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A Consultative Document

Proposed Costing Methodology for Interconnection and Access Services in the Telecommunications Sector

Maintenance History		
Date	**Change Details**	**Version**
December 6, 2006	First Draft	0.1

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1 Introduction

1.1 Background

The Telecommunications Authority of Trinidad and Tobago ("the Authority") is in the process of introducing competition in the telecommunications sector on a gradual basis. Competition in the telecommunications market is being introduced through the licensing of competitors to the incumbent service provider, Telecommunications Services of Trinidad and Tobago, TSTT, in various parts of the market. For example, two new mobile concessions and the associated licenses were awarded at the end of 2005.

However, as long as there remains one dominant operator, the Authority must ensure that competition is not impeded or adversely affected by anti-competitive behaviour. The benefits of competition must be allowed to reach all users. These benefits include the delivery of new and highly efficient telecommunications services with lower prices, higher telecom sector employment and increased investment.

The Authority must facilitate a level playing field for both new and existing service providers. New entrants must be provided with a fair environment in which to compete. The dominant service provider must be provided with the opportunity to compete without unnecessary rules and regulations.

Recognising this situation the Authority has published a consultative document entitled, *Proposed Price Regulation Framework Policy for the Telecommunications Sector of Trinidad and Tobago,* that specifies where, when and how the Authority should intervene to prevent anti-competitive pricing in the telecommunications market. This framework is based on the principle of proportionality: the minimum possible interference to correct for any failures that may exist in the competitive market. In order to regulate prices for telecommunications services that are based on cost, the Authority is required to develop a Costing Methodology.

This draft document presents proposals on the required costing methodology and appropriate costing principles to be adopted in Trinidad & Tobago. It informs the determination of interconnection rates as the Act specifically requires that these prices are cost-based. In addition, the methodology is equally applicable for the determination of other prices (e.g. access to facilities such as unbundled local loops), should that become necessary at any future point.

In this document the Authority seeks to identify and comment on internationally recognized costing principles and standards, and addresses the advantages and disadvantages of each of them (and of all relevant combinations), and makes proposals based on:

- Relevant telecommunications laws
- Data availability
- The estimated cost of implementation
- The goals of the Authority in relation to the development of the sector
- The required timetable for implementation.

1.2 Review Cycle

As the telecommunications sector grows and develops into more efficient and competitive markets and as the science of costing telecommunications network and services grows, the need will arise to revise and update the type of costing methodology that is employed by the Authority. And as such, this document will be modified in consultation with concessionaires, stakeholders, interested parties and the public, as the Authority deems appropriate. The maintenance history will be modified accordingly.

1.3 Consultation Process

The Authority is seeking the views and opinions of the general public and other stakeholders regarding the proposals made in this document in accordance with the Authority's *Procedure for Consultation in the Telecommunications Sector of Trinidad and Tobago.*

The Authority's consultation procedures and comment submission form are available on the Authority's website, http://www.tatt.org.tt. Comments should be submitted on or before **Wednesday 10th January 2007** to policy@tatt.org.tt or mailed to:

Telecommunications Authority of Trinidad and Tobago
BEN Court, 76 Boundary Road
San Juan

2 Issues and Choices in Developing a Costing Methodology

Section 25 (2) (m) of the Act indicates that interconnection charges should be established on a cost basis and "in such a manner as the Authority may prescribe". Section 15 (1) of the Interconnection Regulations, 2006 specify that: " A concession shall set interconnection rates based on costs determined in accordance with such costing methodologies, models or formulae as the Authority shall from time to time, establish." In this document the Authority seeks to explain why interconnection prices should be cost based, and thus to determine the most appropriate costing methodology to be used to determine such prices.

2.1 Why Interconnection and Access charges should be Cost-based

2.1.1 Maximizing economic welfare

As the telecommunications market in the Republic of Trinidad and Tobago goes through a process of liberalization, the Authority needs to establish guidelines on which to set interconnection and access charges. In doing so it should seek to maximize economic welfare. Economic welfare will be at its greatest where interconnection and access charges are set to reflect the costs of provision. This will:

- Encourage new operators to use existing facilities where this is economically desirable (i.e. facilities which it is not appropriate for entrants to duplicate)
- Encourage investment in new facilities where this is economically justified. These facilities may either be a modernisation of existing infrastructure (e.g. to embrace new technology) or the deployment of new infrastructure in greenfield sites. The investment may either be by the incumbent or an entrant.

When charges are based on cost they do not distort the build/buy decision of new entrants – they will be encouraged to use existing facilities if and only if it is economically desirable to do so. Just as important, setting charges in this way also means retaining investment incentives for the incumbent to upgrade or extend its existing facilities when new technology becomes available.

In a fully competitive market charges will tend to reflect costs as a matter of course. If one operator fails to offer cost-based prices another will exploit the opportunity to offer lower prices whilst retaining profit. Similarly, if an operator fails to make the most efficient investment decision, it will soon find itself out of business. It is the task of the regulator to mirror these conditions in the less than fully competitive telecommunications market.

2.1.2 Meeting the requirements of the WTO Agreement

In order to honor the Republic of Trinidad and Tobago's commitments to the World Trade Organisation (WTO) in respect of telecommunications' services, and in particular the Reference Paper on Regulation, the country is committed to the full liberalization of the telecommunications sector and the removal of foreign ownership restrictions. The Republic of Trinidad and Tobago is also obliged to implement the WTO's Regulatory Principles. The Principles can generally be described by five requirements:

- An independent regulator should be established
- There should be transparent licensing of all operators
- A range of anti-competitive safeguards need to be established, covering non-discrimination and the prohibition of cross-subsidies. These safeguards need only apply to "major suppliers"
- Major suppliers must offer interconnect services at transparent, cost-oriented rates
- Major suppliers must offer unbundled interconnect at any technically feasible point.

The term "major supplier" is defined by the WTO as "a supplier which has the ability to materially affect the terms of participation (having regard to price and supply) in the relevant market for basic telecommunications services as a result of control over essential facilities or use of its position in the market." The equivalent term in the Telecommunications Act of Trinidad & Tobago is "dominant concessionaire"

2.1.3 Attracting Investments

There now exists a near-global market in investment capital for telecommunications. This has two major ramifications for interconnect and access charges set by the Authority:

- The Republic of Trinidad and Tobago is competing for a limited (although large) pool of investment capital. This means it is not sufficient simply to open the national market to competition and expect that investment in telecoms networks will follow. A stable and rational competitive framework, of which interconnection and other access services are a major part, and should be established in order to create the regulatory certainty necessary to attract investment. The access services framework also needs to ensure that the prospective returns on investment are at least as good as are available in the many other liberalising national markets.
- The focus of investment capital will be on the most lucrative parts of the market. In contrast, one of the principal objectives of the Government of the Republic of Trinidad and Tobago is to allow the vast majority of the population to have access to services at affordable rates. The framework for telecoms competition must therefore be established so as to enable and encourage this to happen. This means that the approach to determining costs must ensure that adequate returns on investment can be made not just in the main urban areas but throughout the country.

In other words, the pricing framework and costing methodology to be adopted by the Authority should balance the requirement to make telecoms investment attractive, with the need to avoid cream-skimming of the most lucrative parts of the market. Setting cost-based prices for interconnection and access is an important means of achieving this balance.

2.2 Choosing an Appropriate Cost Standard

In this section we consider how costs may be interpreted in practice. There are five main choices to be made when establishing a cost-based pricing standard. These are:

- Historic costs or current costs?
- Fully allocated costs or long run incremental costs?
- Actual or theoretical efficiency?
- Choice of mark-ups on cost
- Choice of rate of return on capital employed.

Invariably the best answers to these questions are those which are most consistent with encouraging efficient investment in telecommunications.

2.2.1 Historic costs or current costs?

Historic cost accounting (HCA) means that the costing methodology works with the costs which the operators have actually incurred in developing their networks. These costs are recorded in the operator's accounts. The alternative approach, current cost accounting (CCA), sometimes referred to as forward-looking costs, takes account of technology and price changes which have occurred since an asset was purchased in order to derive a modern equivalent asset (MEA) value. Within the CCA approach all assets are revalued annually to derive their MEA values, and it is these values rather than the purchase prices which are then used within the cost model. . Under CCA the depreciation lifetime of an asset may also differ from that recorded in a concessionaire's accounts since the depreciation is calculated on the basis of economic lifetime. Figure 1 provides a comparison of the two approaches.

Figure 1: Historic versus current cost accounting

	Historic cost accounting	Current cost accounting
Strengths	Strong audit trail to existing audited accounts Ensures operators recover their actually incurred costs	Provides economically efficient pricing signals for investment decisions
Weaknesses	Historic costs are inefficient because they have no relevance to investment decisions today	Requires time and investment to complete a full revaluation of assets

The Authority considers it important that the concessionaires set prices on a current cost basis, so as to ensure economically efficient investment decisions by potential market entrants. If interconnection or access prices are set below current costs then inefficient entry will be encouraged and/or there will be insufficient investment in alternative infrastructure. If access services are priced above current costs then there will be insufficient entry and/or over-investment in alternative infrastructure will be encouraged.

In general, current costs will be lower than historic costs owing to technology improvements. However, in the access network current costs may be higher than historic costs because the key cost components (labor and wayleaves) are subject to wage inflation.

2.2.2 Fully allocated or long run incremental costs?

Fully allocated costing (FAC) involves the allocation of all of an operator's costs either directly to services or indirectly to network elements and then to services, on the basis of identifiable cost drivers. This is a relatively simple and transparent process, and has been used in the early stages of market liberalization in many countries. The main alternative approach, known as long run incremental costing (LRIC)[1], requires an assessment of how the costs of individual components vary with volume.

Long run incremental costs give the most accurate price signals to the entrant when deciding whether to build its own facilities or buy the incumbent's facilities through interconnection. In the long-run it is possible to avoid the volatility associated with spare capacity (low short-run costs) or capacity constraints (high short-run costs), and establish a true measure of the profitability of entry. Using LRIC means that prices are based on the costs avoided if an increment of output is no longer required – e.g. if an operator were no longer to provide a service. The avoided costs would be those which are directly attributable to the call service, and would exclude all common costs. Figure 2 provides a comparison of the two approaches.

Figure 2: FAC versus LRIC

	Fully allocated costs	Long run incremental costs
Strengths	Can be used with either historic or current cost accounting Based on reconcilable and readily available information Ensures recovery of all costs	Provides economically efficient pricing signals for investment decisions
Weaknesses	No accounting for potential efficiency gains Does not reflect the economic cost of providing the service	Requires current cost accounting Requires assessment of cost volume relationships which can be complex

[1] **Short-run** incremental costs (or **marginal** costs) are not considered appropriate for setting interconnection prices since planning and investment horizons in telecommunications are always long-term. This means that it is not possible to adjust supply to meet short-term fluctuations in demand; rather it is the long-term fluctuations in demand that drive supply.

If LRIC is adopted, the next question that arises is the size of the increment over which variable costs are to be calculated. The approach that regulators have most commonly adopted is known as Long Run Average Incremental Cost (LRAIC) or, synonymously, Total Service Long Run Incremental Cost (TSLRIC). The LRAIC standard assesses costs over an increment represented by the entire output of a service. If incremental cost varies with output (possibly due to economies of scale), LRAIC will be higher than the marginal cost measured at the current level of output. Furthermore, LRAIC includes service-specific fixed costs, (i.e. costs that do not vary with the level of output but would be saved if the firm discontinued production of the service). LRAIC is attractive to regulators both because it accounts for all the costs associated with an entire service, and because it allows costs to be determined without building complex cost-volume relationships for individual network assets. See Section 4.5 for details.

2.2.3 Actual or theoretical efficiency?

The efficiency of an operator should be measured based on its actual network topology (which is a legacy it cannot reasonably alter within the short-to-medium term) but using best-practice operational efficiency for operators of roughly its size and operating in similar markets (for this is an improvement it could commercially justify and practically achieve). By this means the incumbent is not penalized for having optimized its network for historical technologies, nor for obligations imposed on it as a publicly owned employer – legacies which no entrant has to bear. Nonetheless, the incumbent is given incentives to modernize its asset base and to eradicate operational inefficiencies.

In practical terms this means that any cost model should be built on what is known as the "scorched node" approach. Under scorched node assumptions, the core network nodes (e.g. switch and concentrator sites, or base stations in a mobile network) are taken as fixed, and the network construction is optimized given this constraint. This means using the latest available, efficient technology at modern equivalent asset prices.

2.2.4 Choice of mark-ups on cost

The mark-ups on LRIC should, over the long term, enable the operator to recover its joint and common costs. If no mark-ups were included then the interconnect price would not allow the operator to recover its full cost base. If the operator priced in this way and only offered interconnect services, it would go out of business. Mark-ups are therefore required in the long

term, and they should be spread across all of the incumbent's network services including interconnection.

2.2.5 Choice of rate of return

The allowable rate of return should be equivalent to that which would be expected by the financial markets when investing in a telecommunications company in the Republic of Trinidad & Tobago. This rate of return will be based on the typical rate in global telecommunications markets, adjusted to reflect the degree of political, economic, exchange rate and commercial risk involved in Trinidad and Tobago. The cost of capital is usually calculated as a weighted average of the cost of debt and the cost of equity finance.

2.3 Measuring against the Interconnect Price Standard

There are basically three methods of deriving price controls which meet the standard of long run incremental costs. These are:

- Adapting the operator's accounts. This is a **top-down approach** which starts with the reality of the incumbent's actual costs and seeks to modify the basis of calculation to meet the interconnect pricing standard. For example: assets, valued in the accounts on the basis of historic costs, may need to be replaced by modern equivalent assets and revalued at replacement cost; joint and common costs may need to be removed from the cost allocation system in order to estimate LRIC.
- Developing interconnect cost models. This is a **bottom-up approach** which starts from a network engineering model and assesses the optimal network design to meet a given subscriber and traffic profile. A major challenge with the cost modelling approach is the incorporation of operational expenses. Typically this is achieved by identifying best practice ratios of capital to operating expense.
- Compiling **interconnect benchmarks**. Benchmarks involve reading across from the prices of other services in order to obtain a proxy for a concessionaire's interconnection costs. Most typical benchmarking involves a read-across of interconnect rates from other operators, often in other jurisdictions, to assess the reasonableness of a concessionaire's interconnect rates. However, benchmarks take other forms, e.g. a comparison between prices for equivalent

services at the retail and wholesale level; a comparison of price relativities for incumbent and entrant operators; benchmarks of input assumptions for cost models. The challenge in the benchmarking approach is to determine which rates in which jurisdictions are both comparable with those of the operator under scrutiny and with the desired pricing standard itself.

None of these approaches is perfect. Each has its strengths and weaknesses. As a result the best approach varies according to circumstances, with different approaches being favored in different countries at different times. For example:

- The US almost exclusively uses the bottom-up approach, and this approach has been used also in much of the EU (e.g. Sweden, France), Asia (e.g. Korea, Singapore, Hong Kong) and Australia.
- The UK considered bottom-up models but, failing to reconcile them with operator accounts, preferred the top-down approach as the principal source of data. Austria is another country that uses top-down models, and throughout the EU incumbent operators are required to produce separated accounts as a means of assessing costs on a top-down basis
- In many countries interconnect benchmarks have been used either as an interim solution while cost models are developed (e.g. Denmark) or as a longer term solution especially for mobile termination rates (e.g. Germany). Benchmarks are usually set against prices (preferably cost-based prices) for comparable services in other countries, but they can also be set against the prices for equivalent retail services with a discount reflecting the cost-savings available in the supply of the wholesale service.

2.3.1 Strengths and weaknesses

Figure 2.3 illustrates the main strengths and weaknesses of the three approaches. These are described in more detail below.

Figure 3: Comparing the three approaches to estimating cost

Approach	Strengths	Weaknesses
The top-down approach	Based on actual costs Accounts for cost minutiae Strong audit trail	Accounting for potential efficiency gains Requires substantial up-front investment Data sources and data confidentiality
The bottom-up approach	Minimal co-operation needed from incumbent Accounts for theoretical operational efficiency Avoids data confidentiality problems	Little resemblance to actual costs Poor transparency; hard to authenticate Can't deal with operational costs Substantial investment required
The read-across approach	Based on costs of real-world operations Realistic interpretation of efficiency Minimal investment Avoids data confidentiality problems	Cannot reflect an operator's actual costs Limited by effectiveness of regulatory regimes in other countries Limited transparency Cannot easily account for differences in national operating conditions.

2.4 The Top-down Approach

2.4.1 Strengths

The main strengths of adapting the operator's accounts to match the interconnect pricing standard are that it:

- Is the only approach which is totally based on the actual costs of operating in the national market situation. Each of the other approaches requires simulation of national operating conditions.
- Has the ability to take account of the minutiae of real costs. No matter how good the assumptions used in other approaches they cannot match the detail obtained from the original accounts.

- Provides a strong audit trail. Top-down approaches can always be traced back to the audited accounts of the operator and can, if necessary, themselves be audited as a fair and true reflection of the interconnect price standard.

2.4.2 Weaknesses

The main weaknesses of the top-down approach are that it:

- Cannot take full account of potential efficiency improvements. The top-down approach is to some extent constrained by the historic network design and operating practices of the operator.
- Requires substantial up-front investment to establish the necessary cost accounting systems and to perform accounting separation between an operator's wholesale and retail functions. Equally it may take 2-3 years to realise the fruits of this investment.
- Introduces problems of maintaining the confidentiality of an operator's cost data. If the top-down approach is to be transparent, then data must be made publicly available.

2.5 The Bottom-up Approach

2.5.1 Strengths

The main strengths of building an economic/engineering model of an efficient operator are that it:

- Can be achieved with minimal co-operation on the part of the operator whose costs are being measured. The bottom-up method can be managed without substantial data input from the operator. In particular it does not require detailed accounting information to be available.
- Takes full account of all theoretically available efficiencies, both technical and operational. The bottom-up model can adopt a scorched earth approach, which simulates the operator's entire network and facilities being rebuilt in the most efficient manner to support estimated demand for access lines and call traffic.
- Avoids any problems of confidentiality of data. As the model will not be based on the operator's actual network, the cost and volume inputs can be generically obtained.

2.5.2 Weaknesses

The main weaknesses of the bottom-up approach are that it:

- Bears little resemblance to the actual costs of the operator. For example, after two years of effort on bottom-up models in the UK, Oftel was forced to admit that they could not be reconciled with the top-down approach.
- Provides little transparency. The workings of the model cannot be easily understood except by those who built them.
- Is difficult to authenticate. Typically it is difficult to obtain agreement even on the inputs to the model, and it is especially hard to verify the output as there is no real operator against which to calibrate the model.
- Cannot deal with operational costs which comprise maybe 50% of the total network costs of a real-world operator. To address operating costs the bottom-up model has to rely on mark-ups and rules-of-thumb derived from best practice comparisons.
- Requires substantial investment with uncertain benefits. Although several off-the-shelf network cost models are now available, this is a task which needs a significant amount of customisation if the model is to derive credible results.

2.6 The Benchmarking Approach

2.6.1 Strengths

The main strengths of using international comparisons to measure an operator's charges against the interconnect pricing standard are that it:

- Reflects real-world operations, both in technical design of the network and in operating conditions.
- Is the only approach which offers a realistic interpretation of an efficient operator. By comparing interconnect rates of different operators in different countries, the read across method works on the basis of international best practice.
- Requires minimal investment. The cost involved in developing an international benchmark, even quite a sophisticated benchmark, are substantially lower than for either of the other approaches.

- Avoids problems with confidentiality of data. The benchmark can largely be based on publicly available data. Where confidential data is used, it can generally be presented unattributed as a generic assumption.

2.6.2 Weaknesses

The main weaknesses of the read-across approach are that it:

- Cannot reflect the actual costs of the operator. The best that an international comparison can do is to measure the costs of similar operators in similar situations.
- Is limited by the efficiency of operators and the effectiveness of regulatory controls on interconnect prices in other countries. The read-across method provides no empirical evidence of how well the group of operators in the benchmark is doing in meeting the interconnect pricing standard. In the worst case, if all countries simply employed a benchmark technique, there would be no dynamic for lowering interconnect charges.
- Offers limited transparency. Although a simple comparison of interconnect rates can easily be achieved, if due account is to be taken of the variations in operating conditions in different countries, the level of transparency is unlikely to be significantly better than with the bottom-up approach.
- Cannot easily take account of variations in the operating conditions faced by service providers in different countries. These differences concern matters such as wage rates, import taxes, urbanisation and the geographical terrain.

3 Proposed Approach for Trinidad & Tobago

The Authority believes that the appropriate costing methodology for the Republic of Trinidad and Tobago is as follows:

- Current cost accounting (CCA) and long run average incremental cost (LRAIC) should be implemented by all concessionaires. The LRAIC standard[2] has been used effectively in other countries and is the form of LRIC that assesses costs over an increment represented by an entire service. This means that costs can be determined without building complex cost-volume relationships for individual network assets. See Section 4.5 for details.
- A top-down method should be preferred as it is the only method which accurately reflects the costs of operating a network in Trinidad and Tobago. In order to achieve this all concessionaires need to commence work on redesigning their cost accounting systems to capture data in a suitable format for long run incremental costing.
- Recognising that the development of a top-down LRAIC model is a complex task, the Authority will not impose this requirement until 12 months after the adoption of this Policy and its associated Regulations or 18 months after the granting of a concession, whichever is the later.
- Until such time as top-down models are available, the benchmarking approach should be favoured since it can be implemented quickly and effectively and provides a reasonable proxy for cost-based pricing. Benchmarking, either against retail prices and/or against interconnection charges in other countries, ensures that interconnect prices are low enough to be competitive but high enough to ensure that there are adequate incentives for network investment. Benchmarking can also provide a suitably proportionate longer term remedy for pricing services of non-dominant concessionaires.
- The bottom-up approach should not be given a high priority at this time. This is because it is liable to under-estimate the true costs of building and operating a network. A bottom-up approach may be appropriate in developed countries such as the US and Western Europe where networks are already fully built and teledensity approaches saturation levels, but the Authority believes that such an approach would be inappropriate in Trinidad & Tobago. Prioritising the bottom-up approach would amount to a disincentive for network investment –

[2] This standard is alternatively known as Total Service LRIC, TS-LRIC.

investment which is fundamental to achieving the goals of increased teledensity, universal service and, ultimately, economic growth.

Statement on Costing Methodology:

The Authority proposes a top-down long run average incremental cost (LRAIC) model, where assets values are based on current cost accounting, CCA, shall be used as a suitable costing methodology for access services in the telecommunications sector. In the absence of such model, a benchmarking approach shall be used in the interim period. The Authority shall require concessionaires to implement a top down LRAIC model, 12 months after the adoption of this Methodology and its associated Regulations or 18 months after the granting of a concession, whichever is the later.

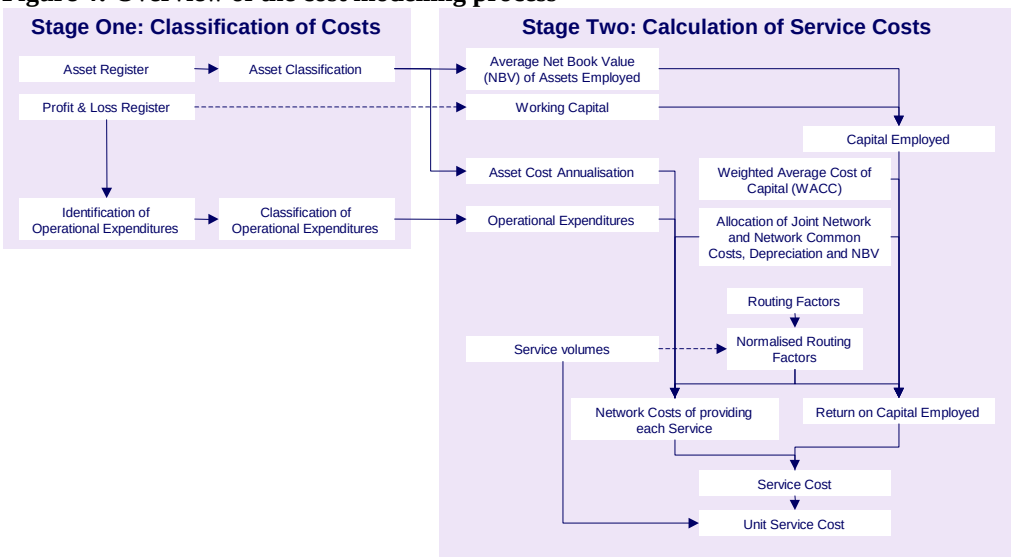
4 Building the Top-down Model

4.1 Overview of the Approach

An overview of the proposed costing methodology is illustrated in Figure 4.1. It consists of two stages:

- **Stage One: Classification of Costs**. This involves the identification and classification of annual costs from the concessionaire's accounting information. Costs are of two types: annual operational expenditure (opex) and capital expenditures (capex) which have to be annualised using some form of depreciation and cost of capital. A detailed classification of assets and opex into predefined categories is performed based on the cause of the cost items specified in the Asset Register and Profit & Loss Statement. The importance of this process is to isolate the "Network" costs from the "Retail" and "Common" costs. Network costs are then further allocated into the costs of individual network elements and "Network Common" costs.
- **Stage Two: Calculation of Service Costs**. This involves the aggregation of network element costs (along with their re-allocations of "Network common") into service costs through the use of routing factors (which measure the relative usage of network elements by different services). Three types of cost are included in this calculation: opex, annual depreciation and return on capital employed. Retail costs will be similarly allocated to services either directly (if the costs are caused by a particular service) or indirectly (if they are shared by multiple services). Finally the common costs of network and retail will be allocated across all the services, using equi-proportionate mark-ups.

Figure 4: Overview of the cost modelling process



The classification of costs will be based on the concessionaire's accounts, and where applicable any separated accounts that may be required in accordance with the Pricing Regulations 2006 and the Accounting Separation Guidelines 2006, which will provide detailed charts of assets and operating expenditure using Historic Cost Accounting methods. The development of a top-down LRIC model requires the following additional steps:

- Revalue all of the assets using current cost accounting , i.e. to establish the modern equivalent assets to those already installed in the concessionaire's network, taking account of price changes and technology improvements.
- Compute annual depreciation
- Estimate and apply the cost of capital.
- Construct cost-volume relationships, to determine the incremental change in cost for each incremental change in service volumes.
- Determine service routing factors (i.e. the relative usage of network elements by different services).
- Determine mark-ups for common costs.

The Authority's proposals for addressing each of these issues are described in the sections that follow.

4.2 Asset Revaluation

Full asset revaluation requires the identification of price trends for all assets within a concessionaire's network over the period from asset purchase to the current day. This requires a full inventory of asset purchase dates and asset prices so that an accurate picture can be obtained regarding price trends and those parts of the asset base to which they apply. This is likely to be a major undertaking that will take several months, and even then it is probable that some of the necessary information to complete the evaluation will not be available, and will need to be estimated. A further complication with full asset revaluation is that when modern equivalent assets do not match directly onto the concessionaire's actual asset base. This issue is, for example, becoming more prominent in the migration to so-called Next Generation Networks based on IP technology rather than traditional circuit-switching.

Indexation is an alternative and more practical approach to modern equivalent asset revaluation. Indexation requires that annual price changes are estimated for broad categories of assets, taking account both of price and technology changes. Indices can be created on the basis of a variety of information sources, e.g. extrapolation from historic price data; vendor price lists, assumptions against cost models deployed in other countries. While less accurate for historic price changes, this approach copes more easily with technology changes, permits cost models to be forward looking and takes account of potential efficiency improvements.

Statement on Revaluation of Assets:

The Authority proposes the adoption of indexation for revaluing the assets of concessionaires in Trinidad & Tobago.

4.3 Depreciation

In historic cost accounting the standard approach is straight line depreciation, in which an asset is depreciated in equal annual amounts throughout its lifetime. In forward-looking cost models it is more common to use an approximation to economic depreciation - that is, the most efficient form of depreciation which would be used in the case of a perfectly competitive market. For example, in a market where asset prices are falling, it is economically rational to take a greater share of depreciation in the earlier years, since otherwise a competitor would be able to enter the market and benefit from lower asset prices through lower capital costs.

There are two main approximations to economic depreciation, the tilted straight line and the tilted annuity. Tilted straight line depreciation allows for the forward-loading of straight line depreciation to precisely the extent justified by the average annual decline in asset prices. Tilted annuity depreciation likewise tilts the basic annuity calculation (in which the total capital charge, equal to depreciation plus return on capital, is held constant throughout an asset's lifetime).

The tilted annuity approach is commonplace in bottom-up cost models. This is because bottom-up models tend to work on the assumption that the network is redesigned each year to be efficient for the subscriber and traffic requirements of that year. Such models work exclusively from first year capital charges. The annuity approach is therefore attractive, whereas the straight-line approach will tend to exaggerate costs as it assumes that capital charges decline over time.

In a top-down model there is no such reason to prefer the tilted annuity approach. An illustrative example for each of these forms of depreciation is given in Annex A.

Statement on Depreciation:

The Authority proposes the adoption of the tilted-straight line depreciation method in calculating the annual depreciation of the assets of concessionaires.

4.4 Cost of Capital

The annual return on capital employed is calculated by multiplying the mean capital employed by the weighted average cost of capital (WACC).

The Mean Capital Employed is the sum of:

- Average Net Book Value of the Assets
- Working Capital.

Working capital is defined as the sum of short-term assets minus short-term liabilities. If data is not directly available from the concessionaire's profit and loss statement, as a general rule, working capital can be approximated as the equivalent of 40 days of opex.

The estimated WACC should be the pre-tax nominal Cost of Capital. Typically the Capital Asset Pricing Model CAPM would be used to derive an estimate for the weighted average cost of capital across each concessionaire's business using the formula:

$$WACC_{pre\ tax} = \left(r_{Debt\ post\ tax} \frac{D}{D+E} + r_{Equity\ post\ tax} \frac{E}{D+E} \right) \Big/ (1 - T_c)$$

Where:

$r_{Debt\ post\ tax}$ = (Risk free rate + debt risk premium) * $(1 - T_c)$

$r_{Equity\ post\ tax}$ = Risk free rate + Beta * market risk premium

T_c = Marginal tax rate

D = Market value of debt

E = Market value of equity

For the **risk free rate** it is normal practice to use the long-term government bond yield (typically 10 years) as the basis for the risk free rate. Clearly, this yield reflects an element of country risk associated with investments in the country in general, but this risk is equally relevant for providers of debt and equity to companies in Trinidad & Tobago.

The **debt risk premium** reflects the difference between the government bond yield and corporate bond yields of the same maturity. This premium is normally about 2.0%, which is an international benchmark for telecommunications companies in developing markets.

The **market risk premium** reflects the difference between the return on Trinidad & Tobago equity and the yield on government bond yields for the same period. This difference can be determined based on ex-post and ex-ante calculations based on analysis of the stock market, or based on international benchmarks.

The **Beta** of a company is a measure of non-diversifiable risk that indicates the volatility of the stock compared with the market average. A Beta of 1.0 suggests that a stock has the same risk profile as the market average. In general for telecoms companies and in particular for mobile operators, Beta values tend to be greater than 1.0 indicating that these investments are more risky than average. Betas are published for many telecoms operators, for example by Bloomberg.

The **debt to capital ratio** part of the WACC calculation D/(D+E) is company-specific. Each concessionaire should be able to supply its own information based on its latest financial statements. Where the concessionaire does not supply the information within a reasonable time period, the information may be determined with reference to benchmarks as determined by the Authority. However, it is important to note that the calculation of the WACC should be based on market values and not on book values.

The **tax rate** should be the marginal rate of corporate tax.
The cost of capital is a key input to all cost models and, in order to ensure a consistent and fair approach to its calculation.

Statement on Cost of Capital:
The Authority proposes to use Weighted Average Cost Capital, WACC, to determine the allowed cost of capital for all concessionaires or any other measures deemed appropriate by the Authority.

4.5 Cost-volume Relationships

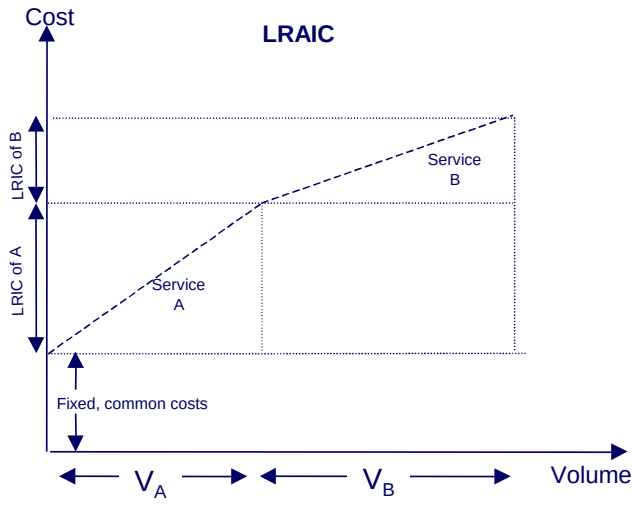
The Long Run Average Incremental Cost, (LRAIC) approach (also known as Total Service Long Run Incremental Costs, TSLRIC) has been used by most national regulatory authorities around the world. LRAIC is a specific form of LRIC with two specific characteristics:

- LRAIC measures an average incremental cost over the entire range of output of the service. It takes no account of economies of scale, but averages costs across all service volume
- LRAIC includes service-specific fixed costs - costs that do not vary with the level of output, but would be saved if the firm discontinued production of the service.

This simplified form of LRIC has been preferred because, where regulators have engaged in full LRIC program, specifying cost volume relationships (CVRs) for each network element, economy of scale effects have not been found to be nearly as profound as initially expected. Furthermore the process of identifying separate CVRs for each network element is a hugely time-consuming and costly task.

The TSLRIC approach is depicted graphically in Figure 5 below.

Figure 5: Long Run Average Incremental Costs



4.6 Service Routing Factors

The aim of the cost model is to determine the unit costs of individual services. However the concessionaire's accounts present costs in terms of network elements, and multiple services make use of each network element. For example, in a Next Generation Network, the core IP-based network may be used by both fixed and mobile services; and a mobile switching center will be used by a variety of call services (e.g. on-net calls, fixed-mobile calls, mobile-to-mobile off-net calls).

In order to allocate the network costs of each network element to the various services that use it, it is necessary to know the extent to which each service uses each of the network elements. The input to the cost model should be a routing factor table of the form shown in Figure 4.3. This shows, for example, that, on average during the busy hour, one minute of traffic from service A passes over 1.2 units of NE2 and 0.9 units of NE3 but does not use NE1 or NE4.

Figure 6: Routing factor example

	Network element 1	*Network element 2*	*Network element 3*	*Network element 4*
Service A	0	1.2	0.9	0
Service B	1.5	0	0	0
Service C	0	1.2	0.9	1

The routing factors represent the usage that a unit of each service makes of each network element. These routing factors have to be weighted by the service volumes to calculate Weighted Routing Factors. The Weighted Routing Factors should then be normalized so that the usage of each Network Element adds to 100%.

4.7 Common Cost Mark-up

The last step in the top-down cost model is to mark-up the unit service costs to include common costs. The Authority proposes that equi-proportionate mark-ups (EPMU) are used: i.e. common costs are allocated in proportion to the LRICs of the services that share these costs. EPMU is simple and effective, and is the standard treatment in virtually every regulatory cost model around the world.

It could be argued that mark-ups should be set so as to recover common costs by setting higher prices for those services to which consumers are price insensitive, or less sensitive, balanced by lower prices for services where consumers are more price sensitive. This system of pricing is known as Ramsey pricing. The trouble with Ramsey pricing is that it requires data on the cross-elasticity of demand for the group of services over which a mark-up is being allocated. Such data is notoriously difficult to obtain, which makes the application of Ramsey pricing impractical, however theoretically attractive.

Statement on Common Cost Mark-up:

The Authority proposes to use equi-proportionate mark-ups (EPMU): i.e. common costs are allocated in proportion to the LRICs of the services that share these costs. EPMU is simple and effective, and is the standard treatment in virtually every regulatory cost model around the world.

4.8 Externality Mark-up

The term "externality" refers to benefits (or costs) that are not taken into account by users when deciding whether to subscribe to, call or use a telecommunications service. The main externality is normally called a "network externality" or sometimes an "option externality". This refers to the benefits which existing subscribers gain when a new subscriber joins the network. Existing subscribers can then contact the new subscriber at times and in places where contact was previously impossible. This benefit is partly captured by the extra calls that are made as a result of subscription and partly through the (much more intangible) knowledge that it is possible to contact the new subscriber.

The Authority believes that there is a theoretical case for including a network externality in interconnection charges. However, there are two reasons why in practice very few regulators have adopted this approach:

- The externality is difficult to measure with any degree of confidence. In the UK Ofcom and the Competition Commission made strenuous efforts to assess the externality when determining mobile termination rates. Their analysis is extensive, but it is not exhaustive and there remain many grounds on which it can be criticised. The base research seems less than robust, relies on parameters[3] which are unreliable and for which there is little empirical basis, and there has been no attempt to consider how the externality may vary over time particularly as the mobile market reaches saturation and handset subsidies are reduced or removed.
- The scale of the externality. There is disagreement amongst economists and regulators as to whether the externality is of a significant scale. The UK Competition Commission estimated it as 0.45 pence per minute for mobile networks, but the Swedish regulator, PTS, concluded that the externality is so negligible that it may reasonably be ignored. It is clear that the scale of the externality reduces the nearer the mobile market is to saturation, but it is not clear at what point it becomes negligible.

The Authority is also concerned that the inclusion of an externality in its cost models may result in unjustified cross subsidies from fixed to mobile services. While the arguments for including an

[3] Such as the Rohlfs-Griffin factor, equal to the ratio of total benefits (private and public) to the private benefit created by a customer's decision to join a network

externality mark-up apply equally to fixed and mobile networks, to the Authority's knowledge they have only been deployed in a few countries (e.g. Greece, UK) and only for mobile termination rates. Given that fixed network penetration in Trinidad is considerably lower than mobile penetration, such an approach would be unreasonable here.

Given that the externality is still being considered by the International Telecommunications Union ITU, the Authority considers that it would be premature to implement any externality mark-up at present.

Statement on Externality:

The Authority shall not include any externality markups when calculating interconnection costs and setting interconnection rates.

5 Benchmarking

Benchmarks may serve as a proxy for cost-based prices, either as a short-term measure while a top-down cost model is being constructed or as a longer-term proportionate remedy for non-dominant concessionaires. In either case the benchmark should be constructed in such a manner that it does provide a reasonable approximation of cost-based prices.

As indicated in Section 2.3, benchmarks can take a variety of forms, and the Authority may use different approaches as appropriate on a case by case basis. However, the principal form of benchmarking is a comparison of cost-based prices for the equivalent service in other countries. This section presents an illustration of such an approach, taking the example of call termination rates.

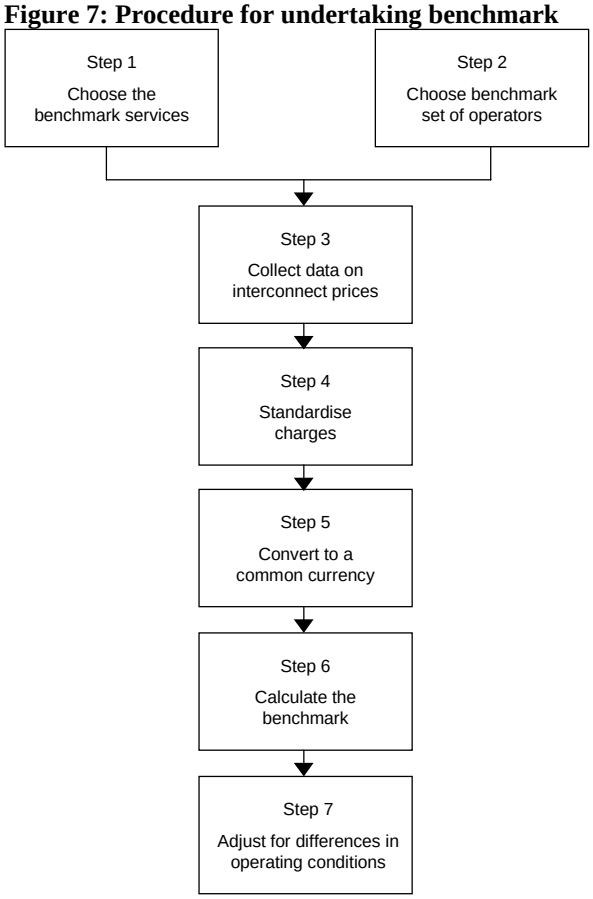
5.1 The Benchmark Process

Figure 5.1 below illustrates the stages involved in undertaking a benchmark for the purpose of approximating costs in Trinidad & Tobago.

There are seven steps in the process:

- Step 1: Choose the services for which a benchmark is required. These will typically be the services for which the concessionaire is deemed to be dominant or over which the concessionaire can exercise bottleneck control.
- Step 2: Choose the operators for the benchmark set against which prices are to be compared. The operators should be in markets that have embarked on liberalisation and have regulated rates, so that there can be some assurance that the benchmark rates are cost-based. Also the operating environments should be as similar as possible to Trinidad & Tobago in key economic and demographic indicators, such as GDP per capita, teledensity, population density and urbanisation, as these will be indicators of similar operational costs to those of the concessionaire in Trinidad & Tobago. To create a robust benchmark it is usually advisable to have at least 8 operators in the benchmark set.

Figure 7: Procedure for undertaking benchmark



- Step 3: Collect data on prices for each service and each operator.
- Step 4: Standardise the various charging formats of the operators. The benchmark operators are likely not only to have different price levels, but also different price structures. This means that prices have to be standardised to be presented in a common format. For example, standardisation must take account of call set-up charges, different billing increments, different distance bands and different peak and off-peak periods.
- Step 5: Convert all charges to a common currency. The Authority believe that US$ is probably the best choice of a common currency, and that conversion should be done on the basis of simple exchange rates. However, a case may be made for the use of Purchasing Power Parities (PPPs) to account for differences in the buying power of a US$ in each of the benchmark countries. This could, for example, replace the adjustments for wage rate differences in Step 7.
- Step 6: Calculate the basic benchmark. Typically the benchmark will be set as the simple average of the rates from the benchmark operators, but other possibilities include the median

rate, or the average of a subset of the rates (e.g. excluding the highest and lowest rates, or the average of the lowest three rates). The choice of the benchmark will to some extent depend on the purpose for which the benchmark is being used, and should reflect the policy objectives relevant to that situation.

- Step 7: Enhance the benchmark to take account of differences in national operating conditions. This step is optional, and may not be required if the operating environments of the benchmark operators are similar to the environment in Trinidad & Tobago. If there are significant differences, (e.g. in wage rates, teledensity, urbanisation) it may be appropriate to make adjustments to the benchmark outcomes on account of their being significant difference in efficient operational costs in the different environments.

5.2 Sample Benchmarks

Interconnect charges for a range of fixed network incumbent operators are shown in Figure 5.2. This figure presents the average interconnect charges for fixed network termination based on a standard benchmarking model published by Ovum. All rates have been converted into US$ at the prevailing exchange rate on 23 March 2006.

It should be noted that the interconnection rates shown here are not necessarily cost-based, and the Authority is not wishing to pre-judge the outcome of a detailed benchmarking study appropriate for Trinidad & Tobago using the process described in Section 5.1. This benchmark is provided for illustrative purposes only.

Figure 8: Fixed network termination prices (US cents per minute)

Austria	1.21
Belgium	1.10
Brazil	2.66
Chile	1.13
Denmark	0.57
Finland	2.17
France	1.14
Germany	0.83
Ireland	0.79
Italy	0.88
Japan	1.97
Mexico	1.01
Netherlands	1.23
Norway	1.28
Peru	2.56
Poland	0.96
Portugal	1.21
Spain	0.87
Sweden	0.68
Switzerland	1.06
UK	0.45

Source: Regulation@Ovum, March 2006

A similar set of mobile termination charges are shown in Figure 5.3. This figure presents the average interconnect charges for mobile termination based on a standard benchmarking model published by Ovum. All rates have been converted into US$ at the prevailing exchange rate on 23 March 2006.

It should be noted that the interconnection rates shown here are not necessarily cost-based, and the Authority is not wishing to pre-judge the outcome of a detailed benchmarking study appropriate for Trinidad & Tobago using the process described in Section 5.1. This benchmark is provided for illustrative purposes only.

Figure 9: Mobile termination prices (US cents per minute)

Austria	15.06
Belgium	16.59
Brazil	14.45
Chile	14.10
Denmark	14.27
Finland	9.26
France	15.63
Germany	16.49
Ireland	13.58
Italy	18.47
Japan	11.33
Mexico	15.85
Netherlands	13.99
Norway	12.31
Peru	20.53
Poland	16.75
Portugal	16.81
Spain	14.14
Sweden	9.39
Switzerland	20.26
UK	10.60

Source: Regulation@Ovum, March 2006

Figures 10 and 11 use the data provided in Figures 8 and 9 to indicate three different ways in which a benchmark may be created.

Figure 10: A benchmark of fixed network termination (US cents per minute)

Average	1.23
Median	1.10
Average excluding extremes	1.27
Range	0.45 - 2.66

Figure 11: A benchmark of mobile termination prices (US cents per minute)

Average	14.76
Median	14.45
Average excluding extremes	14.96
Range	9.26 - 20.53

Appendix A: Approximations to economic depreciation

Economic depreciation is the annual change in the value of an asset in a fully competitive market. The economic life of the asset is determined by the time at which the net cash flow becomes negative, while the value of the asset is determined from the net present value of future cash flows, based on changes in prices and operating costs. For illustration, consider an asset which has an investment cost of 100, whose purchase price is falling at 5% per annum, and for which operating expenditure is 15% of the investment cost. Figure A1 shows the depreciation schedule for such an asset, assuming an 18% weighted average cost of capital.

Figure A1: Profile of economic depreciation

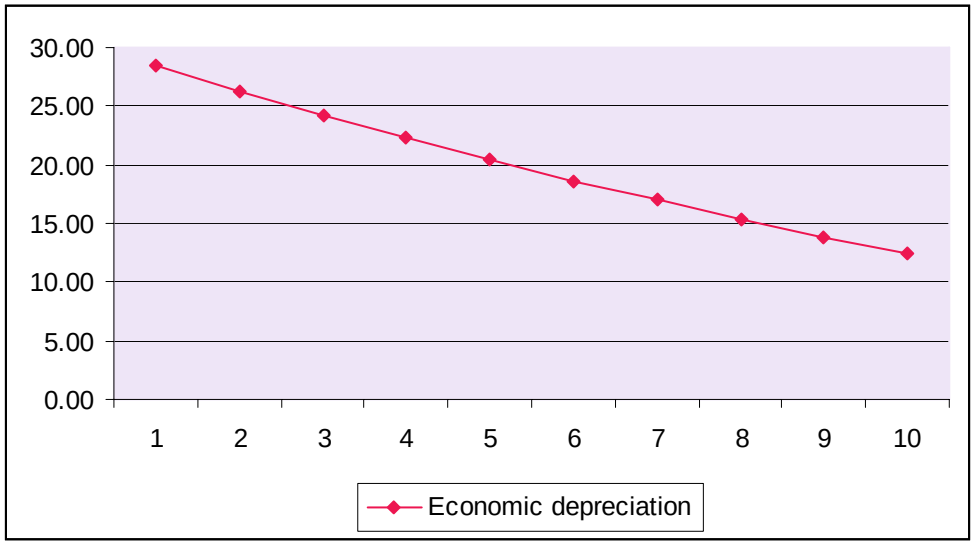


Figure A2 illustrates the annual capital charges using the various accounting depreciation methods that are commonly used to approximate to economic depreciation. These are:

- **Annuity** - in which the annual capital charge (i.e. depreciation plus cost of capital) remains constant throughout the asset lifetime
- **Tilted annuity** - in which the basic annuity is adjusted to take account of annual changes in asset values (and thus in the available revenues in a perfectly competitive market)

- **Straight line depreciation** - in which annual depreciation remains constant throughout the asset lifetime
- **Tilted straight line depreciation** - in which the basic annuity is adjusted to take account of annual changes in asset values (and thus in the available revenues in a perfectly competitive market)

Figure A2: Profile of different accounting depreciation methods

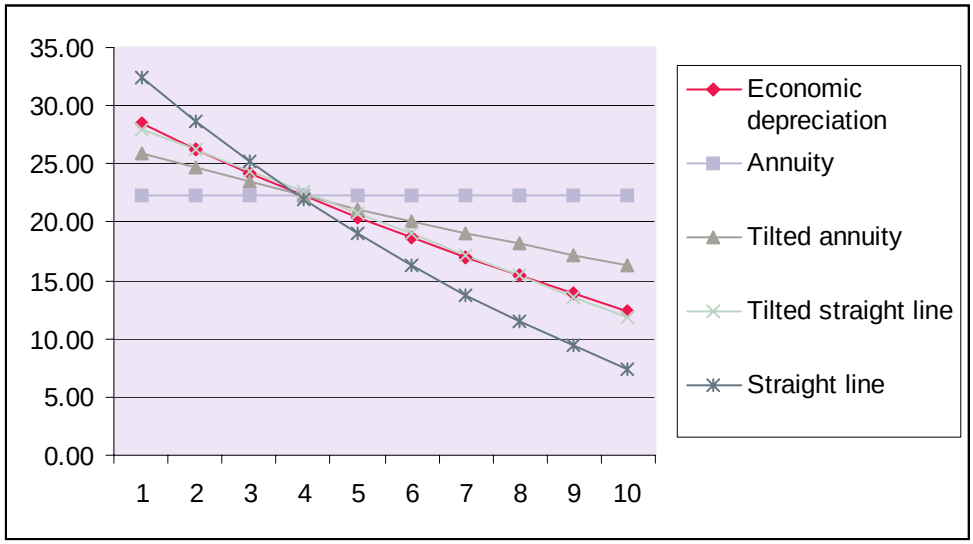


Figure A3 compares the annual capital charge using these various methods of accounting depreciation with the profile derived from economic depreciation.

Figure A3: Annual capital charge using depreciation methods

	Year 1	2	3	4	5	6	7	8	9	10
Economic depreciation	28.48	26.30	24.24	22.28	20.41	18.64	16.96	15.36	13.84	12.40
Annuity	22.25	22.25	22.25	22.25	22.25	22.25	22.25	22.25	22.25	22.25
Tilted annuity	25.97	24.67	23.44	22.27	21.15	20.10	19.09	18.14	17.23	16.37
Tilted straight line	28.00	26.20	24.40	22.60	20.80	19.00	17.20	15.40	13.60	11.80
Straight line	32.50	28.69	25.18	21.95	18.98	16.25	13.75	11.45	9.35	7.44

Assumptions:	
Investment	100
WACC	18%
MEA price trend	-5%
Asset life (years)	10
Opex as % of investment	15%
% annual change in opex	0%

Appendix B: Glossary of Terms

Current Cost Accounting (CCA): Financial accounts prepared on the basis of the current value of a company's asset.

Economies of scale: Economies of scale exists if the average cost per unit declines as volume of output increases.

Economies of scope: Economies of scope occurs due to the presence of common and shared fixed costs or of joint costs in producing different products or in providing a range of services.

Fully Allocated Costs: The costs that would arise for each service provided by an operator id an appropriate share of all of the operator's costs were allocated to each service.

Historic Cost Accounting (HCA): Financial accounts prepared on the basis of the cost of a company's assets when they were purchased, adjusted for depreciation.

Increment: The output over which costs are being measured.

Incremental costs: The additional costs that would result from a defined increment to demand.

Long Run: The period over which the factors of production, including capital, are variable.

Long Run Incremental Costs (LRIC): The incremental costs that would arise in the long run with a defined increment to demand.

Long Run Average Incremental Costs (LRAIC): The term used by the European Commission to describe LRIC with the increment defined as total service.

Modern Equivalent Asset (MEA) value: The cost of replacing existing assets with modern assets that would perform the same function.

Scorched earth assumption: A modeling assumption that optimally-sized switches are employed at locations optimal to the overall transmission design, as if the network was being optimally redesigned on a 'greenfield' site.

Scorched node assumption: A modeling assumption that add up to date technologies are employed to perform existing functions at each existing node. So that, for instance, a small analogue switch would be replaced by a small digital switch and not by the remote concentrator which might, in due course and in practice, be its replacement. Optimal transmission technologies are used to connect up these models.

Stand Alone Cost: The cost incurred in providing a service in isolation.

Total Service Long Run Incremental Cost (TSLRIC): Synonymous with Long Run Average Incremental Cost.