ANNEXURE A

SUMMARY OF METHODOLOGY USED IN OTHER TSLRIC MODELS

1. TOP-DOWN VS. BOTTOM-UP MODELING

Top-down models begin with the accounting costs of the firm, and identify those elements of the firm's cost that are incremental with respect to the specific services that are being modelled. The top-down approach frequently requires adjusting historic costs to reflect current replacement cost. In addition, the approach develops relationships between the costs of the firm and the volumes of underlying cost-drivers (such as the relationship between switch costs and calling volume). Engineering economics simulations are sometimes used to derive the relationships between assets (and the corresponding costs) on the one hand, and the volume of an underlying cost driver on the other.

Bottom-up modelling refers to engineering-economic models that begin with the best current engineering practices and design a network that provides the services being modelled. In fact, most engineering-economic models incorporate both bottom-up and top-down approaches: engineering principles are used to determine network assets such as loop and switch capacity, while accounting information is used to determine a range of operations and maintenance costs and indirect costs. The mix of engineering-economics and accounts-based approaches can vary among jurisdictions.

1.1 The UK

British Telecom (BT) was created as a distinct public corporation in 1981. Privatization of BT began in 1984 and was completed in 1993. In 1984, price cap regulation of BT was introduced. Prices for regulated services continue to be governed by price caps, but price cap regulation has evolved in response to a rapidly changing environment. Part of this evolution has been a move from traditional price caps towards prices based on Long Run Incremental Costs (LRIC). The LRIC methodology has been used to re-initialize price caps, to determine the X-factor, and to set floors and ceilings for baskets of regulated services.

In the mid-1990s, BT developed a top-down model, while several competitors developed a bottom-up model of BT's network. In June 1996, NERA reconciled the two models by (1) identifying the factors giving rise to differences in the estimates of LRIC, (2) determining which model (if either) had adopted the correct approach and (3) modifying the model with the incorrect approach (if any).[1] NERA successfully reconciled the models' estimates of LRIC for local and tandem exchanges, but was not able to reconcile fully the estimates of the LRIC of transmission.[2]

Since this reconciliation, LRIC has been estimated with a top down model based on the Current Cost Accounts (CCA) that BT is required to maintain.[3] The UK regulator (at that time, Oftel) determined that the transition from Historical Cost Accounts (HCA) to CCA did not result in any windfall profits or losses for BT.[4] Subsequently, Ofcom determined that the prices for services BT supplied to its competitors would result in over-recovery of some assets deployed prior to the transition from HCA to CCA. Therefore, it adjusted (re-initialized) the prices for Wholesale Line Rental and Local Loop Unbundling to help ensure that there would be no over-recovery of the costs of these assets (mainly copper cables and ducts) placed in service before August 1, 1997.[5]

1.2 The US

Major TELRIC cost models that have been submitted in proceedings before the US Federal Communications Commission (FCC) include the Benchmark Cost Proxy Model (BCPM) sponsored by incumbent local exchange carriers, the HAI Model sponsored by long distance carriers, and the Hybrid Cost Proxy Model (HCPM),

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[1] Reconciliation and Integration of Top Down and Bottom Up Models of Incremental Cost, June 1996, Prepared for Oftel by National Economic Research Associates (NERA), p. 5. Henceforth, NERA Reconciliation Report.

[2] NERA Reconciliation Report, p. 38.

[3] The LRIC methodology is described in BT: Accounting Documents, 17 August, 2004, available at http://www.btplc.co.uk/Thegroup/Regulatoryinformation/Financialstatements/PDF2004/AccountingDocuments17August2004.pdf. Henceforth, BT's LRIC Methodology. The implementation of this methodology is described in BT: Long Run Incremental Cost Model, Relationships and Parameters, 17th August 2004, available at http://www.btplc.com/Thegroup/Regulatoryinformation/Financialstatements/PDF2004/LRIC_RP17August2004.pdf. Henceforth, BT's LRIC R&P.

[4] OFCOM. Valuing copper access: Final statement. 18 August 2005. At 1.6.

[5] OFCOM. Valuing copper access: Final statement. 18 August 2005. At 1.7.

developed by the FCC. In 1999, the FCC incorporated elements of all three models to create a "model platform" or synthesis model that it would use to calculate the funding requirements for Universal Service.[6]

Verizon's Integrated Cost Model (ICM)[7] and the BellSouth Analysis of Competitive Entry or BACE Model have been submitted in state proceedings where state contributions to universal service, arbitrated interconnection prices and other issues related to competition between incumbents and entrants are determined.

All these models use bottom up, engineering-economics approaches to designing access and interoffice networks that can efficiently produce the required services. Asset volumes are determined by the design, and the corresponding investments are calculated using the latest (i.e., forward looking) prices. However, maintenance and operations expenses, and indirect or overhead costs are not based on engineering economics, but are calculated using historical ratios of expenses to investment, or alternatively, historical data on expenses per line. To this extent, the US models, like those in many other jurisdictions, are a mix of top-down and bottom-up modelling.

1.3 New Zealand

The New Zealand Commerce Commission has created its own synthesis model based on the FCC's Hybrid Cost Proxy Model ("HCPM") model for the access network, and the Cost-Pro New Zealand Model for transport and switching. In addition, the Commission has developed a wireless cap for remote areas.[8] According to the Commission, the advantages of the bottom-up approach include greater accuracy, greater transparency, and greater Commission control over the modelling process.[9]

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[6] In the Matter of Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket No. 97-160, Fifth Report & Order, Released: October 28, 1998. At 3.

[7] This model is discussed in Final Order on Rates for Unbundled Network Elements Provided by Verizon Florida, Docket NO. 990649B-TP, Order No. PSC-02-1574-FOF-TP, Issued: November 15, 2002.

[8] Determination for TSO Instrument for Local Residential Service for Period Between 20 December 2001 and 30 June 2002, New Zealand Commerce Commission, 17 December 2003 (Hereafter, NZ Determination 2001-2), p. 13.

[9] NZ Determination 2001-2, pp. 98-99.

1.4 Malaysia

The Malaysian Communications and Multimedia Commission adopted a bottom-up approach to calculating the Total Service Long Run Incremental Cost of rebuilding and operating the incumbent's network.[10]

2. THE SERVICE, OR OTHER INCREMENT, WHOSE COST IS TO BE DETERMINED

Cost models have been developed to help implement pricing of local access and interconnection services, encourage the spread of competition, and raise funds required to support universal service policies. The increments to which these models are applied are correspondingly diverse. When used to determine the funds required to achieve universal service goals, the increment can include all the *supported* services. Even in this context, the increments can vary in several dimensions. Examples include the set of supported services, the geographic areas eligible for support, and the customer classes that are supported.

In bottom-up models, the cost of the increment is typically calculated as the difference between the cost of producing a baseline that does not include the increment, and the cost of producing the baseline plus the increment. In top-down models, the incremental cost is typically calculated as the difference between a comprehensive baseline that includes the increment in question and also other services, and the cost of this baseline less the specified increment. In either case, the calculation often includes an allocation of common costs to the increment in question. The increments and the baselines vary from one jurisdiction to another.

2.1 The UK

BT's top down model is based on financial statements that are prepared in accordance with its license conditions.[11] BT's Network Business is defined to include Inland Public Switched Telephone Network, Inland Private Circuits, the local loop Access Network, and other components of BT's Network Business.[12] Within BT's Network Business, the two main increments are the *Core*, comprising nine network

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[10] Malaysian Communications And Multimedia Commission, A Consultation Paper On Access Pricing,13 May 2002, p. 5. Henceforth, MCMC Consultation Paper.

[11] BT's LRIC Methodology, p. i.

[12] BT's LRIC Methodology, Section 5.3.1.2.

components, product management, planning and policy, Inland Private Circuits, and Interconnect Connections and Rentals[13] and the *Access Network*, which comprises principally the local loop network.[14]

The point from which the LRIC of an increment is measured, i.e., the baseline, is the whole of BT.[15] The LRIC of an increment is the reduction of BT's cost if that increment were removed and all other activities were to continue.

1.5 The US

Cost models in the US are required to "estimate the cost of providing service for all businesses and households within a geographic region. This includes the provision of multi-line business services, special access, private lines, and multiple residential lines".[16] The models are used to calculate costs at the wire centre level. To determine the amount of universal service support, the incremental cost of supported services[17] is calculated, and provision is made for common and overhead costs.

In the US, the baseline is no output. The model calculates the total cost of an efficient, least-cost network that provides a range of switched services and private lines, and then calculates the portion of that cost that can be attributed to the supported services.

2.3 New Zealand

In New Zealand, the incumbent operator must meet its Telecommunications Service Obligation to provide a free local calling option to all residential customers for voice and data calls, maintain the standard residential charge at the November 1, 1989 level, charge rural residential subscribers no more than the standard rental, continue to serve

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[13] BT's LRIC Methodology, Section 5.3.1.3.

[14] BT's LRIC Methodology, Section 5.3.1.4.

[15] BT's LRIC Methodology, Section 5.3.2.

[16] In the Matter of Federal-State Joint Board on Universal Service, CC Docket No. 96-45, Report And Order, Released: May 8, 1997. At 250. Henceforth, FCC's Universal Service Order.

[17] In its Universal Service Order, the FCC stated that "the definition of supportable services includes: voice grade access to the public switched network, with the ability to place and receive calls; Dual Tone Multifrequency (DTMF) signaling or its functional equivalent; single-party service; access to emergency services, including in some instances, access to 911 and enhanced 911 (E911) services; access to operator services; access to interexchange services; access to directory assistance; and toll limitation services for qualifying low-income consumers." FCC's Universal Service Order, at 22.

areas that were served in December 2001, provide directory service, and meet quality of service standards.[18] The Commission is required to determine "… the unavoidable net incremental costs to an efficient service provider of providing the service required by the TSO instrument to commercially non-viable customers".[19]

The Commission concluded that the unavoidable net incremental cost of the obligation is equal to "the difference in the firm's total costs between the circumstances where it supplies those customers in conjunction with all its other customers, and where it does not".[20]

In the access network, the cost of the TSO can be measured by the cost of serving remote clusters of Commercially Non-Viable Customers (CNVCs). In the core network, the cost of the TSO can be measured by the incremental cost of conveying the traffic associated with the CNVCs.[21]

2.4 Malaysia

When considering fixed network interconnection services, the MCMC defines an increment that includes "the whole of TMB's inland fixed (including ISDN) wholesale services together with its leased line (or 'private circuit') service. Both TMB's own customer services as well as the traffic for interconnect licensees are taken into account. Only traffic related costs are relevant to interconnection services. Line related costs are considered in the access network".[22]

3. NETWORK ARCHITECTURE

Most cost models reflect the current network architecture – the number of switching levels, the functions of the switches at each level, and the tapered structure of the loop, even when this architecture is not fully efficient. For example, a report prepared for the European Commission stated that: "The network hierarchy assumed in this model may also not be fully applicable to existing networks. We have assumed that a forward-looking network will have two levels of switching — local switches and

[18] NZ Determination 2001-2, p. 22.

[19] Commerce Commission, TSO Model Documentation Version 1.0 23 April 2003, p. 3.

[20] NZ Determination 2001-2, p. 23.

[21] NZ Determination 2001-2, p. 23.

[22] MCMC Consultation Paper, p. 4.

tandem switches. Some EU Member States may, however, be operating with three or four levels of switches. We believe that operators may be migrating to a flatter network structure, although other layers can be considered part of the tandem layer for the purposes of the model".[23] Differences in the assumed network architecture across jurisdictions may limit the comparability of results across jurisdictions.

3.1 The UK

In the UK, the network is assumed to have the following hierarchical structure: Network Terminating Equipment (NTE) at a subscriber's location is connected to a remote concentrator, which is connected to a local exchange. The local exchange is connected to a tandem switch, which is, in turn, connected to other tandem switches. An interconnecting network operator may require call origination (or termination) service, which conveys a call between a remote concentrator and a local exchange; local-tandem conveyance and local-tandem transit, which convey traffic from a local exchange to a tandem exchange, and inter-tandem conveyance and inter-tandem transit, which convey traffic between tandem switches.[24] In the UK, a local call may require more than one instance of tandem switching.

Two broad loop arrangements have been considered in the UK in connection with Local Loop Unbundling (LLU). First, some areas are served by links from a local exchange to several Primary Cross Connection Points (PCPs), and links from the PCPs to Distribution Points (DPs) that are then connected to subscribers. An alternative arrangement used to serve subscribers that are closer to the local exchange eliminates the PCP: links directly connect the local exchange to the DPs.[25] Four alternative implementations of this architecture were considered: (a) the current

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[23]"Study On The Preparation Of An Adaptable Bottom-Up Costing Model For Interconnection And Access

Pricing In European Union Countries: A Final Report for Information Society Directorate-General of the

European Commission", Europe Economics, April 2000, p. 12.

[24] Ofcom, Review of BT's network charge controls: Explanatory statement and Notification of proposals on BT's SMP status and charge controls in narrowband wholesale markets. Consultation document

Issued: 23 March 2005, p. 7.

[25] Report for Ofcom: Cost of the BT UK local loop network, Non-confidential version. Analysys, 21 February, 2005, p. 10.

architecture, with copper links from the local exchange to the NTE, (2) fibre from the exchange to the PCP, and copper thereafter, (3) fibre from the exchange to the DP and copper thereafter, and (4) fibre from the exchange all the way to the subscriber's premises.[26]

3.2 The US

The architecture assumed by US cost proxy models includes the loop, which connects subscribers to a local exchange, interoffice transport that connects local exchanges to a tandem exchange, and the tandem exchange itself. Inter-tandem conveyance is not part of the cost model. Thus, the local network has only one layer of tandem switching. In some cases, a single switch performs the functions of both a local exchange switch and a tandem switch.

When the number of subscribers served by a switch exceeds a specified threshold, a standalone switch is deployed in the exchange. When the number of subscribers is too small to warrant a standalone switch, a less expensive remote switch with limited functionality is used. Switches are interconnected with one another in fibre-optic rings.[27]

The loop architecture consists of feeder cables from the exchange to a distribution point (a Digital Loop Carrier or DLC box if the feeder is fibre-optic cable, or a Serving Area Interface or SAI if the feeder is copper cable), and distribution plant (copper cables) connects the DLC or SAI to a Network Interface Device (NID) at the subscriber's location.[28]

3.3 New Zealand

The "switching network model" is based on a four-tiered architecture of nodes – remote multipexors, Remote Line Units hosted at a local exchange, Local Exchanges, and Tandems and Gateways.[29] The loop or access network has three tiers: a copper

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[26] Report for Ofcom: Cost of the BT UK local loop network, Non-confidential version. Analysys, 21 February, 2005, p. 7.

[27] In the Matter of Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket No. 97-160, Fifth Report & Order, Released: October 28, 1998, at 24. Henceforth, Fifth Report.

[28] Fifth Report, at 22.

[29] NZ Determination 2001-2, p. 100.

drop cable from the subscriber's premises to a nearby Drop Terminal or Cable Terminal, copper distribution cable from this terminal to the Main Distributing Frame or MDF (if it is close enough) or to a Feeder Cabinet, and copper or optical feeder cable from the Feeder Cabinet to the MDF.[30] The transport network is based on SDH rings, with digital radio links to some offshore and remote sites.[31]

3.4 Malaysia

The MCMC has modelled a network with a four layer hierarchy described as: "links that connect remote concentrators and host (local) switches (DRS-DLS links); links that connect host (local) switches and other local switches (DLS-DLS); links that connect host (local) switches and tandem switches (DLS-DTS); and links that connect tandem switches and other tandem switches (DTS-DTS)".[32]

4. SCORCHED NODE

In a scorched node approach, the locations (typically wire centres) of the network nodes in cost models are specified to be at the incumbent's existing locations. Most models of fixed-line networks adopt the scorched node assumption, but the details may vary from one jurisdiction to another. For example, the actual locations of remote nodes may also be fixed in some jurisdictions, while in others these nodes are optimized in the cost modelling.

4.1 The UK

The LRIC methodology adopted by BT uses the scorched node assumption: "BT maintains its existing geographical coverage in terms of customer access and connectivity between customers, and provides the infrastructure to do this from existing network nodes".[33] The LRIC Model developed by BT applies the scorched node assumption repeatedly in developing cost-volume relationships for cost drivers at various levels of its network hierarchy.[34] A report prepared for Ofcom compares

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[30] NZ Determination 2001-2, p. 101.

[31] NZ Determination 2001-2, p. 100.

[32] Consultation Paper on Access Pricing, p. 40.

[33] BT's LRIC Methodology, p.68.

34 For examples, see BT's LRIC R&P, at p. 36 (for ducts), Appendix 2, p. 75 for PDH/SDH/Radio nodes, and Appendix 2, p. 84 for power equipment.

loop costs under a scorched node assumption (where the number of PCPs is taken as given) to a "scorched earth" alternative, and concludes that the small saving the could potentially be achieved by a scorched earth design does not warrant a change in the assumed scorched node architecture.[35]

4.2 The US

The FCC requires that all cost models must use the scorched node assumption when locating the incumbent's wire centres: "The Universal Service Order established ten criteria to ensure consistency in calculations of federal universal service support. Criterion one requires that a model must include incumbent LECs' wire centres as the centre of the loop network and the outside plant should terminate at incumbent LECs' current wire centres".[36] All US models utilize this scorched node assumption. The HAI Model originally took the "greenfield" approach, but adopted the scorched node assumption after an alternative model (the Benchmark Cost Model) implemented this approach.[37]   The model separately calculates the costs of providing supported services in approximately 12,500 wire centres.

The scorched node assumption does not apply to SAIs, DLCs or other nodes and junction points in the loop (or access) network.

4.3 New Zealand

The Commission adopted a scorched node methodology, and assumed that the locations of large exchange sites would be retained in the model, but that small exchange sites and the access network would be optimally placed in accordance with modern practice.[38] The Commission's approach is to remove some nodes with a small number of lines.[39]

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[35] Report for Ofcom: Cost of the BT UK local loop network, Non-confidential version. Analysys, 21 February, 2005, p. 41.

[36] Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket No. 97-160, Tenth Report And Order, Released: November 2, 1999, at footnote 394. Henceforth, Tenth Report.

[37] History of the Hatfield/HAI Model, Version 5.0a, p. 1.

[38] NZ Determination 2001-2, p. 13.

[39] NZ Determination 2001-2, p. 99.

4.4 Malaysia

The MCMC has adopted the scorched node approach. The bottom-up cost model is "based on TMB's existing number of exchange sites and transmission links".[40]

5. BEST TECHNOLOGY

Forward-looking models may differ in their definitions of the forward-looking technologies to be included in the modelled network. This may be particularly true of ISDN, of technologies that support high speed internet access and of wireless alternatives to wireline loops in sparsely settled areas.

5.1 The UK

The top-down approach does not require the design of a network using the best currently available technology. Rather, the book values of assets used by BT are restated to reflect current costs. Existing assets that continue to be efficient choices are valued at current market rates where possible, either by indexation or by absolute valuation.[41] When existing assets differ from the Modern Equivalent Asset or MEA, the cost of the MEA is used.[42] Thus, for example, "UXD local exchanges are older technology which are valued as a mix of System X and AXE10 exchanges for CCA purposes".[43] The specified MEA incorporates the best technology available.

5.2 The US

In the US, the technology chosen by the model "must be the least-cost, most-efficient, and reasonable technology for providing the supported services that is currently being deployed".[44] In some instances, optimization techniques are used to design the modelled network. In determining which technologies to deploy, the modelling decision is made to deploy the technology currently available that will minimize costs of operating expenses as well as capital expenses over the expected life of the technology.[45]

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[40] MCMC, Consultation Paper on Access Pricing, pp. 5-6. [Footnotes omitted]

[41] BT's LRIC Methodology, Section 4.2.

[42] BT's LRIC Methodology, Section 4.2.

[43] BT's LRIC R&P, Appendix 2, p.4.

[44] Universal Service Order, 12 FCC Rcd at 8913, para. 250 (criterion one).

[45] Computer Modeling of the Local Telephone Network, C.A. Bush, D.M. Dennet, J. Prisbrey & W.W. Sharkey (FCC); and Vaikunth Gupta (Panum Telecom, LLC)], October 1999, p.30.

Inefficient technologies are not included in the modelled network. For example, for the tails of private circuits, the FCC concluded that: “the T-1 option should not be employed in the current version of the model. We agree with those commenters addressing this issue that traditional T-1 using repeaters at 6000 foot intervals is not a forward-looking technology”.[46]

The access network (or loop) uses a mix of copper and fibre cables, deployed in accordance with engineering rules. The interoffice network connecting local and tandem switches is based on SONET (SDH) rings. Modern digital switches are deployed at all switching locations.

5.3 New Zealand

The Commission’s position is that a “best in practice” network would use a modern equivalent asset based on technologies that are already deployed. Technologies that are not “fully developed and deployable on a large scale”, such as voice-over IP equipment, are not incorporated into the forward-looking design.[47] Conventional TDM switching does meet the test, and is included in the designed network.[48]

The transport architecture in the model is based on Synchronous Digital Hierarchy (SDH) fibre-optic rings, and route diversity is incorporated in the design. Some remote and offshore sites are connected to the network using Digital Microwave Radio (DMR) systems.[49]

The model incorporates wireless (Multi-Access Radio or MAR system) loop technology when that alternative has lower cost than traditional copper pairs. According to the Commission, less than 2% of the lines served as part of the TSO are modelled with wireless loops.[50]

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[46] Tenth Report at 79.

[47] NZ Determination 2001-2, p. 36.

[48] NZ Determination 2001-2, p. 100.

[49] NZ Determination 2001-2, p. 100.

[50] NZ Determination 2001-2, p. 101.

5.4 Malaysia

The MCMC's model deploys "the most efficient means possible and commercially available".[51] For the conveyance network, the model calculates cost based on SDH rings and spurs.[52]

6. OPTIMAL LAYOUT OF THE NETWORK

A major component of the cost of local service and unbundled local loops is the cost of the feeder and distribution plant – including the structures such as trenches (or poles) that support the cables as well as the cables themselves. Models use significantly different methods to calculate the quantity of (i.e., the distance traversed by) the structures and cables required to serve all identified customer locations: clustering of subscriber locations; minimum spanning trees; inclusion of Steiner nodes; typical distribution area parameters; and geo-coded location data.

6.1 The UK

BT's top down model does not model customer locations, or develop algorithms for the network layout.

6.2 The US

In the US, the FCC determined that the selected platform should be capable of laying out an optimal network using customer-specific geo-coded data if such data were available. The HAI model had implemented this approach. In the absence of geo-coded data, the FCC endorsed the approach taken by the BCPM, namely, to use the road network to estimate the locations of customers. The FCC also endorsed the HCPM's approach to identifying serving areas based on natural clusters of customers.[53] The HCPM's clustering approach implemented Minimum Spanning Tree algorithms to help lower the cost of the designed loop infrastructure.[54]

6.3 New Zealand

The Commission has used the U.S. FCC's HCPM to design the layout of the access network. In applying the model, it has used rectilinear distances to calculate the costs

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[51] Public Inquiry Report on Access List Determination, p. 25.

[52] MCMC Consultation Paper, Appendix B, Section B.1.

[53] Fifth Report at 26.

[54] HCPM, p. 11.

of the access network within ESAs. For longer feeder cables, the Commission has adopted the Cost-Pro approach, and used information on road distances in New Zealand.[55]

6.4 Malaysia

In a report issued on March 14, 2001, the MCMC stated that the costs associated with local loops are non-traffic sensitive costs. To the extent that these costs are not recovered through line rental and connection charges, and access deficit would result. In this report, the MCMC does not specify how forward-looking loop costs would be defined.[56]

7. PROVISIONING AND ASSET VALUATION

In bottom-up models, the quantities of network assets are most often determined in accordance with best engineering practice rather than by minimizing the cost of meeting only current demand. For example, switch capacity is often sized to meet a given grade of service (e.g., ensuring that the probability of delay in providing dialtone meets required standards). Similarly, the number of twisted pairs installed per active service and the planned fill factors for multiple-pair cables are often based on established engineering standards, or rules of thumb. The implementation of such standards can result in a modelled network that is different from one obtained from an explicit optimization algorithm and may be preferable to optimization techniques when the additional benefit of such calculations is small relative to the additional modelling complexity.

The costs of these assets are calculated using a measure of current prices. Asset values are then recovered over time by annual charges that account for depreciation, capital recovery and the expected changes in the cost of replacement assets. Jurisdictions use different calculations for future asset prices, depreciation, the cost of capital and the 'tilt' determining the time profile of capital cost recovery.

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[55] NZ Determination 2001-2, p. 122.

[56] MCMC, A Report on a Public Inquiry under Section 55 of the Communications and Multimedia Act 1998 on Access List Determination, 12 March 2001, p. 29.

7.1 The UK

The top down model does not design a forward-looking network, but it does develop asset-volume relationships and cost-volume relationships that are similar to provisioning rules. The model estimates cost-volume relationships relating cost drivers (such as the volume of traffic conveyed) to costs (such as the cost of the local switches required to convey the given volume of traffic), assuming that all inputs are variable.[57] The cost of an increment is obtained by estimating the impact on cost of removing the volumes of each cost driver associated with the increment.

The Asset-Volume and Cost-Volume Relationships at the heart of the top-down approach are obtained from three sources: (i) engineering-economics studies, (ii) statistical studies of detailed data, where available and (iii) interviews and field research.[58]

BT uses three asset valuation methods to establish the current costs of its assets: indexation, absolute valuation and the Modern Equivalent Asset method.[59] When an existing technology is efficient, an asset would be replaced by a new unit of the same asset. In this case, the replacement cost is calculated according to one of two methods: indexation or absolute valuation.

For the indexation method, cost trends (adjusted for predicted trends when historical trends are not expected to persist) are used to generate indices. These indices, together with the cost composition of each asset (BT pay, raw materials, contract and other) are used to generate index trends. The year-end valuation for each asset is built up from the asset data by vintage: the gross book value of an asset when it was purchased is multiplied by the ratio its index in the valuation year to its index in the purchase year to obtain the Gross Replacement Cost in the valuation year.[60]

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[57] BT's LRIC R&P, pp. 6-7.

[58] BT's LRIC R&P, Section 3.3.

[59] BT, Current Cost Accounting – Detailed Valuation Methodology. 6 December 2002. Section 1.3. Henceforth, BT's Valuation Methodology. Available at http://www.btplc.com/Thegroup/Regulatoryinformation/Financialstatements/PDF2002/Detailed_Valuation_Methodology.pdf.

[60] BT's Valuation Methodology, Section 1.8.

For absolute valuation, the asset value is calculated by multiplying the number of units of the asset deployed in the efficient network by the unit price.[61]

When the existing technology is inferior to a newer alternative, BT assumes that the "replacement cost is based on the cost of a modern equivalent asset, that is the cost of a modern asset with similar service potential".[62] When conditions do not permit the immediate replacement of older assets with newer technology (e.g., when manufacturing capacity is a constraint, and lead times are long), and when BT has definitive plans to replace the older asset, BT assumes that the mix of technologies used as the modern equivalent is that forecast to be in place in three years.[63]

> *1.1 Depreciation on tangible fixed assets is calculated on a straight-line basis, and the asset value is written off over the asset's estimated useful life after taking into account any expected residual values. Freehold land is not depreciated.*[64]

7.2 The US

In the US, cost models are used to design a forward-looking network, and the modelled assets are evaluated at current prices. Data on input prices paid by large incumbent carriers are not in the public domain – vendors typically negotiate prices with their largest customers, and seek to shield their winning prices from the vendors with whom they compete. The FCC has often resorted to an analysis of costs based on publicly available data as an alternative to using either list prices or estimates of the discounts offered by vendors to their largest customers.

To determine current cable and structure costs, the FCC sought to supplement the record by surveying incumbent carriers and new entrants. Ten companies eventually responded to the survey.[65] The FCC concluded that the survey data on cable costs were not verifiable.[66] Inputs on cable costs were therefore based on a study that relied on public information. The study obtained recent contracts for the extension of services by rural carriers, and regressed the costs on line counts and soil conditions,

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[61] BT's Valuation Methodology, Section 1.4.

[62] BT's Detailed Valuation Methodology, Section 1.4.

[63] BT's Detailed Valuation Methodology, Section 1.4.

[64] BT's LRIC Methodology, Section 4.10.2.

[65] FCC Tenth Report, at 89,

[66] FCC Tenth Report, at 107.

creating a basis for selecting inputs to the selected model platform.[67] The FCC used the same study as a basis for estimating the costs of structures that support the local loop.[68] The FCC relied on information developed during the proceeding to adjust the results of the public study.

For the SAI, the FCC found that, in the absence of contract data between LECs and their suppliers, an engineering economics analysis of the components of the SAI yielded reasonable estimates of cost.[69]

For DLCs, the FCC began with available contract data for the years 1995-1998, and adjusted the cost to reflect a proposed 2.6% reduction per year in the fixed and per line DLC cost.[70]

For switches, the FCC again relied on a public dataset developed by the Rural Utilities Service (RUS).[71] The FCC employed regression analysis to determine the fixed costs of remote switches and host (or standalone) switches, and cost per line served (which was assumed to be the same for both kinds of switches. The explanatory variables included the number of lines served, and the switch type.[72] The FCC added the costs of installation, power, and the MDF to the results obtained from is regression, since the original data did not account for these costs. In justifying its approach over alternative approaches advanced by interested parties, the FCC stated that: “The Commission's estimates, however, are based upon the most complete, publicly-available information on the costs of purchasing and installing new switches and therefore represent the Commission's best estimates of the cost of host and remote switches”.[73]

Depreciation is calculated as the asset’s current cost divided by its adjusted projection life. “The projection life of an asset is the asset's expected service life at installation, reflecting not only the physical life of the equipment, but also the obsolescence

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[67] FCC Tenth Report at 113.

[68] FCC Tenth Report, at 218.

[69] FCC Tenth Report, at 251-254.

[70] FCC Tenth Report, at 272.

[71] FCC Tenth Report, at 298.

[72] FCC Tenth Report, at 293.

[73] FCC Tenth Report, at 319.

associated with the replacement of older equipment with equipment that uses new technologies and forecasts of future replacements". The projection life of an asset is then adjusted by its future net salvage value.[74]

7.3 New Zealand

The Commission has valued the assets required by its cost model on the basis of "optimised replacement cost" or ORC.[75] The ORC is defined to be the current cost of the asset in question. The actual input values used by the model are not included in the public version of the model.[76]

The Commission proposed a tilted annuity depreciation methodology. When the ORC is predicted to decline over time, the calculated capital cost is higher in the earlier years, permitting more rapid cost recovery than would be realized with straight line depreciation. For assets with increasing ORC, recovery would be delayed.[77]

7.4 Malaysia

The MCMC has assumed that the conveyance network has the same structure (number and length of logical routes), and the distances of routes and trenches as the incumbent's network.[78]

The Commission has determined that a tilted depreciation schedule should be used in order to best approximate economic depreciation.[79]

8. OPERATIONS AND MAINTENANCE EXPENSES

In most jurisdictions, O&M expenses are developed from historical costs contained in the incumbent's accounts; the specifics of the calculation vary from one model to another. The most common approaches are to calculate the expenses either as a fraction of the investment in the corresponding assets, or as an amount per line.

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[74] FCC Tenth Report, footnote 1318.

[75] NZ Determination 2001-2, p. 13.

[76] Commerce Commission, TSO Model Documentation Version 1.0 23, April 2003. Appendix 2, p. 23.

[77] NZ Determination 2001-2, p. 37.

[78] Malaysian Communications and Multimedia Commission, A Consultation Paper On Access Pricing, 13 May 2002, p. 41.

[79] A Report on a Public Inquiry Under Section 65 of the Communications and Multimedia Act 1998 on Access Pricing, Malaysian Communications and Multimedia Commission, 31 July 2002, p. 22.

8.1 The UK

BT's accounting systems identify separately the labour costs and related stores costs incurred in maintaining a particular type of local exchange.[80] Maintenance expenses related to customer-facing activities and those related to direct plant are identified and assigned to specific activities – no allocation is required for the bulk of such expenses. Once the assignment of maintenance expenses to activities is concluded, these expenses are included in relevant Cost-Volume relationships, and therefore are part of the LRIC calculated by the model. BT illustrates its approach with an example based on maintenance of vehicles.[81] This approach does not require BT to calculate ratios of maintenance expenses to asset values.

8.2 The U.S

For the expenses related to the maintenance of specific kinds of telecommunications expenses, the FCC adopted a four-step procedure to estimate forward-looking costs.

1. For data from five large companies, the FCC calculated current cost to book cost ratios for relevant assets, for the years ending 1997 and 1998.
2. The FCC calculated two sets of composite current-to-book ratios (year end 1997 and 1998) for each account by combining the data for the five companies.
3. These composite ratios were applied to the 1997 and 1998 investment account balances (book values of the assets) to obtain adjusted balances (current book values) for each account. The average adjusted balance for the two years was calculated for each asset.
4. The FCC calculated expense-to-investment ratios for each asset by dividing the total 1998 expense by the current asset value calculated previously in step 3.

The FCC applied these expense-to-investment ratios to the model-derived investment balances to obtain forward-looking plant-specific operations expense estimates.[82]

[80] BT's LRIC Methodology, p. v.

[81] LRIC R&P, p. 31.

[82] Tenth Report, at 341 and 346. Footnotes omitted.

8.3 New Zealand

For repair and maintenance expenses, the Commission relied on figures provided by Telecom to develop the inputs for the CostPro model, which treats these expenses as a percentage of the total capital value of the installed plant.[83]

8.4 Malaysia

The MCMC has considered four options for modelling the incumbent's cost. The options vary in the assumptions made, including assumptions about operating costs. The MCMC has considered both Malaysian-specific data and an international benchmark based on FCC data.[84]

9. INDIRECT COSTS

General overheads are typically estimated using historic costs, and are allocated among services using a reasonable factor, such as the proportion of direct costs for each service.

9.1 The UK

When specific apportionment bases cannot be derived a corporate expenditure, it is initially attributed to the corporate costs support function. The attribution of these support costs to activities and plant groups reflects the value added by the management effort related to those activities and plant groups, and is based on the pay and fixed asset costs associated with each activity and plant group.[85]

9.2 The U.S

The FCC has estimated forward-looking common (support) costs in three categories that are indirect, i.e., hard to associate with specific services or assets: corporate operations expenses, customer service expenses, and plant non-specific expenses.[86]

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[83] NZ Determination 2001-2, p. 151.

[84] Malaysian Communications And Multimedia Commission, A Report On A Public Inquiry Under Section 65 Of The Communications And Multimedia Act 1998 On Access Pricing, 31 JULY 2002, page 5.

[85] BT's LRIC Methodology. Section 2.6.3.

[86] Tenth Report, at 377.

For selected accounts,[87] the FCC estimated the expense per line for each account using the regression equation[88]:

Expenses = β1 Switched Lines + β2 Special Lines + β3 Local DEMs + β4 Toll DEMs + ε

The FCC set the coefficient on the volume of local calls (Local Dial Equipment Minutes, or DEMs) equal to 0 because it did not believe that the volume of local calling should affect the relevant expenses, and it divided all variables in the regression by Total Lines in order to estimate the expenses per line.[89] The regression can then be used to apportion these expenses to switched lines, which are used by the supported services.

Based on a study using public information, the FCC also determined that 34.4 percent of Account 6613, Product Advertising, should be included as a common cost.[90]

The FCC also included the costs of Local Number Portability in this category of common costs, and used carrier-specific per line costs of LNP that it had determined in prior proceedings.[91]

In addition to these common support costs, additional indirect costs result from investments in assets that are used to support overhead functions. The FCC defines these overhead assets to include “buildings, motor vehicles, and general purpose computers”.[92] Modelled GSF investments are estimated in a three-step procedure:

1. For each study area, the model calculates an investment ratio for each GSF account (i.e., asset) by dividing the investment for the account by the investment in total plant in service (TPIS) less GSF investment.
2. A preliminary estimate for GSF investment for each account is obtained by multiplying the model's estimate of TPIS by the GSF investment ratios calculated in step one.
3. The preliminary estimate of GSF investment for each account is reduced to account for the use of the GSF facilities by non-supported services. The

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[87] The expense categories included in the regression were ARMIS accounts 6510 (Other Property, Plant, and Equipment); 6530 (Network Operations); 6620 (Service Expense/Customer Operations); and 6700 (Executive, Planning, General, and Administrative). Tenth Report, at 387.

[88] Tenth Report, footnote 1204 and 382.

[89] Tenth Report, at 391.

[90] Tenth Report, at 407.

[91] Tenth Report, at 408.

[92] FCC Tenth Report, at 409.

adjustment is based on the ratio of the expenses of supported services to the expenses of all services modelled. [93]

9.3 New Zealand

The Commission noted that common costs would be incurred even if CNVCs were not served, and concluded that the common costs were not incremental costs incurred in providing service to CNVCs. Therefore, it did not include any common costs (including indirect costs) in its model.[94]

9.4 Malaysia

The MCMC has defined a category of indirect costs that include human resources, accounting services, the executive function, and non-network buildings. The model can be run with alternative assumptions regarding these costs – the user can input either FCC data of data developed by a Malaysian Taskforce.[95]

10. COMMON COSTS

Some network element costs are common to all services that use those elements, and general overhead costs are arguably common to most, or all, services. Across jurisdictions, models differ in which non-PSTN services (e.g. ISDN and DSL) are allocated a portion of common costs, and how the factors that determine the allocation percentage.

10.1 The UK

BT defines the fixed common costs (FCCs) of a set of services as being equal to the difference between the cost of producing the services jointly, and the sum of the incremental costs of the services.[96] FCCs that are shared between the Core and the other increments are apportioned over the Core components, using equi-proportional markups.[97] FCCs shared between components within an increment are also allocated using an equi-proportionate mark-up.[98] The fixed common costs are calculated using

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[93] FCC Tenth Report, at 409.

[94] Commerce Commission, Determination for TSO Instrument for Local Residential Service for period between 1 July 2002 and 30 June 2003, 24 March 2005. At 24. Henceforth, NZ Determination 2002-2003.

[95] Consultation Paper on Access Pricing, p. 8.

[96] BT's LRIC Methodology, Section 5.3.3.

[97] BT's LRIC Methodology, Section 5.3.5.1.

[98] BT's LRIC Methodology, Section 5.3.4.

the Cost Volume Relationships developed by the model: they are the vertical intercept of the cost-volume curve for a group of components or services.

10.2 The US

In the US approach, virtually all network components are part of one network element, and are therefore direct costs associated with that element. Virtually all costs that are shared by network elements are indirect costs, and the treatment of these indirect costs is described above in Section 9.

10.3 New Zealand

The Commission does not include a portion of the common costs of serving CNVCs and other customers in its calculation of the net cost of the TSO.[99]

10.4 Malaysia

The MCMC has allocated common costs of access and conveyance networks to the corresponding services. Examples include the site for a local switch which is used for call origination and also conveyance, and trenches used for access and conveyance. Trench costs are shared equally by conveyance and access networks, and switch site costs are allocated in proportion to the total costs of the access and conveyance networks.[100]

11. TRANSPARENCY VS. COMMERCIALLY SENSITIVE INFORMATION

Clear documentation of a cost model and access to its underlying data can help third parties assess results based on common assumptions and test their robustness. However, cost models may include commercially sensitive information such as demand forecasts, the choice of technology to be implemented in the longer run, and input prices that the incumbent expects to pay its vendors. They may also include proprietary third-party information (such as geo-coded customer location data in the US, and prices charged by vendors). Different jurisdictions have resolved the tension between protecting commercially sensitive information and transparency in different ways.

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[99] NZ Determination 2002-2003. At 24.

[100] Consultation Paper on Access Pricing, pp. 7-8.

11.1 The UK

The UK regulator, Ofcom, appears to be moving away from LRIC-based pricing towards pricing based on fully allocated current costs, largely because the former approach lacks transparency. Ofcom notes that LRIC+ is a time consuming operation that BT carries out on an irregular basis, that Ofcom has little insight into this operation, that the underlying data used by BT are not subject to external audit scrutiny, and that it is difficult to monitor BT's performance (or profitability) under LRIC+. In contrast, CCA Fully Allocated Costs are judged to be more transparent. Ofcom proposes moving to CCA FAC for Network Charge Controls and Wholesale Line Rental.[101]

11.2 The US

In several cases, the FCC has rejected data submitted by the ILECs and relied instead on studies that use publicly available data. Examples include:

- Cable prices: The FCC concluded that cable cost and structure cost data received from a number of non-rural LECs, as well as AT&T are not sufficiently reliable to use to estimate the nationwide input values for cable costs or structure costs.[102]
- Switch Prices: The FCC concluded that proprietary data submitted in response to a survey request were not reliable, and that a publicly available dataset that it had used was more reliable.[103]

However, the FCC has used proprietary data submitted by the LECs when all alternatives are worse. For example, the FCC used contract data on Digital Loop Carriers (DLCs) that were submitted to the record to develop inputs of DLC costs for the model.[104]

11.3 New Zealand

The Commerce Commission states that the transparency of the HCPM and the CostPro Models was one of the factors that led to their selection.[105] The Commission

[101] Ofcom: Local loop unbundling: setting the fully unbundled rental charge ceiling and minor amendment to SMP conditions FA6 and FB6, Consultation document, 7 September 2005. At 3.8-3.9.

[102] FCC Tenth Report, at 106.

[103] FCC Tenth Report, at 302.

[104] FCC Tenth Report, at 274.

[105] NZ Determination 2001-2, at 450.

also noted that transparency was an important criterion when evaluating the merits of annual charge factors.[106] Recognizing the need to protect confidential information, the Commission has redacted all such information from the public version of its reports, and required all parties with access to the information to sign confidentiality agreements, maximizing transparency while meeting its obligations.[107]

11.4 Malaysia

The MCMC made available cost models for viewing by interested parties. These models were populated by dummy data in order to protect confidential information.[108]

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[106] NZ Determination 2001-2, at A1.87.

[107] NZ Determination 2002-2003, at 4-5.

[108] A Consultation Paper on Access Pricing, p. 1.

ANNEXURE B

COMPARISON OF OPERATIONS AND MAINTENANCE EXPENSES IN PIEII AND US MODELS

Telstra Accounts	PIE II Model Factors	USOA Accounts	HM5.0a Factors, Five States		HCPM/FCC Factors
			Min	Max	
Land & Buildings (Properties)	[c-i-c]	Buildings (2121)	6.95%	11.59%	9.06%
SDH Transmission (SD)	[c-i-c]	Circuit Equipment (2232)	1.53%	1.53%	2.00%
Main cable (XU)	[c-i-c]	Aerial Cable (2421) Copper Underground Cable (2422) Copper Buried Cable (2423) Copper	7.25% 1.68% 2.79%	23.84% 2.43% 7.88%	6.69% 2.10% 4.46%
Distribution Cable (SC)	[c-i-c]	Aerial Cable (2421) Copper Underground cable (2422) Copper Buried Cable (2423) Copper	7.25% 1.68% 2.79%	23.84% 2.43% 7.88%	6.69% 2.10% 4.46%
Optical Fibre (BO)	[c-i-c]	Aerial Cable (2421) Copper Underground cable (2422) Copper Buried Cable (2423) Copper	7.25% 1.68% 2.79%	23.84% 2.43% 7.88%	0.73% 0.84% 0.61%
Main Conduit (XC) Distribution Conduit (XN)	[c-i-c] [c-i-c]	Conduit Systems (2441)	0.08%	0.96%	0.58%
Switching (SL) Transit Switching (ST) Signalling Transfer Point (SP)	[c-i-c] [c-i-c] [c-i-c]	Digital Electronic Switching (2212)	2.69%	2.69%	5.58%
Misc Transmission (ZT) DC Power (DP) Network Management (NM)	[c-i-c] [c-i-c] [c-i-c]	No directly comparable data No directly comparable data			
Customer Radio (XR) Radio transmission (BD)	[c-i-c] [c-i-c]	Not applicable Not applicable			

SOURCES

HM 5.0a: Output by wire centre for Florida, Georgia, Maryland, Missouri & Montana, Worksheet “96 Actuals”. Maximum and minimum calculated after negative ratios were removed.

HCPM: Output by wire centre for Contel, Alabama, worksheet “96 Actuals”.

FCC: CC Docket 96-45, Tenth Report and Order, Appendix A.

NOTES:

HM 5.0a does not distinguish between copper and fibre cable. In the table, the model’s values for aerial, buried and underground cable are shown for both copper and optical fiber cables.

The US circuit equipment account includes copper-based transmission equipment.