

QUESTION 12-3/1

TARIFF POLICIES, TARIFF MODELS
AND METHODS OF DETERMINING
THE COSTS OF SERVICES ON NATIONAL
TELECOMMUNICATION
NETWORKS, INCLUDING
NEXT-GENERATION NETWORKS



TARIFFS

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Tariff policies, tariff models and methods of determining the costs of services on national telecommunication networks, including next-generation networks



ITU-D Study Groups

In support of the knowledge sharing and capacity building agenda of the Telecommunication Development Bureau, ITU-D Study Groups support countries in achieving their development goals. By acting as a catalyst by creating, sharing and applying knowledge in ICTs to poverty reduction and economic and social development, ITU-D Study Groups contribute to stimulating the conditions for Member States to utilize knowledge for better achieving their development goals.

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Reports, Guidelines, Best Practices and Recommendations are developed based on input received for review by members of the Groups. Information is gathered through surveys, contributions and case studies and is made available for easy access by the membership using content management and web publication tools.

Study Group 1

For the period 2010-2014, Study Group 1 was entrusted with the study of nine Questions in the areas of enabling environment, cybersecurity, ICT applications and Internet-related issues. The work focused on national telecommunication policies and strategies which best enable countries to benefit from the impetus of telecommunications/ICTs as an engine of sustainable growth, employment creation and economic, social and cultural development, taking into account matters of priority to developing countries. The work included access policies to telecommunications/ICTs, in particular access by persons with disabilities and with special needs, as well as telecommunication/ICT network security. It also focused on tariff policies and tariff models for next-generation networks, convergence issues, universal access to broadband fixed and mobile services, impact analysis and application of cost and accounting principles, taking into account the results of the studies carried out by ITU-T and ITU-R, and the priorities of developing countries.

This report has been prepared by many experts from different administrations and companies. The mention of specific companies or products does not imply any endorsement or recommendation by ITU.

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QUESTION 12-3/1

Tariff policies, tariff models and methods of determining the costs of services on national telecommunication networks, including next-generation networks

1 Introduction

Increasingly, conventional public switched telephone networks (PSTNs) have been or are being replaced with so-called “new-generation networks” (NGNs), which, according to the analysts, do not have the same service cost structure as conventional networks on account of their architecture. In particular, most of the costs are fixed costs that are independent from usage; in addition, in infrastructure networks, costs are almost independent of distance. Tariffs for IP-based services will of necessity have to take account of these characteristics.

Tariffs for telecommunication services are traditionally regulated according to the price of each service, with fixed voice, mobile voice and data being handled separately. In NGNs, the services on offer are connected because they are implemented on the same infrastructure; whence the need for the regulator to think in terms of an overall service offering.

When moving to NGNs, developing countries can obtain considerable economic and social benefits, notably in view of the access to universal service for the most disadvantaged sectors of the population. In addition, given that NGN networks allow access to voice, data and audiovisual content over a single carrier medium, it is important to envisage solutions aimed at enabling developing countries to significantly increase data exchange at national and international levels.

Lastly, there is an urgent need to develop site-sharing strategies allowing operators to run their networks at low cost and protect the environment, and enabling developing country users to access those services at a lower price.

Question 12-3/1 is a revised version of previous Question 12-2/1 (WTDC-06) on "Tariff policies, tariff models and methods of determining the costs of services on national telecommunication networks, including next-generation networks". However, pursuant to the decisions of the World Telecommunication Development Conference (Hyderabad, 2010), it has kept the same title.

The terms of reference assigned by WTDC-10 to the Rapporteur's Group for the period 2010-2014 are to continue the study undertaken during the previous study period (see <http://www.itu.int/pub/D-STG-SG01.12.2-2010> for the final report of the 2006-2010 study period), emphasizing:

- the effects or benefits of NGN migration for all stakeholders, including consumers;
- the cost structure of NGN services compared to that of services provided over traditional networks;
- new charging methods for services provided over NGN networks and practical case studies;
- regulating the tariffs for telecommunication/ICT services provided over NGN networks;
- the economic investment plan models used by countries experienced in the transition to NGN, in the interests of providing guidance to developing countries;
- the financial and tariff impacts of site sharing for mobile terrestrial services, broadening the study to embrace all telecommunication infrastructures.

The outcomes of the deliberations of the Rapporteur's Group for the period 2010-2014 are set out in this report, which contains:

- guidelines for making the transition from existing service offerings in developing countries to service offerings that combine voice and data, and economic investment plan models used by countries experienced in the transition to NGN, for the purpose of providing guidance to developing countries; and
- guidelines for promoting growth in data communications in developing countries.

2 Working Methodology

2.1 Working Methods

The main working method adopted by the Rapporteur's Group with a view to obtaining a large body of contributions and information was a questionnaire covering all the issues to be studied. This choice was consistent with the methodology adopted during the previous study periods.

2.1.1 Survey on Tariff Policies Drawn up by the BDT Regulatory and Market Environment Division (RME)

The Rapporteur's Group decided, when it met in September 2010, to adapt some questions of the survey drawn up by the BDT Regulatory and Market Environment Division (RME) on Tariff Policies, which is sent each year to National Regulatory Authorities (NRAs) of ITU Members States (see Annex 1). The number of replies received to the questionnaire for 2010 to 2012¹ is indicated below.

Table 1: Number of countries replying to the questionnaire, by region (BDT classification) from 2010 to 2012

Region	Year		
	2010	2011	2012
Africa	26	23	27
Americas	22	25	24
Arab States	8	13	12
Asia and Pacific	8	18	22
Europe	14	24	28
CIS	3	6	6
Total	81	109	119

2.1.2 Questionnaire on Economics and Costing Issues of NGNs

In addition, the Rapporteur's Group decided to supplement the data obtained via the annual BDT survey by having the countries present case studies relating to their experience of NGNs. Furthermore, a questionnaire on economics and costing issues of NGNs was developed and sent to the NRAs in 2011 (Annex 2) and the analysed results are integrated in this report.

¹ As the survey is sent out in August each year, data for 2013 have not yet been collected.

Table 2: Number of countries replying to the above questionnaire, by region (BDT classification)

Region	Year 2012
Africa	10
Americas	6
Arab States	0
Asia and Pacific	2
Europe	2
CIS	0
Total	20

The Rapporteur's Group took into account all the contributions received from ITU Members during this study period for the purpose of drawing up the report.²

2.2 Coordination with Other ITU Sectors and Study Groups

In terms of coordination with other ITU Sectors and Study Groups, the Rapporteur's Group sent liaison statements to ITU-T Study Group 3³ on economic and policy issues (Series D Recommendations on international tariff setting), with a view to obtaining contributions on issues which might be related to Question 12-3/1. Moreover, the Rapporteur's Group invited the ITU-T Study Group 3 regional tariff groups for Africa, Asia and the Pacific, and Latin America and the Caribbean (SG3RG-AFR, SG3RG-AO and SG3RG-LAC) to take part in the work on Question 12-3/1 and asked them to provide, where possible, data and contributions on service tariff models. In addition, the Rapporteur and BDT Focal Point for Question 12-3/1 have participated in the work of ITU-T Study Group 3 and its regional groups in order to coordinate the work.

3 Economic Implications of NGNs

3.1 Effects or benefits of NGN migration for all stakeholders, including consumers

An NGN is defined by ITU-T as a convergent, multimode (fixed and mobile) access platform based on the IP and horizontally integrated (Recommendation ITU-T Y.1001) and consolidating the technologies, network solutions and the electronic communication services such as data, voice, audiovisual content or other applications. It has a layered, packet mode architecture (Recommendation ITU-T Y.2001),⁴ facilitating the delivery of multiple services over a single infrastructure. This architecture includes:

- a service layer;
- a control layer independent of physical resources;
- a packet-mode transport layer (ATM, IP, etc.);

² Contributions can be accessed at: <http://www.itu.int/en/ITU-D/Study-Groups/2010-2014/Pages/sg1-and-rgq-documents-by-question.aspx> .

³ ITU-T Study Group 3, <http://www.itu.int/en/ITU-T/studygroups/2013-2016/03/Pages/default.aspx>

⁴ http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=13 .

- standardized open interfaces between different layers;
- transport layer control functions.

There are three possible types of evolving NGN:

Class 4 NGNs allow:

- replacement of telephone transit centres (Class 4 switch);
- growth of in-transit telephone traffic.

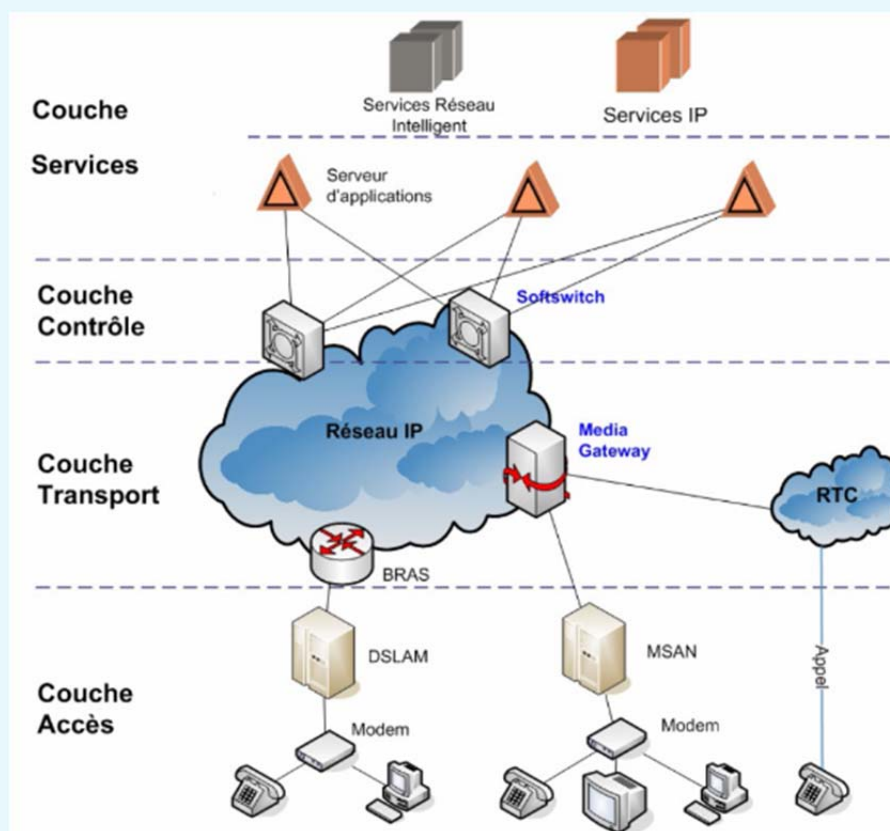
Class 5 NGNs allow:

- replacement of telephone access centres/ autonomous routing centres (Class 5 switch);
- growth in telephone access traffic;
- VOICE over DSL/cable.

Multimedia NGNs allow multimedia services to be offered to users with broadband access such as xDSL, cable, WiFi/WiFiMax, EDGE/UMTS, 4G, and the like. Multimedia NGN is an architecture that offers multimedia services (such as voice and video messaging, audio/video conferencing, voice/video ring-back tone) for users equipped with IP multimedia terminals. This enables the operator to innovate in terms of services compared to NGN telephony, which can offer only telephone services.

In what follows we consider multimedia NGNs and their impact for different stakeholders (operator, service provider and consumer).

Figure 1: A typical NGN



The economic and financial effects of the NGN will vary according to the particular stakeholder (operator, service provider or consumer).

3.1.1 NGN's Economic Effects for Operators

- Operational costs reduction by running a single converged network with common IP platform (NGN), rather than multiple networks (exchanges). NGN terminal devices are more energy-efficient and compact.
- Innovation enhancement. Converged services (voice telephony, transmission of data or audiovisual content via common interfaces and using a single carrier medium) or bundled packages (double-, triple-, and quadruple-play) can be developed to improve the customer experience. NGNs are a key enabler of fixed and mobile service convergence and essentially deliver convergence between the traditional world of PSTN and the new world of data networks. From an operator's perspective, NGNs provide a means of migrating from the old world to the new world of the "Information Society". They are making the convergence of fixed and mobile networks and the integration of voice and non-voice services their goals in response to consumer demand; such a market-based approach will lower operational costs and allow greater flexibilities for service innovation and increase their revenues.
- The key factors for growth of average revenue per user (ARPU) are not access but cross-selling and convergent offers. Infrastructure operators will earn new revenues through the development of high-speed capacity, added-value services and IP-based services and by concluding commercial QoS agreements with application service providers, which will result in the possibility of new customer groups (high speed on demand).
- Migration to NGNs could change the operator's business models completely by reducing the time to market for new services, which can be brought to market faster and at lower cost. Operators would see much greater efficiencies and lower production costs, and might be able to develop new services in order to boost revenues and profitability.
- More effective network operation: traditional PSTNs will come to the end of their normal economic life cycle; for example, the necessary hardware will become more difficult to find and more costly. IP-based networks are likely to be easier to operate and maintain than the existing legacy networks and provide the scope for operators with sufficient flexibility in their cost base to reduce both operating expenditures (OPEX) and capital expenditure (CAPEX). Not allowing an adequate return on investment, the infrastructure operators will not be motivated to invest in NGN networks. Besides the inevitable impact on the quality of the offered services, this could lead to a concentration in the market.
- Ease of NTU (Network Terminal Unit) portfolio management thanks to the smaller standardized categories.
- Intelligence management of all telecommunication/ICT needs.

3.1.2 NGN's Economic Effects for Service Providers

- More opportunities with different solutions: services favoured by NGNs are broadband, convergent services (voice/data/images) associated with real-time multimedia communications; services linked to content (such as distributed management); and contextual services relating to mobility and geolocation.
- Value will be progressively redistributed from access to services, thus giving more weight to service and content providers. In order to keep customers and develop revenues, operators will enter into partnerships with service and content providers.

- Operators in general regard Internet service providers (ISPs) as key players and a target group of privileged users of NGN architectures.
- Content providers can rapidly develop multiple offers adapted to consumer demand.

3.1.3 NGN's Economic Effects for Consumers

Consumers want more personalized services and better quality of service. They also want simple invoicing systems reflecting all services used on the network.

- Continuity: Changeover from PSTN (public switched telephone network) to NGN is transparent to consumers, who will continue to use those PSTN services they are used to.
- Ease of migration: Consumers will be able to migrate seamlessly to new services offered by the same operator.
- Single access for multiple services: This will be enabled by the separation of the service layer from the network layer.
- Freedom of communication: Anytime & anywhere – Customers have access to suitable communication means (voice, data, and audiovisual content) in line with their requirements.
- Innovative new services: New services will have richer functionality (e.g. personalized), and have a reduced time-to-market, since they exploit the distributed intelligence inherent in an NGN.
- Migration to NGN will enable consumers to choose their service providers and connection provider separately. They will thus benefit from greater freedom and flexibility in choosing offers from different service providers and create their own “dynamic service package”. This elimination of the intermediary will inevitably create further pressure on prices, which will force operators to seriously review their future business models and incorporate innovative aspects in their networks (such as dynamic supply and quality of service (QoS) guarantees).

Summary: The economic consequences of migration to NGNs are manifold and are different for each stakeholder (operators, service and content providers, or consumers).

Guidelines: The process of migration to NGNs will have to take account of the respective roles and interests of all the parties concerned in order to establish the partnership frameworks needed to optimize the expected results of migration.

3.2 The Cost Structure of NGN Services Compared to that of Services Provided over Traditional Networks

3.2.1 General Considerations on Cost in Telecommunications

3.2.1.1 Determination of Cost of Telecommunication services

Telecom Pricing Principles

For the telecom sector, the key principles in setting price/tariffs can include the following:

- **Cost basis:** Charges must reflect the underlying cost of providing service. In case of ceilings and forbearance, operators should provide justification of how they arrived at the charges by reflecting the underlying cost. On other part regulators are focusing more and more on cost-based and cost-oriented pricing.
- **Unbundling:** The prices must be arrived at by considering sufficiently unbundled infrastructure so that service providers do not pay for facilities which are not part of their product.

- **Transparency:** Operators must publish details of tariffs and fees and make them available to the public or any interested parties.
- **Transparency and non-discrimination:** An operator should offer the same wholesale tariff for identical services and should offer discounts where it makes commercial sense, and the discounts should be clearly reflected as discount on the published tariff.

Pricing Methodologies

There are two main approaches to preventing propensity to charge excessively high prices: price cap regulation and rate of return regulation, among others described below.

- **Price cap approach:** A flexible price range is usually provided under a price cap methodology, which imposes an upper limit on the average price increase of telecom interconnection services. The price cap regulation is founded on a principle that efficiency and productivity gains by the operator should be passed to interconnecting operators. The Price cap provides greater pricing flexibility and incentive for operator to improve efficiency. As the telecommunication market moves towards competition, form of regulation with incentive to increase productivity might be more desirable. The price cap approach has been used in many countries because it is thought to give firms stronger incentives to be efficient. The regulator naturally takes into account the service providers' rate of return. If it is high, the price cap is likely to be reduced; if it is low, the price cap may be relaxed.
- **Rate-of-return approach:** This is the traditional method of telecommunications regulation. The regulator allows the service providers to charge the prices expected to produce profits equal to a fair rate of return on the capital invested. The regulatory agencies fix the rate of return that the service providers can earn on its assets. They set the price the service providers can charge so as to allow it to earn a specified rate of return and no more. The regulated price can be reviewed as the situation changes to ensures that the service provider can continue to provide the service, ensuring sustainability of interconnection. The disadvantage of the rate-of-return approach is that it lacks incentives to minimize costs. In rate-of-return regulation, the operator's prices are set at a level sufficient to cover its costs. From a dynamic perspective, therefore, the operator has little incentive to reduce its' rate base or its operating costs.
- **Prices based on costs:** Prices may be based on short run marginal (or variable) costs, long-run incremental costs (which include investment costs) and fully allocated costs. All cost-based pricing requires considerable information and monitoring, and a number of conceptual and practical problems need to be resolved in measuring and assigning costs to the various telecom services. Price must ensure that it covers its costs. The challenge in defining cost-based prices is that services are usually produced jointly. A large part of the total cost is a common cost, which can be difficult to apportion rationally amongst the different services. A mark-up is required to cover the deficit that would arise if an efficient cost-based price were determined. Different methods for ascertaining the mark-up include: mark-up varying inversely with elasticity of demand of different users or services (Ramsey rule); applying a rule-of-thumb, such as a risk-adjusted reasonable commercial return; and applying different price slabs to different units of usage, or obtaining the requisite revenue through rentals. They are easier to develop since they are based on linear relations with the actual cost information and are easier to understand by accountants. They are based on accounting data that are available to the regulators. A limitation is that the demand is ignored; the price is set by adding a mark-up to the cost. They do not provide incentives for improving the efficiency of the provider and deploying newer technologies since they cover his full historic cost. They are not always based on causal relations but depend on arbitrarily chosen coefficients for sharing the non-directly attributable cost; hence these do not reflect the actual cost of services.
- **Price floors and ceilings:** They can be used for providing flexibility, and to limit an operator from abusing its dominant market position.

3.2.1.2 Telecommunications Costs

Determining or verifying the costs for telecommunications services are among the major challenges of regulators. Nevertheless, cost analysis can be of crucial importance. In particular, regulators use cost analysis in setting or approving prices, including “retail” prices for consumers and “wholesale” prices for competitors e.g. interconnection and in enforcing competition policy. Different cost approaches, concepts, definitions, interpretations and data sources lead to complexity. Generally, the nature of the problem being addressed, the telecommunication market environment and the purpose of the costing exercise will determine which the most appropriate approach to follow. There are three fundamentally different approaches to cost analysis versus accounting cost, engineering cost and economic cost.

Accounting cost

It is principally concerned with the recording, classification and interpretation of actual incurred costs by the service provider. Data sources include corporate financial accounts statutory financial statements like cash-flow statements, profit and loss accounts and balance sheet and more detailed management accounting measures. Though the values in an account may represent historical costs or current costs, the focus of accounting is the historical record that bears on the actual cost and revenue performance in the current period for ongoing organizations. If firms are just starting in business special accounting rules may have to be applied. The accounting data as recorded by services providers according to the standards followed in the country have been used by regulators as the major source of information in regulating not only telecommunications but other public utilities as well. Management accounting systems have provided the main data source for cost of service measurements. This typically involves two basic steps. The first step is to identify direct costs or directly attributable costs which are appropriate for regulatory purposes and assign them to service or services that use the cost items represented in the account. An accounting cost study that stops at this first step is called a direct cost study or an embedded direct cost analysis if historical costs are used. The second step in the accounting approach is to allocate the remaining accounting costs across services. This typically occurs in two parts. In the first part, the analyst identifies accounting costs that appear to be reasonably attributable to particular services or to activities whose costs have already been directly assigned. Such costs are sometimes called indirectly attributable costs. In the second part of this step, the analyst allocates costs that appear to be common to all services across. In accounting these are called common or overhead costs. Also in accounting, a cost is considered an overhead cost if it relates to all services that the company provides such as cost incurred for executive salary. This second step creates what is called a fully distributed cost study.

Engineering cost

It is directed to examining the cost of alternative ways of performing specified tasks. This approach is primarily concerned with forward-looking management decisions. Engineering cost analysis assess is different ways of meeting a specified objective, such as provisioning a certain amount of capacity. The goal of engineering cost analysis is generally to determine the optimal method of building telecommunications facilities. Both engineering and economic costing are primarily concerned with management decisions that have not yet been taken. At the completion of the engineering cost analysis, a decision whether to invest in a specific expansion plan will be made. If a decision to invest is taken, the engineering estimates of the cost of that expansion plan are recorded and later compared with the actual experienced accounting costs of the plan, as a basis for improving future engineering estimates.

Economic cost

It is concerned with the most efficient way of allocating society’s limited economic resources among different possible uses. The economic cost of an activity is the actual forward-looking cost of that activity that emphasizes concepts of cost variability, incremental costs and opportunity costs. This is the cost of accomplishing that activity in the most efficient way possible, given technological, geographical and other real world constraints. Forward-looking costs are the costs of present and future uses of a firm’s (or society’s) resources. In contrast with the accounting approach, the *economic approach* focuses on how

changing the output of the utility will affect the total cost of the company. This cost is the present value of the opportunity costs of the firm, for a specific future production period, and for a specific level of production. Because the economic approach is forward looking, it does not rely upon a particular database of cost data. Economic cost studies in telecommunications regulation traditionally relied upon projections of incremental cash flows associated with changes in output or econometric estimates. The econometric approach relies upon historical data to make statistical estimates of how variations in output affect total cost. More recently proxy cost methods have been developed to estimate economic costs. These methods use computer models of how a company might engineer its network to estimate how changes in output affect the costs of the network. The economic approach always includes the cost of capital as a cost. Lastly, the economic approach generally includes opportunity costs, which are the alternatives that must be foregone by the utility if it provides the output whose costs are being measured.

In summary, both the economic theory of cost and engineering cost analysis can help management make its best judgments about the firm's production and output levels by facilitating comparisons among alternative possibilities before decisions are taken. Accounting cost analysis can assess the experienced actual cost of decisions after they are taken and provide a foundation for forecasting future costs. Each approach to costing can contribute to an improved understanding of costs and facilitate improved decision making by service providers and telecom regulators. In that sense these approaches are complementary.

3.2.1.3 Costing Methodologies

Cost studies should be as thorough as possible, given the available data. Three general approaches to cost studies can be pursued, either separately or in combination: Each approach could, in principle, yield meaningful cost results by itself. If there are too many data gaps then the results obtained may not be meaningful unless interpreted in combination with results from another approach. These three methods of constructing cost models are top-down, bottom-up or outside-in approach.

Top-down methodology

Under a top-down modeling approach actual (historical) accounting data (e.g. capital employed, traffic volumes, etc.) of a specific carrier entity are taken as a starting point for parameterisation of the model. Top-down modeling approaches rely on actual network architectures and configurations and assume their efficiency. After certain efficiency adjustments and a proper asset valuation the historical cost-volume relationships of costs are projected forward to develop forward looking incremental costs. The top-down approach begins with aggregate, company-wide cost data such as total annual expenditures, capital investments and operating costs. The top-down approach reflects by definition and by construction the current cost level of a specific carrier. Ideally, such costs will be tracked according to some general categories, such as whether they are capital or operating costs. The goal of a top-down study is to take these aggregate costs and allocate them among all services provided by the carrier. The advantage is that this method assures that all of the carrier's costs are accounted for. On the other hand, determining a suitable allocation formula poses problem. It can be used as a check and comparison against a comprehensive bottom-up, incremental cost analysis. However, such a complete bottom-up analysis is rarely possible because of a lack of adequate data. Aggregate company costs, by contrast, are usually available. As a result, the top-down analysis often becomes an integral part of the cost study and is used to estimate capital and operating costs where exact facility input data are unavailable.

Bottom-up methodology

A bottom-up approach models the network and cost structures of a hypothetical operator. This efficient operator employs modern technology and is not constrained by technology, systems and architectural decisions of the past. A bottom-up model identifies all components of the network necessary to produce the services in question. Based on engineering and economic experience and evidence, cost causation relationships are then defined to link the relevant quantities of network components with outputs and other relevant cost drivers. This method is expected to give good estimates of unit costs, assuming

sufficient data are available which is rarely accessible to the regulator. It is based on the idea that service costs can be identified from the facilities and other inputs needed to provide the services. The costs of the inputs are combined in proportion to their utilization in providing each service, then divided by the number of total units of service, resulting in per-unit facility costs. This approach depends on the availability of complete, disaggregated data on input costs and the relative use of facilities in the provision of different services. This can be analyzed on a historical cost basis or a forward-looking incremental cost basis, but any results expressed as pure, incremental facility-based unit costs must be reconciled with joint and common costs and administrative overheads.

Outside-in methodology

The third approach is to use “proxy” estimates from outside sources, establishing cost “benchmarks,” or ranges of costs, for services or facilities. There are two steps. First, the regulators must define the appropriate cost elements and the scope of cost comparisons—whether they will be comparisons of specific facility costs, operating unit costs or service-wide costs. Second, the results have to be adjusted to account for differing conditions between the subject country and the benchmark country. In principle, it would be desirable to develop a broad database of proxy costs from as many countries as possible. That could form a kind of econometric regression model or statistical correlation analysis of costs in almost any environment—if enough variable data were known. The challenge, of course, is to achieve an accurate measurement of costs in the proxy countries, using direct bottom-up and top-down approaches. Then it would be possible to compare reliable results from different countries and come to conclusions about the effect on interconnection costs of national variations in labor costs, topography, demography and other factors.

3.2.1.4 Network Design Considerations

In a top-down modeling environment this is a decision between whether or not to allow the incumbent to base its costs on the existing network topology (scorched node) or on an ideal network topology that would meet the demands of a fully efficient operator (scorched earth). In a bottom up modeling environment this is a decision between whether or not the bottom up model should take into account the existing network topology (scorched node), or that the costs in the model should be based on an ideal topology (scorched earth)

Scorched earth approach

A scorched earth approach, also called the Greenfield scenario, assumes that optimally dimensioned switches would be employed at locations that are optimal to the overall transmission design. The scorched earth scenario reflects the structure of a completely new network that would have been designed from scratch. The main difficulty in this approach is the agreement between all market players on the optimal network structure.

A scorched node approach, on the other hand, assumes that the existing nodes will still be used in the model. However, the scorched node approach replaces existing technologies with optimal technologies that are able to deliver equivalent functionality (e.g. this could mean the replacement of an analogue tandem switch by a digital tandem switch and possibly also the replacement of a host switch by a remote concentrator). Moreover, it assumes the utilization of optimal transmission technologies that connect these different nodes. This approach has the advantage that it takes into account the current geographical situation of the existing incumbent. However, this may perhaps not be the most efficient solution, compared to the scorched earth approach. The scorched node approach is often altered into a modified scorched node approach. This approach takes the actual node-configuration as a starting point but changes the actual structure in order to replicate a more efficient network than is currently in use.

3.2.1.5 Basis of Costing

Without a doubt “cost-based pricing” is recited with such frequency and conviction, particularly by economists, as the correct answer to most telecom and other public utility regulatory problems, one is tempted to conclude the regulation of telecom prices should be a straightforward and non-controversial issue. The most appropriate approach to cost analysis depends upon the problem being addressed and the purpose of the costing exercise. All approaches to costing require judgment in implementation, have limits to their ranges of usefulness in application, and require a careful interpretation of the meaning, significance and limitations of cost study results. Cost analysis can be an extremely useful tool for telecom managers and regulators. It is a tool to guide and facilitate judgment in decision-making, not a substitute for judgment.

Historical cost accounting

This refers to the costs actually recorded and accounted for in the operator's books, without any additions, such that they reflect the costs actually incurred. This makes less difference for mobile than for fixed networks but, in a world of some inflation and changing relative prices, current cost accounting better expresses how costs move over time.

Current cost accounting

Costs are calculated on the basis of current prices for current estimates of the various cost-components. This can be further sub-divided into presently incurred costs and costs that are likely to arise in the near future, i.e. prospective or forward-looking costs.

3.2.1.6 Methods of Cost Allocation

The Cost Allocation Principles indicate how various costs should be treated and allocated/apportioned to different services/network elements. The following three methods are generally used for allocation/apportionment of cost:

- Fully Allocated Costing (FAC)
- Long Run Incremental Costing (LRIC)
- Activity Based Costing (ABC)

There are important costing principles which a costing model should observe and these include: Cost causation principle (like an Activity based costing), Objectivity principle, Consistency principle, Transparency principle (Auditability and Accounting Separation), practicality, efficiency, and contribution to common costs, present value. However, objective costs cannot be calculated without sufficiently detailed cost data.

Fully allocated costs

FAC is done in two steps. In the first step, all the costs are identified into three categories:

- **Direct costs:** These are the costs, which can be directly identified to services/ network elements. For example, in a Basic Telephone Service network, cost of local exchange can be directly allocated to the account head of “Local Exchange”.
- **Indirect costs:** These costs cannot be directly allocated to any one-service/ network element as they may be shared by more than one (identifiable) services/ network elements. For example, in a Basic Telephone Service network, access cables and exchange cables may share the cable trench. Hence, the cost of trench for laying cables will be shared by the network elements “Access – cable” as well as “Network- Exchange to Exchange Transmission”.
- **Unattributable costs:** Such costs cannot be identified to a particular service/network element such as corporate expenses.

In the second step, the direct, indirect and un-attributable costs are allocated to various services / network elements on the basis of suitable cost drivers.

Here, the cost of a service derives from the usage of a set of algorithms that allocate both direct and indirect costs to it. The idea of the FDC approach is to simply divide the total cost that the firm incurs amongst the services that it sells. Both fixed and variable costs are used in the production of the output and therefore both contribute to the revenue generated by these products or services. Its simplicity in directly relating prices to information that is available in the accounting and billing system makes the model auditable. FDC is based on historic costs because accounting data concerns the firm's actual costs but it is possible to use current costs carrying out modifications to the accounting.

Long Run Incremental Costs (LRIC)

LRIC is the incremental costs that arise in the long run with a specific increment in volume of production. An increment is the unit of output over which costs are being measured. Incremental costs are the costs that are caused by providing a defined increment of output given that some level of output is already being produced. Long Run Average Incremental Cost (LRAIC) is a variant of LRIC, which associates long-term horizon to incremental cost. Incremental costs measure the cost variance when increasing or decreasing the production output by a substantial and discrete increment. LRAIC equates tariff to cost of production of the additional unit of the service. Added to unit cost is an allocated share of common costs, excluding administrative costs.

The cost of the services is computed by apportioning the cost of the network elements (similarly as in the activity-based approach), and by adding the cost of labor and the rest of the overheads as a simple markup on the cost of the infrastructure. Such a markup follows the trends observed in actual networks. LRAIC of a service equals to the total cost of the company minus the cost of the total company if it continues to provide all the other currently provided services but the specific one. The sum of LRAIC of all services is less than the total cost of the company due to the existence of common costs. It is natural to use current cost with LRAIC because the aim is to construct prices that would prevail in a competitive market.

Activity Based Costing (ABC)

ABC is the methodology by which costs are assigned based on the activities required to deliver a service and the resources these activities absorb. The key to this methodology lies in two aspects: (1) What is causing the activity (2) What is causing the costs. Simply put, ABC works on the premise that the budget is absorbed by resources and the resources are absorbed by services. ABC is one way of trying to make a more accurate determination of the true time, cost and value of specific activities, and thereby evaluate their real contribution to meeting the overall objective. Through early involvement, the cost estimator can not only influence the final design by feeding in the relevant cost information, but can also actively contribute to cost reduction by identifying cost drivers and to highlight how, for instance, a relatively small increase in system performance can have a disproportionately heavy impact on final cost. Costs are assigned based on the activities required to deliver a service and the resources these activities absorb.

The major cost drivers are the number of subscribers, the volume of traffic (call attempts and call minutes) and the geographical area covered by the network. For many of the elements, there is more than one cost driver. It is based upon a hierarchy of four levels and is a refinement of the traditional FDC approach. The bottom level consists of the input factors that are consumed by the network operator, e.g. salaries of personnel, and depreciation of network elements, cost of capital, depreciation of buildings and vehicles, marketing cost, overhead, power consumption, and the cost of renting raw bandwidth. The goal is to apportion these cost elements to the services that the network provides. Instead of a one-stage assignment where costs are assigned directly to Products and Services, ABC assigns costs from the General Ledger ("Resources") to "Activities". Costs in "Activities" are then assigned to Products and Services ("Cost Object").

In theory, ABC has no conflict with FDC and LRAIC either. ABC can be used to replace the arbitrary cost absorption method that is used to calculate to say, LRAIC. The use of ABC might bring much more transparency in the calculation of transferred cost, making the current costing practice look redundant.

Marginal Costing

Marginal cost is one of the most important concepts in standard microeconomic theory. It focuses attention not on the total level of cost, nor the average level of cost, but rather on the change in costs that occurs as the volume of output is increased or decreased. Marginal cost is defined as the change in the total cost of production resulting from an extremely small change (upward or downward) in the level of output. To be strictly technical about it, marginal cost is the first derivative of the total cost function with respect to output.

The minimal measurable change can be extremely small e.g., one Erlang of traffic, one more second of calling duration, or one more local loop. In attempting to estimate marginal costs, the analyst often encounters practical difficulties when the measurements are directly calculated at the smallest possible level. Accordingly, most practical estimates of marginal cost are based at least in part on a slightly larger increment of output than what is envisioned in economic theory.

The incremental cost can be viewed as an "average" level of marginal cost, if it is computed over a narrow increment in the immediate vicinity of the current volume of production.

3.2.1.7 Principles of Cost Allocation

Costs shall be allocated or attributed to different services, geographical areas, network elements and products/network services through following Accounting Standards/Principles:

- **Causation:** costs should be allocated to those services or products/network services that cause the cost or revenue to arise.
- **Survey and sampling:** Operators may need to use survey and sampling techniques such as pattern of usage of network element for each type of product/network service, staff activity data, engineering information etc. in order to allocate costs to the relevant segments. The fundamental objective of this activity is to arrive at an appropriate basis of attribution to comply with the principle of causation. Where sampling is used it should be based either on generally accepted statistical techniques or other methods, which should result in accurate attribution of cost, revenue, etc.
- **Consistency:** To assist comparability, the same bases and assumptions should be used from year to year. However, it is recognised that with rapidly changing technologies, it may be necessary to review attribution principle annually.
- **Materiality:** The principle of materiality may be followed to avoid any detailed/ cumbersome procedures if the impact is not considered very material. For example the iterative attribution methods may not be used for certain items, if the effect of that particular item is not expected to be material to the ultimate outcome.
- **Practicality:** The principle of practicality would reflect the need in any system to undertake sampling analysis, and at times use prudent and unbiased estimates of cost and volumes.
- **Objectivity:** This principle requires that the allocation method proposed should be reasonable, substantiated and arbitrary allocation method should be minimal.
- **Transparency:** The methodologies followed for attribution and preparation of statements by each operator should be comprehensively documented so as to be transparent to the regulator / other users of the statement.

3.2.1.8 Principles of Cost Recovery

In drafting rules for interconnection charges, policy-makers and regulators may have several objectives and priorities.

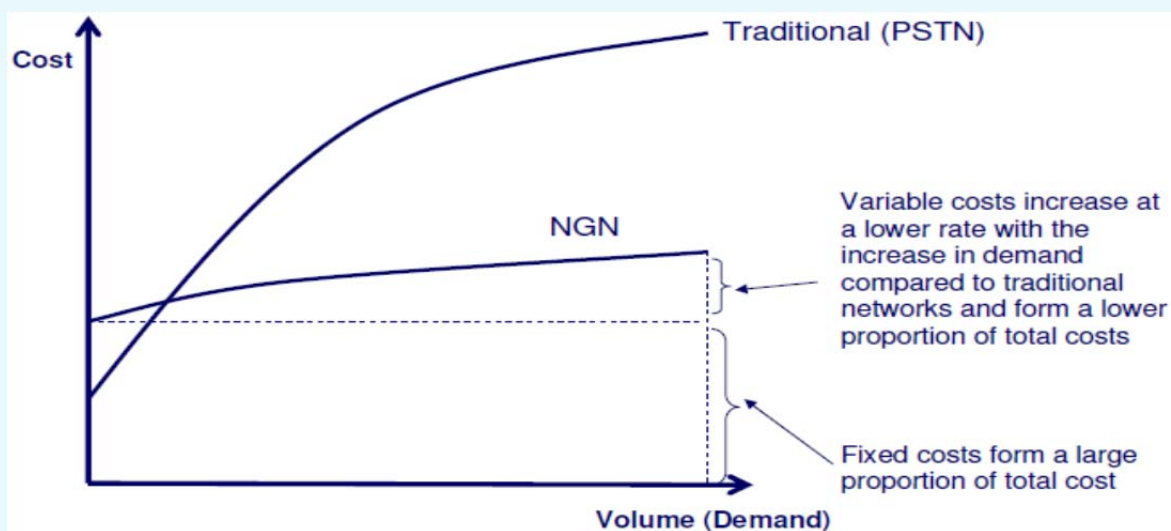
Efficiency: The goal of economic efficiency is generally achieved by establishing charges that are as close to cost as possible, and that are specifically based upon cost causation. That is, when certain costs stem from the activities of a given carrier or customer, they should be recovered through charges levied on that carrier or customer. Moreover, the relationship between costs and charges should be direct. Variable (traffic-sensitive) costs should be recovered through traffic sensitive charges, and fixed (non-traffic-sensitive) costs should be recovered through fixed or “flat” charges. Under a pure efficiency policy, these differences should be reflected in interconnection charges.

Equity and competitive balance: In many markets, sustaining and nurturing competition is often a more immediate policy priority than achieving short-term economic efficiency. The competitive balance principle calls for interconnection charges to be generally set at the same levels for all similarly situated carriers. They may even be set at deliberately favourable levels for new market entrants. The equity principle, meanwhile, may lead regulators to impose interconnection costs equally, or at least proportionally, on both interconnected carriers, even though, from a cost-causation point of view, one carrier may be generating more costs than the other. Equity can also be the motivating philosophy behind interconnection policies that base charges on discounts from relevant retail prices.

Laissez-faire: Adherents to the laissez-faire doctrine believe that regulation can often be more of a hindrance than help in introducing competition—or at least that regulation is unnecessary to achieve that end. A total “hands-off” approach represents a kind of wishful thinking for most countries, where a single dominant operator has nearly total control of bottleneck facilities and considerable economic power to influence interconnection terms. However, policies encouraging negotiated interconnection agreements, with regulatory intervention only as a last resort, are quite common in established and newly liberalized markets alike.

3.2.2 NGN Costing related Issues in Comparison with Traditional Networks

Figure 2: NGN costs should be lower and less dependent on traffic volumes



Source: Contribution from India (Document [1/277](#)), September 2013.

An NGN can be described as a network that facilitates three things:

- single independent access to applications and content;
- high availability, high bandwidth core and access network that supports multiple services;
- a platform that allows rapid development and deployment of new integrated applications to the end user.

Next generation networks (NGNs) comprise two main elements: a next generation core and next generation access. The core network element refers to the core IP network and is characterized by replacement of legacy transmission and switching equipment with IP technology in the core or “backbone” network. The elements are of 3 types:

- 1) connectivity components: e.g. routers, switches;
- 2) application servers: e.g. SIP (Session Initiation Protocol) Registrar, softswitches;
- 3) links between connectivity components and application servers, e.g. STM-1, Gigabit Ethernet, or 10GE.

The term “next generation access (NGA)” is commonly used to describe the requirement of fibre coming closer to the end-user, or providing the direct connection i.e. the connection from customer to network node. The traditional copper or cable wire is largely or entirely replaced with fibre-optic technology. The new wireless technologies can also be regarded as NGA technologies.

An NGN is divided into two distinct layers: the service layer and the transport layer. Service-related functions are independent of underlying transport-related technologies and there is unfettered access for users to networks and competing service providers. Thus, the users of the NGN are able to freely choose among services from different service providers. The NGN concept is focused on the provision of services, and is independent of users’ access technologies. The cost elements will depend on whether the cost is caused by subscribers or traffic. Unlike the traditional models where network capacities are measured mainly per subscriber or per voice call or minute, in an NGN model, there are four relevant measures of capacity:

- 1) per subscriber, applying mainly in the access network, though billing systems may have a per subscriber element;
- 2) per megabit of traffic;
- 3) per packet of traffic;
- 4) per session.

Items 2 to 4 are traffic volume-related and associated with the core network, while item No. 1 is access network-based.

Along with traditional voice and data equipment the NGN architecture contains converged network equipment types such as Call Agents (e.g. Media Gateway Controller – MGC, Gatekeeper – GK, SIP Server and Softswitch – SS), Media Gateways (MG), Signalling Gateways (SG), Feature Servers, Application Servers, Media Servers and provides management, provisioning and billing interfaces.

The NGN cost structures can be grouped into three main categories:

- service-specific costs;
- core network costs; and
- access network costs.

Service-specific costs are associated with the application servers such as the IP-centres, gateways, and other applications. These are allocated costs to services based on the key cost drivers of the service provided. For instance in the case of a voice service, the allocation can be in terms of minutes of voice use.

Core network costs are associated with the core next generation IP network and comprise shared fixed and variable allocated costs on the available capacity.

Access network costs arise from the rollout of the network up to the user premises. They include the costs of deployment of the last mile network, but without forgetting that these costs are shared among operators as part of the unbundling process. The costs are mainly the fixed-costs incurred when installing elements such as nodes, fibre, VDSL, cooper loop, wireless medium and internal wiring at the consumer premises. Whereas the NGN will in future decline in actual costs, it is assumed that the cost structure of the NGN is similar to the cost structure of traditional circuit switched networks in terms of the transport layer components.

The differences in the cost structure arise, first, from the NGN-specific components which include at least the following: VOIP soft switch or media gateway, access fibre, HFC optical Node, DSLAM, MSAN, Packet switched aggregation node, packet switched router, broadband remote access server, IP MPLS core, NGN Line Media, NGN trunk Media and fibre Cables. However, it is expected that the main differences in the NGN cost structure compared to traditional networks concern investment as well as operating costs. This is due to the use of optical fibre technology (vs. copper wire), as well as the use of softswitch technology (vs. central network equipment) and a more centralized and secure (in terms of personal data protection) network management scheme.

For most countries that have begun to deploy NGNs and responded to the questionnaire on economic and cost-related aspects of NGNs, the main services include broadband, voice telephony, IP TV services and movies and video entertainment. These are offered on both fixed and mobile platforms.

In general, according to the replies received to the questionnaire, the cost structure of NGNs differs from that of traditional networks because NGNs are subject to additional common costs associated with the architecture of the converged IP core network carrying aggregated traffic from multiple access services, while traditional network architecture is based on distinct access and core networks carrying non-aggregated traffic from multiple access services. The main difference in cost structure between NGNs and traditional networks is thus the supplementary network associated with common costs.

In NGNs there are three main cost elements:

- direct and attributable network-related costs;
- common network-related costs;
- common costs not related to the network.

In traditional networks there are two main cost elements:

- direct, related and attributable costs;
- common costs not related to the network.

However, some regulators consider that the NGN cost structure is similar to that of traditional switched circuit networks in terms of transport layer elements. Such regulators consider that the difference in cost structure is evident only at the level of specific NGN components.

In all cases, it is essential to evaluate upstream the costs of services in order to calculate cost-based tariffs. The regulator has to approve the pricing structure in order ultimately to approve tariffs and ensure that prices set by the operators are affordable for consumers.

To summarize: the cost structure of NGNs differs from that of traditional networks, on the one hand, as regards NGN-specific components and, on the other, because for NGNs, we identify common network costs in addition to traditional cost structures.

Guidelines: regulatory frameworks should be adapted to reflect these aspects.

3.3 New Charging Methods for Services Provided over NGN Networks and Practical Case Studies

The new charging methods for NGNs require definition of the charging units. Several levels are defined for communications based on calls generating traffic flows over NGNs:

- Level 1: customer service time at call level
- Level 2: activity/communication time at session/application level
- Level 3: communication time at flow level
- Level 4: transmission time at packet level.

3.3.1 General Considerations on New Charging Methods Provided over NGN

Cost accounting models are useful tools for regulators in setting wholesale fees, identifying anti-competitive practices, estimating net costs of universal service obligations and establishing retail price controls, since they also provide information on margins achieved in each service category. The models are also useful for operators in providing valuable information on production efficiency and help to identify specific activities or network components that weaken competition.

3.3.1.1 Charging and Accounting Principles for NGNs

Allocation efficiency requires that resources, products and services are allocated to the person or persons who value them the most. For this to happen, consumers of final products or services should pay prices that reflect the cost of the resources used to provide those products or services.

Several variants for calculating “x-LRIC” (long-run incremental costs or long-run average incremental costs (LRAIC)) were used in the past to determine the cost components and it is recommended to consider all costs incurred. Standard revenue margins need to be considered to guarantee business sustainability. (See Annex 3 – Approaches to costing of telecommunication services).

Costing should be based on capacity in terms of resources utilized. It must be taken into account that packet mode switching uses resources as a function of the packet flows through the network, rather than time.

The generic activity-based costing (ABC) method allocates direct and indirect costs to a service as a function of the cost drivers for any service using the network resources. Indirect costs are allocated based on an analysis of cost drivers. These activity-based costs constitute the directly and indirectly attributable costs.

3.3.1.2 Trends in Charging

Since the initial most used charging in PSTNs, a major evolution in customer charging is taking place on two dimensions:

- migration from a static charging per customer based on few parameters towards the aggregation of multiple parameters for multimedia services (such as bandwidth, content and QoS values) in a dynamic manner;

- incorporation of market driven procedures like the online charging systems that take into account competition influence with personalized offers of service based on consumption volume, service priority, time, day and week, negotiated QoS, etc.

3.3.1.3 Pricing and Market Dynamics – Evolution of Charging Units

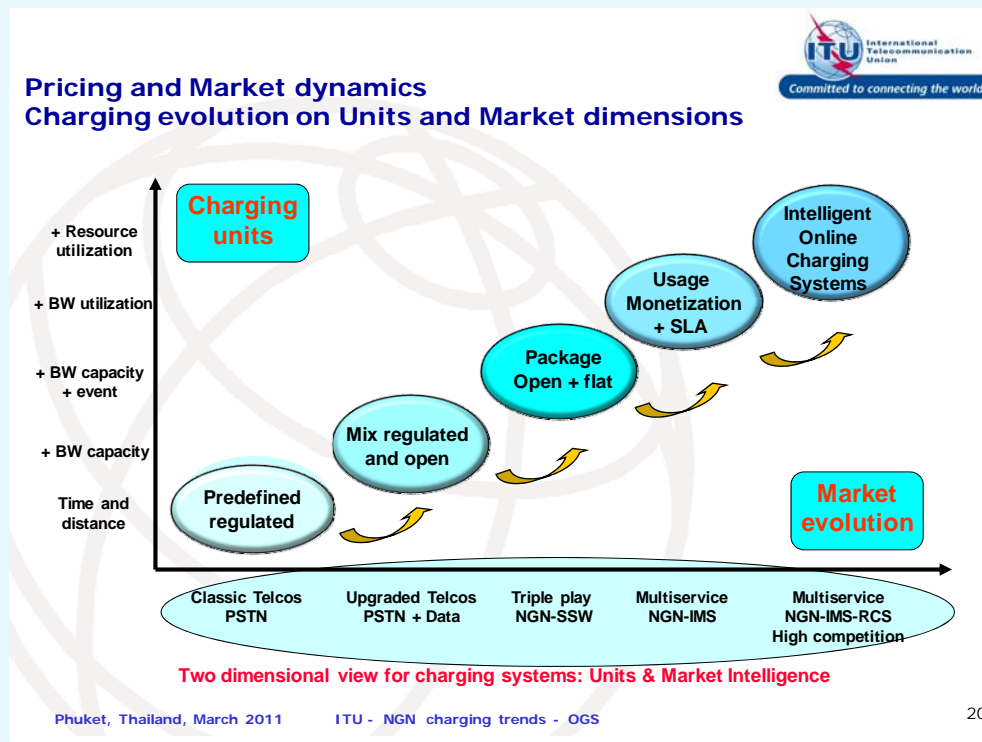
Several units are used to evaluate traffic utilization and determine costs for charging. These include:

- ports associated with customers per class;
- calls generated at user interface;
- Erlangs or minutes of traffic originated/terminated at user interface ;
- sessions/flows/information/requests generated at user interface;
- packets handled at a given resource through the network;
- Mbits transported through a given network link/path.

These units can be used to define:

- interface or link gross capacity;
- required bandwidth at busy period;
- consumed information volume by linear function or stepwise (related to QoS);
- event driven, individual or by category;
- resource utilization time;
- content type, premium service, value added service.

Figure 3: Pricing and market dynamics – Charging evolution on units and market dimensions



Source: ITU Regional Seminar on Costs and Tariffs for Member Countries of the Regional Group for Asia and Oceania (SG3RG-AO), Thailand, 8-9 March 2011⁵

Intelligent charging and services personalization are possible and permit:

- adaptation to customer requirements;
- provision of intelligent content;
- traffic shaping;
- QoS management;
- attenuation of busy periods;
- volume discount for heavy users;
- premium content offers;
- increased loyalty and decreased churn.

Intelligent charging also makes it possible to optimize revenues and resources, inter alia by means of:

- Online charging systems (OCS)
 - real-time discounts or offers;

⁵ <https://www.itu.int/ITU-D/finance/work-cost-tariffs/events/tariff-seminars/Phuket-11/Agenda.htm>.

- currency-based spend controls;
 - balance sharing policies.
- Subscriber policy and charging system (SPCS)
- clear view of all usage costs;
 - applying policies and limits across all devices;
 - notifications and alerts and advice-of-charge;
 - sharing, discounting and usage-based policies;
 - personalized, dynamic discounts and offers.

To summarize, the new methods used for charging on NGNs consist in:

- migrating from time-based charging towards multi-parameter-based charging considering IP traffic characterization;
- applying ABC (“activity-based costing”) methodology for evaluation of the bottom line per service or service packages;
- introducing market dynamics to monetize bandwidth and implement intelligent subscriber policy and charging systems.

3.3.2 Reformulation of Cost and Tariff Models or Adoption of New Models Applicable to NGN Services: Practical Examples

This section presents the comments made by regulatory authorities and some network operators.

3.3.2.1 Reformulation of Cost and Tariff Models Applicable to NGN Services

Some countries like **Tanzania** consider it appropriate to adopt new cost and tariff models applicable to NGN services. A combination of the Long Run Incremental Cost (LRIC) and Fully Allocated Cost (FAC) models will be used (see Annex 3). The criteria for determining costs are as follows:

- Direct and attributable access network related costs. These costs will be attributed wholly to the given service using the LRIC methodology.
- Network (converged IP-based core network) related common costs. These costs will be attributed in portion to the service using the FAC methodology, and the costs are traffic sensitive (traffic related costs).
- Non-network related common costs. These costs will be attributed to the service using equiproportionate mark-up (EPMU) or the Ramsey pricing model.

According to **Costa Rica**, the costs associated with the new services, as well as their characteristics, are substantially different from the services given by traditional networks. Therefore, the costs and tariffs should be different. The main difference is the bundling of different services in a given tariff plan or scheme, as well as the use of flat tariffs.

In **Switzerland**, the regulator has no defined position on this issue yet, since there are as yet no regulated NGN services. Operators are currently running tests with NGN. They consider introducing tariffs based on volume, event-based tariffs and/or flat fees.

In **Zimbabwe**, the operator Africom takes the view that it should consider newer NGN tariff models. The NGN model of choice depends on the use made of the service, but this presents challenges because it is not well understood by end users. Service use is classified as follows:

- application based e.g. only charge for Facebook, Gmail App, Skype or Video based applications;
- hours of use: Limit user a certain hours a day on certain activities, e.g. unlimited video/web during non-peak hours;
- basic usage rate and extended usage e.g. first Gig used is low and thereafter there is a premium overage charge.

Another operator in Zimbabwe, POTRAZ, is in the process of reformulating its tariff proposal guidelines with a view to accommodate NGN services. They are moving away from using the "top down" approach to a forward looking approach using the scorched node approach as given in network design plans submitted to the regulator.

SPIRITAGE Communications Zimbabwe has taken as its starting point existing cost and tariff models that are applicable to NGN services. This is their short-term strategy. In the medium–long term, they would like to start developing / reformulating costing strategies that will be relevant to NGN services.

The criteria are:

- In the short term, adopting the cost and tariffing models that are applicable to NGN services in general such as the LRIC method – normally used for interconnection and wholesale business.
- Identifying and separating those elements of costing/tariffing that are relevant to business model.
- Over time, study the practicality of the methods adopted, merits and demerits, cost behaviour, cost-volume relationships in the context of our business and the industry.
- Redefining the model and reformulate a new costing model for determining tariffs.

In **Hong Kong**, China, all telecommunications markets have been fully liberalized since 2003. Tariffs of telecommunications services are set by operators based on commercial considerations and are not subject to any requirements of obtaining prior approval from OFTA.

For the regulator ATCI in **Côte d'Ivoire**, it would be necessary to reformulate the models of costs and tariffs applied to NGN services, by integrating the cost factors of NGN network in the model of cost CMILT bottom-up which was used to calculate the costs of the services provided by the traditional networks.

In **Malaysia**, the regulator is currently adopting a light-handed approach and has not stipulated any cost or tariff models for NGN services.

For the **Democratic Republic of Congo**, it is not necessary to reformulate the cost models as it is enough to use comparative costs methods.

In **Trinidad and Tobago**, the Regulatory Authority TATT has developed a Long Run Average Incremental Cost (LRAIC) Model, in accordance with Regulation 15 of the Telecommunications (Interconnection) Regulations, Regulation 18 of the Telecommunications (Access to Facilities) Regulations, Schedule D Part III and Schedule F Part II of the Telecommunications (Pricing) Regulations. This model is top down in its approach and therefore all operators' actual network costs (from traditional and/or NGN networks) are modelled. The Methodology employed is found in the LRAIC Specification Paper on the Authority's website at: http://www.tatt.org.tt/linkclick.aspx?fileticket=ZQ_tfqJ-w-A%3d&tabid=254.

For **Peru**, the implementation of NGNs entails changes in costs (CAPEX and OPEX), necessitating a reformulation of the cost models and the introduction of changes in the model parameters, in response to technological changes.

For its part, **Paraguay** maintains that the availability of broadband on NGNs opens up the field for new business models, which calls for adjustments in the calculation of the tariffs offered to the public. It also affirms that, while the long-run incremental cost (LRIC) methodology remains appropriate, there is a need

to modify the network modelling, given the clear operational differences that exist with respect to conventional networks.

Argentina has not adopted a new model, but rather, in line with current practice vis-à-vis market liberalization, favours the principle of service prices being set freely, with the agreement of the concerned parties in the case of interconnection. The prices in question must be reasonable and non-discriminatory, cost-oriented and based on the LRIC calculation for wholesale services.

Panama and **Colombia** do not have new pricing methods for services provided on NGN networks. Panama adapts the existing ABC model, to the features of the new NGN networks and services, while Colombia is in a study stage of a flexible model capable of simulating different stages of network evolution.

The results of the NGN survey (see Annex 2) show that some countries consider that the trends in operating and investment costs and changes in cost model parameters due to advances in technology require new tariff and cost models. They take the view that network modelling should be modified to reflect the fact that operation of NGNs differs from that of traditional networks, and that new business models can be applied to NGNs.

Other countries consider that it is not necessary for the time being to adopt new models, since competition has ensured that prices are fixed freely on the basis of agreements between the parties, in the case of interconnection. Most countries consider that the long-run incremental costs method (LRIC) is still a good solution for calculating the costs of all services.

3.3.3 New Models Applicable to NGN Services

- a) Adaptation of the activity-based costing (ABC model), to the characteristics of the new NGN networks and services:

In the ABC (activity-based costing) model the costs are assigned and distributed according to the cost causality principle. The traditional network pricing model is based on the identification of access, switching, and transport elements/equipment, and the percentage distribution of traffic per type of activity. The difference in NGN is that the traffic is not discreetly separated and dedicated, and there is broadband usage and assignment by capacity demand. However, it is still possible to identify and distribute, in percentage terms, the associated cost to each network element.

For voice calls, the occupation of time-division multiplexing (TDM) trunks and Erlang traffic is used, and for the case of packet data, a percentage of the traffic in megabytes per second by each service or the proportional use of a 2 megabyte trunk, is used.

In the case of soft switches, for investment levels and O&M costs, the cost constitutive elements are identified (hardware capacity, software, features/functionality/services, use licenses, etc.), in order to identify each subject of cost and associated capacity and type of service.

- b) Study of a flexible model that allows simulation of different stages of network evolution:

At present, the regulator in **Colombia** is conducting a study on the application of a flexible model that will allow the characterization, in cost terms, of the provision of multiple telecommunication services, in a technologically convergent environment, in which the technological transitions of fixed and mobile networks are explicitly evaluated.

The model will consider the separation of typical layers of an NGN network, including a network with fixed and/or mobile access, core level packet switching, transmission through high capacity optical fibre link, and management and application platforms with open interfaces. The model will also consider the capacity to simulate different stages of network evolution, from centralized switching with elements of traditional TDM network, to model distributed with IP switching. Initially, the definition of efficient cost-based in the estimation of at long run incremental costs, will prevail. This exploratory study will serve as a basis for future discussion about the technical and economic aspects of the migration towards NGN networks.

Summary: Most countries consider that variations of the long-run incremental costs (LRIC) model are still the appropriate way of determining costs of services including those offered by NGNs. There is, however, no consensus as to the necessity of adopting new models. Some countries consider that there is no need for new models because, in a competitive environment, prices are set freely and by agreement as regards interconnection. Other countries, on the other hand, consider that new cost and tariff models will be appropriate for NGN services.

Guidelines: Recognizing that cost models remain useful tools for regulation with a view to setting wholesale tariffs, identifying anti-competitive practices, estimating net costs of universal service obligations and establishing retail tariff control, countries must assess the level of development of NGN services in order to design suitable models.

3.4 Regulating the Tariffs for Telecommunication/ICT Services Provided Over NGNs

While the advent of IP networks and services pose new challenges around the world for operators, regulators and policy makers, for the latter two, these challenges tend to comprise two parts: first, whether to legalise new services enabled by Next Generation Networks (NGNs) and where legalised, what aspects of these new services to regulate and whether those aspects which they seek to regulate can technically be enforced. Second and more fundamentally, to enable widespread development of IP networks and NGN services, regulators need to reexamine their roles and the degree of regulation required and its timing and sequencing.

Many of these challenges may emanate from an attempt to regulate new services in a legacy fashion, or legacy failure to regulate the dominance of incumbents or essential facilities that may inhibit the entrance of new services.

The technological advancements in telecommunications are leading towards the trend of unification of networks and services, and NGN are rapidly growing and developing globally. NGNs, being IP-based, enable customers to receive voice, data and video over the same network. NGN offers reduced network and operational complexity resulting in better and more reliable service. It offers unrestricted access by users to different service providers also supporting generalized mobility. NGNs require a new regulatory approach. For that reason it is essential to discuss and resolve issues including:

- Whether or not new generation networks are subject to ex-ante regulation.
- How to implement the concept of investment ladder to the architecture of NGNs to allow competition on infrastructure in the long term and how to encourage operators to invest in NGNs.
- How to adapt their current access regulation regimes to this changing competitive and dynamic environment in which many incumbents have announced or begun the migration to NGN as well as the rollout of optical high-speed access networks.
- How to determine and apply different tariff models adapted for NGNs, in accordance with market conditions, in order to establish of effective competition, and protect consumers' interests.
- How to determine the regulatory framework for the purpose of any service (data, voice, video) provided through the network operators should be treated without any discrimination because of the importance of network neutrality.

In countries such as **Tanzania**, where the market has been completely liberalized thanks to a policy of licensing and investment incentives that favour new investors, tariff regulation applies only to wholesale tariffs, which have to be based on costs.

Elsewhere, for example in **Hong Kong**, China, rollout of NGN services is purely market-oriented and the regulator's role is essentially that of a facilitator. The regulator adopts a market-oriented approach that favours competition and consumption. Since all the telecommunications markets have been completely

liberalized, there is no limit on the number of licenses awarded, no deadline for applications, no minimum investment or network rollout requirements, and no controls on foreign share ownership. The regulator adopts a technologically neutral and market-oriented approach and intervenes in the market only if certain strategic objectives are not met.

In the **United States**, by contrast, some price regulation is applied. For example, operators with significant market power are required to apply prices that are geographically averaged when rolling out fibre-optic lines if there are significant cost differences between different geographical areas, the aim of this being to prevent local distortions of competition.

In **Turkey**, in order to encourage competition for facilities, Turkey's telecoms regulator ICTA, took a [decision](#) on October 3, 2011 that access to fibre services (FTTH and FTTB – fibre to the home and fibre to the building) will be excluded from market analyses for five years, or until the share of fibre Internet subscriptions reaches 25% of all broadband subscriptions.

In **Sweden**, when new fibre-optic lines are introduced as far as homes or in residential areas, the operator with significant market power is allowed, during a transitional period, to apply a price that is not based on LRIC for the relevant geographical area ("geotype"), but instead to apply one based on a geotype that better reflects that area, subject to a ceiling.

In **Trinidad and Tobago**, the regulatory framework offers a stable environment which encourages investment and new entrants onto the market. The regulatory authority has developed a pricing framework which stipulates a catch-up structure with a view to ensuring an efficient market in cases where competition is not always effective. That framework sets out the principles by which the authority defines the relevant telecommunication service markets, the methodology used to ascertain whether there is a dominant or exclusive supply position in these markets, and imposes price regulation if it is justified. It has also stipulated forms of price regulation and is intended to provide for notification of price changes, prevent abusive cross-subsidies and anti-competitive tariffs, and promote new offers of services. On the other hand, it contains no specific reference to technologies such as NGNs, although all services defined by the relevant markets are subject to the sort of price regulation required by this framework.

The impact of lower prices on innovation, investment, consumption and operator revenue: the case of France⁶

Whatever the form of tariff regulation adopted, we must not lose sight of the crucial role of competition in lowering prices. The experience of some countries such as **France** has shown a strong correlation between price reductions, investment in technological and commercial innovation, increased consumption and higher operator revenues.

The consumer price index (CPI) for telecommunication services (fixed telephone and Internet services and mobile telephone services) published by the National Institute of Statistics and Economic Surveys (INSEE) was 81.51 in December 2011 compared to 100 in January 1998, reflecting a fall in telecommunication prices of 18.49 per cent (or 1.4 per cent annually on average). Over the same period, consumer prices overall rose by 25.72 per cent (or 1.8 per annum on average).

This is because telecommunication service prices fall under the pressure of competition, and in addition, very strong growth in the telecommunication sector has enabled operators to recover the cost of their networks and invest in order to be in a position to offer new services without overall cost increases for customers. According to ARCEP figures published in its annual surveys⁷, the number of subscriptions for

⁶ Cf. Publication on 1 February 2012 of the Survey on trends in telecommunication prices in France from 1998 to 2011 by the *Bureau de la veille économique et des prix* (Bureau-1B@dgccrf.finances.gouv.fr), of the *Sous-direction de la communication, programmation et veille économique*.

⁷ <http://www.arcep.fr>

fixed Internet services grew 17 fold between 1998 and 2010 (an average annual growth rate of 15.8 per cent).

Since 1998 operators' telecommunication revenues from customers have increased by 82 per cent (an average of 5.1 per cent annually) while total investment rose by 32 per cent (2.4 per cent annually).

Between 1998 and 2002, the ratio of total investment to revenue from customers was 24 per cent a year on average. Since 2002, that ratio has remained steady at around 15 per cent, which shows that operators have been making constant efforts in technological and commercial innovation.

It would therefore appear to be important for governments and regulatory authorities to continue their efforts to lower telecommunication service tariffs through growth and competition or other regulatory means.

Summary: While the introduction of NGN services is entirely market-oriented, the role of the regulator is essentially that of a facilitator. Nevertheless, price regulation is necessary in order to approve the prices set by operators with significant market power in order to prevent distortions in competition.

Guidelines: It is essential to develop price directives to regulate the activities of operators with significant market power. This should involve regulation on an ex post basis, using existing regulatory tools such as cost models to clarify decisions ex post and ensure that such decisions are taken in a prompt and efficient manner.

3.5 Economic Investment Plan Models Used by Countries Experienced in the Transition to NGNs

3.5.1 Current Studies and Country Cases Regarding Economic Investment Plan Models for NGN Migration

There are a number of approaches to the investment plan model for transition to NGNs, but four of these predominate, in the light of the experiences of countries that have already migrated from traditional networks to NGN. These approaches are those based on:

- public investment;
- public-private partnerships;
- mutualization of private financing or private co-finance;
- private investment through competition.

In **Tanzania**, for example, the Government has invested heavily in ICTs with the construction of the National ICT Broadband Backbone (NICTBB)). The private sector (licensed operators) has adopted a private partnership approach (consortium) which invests in network infrastructure and establishes fibre-optic rings in the towns and laying "fibre to the building" (FTTB) lines.

Other countries, such as **Malaysia** and **Switzerland**, have opted for public-private partnerships. For example in **Malaysia**, the Government concluded a public-private partnership agreement with **Telekom Malaysia (TM)** in order to develop fibre-optic infrastructure. One third of the agreed investment for transition of the TM fixed network to NGN has been funded by the Government. In **Switzerland**, development of the multifibre "fibre to the home" (FTTH) network has involved several cooperative initiatives between the public telecommunication operators and local public services.

Elsewhere, for example in **Trinidad and Tobago** and in **Hong Kong**, China, investment in NGNs is determined mainly through competition in infrastructure development.

In the **United States**, the Recovery and Reinvestment Act of 2009 allocated USD 7.2 billion to a project, administered by two federal agencies, to extend broadband access to communities with limited or no access to such services throughout the country.

This led to the Broadband Initiatives Program (BIP) and the Broadband Technology Opportunities Programme (BTOP). BIP offers subsidies to fund broadband infrastructure in rural areas. BTOP offers grants for development off broadband infrastructure, public computer centres and sustainable projects based on broadband use. The great majority of recommendations in the plan concern efforts to improve the effectiveness of government in streamlining processes and providing incentives for private initiatives that can promote consumers' interests and national priorities, rather than providing for new government credit facilities. The main requests for funding relate to public safety and network development in areas not yet covered. For example, the plan recommends that Congress provide public funding (to the tune of USD 12-16 billion over ten years) to subsidize the federal programme to create a secure public interoperable wireless broadband network; up to USD 15.5 billion are to be spent out of existing universal service funds (USFs) to support broadband. The plan's objective is to make 500 MHz of new spectrum available, through bidding processes, for broadband uses over the next ten years, and the global costs of implementing the plan are expected to be fiscally neutral.

3.5.2 ITU-D Activities on Strategies for the Deployment of NGN in a Broadband Environment

ITU-D has developed a series of papers and seminars related to regulation, costing and policy⁸ approaches to help countries develop their telecommunication/ICTs services. A major focus in recent years has been on Next Generation Networks, specially related to what are the challenges and benefits from the new telecommunications/ICT technologies. To assist ITU Members on this issue, a report on *Strategies for the deployment of NGN in a broadband environment - Regulatory and economic aspects* has been prepared among others studies. It looks at the higher levels strategic issues as well as the economics and fundamental aspects related to the migration to NGN. The report's purpose is to provide insights to help develop national strategies and regulatory approaches towards broadband that will benefit the telecoms industry, consumers and all businesses that make use of telecoms services. This report is freely available at the website: <http://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Studies.aspx>. Another important source of data is the [ITU ICTeye](http://www.itu.int/net4/itu-d/icteye/)⁹. This database is a one stop-shop for telecommunication/ICT indicators and statistics, regulatory and policy, national tariff policies and costing practices information.

Summary: the four approaches for investment plans, on the basis of the experience of countries that have already migrated from traditional networks to NGNs, are: 1) public investment; 2) public-private partnership; 3) mutualization of private financing; and 4) competition-based private finance.

Guidelines: It is essential to decide on the appropriate frameworks for the development of investment plans based on the four approaches.

⁸ ITU-D Events on Regulatory, Economic and Financial Issues available at: <http://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Events.aspx>

⁹ ITU ICT-eye available at : <http://www.itu.int/net4/itu-d/icteye/>

3.6 The Financial and Tariff Impacts of Site Sharing for Mobile Terrestrial Services, Broadening the Study to Embrace All Telecommunication Infrastructures

This section is based on responses to the questionnaire on Tariffs related to “infrastructures sharing”. There were four main questions in the survey:

- What is the level of regulation¹⁰ in regards to passive, active and fixed network sharing?
- Are the regulations oriented to mutual agreements or based on regulation enforcements?
- What financial benefits from infrastructure sharing agreements have been took by operators in terms of cost reduction of services?
- To what extent infrastructure sharing regulations provide incentives to infrastructure network investments?

3.6.1 Passive and Active Network Infrastructure Sharing

Network sharing encompasses a number of possible arrangements and economic models. In terms of the arrangements, infrastructure sharing can be passive or active. “Passive” refers to sites, antenna masts, or electrical power supply; “active” refers to sharing of the actual transmission elements such as antennas or base stations.

Different economic models are possible: antenna “swaps”, setting up a specialist company, or outsourcing of network equipment management to specialist companies. There are different forms of telecommunication infrastructure sharing, including:

- infrastructure sharing and co-leasing;
- spectrum sharing;
- network interconnection;
- local group unbundling.

The regulatory practice presented by administrations which have responded to question 11 of the Questionnaire on tariff policies deals with the existence of regulatory mechanisms for sharing passive infrastructure, active and fixed network. It shows that the vast majority of these countries have adopted regulations or legislation on infrastructure sharing.

An example of this policy is the case of **Switzerland**, which summarizes its regulatory objectives in the following terms:

Providers of telecommunication services that have a dominant position in the market must provide access to other providers in a transparent and non-discriminatory manner at cost-oriented prices in the following forms to their facilities and their services:

- fully unbundled access to the local loop;
- fast bitstream access for four years;

¹⁰ Note: Appendix A of the WTO Agreement on Basic Telecommunication Services defines basic conditions and arrangements by which signatory countries are required to ensure that essential facilities are made available to competing businesses. The concept of essential facility is crucial to implementation of the law on competition in the telecommunication sector, where an essential facility is generally defined as a facility which meets the following conditions: i) it is provided by a monopoly or depends to some degree on a monopoly; ii) it is needed by competitors (for example interconnection service operators) in order to be able to compete meaningfully; iii) it cannot in practice be replaced by competing companies for technical or economic reasons.

- rebilling for fixed network local loops;
- interconnectivity;
- leased lines;
- access to cable ducts, provided these have sufficient capacity.

It is interesting to note here two main issues: (i) the obligation to share applies to companies with "SMP" (significant market power), and (ii) the existing restriction in the form of full unbundling restricts local loop sharing to the copper local loop. These are important regulatory aspects. On one hand, these objectives show a concern with the promotion of competition and, on the other, there is a regulator concern on the potential of regulatory mechanisms to diminish the incentives for investment in new technologies.

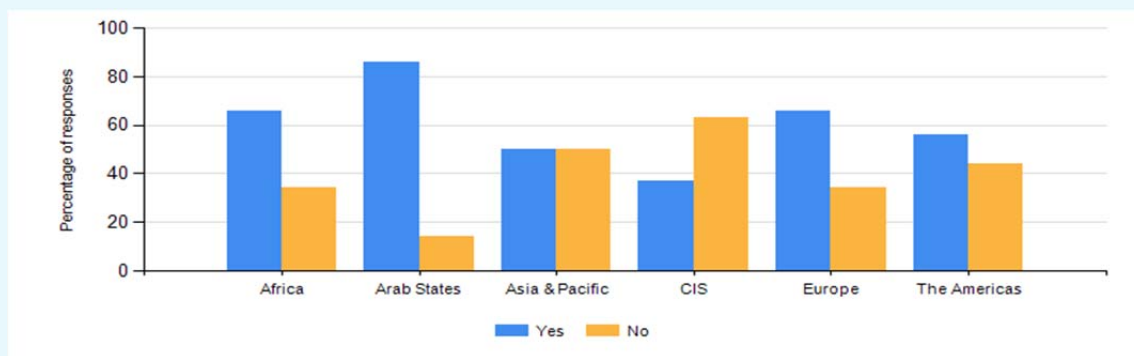
Malaysia has been encouraging both passive and active infrastructure sharing among operators with infrastructure, including these mechanisms as criteria for the 3G spectrum auction.

On the other hand, there are countries like **Costa Rica** and **Zimbabwe**, where there are no specific regulations in place, although the regulator has been encouraging infrastructure sharing where possible.

In **Togo**, the new Law of 11 December 2012 on electronic communications stipulates that the regulatory authority must encourage sharing of passive infrastructure and may require such sharing arrangements in order to meet criteria of competition and land use. This is also the case in **Côte d'Ivoire**.

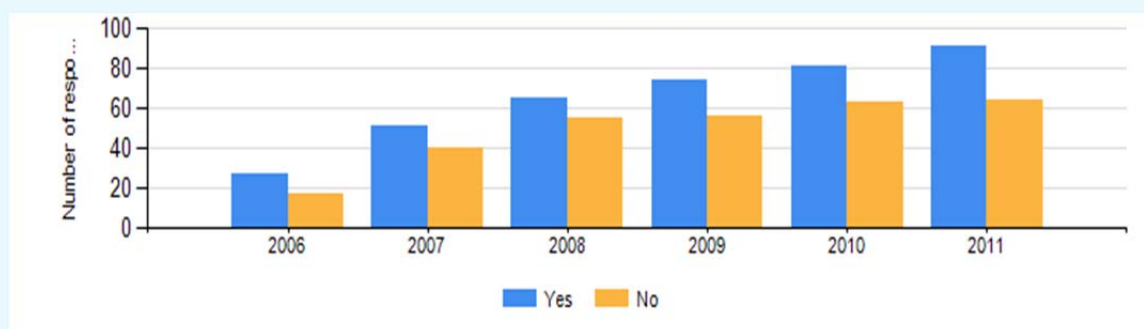
A summary of replies to the questionnaire by region and year clearly shows that there are more administrations indicating that infrastructure is mandated, whatever the region and regardless of the year of the reply.

Figure 4: Is infrastructure sharing mandated? Data by region, 2012



Source: ITU/BDT Tariff Policies Survey.

Figure 5: Is infrastructure sharing mandated? World trends, 2006 2011



Source: ITU/BDT Tariff Policies Survey.

3.6.2 Mutual Agreements or Regulation Enforcements

The question here is related to the level of intervention at the time given by the regulator to mediate specific conflicts arising from infrastructure sharing. The more detailed the regulations on infrastructure sharing, the more waivers will be granted to promote sharing arrangements.

Based on question 12 of the Questionnaire on tariff policies, the answers given by countries show that most of the regulators intervene somehow in sharing arrangements only when agreements cannot be reached by the companies (ex post regulation), supported by the regulation framework established.

The most interventionist countries are **Switzerland** and **Trinidad and Tobago**, which present a more detailed regulatory framework on infrastructure sharing. At the intermediate level of intervention we can include **Hong Kong (China)**, **Brazil** and **Malaysia**, which have less detailed regulation on infrastructure sharing. **Costa Rica** and **Zimbabwe** state that there are no specific regulations governing infrastructure sharing and/or that they only follow (in case of mediation being necessary) sharing agreements freely negotiated by companies.

3.6.3 Financial Benefits from Infrastructure Sharing Agreements

Operators and providers in the telecom market have seen a growing need to drive down the cost of capital assets or infrastructure deployed for telecom services. This has been expressed in recent times by many operators who come together, on basis of mutual agreements, to consider sharing infrastructure. That infrastructure sharing could promote: a) significant reduction in cost of Capex (capital expenditure) employed in network rollouts or deployments; b) cost efficiency improvement in network deployments; c) enable operators to improved their coverage and capacity; d) service delivery improvements; e) product innovations investments through capital gained or recouped; and f) positive impact on customer experience and quality of service.

In this regard, question 13 in the questionnaire sent to the administrations of ITU Members sought to capture the views of the telecommunications market stakeholders in relation to the potential of cost savings resulting from sharing infrastructure and to what extent such reductions are passed on to end users.

In summary, the majority of respondents indicated that operators obtain cost reductions by sharing infrastructure, but the information on the percentage of reduction was not provided owing to the strategic nature of the information.

Figure 6: Does site sharing result in lower prices for end users? Data by region, 2012

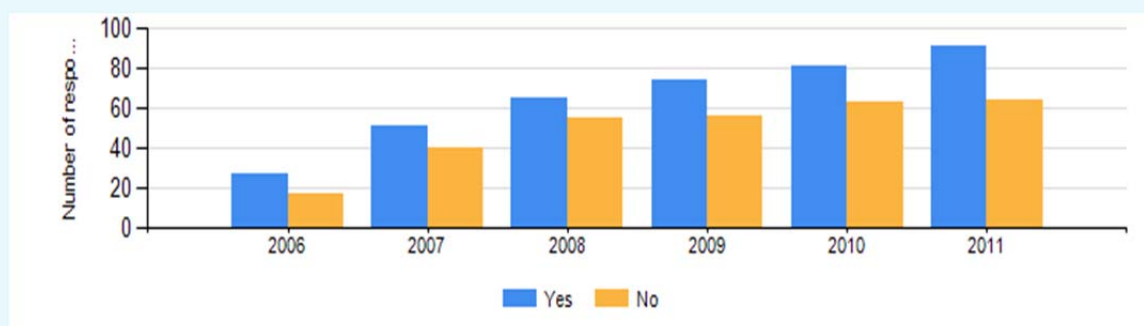
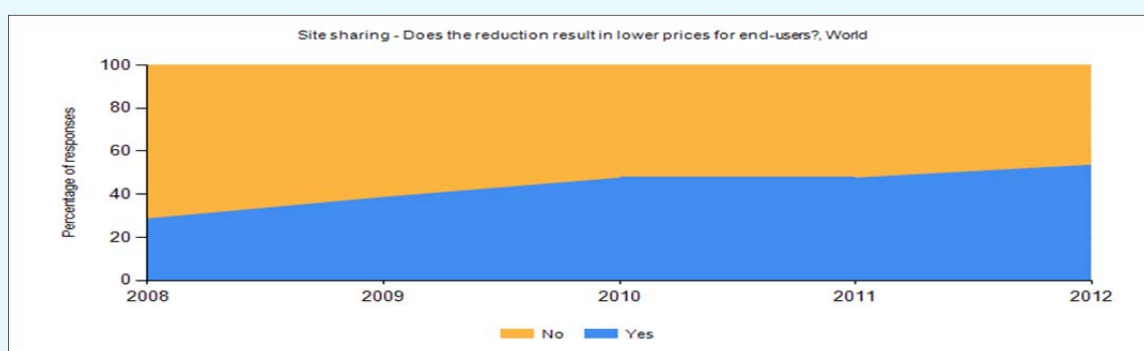


Figure 7: Does infrastructure sharing result in lower prices for the end user? World trends, 2008 2012



Source: ITU/BDT Tariff Policies Survey.

The replies to the question on the impact of cost reductions on end user prices varied from one region to another. Overall, however, more administrations take the view that operators pass on the benefits of infrastructure sharing to the end user, irrespective of the year.

Noteworthy are the cases of **Switzerland**, **Tanzania** and **Costa Rica**.

The Administration of **Switzerland** has stated that the applicable regulations¹¹ described in 3.6.1 decrease the wholesale tariffs of the dominant operator for access opportunities by about 50 per cent.

The Administration of **Tanzania** states that interconnection service is charged at cost of providing it while other sharing types are priced for cost recovery and revenue generation, i.e., passive and active sharing that are not mandated, and that the extent of cost reduction need to be looked into case-by-case basis.

On the other hand, the administration of **Costa Rica** stated that the incumbent has not benefitted from these agreements, mainly because the interconnection prices are set by the regulator below costs. Small operators have benefitted from not having infrastructure, obtaining a competitive advantage as a consequence of low interconnection prices.

¹¹ “The telecommunication service providers occupying a dominant market position are required to allow other providers to access their resources and services, on transparent and non-discriminatory terms and at prices based on costs.”

3.6.4 Infrastructure Sharing Regulations and Incentives to Network Investments

The impact of regulation on investment in the telecommunication industry has been quite articulated with the so-called “theory of the ladder of investment”¹². According to this theory, the dynamic efficiencies of competition could be captured through a process of accommodation of entry. In other words, by allowing new entrants to have equal access to the incumbents’ facilities through initially low prices and later on gradually raising them, service based on competition would lead to facilities-based competition (dynamic efficiency). According to this theory, the increase of facilities access fees ultimately makes service-based competition less profitable, giving incentives to entrants to make investments in their own facilities. Thus, static efficiency would lead to dynamic efficiency, that is, satisfaction of new requirements (new products and services) and innovation (alternative technology platforms).

Some experts believe that this theory is arbitrary, in the sense that it distorts the investment decision, slows down both the deployment of alternative access networks and innovation in the productive process (González and Martín, *Finances et Développement*, IMF 2011). Others, according to empirical studies demonstration, mention that the application of the “ladder of investment” theory still awaits confirmation¹³. Either way, the fact is that the ladder of investment theory has been contributing to the development of new regulatory frameworks, favouring LLU (local loop unbundling) and other types of asymmetric regulation.

The context above encompasses what is behind the question 14, answered by the administrations. The development of new regulatory frameworks, favouring LLU (local loop unbundling) and other types of asymmetric regulation is based on the “ladder of investment theory”, which is predominant as justification for mandatory regulatory intervention. On the other hand, there are other more sceptical views on the capacity of this “theory” to give incentives for network investments or eventually lead to facilities-based competition (dynamic efficiency).

In this sense we can highlight some answers that are linked with these backgrounds above.

Switzerland, for example, states that the extent of the incentives to infrastructure network investments given by infrastructure sharing regulations depends on the cost modelling that the regulator uses when determining prices. Furthermore, the Swiss Administration states that if the LRIC model is applied, the investment incentives for the regulated dominant operator should remain on an efficient level and the incentives for investments of non-SMP operators should be fostered significantly.

Trinidad and Tobago states that incentives can accompany any such infrastructure-sharing regulations to ensure a more confident investor, although recognizing the difficulty of requiring mandatory access that gives incentives to new entrants while also giving incentives for investors to roll out infrastructure networks.

Costa Rica states that the existing interconnection prices do not provide any incentive for investment in network infrastructure, while the Administration of **Malaysia** states that the prices for infrastructure sharing are not regulated and that commercial prices for infrastructure sharing provide adequate incentives to invest. According to the **Malaysian** statement, this view is supported by the presence of new entrants whose sole activity is building towers for leasing to other service providers.

Finally, the case of **Hong Kong, China**, which also highlights the difficulties of combining infrastructure sharing regulations and incumbent operator’s incentive to make further investment in network infrastructure. Infrastructure sharing regulation in Hong Kong is somewhat different from that of many

¹² Cave, M 2006 “Encouraging Infrastructure Competition via the Ladder of Investment, *Telecommunications Policy*”, Vol. 30, pp. 223-237.

¹³ Gentzoglanis and Aravantinos, 2010, *Investment in Broadband Technologies and the Role of Regulation*, University of Sherbrooke.

other countries, especially in regards of unbundling of access networks. The policy applied no longer regulates the opening-up of the incumbents' "last-mile" but instead encourages facility-based competition. The Hong Kong Government announced on 6 July 2004 the decision that the regulatory intervention under the "Type II interconnection" (LLU) should be withdrawn. The Government considered that the continuation of mandatory "Type II interconnection" was justified only if the benefits from facilitating effective competition and enhancing consumer choice outweighed any potential detriment arising from dampening of incentive for investment in network infrastructure. With this action, the Territory of Hong Kong is among the first few economies in the world to phase out this mandatory regulatory intervention in its mainstream regulatory policy, opening up the "last mile" of the incumbent fixed operator.

Currently, according to the Hong Kong administration, since the announcement of the revised Type II interconnection policy in July 2004, the new fixed network operators (FNOs) have continued to invest and roll out their self-built networks. As of the date the mandatory Type II interconnection was withdrawn, the number of households in Hong Kong that were connected to at least two self-built customer access networks (CANs) had over 81% of the total number of households. This was a substantial increase compared with 53% of 2004 when the Government announced to withdraw the mandatory Type II interconnection policy. In consequence of it, according to the Hong Kong administration, a more advanced and innovative services were introduced by FNOs, using their high-capacity self-built CANs. These include the following:

- more affordable and faster broadband Internet access service to customers, with an 85 per cent household penetration as of July 2011;
- the fibre-to-the-home ("FTTH") technology deployed by the FNOs is capable of delivering transmission capacity of up to 1 000 Mbps to individual premises;
- the launch of IP telephony service by almost all FNOs and service-based operators (SBO) over broadband connections. The total number of IP telephony subscribers reaches 583 000 in March 2011, accounting for about 13.6% of all fixed line telephone customers;
- the launch and increasing popularity of local IP television services; and
- the offer of "triple-play" services by a number of FNOs providing bundled packages of telephony, broadband access and IP television services to customers.

More information about the withdrawal of mandatory "Type II interconnection" could be accessed in OFTA's website at: <http://www.ofta.gov.hk/en/tas/interconnect/tas20080703.pdf>.

The Guidelines of GSR 2008 on good practices regarding innovative infrastructure sharing strategies remain relevant and useful and seek to promote economically affordable access for all.¹⁴

¹⁴ Global Symposium for Regulators 2008, Best practice guidelines, available at: <http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR08/consultation.html>.

Summary: Several forms of telecommunication infrastructure sharing exist, including co-leasing, network interconnection, and local loop unbundling. Such sharing arrangements are increasingly required by regulations in order to facilitate access to facilities, ensure competition, and achieve gains in productivity that will be passed on to end users. However, the financial implications of infrastructure sharing, including in terms of passing on productivity increases to the end user, have not been proven. The debate is still open as regards the right balance between regulation of infrastructure sharing and investment incentives.

Guidelines: Regulatory frameworks must be developed for infrastructure sharing and to provide incentives for operators to encourage infrastructure sharing, including access to facilities, while also promoting investment. It is also important to hold public consultations on the various strategies and regulations for infrastructure sharing, with the participation of all the parties involved.

4 Guidelines

4.1 Guidelines for Making the Transition from Existing Service Offerings in Developing Countries to Service Offerings that Combine Voice and Data, and Economic Investment Plan Models Used by Countries Experienced in the Transition to NGNs, for the Purpose of Providing Guidance to Developing Countries

4.1.1 General Considerations

- a) Operators have their own, mainly economic, reasons for migrating to NGNs. These reasons will determine the timetable of investment in the new infrastructure. The reasons most often put forward include:
 - the need to be more competitive;
 - creation of new sources of revenue to make up for loss of revenue from traditional activities;
 - reduced operating costs;
 - managing the life cycle of past investment. The difficulty lies in managing this life cycle so as to ensure that migration has no significant impact on investment costs.
- b) Consumers do not consume NGNs; they consume electronic communications routed via NGNs, and electronic communications contain content other than that linked to inter-personal communication, be it information accessible via the Internet, musical or audiovisual content, games, and personalized content and “self-made” products. Given that NGNs are a powerful tool for access to content sought by the consumer, the content industry and networks industry are now entering into a mutually beneficial relationship in which one complements the other: content providers supply traffic for the network operators in one direction, while in the other, the network operators enable content providers to reach a bigger audience. As a result, the sectoral regulators of electronic communications, whether or not their mandate includes regulation of content, will be called on increasingly to become involved in regulating relations between operators and content providers, as these relations are crucial to the efficiency of the end-user market for communication services in the broad sense.
- c) An investment can be analysed in terms of allocating funds with the intention of obtaining revenue at a later date. In other words, a planned investment applies to the totality of activities and

operations which consume limited resources and from which one expects to derive revenues or other financial or non-financial benefits. The investment decision can be analysed as a choice regarding resource allocation to a given project with a view to generating surplus profit. It involves a wager on the future, involving both a risk but also a degree of confidence, and requires expenditure which is certain in the hope of obtaining future gains which are uncertain or unpredictable.

- d) Transition to NGNs calls for business models allowing investment to develop a core IP network with a range of available access technologies. In order to ensure a smooth transition, it will be necessary to review policy requirements as regards factors determining the choice of terminal devices and access technologies. Mobile phones and the Internet have provided early “NGN” experience for many uses of services such as push-to talk, Instant Messaging, two-way video and content (video, audio and text) streamed and broadcast to the user in many parts of the world. Most developed countries have embraced NGNs by adopting technology-neutral regulation, and developing countries can learn from such experiences when designing frameworks for transition to NGNs.
- e) NGN evolutions are driven by market requirements and thus reflect emerging global standards. This implies that for migration to NGN, it is important that the regulatory framework takes account of these emerging standards and avoid to greatest extent possible the addition of country-specific requirements that could be costly to develop and may delay NGN deployment or service offerings. The challenge is for developing countries to actively contribute to and influence the international standardization process to include the capabilities required for the roll out of NGN networks and growth of the data communications within their environs.
- f) Transition of current switched telephony networks to the future networks will take time, especially for services requiring reliable broadband access. Political decision makers will need to decide on the best way of promoting innovative services while maintaining and upgrading existing PSTNs to meet requirements. Policies will need to combine the benefits of the new services with continuity as regards the PSTNs, as well as any other social objectives such as extending existing universal service obligations to the new services, all in an environment in which market prices for transport services are likely to go on falling.

4.1.2 Guidelines

In the light of case studies, the following guidelines may be proposed:

- It is important and necessary to adapt the existing legal and institutional framework and ensure that it is fully implemented in order to promote a genuine NGN investment promotion policy and avoid the disparities seen all too often between official regulations and actual conditions, which often act as a deterrent.
- In view of the importance of the investment needed for migration to NGNs, it is important that the national regulatory authorities take into account the risk profile of these investments when establishing tariffs in cases of mandatory access intended to promote competition.
- Structural measures should be introduced with the aim of encouraging competition and ensuring choice for consumers. These measures should also aim to improve price transparency and improve provision of information for users of new NGN services, in particular:
 - to improve users’ capacity to obtain and disseminate information;
 - to enable customers to move as easily and as quickly as the chosen technology will allow, without penalty and free of charge, to an alternative service provider and to be informed of this possibility in a way that is clear and easily accessible.
 - to promote telecommunication infrastructure sharing

There are many sound reasons for infrastructure sharing or pooling when rolling out NGNs. High costs of infrastructure rollout have an impact on what is charged to the customer. An expensive service is already an impediment to gaining a secure foothold in an environment where average purchasing power is low. Inadequate infrastructure development can lead to adverse electromagnetic impacts, resource saturation, issues of right of way, and so on. The number of fixed and mobile operators, scarce radio resources, high investment costs for NGNs, and the need to optimize the use of infrastructure, are all arguments in favour of infrastructure sharing. The advantages are:

- rapid and efficient network rollout;
- lower investments costs for operators;
- guaranteed universal access and services;
- lower tariffs;
- smooth network expansion at the national level.

Developing countries are encouraged to consider the following aspects when designing the transitional framework.

- 1 Adaptation of policy, and of the regulatory and legislative frameworks.
- 2 Design of an industry structure that defines the desired network and service model.
- 3 Market power and access to essential facilities: new and emerging service models and architectures may create opportunities for abuse of market power.
- 4 Interconnect settlement models: new value paradigms in NGN architectures mean that new models may be needed for settlement of interconnect service provision, possibly based on bandwidth, QoS, volume, content etc., in contrast to current concepts which focus on distance and time.
- 5 Socially important services (and value-added services) to all including the elderly and physically challenged: how are social services defined, and what are the regulatory implications for these services?
- 6 Access to emergency services: what provisions have to be made for access to emergency services, and for which services? How can relevant information be obtained?
- 7 Consumer issues – security and privacy: how to protect customer data within an architecture that is open to multiservice providers, while still facilitating socially and nationally important service requirements?

4.2 Guidelines for Promoting Growth in Data Communications in Developing Countries

4.2.1 General Considerations

- a) One of the key ingredients in the promotion of growth in data communications is the availability of local content to be recorded and shared for the benefit of people throughout the world. Societies across the world have rich heritage and knowledge. The policy makers ought to look for ways for promoting the creation and preservation of such cultural heritage, including element that are tangible, oral and intangible. Growth in Internet and innovative technologies has presented historical advancement in the development and dissemination of content. Empirical research has shown that there is a strong correlation between the development of network infrastructure and the growth of local content.

The growth of local content varies across countries and is tied to enabling factors such as the level of Internet infrastructure development, the roll out of broadband and availability of compatible ICT equipment. Government has been identified as an important “anchor tenant” for broadband and

can help create demand through its services and by supplying affordable broadband in schools and universities. But services provided by the government alone will not create the critical mass of users needed to help operators lower the retail price of broadband.

- b) Creating local content, recording and distributing it benefits from a specific set of skills and tools. Governments, especially ministries of education, should evaluate the level of multiple skills, such as ICT skills, knowledge and attitudes which would lead to the critical mass of competences existing at local level and take appropriate measures to create an enabling learning environment. Key steps include improving basic literacy (e.g. drafting, language, etc.), critical thinking ability, as well as media, information and digital literacy skills. Policy steps to improve ICT, digital, media and information literacy should include both the formal educational system and lifelong learning. Targeted programmes aimed at certain segments of the youth and adult population can also teach necessary skills to members in a community who can then help others create, record and disseminate local content.
- c) In addition to Internet connectivity, ICT equipment such as computers, mobile phones, cameras, scanners and audio/video recorders are important tools for digital content creators. Any trade barriers, taxes or levies that limit the development, production and importation of these devices, or increase their cost, could have a negative effect on local content creation and distribution at the local level. In some cases, ICT equipment or services are taxed heavily as they are considered luxury goods. Efforts should be made to improve policy coherence between taxation policy and ICT policy.
- d) Software is an important component of digital content creation but its cost can mean that is it beyond the reach of many users. Open free online tools and materials, as well as open access to content, especially local scientific content, are an increasingly important way for users throughout the world to access sophisticated software, tools and services that can help in all steps of content creation. Thus both developed and developing countries need to encourage open access to this software.
- e) In recognition of the benefits accruing from the deployment of NGNs, many countries have embraced the drive to promote convergence and growth in data networks.

For instance, in **Malaysia**, while there is no specific regulatory framework in place to promote the use of data communication, the Government and regulator have been encouraging its use by removing obstacles/impediments. Under the broadband initiatives, the Government and regulator has been distributing 1 million netbooks to low income schoolchildren and introducing broadband access at community centres, libraries as well as providing Wi-Fi services to the villages.

In 2007, the Government of **Portugal** launched its national “Magalhães” (Magellan) programme to supply subsidized portable computers with 3G connectivity to all secondary school pupils and teachers using funds from the 3G concession auction. In 2008, this initiative was extended to primary schools and was able to reach more than 1.3 million pupils and teachers in a three-year period.

In the Budget Statement 2012, the Government of **Trinidad and Tobago** reiterated that the quest for a knowledge intensive economy and access to Information and Communication Technology constitute a mainstay for sustainable development. The Government stated that it will ensure that the unserved and under-served communities in Trinidad and Tobago get the required access to the Internet through “modern, accessible and affordable broadband platform” to facilitate the use of ICT services such as e-Government, e-Health and e-Commerce. The Government is preparing a strategic map to roll out a nationwide high speed broadband network within two years. This project would require a financing plan for the backbone infrastructure, the details of which are still being negotiated.

The project emphasizes the following elements:

- drawing up a strategic map to roll out a nationwide high speed broadband network- backbone infrastructure;

- encouragement of partnerships between Government and the private sector in the deployment of the NGN;
- design of consumer education and protection programmes;
- identification of the unserved and underserved areas; and
- reduction of bureaucracy in implementation.

In recognition of the challenge of promoting data communications likened to the “chicken-and-egg” problems with supply and demand, it is acknowledged that people will not use broadband without attractive content and services.

4.2.2 Guidelines

In the light of the experience of some countries, the following guidelines are proposed:

- **Expanding connectivity**
 - Government investments in road construction or electrification should consider installing the infrastructure for fibre-optic networks at the same time to save on the significant digging costs. These backhaul networks can support both fixed and mobile Internet connectivity over the last mile.
 - Governments can promote the development of local Internet exchanges in order to foster the local distribution of content in a cost-effective way.
 - Efficient spectrum policy: Review spectrum allocation plans to ensure the accommodation of the Broadband Wireless Access Services.
 - Governments should look at existing international connectivity, available capacity and conditions therein and design mechanisms to increase exchange of content by increasing international capacity into their country. Adopt steps that lower the costs and barriers of delivering international bandwidth are particularly important.
- **Promoting competition**
 - Adopt Infrastructure sharing as a way to foster Internet competition.
 - Design policies that reduce barriers to entry in telecommunications, and the supply of Internet access in particular.
- **Adapting the regulatory framework**
 - Regulatory framework to promote data communications will focus on the implementation of legislation to that promotes the e-environment. These include: Data protection; Electronic transactions; Cybersecurity and Universality.
- **Improving access**
 - Enabling affordability of services addressed to end users
 - Review the programmes to be funded/subsidized through USF under the NGN regime.
 - Promote use of Internet access services, coupled with computing devices that range from entry-level netbooks to higher-performing laptops. Many emerging countries have designed programmes of providing millions of such gadgets to their communities. Many of the offerings are linked to financing options that further reduce the entry barriers to lower-income Internet entrants;
 - Avoid increasing taxation of ICT products and services and encourage lower taxes. For example, in 2009 **Sri Lanka** adopted a plan to reduce taxes and duties on ICT products and services. As a result, the number of people able to afford a broadband subscription rose from about 3.5 million to more than 13 million in 18 months.
- **Fostering content development**
 - Focus on the three major pillars of access, affordability, and awareness, and meet the challenges of extending the reach and impact of broadband services.

- Training programmes in documentation/packaging and distribution of data services such as music, video, and other multimedia experiences offered via broadband technologies.
- **Programme funding mechanisms**
- Globally it is seen that many diverse funding approaches have been used, and certain types of measures by the public authorities and subsidies are likely to be required, even in high-GDP countries. A mixed approach using both public and private investment is likely to be required.
- To ensure successful roll-out of broadband communication, governments may consider investments similar to the approach of universal service funds that have been used in the past to ensure basic telephony is available to all. An NGN fund for broadband can be centrally supported or by other parts of the industry.
- Given the importance of the education sector in the growth of data communications, countries may consider integrating education funding programmes with the NGN fund programmes.

5 Conclusion

In recognition of the benefits accruing from the deployment of NGNs, many countries have embraced the drive to promote convergence and growth in data networks. NGNs reflect convergence of networks. The NGN enables users from the mobile telephony network, the fixed telephony network and the broadband network to connect to one common network. This makes it possible to create one shared environment where all types of communication services are deployed.

Rollout of NGNs achieves its full potential with the rollout of broadband networks and in the development of data communications. Furthermore the UN Broadband Commission in 2011 set a number of global objectives including making broadband policy universal and making broadband financially affordable.¹⁵ It is thus expected that by 2015, all countries should have a national broadband plan or strategy to integrate broadband in their definitions on access and universal service.

However, many challenges need to be overcome in order to achieve this, from devising investment models to dealing with issues of regulation.

That is because, in designing models or strategies for migration to NGN and development of a broadband network, and giving an important place to sharing arrangements and public-private partnerships, changes are needed in terms of regulation mainly to regulate the methods of tariff setting that will be applied and ensure that prices are affordable for users. Network rollout, availability of services, and accessibility for users, are the main aspects which should guide discussions on electronic communications.

Throughout this study period, it has been clear from the experience of countries that have already migrated that strategies for transition to NGNs and development of broadband networks should no longer be based exclusively on private investment by individual operators. The most widely used approaches are those based on public investment, mutualization of private investment, and public-private partnerships, are the most widespread practices.

As for methods of costing, price-setting and tariff regulation in an NGN environment, there would seem to be a long way to go in order to handle the new cost parameters that have to be considered and in order to reach agreement on the need to change costing models. There is however one constant: lower prices for telecommunication services are an essential factor for increasing consumption, and investment in innovation leads to increased revenue for operators.

¹⁵ <http://www.broadbandcommission.org/>.

Annexes

Annex 1: ITU/BDT Questionnaire on Tariff Policies

Annex 2: Questionnaire on Economics and Costing Issues of NGNs

Annex 3: Glossary and Abbreviations

Annex 1: ITU/BDT Questionnaire on Tariff Policies

The ITU/BDT questionnaire on tariff policies is available on the web site <http://www.itu.int/en/ITU-D/Regulatory-Market/Pages/SurveyTariff.aspx>. The results of the survey by year and region are available via the ITU database on ICTEye at the web site: <http://www.itu.int/ITU-D/ICTEye/>.

The screenshot shows a web browser window displaying the ITU Survey on Tariff Policies 2013 page. The browser's address bar shows the URL <http://www.itu.int/en/ITU-D/Regulatory-Market/Pages/SurveyTariff.aspx>. The page features the ITU logo and the slogan "Committed to connecting the world". A navigation menu includes "ITU", "General Secretariat", "Radiocommunication", "Standardization", "Development", "ITU Telecom", and "Membership". Below the menu, there are links for "About", "Activities", "Events", "Join ITU-D", "Partners", "Projects", "Publications", "Regional Presence", "Resources", and "Study Groups". The main content area is titled "ITU Survey on Tariff Policies" and includes a breadcrumb trail: "YOU ARE HERE: HOME > ITU-D > REGULATORY & MARKET ENVIRONMENT > ITU SURVEY ON TARIFF POLICIES". The page is dated "ITU SURVEY ON TARIFF POLICIES 2013". Under the heading "THE SURVEY", it states: "The 12th annual Tariff Policies Survey of the Telecommunication Development Bureau (BDT) of the International Telecommunication Union (ITU) is now available for completion by your organization on ITU's online 'ICT Eye portal' at: www.itu.int/net4/ITU-D/ICTEye/Login.aspx". It also mentions that a PDF version of the questionnaire is available in English, French, and Spanish. A section titled "The ITU ICT EYE" describes the ITU as a specialized agency for telecommunications and highlights the ICTEye website as a one-stop-shop for ICT information. On the right side, there are sections for "Broadband" (with sub-sections for Broadband News and Mapping Broadband) and "HIGHLIGHTS". The "Broadband" section lists items like "Broadband Thematic Reports NEW", "Case studies", "Broadband on ICT Eye (coming soon)", "GSR 12 Best Practice Guidelines", and "Broadband Commission for Digital Development". The "HIGHLIGHTS" section features the "ICTEYE" logo and lists events such as "ITU High-Level Workshop on Regulatory and Economic Aspects of Roaming" and "ITU Asia-Pacific Centre of Excellence training on 'NGN Interconnection - Costing and Pricing'".

Annex 2: Questionnaire on Economics and Costing Issues of NGNs



International Telecommunication Union
Telecommunication Development Bureau (ITU-D) - ITU-D Study Group 1

Question 12-3/1: Tariff policies, tariff models and methods of determining the costs of services on national telecommunication networks, including next-generation networks

Questionnaire on economics and costing issues of NGNs

Remarks: This short Questionnaire is addressed to National Regulatory Authorities and Telecommunication Operators. National Regulatory Authorities are kindly requested to complete this Questionnaire and send the answer to Ms Carmen Prado-Wagner (prado@itu.int) as well as to forward it to Telecommunication Operators and Service Providers to obtain their answer. The deadline for completion is the 31 October 2011. Thank you in advance for your cooperation. The results from this Questionnaire will be useful for the works of Question 12-3/1. This Questionnaire is available on the website: www.itu.int/ITU-D/finance/.

Section 1: Cost structure of NGN services compared to that of services provided over traditional networks

- 1) Please describe the NGN services and products that are provided, and indicate their associated costs

Answer:

- 2) How does the NGN cost structure differ from the cost structure of traditional networks? Please indicate the relevant cost elements.

Answer:

Section 2: New charging methods for services provided over NGNs

- 3) Does your organization consider it appropriate to reformulate or adopt new cost and tariff models applicable to NGN services? If so, please indicate the models used and the criteria for determining costs.

Answer:

Section 3: Regulating the tariffs for telecommunication/ICT services provided over NGNs

- 4) What sort of regulatory environment would provide an incentive for investment in networks using NGN technology, without affecting the tariffs of services already currently provided?

Answer:

- 5) What regulatory actions are planned or being applied to implement an NGN environment for broadband services in your country?

Answer:

- 6) What price regulation mechanism has been or will be introduced to preserve competition and encourage new players in an NGN environment for broadband services in your country?

Answer:

Section 4: Investment models for the transition to NGN

- 7) What strategy has been implemented by the regulator and operators for investment in NGN infrastructures or transition to NGN?

By the Regulator:

By the Operators:

- 8) Please describe the investment process that is planned or being applied to implement the transition to NGN.

By the Regulator:

By the Operators:

Section 5: Guidelines for promoting growth in data communications in developing countries

- 9) What policy measures and incentives have been designed to promote data communication in your country?

Answer:

- 10) Is a regulatory framework in place to promote the use of data communication?

Answer:

Section 6: Infrastructure sharing

- 11) Are there regulations on passive, active or fixed-network sharing? If so, please describe them.

Answer:

- 12) Do the regulations generally rely on mutual agreement or on enforcement? If the regulations rely on mutual agreement, to what extent are the mutual agreements implemented?

Answer:

- 13) Do operators benefit financially from infrastructure-sharing agreements in terms of cost reduction of services? If so, how big are the cost reductions?

Answer:

- 14) To what extent do you think that infrastructure-sharing regulations provide incentives to invest in infrastructure networks?

Answer:

Thank you for your cooperation!

Please send the answers to prado@itu.int

Annex 3: Glossary and Abbreviations

ABC: Activity-based costing, a method of performance management which can be used to elucidate cost formation and factors in cost variation.

Architecture: Overall framework which determines communication rules (codes, protocols, interfaces) between different constituent network elements.

ADSL: Asymmetric digital subscriber line. A technology that enables high-speed data services to be delivered over twisted pair copper cable, typically with a download speed in excess of 265 kbit/s, but with a lower upload speed (see Recommendation ITU-T G.992).

ARPU: Average revenue per user. Usually expressed per month, but also per year.

ATM: Asynchronous transfer mode. A transmission mode in which the information is organized into cells; it is asynchronous in the sense that the recurrence of cells from an individual user is not necessarily periodic.

BDT: ITU Telecommunication Development Bureau.

BRAS: Broadband remote access server.

Broadband telephony: Recommendation ITU-T I.113 defines broadband as transmission capacity superior to that of ISDN primary bit rate (1.5 or 2.0 Mbit/s).

BTS: Base transceiver station.

CAPEX: Capital expenses.

Competition: Refers to the introduction of competition between national and/or foreign service providers, without restriction. For the cellular mobile service, the number of licence holders depends on the available spectrum. Therefore, for the purposes of this report, all countries authorizing more than one operator are considered as being open to competition.

Convergence: a term used for a number of distinct phenomena:

- A trend among IT, telecommunications and media industries to converge thanks to digital technologies which allow conversion of voice, text, data and still/moving images into coded message that can be mixed, transmitted, stored and managed without errors, in large quantities and more or less instantaneously over fixed or mobile networks.
- Convergence among the audiovisual and telecommunication sectors; this means the potential, thanks to technological advances, for using different physical carrier media (cable networks, terrestrial or satellite wireless networks, IT or TV terminals) to carry and process all types of information and services, whether audio, video, or IT data.
- Fixed/mobile convergence – the increasing convergence of technologies and services using fixed and mobile technologies.

DSLAM: Digital subscriber line access multiplexer.

EDGE: Enhanced data rates for GSM evolution – mobile telephone standard which is an extension of GSM with retrocompatibility.

Ethernet: A local packet-switched network protocol

EU: European Union.

FAC: Fully allocated costs

FDC: Fully distributed costs.

Frameworkx: New name of NGOSS on good practices and standards, providing a model for effective and efficient commercial operations.

Fibre to the subscriber: A high-speed fibre-optic Internet connection that terminates at a residence. See FTTx.

FTTx: Fibre-to-the-x, where x is a home (FTTH), building (FTTb), curb (FTTC) or neighbourhood (FTTN) (non-exhaustive list). These terms are used to describe the reach of an optical fibre network.

GDP: The market value of all final goods and services produced within a nation in a given time period.

Gigabit Ethernet (10GbE, 10GE, 10GigE): different technologies used for Ethernet frames at 10 Gbit/s (IEEE 802.3 ae).

GSM: Global system for 2G mobile communications. Digital mobile standard developed in Europe, and currently the most widespread 2G digital mobile cellular standard. GSM is available in over 170 countries worldwide. For more information, see the website of the GSM Association at: www.gsmworld.com/index.htm.

ICTs: Information and communication technologies. Covers the technologies used for processing and transmission of data, mainly IT, Internet and telecommunications.

IMS: IP multimedia subsystem. A standardized NGN architecture for telecom operators that want to provide mobile and fixed multimedia services. It uses a VoIP implementation based on a 3GPP standardized implementation of SIP, and runs over the IP (IPv4 or IPv6). Existing phone systems (both packet-switched and circuit-switched) are supported.

Incumbent operator: The major network provider in a particular country, often a former State-owned monopoly.

Interconnection: The physical connection of separate ICT networks to allow users of those networks to communicate with each other. Interconnection ensures interoperability of services and increases end users' choice of network operators and service providers.

Interconnection charge: The charge – typically a per-minute fee – that network operators levy on one another to provide interconnection.

Internet: Interconnected global networks that use the Internet protocol (see IP).

IP: Internet protocol. The dominant network layer protocol used with the TCP/IP protocol suite.

IP telephony: Internet protocol telephony. IP telephony is used as a generic term for the conveyance of voice, fax and related services, partially or wholly, over packet-based, IP-based networks. See also VoIP and broadband telephony.

IPTV: Internet protocol television.

ISP: Internet service provider.

ITU: International Telecommunication Union. The United Nations specialized agency for telecommunications. See: www.itu.int/.

IXP: Internet exchange point. A central location where multiple Internet service providers can interconnect their networks and exchange IP traffic.

LDCs: Least developed countries. These are the 49 least developed countries recognized by the United Nations (as at 1 December 2012).

Line sharing/partial unbundling: A form of network unbundling that allows a competitive service provider to offer ADSL using the high-frequency portion of a local loop at the same time that an incumbent continues to offer standard switched voice service over the low-frequency portion (voice) of the same loop.

LLU: Local loop unbundling. The process of requiring incumbent operators to open the last mile of their legacy networks to competitors. See also ULL (unbundled local loop).

LRAIC: Long-run average incremental costs. Costing model based on an analysis of long-run incremental costs, whereby the total costs incurred by the two interconnected operators supporting the traffic are divided by total demand; this formula then replaces the assignment of specific costs to each operator.

LRIC: Long-run incremental costs. Additional costs of providing a service over the long term.

Media Gateway: Converts voice and video between IP networks and switched telephone networks (STNs).

Mobile: As used in this report, the term refers to mobile cellular systems and to mobile phones.

MPLS: Multi-protocol label switching, mechanism for carrying data based on switching of “labels”. MPLS can be used to carry almost any type of traffic including voice or IPv4 or IPv6 packets and even Ethernet or ATM.

MSAN: Multi-service access node.

NGN: Next-generation network. A broad term for a certain kind of emerging computer network architectures and technologies. It generally describes networks that natively encompass data and voice (PSTN) communications, as well as (optionally) additional media such as video. See Recommendation ITU-T Y.2011.

NRA: National regulatory authority. The regulatory agency or official service at the central or federal government level that is charged with implementing and enforcing telecommunication/ICT rules and regulations.

NTU: Network terminal unit.

OPEX: Operational expenditures/Operating expenses.

Packet: Block or grouping of data that is treated as a single unit within a communication network.

PSTN: Public switched telephone network. The public telephone network that delivers fixed telephone service.

Quadruple Play: Package of fixed and mobile telephony, video, and broadband Internet services.

Ring-back tone: Personalized telephone ring tones.

Scorched node: method of network modelling that takes account of existing network nodes (transit and subscriber switches, and the transmission technology used).

SIP: Session initiation protocol – protocol for opening a session, used for establishing, maintaining and terminating calls from terminals in packet (softswitch) mode. Type of telephone exchange which uses software to carry out functions once carried out by an STM-1 (synchronous transport module level 1, for SDH reference transmission / optical fibre transmission networks). The other levels are: STM4, STM-16, STM-64 and STM-256 for terrestrial links.

Softswitch: A type of telephone switch that uses software running on a computer system to carry out the work that used to be carried out by hardware.

STM-1: Level-1 synchronous transport module, level 1 standard transmission format for SDH (synchronous digital hierarchy)/fibre optic transmission network. Other levels are STM-4, STM-16, STM-64 and STM 256 for terrestrial links.

STN: Switched telephone network.

TCP: Transmission control protocol. A transport layer protocol that offers connection-oriented, reliable stream services between two hosts. This is the primary transport protocol used by TCP/IP applications.

TCP/IP: Transmission control protocol/Internet protocol. The suite of protocols that defines the Internet and enables information to be transmitted from one network to another.

TDM: Time division multiplexing.

Triple play: A term referring to the bundling of fixed and/or mobile voice, video and broadband Internet access services.

TSLRIC: Total service long-run incremental costs.

ULL: Unbundled local loop. See LLU.

UMTS: Universal mobile telecommunication system, a third-generation mobile phone technology.

VDSL: Very high-speed digital subscriber line – a very high-speed digital (copper) subscriber line (Recommendation ITU-T G.993-2). VDSL-2 permits speeds of 100 Mbit/s (reception) and 50 Mbit/s (transmission).

VoIP: Voice over IP. A generic term used to describe the techniques used to carry voice traffic over IP (see also IP telephony and broadband telephony).

Wi-Fi: Wireless fidelity. A mark of interoperability among devices adhering to the 802.11b specification for wireless LANs from the Institute of Electrical and Electronics Engineers (IEEE). However, the term Wi-Fi is sometimes mistakenly used as a generic term for wireless LAN.

WiMAX: Worldwide interoperability for microwave access (IEEE 802.16m).

WLL: Wireless local loop. Typically, a phone network that relies on wireless technologies to provide the last kilometre connection between the telecommunication central office and the end user.

WTDC: ITU World Telecommunication Development Conference.

xDSL: DSL stands for digital subscriber line, and xDSL is the general representation for various types of digital subscriber line technology. ADSL: Asymmetric digital subscriber line. A technology that enables high-speed data services to be delivered over twisted pair copper cable, typically with a download speed in excess of 265 kbit/s, but with lower upload speed (see Recommendation ITU-T G.992.1). ADSL2: Asymmetric digital subscriber line 2 (Recommendations ITU-T G.992.3 and G.992.4). Extension of the initial ITU-T Recommendation, with higher data speeds, new power-saving elements and broader specifications. ADSL2+: Asymmetric digital subscriber line 2+ (Recommendation ITU-T G.992.5). Revised version of ADSL2 in which data speeds are increased using higher frequencies on copper lines.

x.G: Series 1G to 4G cellular telephony.

3G: Third-generation mobile network or service; generation of mobile systems designated IMT 2000 by ITU. The system allows faster communication services than 2G in particular for voice, fax, and Internet, from any place and at any time.

4G: Fourth-generation mobile network or service. Mobile broadband standard offering both mobility and very high bandwidth.

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