Final Report

ITU-D
Study Group 1

Question 4/1

Economic policies and methods of determining the costs of services related to national telecommunication/ ICT networks including next-generation networks

6th Study Period
2014-2017

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Question 4/1: Economic policies and methods of determining the costs of services related to national telecommunication/ICT networks, including next-generation networks

Final Report

Preface

ITU Telecommunication Development Sector (ITU-D) study groups provide a neutral contribution-driven platform where experts from governments, industry and academia gather to produce practical tools, useful guidelines and resources to address development issues. Through the work of the ITU-D study groups, ITU-D members study and analyse specific task-oriented telecommunication/ICT questions with an aim to accelerate progress on national development priorities.

Study groups provide an opportunity for all ITU-D members to share experiences, present ideas, exchange views and achieve consensus on appropriate strategies to address telecommunication/ICT priorities. ITU-D study groups are responsible for developing reports, guidelines and recommendations based on inputs or contributions received from the membership. Information, which is gathered through surveys, contributions and case studies, is made available for easy access by the membership using content-management and web-publication tools. Their work is linked to the various ITU-D programmes and initiatives to create synergies that benefit the membership in terms of resources and expertise. Collaboration with other groups and organizations conducting work on related topics is essential.

The topics for study by the ITU-D study groups are decided every four years at the World Telecommunication Development Conferences (WTDCs), which establish work programmes and guidelines for defining telecommunication/ICT development questions and priorities for the next four years.

The scope of work for **ITU-D Study Group 1** is to study "**Enabling environment for the development of telecommunications/ICTs**", and of **ITU-D Study Group 2** to study **"ICT applications, cybersecurity, emergency telecommunications and climate-change adaptation"**.

During the 2014-2017 study period **ITU-D Study Group 1** was led by the Chairman, Roxanne McElvane Webber (United States of America), and Vice-Chairmen representing the six regions: Regina Fleur Assoumou-Bessou (Côte d'Ivoire), Peter Ngwan Mbengie (Cameroon), Claymir Carozza Rodriguez (Venezuela), Victor Martinez (Paraguay), Wesam Al-Ramadeen (Jordan), Ahmed Abdel Aziz Gad (Egypt), Yasuhiko Kawasumi (Japan), Nguyen Quy Quyen (Viet Nam), Vadym Kaptur (Ukraine), Almaz Tilenbaev (Kyrgyz Republic), and Blanca Gonzalez (Spain).

Final report

This final report in response **to Question 4/1: "Economic policies and methods of determining the costs of services related to national telecommunication/ICT networks, including next-generation networks"** has been developed under the leadership of its Rapporteur: Amah Vinyo Capo (Togo); and ten appointed Vice-Rapporteurs: Mohamed Abdullah Suliman Al KharusI (Oman Telecommunications Regulatory Authority (TRA), Oman), Saad AlshammarI (Saudi Arabia), Gilbert Balekette (Central African Republic), Mamadou Pathé Barry (Guinea), Luc Y.A. Boko (Benin), Romain Ciza Mweze (D.R. of the Congo), Seyni Malan Faty (Senegal), Alexandre Ipou (Côte d'Ivoire), James Ngari Njeru (Kenya) and Denis Ricardo Villalobos Araya (Instituto Costarricense de Electricidad (ICE), Costa Rica). They have also been assisted by ITU-D focal points and the ITU-D Study Groups Secretariat.

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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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Executive Summary

i. Introduction

In recognition of the progress made during the previous study period on Question 12-3/1, the revised Question 4/1 takes into account the fact that, thanks to next-generation networks (NGNs), operators and service providers will have access to telecommunication/ICT networks, including broadband infrastructure networks and services, in a converged manner, in order to facilitate the delivery and use of multimedia services and electronic applications (e-Government, e-Education, eHealth, e-Banking and e-Commerce).

Operators are currently deploying such NGN networks, and this is likely to require changes to existing accounting tools including putting in place regulatory accounting mechanisms in order to continue to strengthen competition and enhance long-term benefits for end users. As access and core networks move to NGN, new accounting mechanisms and tools able to deal with these network structures may be required in the future. Given that there is only one platform for all services, the identification and distribution of common costs will be more challenging.

Furthermore, while NGNs enable an operator to share use of a single platform to offer a number of different services, the question of infrastructure sharing among operators remains relevant, since the advantages of sharing may have positive impacts on operator costs and on tariffs applied to consumers. In this regard, it is also relevant to consider the impact of a reduction in tariffs on consumption, revenues, investment and innovation.

Lastly, it was considered useful to analyse, as a specific cost participating in the structure of operators' costs, the question of costs of licences for network operation or telecommunication service provision, not in respect of the amounts involved but rather in terms of the methodological approach used to determine them in different countries.

Work on this Question has thus focused on the following areas:

1) New charging methods (or models, if applicable) for services provided over NGN networks.
2) Different models for infrastructure sharing, including through commercially negotiated terms.
3) Consumer price evolution and impact on ICT service usage, innovation, investment and operator revenues.
4) Methods of determining the cost of licences for the operation of networks and/or the provision of telecommunication services delivered to operators or service providers, including the costs of resources (e.g. frequencies and telephone numbering) made available to them in the country in a convergent environment.
5) Regulatory accounting in an NGN environment.

An expected outcome of the study of Question 4/1 is obviously a definition of good practices in each of the following areas:

a) Promoting appropriate infrastructure sharing.
b) Encouraging price/tariff reduction to consumers through competition.
c) Stimulating access to and use of these services.

ii. Background

Question 12-3/1 in the previous study period resulted in specific conclusions regarding subjects that come within its remit.

As regards the structure of NGN network costs, it was noted that this structure differs from that of traditional networks, both in relation to network elements specific to NGNs and because, in the case of NGN networks, common network costs are identified in addition to traditional cost structures.

This is because most countries consider that the different variants of the Long-run Incremental Costs (LRIC) model remain suitable for determining costs of different services including those provided by NGNs. Nevertheless there is no consensus as to the need for new cost and tariff models to be suitable for NGN services.

As regards investment plans, it was noted in the light of the experience of countries that have already migrated from traditional to NGN networks that there were four main approaches: i) public investment, ii) public-private partnership; iii) mutualization of private financing; and iv) private investment based on competition.

As regards telecommunications/ICT infrastructure sharing, several forms of passive infrastructure sharing were identified, including co-location, local loop unbundling, and mutualization of financing. Such forms of sharing are in some places required by regulation, to facilitate access to installations and guarantee competition. But the financial impact of infrastructure sharing, such as the implications of increased productivity for end users, were not shown. The discussion remains open on achieving a balance between regulating infrastructure sharing and providing incentives for investment while ensuring network coverage and competition.

iii. Objectives

The results of the study on revised Question 4/1 will be communicated in ITU-D reports and submitted to decision makers, regulators, service providers and national telecommunication operators, especially in developing countries, as well as ICT regulators' associations and regional or international organizations. The goal is to share good practices of countries that have implemented policies or had positive experience relevant to the subjects under study, by drawing up guidelines.

iv. Working methodology

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. The sections below present the different sources of information for work on this Question.

a) 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 2014, 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 to the questionnaire received during the current study period is indicated below.

Table 1: Number of countries replying to the questionnaire on tariff policies, by region (BDT classification)

Region	Year		
	2014	2015	2016*
Africa	30	31	22
Americas	24	26	22
Arab States	13	11	9
Asia and Pacific	23	20	13
Europe	30	30	35
CIS	6	7	6
Total	**126**	**125**	**107**

Source: ITU Tariff Policies Survey

* The number of responses for 2016 is provisional; the survey is open until March 2017.

b) Case studies by country with a view to better understanding impact surveys and quantitative aspects of topics under Question 4/1

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 with regard to the five questions to be considered under Question 4/1. Seven replies were received (from Guinea, Mozambique, New Zealand, Democratic Republic of the Congo, Sri Lanka, Tonga and Turkey). A Questionnaire was developed and sent to the NRAs in 2015 (**Annex 2**) and an analysis of the case studies is included in the content of this report.

The Rapporteur's Group also took into account all the contributions received during this study period for the purpose of drawing up the report (see **Annex 3**).[1]

c) 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 notes to ITU-T Study Group 3 on economic and tariff policy Questions (Series D Recommendations/international tariff setting), with a view to obtaining contributions on questions the study of which might be related to Question 4/1. In addition, 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 4/1 and asked them to provide, where possible, data on service tariff models. As regards the study of frequency operation fees, the Rapporteur's Group collaborated with the group working on Resolution 9 (Rev. Dubai, 2014).

[1] Contributions can be accessed at http://www.itu.int/en/ITU-D/Study-Groups/2014-2018/Pages/sg1-and-rgq-documents-by-question.aspx.

1 CHAPTER 1 – New methods of charging for services

1.1 Cost standards

1.1.1 Different cost types

As a reminder, a next generation network (NGN) is a packet-based network capable of providing telecommunication services to users and of making use of multiple broadband, QoS (Quality of Service)-enabled transport technologies, and in which service-related functions are independent from the underlying transport-related technologies. It enables users to have unfettered access to networks and to competing service providers and services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.[1]

NGN is characterized by the following basic features:

- Packet-based transfer;
- Separation of control functions among bearer capabilities, call/session, and application/service;
- Decoupling of service provision from transport, and provision of open interfaces;
- Support for a wide range of services, applications and mechanisms based on service building-blocks (including real time/streaming/non-real time and multimedia services);
- Broadband capabilities with end-to-end QoS and transparency;
- Interworking with legacy networks via open interfaces;
- Generalized mobility;
- Unfettered user access to different service providers;
- A variety of identification schemes that can be resolved to IP addresses for routing in IP networks;
- Unified service characteristics for the same service as perceived by the user;
- Converged services between fixed and mobile networks;
- Independence of service-related functions from underlying transport technologies;
- Support of multiple last-minute technologies;
- Compliance with all regulatory requirements, for example concerning emergency communications, security/privacy, etc.

One objective of national regulatory authorities is the creation of favourable condition for promoting and encouraging fair competition in the ICT sector. In pursuit of that goal, NRAs can use cost models to determine the cost of providing a given service. The cost models most widely used in the ICT sector are the long-run incremental cost (LRIC) model and the fully distributed costs (FDC) model.

Long-run incremental cost (LRIC) model

The LRIC model is a forward-looking model which considers future demand on the network. In addition, it can be constructed on the basis of a hypothetical efficient operator's network.

Two different approaches may be used to construct the cost model:

- The "top-down" approach.
- The "bottom-up" approach.

[1] *Recommendation ITU-T Y.2001 (12/2004) – General overview of NGN.*

The top-down approach is used to estimate costs of services using an LRIC model based on the existing network structure and operator's operating costs. It is thus based on the costs derived from the operator's accounting data, representing the purchase price of articles according to the fixed assets register. The bottom-down model, on the other hand, is used to calculate costs based on an LRIC model which replicates an existing operator's network but with an efficient network using modern and cost-effective technology designed to meet future demand. The bottom-up model is based on "current costs" which reflect the current market value of the network elements. A practical variant of this approach uses a "scorched node" approach based on the number and siting of existing nodes used by the operator, rather than a "scorched earth" approach based on a total reconfiguration of the network which takes no account of the addresses and numbers of existing nodes. Certain regulators have chosen to implement a "hybrid model" whereby both models are developed. This makes it possible to conciliate the results of the two models and offers a reality check.

The LRIC model has become the model of choice for determining wholesale service prices and in particular termination rates. Recently some NRAs have elected to use a different form of the LRIC method known as "Pure LRIC", which covers only marginal costs of providing a service, taking no account of common costs.

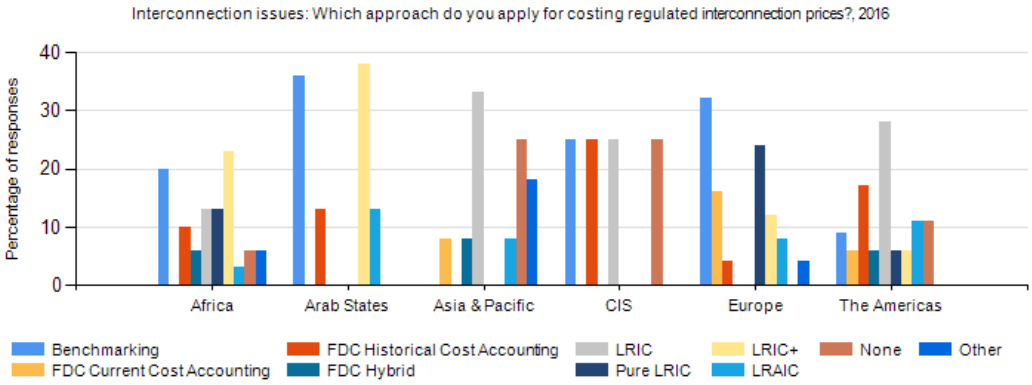
Another cost model is the FDC model, a top-down model based on the operator's existing network and associated accounting data. The FDC model is the preferred one for incumbent operators as it covers all costs incurred by operators in providing services including common costs, which is why the resulting cost estimates are higher than those obtained with the LRIC model. The FDC model has been popular in recent years owing to its simplicity in attributing costs incurred by the operator. Those costs include:

- Directly attributable costs: costs generated by and directly linked to the service.
- Shared costs: costs shared by more than one service (indirectly attributable costs) but which can be traced back and attributed to the services in question. The Activity Based Costing (ABC) model can be used to distribute shared costs among services.
- Common costs: costs not linked to specific services and which cannot be directly attributed to them. One example is a company's staff costs. As a result, they are normally attributed to services on a proportional basis.

1.1.2 New cost models (for wholesale regulated services)

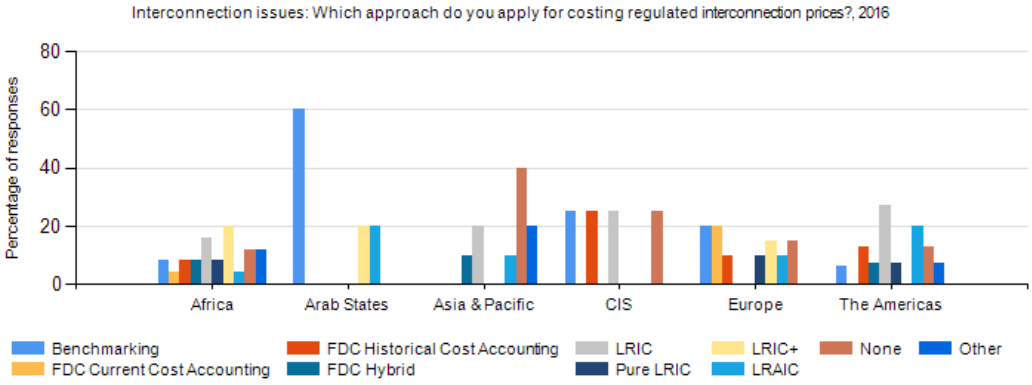
The results of the ITU survey on tariff policies in 2015 show that a number of countries are adopting cost models in order to determine costs of wholesale regulated services, and that the LRIC model is used increasingly to determine costs and tariffs for services in an NGN environment, even if benchmarking still occupies an important place in certain regions.

Figure 1: Fixed termination – Interconnection issues – Which approach do you use to regulate interconnection prices?



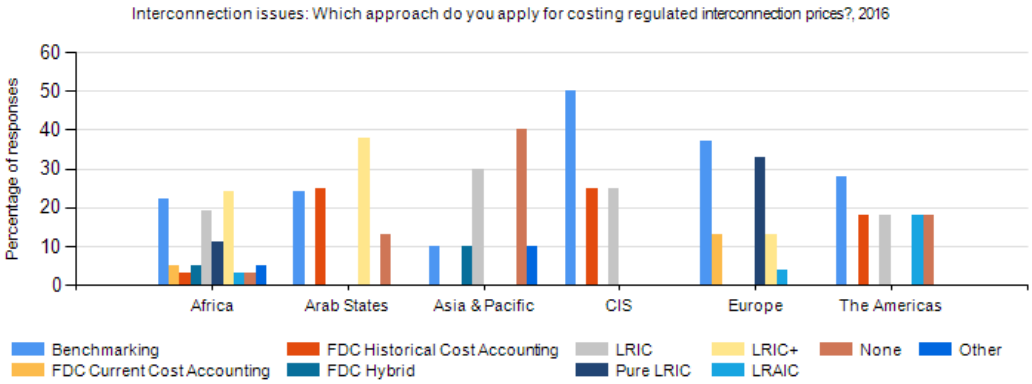
Source: ITU ICTEye – Tariff Policies Survey 2016

Figure 2: Fixed outbound traffic



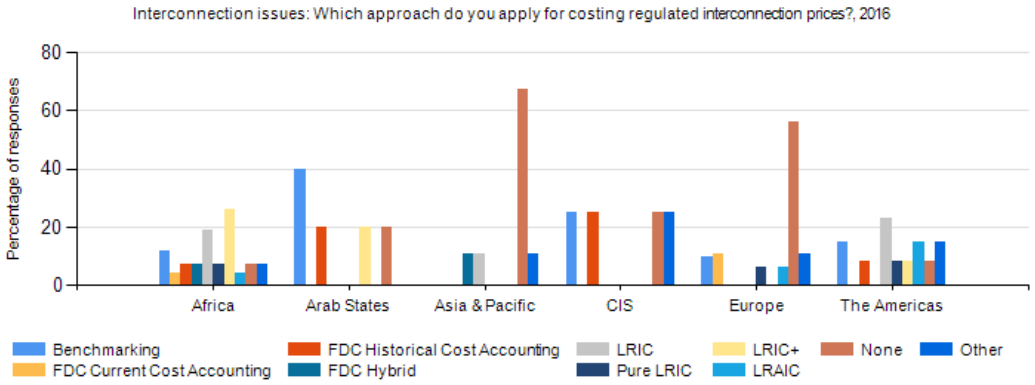
Source: ITU ICTEye – Tariff Policies Survey 2016

Figure 3: Mobile termination



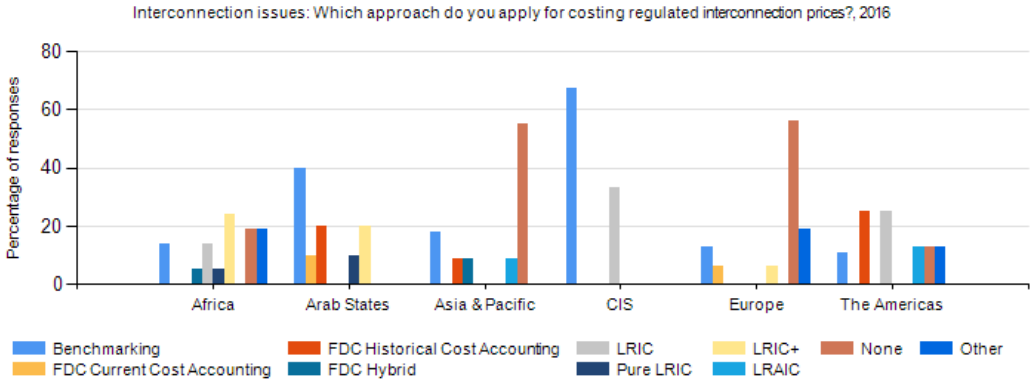
Source: ITU ICTEye – Tariff Policies Survey 2016

Figure 4: Outbound mobile traffic



Source: ITU ICTEye – Tariff Policies Survey 2016

Figure 5: National transit



Source: ITU ICTEye – Tariff Policies Survey 2016

Table 2: Cost methodology used by regulated wholesale services (interconnection) by region

		Africa	Arab States	Asia-Pacific	CIS	Europe	Americas	Total
Interconnection – which approach do you use to regulate interconnection prices?*	Benchmarking	6	3	0	1	8	2	**20**
	FDC Current Cost Accounting	0	0	1	0	4	1	**6**
	FDC Historical Cost Accounting	3	1	0	1	1	3	**9**
	FDC Hybrid	2	0	1	0	0	1	**4**
	LRIC	4	0	4	1	0	5	**14**
	Pure LRIC	4	0	0	0	6	1	**11**
	LRIC+	7	3	0	0	3	1	**14**
	LRAIC	1	1	1	0	2	2	**7**
	None	2	0	3	1	0	2	**8**
	Other	2	0	2	0	1	0	**5**

		Africa	Arab States	Asia-Pacific	CIS	Europe	Americas	Total
Réponses totales des pays		**31**	**8**	**12**	**4**	**25**	**18**	**98**
Region size		**44**	**21**	**40**	**12**	**43**	**35**	**195**
* This indicator allows one multiple-choice question by country/economy.								
Year: 2016 or most recent available data.								

Source: ITU ICTEye - Tariff Policies Survey 2016.

Regulatory authorities tend to regulate wholesale services because they are the key element that determines retail service prices, and also with the aim of preventing anti-competitive behaviour by dominant service providers, such as margin squeeze and predatory pricing. Wholesale service prices will also have an impact on the capacity of new entrants to use the existing network and generate revenue before deciding to invest in construction of their own networks. The LRIC and FDC models are the ones most widely used to determine prices of regulated wholesale services.

Results obtained from cost models can also provide useful information for *ex post* surveys on anti-competitive practices and remedies such as separate accounting and tariff approval.

1.1.3 The experience of certain countries

The case of the Body of European Regulators of Electronic Communications (BEREC)

The Body of European Regulators for Electronic Communications (BEREC) in June 2015 published an updated version of the fixed termination rated (FTR), mobile termination rate (MTR) and SMS benchmark. The report is based on the results of a request for information addressed to 36 NRAs in January 2015.

The report offers an overview of rates for fixed and mobile interconnection services in Europe and the cost model used in these countries.

Figures 6 and **7** below show that most of the 36 NRAs covered by the report have used a pure LRIC bottom-up cost model. As noted above, this type of cost model covers only the supplementary costs incurred by the operator in providing services, and does not include common costs. An LRIC model might be the best tool for regulators aiming to reduce fixed or mobile termination costs and costs of other wholesale services. Use of the pure LRIC model is expected to become widespread in different regions over the coming years.

Figure 6: Fixed cost models in Europe, January 2015

COST ACCOUNTING MODEL			
Country	Model	BU LRIC rate (Target rate) €cent	When BU LRIC rate applied
AT	Pure BU LRIC	0.135/0.085	01/11/2013
BE	TD		
BG	Pure BU LRIC	0.2556	01/01/2015
CH	BU LRAIC+		
CY	TD	0.632	
CZ	Pure BU LRIC	0.1086	Second half of May 2014
DE	BU LRAIC+		
DK	Pure BU LRIC		01/01/2013
EE	TD/ Benchmark		
EL	Pure BU LRIC	0.0545	01/01/2017
ES	Pure BU LRIC	0.0817	01/11/2014
FI	FDC		
FR	Pure BU LRIC	0.0790	01/01/2013
HR			
HU	Pure BU LRIC	0.1296	01/01/20147
IE	Pure BU LRIC	0.0009	01/07/2014
IS	Other		
IT	Pure BU LRIC	0.0430	01/07/2015
LI	TD		
LT	BU LRAIC		Potentially 01/07/2015
LU	Pure BU LRIC	0.1400	Begin of 2015
LV	Benchmark	0.1000	01/07/2014
ME	Other		
MK	TD LRIC		
MT	Pure BU LRIC	0.0443	01/07/2013
NL	BU LRAIC+	0.1080	
NO	BU LRAIC+		
PL	BU LRAIC+		
PT	Benchmark		
RO	Pure BU LRIC	0.1400	01/04/2014
RS	TD-FAC-HC		
SE	Pure BU LRIC	0.12/0.07	01/01/2014
SI	Pure BU LRIC		
SK	Pure BU LRIC		
TR	BU LRIC+		
UK	Pure BU LRIC	0.0444	01/01/2014

Source: BEREC report “Fixed and mobile termination rates in the EU”, June 2015.

Figure 7: Mobile cost models in Europe, January 2015

	COST ACCOUNTING MODEL		
	Model	**BU LRIC rate (Target rate) €cent**	**BU LRIC rate applied from**
AT	Pure BU LRIC	0.8040	01/11/2013
BE	Pure BU LRIC	1.0800	01/01/2013
BG	Pure BU LRIC	0.9715	01/01/2015
CH	Commercial negotiations		
CY	Benchmark or TD	0.632	
CZ	Pure BU LRIC	0.9772	01/07/2013
DE	BU LRAIC+		01/01/2013
DK	Pure BU LRIC		01/01/2013
EE	Benchmark		
EL	Pure BU LRIC	1.1030	01/01/2015
ES	Pure BU LRIC	1.0900	01/07/2013
FI	FDC		
FR	Pure BU LRIC	0.7800	01/01/2013 and 01/07/13
HR	Pure BU LRIC	0.8129	01/01/2015
HU	Pure BU LRIC	0.5542	01/04/2015
IE	Other		
IS	Benchmark		
IT	Pure BU LRIC	0.9800	01/07/2013
LI	Benchmark		
LT	Benchmark		
LU	Pure BU LRIC	0.9700	2015
LV	Benchmark	0.10500	01/07/2014
ME	HCA FDC	1.9000	
MK	BU LRAIC+	1.4634	01/09/2014
MT	Pure BU LRIC	0.4045	01/04/2014
NL	BU LRAIC+	1.0190	
NO	BU LRAIC+	0.9179	01/07/2015
PL	Pure BU LRIC	1.0187	01/07/2013
PT	Pure BU LRIC	1.2200	31/12/2012
RO	Pure BU LRIC	0.9600	01/04/2014
RS	Benchmark		
SE	Pure BU LRIC	0.0000	01/07/2013
SI	Pure BU LRIC	1.1400	01/09/2014
SK	Pure BU LRIC	1.2260	01/08/2014
TR	BU LRAIC+		
UK	Pure BU LRIC	1.8708	01/04/2014

Source: BEREC report "Fixed and mobile termination rates in the EU", June 2015.

The case of Anatel Brazil[2]

ANATEL (Brazil) has developed several cost models each of which is based on a distinct method. The top-down approach is based on allocation of current or historic costs declared by enterprises present in the market, thereby highlighting both actual costs and inefficiencies. The bottom-up approach assumes that costs are based on the operation of a modelled network designed – in terms of topology and infrastructure – so as to respond effectively to the expected demand for traffic.

[2] Document 1/33, "Cost model in Brazil", Federative Republic of Brazil.

For both models (bottom up and top down) ANATEL adopted the long-run marginal cost (LRIC) method taking account of a sufficiently long period to allow fixed costs to be regarded as variable costs.

The following premises were adopted for the bottom-up model:

- Modelling of a hypothetical efficient service provider assuming typical network characteristics through time, like scale and technology evolution (e.g.: along mobile service generations as 2G and 3G; and fixed services as TDM and NGN).
- Network development driven by regulatory obligations, such as minimal coverage requirements as defined in spectrum auctions, and regulatory quality standards.
- Traffic profile estimated over the market average.
- Network modelled for the interval between 1995 and 2064.
- "Economic Depreciation" as the fashion of network's assets depreciation.
- "Scorched Node" methodology: although strongly based on a real topology, the modelled network can adopt more efficient choices in its design.

As regards tariff regulation, ANATEL will propose, on the basis of the values obtained with the top-down model, a progressive reduction in termination tariffs based on the results obtained in the bottom-up model. This method should be applied to companies occupying a dominant market position.

The case of the A.S. Popov National Academy of Telecommunications of Odessa (Ukraine)[3]

The A.S. Popov National Academy of Telecommunications of Odessa (Ukraine) proposes a method based on the development and use of a reference model of a service provision and a simulation model for determining operating costs.

The reference model is constructed in such a way as to take account of network elements involved in service provision. To that end, the process of telecommunication traffic flow between different network elements is modelled using the most suitable itinerary. Development of this model enables us to exclude elements of the operator's network which, for various reasons, are not necessary for the range and volume of services that are envisaged during the proposed period of validity of the tariffs.

The model is developed and applied to two components: the transport network and service provision.

The final result of the modelling at the stage of developing the reference model is identification of the base network elements (cost factors) that contribute to service provision, and determination of the numerical equivalent of consumption for each of those elements in the transport and service provision components.

The development of the simulation model enables us to determine the current value costs (operating costs) that are unavoidable in ensuring uninterrupted operation of all network infrastructure elements that ensure the operation of a given subsystem. To that end, operation of a hypothetical subsystem of analogue scale is modelled using input data for the current state of the market and legislation in force, and taking account of the specific operational aspects of the operator's subsystem. Modelling at this stage enables us to determine the costs that can be attributed to a single element of the base network (cost element).

The tariff for the service in question is determined on the basis of the numeric equivalent of consumption of each element in relation to each service, and the cost of each element obtained by modelling.

[3] Document 1/147, "Practical aspects of applying a method of determining tariffs for telecommunication services based on cost modelling", Odessa National Academy of Telecommunications n.a. A.S. Popov (Ukraine).

1.1.4 NGN costing models (inputs and outputs)

NGNs are based on the IP protocol and provide a single platform for different services (fixed, mobile and data). Network costs are thus categorized as fixed costs, rather than variable costs.

The cost model applied to an NGN is different from that of a traditional network, although most of the inputs in a traditional cost model will still be used, with some modifications. The usual cost model inputs are:

- Network elements: topology (nodes, trunks and links) needed to allow provision of service, and traffic flow data;
- Weighted average cost of capital (WACC): average return which a company would pay to its shareholders and lenders for their investment in the company. The WACC formula depends on a number of factors including the company's level of debt (capital structure represented by the respective percentages of own capital and debt in the company), the market premium and "beta version".

Given the wide dispersion of national indebtedness, some regulators such as Brazil's ANTEL, have chosen to set a limit (30 per cent in Brazil) on the level of debt, based on the average level of debt adopted by investment banks and regulators around the world and the average for global companies. Similarly, ANTEL has found that its previous WACC methodology, based on an adjusted Global Capital Asset Pricing Model (CAPM), presented some structural problems due to the global financial crisis, and decided to review its methodology in favour of one based on a local CAPM and other approaches in order to better reflect the specificities of the local market.

- **Licence charges**: the price paid for the license needed to operate in the ICT sector. Since licences are generally valid for several years, that portion of the license fee that pertains to the time frame of the cost model should be used.
- **Operating costs**: the total cost of operational activities entailed in providing services and maintaining the network. That cost should be lower for NGNs than for existing networks because only one platform is required to provide all services on an NGN, unlike existing networks in which a different platform is used for each service (fixed, mobile, data).

1.1.5 What's next?

The calculation methods applied to wholesale services in the ICT sector have evolved in recent years as a result of the strong competition in the ICT sector and dynamic promotion of network technology.

As a result of this, it is predicted that fixed and mobile termination tariffs will continue to fall as a result of the growing popularity of the pure LRIC model compared to traditional LRIC cost methods. Consequently call termination will tends towards "Bill and Keep". Furthermore, it is predicted that fixed and mobile interconnection tariffs will ultimately be deregulated owing to the significant reduction in the cost of services once migration to NGN IP is complete.

1.2 New charging methods on NGNs

It is recalled that the matter of new charging methods was taken up under Q12-3/1 during the previous study period. It was noted that the charging initially used in the PSTN had evolved significantly in 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.

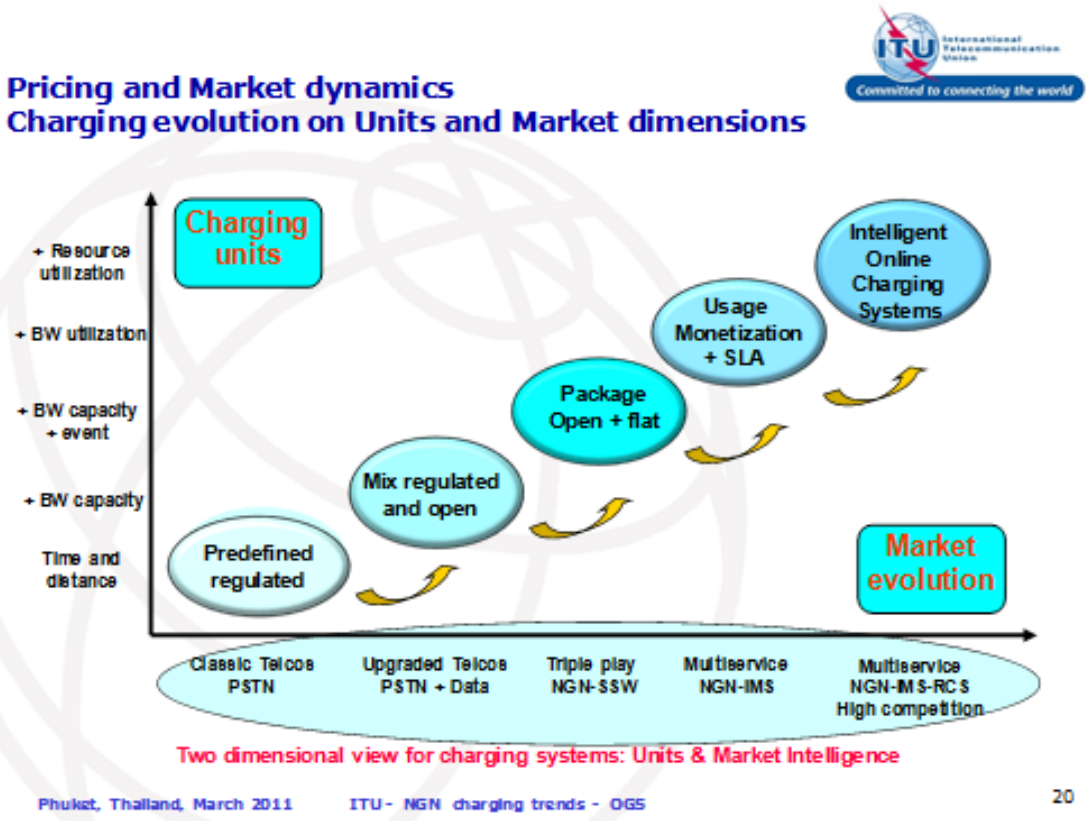
Several units are used to evaluate traffic utilization and determine costs for charging. These include:

– 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 8: Pricing and market dynamics – Charging evolution on units and market dimensions



Smart charging and service 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.

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

- Online charging systems (real-time discounts or offers, currency-based spend controls, balance sharing policies);
- Subscriber policy and charging systems (clear view of all usage costs; application of 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, and with reference to Recommendation ITU-T D.271 on charging and accounting principles for NGN, the new methods used for charging on NGNs consist in migrating from time-based charging towards multi-parameter-based charging considering IP traffic characterization.

The new charging methods are also addressed in the report of Q6/1.

The discussion is now starting to focus on the challenges that the new charging methods entail for both regulators and consumers. The question is whether, for example, those methods, in particular open bundled offers + flat rates, result in respect for the principles of correctness and fairness, inasmuch as not all tariff arrangements are as yet based on smart online charging systems which take into account the specific needs of each customer. Charging on the basis of bundled offers + flat rates appears to be widespread, but the question is: “Does the consumer really need all the services contained in the bundled offer for which he/she is paying a flat rate, and is he/she in fact able to consume all those services?”

This question calls for further examination in order to avoid new forms of cross-subsidization between consumers.

2 CHAPTER 2 – Different models for sharing infrastructure

2.1 The different types of infrastructure sharing and network access

2.1.1 Background

In most countries, infrastructure sharing is explicitly provided for in the basic texts for the new telecommunications regulatory environment. Nevertheless, the culture of infrastructure sharing is not itself widespread in all countries. It comes as no surprise to find two or three antenna masts within a radius of 500 metres, all belonging to different telecommunication or TV operators. There is thus a duplication of long-term investment which could be better used elsewhere to bring down the prices charged to consumers.

In response to public concerns at the proliferation of radio facilities, and in the light of existing regulations in areas including the environment, health, urban planning and the aesthetic qualities of the sites concerned, a number of countries have drafted regulations on infrastructure sharing.

In principle, infrastructures amenable to sharing are those that can be shared without detriment to competition in the market. The abundant literature in this area generally takes the view that infrastructure sharing should concern primarily passive network hardware. The associated investment is generally of a long-term nature, and requires a long period (10 to 20 years) to realize a return. As for the active hardware (switching, BTS, routers and the like) which form the core of the operator's activity, it is generally agreed that these should remain under the control of the operators. The profitability of this equipment is more immediate (three to five years) and real competitive differentiation is possible.

2.1.1.1 Active infrastructure

Active infrastructure sharing involves sharing the active electronic network elements: (i) the intelligence in the network embodied in base stations and other equipment for mobile networks; (ii) access node switches; and (iii) management systems for fibre-optic networks.

In the case of mobile operators, active infrastructure sharing concerns mainly the active elements in their microwave networks. This means antennas, antenna systems, and transmission systems. In practical terms operators can share these elements and continue to use the different parts of the radio frequency spectrum assigned to them.

Nevertheless, sharing active infrastructure is more prone to disputes, as it goes to the heart of the value-producing elements of a business.

Some countries, like the Democratic Republic of the Congo (DRC),[4] adopt the precautionary approach whereby active infrastructure sharing is introduced gradually, taking account of the relative immaturity of the market. Assessments of the growth in demand for ICT services and evaluations of the experience of using infrastructure sharing arrangement must also be used to provide guidance criteria.

2.1.1.2 Passive infrastructure

This involves operators sharing the non-electrical, civil engineering elements of telecommunication networks. These may include (i) rights of way or easements, (ii) ducts, (iii) pylons, (iv) masts, (v) trenches, (vi) towers and poles, (vii) equipment rooms and associated power supplies, air conditioning, and security systems.

In the case of mobile infrastructure sharing, the passive elements are defined as the physical network components that are not necessarily owned or managed by every operator. The passive infrastructure

[4] According to the case studies collected by country.

in a mobile network is composed mainly of: electrical or fibre-optic cables, masts and pylons, plots of land, towers, roof tops and other premises, shelter and support cabinets, electrical power supply, air conditioning, alarm systems, and so on.

The regulator will need to (i) recommend the deployment of an open architecture, as opposed to an integrated vertical architecture; (ii) have a geographical information system (GIS) to determine the location and ownership of equipment to be shared; (iii) define certain infrastructure elements as essential; (iv) where appropriate, enforce operational separation of the body responsible for commercializing any sharing arrangements.

In the case of some countries, such as DRC and Côte d'Ivoire, regulation provides for infrastructure sharing between operators in the sector, but also the possibility for a non-operator to make infrastructure available to operators, as is the case with TowerCo. Nevertheless the particular operating regime which these new stakeholders are required to follow has yet to be made clear in most of the regulations.

2.1.1.3 National mobile roaming

National mobile roaming enables subscribers to a home network, when in an area away from home, to access services through another host network in the current area.

In the case of national mobile roaming, operators do not share infrastructure but simply ensure continuity of service where it is not possible for every operator to cover the territory in question in its entirety.

In a number of cases, regulation requires operators to provide national mobile roaming facilities mainly in order to host newcomers, or in areas concerned by the universal service.

2.1.1.4 Unbundling

Unbundling concerns mainly the local loop, which is that part of a telecommunication network between the end subscriber's telephone socket and the local exchange to which the subscriber is connected. The concept of local loop has evolved, especially in the context of unbundling of fibre-optic links.

2.1.1.5 Infrastructure sharing agreements

The infrastructure to be shared between operators is specified in a written contract setting out the specific arrangements and conditions. The regulatory authority recognizes the right of other infrastructure owners to make their infrastructure available to operators. The regulator will, however, require this to be done within the constraints of an existing standard offer, developed by each infrastructure owner. The infrastructure provider must be officially authorized to negotiate with the operators. In the interests of greater transparency, the standard offer must contain sufficient relevant information to enable those seeking sharing arrangements to negotiate fair terms on an informed basis.

In general terms the regulator:

- May assume overall responsibility for designing and updating the public geographical information system (GIS) which is to be open for consultation and used to determine the location and ownership of shared equipment and thus facilitate the process of sharing;
- Must ensure that infrastructure owners, especially private owners, are assured of a reasonable return on investment;
- Must, in collaboration with all stakeholders, draw up clear, transparent and objective rules and procedures for infrastructure sharing. These rules must reduce the risk of operators owning

certain infrastructures, in particular those defined as essential, deriving benefits from them to the detriment of competitors in the service market.

For example, in the specific case of the Democratic Republic of the Congo, the regulatory framework has entrusted the regulator with responsibility for (i) defining rules, principles and procedures for negotiating arrangements for sharing sites and infrastructure among operators; (ii) monitoring compliance of contracts concluded between operators; and (iii) receiving declarations from operators and infrastructure providers.

2.2 Incentives to encourage the sector to practise infrastructure sharing

2.2.1 National initiatives

Infrastructure sharing is provide for by regulation in most countries. Different approaches are adopted, depending on the case: either *recommending* sharing arrangements or *requiring* it. A number of initiatives have been adopted in some countries such as Brazil, where the three regulatory agencies in the telecommunication, electricity and hydrocarbon sectors decided in 1999 to draw up common regulations on infrastructure sharing. For these regulators, the facilities subject to obligatory sharing arrangements include rights of passage over private property, towers and ducting, and coaxial or fibre-optic cables installed in cables.

In Africa, in countries such as Cameroon, the same approach has led telecommunication, TV, electricity and railway operators, under the direction of the telecommunication regulator, to conclude a framework agreement on infrastructure sharing. The Nigeria Communications Commission (NCC) has also drawn up guidelines on co-siting and sharing of infrastructure.

2.2.2 Regional initiatives

At the regional and subregional levels, initiatives have been adopted, such as the ITU/EC project for the West African ICT Common Market which resulted in 2005 in a report containing a set of guidelines which were adopted by WATRA (the West Africa Telecommunications Regulators' Association) at its third ordinary general meeting in Accra in September 2005. The eighth Forum on Telecommunications/ICT Regulation in Africa (FTRA-2007), held in Nairobi on 6 and 7 June 2007, highlighted the example of the Optical Power Ground Wire (OPGW), implemented jointly by the incumbent operators of Mali, Mauritania and Senegal in partnership with the Société de Gestion de l'Énergie de Manantali (SOGEM), as a good example of sharing.

Regulators participating in the Global Symposium for Regulators (GSR) in 2008 proposed guidelines on good practices relating to infrastructure sharing[5] and free access strategies intended to promote economically affordable access to broadband.

2.3 The benefits of infrastructure sharing

Infrastructure sharing brings with it a number of benefits, described in the previous final report on Question 12-3/1.[6] These benefits include:

Economic benefits:

- No wasteful duplication of hardware;
- Economies of scale;
- Reduced investment costs for operators and expected lower prices paid by consumers;

[5] https://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR09/consultation_contributions/GSR09_BestPractice_F.pdf.
[6] http://www.itu.int/pub/D-STG-SG01.12.3-2014.

– Easier access to costly resources for new or "small operators";
– Lower barriers to free competition

Social benefits:

– Reduced public health risks (linked to radio emissions);
– Preservation of open spaces.

Benefits in terms of competition:

– Fewer interconnection disputes between operators because they are forced to cooperate;
– Access to scarce resources for new or small operators;
– Lower barriers to competition;
– Improved offers of services.

Environmental benefits:

– Reduction in nuisance factors associated with civil engineering work (noise, degradation of public roads, obstacles to road traffic, accidents, etc.);
– Fewer health risks associated with the many different radio emissions;
– Fewer risks of damage caused by falling masts and towers;
– Preservation of open spaces.

This report, in accordance with the mandate of Question 4/1, sets out to assess the impact of infrastructure sharing, and provides figures in particular on the costs of investment, tariffs and competition, in the light of countries' experience.

2.4 Impact on investment costs, prices for telecommunication/ICT services and competition in the telecommunication/ICT market

The experience of the Russian Federation in telecommunication infrastructure sharing[7]

As a general rule, until 2008, Russian mobile operators built their networks individually and located towers and base stations at the same sites.

In 2009, the period of aggressive growth in the telecommunication market came to an end, growth in revenues slowed down, and under these circumstances cost optimization became the most logical strategy for the "Big Three" operators (Beeline, Megafon, and MTS). Forming alliances for deployment and operation of shared communications equipment has become a general trend.

Mobile operators need to seek ways of enhancing efficiency of investment in the development of networks (3G, 4G). Infrastructure sharing as a business model is an effective tool for reducing the cost of investment (CAPEX) and operating costs (OPEX), as network development costs and the time required for this are considerably reduced.

Shared construction of antennas, network facilities and fibre-optic ducts can save up to 40 per cent of CAPEX if only two enterprises participate, and more can be save with more participants. For example, in 2010 Megafon saved more than 890 million roubles (about USD 13 million) on total investment of 67.24 billion roubles (about USD 985 million), and in 2011 cost savings already exceeded 2 billion roubles (about USD 29 million).

[7] Document 1/214, "Experience of the Russian Federation in the sharing of telecommunication infrastructure", Russian Federation.

In the Russian Federation the following classification of infrastructure sharing is used:

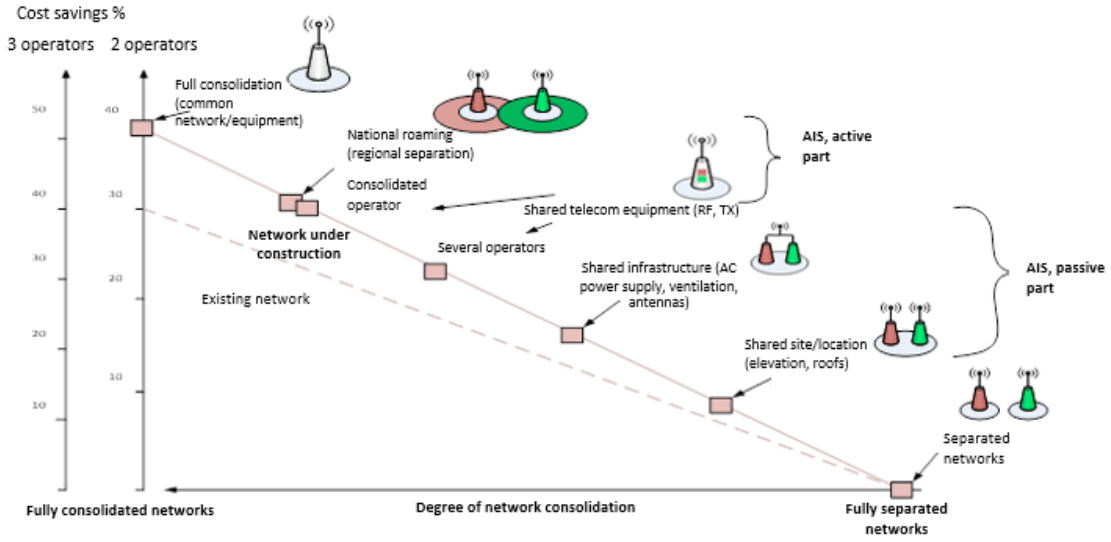
– Passive infrastructure sharing (PIS) including non-discriminatory access to telecommunications infrastructure;

– Active infrastructure sharing (AIS).

The possibility of pooling infrastructure entails a reduction in costs for the deployment and operation of networks, and improves the quality of service and availability of communications.

Figure 9 shows the cost savings in relation to the number of collaborating operators and the particular sharing option selected.

Figure 9: Cost savings in relation to the number of operators



Source: Contribution of the Russian Federation, September 2015

1) Experience of passive infrastructure sharing

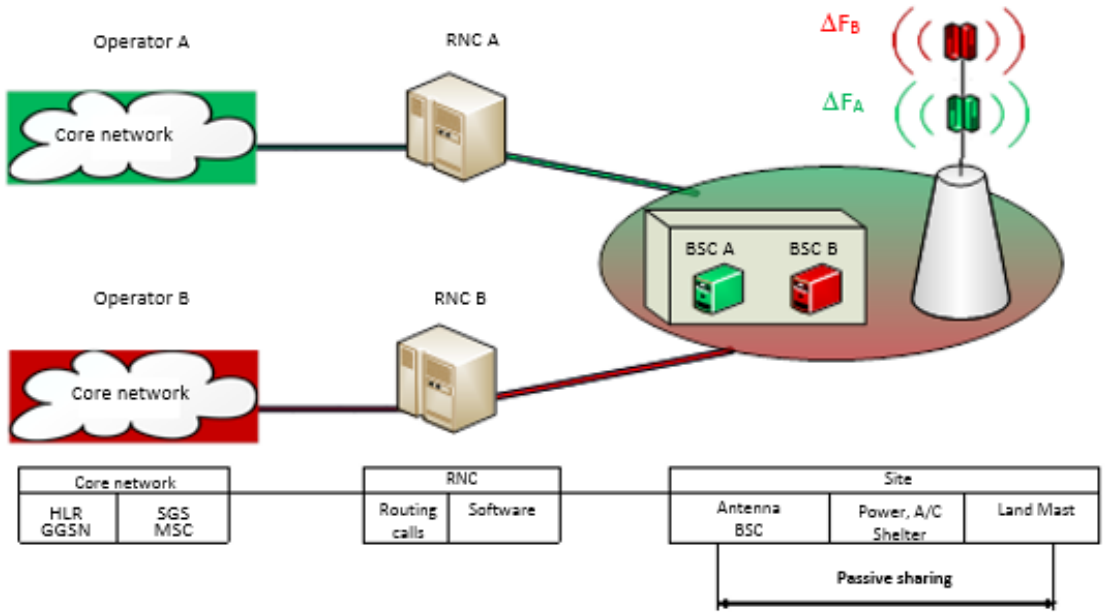
This means sharing of the passive network infrastructure elements (masts, containers, towers, electrical power supplies, air conditioning), referred to as Passive Infrastructure Sharing (PIS).

The project to create a cellular network along the "Amur", the federal motorway linking Chita and Khabarovsk (more than 2 100 km), was the first major alliance involving the "Big Three" in 2011. In order to ensure 100 per cent coverage along the motorway 102 base stations were built. Total investment in the project was around 4 billion roubles (around USD 58.6 million), including the costs of electrical power networks, construction of access roads, and so on. The operators invested around 2 billion roubles, and the government provided the remaining 2 billion.

Apart from constructing new sites and links, allowing access to network infrastructure for all telecommunication operators is also an important factor in achieving improvements and greater efficiency in applying the passive infrastructure sharing model.

In 2013, the "Big Three" spend a total of around 40 billion roubles for infrastructure leasing, about ten per cent of total operating costs. Those costs could be minimized by providing information, developing and updating a register on the possible use of infrastructure to host telecommunication networks, and adopting a unified methodology to calculate prices for access to that infrastructure.

Figure 10: Typical PIS model



Source: Contribution of the Russian Federation, September 2015

Over five to seven years, average annual saving of 10 to 30 per cent of CAPEX and OPEX can be achieved.

2) Experience of active infrastructure sharing (AIS)

This involves sharing of access network elements (RAN) (antennas, BTS and RNC).

Active infrastructure sharing was authorized by the Russian Government Decree of 27 November 2014. Changes in the rules for registration of radio systems and HF devices currently allow registration of a radio system or HF device in the names of two or more operators. All restrictions regarding sharing of radio access networks in the territory of the Russian Federation have thus been lifted. Regulations on sharing of RAN communication equipment, for all UMTS basic mobile standards, were established in 2012, and in 2014 for GSM 900/1800 and LTE.

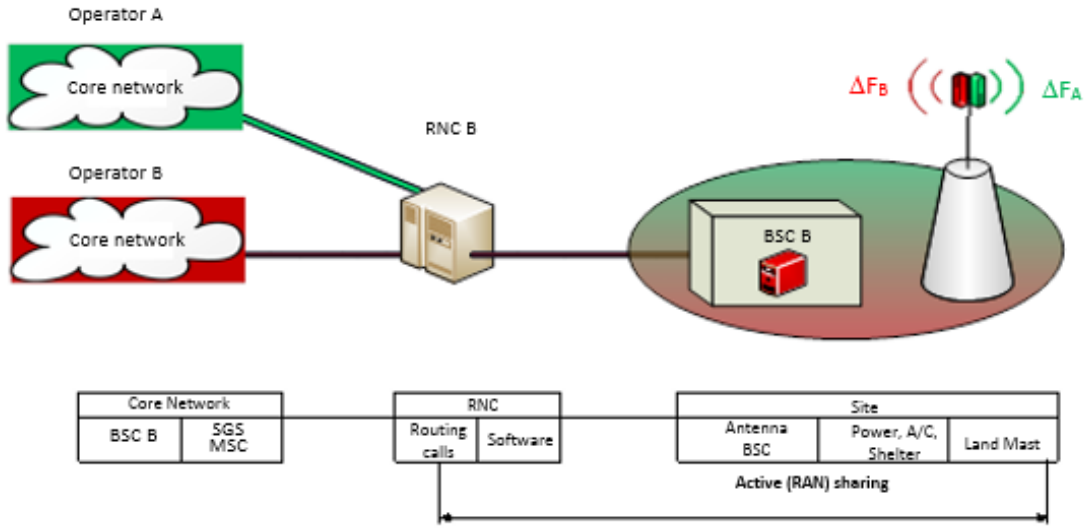
Using infrastructure according to the active sharing model, savings for CAPEX and OPEX may be up to around 50 per cent. If a base station is used by several operators, each operator pays for using spectrum allocated in accordance with the authorization.

In December 2014, VimpelCom (a Beeline trademark) and MTS signed an agreement on joint construction of LTE networks in 36 Russian regions. It is assumed that MTS will construct networks in 19 regions and VimpelCom in another 17. As a result, in all these regions, the operators will provide one another with base stations, sites, infrastructures and backhaul resources.

In these 36 regions of the Russian Federation (with a total population of around 50 million), each operator would have constructed about 10 000 base stations. Since an LTE base station costs around USD 10 000, each operator will have saved USD 100 million in CAPEX thanks to sharing of active radio access networks.

Furthermore, since the end of 2011, Megafon has launched the LTE network with Skartel (a Yota trademark) which was subsequently bought by Megafon. As the regulations have not been finalized, they have collaborated on the basis of a "virtual operator" model whereby Megafon operates Skartel frequencies.

Figure 11: Typical AIS model



Source: Contribution of the Russian Federation, September 2015

Thus telecommunication operators have had an opportunity to create LTE networks in places that would not have been attractive in the case of construction by one operator alone, and can ensure excellent coverage thanks to better choice of base station sites. That means that in two years, millions of people in different regions in Russia will be assessing the advantages of high-speed mobile Internet access.

Russia's experience shows that passive or active infrastructure sharing can result in savings for operators of the order of 10 per cent of the costs of investment and operation, while also reducing delays in coverage and ensuing competition.

Experience of the Sultanate of Oman: Public financing for broadband development[8]

The Government of the Sultanate of Oman has taken account of the way in which the country can develop its infrastructure and offer cutting-edge Internet services. It has accordingly adopted a national broadband strategy with three main goals: improving the country's broadband service to make it profitable and competitive, encourage use of broadband in the Sultanate, and develop broadband infrastructure in the long term with public funding. With those goals in mind, the Government, though Council of Ministers Resolution of 3 April 2012, created the Oman Broadband Company (OBC) with a view to implementing a public investment plan to the tune of USD 275 million in order to construct and manage the Muscat FTTH network. The aim of creating the OBC was to make good certain deficiencies and to exploit the best possible conditions of a single fibre-optic network to serve current and future operators in Oman without competing with them. OBC will work on extending the fibre-optic networks to the major cities with large populations outside the Governorate of Muscat for houses and commercial premises. This could considerably reduce the capital costs of network deployment for current and future telecommunication providers.

[8] Document 1/78, "The Government of Oman, incentives for broadband network development", Sultanate of Oman.

2.5 Guidelines on infrastructure sharing

The Rapporteur Group strongly recommends that the guidelines[9] already proposed at the level of subregional regulatory authorities and international forums should be implemented in order to take full advantage of the benefits of infrastructure sharing. Governments and regulators must be more involved in guiding operators, whether through regulation or public investment, encouraging infrastructure sharing to optimize costs and accelerate network deployment, above all with regard to broadband.

[9] GSR-ITU 2008: Best Practice Guidelines on Innovative Infrastructure Sharing Strategies To Promote Affordable Access For All, in https://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR08/consultation.html. FRATEL-UIT 2009: Le partage d'infrastructures: Les meilleures pratiques: http://www.fratel.org/wp-content/uploads/2011/12/2009-rapport_activite.pdf. FTRA 2007: Infrastructure sharing in Africa: Regulatory challenges and mechanisms, Eighth Forum on Telecommunication Regulation in Africa, Nairobi, Kenya, 6-7 June 2007.

3 CHAPTER 3 – Consumer price evolution and the impact on telecommunication/ICT services

3.1 Background

Whatever the form of tariff regulation adopted, we must not lose sight of the crucial role of competition in promoting diversity of services and lowering prices. The experience of some countries such as France,[10] described in the previous report for Question 12-3/1, 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 year 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 surveys,[11] the number of fixed Internet subscriptions grew 17 fold between 1998 and 2010 (an average annual growth of 26.5 per cent) while the number of mobile telephone subscriptions grew six fold over the same period (an average annual growth rate of 15.8 per cent).

Since 1998 telecommunication operators' 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 on average).

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.

In accordance with the mandate of Question 4/1, this chapter focuses on the experience of other countries as regards the evolution of tariffs and its impact on investment, consumption, operator revenues and innovation, in order to encourage governments and regulators to continue their efforts to reduce tariffs for electronic communication services by boosting competition or through other regulatory means.

3.2 Trends in prices of telecommunication/ICT services

The cost and accessibility of ICT services remain key factors in their adoption. High tariff levels remain a major obstacle to the use of ICTs, in particular in the case of broadband.

At the global level, available data between 2008 and 2014 confirm that prices followed a downward trend, in terms of USD and purchasing power parity ($ PPP) but also in terms of Gross National Income per capita (GNI p.c.). ICT consumption as measured by the number of subscriptions for different services is also growing.

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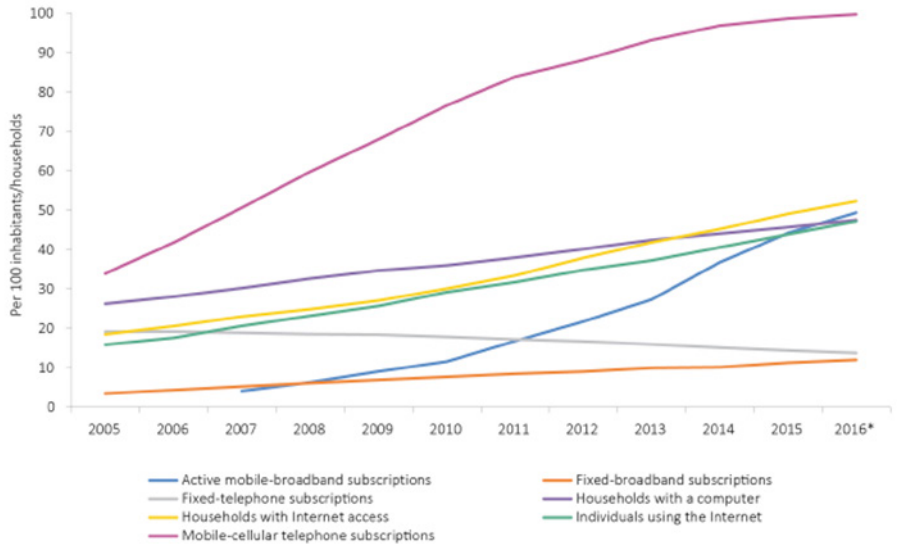
10 See the study on telecommunication price trends in France from 1998 to 2011, published 1 February 2012 by the Bureau de la veille économique et des prix (Bureau-1B@dgccrf.finances.gouv.fr) under the Subdirectorate for communication, programming and economic monitoring.

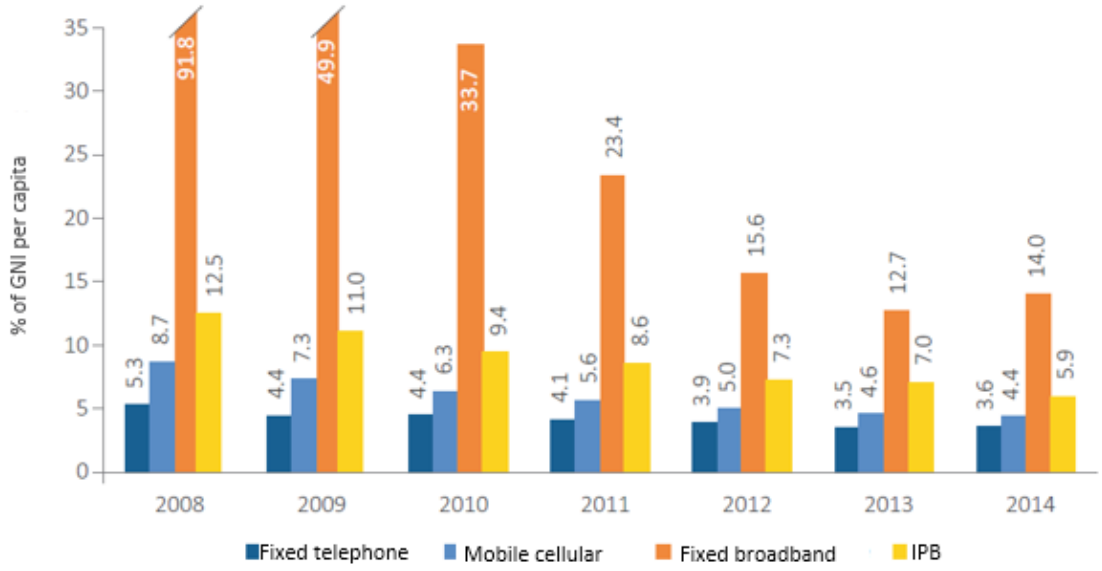
11 http://www.arcep.fr/.

Figure 12: Global changes in major ICTs, 2000-2016*



Note: *estimates.
Source: ITU MISR 2016.

Figure 13: The IPB and sub-baskets, worldwide, 2008-2014



Note: Simple averages. Based on 140 economies for which price data on the three services were available for 2008-2014.
Source: ITU MISR 2016.

3.2.1 Prices of cellular mobile services

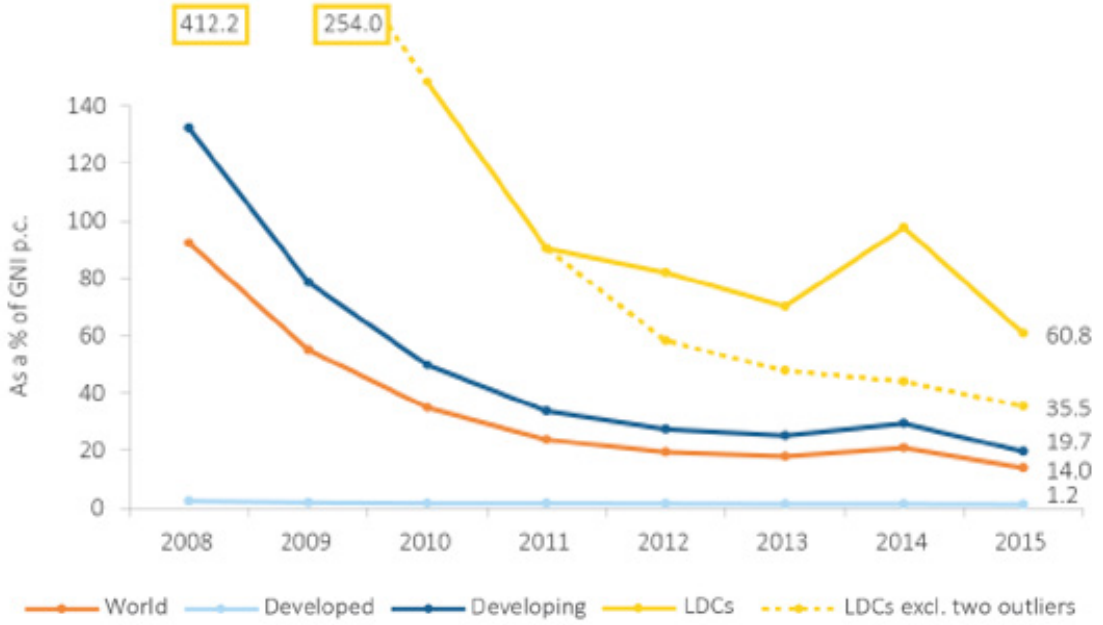
Cellular mobile prices continues to fall while penetration and coverage reach record levels (7.3 million cellular mobile subscribers and 95 per cent coverage of the world's population by a mobile signal).

3.2.2 Fixed broadband service prices

Having fallen everywhere in the world until 2013, fixed broadband prices rose between 2013 and 2014. Broadband prices remain prohibitive in many developing countries especially the least developed,

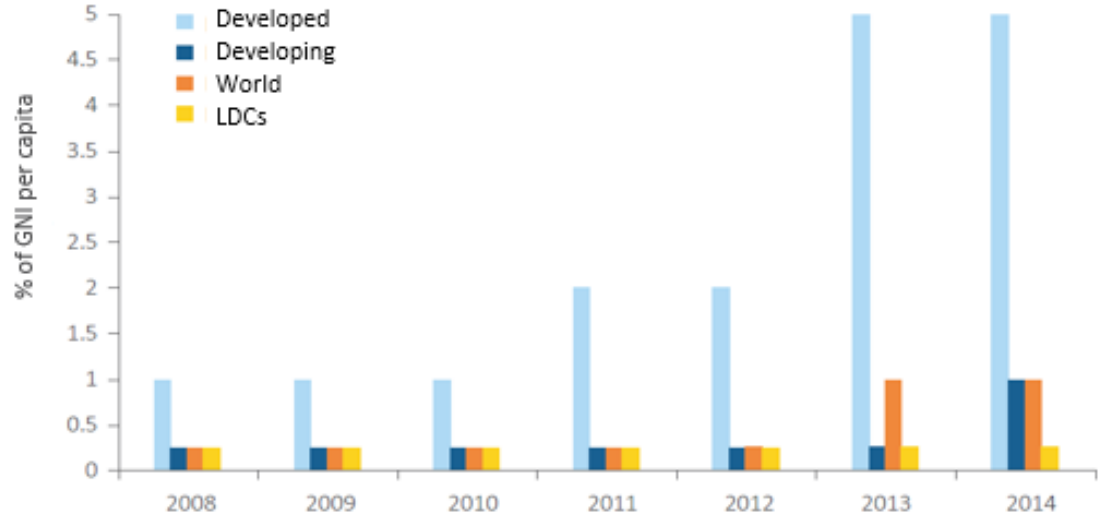
small Island developing States. Nevertheless, if fixed broadband prices rose in 2014, entry-level offers in some countries are applied to higher data speeds or volumes for the same price.

Figure 14: Fixed-broadband basket: as a percentage of GNI p.c. 2008-2015



Note: Simple averages. Based on 144 economies for which 2008-2015 data on fixed-broadband prices are available.
Source: ITU MISR 2016

Figure 15: Most common entry-level fixed-broadband speed, globally and by level of development, 2008-2014



Note: Based on 144 economies for which 2008-2014 data on fixed-broadband prices were available.
Source: ITU MISR 2015.

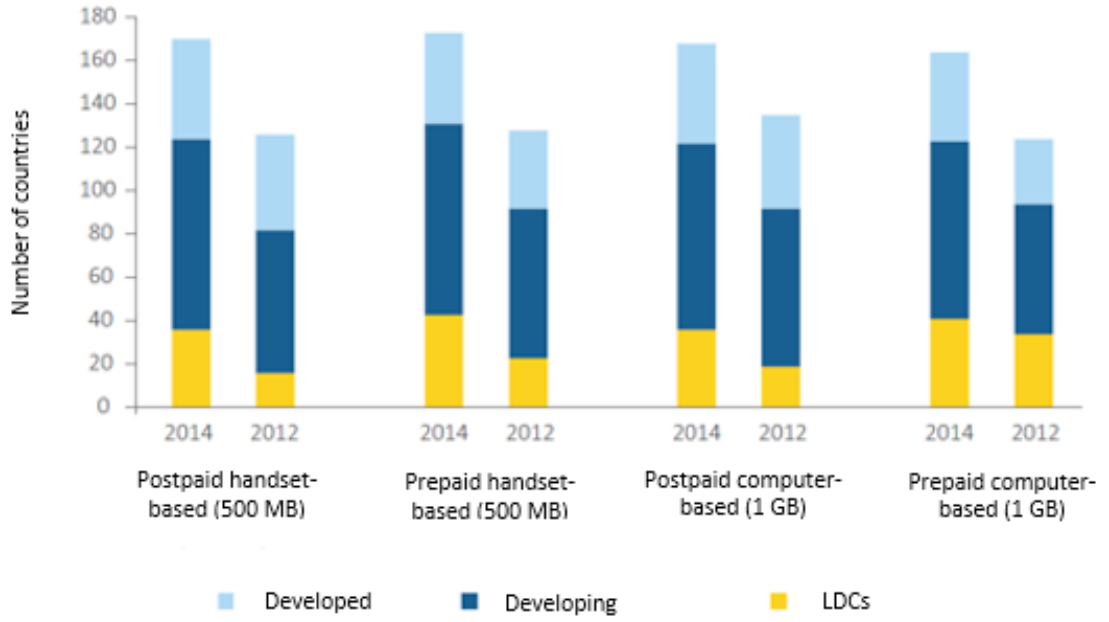
Mobile broadband is more affordable than fixed in most countries. In 2015, 111 countries, including all the developed countries and 67 developing countries, had met the Broadband Commission's target: *"making broadband affordable: By 2015, entry-level broadband services should be made affordable (less than 5 per cent of average monthly income)".*

On the basis of comparable fixed- and mobile-broadband prices for 160 economies worldwide, mobile-broadband services tend to be cheaper. While 102 countries had achieved the Commission's target in terms of fixed-broadband prices, 105 countries had achieved it in terms of mobile-broadband prices.

3.2.3 Mobile broadband services

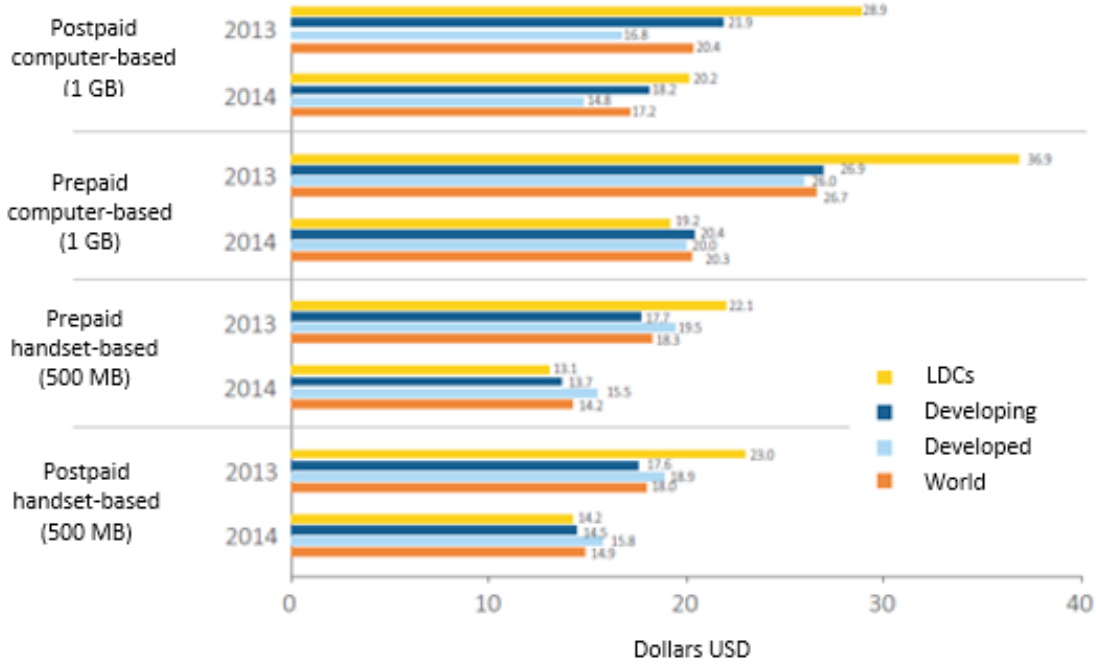
Mobile broadband tariffs fall as the number of offers and subscriptions increases.

Figure 16: Availability of mobile-broadband services by type of service and level of development, 2014 and 2012



Note: A mobile-broadband service is counted as having been available if it was advertised on the website of the dominant operator or prices were provided to ITU through the ICT Price Basket Questionnaire.
Source: ITU MISR 2015.

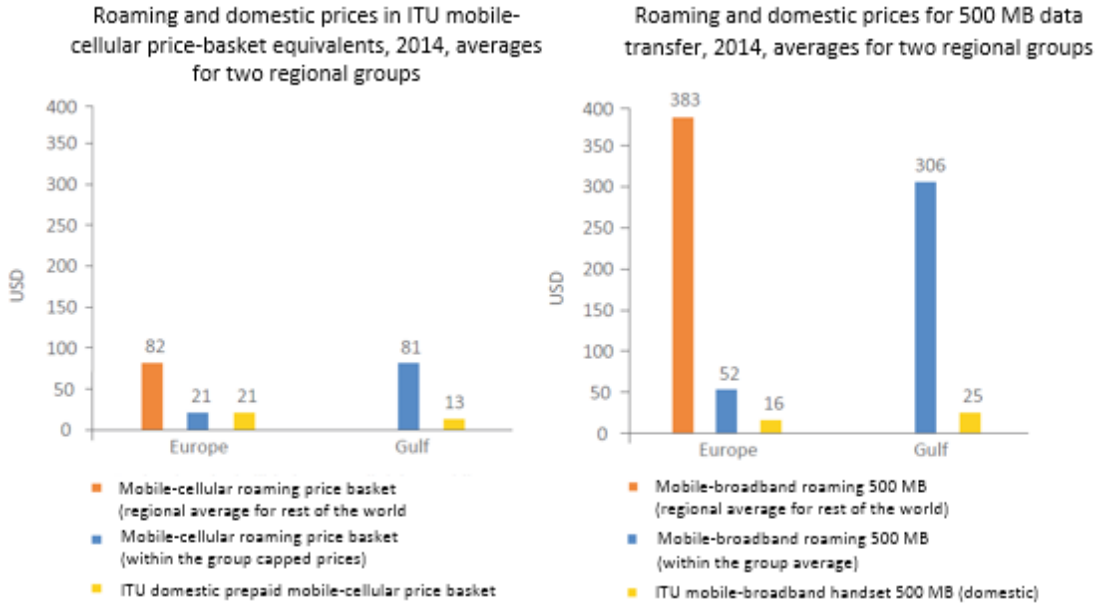
Figure 17: Mobile-broadband prices, in USD, world and by level of development, 2013-2014



Note: Simple averages. Based on 119 economies for which 2013 and 2014 data on mobile-broadband prices were available for the four types of data plan. The respective averages include: 22 LDCs, 84 developing countries and 35 developed countries.
Source: ITU MISR 2015.

3.2.4 Mobile roaming prices

Figure 18: International mobile roaming and domestic prices in Europe and the Gulf, 2014



Note: Average regional prices were used for SMS in the calculation of the GCC-capped mobile-cellular roaming price basket. The mobile-cellular roaming basket includes the cost of making calls and sending SMS texts while abroad. Data on the GCC regional averages for both – the mobile-cellular roaming price basket and the mobile-broadband roaming prices – are not available.
Source: ITU, based on BEREC, GCC Roaming Working Group and ITU data.

A comparison of roaming prices and national prices showed that charges for roaming calls and SMS were three to six times higher than the corresponding national rates, except for calls in the European

Union for which prices were very similar thanks to regulation. As regards mobile data transfer, roaming charges in the European Union were three times higher than national prices and the difference was far greater for non-regulated tariffs once European customers left the EU.

It is clear that prohibitive pricing may discourage customers from connecting when abroad and thus stifle social and economic activity and limiting access to ICTs. Some regions have succeeded in reducing roaming charges through regulation, demonstrating that international and regional cooperation on this issue can help to spread the benefits of lower charges.

3.3 Impact of price reduction on consumption, revenue and investment

The following analysis relates to the period 2008-2014. The ICT Price Basket (IPB) represents prices, consumption is represented by fixed and mobile telephone subscriptions, fixed and mobile data subscriptions, while revenues are represented by operators' receipts and operators' investment. Data used come from ITU sources,[12] and the 69 countries in six regions based on ITU classifications are those whose data in respect of these parameters are available to allow an analysis over seven years of monitoring.

The analysis is based on a calculation of average annual geometric growth.

Two consistent trends are noted:

– Prices are falling;

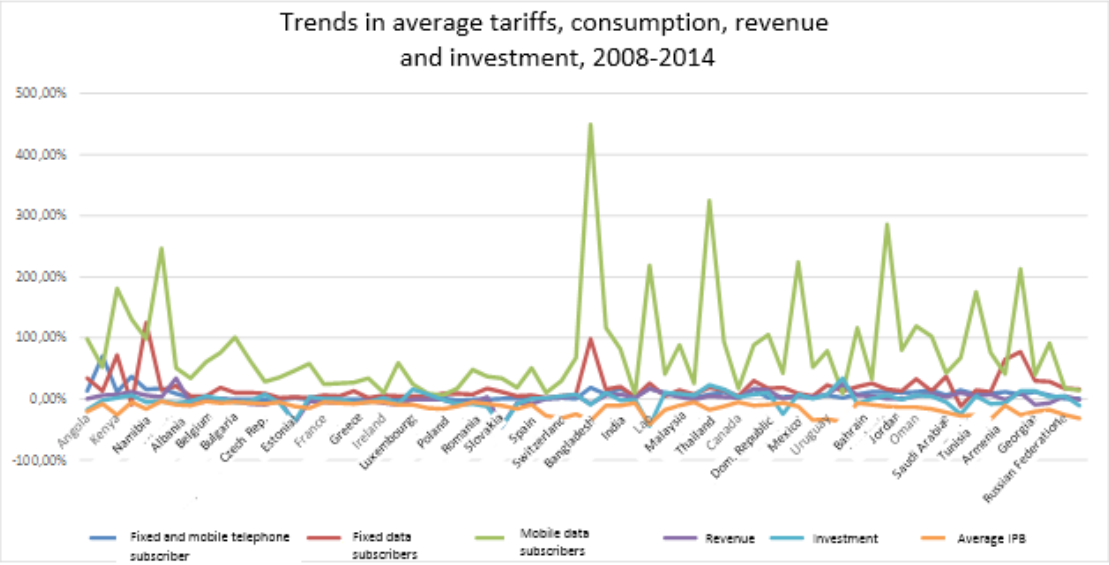
– Consumption (fixed and mobile data) is increasing sharply.

Apart from these two observations, we note that for most countries a fall in prices coincides with a growth in consumption, revenues and investment. In some countries, however, especially in Europe, there was a decline in investment and sometimes also in revenue as prices fell, reflecting the level of development and saturation of these markets.

The case of trends in average charges, consumption, revenue and investment in each country is shown below by region. This corresponds to estimates prepared by the Rapporteur Group for Question 4/1 based on ITU data.

[12] Yearbook of Statistics, Telecommunication/ICT Indicators 2005-2014.

Figure 19: Trends in average tariffs, consumption, revenue and investment, 2008-2014



Source: Estimates by the Rapporteur Group for Question 4/1 based on ITU data.

Figure 20: African Region

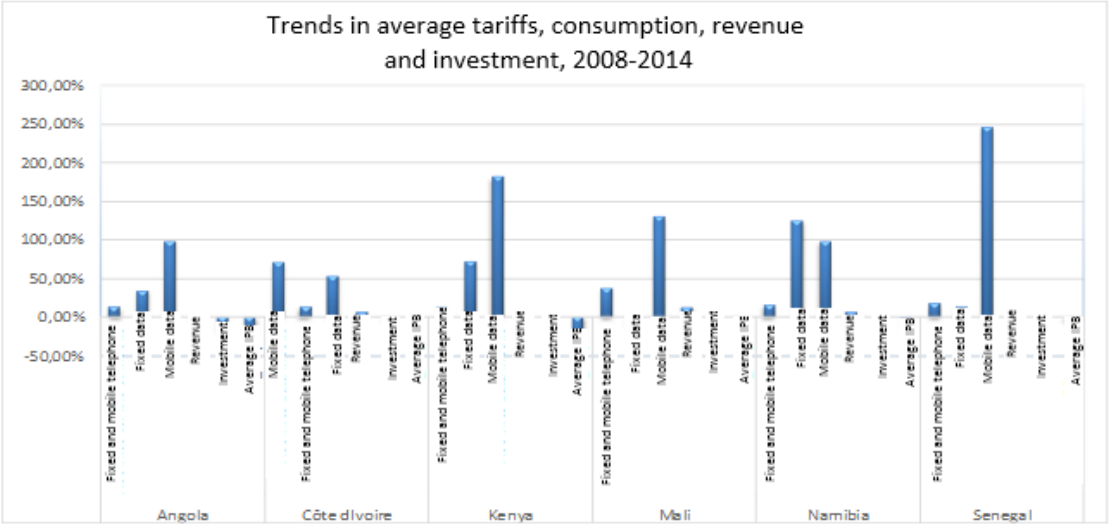


Figure 21: European Region (1)

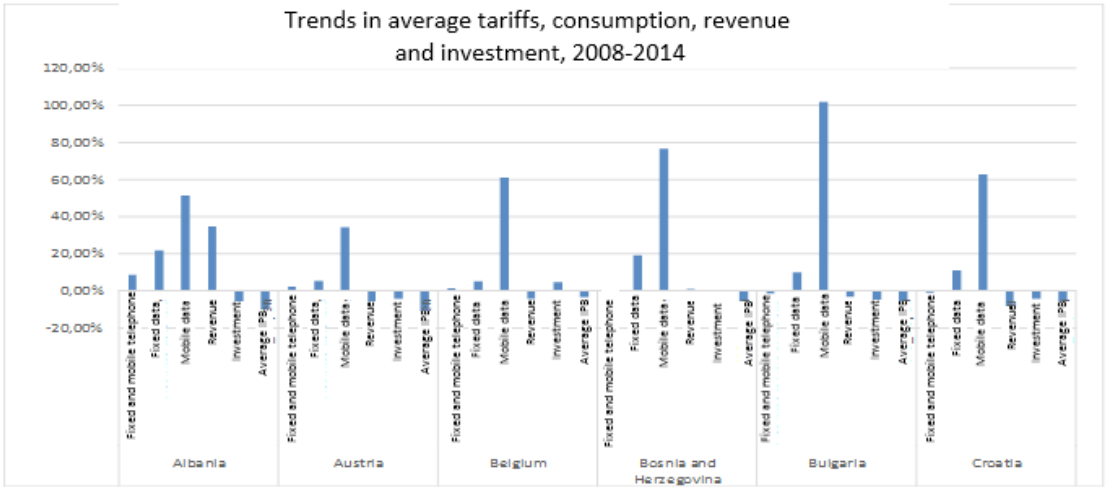


Figure 22: European Region (2)

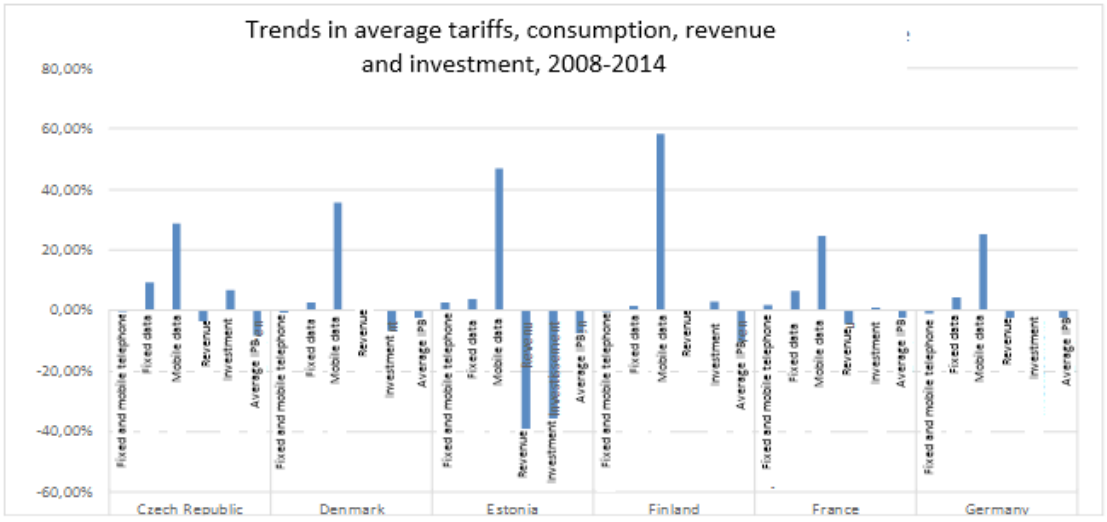


Figure 23: European Region (3)

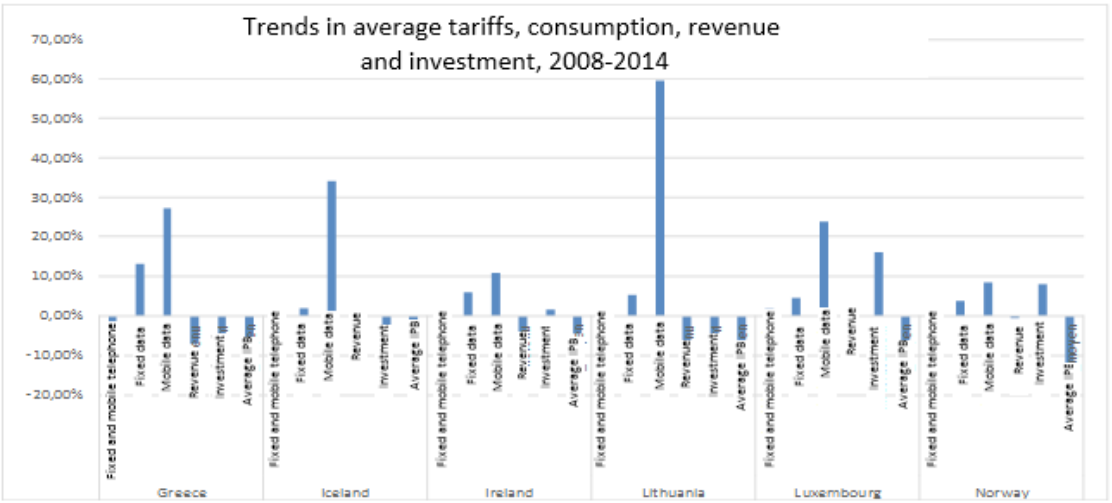


Figure 24: European Region (4)

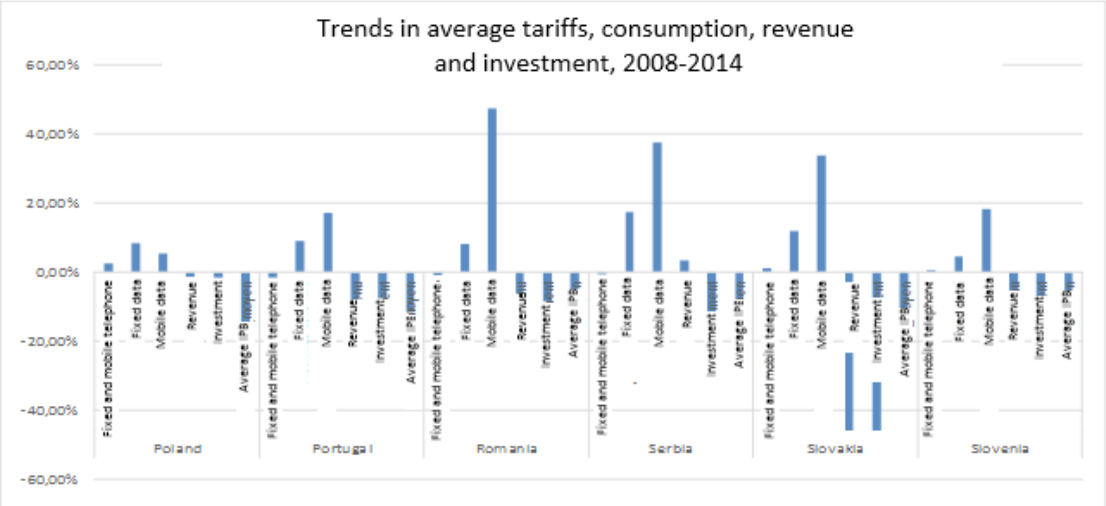


Figure 25: European Region (5)

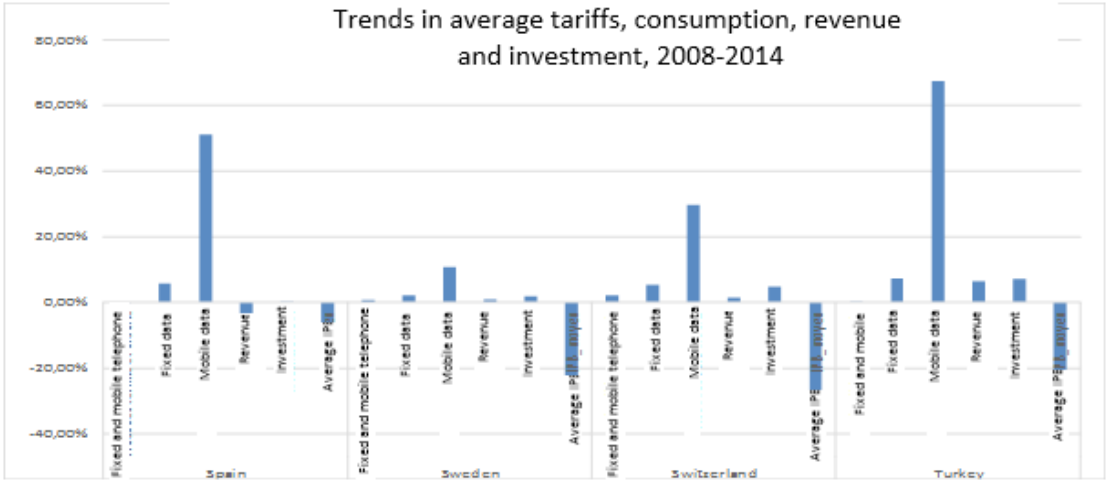


Figure 26: Asia and the Pacific (1)

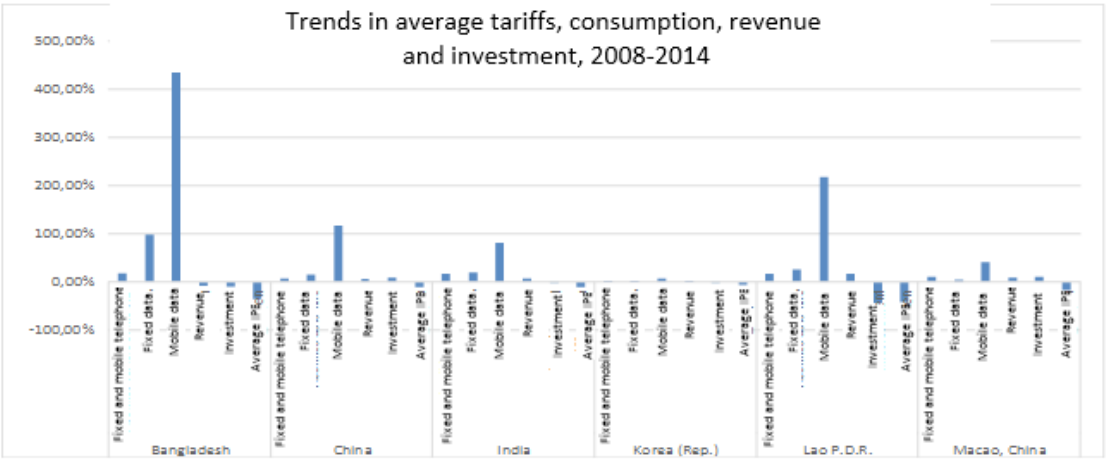


Figure 27: Asia and the Pacific (2)

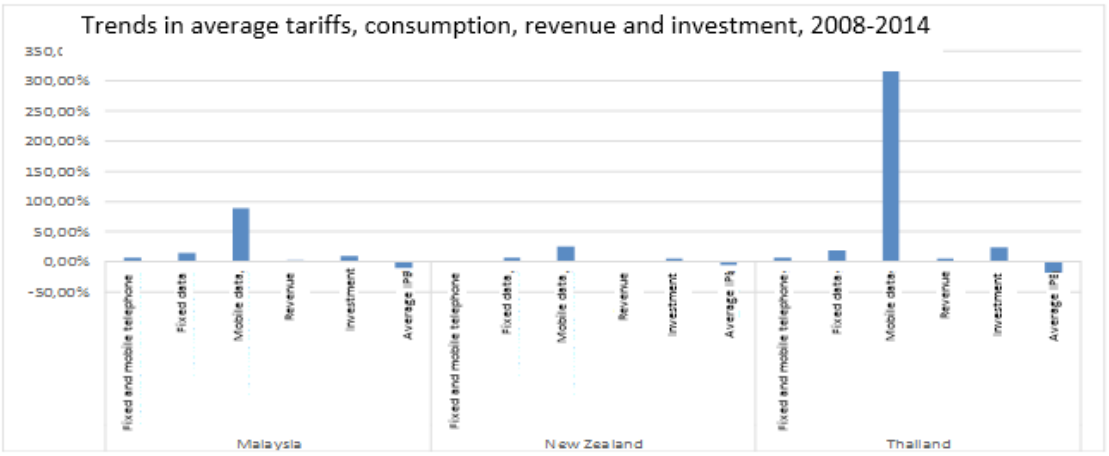


Figure 28: Americas (1)

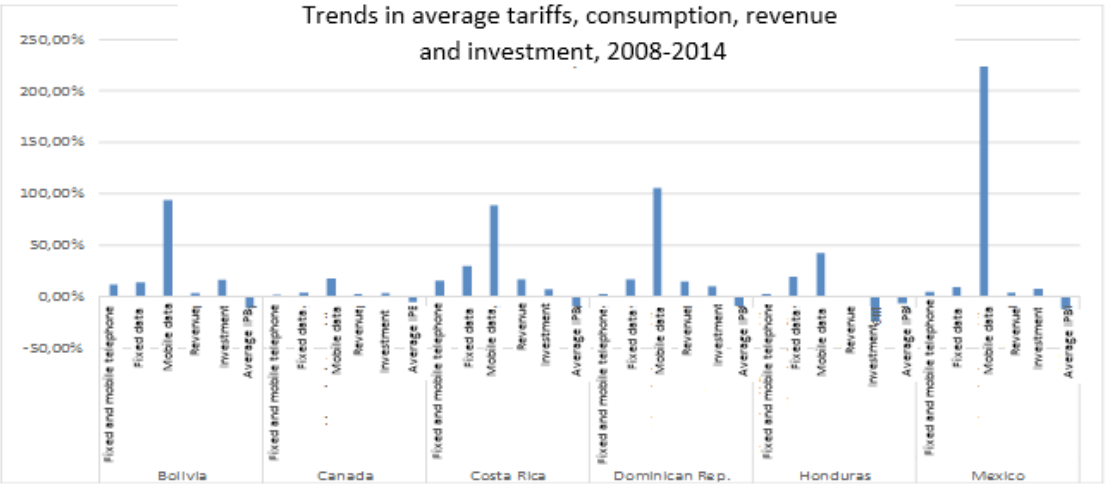


Figure 29: Americas (2)

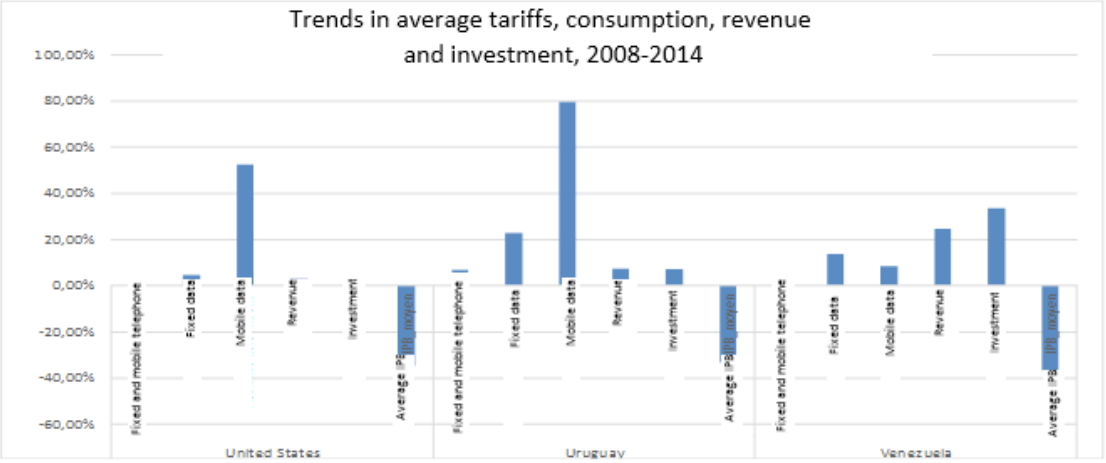


Figure 30: Arab States (1)

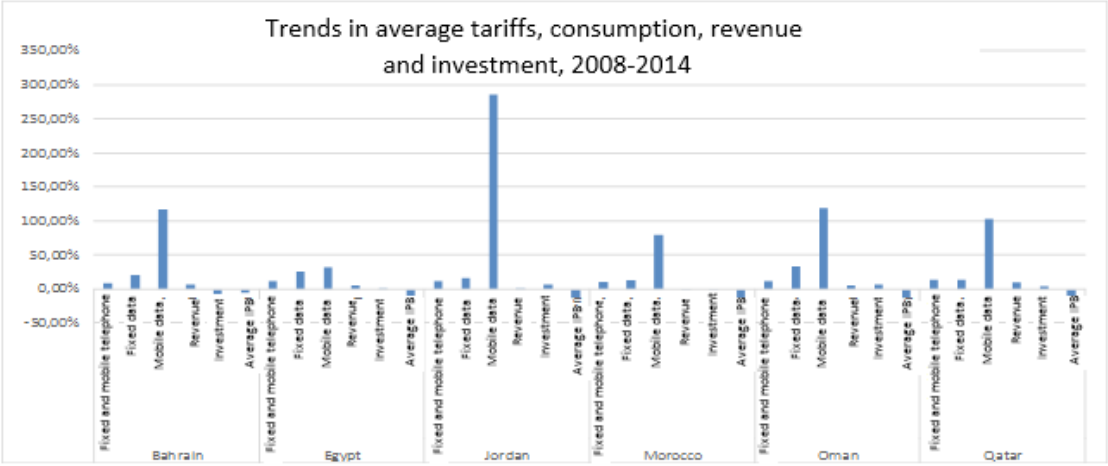


Figure 31: Arab States (2)

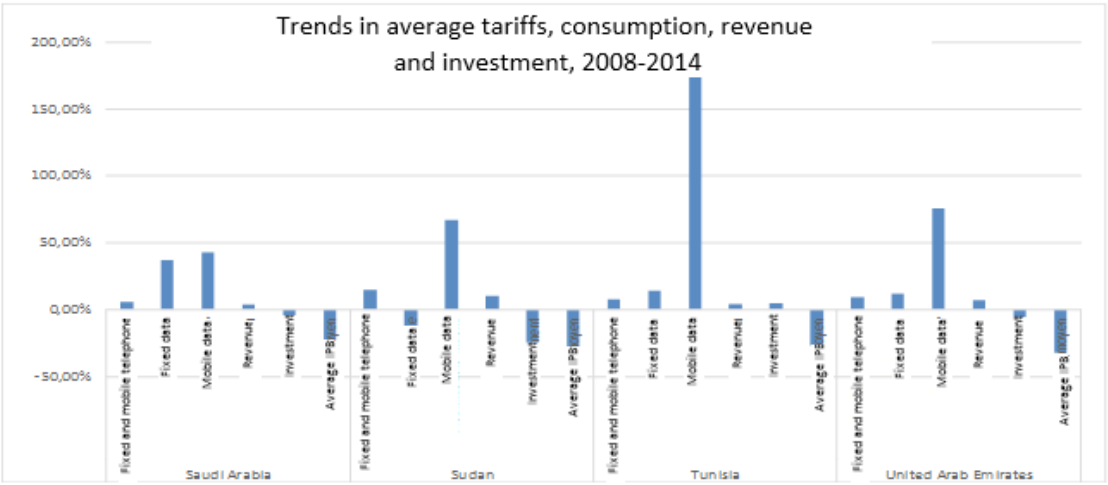
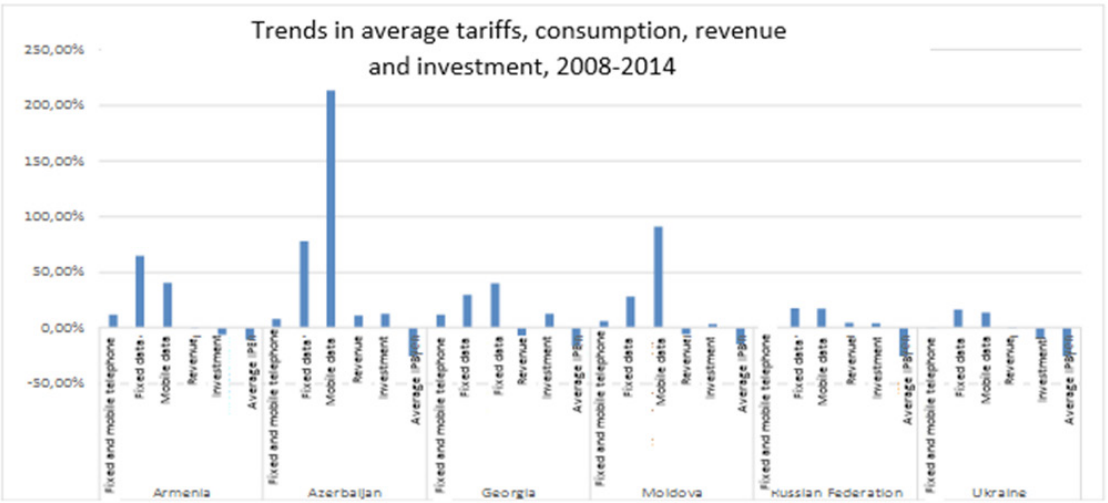


Figure 32: CIS region



As a general rule, the above graphs suggest that the reduction in tariffs does not have a negative impact on the major quantifiable parameters such as consumption, income and investment.

Public policies encouraging or promoting lower tariffs will need to be pursued as both the main stakeholder (consumers and operators) benefit from them.

4 CHAPTER 4 – Methods of determining licence fees

Licence charges, costs or fees, depending on the term used in various national regulations, are applied in different ways, both in respect of the methods used to determine them and the object to which they are applied. In some countries licences are granted for the purpose of exploiting radio frequencies, as is the case with a number of countries in Europe, while in other countries, especially in Africa, they are granted for the purpose of establishing and operating networks, irrespective of the frequencies used. The methods of determining licence charges or fees also vary from one country to another. Some administrations (NRAs or ministries), without methods of their own, apply "benchmarking" based on charges applied elsewhere.

This chapter focuses on some case studies and country experiences in order to produce a synthesis of existing methods.

4.1 Methods of determining individual licence fees for operating networks and services

4.1.1 The case of Côte d'Ivoire and the countries of the West African Economic and Monetary Union (WAEMU)

WAEMU community law as transposed into national laws defines four types of legal regime applicable to the operation of networks and services: individual licensing; general authorizations; declarations; and unrestricted activities.

The individual licence is issued by the State to a public institution or private individual under Ivorian law on the basis of advice taken from the ARTCI. It is issued on the basis of a set of licence conditions attached to it, drawn up by the regulatory authority and specifying the minimal conditions for establishing and operating a network or providing a service. The licence conditions are approved by Council of Ministers decree.

Individual licenses are required in the following cases:

- Establishment and operation of an electronic communications network open to the public including networks that require use of scarce resources;
- Provision of public telephone services;
- Establishment and/or operation of a network providing national or international transmission capacity;
- Provision of services under special conditions pertaining to public order, security or public health.

If individual licensing is applied as the right to operate the above networks and services, the methods used to determine the fee for the licence are not identical throughout the country.

The case of Côte d'Ivoire

Under the terms of Decree No. 2015-781 of 9 December 2015 setting the amount, conditions, and procedures for paying individual fees of category C1A,[13] the award of an individual category C1A licence is subject to a fee of 100 billion CFA francs payable as follows:

[13] Activities pertaining to the establishment and operation of an electronic communications networks open to the public including those requiring the use of scarce resources, with a view to providing the telecommunication/ICT services under the licence conditions annexed to the licence.

Table 3: Attribution of an individual licence of category C1A

1st case	2nd case
– 50% on issue; – 25% year (n+ 1); – 15% year (n+2); – 10% year (n+3). The licence period is extended for one extra year, or 16 years, if the first instalment is paid before 10 December 2015.	– 75% on issue; – 15% year (n+1); – 10% year (n+2). The licence period is extended for two more years or 17 years, if the first instalment is paid before 10 December 2015.

Methods proposed by Togo

In Togo, as in other African countries, a licence is an authorization to set up and operate an electronic communications network, fixed or mobile, irrespective of the frequency resources used.

In the case of licences awarded through competitive processes, the amount of the licence fee is determined in the light of offers from applicants. The authority responsible for determining the fee sets a reserve price using one of a number of specific methods. In addition, in the case of licence renewal for which the competitive process is not used, the authority responsible for setting the licence fees is required to adopt transparent and objective methods.

The three methods described below are proposed in order to facilitate the work of the governments that in general set the licence fee; it is understood that the amount will be adapted to current circumstances, and to policy for this sector as the government gives greater priority to investment in infrastructure or to revenue from the licence fees.

Method 1: Price benchmarking with countries that have purchasing power parity (PPP) comparable to that of the country carrying out the estimate

– For a given technology, the licence cost is adjusted to the same duration;
– Parameters: cost of licence per year and head of population in countries with purchasing power parity similar to that of the country carrying out the estimate, according to the World Bank classification.

$$\text{Licence cost} = CM/_{hbt} \times P \times D \times (1+t)$$

where:

$CM/_{hbt}$ – average licence cost per inhabitant in the reference countries

P – population of the country carrying out the estimate at the time of awarding the licence

D – period of the licence

t – global inflation rate; the reference year for the inflation rate is the year of first granting the same type of licence by one of the countries selected for benchmarking.

Method 2: Benchmarking based on the sale price per MHz/inhabitant/year at the international level

– Choice of countries that have sold licences relating to the same technology, in particular through auctions and other methods

– Parameters: price per MHz/inhabitant/year in each of the chosen reference countries with respect to the PPP ratio between each of those countries and the country carrying out the estimate.

$$\text{Licence cost} = PM/_{hbt/year} \times P \times D \times (1+t)$$

where:

$PM/_{hbt/year}$: average licence cost of one MHz per inhabitant per year in each of the reference countries with respect to the PPP ratio between each country and the country carrying out the estimate.

D – period of the licence

P – population of the country carrying out the estimate at the time of first awarding the licence

t – global inflation rate; the reference year for the rate of inflation is the year of first granting the same type of licence by one of the countries selected for benchmarking.

Method 3: Determination on the basis of actual turnover

Licence cost = 5 per cent of accumulated actual turnover over the entire licence period.

Possibility also of setting a floor price using methods 1, 2 and 3 and allowing an upward adjustment when the licence expires.

The actual turnover is the turnover reflected in the certified accounts of the operator concerned. The advantage for a country in choosing turnover rather than other parameters such as added value or Gross Operating Surplus (GOS) lies in the fact that the government will not be affected by any tendency of operators to inflate operating charges in order to pay less.

4.1.2 Experience of the European Union (EU): Contribution of the Swiss Confederation

The obligation imposed on operators to apply for an individual licence gives National Regulatory Authorities (NRAs) great control over access to many markets. An individual licensing system, if subject to unnecessarily complex and onerous regulations and administrative procedures, becomes a major obstacle to market entry for new players. This is especially harmful to a country's economic development, as it impedes the development of markets for communication services that will offer choice and diversity of innovative services to meet users' needs and ensure that consumer and businesses enjoy the best possible conditions in terms of price and quality. At the beginning of the 2000s, many European countries concluded that the administrative obstacles resulting from individual licensing (for a specific operator, which has to submit an explicit application to a regulatory authority before being authorized to start operating the service) were disproportionate and unproductive because they discouraged innovation and competition. The new regulatory framework is based on a general system of authorization in law to authorize the activities of operators providing electronic communication networks and services. In other words, before starting to provide services it is not necessary for a future market player to obtain explicit authorization from the NRA which must be notified. The procedure prior to beginning operation is limited to notification alone, and this is both necessary and sufficient. Notification involves merely a declaration informing the NRA of the intention to begin providing electronic communication services or networks. It may be accompanied by information needed to enable the NRA to maintain a register or list of electronic communication network and service providers.

Individual licenses (specific authorizations) are still required for use of radio spectrum and numbering resources. Nevertheless, as regards use of scarce resources (radio frequencies or numbers), specific authorizations are not necessarily justified and the general licensing system may also be applicable. In order to comply with the principle of technological neutrality (non-discrimination between different means of electronic communication) this regulatory framework applies to broadcasting networks (land, satellite and cable) as well as to telecommunication networks. The general licensing system ensures an appropriate level of regulatory control of electronic communication infrastructures and services. It is part of an overall legal framework with obligations for the sector that can be applied to all types of electronic communication networks and services, as general authorizations entail legal obligations intended to ensure inter alia universal service funding, interoperability of services and network interconnectivity, consumer protection, facilitation of legal intercepts, emergency communications and maintenance of network integrity and security.

Administrative charges may be levied on service providers in order to fund the activities of the national regulatory authority in connection with notification system management, authorizations for use and enforcement of legal requirements applicable to network and service providers. Those charges should cover only actual administrative costs arising from those activities. Where the administrative charges are very low, flat-rate charges could be applied.

4.2 Individual frequency licence fees

This section of the report is based on work done on Resolution 9 in accordance with WTDC-14 Resolution 2, which clarified the scope of Question 4/1, to indicate that the study of frequency licence fees will be done as part of the work on Resolution 9 (Rev. Dubai, 2014) to avoid duplication of effort.

Principles of spectrum valuation

- Spectrum is allocated for better use in such a way as to ensure that society's needs are met.
- Mechanisms must be put in place in order to encourage and promote growth in the value of spectrum use to its maximum value.
- Access to spectrum must be facilitated by low prices and less restrictive management methods.
- As far as possible, spectrum managers and regulators must promote spectrum use with flexibility and certainty.
- A balance must be maintained between the costs of interference and the benefits obtained in the case of extensive use of spectrum.
- The spectrum fee grid based on objective factors must ensure that that no operators with licences to operate in a given band are subject to discrimination.
- Tariffs must be calculated and published in a transparent manner.
- Setting charges is easy to manage if charges take account of parameters such as bandwidth, frequency bands or coverage.
- Spectrum fees must be modified when appropriate in order to reflect changes in growth indicators or technological advances resulting from higher demand for a given band.
- Mechanisms must be put in place to avert, detect or prevent hoarding of spectrum, which may deter competition.
- A balance must be established between a financial approach and other important mechanisms, i.e. regulatory (competition) and social (universal service).

Goals of spectrum valuation

- Spectrum prices must promote efficient spectrum use. The price of spectrum, as a vital natural resource, must reflect its value and it must be used wisely. Spectrum use has considerable economic benefits which must be optimized.
- Costs associated with radio spectrum regulation and management (including monitoring and management) must be paid by all users, public and private, that benefit from spectrum management activities.
- Social and cultural goals can be achieved through spectrum use, and spectrum valuation can help in efforts to achieve the government's social and cultural objectives.

Spectrum prices for radio frequencies are determined by administrative methods or by methods based on market value, or a combination of the two (administrative and market mechanisms):

- Administrative mechanisms including Administrative Incentive Pricing (AIP) and price-setting formulas that allow recovery of management costs for the regulator.
- Market-based mechanisms for determining spectrum prices including market transactions such as spectrum auctions and exchanges.

Spectrum managers must consider a number of factors when deciding on methods, financial bases, value and payment periods for spectrum charges for a given band, type of use and user. Those factors are:

- Fiscal context;
- Specific principles of relevance, and objectives for certain types of spectrum fees;
- Funding the regulator's activities;
- Spectrum supply and demand;
- Technological changes;
- Type and period of spectrum licence and renewal options.

4.2.1 Administrative method

Administrative frequency assignment generally involves charging fees for frequency management and use.

- Management fees include planning fees and administrative costs;
- Fees for use include authorization to occupy the band and profits arising from spectrum use;
- Frequency management fees based on recovery of costs linked to expenditure are of two kinds, namely direct expenditure and indirect expenditure:
- Wages of professional staff (including monitoring and follow up) and administrative management staff;
- Investment in databases and ICTs including spectrum management tools, the national frequency allocation table, users' databases and monitoring systems including equipment such as fixed and mobile stations, their new models and calibrations;
- Long-term and short.-term expenditure for automated management;
- Space for offices and equipment;
- Research activities and associated expenditure with consultations and publications;
- Activities to reduce interference and effect coordination;

– Participation in conferences of ITU and other bodies;
– General management expenses;
– Legal fees for carrying out activities.

Spectrum fees – simplified formula: The simplest general formula for determining administrative spectrum fees with the aim of covering direct and indirect expenditure is the following:

Spectrum fee = management costs (direct and indirect) / total spectrum assigned to user

The spectrum price may also be calculated by a number of elements based on one or more criteria using the following formula:[14]

$$P = \frac{V}{M} \times \frac{K_f K_S}{K_m} \times C_S \times K_P$$

where:

P: spectrum price

V: volume of space or surface area occupied

M: results obtained for radio equipment taking into account the number of channels assigned or the number of users provided with the service (radio)

K_f: coefficient characteristic of the space used

K_S: coefficient for the location where the radio station is sited

K_m: coefficient for the social benefit of radio

C_S: annual spectrum management expenditure

K_P: coefficient for the level of demand for spectrum access in the band in question.

4.2.2 Methods based on market value

Auctions are an important method of granting licences and assigning frequencies to mobile service operators throughout the world. Ideally an auction is the optimal method, enabling regulators to achieve their goals of economic and technical efficiency through competitive bidding. The typical indicators of success for an auction include a measure of participation (the greater the better), an absence of collusion in the bidding, and prices paid by winning bidders reflecting fairly closely the actual spectrum values. Auctions are especially suitable for assigning rights and licences for high-value spectrum such as bands for mobile and fixed services.

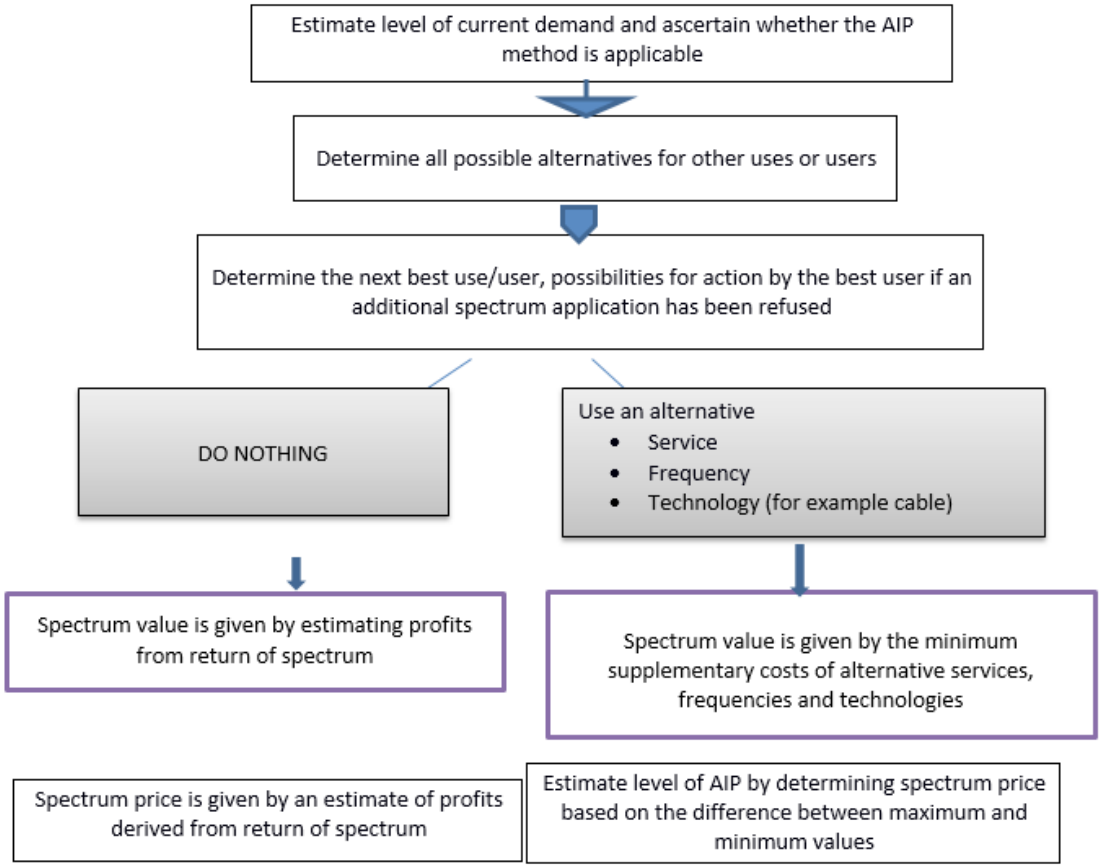
Administrative Incentive Pricing (AIP)

Determination of the spectrum price equal to its opportunity price is calculated for an estimate of the additional expenses which the enterprise will incur in order to offer the same services using a little less spectrum or having used some in the next less expensive band or simply without using the frequencies in question (for example, adopting optical fibre).

These supplementary expenses measure the lost opportunity of using the frequency band in question.

[14] Vadim Nozdrin, paper delivered at the ITU-BR Regional Radiocommunication Seminar, Lusaka, 2003.

Figure 33: Method of spectrum valuation



4.2.3 Other methods: Model based on enterprise valuation

The business model takes account of the changes that depress or boost economic activities, including economic crisis, changes in fiscal policy, and new commercial relationships that will impact on performance in the sector and certain structural and regulatory adjustments where needed.

The spectrum valuation model does not reveal the specific value of the spectrum. The model based on enterprise valuation involves determining the spectrum value from the commercial point of view of the user. The exercise is of great relevance for operators. The operator's and regulator's objectives converge at the point of optimum spectrum values.

The concern of the regulatory authorities is to seek technical and economic efficiency, while the operator will want to exploit assigned frequencies for profit. The principles of enterprise-based spectrum valuation involve estimating the profits which will be derived from the spectrum in question over the period of use.

4.2.4 Advantages and drawbacks of different spectrum valuation methods

Table 4: Spectrum valuation methods – advantages and drawbacks

Methods	Advantages	Drawbacks
Simple fees	– Can be used for all spectrum users (public and private). – Can be used without establishing a model for calculating fees and can determine those fees on the basis of certain radiocommunication rules of implementation.	– The fees do not reflect the regulator's management costs or the values estimated by the user. When applied on its own it does not produce any technical or economic efficiency in spectrum use.
Recovery of spectrum management costs	– Users know that they pay only the costs relating to the spectrum management authority. Money collected from the paying public is not used to fund the administration's activities, the beneficiaries of which are identifiable.	– For calculating spectrum models and fees the spectrum management authorities will face a complex task in allocating direct and indirect costs. Given certain legal restrictions it may be that not all management activities will be financed.
Incentive factors	– Can promote efficient spectrum use. – Recovers some or all licensing costs, even if that is not the main purpose	– Requires much effort to attain market value. – May not be suitable for all services.
Fees based on opportunity costs	– Close approximation to market value – Can promote efficient spectrum use.	– Requires large quantities of data and much analytical effort – Applicable only for limited part of spectrum, and only for uses that compete for a precisely defined band.
Fees based on gross revenue of users	– Links price of spectrum to commercial activities in which spectrum is used. – Easy to calculate.	– Can be applied only to users whose revenues are directly linked to spectrum use. – Does not promote efficient use if revenues are not proportional to the quantity of spectrum used. – May be regarded as a supplementary revenue.

4.3 Best practices for determining licence fees

Experience of determining licence fees shows that the method used is based on the same philosophy that guides the different national regulatory frameworks. In the European Union, for example, a licence is intended *a priori* for the right of use of frequencies in addition to administrative costs covering the operations of the regulatory authority, while elsewhere, a licence is seen as an authorization to enter the market irrespective of whether or not frequencies are used. In both cases, determination of licence fees calls for a transparent method for those involved.

Consequently, the methods described in this chapter, whether or not regarded as best practice, may provide guidance for different administrations. The golden rule is that the method applied by each country should be known, objective and transparent for all stakeholders.

5 CHAPTER 5 – Regulatory accounting in an NGN environment

Cost accounting is a particular discipline that has its roots in general accounting. It can be used to calculate different costs (complete, partial) and as such is a useful business management tool.

In a "multiservice network" environment, operators need to be able to capture all costs incurred (direct, common/shared, indirect) in order to provide services. Cost accounting enables them to attribute costs to the different services. This requires a tool for attributing costs to the principal network activities and create an objective relationship "incremental resources vs. traffic by service".

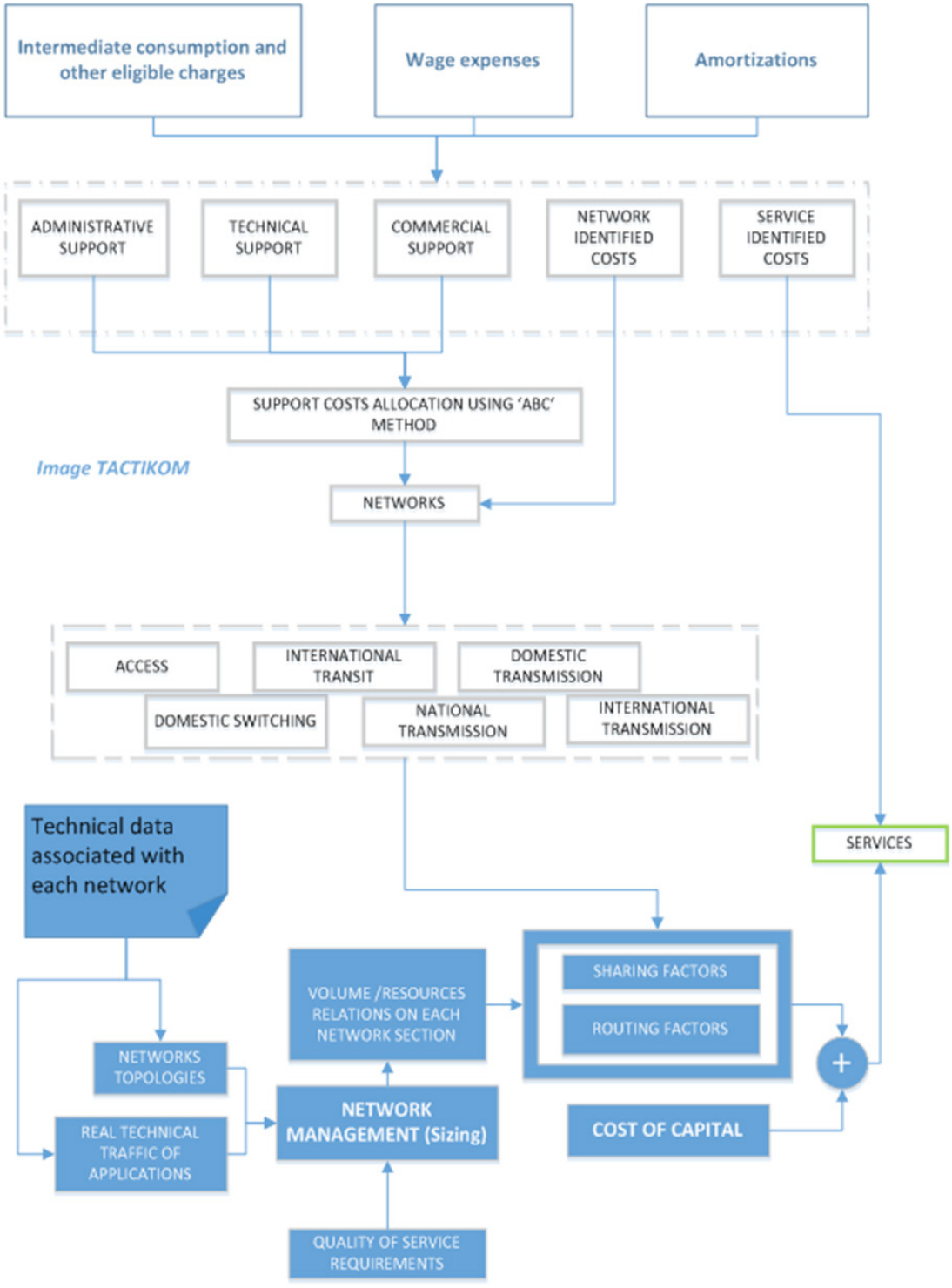
Regulatory accounting defines the rules governing the way in which costs are accounted and determines the criteria for allocating and distributing costs to services, with a view to ensuring correctness and fairness. It provides information on the margins achieved for each category of service, enabling the regulatory authorities to determine the existing level of competition and form an opinion on the level of competition in the market and the possible need for stronger regulation.

With this in mind, the regulatory framework provides the key parameters for defining a cost accounting model, which are:

- The services covered by the cost accounting model;
- The accounting period;
- Criteria for valuation of assets;
- Cost standards and categories;
- Types of cost accounting model;
- Internal transfers to ensure adherence to the principle of non-discrimination.

5.1 Overview of accounting separation model

Figure 34: Overview of accounting information system



Source: Contribution from Tacticom, July 2016

5.2 Principles of regulatory accounting for NGN operators

The accounting principles for correct attribution of costs to different services remain valid even in an NGN environment. The ITU *Regulatory Accounting Guide*, March 2009,[15] identified ten accounting principles, of which the main ones are indicated below.

Principle 1: Causality

The income and costs allocation to the different activities and services must be done based on causal drivers.

- Any service, consumption of which does not result in consumption of a given resource, must not be required to bear even part of the cost of that resource (fairness).
- Any service, consumption of which has a positive impact on increasing the quantity of a given resource that is used, should bear the commensurate proportion of the cost of that resource (correctness).

Principle 2: Objectivity

The allocation of revenues and costs must be objective and not intended to benefit an operator, product, service, component, business or disaggregated business.

Principle 3: Transparency

Costs allocated to different services must be broken down according to their nature and using methodologies for determining costs on the basis of activities (ABC method) or an established relationship between cost and volume.

Principle 4: Priority and proportionality

In the event of a conflict between one or all the principles described below, the principles are applied in the same order of priority in which they appear in the context of the NRA's separate accounting.

Principle 5: Objectivity

The chosen basis for allocation must be objective, quantifiable, and based on allocation criteria and statistical samples that may be contrasted and verified by NRAs in the audit process. Attribution must not intentionally benefit one particular operator, product, service, component, business unit or disaggregated activity.

Principle 6: Coherence

The same allocation basis must be used from one year to the next, unless there have been essential change or improvements in data. Where there have been significant changes to regulatory accounting principles, allocation methods or accounting policy that have a major impact on the information submitted in separate accounts, the separate accounts from the previous year must be adjusted accordingly if possible.

Principle 7: Material importance

In certain cases, using one specific allocation basis is not necessary if the effect of the allocation is not significant for the result, individually or collectively, with other cost allocations using the same basis for allocation. Nevertheless it is not possible to measure the effect without adopting a substitute base and, where there is doubt, the most appropriate cost allocation basis is used.

[15] ITU/BDT Regulatory and Market Environment- Publications on Economics and Finance: www.itu.int/pub/D-PREF-EF/en.

5.3 Cost allocation process including licensing costs

Whether in a context of circuit-switched telecommunication networks or when packet-based networks are use, costs must be attributed to products and services for commercial and regulatory purposes. Cost accounting must accurately capture the relationship between assets and services. Cost allocation is one method of determining the cost of services provided for users. It does not determine the price of the service.

Whatever cost model is used, the real challenge is knowing how to obtain a system of cost allocation which:

- Is economically sound;
- Is consistent with actual technical and commercial conditions; and
- Takes account of all activities related to the production of services.

The main mission of a network operator (including NGN) is to provide a technical package that meets the needs of direct and indirect consumers. The operator must therefore have the means needed to offer all or some of the following base functions:

- Access to the direct consumers' network;
- Domestic switching;
- International transit centre;
- National transmission (to other operators in the same country);
- Domestic transmission (between the operator's own communication nodes);
- International transmission.

These functions will be the principal analysis points (or principal activities under the terms of the model). The operator can, in the transitional phase leading to the NGN, have a number of "subnetworks" that constitute the main network. Each subnetwork will be used for all or some of the six principal functions. Each subnetwork can manage a number of classes of quality of service.[16] Each class of quality of service can cover a number of applications each of which encompasses the services offered to direct and indirect consumers. The support activities listed below are auxiliary analytical points and will be "auxiliary activities" for the accounting model:

- Administrative support;
- Technical support;
- Commercial support.

Some cost elements may be directly attributable to a given application. Some costs can be directly attributed to a specific network; in the case of investments, it is useful to allocate the **amortization of investment** to the network and the segment concerned.

As regards licenses, these generally refer to a right acquired from the State in return for payment. Some States regard this as a charge payable over several accounting periods, while others treat is as an asset, but in all cases the accounting model has to take them into account.

All that remains is to use the auxiliary activities as a means of allocating support costs to the principal activities. To do this the cost model must allow use to be made of well-known techniques known as "Activity-Based Costing" (ABC).

[16] Example: Those defined in Recommendation ITU-T Y.1541 (https://www.itu.int/rec/T-REC-Y.1541/en).

The outcome of this process will be that the accounting model will enable us to attribute all relevant costs to each of the operator's networks and each of a given network's principle activities.

All that remains then is to determine the total volume of resources or allocation drivers for each of the principal activities and for each network and, for each service defined in each application offered by the operator, to calculate very precisely the proportion represented by the incremental resources generated by that service in each network segment.

5.3.1 Allocation of costs to services

A detailed knowledge of the general topology of the operator's network is essential. The first step is to be familiar with the applications offered by the operator to customers. Thereafter an analysis of the general network will show how each of those applications is provided. We may conclude that the operator provides all applications on one (convergent) network, but it is often the case that the operator uses two or more subsidiary networks, with a principal network (the first) to which is also connected the transmission infrastructure (optical fibre, microwave, cables, etc.) and other network fragments that comprise principally communication nodes and make extensive use of the principal network's transmission infrastructure. Infrastructure sharing thus begins with the operator.

Once the network topology is properly understood, the task is to gather from the operator hourly technical traffic data (24/24 and over a sufficiently representative period) for each application over all the routes of the network.

Once the services have been defined in technical terms for each application, overall and incremental dimensioning by service enables us to use network engineering techniques to establish a **watertight relationship between incremental resources and (traffic) volume** on each network segment.

The result is a table of routing factors for each subnetwork and, in the case of several subnetworks, tables of sharing factors (for example, the proportion of resources of each segment in network No. 1 used by network No. 2 applications). With these factors, it is then possible to allocate to each service the costs resulting from the allocation process.

This must also include the cost of capital which will have been determined in advance using the usual methods.

5.3.2 Specific features of the integral NGN

In order to determine the costs that are causally attributable to various services within a multi-service environment based on packets, it is essential to quantify the relationship between traffic volumes, Quality of Service (QoS) and capacity. One approach involves using the QoS routing algorithm, i.e. allocating costs to services by QoS.

Introducing quality of service as a metric influencing the allocation of costs reflects the fact that a guaranteed higher quality of service means also higher demand for network resources in providing the service in question. Determining weighting factors to take account of quality of service is based on engineering rules determined by the operator and regulator as part of cost modelling.

The above account implies that commercialization of services, and thus regulation of services where needed, is done for each application of each class of quality of service among those defined in the series Y Recommendations, on the global information infrastructure and Internet protocol.[17]

Integral NGN is a commercial package that might be made up of a basket of applications (therefore probably of several classes of quality of service). For the regulator, the difficulty of such baskets of services lies in the fact that although they may be well understood individually, their overall impact

[17] http://www.itu.int/en/ITU-T/publications/Pages/structure.aspx#Y.

in terms of consumption of incremental network resources is not simply the sum of the individual impacts of each application. The regulatory accounting system should enable the regulator to meet that requirement.

5.4 Format of regulatory separated accounts for an NGN licensee

All operators should have the following elements, which are also essential for regulatory accounting:

- The balance of accounts (using cost accounting if possible);
- The complete organigram and/or tree structures of cost centres showing resources associated with each entry;
- The ledger (based on cost accounting if possible) limited to expenditure accounts;
- Expenditure categories and the associated conditions for amortization of investment;
- The fixed assets file (using cost-accounting if possible);
- Loans and applicable conditions (amounts, currency, interest, etc.);
- Full topology of the network including subnetworks;
- A connection diagram showing all traffic routes around each identified network node;
- Incoming and outgoing traffic for each identified route and each application concerned.

Fixed assets file

- Investment in structures must be linked to an identifiable cost centre. In many cases a clear title is enough (for example, office of the chief accountant), but if the operator has codified the cost centres and linked the code to the assets in question, processing will be rapid and effective.
- Industrial or production investments should identify the network and network segment corresponding to one of the principal activities referred to above.

In the case of industrial investments the technical documents that will be used by the technical teams to allow them to capture accounting records following entry into service must include two columns of boxes to tick – one for the network and another for the network segment.

In both cases it is desirable to add an additional field to the fixed assets file for information on the "analytical code" described below.

Expenditure accounts

- If the operator has a cost accounting system, there is nothing else to do, as in general the operator will have available a cost accounting ledger which can answer any question.
- If the operator does not have a cost accounting system, the fairly detailed description of the expenditure accounts as they appear in the balance sheet very often indicates the third party involved, which may suffice, but it may be better if the beneficiary service is always clearly indicated, either spelled out or as a code.
- It is also important to note that Recommendation ITU-T D.271, on charging and accounting principles for NGN, has been revised and approved in its 2017 version. It sets out the general principles and conditions applicable by administrations for the capability to transport IP packets over IP-based networks between standards-based interfaces and the services that they support.[18]

[18] http://www.itu.int/rec/T-REC-D.271/en.

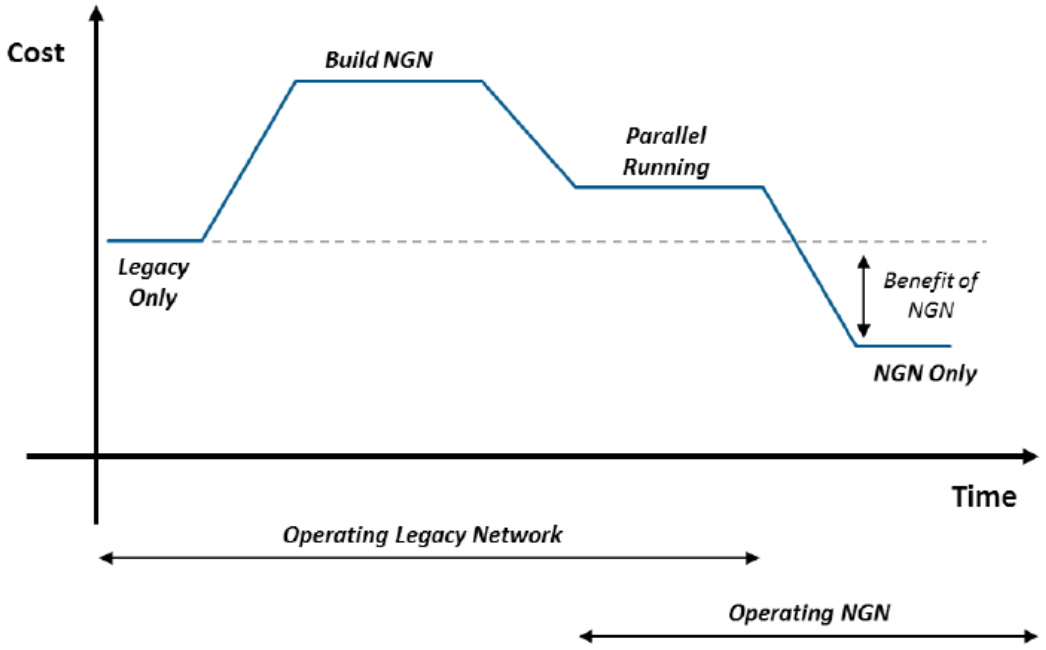
5.5 Challenges of cost accounting

Cost accounting has to cope with the changes brought about by the process of migration of the traditional network to NGN.

Allocation of costs during the transition process

Once the operator starts investing to deploy the NGN, the cost increases and then falls again during the phase in which the operator use both networks (traditional and NGN) in parallel. Lastly, once the operator deactivates the traditional network, the total cost falls below that of operating the traditional network.

Figure 35: Comparison of cost distribution in traditional networks and NGNs



Source: Contribution from the Sultanate of Oman at the meeting of 23 September 2016

Methodologies for allocating costs in next generation networks (NGNs) and next generation access (NGA)

Where a number of services are provided on the same NGN, the question arises as to the allocation of cost between those services. In the case of the traditional network, the methodology is simple, as the network is made up of circuits of defined capacity that are made available to services, so simple arithmetical calculation can be used to estimate and allocate costs. In an NGN environment, capacities are allocated dynamically. This means that in the NGN, it is essential to know what to measure, where in the network and when. As for the main problem with regard to NGA, there is a parallel operation of copper wire and fibre sharing the same path layer network to provide services. In such a situation we need to ascertain the basis for allocating through traffic costs between copper wire and optical fibre.

6 CHAPTER 6 – Conclusions and guidelines

Costs of deployment and provision of services are presumed to fall in an NGN environment following migration of the traditional network to NGN. Consumers are thus presumed to benefit from this increase in productivity with a reduction in tariffs. However, changes in the commercial package based on baskets of services and flat-rate charges do not necessarily result in the full transparency regulators need to ensure that fair and equitable prices are applied for consumers.

The subjects considered in this report, namely cost models in an NGN environment, the financial impact of infrastructure sharing, the evolution in tariffs or prices and their impact on investment, revenue and consumption, and regulatory cost accounting, all seek to achieve the same goal, which is to answer the question: how are we to ensure fair prices for consumers of all categories?

An analysis of data from 69 ITU Member States over the period 2008-2014 shows that tariffs may fall without any adverse effect on investment or operators' revenues. This is generally the case apart from certain European countries, when the market appears to be stagnating in terms of growth.

Experiences of infrastructure sharing involving governments and regulatory authorities, to adapt regulation, finance backbone projects or enforce specific obligations, show that cases of infrastructure sharing can have a significant impact in terms of reducing network deployment times and cutting costs.

Establishing a regulatory accounting system assures the regulator that rules of competition can be applied and operators will apply fair prices for consumers; those prices must continue to fall.

In the light of these conclusions, the Rapporteur Group for Q4/1 proposes the guidelines set out below.

6.1 Guidelines on infrastructure sharing

A number of guidelines already exist. For this reason we suggest that governments and regulators apply the different forms and arrangements for infrastructure sharing that have already been proposed.

In particular, the following forms of infrastructure sharing, according to recent experience, seem likely to reduce coverage times and costs still further:

- Those based on regulatory changes in support of operators' initiatives;
- Those entailing involvement or intervention of government in funding investment for shared use;
- Those imposing models of obligatory deployment by operators on the basis of shared territory with a requirement for national roaming or active infrastructure sharing, in particular of frequencies.

Regulatory authorities and governments are invited to develop policies and incentives for the implementation of infrastructure-sharing models.

6.2 Guidelines on reducing tariffs/prices

Market trends show a decline in tariffs. The state of technology and productivity gains suggest that this downward trend will continue.

Policies implemented by governments and market regulation should aim to:

- Strengthen competition;
- Apply tariff regulation in market segments where market rules do not allow for a tariff-reduction approach; any such cases should require justification and be handled in a proportionate manner;

– Promote initiatives including active and passive infrastructure sharing, public and/or private financing in shared-use investment, which have a strong impact on cost reduction, and ensure that those reductions are reflected in final consumer prices as a result of sound regulatory accounting;

– Promote fiscal, parafiscal and other incentives to encourage operators to lower tariffs, including the elimination of customs duties on telecommunication/ICT equipment and terminals;

– Regulate operators' profit margins in cases where competition fails to produce satisfactory results in terms of achieving the desired price levels. To that end, the requirement to maintain a regulatory accounting system must be enforced.

6.3 Guidelines for stimulating access to and use of services

Governments and regulators are invited to stimulate access to and use of services by promoting policies and measures to:

– Lower tariffs;

– Implement strategies for universal access irrespective of category and location of users, and intended in particular to benefit persons with disabilities;

– Develop uses at the level of individuals, enterprises, public authorities, and in terms of government – citizen and government – enterprise relations.

Abbreviations and acronymes

Various abbreviations and acronyms are used through the document, they are provided here.

Abbreviation/acronym	Description
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).
AIS	Active Infrastructure Sharing
AIP	Administrative Incentive Pricing
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.
BEREC	Body of European Regulators of Electronic Communications
BDT	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
CAPM	Capital Asset Pricing Model
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.

Abbreviation/acronym	Description
CPI	Consumer price index
DSLAM	Digital Subscriber Line Access Multiplexer
EDGE	Enhanced Data Rates for GSM Evolution: Mobile telephone standard which is an extension of GSM with retrocompatibilty.
Ethernet	A local packet-switched network protocol.
EU	European Union
FAC	Fully Allocated Costs
FDC	Fully Distributed Costs
Frameworx	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.
FTR	Fixed termination rates
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.
GCC	Gulf Cooperation Council
GDP	Gross domestic product
GIS	Geographical Information System
Gigabit Ethernet (10GbE, 10GE, 10GigE)	Different technologies used for Ethernet frames at 10 Gbit/s (IEEE 802.3 ae).
GNI:	Gross National Income
GOS	Gross Operating Surplus
ICTs	Information and Communication Technologies: It 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).

Abbreviation/acronym	Description
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.
IPB	ICT Price Basket
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.
LTE	Long Term Evolution
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
MTR	Mobile Termination Rates
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.

Abbreviation/acronym	Description
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.
PIS	Passive Infrastructure Sharing
PPP	Purchasing Power Parity
PSTN	Public Switched Telephone Network: The public telephone network that delivers fixed telephone service.
QoS	Quality of Service
Quadruple Play	Package of fixed and mobile telephony, video, and broadband Internet services
Ring-back tone	Personalized telephone ring tones
RNC	Radio Network Controller
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 (soft switch) 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.
SMS	Short Message Service
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.

Abbreviation/acronym	Description
TSLRIC	Total Service Long-Run Incremental Costs
ULL	Unbundled Local Loop: See LLU.
UMTS	Universal Mobile Telecommunication System: A third-generation mobile phone technology.
US	Universal Service
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).
WACC	Weighted Average Cost of Capital
WAEMU	West African Economic and Monetary Union
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	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 5G mobile cellular telephony.
3G	Third-generation mobile network or service; generation of mobile systems designated IMT 2000 by ITU. The system allows faster communication services that 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.
5G	Fifth-generation mobile network or service.

Annexes

Annex 1: ITU/BDT questionnaire on tariff policies

All the information about the ITU Tariff Policies survey, as well as the ICTEye database is available at: http://www.itu.int/en/ITU-D/Regulatory-Market/Pages/SurveyTariff.aspx.

Annex 2: Template used for country case studies for Question 4/1

Section 1: Market context

1.1 Please describe the market context in your country (e.g. technology, number of players, number of subscribers, market share, etc.)

Section 2: New charging methods (or models) for services provided over Next Generation Networks (NGNs)

2.1 What are the method/cost models adopted for determining NGN/NGA tariffs in your country? Please explain your experience in building and implementing them.

2.2 Did you consider the pure LRIC model as an option? If not, what are the reasons for not adopting it?

Section 3: Different models for infrastructure sharing

3.1 Please describe your experiences on infrastructure sharing, including sharing infrastructure with other non-telecom operators and other sectors such as electricity, TV, railways, etc.

3.2 Please describe the benefits of sharing infrastructure and its quantitative impact on:

- Investment costs
- Prices of telecommunication/ICT services
- Competition in telecommunication/ICT services.

Section 4: Consumer price evolution and the impact on ICT services

4.1 Please describe the quantitative impact of price reduction on:

- Adoption and use of ICT services (e.g. e-banking, e-commerce, e-learning, etc.)
- Consumption (e.g. penetration, number of subscribers, use of telecom services, etc.)
- Innovation
- Investment by operators
- Revenues of service providers and operators.

Section 5: Methods of determining licence costs

5.1 Please describe the different types of licence and the methods of granting them in your country.

5.2 Please describe the different methods of determining licence fees, the amounts involved, and payment modalities.

5.3 How have licence fees evolved in your country?

Annex 3: List of contributions and other documents received for Question 4/1

Reports

Web	Date	Source	Title
1/REP/4	2014-09-16	Rapporteur for Question 4/1	Report of the Rapporteur Group Meeting on Question 4/1 (Geneva, Tuesday 16 September 2014, 14:30- 17:30 hours)
RGQ/REP/4	2015-04-15	Rapporteur for Question 4/1	Report of the Rapporteur Group Meeting on Question 4/1 (Geneva, Tuesday 16 September 2014, 14:30- 17:30 hours)
1/REP/14	2015-09-17	Rapporteur for Question 4/1	Report of the Rapporteur Group Meeting on Question 4/1(Geneva, Thursday 17 September 2015, 14:30- 17:00 hours)
RGQ/REP/13	2016-04-15	Rapporteur for Question 4/1	Report of the Rapporteur Group meeting on Question 4/1 (Geneva, Wednesday, 6 April 2016, 09:30-12:30 and 14:30- 17:30 hours)
1/REP/24	2016-09-20	Rapporteur for Question 4/1	Report of the Rapporteur Group meeting on Question 4/1 (Geneva, Friday, 23 September 2016, 09:00-12:00 hours)
RGQ/REP/22	2017-01-13	Rapporteur for Question 4/1	Report for the Rapporteur Group meeting on Question 4/1 (Geneva, Thursday, 12 January 2017, 09:30- 12:30 hours)
1/REP/34	2017-03-01	Rapporteur for Question 4/1	Report of the Rapporteur Group meeting on Question 4/1 (Geneva, Friday, 31 March 2017, 09:00-12:00 hours)

Question 4/1 contributions for Rapporteur Group and Study Group meetings

Web	Date	Source	Title
1/470	2017-03-17	BDT Focal Point for Question 1/1	GSR-17 provisional programme focusing on living in a world of digital opportunities
1/452	2017-03-13	Iran University of Science & Technology	Economic facilities for developing services related to national telecommunication/ICT networks in Iran (v0.8)
1/440	2017-01-12	Rapporteur for Question 4/1	Report of the Rapporteur Group meeting on Question 4/1, Geneva, 12 January 2017
1/415 [OR]	2017-02-10	Rapporteur for Question 4/1	Draft Final Report for Question 4/1
1/392	2016-09-28	Rapporteur for Question 4/1	Liaison Statement from ITU-D Study Group 1 Question 4/1 to ITU-T Study Group 3 on collaboration
1/379	2016-09-07	Oman Telecommunications Regulatory Authority (TRA)	Contribution towards Chapter 5: Regulatory accounting in an NGN environment

Web	Date	Source	Title
1/357	2016-09-07	Switzerland (Confederation of)	Contribution for inclusion in Section 4 of the report on Question 4/1, "Methods of determining the licences costs"
1/349 +Ann.1-2	2016-08-18	BDT Focal Point for Question 4/1	Results from the ITU Tariff Policies Survey 2015 on Section 7 on Next Generation Networks
1/345 +Ann.1-2	2016-08-18	BDT Focal Point for Question 4/1	Results from the ITU Tariff Policies Survey 2015 on Section 5: Interconnection Issues
1/324	2016-08-05	Côte d'Ivoire (Republic of)	Specific solutions involving infrastructure sharing for national digital development
1/322	2016-08-05	Côte d'Ivoire (Republic of)	Case study replies using the questionnaire Template
1/308 +Ann.1	2016-08-04	BDT Focal Point for Question 6/1	GSR 2016 Discussion Papers and Best Practice Guidelines
1/300 [OR]	2016-08-04	Rapporteur for Question 4/1	Draft report for Question 4/1 (Economic policies and methods of determining the costs of services related to national telecommunication/ICT networks, including next-generation networks)
1/281	2016-11-23	Guinea (Republic of)	Charges levied in the mobile telephone sector in Guinea
1/276	2016-07-23	Tactikom	Overview of an accounting model
1/275	2016-07-23	Tactikom	New environment directly influencing methods of determining costs of electronic communication services in the new sectoral ecosystem
1/244	2016-04-06	Rapporteur for Question 4/1	Report of the Rapporteur Group Meeting on Question 4/1, Geneva, 6 April 2016
RGQ/228	2016-03-22	BDT Focal Point for Question 4/1	ICT and Broadcasting Infrastructure Sharing summary and guidelines
RGQ/224 +Ann.1	2016-03-22	BDT Focal Point for Question 4/1	Results from the ITU Tariff Policies Survey 2014 on Section 8 on infrastructure sharing
RGQ/223 +Ann.1	2016-03-22	BDT Focal Point for Question 4/1	Development of Next Generation Networks (NGN): country case studies update for European countries
RGQ/219 +Ann.1	2016-03-22	BDT Focal Point for Question 4/1	Presentation on Trends on telecommunication/ICT services? Regulation and tariff policies
RGQ/207	2016-03-21	Togolese Republic	Draft report for Question 4/1 (Economic policies and methods of determining the costs of services related to national telecommunication/ICT networks, including next-generation networks)
RGQ/180	2016-03-07	Lao People's Democratic Republic	Lao P.D.R Telecommunications Sector overview
RGQ/166	2016-02-25	Viet Nam (Socialist Republic of)	Current issues of determining the costs of telecommunication services in Viet Nam

Web	Date	Source	Title
RGQ/156	2016-02-19	Togolese Republic	Methods for determining license fees or costs
RGQ/145	2016-02-16	Guinea (Republic of)	Template for country case studies for Question 4/1. Consumer price evolution and the impact on ICT services
RGQ/122	2015-09-09	Mozambique (Republic of)	Mozambique country case study for Question 4/1
RGQ120	2015-09-09	New Zealand	Case study from New Zealand – Response to ITU-D Q4/
1/219	2015-08-30	Egypt (Arab Republic of)	General procedures and practical issues for estimating WACC
1/214	2015-08-25	Russian Federation	Experience of the Russian Federation in the sharing of telecommunication infrastructure
1/207	2015-08-26	Tonga (Kingdom of)	Tonga case studies for Question 4/1
1/201	2015-08-24	ITU-APT Foundation of India	New Pricing approach on Mobile Termination Rate (MTR) and Fixed Termination Rate (FTR) in India
1/199	2015-08-21	Democratic Republic of the Congo	Case studies relating to the questionnaire in the Annex to Question 4/1
1/196 +Ann.1-4	2015-08-21	BDT Focal Point for Question 4/1	Results from the ITU Tariff Policies Survey 2014 on section 3 on Cost and Tariff Models
1/164	2015-07-31	Côte d'Ivoire (Republic of)	The need to develop a method of estimating licence costs
1/163	2015-07-31	Côte d'Ivoire (Republic of)	Elaboration of guidelines on passive infrastructure sharing
1/157	2015-07-31	Rapporteur pour la Question 4/1	Draft report for Question 4/1 (Economic policies and methods of determining the costs of services related to national telecommunication/ICT networks, including next generation networks)
1/147	2015-07-27	Odessa National Academy of Telecommunications n.a. A.S. Popov	Practical aspects of applying a method of determining tariffs for telecommunication services based on cost modelling
1/146	2015-07-27	Saudi Arabia (Kingdom of)	Costing models used to determine the cost of providing the wholesale services
1/137	2015-07-21	Gambia (Republic of the)	Cost of service regulation: The Gambian experience
1/131	2015-07-13	Indonesia (Republic of)	Contribution paper for ITU Global Strategic Dialogue on international mobile roaming
1/112	2015-05-11	Rapporteur for Question 4/1	Template for country case studies for Question Q4/1

Web	Date	Source	Title
1/111	2015-05-11	Rapporteur for Question 4/1	Revised table of content and timeline for the Report on Question 4/1
1/95	2015-04-11	India (Republic of)	Possible charging mechanism of wholesale pricing i.e. Interconnection Usage Charges (IUC) in developing countries
RGQ/86	2015-03-19	Brazil (Federative Republic of)	Differences between local CAPM and global CAPM to estimate the cost of equity
RGQ/78	2015-03-15	Oman (Sultanate of)	The Government of Oman incentives for broadband network development
RGQ/71	2015-03-10	Democratic Republic of the Congo	Contribution à la Question 4/1 sur la Section 2 relative au partage des infrastructures
RGQ/19	2015-01-22	Odessa National Academy of Telecommunications n.a. A.S. Popov	Some features of tariffs determination for telecommunications services on the basis of the simulation the cost of their providing
RGQ/10	2014-12-15	Rapporteur for Question 4/1	Draft work plan for Question 4/1
RGQ/1	2014-09-08	Viet Nam (Socialist Republic of)	Current methods of determining the costs of telecommunication services in Viet Nam
1/40	2014-08-05	Côte d'Ivoire (Republic of)	Development of the Internet in Côte d'Ivoire
1/34	2014-07-31	Brazil (Federative Republic of)	Using a local CAPM model to estimate the WACC in the telecommunication sector
1/32	2014-07-28	Odessa National Academy of Telecommunications n.a. A.S. Popov	Determination of tariffs for telecommunication services based on process modelling
1/26	2014-07-08	BDT Focal Point for Question 4/1	List of resources en economic regulation developed in the framework of the Regulatory and Market Environment Division (RME)
1/25	2014-07-08	BDT Focal Point for Question 4/1	Trends on telecommunication/ICT services Regulation and Costs and Tariff Policies

Contributions for QAll for Rapporteur Group and Study Group meetings

Web	Received	Source	Title
1/458 +Ann.1	2017-03-17	Telecommunication Development Bureau	Feedback received through the survey on ITU-D Study Group Questions, Procedures, and Proposals on Future Activities
1/457	2017-03-17	Telecommunication Development Bureau	Innovation activities in ITU-D
1/454	2017-03-15	Russian Federation	Proposals for the revision and rearrangement of ITU-D Study Groups 1 and 2' Study Questions

Web	Received	Source	Title
1/447 +Ann.1-2	2017-03-09	Rapporteur for Question 9/2	Analysis of feedback received through the global survey on the work of ITU-D study groups
1/434	2017-02-22	Vice-Chairman, ITU-D Study Group 2 , and Co-Rapporteur for Question 8/2	Study Groups, study Questions, and working method for WTDC-17
1/432 +Ann.1	2017-02-17	Côte d'Ivoire (Republic of)	Draft texts for the revision of the study Questions and new Questions for the period 2018-2021
1/431	2017-02-17	Côte d'Ivoire (Republic of)	Proposal for new Question on Internet of Things for the study period 2018-2021
1/396	2017-01-30	Chairman, ITU-D Study Group 1, Vice-Chairman, ITU-D Study Group 1	Survey on ITU-D Study Group Questions, Procedures, and Proposals on Future Activities
1/371	2016-09-07	Telecommunication Development Bureau	Update on innovation activities to ITU-D Study Groups
1/332	2016-08-05	General Secretariat	WSIS Stocktaking 2014-2016 Regional Reports of ICT Projects and Activities
1/331	2016-08-05	General Secretariat	WSIS Prizes 2016-2017
1/330	2016-08-05	General Secretariat	WSIS Stocktaking 2016-2017
1/310	2016-08-04	General Secretariat	WSIS Action Line Roadmaps C2, C5 and C6
1/309	2016-08-04	General Secretariat	ITU's Contribution to the Implementation of the WSIS Outcomes 2016
1/307	2016-08-04	General Secretariat	WSIS Forum 2016 and SDG Matrix
1/306	2016-08-04	General Secretariat	WSIS Action Lines Supporting Implementation of the SDGs
1/305	2016-08-04	General Secretariat	WSIS Forum 2016: High Level Track Outcomes and Executive Brief
1/304	2016-08-04	General Secretariat	WSIS Forum 2016 Outcome Document – Forum Track
1/303	2016-08-04	General Secretariat	WSIS Forum 2017 – Open Consultation Process
1/253 Rev.1	2016-05-31	Chairman, ITU-D Study Group 1	Compendium of Draft Outlines for expected outputs to be produced by ITU-D Study Group 1 Questions and Resolution 9 (September 2016)
RGQ/204	2016-03-18	BDT Focal Point for Question 8/1 and Resolution 9	Outcomes of RA-15,WRC-15 and CPM19-1 related to ITU-D

Web	Received	Source	Title
RGQ/152	2016-02-18	Kazakhstan (Republic of)	Contribution from Kazakhstan to Questions 1/1, 2/1, 3/1, 4/1, 5/1, 6/1, 7/1, 8/1 and 5/2
1/232 +Ann.1	2015-09-13	Chairman, ITU-D Study Group 1	Work plan for ITU-D Study Group 1 (September 2015)
1/231 (Rev.1)	2015-09-04	Chairman, ITU-D Study Group 1	Compendium of Draft Outlines for Expected Outputs to be Produced by ITU-D Study Group 1 Questions and Resolution 9 (September 2015)
1/229 (Rev.1)	2015-09-02	Argentine Republic	Draft new Resolution: "Telecommunication/ICT accessibility for persons with disabilities and persons with specific needs"
1/228 (Rev.1)	2015-09-02	Argentine Republic	Modification of the Resolution ITU-R 61 "Contribution in implementing the outcomes of the World Summit on the Information Society"
1/200	2015-08-25	Telecommunication Development Bureau	ITU-D Study Groups Innovation Update
1/183	2015-08-07	Telecommunication Development Bureau	1st ITU-D Academia Network Meeting
1/145	2015-07-24	General Secretariat	WSIS Forum 2015: High level policy statements, Outcome document, Reports on WSIS Stocktaking
1/126	2015-07-06	Uganda (Republic of)	Increasing women's participation in ITU Study Groups' work
1/125	2015-06-29	BDT Focal Point for Question 1/1	ITU GSR15 discussion papers and best practice guidelines
1/70	2014-09-18	Chairman, ITU-D Study Group 1	Appointed Rapporteurs and Vice-Rapporteurs of ITU-D Study Group 1 Questions for the 2014-2018 period
1/66	2014-09-04	Telecommunication Development Bureau	List of information documents
1/65	2014-09-03	Australia, Samoa (Independent State of), United Kingdom of Great Britain and Northern Ireland, Vanuatu (Republic of)	Numbering misappropriation
1/64	2014-09-03	Intel Corporation	New question for ITU-D Study Group 1 (2014-2018): Assistance to developing countries for the implementation of ICT programs in education
1/50	2014-08-28	United States of America	Selected recent developments in U.S. spectrum management
1/48	2014-08-23	Nepal (Republic of)	Need for developing detailed table of contents for each Question under both the ITU-D Study Groups at the beginning

Web	Received	Source	Title
1/38 +Ann.1	2014-08-04	Telecommunication Development Bureau	Quality of Service Training Programme (QoSTP)
1/22	2014-06-27	BDT Focal Point for Question 1/1	Status report on Regulatory and Market Environment
1/5 (Rev.1-2)	2014-09-08	Telecommunication Development Bureau	Candidates for Rapporteurs and Vice-Rapporteurs of ITU-D Study Group 1 and 2 study Questions for the 2014-2018 period
1/4	2014-09-01	Telecommunication Development Bureau	List of WTDC Resolutions and ITU-D Recommendations relevant to the work of the ITU-D Study Groups
1/3	2014-08-20	Telecommunication Development Bureau	Resolution 9 (Rev. Dubai, 2014): Participation of countries, particularly developing countries, in spectrum management
1/2 +Ann.1	2014-08-20	Telecommunication Development Bureau	Resolution 2 (Rev. Dubai, 2014): Establishment of study groups + Full text of all ITU-D Study Group 1 Questions in Annex 1
1/1	2014-06-11	Telecommunication Development Bureau	Resolution 1 (Rev. Dubai, 2014): Rules of procedure of the ITU Telecommunication Development Sector

Information Documents

Web	Received	Source	Title	Questions
N/A				

Liaison Statements

Web	Received	Source	Title
1/92	2015-04-08	ITU-T Study Group 3	Liaison Statement from ITU-T SG3 to ITU-D SG1 Question 4/1 on Activities to Question 4/3 related to regional cost models
1/20	2014-06-09	ITU-T Study Group 3	Liaison Statement from ITU-T SG3 to ITU-D SG1 Q4/1 on Wholesale Invoicing Checklist

Liaison Statements for QAll

Web	Received	Source	Title
1/460	2017-03-17	ITU-T JCA-AHF	Liaison Statement from ITU-T JCA-AHF to ITU-D SG1 on recent meeting reports of Joint Coordination Activity on Accessibility and Human Factors (JCA-AHF)
1/456	2017-03-17	ITU-T JCA-AHF	Liaison Statement from ITU-T JCA-AHF to ITU-D SG1 on Call for voluntary contributions to the ITU Accessibility Fund
1/398	2017-01-31	ITU-T Study Group 12	Liaison Statement from ITU-T SG12 to ITU-D SG1 and SG2 on operational plan for implementation of WTSA-16 Resolution 95 (Hammamet, 2016)

Web	Received	Source	Title
1/287	2016-07-29	TSAG	Liaison Statement from TSAG to ITU-D Study Groups on ITU inter-sector coordination
1/286	2016-07-29	ITU-T JCA-AHF	Liaison statement from ITU-T JCA-AHF Chairman to ITU-D SG1 on JCA-AHF recent meeting report
1/260	2016-10-31	ITU-T Study Group 15	Liaison Statement from ITU-T SG15 to ITU-D Study Groups 1 and 2 on the latest version of the Access Network Transport (ANT), Smart Grid and Home Network Transport (HNT) Standards Overviews and Work Plans
1/257	2016-06-28	ITU-T Study Group 12	Liaison Statement from ITU-T SG12 to ITU-D SG1 and SG2 on revised definition of Quality of Experience (QoE) and new terms in Rec. P.10/G.100
1/256	2016-06-28	ITU-T Study Group 12	Liaison Statement from ITU-T SG12 to ITU-D SG1 and SG2 on ITU inter-Sector coordination (reply to TSAG LS17)
1/186	2016-03-09	ITU-R Study Groups-Working Party 5D (IMT System)	Liaison statement from ITU-R WP 5D to ITU-D SG1 on Working document towards a preliminary draft new report ITU-R SM.(innovative regulatory tools)
1/181	2016-03-07	ITU-T Study Group 15	Liaison statement from ITU-T SG15 to ITU-D SG1 and 2 on the latest version of the Access Network Transport (ANT), Smart Grid and Home Network Transport (HNT) Standards Overviews and Work Plans
1/172	2016-03-03	ITU-D Study Group 15	Liaison statement from ITU-T Study Group 15 to ITU-D SG 1 and 2 on ITU-T SG15 OTNT standardization work plan
1/171	2016-03-03	ITU-T Study Group 15	Liaison statement from ITU-T Study Group 15 to ITU-D SG 1 and 2 on new technical classification and numbering of ITU-T L-Series Recommendations
1/139	2016-02-08	TSAG	Liaison statement from TSAG to ITU-D study groups 1 and 2 on ITU inter-Sector coordination
1/124	2015-11-18	ITU-R Study Group Department	Liaison statement from ITU-R Study Group Department to ITU-D SG 1 and 2 on Resolutions approved at the Radiocommunication Assembly (RA-15)
1/118	2015-09-29	Asia-Pacific Telecommunity (APT)	Liaison statement from the APT Standardization Program Forum (ASTAP) to ITU-D Study Group 1 and 2 on NGN activities
1/202	2015-08-24	ITU-T JCA-AHF	Liaison Statement from ITU-T JCA-AHF, Chairman to ITU-D SGs on Draft meeting report of Joint Coordination Activity on Accessibility and Human Factors (JCA-AHF) in Geneva on 17 June 2015

Web	Received	Source	Title
1/128	2015-07-10	ITU-T Study Group 15	Liaison Statement from ITU-T SG15 to ITU-D SGs on the latest versions of the Access Network Transport (ANT), Smart Grid and Home Network Transport (HNT) Standards Overviews and Work Plans
1/127	2015-07-04	ITU-T Study Group 15	Liaison Statement from ITU-T SG15 to ITU-D SGs on ITU-T SG15 OTNT standardization work plan
1/124	2015-07-12	TSAG	Liaison Statement from TSAG to ITU-D Study Groups on ITU inter-sector coordination
1/120	2015-06-23	ITU-R Study Groups – Working Party 1B	Liaison Statement from ITU-R WP1B to ITU-D Study Group 1 on Working document towards a preliminary draft new report ITU-R SM on Innovative regulatory tools
1/116	2015-05-19	ITU-T Focus Group on SSC	Liaison Statement from ITU-T FG-SSC to ITU-D SGs on Final deliverables of the Focus Group on Smart Sustainable Cities (FG-SSC) and proposal of a new Study Group
1/113	2015-05-12	ITU-T Study Group 13	Liaison Statement from ITU-T SG13 to ITU-D SGs on Development of the Roadmap on IMT
1/100	2015-04-30	ITU-T Study Group 11	Liaison Statement from ITU-T SG11 to ITU-D Study Groups on the progress on standardization work to combat Counterfeit ICT devices
1/99	2015-04-29	ITU-T Study Group 16	Liaison Statement from ITU-T SG16 to ITU-D SGs on ITU-D SG1 and SG2 Questions of interest to ITU-T Study Groups
1/98	2015-04-29	ITU-T Focus Group on Digital Financial Services	Liaison Statement from ITU-T Focus Group on Digital Financial Services (DFS) to ITU-D Study Groups on BDT's work on ITU m-Powering Development
1/97	2015-04-29	ITU-T Focus Group on Digital Financial Services	Liaison Statement from ITU-T Focus Group on Digital Financial Services (DFS) to ITU-D Study Groups concerning its work
1/68	2015-03-03	ITU-T Study Group 16	Liaison Statement from ITU-T SG16 to ITU-D SGs on ITU-D SG1 and SG2 Questions of interest to ITU-T Study Groups
1/28	2015-02-10	ITU-R Study Groups – Working Party 5D	Liaison Statement from ITU Radiocommunication Study Groups WP5D to ITU-D Study Groups concerning the Handbook on "Global Trends in IMT"
1/27	2015-02-10	ITU-R Study Groups – Working Party 5D	Liaison Statement from ITU Radiocommunication Study Groups WP5D to ITU-D Study Groups concerning the Handbook on "Global Trends in IMT"
1/21	2015-01-23	ITU-T FG DFS	Liaison Statement from ITU-T Focus Group on Digital Financial Services (DFS) to ITU-D Study Groups on BDT's work on ITU m-Powering Development

Web	Received	Source	Title
1/20	2015-01-22	ITU-T FG DFS	Liaison Statement from ITU-T Focus Group on Digital Financial Services (DFS) to ITU-D Study Groups concerning its work
1/18	2014-05-23	ITU-T JCA-AHF	Liaison Statement from ITU-T Joint Coordination Activity on Accessibility and Human Factors (JCA-AHF) on Assistive Listening Devices (ALD) and the allocation of Mobile Phone Services in the 2.3-2.4 GHz band
1/16	2014-03-10	ITU-T Study Group 11	Liaison Statement from ITU-T Study Group 11 to ITU-D SG1 and SG2 on Request for status update from GSMA and ITU on proposed studies on the issue of mobile theft, grey market and counterfeit devices
1/15 (Rev.1)	2014-03-10	ITU-T Study Group 11	Liaison Statement from ITU-T Study Group 11 to ITU-D SG1 and SG2 on Technical report on counterfeit equipment
1/12	2014-02-10	ITU-T Focus Group on Innovation	Liaison Statement from the ITU-T FG on Innovation to ITU-D SG1 and SG2 on New Standardization Activities for ITU-T study groups and ICT Innovation Panel
1/9	2013-10-22	ITU-T Focus Group on Innovation	Liaison Statement from the ITU-T FG on Innovation to ITU-D SG1 and SG2 on inputs on ICT innovation panel

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