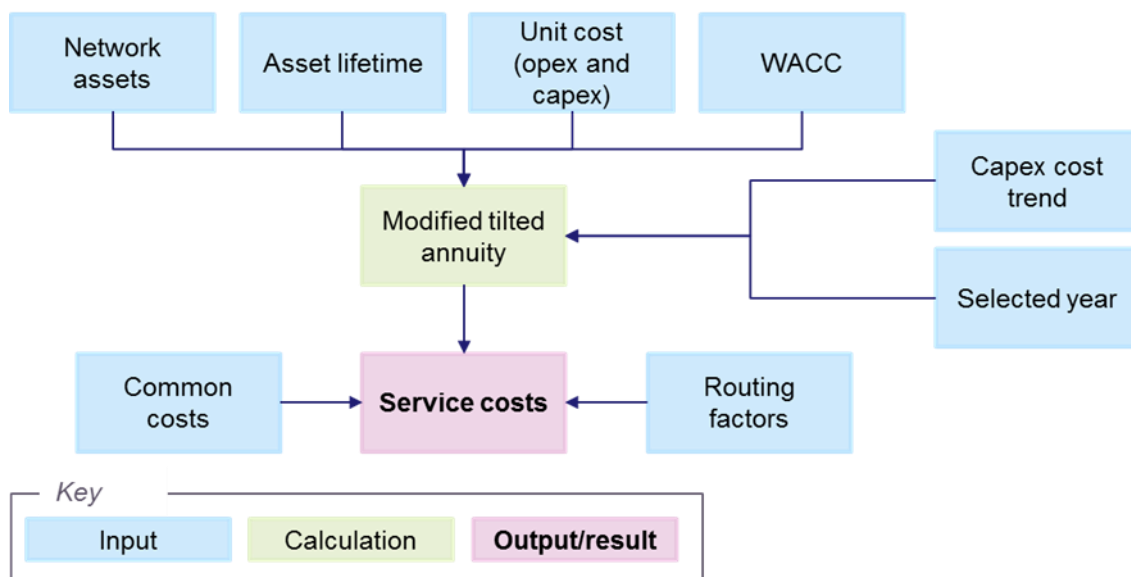
Service costing

The output of the selected depreciation calculation is a total economic cost by asset. The service costing calculation (in the *TSLRIC* sheet) uses the routeing factors to assign the total costs for each modelled asset to each technical service[11]. The TSLRIC for each product is then built up from the TSLRIC by technical service.

The business overhead required to operate the copper network is added on to the TSLRIC cost per product in the *TSLRIC* sheet as an equi-proportional mark-up (i.e. in proportion to the directly allocated costs).

The model calculates in real terms before making a conversion to nominal terms once the results are calculated.

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[11] We break down *products* into building blocks which we call *technical services.* Those technical services are then mapped to a *group of assets.* Each technical service uses a specific list of assets; technical services do not overlap. This simplifies the process of assigning asset costs to products.

4 Installing and running the model

The UBA model file is standalone and can be saved in any convenient folder or location. Key input parameters and the numerical results can be viewed in the *Output* sheet of the UBA Model CC.xlsx workbook. The graphical results can be viewed in the charts preceding the *Output* sheet. If it is desired to change any of the input information and see the impact on the results, the model needs to be manually recalculated before the new result is displayed. At any point, pressing Ctrl+Alt+F9 will instruct Microsoft Excel to perform a full recalculation of the workbooks.

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Annex A Description of the content of the model

This section provides detailed information of the structure of the UBA model file described in the main body of the report. This annex should be read in conjunction with the model descriptions in Section 3.2.5.

Figure A.1: Key inputs, calculation and outputs of the network costing file UBA Model CC.xlsx [Source: Analysys Mason, 2014]

Sheet title	Contents
C	This contents sheet
V	A history of the versions of this workbook
S	A guide to the styles used in this workbook
Chart1	Chart for use in MsWord: UBA monthly additional costs, EUBA 0, 5 year result
Chart2	Chart for use in MsWord: UBA monthly additional costs (NZD) for all UBA products
Chart3	Chart for use in MsWord: Total annual opex (NZD m)
Chart4	Chart for use in MsWord: Time trend for total annual opex (NZD m)
Chart5	Chart for use in MsWord: Total annual gross replacement cost (NZD m)
Chart6	Chart for use in MsWord: Time trend for total annual gross replacement cost (NZD m)
Output	Output tables and selected inputs
In>>	Inputs and parameters for the network calculations
Lists	Defines the names of commonly used lists in the model
LinkedIn	Links inputs from other calculations
AssetIn	Defines assets and associated inputs
Cov	Coverage calculations
NwDesIn	Defines network design inputs
DmdSubCalc	Demand and subscriber/connections calculations
NwCalc>>	Network calculations based on previous inputs and parameters
NwDes	Calculates network assets required
FullNw	Collates the number of network elements required in each year according to demand drivers and network design rules
NwDeploy	Calculates total number of items deployed and incremental deployment in each year (including replacement)
RF	Collates values and calculations specifying routeing factor load of each service on each network element
CostTrend	Determines the capex and opex cost trends for each network element over time
NwEleOut	Calculates the recovery profile and traffic loading on each type of network element
CostCalc>>	Cost calculations based on network calculations and cost inputs and parameters

Sheet title	Contents
CapexDirect	Calculates total direct capex based on direct cost per network element, unit prices and direct capex trends
CapexIndirect	Calculates total indirect capex based on indirect cost per network element, unit prices and indirect capex trends
UnitOpex	Calculates opex per network element according to base price and opex trend
Opex	Calculates total opex based on cost per network element, unit prices and opex trends
MTAD	Calculates modified tilted annuity depreciation
LiveCost	Summary of calculations of depreciation scenario chosen
TSLRIC	TSLRIC calculations allocating costs per unit output by technical service

Some further key calculations within the service unit cost file are described below.

Asset counts used in service costing

For the calculation of modified tilted annuity depreciation, the number of assets required for the calculation takes into account the planning period. Retirement delay and assets purchased to replace assets coming to the end of their lives are not required for the single year calculation.
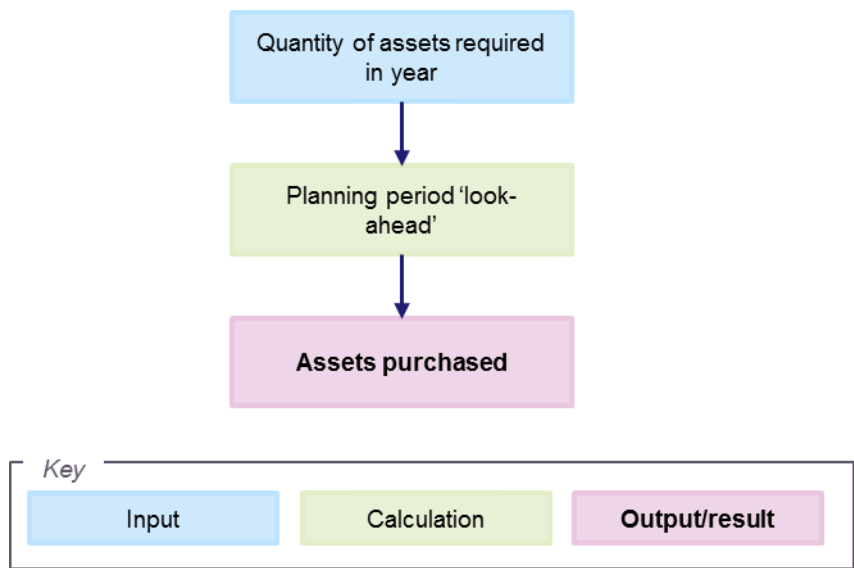

Figure A.2: Asset count calculations for Modified Tilted Annuity Depreciation Calculation [Source: Analysys Mason, 2014]

The opex calculations take account of the number of assets actually deployed in the network taking into account the planning period. This takes account of both the 'pure planning' period when the requirement for the asset is identified and it may be ordered, and the 'operational but not needed yet' phase when the asset has been commissioned, uses floor space and energy, and needs maintenance to make sure it is working when it is actually required.

Modified Tilted Annuity Calculation

The MTAD calculation can be summarised in the following terms:

$$\text{Gross Replacement Cost} \times (1 + \text{WACC})^{\frac{\text{Planning period} - 6}{12}} \times \frac{\text{WACC} - (\text{Capex cost trend} + \text{additional tilt})}{1 - (((1 + (\text{Capex cost trend} + \text{additional tilt}))/(1 + \text{WACC}))^{\text{asset lifetime}})}$$

The tilted annuity formula calculates the annualised cost of recovering the investment and the return on capital with a tilt of the forecast price of the asset.

The adjusted tilted annuity approach adjusts the tilt used in line with the trend in demand over the lifetime of the asset. The additional tilt, therefore, prevents under-recovery of costs over the life of the asset when demand is falling and over-recovery where demand is growing.

The network gross replacement cost is calculated taking into account assets required in the network and a planning period. This accounts for the investment in assets ahead of the demand that requires them to be in place. The cash flow impact of this investment is also taken into account in the formula by the term after the GRC in the formula above.

*Figure A.3: Modified Tilted Annuity Calculation [Source: Analysys Mason, 2014]*
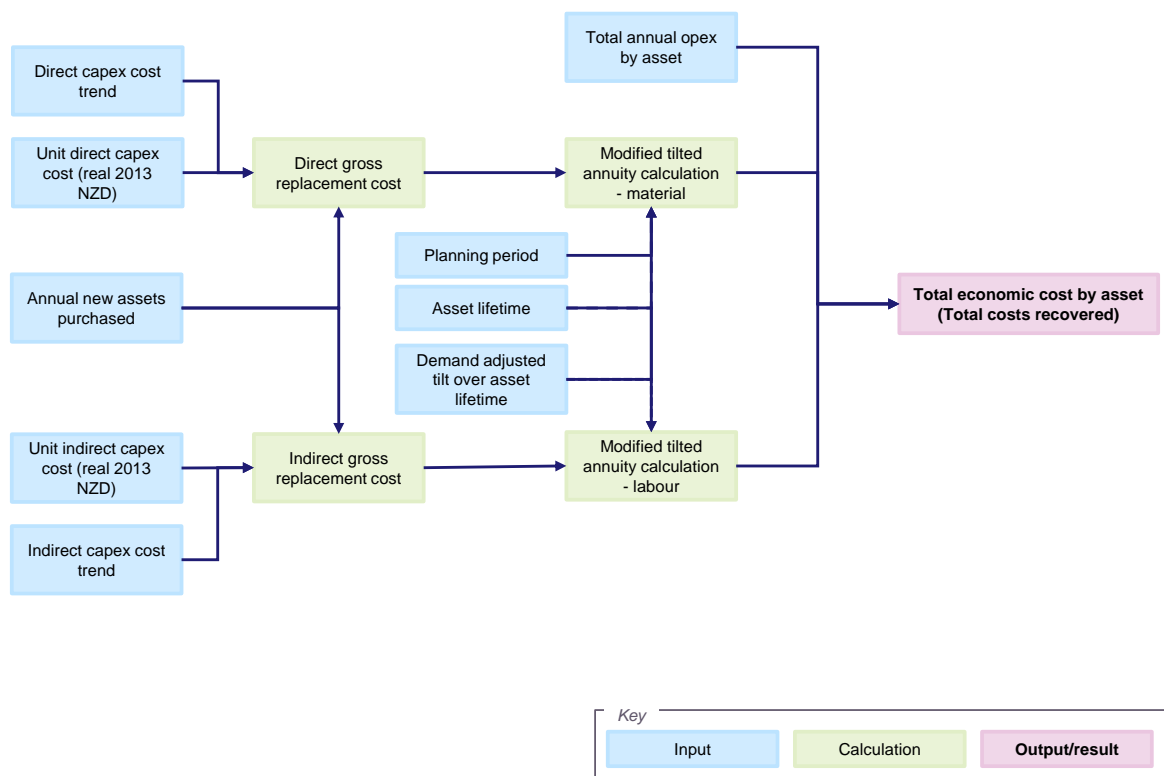
Service costing calculation

The total economic costs can be divided into common and incremental costs:

- Incremental costs can be attributed to a specific asset, and
- Common costs are not attributable to a particular asset

The incremental costs are attributed to the relevant assets and can then be mapped to the services which they support using the routing factors in *DmdSubCalc*. Common costs are then allocated to services on the basis of an equi-proportional mark up.

Figure A.4: Service costing calculation [Source: Analysys Mason, 2014]
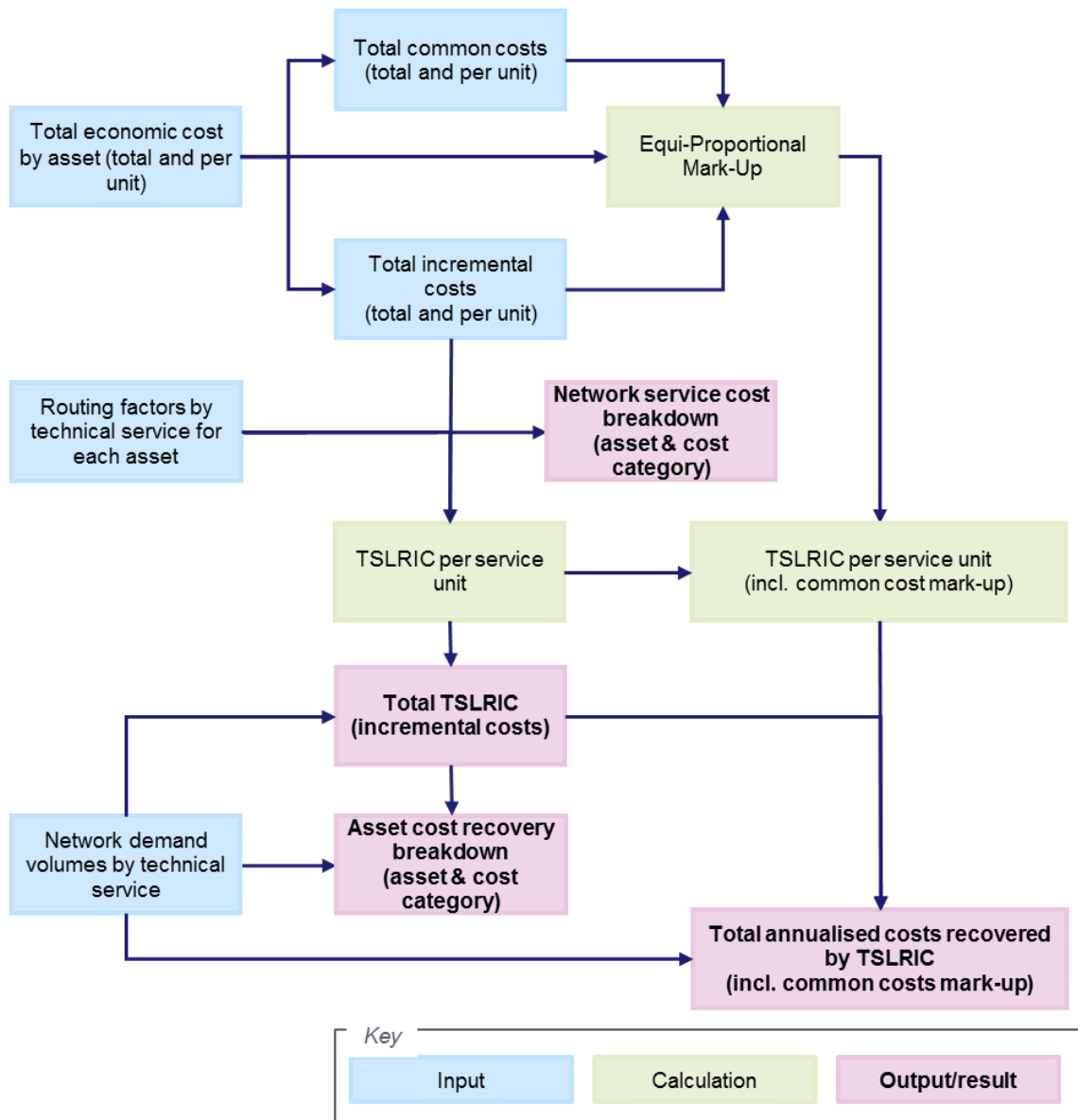
Annex B Glossary of terms

This section lists the terms and their definitions as used in this document and the calculation files referred to, as well as a number of others not used in this document. The terms and their definitions are in agreement with the Glossary of Terms provided to the Commission.

Figure B.1: Glossary of terms used in this work [Source: Analysis Mason, 2014; Chorus, 2014]

Term	Definition
ADSL	Asymmetric digital subscriber line
Baseband	The baseband product is a technology neutral voice input service that is either bundled with a broadband product or provided on a standalone basis should a customer not require a broadband connection
Bitstream Services (fibre based)	Services described in the Service Descriptions for Bitstream 2, 3, 3a, 4, ATA Voice, Multicast and UFB Handover Connection, available at chorus.co.nz/ufbservices
BFAS	Bandwidth fibre access service
BOF	Broadband Over Fibre – pre-UFB Spark fibre bitstream product
BUBA	Basic Unbundled Bitstream service
Cabinet	A Chorus owned, leased or licensed structure that is not an Exchange and at which Chorus copper local loops connect to a distribution frame
Capex	Capital Expenditure
CFH	Crown Fibre Holdings Limited – the Government entity established to manage the UFB Initiative
Chorus	Chorus Limited and its subsidiaries
ComCom	The Commerce Commission
Core Network	The network used to connect exchanges
Cost Centre	A cost centre is a 4 digit code that represents a unit in the Chorus management reporting structure.
CT	Cable terminal
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer – a device that connects many digital subscriber lines to a network by multiplexing the DSL traffic onto one or more network trunk lines
EAS	Ethernet Aggregation Switch
EMS	Element Management System
End User	In relation to a telecommunications service, means a person who is the ultimate recipient of that service or of another service whose provision is dependent on that service
ESA	Exchange Service Area
ETP	External Termination Point at an End User's premises or, where there is no termination point external to the premises, the first jack on the premises wiring or, the building distribution frame
EUBA	The Enhanced UBA services as set out in section 4 of the UBA Service Description

Term	Definition
FAR	Fixed Asset Register
Exchange	A Chorus owned or leased building, or leased or licensed area within a building, with a floor area of at least 15 square metres and a main distribution frame terminating copper local loop of at least 200 pairs connected to End-User premises, the primary function of which is to provide fixed wire line telecommunications services, and includes all of the Chorus owned, leased or licensed property on which the building is situated
EPMU	Equi-proportional markup
FPP	Final Pricing Principle
GE	Gigabit Ethernet
GRC	Gross Replacement Cost
HFC	Hybrid-fibre coaxial
HSNS	High Speed Network Service - a service for RSPs to use in delivering data and voice services to Medium to Large Enterprises
ISAM	An Alcatel model name for a DSLAM it manufactures
km	Kilometres
kWh	kiloWatt-hours
LFC	Local Fibre Company, LFC means a local fibre company, being an entity in which CFH, the Government and a partner holds shares, and through which the investment of CFH and the partner in relation to the UFB Initiative is effected
MTAD	Modified Tilted Annuity Depreciation
NetMap	Chorus' internal database of outside plant
NGA	Next Generation Access
NZD	New Zealand Dollar
OFDF	Optical fibre distribution frame
OLT	Optical line terminal
Opex	Operating Expenditure
RSP	Retail Service Provider
S98	Section 98 of the Commerce Act (1986)
SerCo	Service Company: Subcontractors who carryout network deployment and maintenance tasks on behalf of Chorus
SFP	Small form-factor pluggable
SHDSL	Symmetrical high-speed digital subscriber line
SMS	Service Management System
Spark	Spark New Zealand
sqm	Square metres
TDL	Telecommunications Development Levy
TSLRIC	Total Service Long Run Incremental Cost
UBA Service	The Unbundled Bitstream Access Service supplied by Chorus pursuant to the standard terms determination dated 13 December 2007 (Commission Decision 611)
UCLL Service	Chorus' Unbundled Copper Local Loop Network Service supplied by Chorus pursuant to the standard terms determination dated 7 November 2007 (Commission Decision 609)

Term	Definition
UFB	Ultra Fast Broadband
UFB Initiative	The Government led initiative to aim to enable 75% of New Zealanders to be able to access Ultra-Fast Broadband by 31 December 2019
UUB	Underground Utility Box
VDSL	Very High bit rate digital subscriber line
VDSL2	Very High bit rate digital subscriber line 2
WACC	Weighted Average Cost of Capital