Final Report

ITU-D
Study Group 2

Question 9/2

Identification of study topics in the ITU T and ITU R study groups which are of particular interest to developing countries

6th Study Period
2014-2017

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Question 9/2: Identification of study topics in the ITU-T and ITU-R study groups, which are of particular interest to developing countries

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 2** was led by the Chairman, Ahmad Reza Sharafat (Islamic Republic of Iran), and Vice-Chairmen representing the six regions: Aminata Kaba-Camara (Republic of Guinea), Christopher Kemei (Republic of Kenya), Celina Delgado (Nicaragua), Nasser Al Marzouqi (United Arab Emirates), Nadir Ahmed Gaylani (Republic of the Sudan), Ke Wang (People's Republic of China), Ananda Raj Khanal (Republic of Nepal), Evgeny Bondarenko (Russian Federation), Henadz Asipovich (Republic of Belarus), and Petko Kantchev (Republic of Bulgaria).

Final report

This final report in response to **Question 9/2: "Identification of study topics in the ITU-T and ITU-R study groups which are of particular interest to developing countries"** has been developed under the leadership of its Rapporteur: Nasser Al Marzouqi (United Arab Emirates) with the assistance of the 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.

Please consider the environment before printing this report.

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Executive Summary

i. Introduction

Question 9/2 adopted by the 2014 World Telecommunication Development Conference (WTDC-14) calls for: "Identification on a continuing basis of those study group topics in the ITU T and ITU R which are of particular interest to developing countries". This Question is for the benefit of both ITU-D study groups.

First adopted at WTDC-94, this Question was renewed for the fifth time at WTDC-14. The choice of these topics is based on an agreed set of Guidelines which are normally adopted at the first meeting of the Study Group based on proposals made by the Rapporteurs.

ii. Executive summary

This report illustrates ITU Radiocommunication Sector (ITU-R) and ITU Telecommunication Standardization Sector (ITU-T) studies and activities which are of particular interest to developing countries. The ITU-R and ITU-T study groups undertake many studies on topics with diverse purposes, outputs and focuses. Many of these studies on topics are, or could be, of interest to ITU-D Membership, developing countries in particular.[1] Developing countries frequently lack resources to follow the work of even a limited number of study groups in the other two Sectors, and are not aware of the agreed Questions, their purpose and status of implementation. There is no doubt that some developing countries are now in a position to take part in the work of some of the study group Questions from the other two Sectors, whilst they are likely to benefit from the outputs of these studies.

ITU-D Question 9/2 held five meetings during this study period. Due to the nature of this Question very few contributions were received for consideration. Representatives from the Radiocommunication Bureau (BR) and the Telecommunication Standardization Bureau (TSB) were invited to Question 9/2 meetings, as were representatives of the ITU General Secretariat.

This Question developed a general survey which served both ITU-D study groups. The purpose of this survey was to gather information and feedback from the ITU-D Membership to determine the extent to which the Member States, and in particular the developing countries, benefit from the outputs of ITU-D Study Group 1 and 2 studies. The results of the survey will be submitted to WTDC 2017 to prepare for the next study period.

It is foreseen in the next study cycle that Question 9/2 might discontinue if an alternative reporting mechanism from TSB, BR and General Secretariat to both ITU-D study groups can be elaborated. During the final ITU-D Study Group 2 meeting for the study period it was expressed that the topic is important. However, the mechanism should be re-considered taking into account close coordination with the Inter-Sector Coordination Team and close cooperation with the ITU-T and ITU-R sectors and the General Secretariat.

A possible future mechanism can be inviting representatives of the two Sectors and the General Secretariat to the opening plenaries of the two ITU-D study groups to present their activities and outputs which are deemed useful not only for developing countries but also for developed countries. One of the Vice-Chairmen from ITU-D study groups can lead to consolidate the presentations into a Report. Further consultations should be undertaken to explore the possible alternative mechanism to ensure that the work carried out by Question 9/2 could continue in a different form. Consideration should also be given to the advantages of holding Question 9/2 meetings. A Report should still be

[1] These include the least developed countries, small island developing states, landlocked developing countries and countries with economies in transition.

developed to benefit those who cannot participate in the actual meetings. In this regard, it is important to consider how the Report will be developed if there is no dedicated study Question.

iii. Guidelines

The following types of topics were identified for Question 9/2:

- Broad areas of studies undertaken in ITU-T and ITU-R which are of interest to the developing countries, delineated in terms of priorities and resources available;
- Questions in ITU-T and ITU-R study groups which are of relevance to Questions under study in ITU-D study groups;
- Other additional relevant Questions based on requests of the members of the Study Group during the new life period of this Question; and
- Any new topics not covered by any Question adopted by WTDC-14 for Study Group 1 or Study Group 2.

1 CHAPTER 1 – ITU-R Questions, Recommendations and Handbooks of particular interest to developing countries

ITU-R

The role of the Radiocommunication Sector (ITU-R) is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using satellite orbits, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.[1]

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by study groups.

The ITU Radiocommunication Sector specializes in facilitating international collaboration to ensure the rational, equitable, efficient and economical use of the radiofrequency spectrum and satellite orbits by:

1) Holding World and Regional Radiocommunication Conferences to expand and adopt Radio Regulations and Regional Agreements covering the use of the radio-frequency spectrum;
2) Approving ITU-R Recommendations, developed by ITU-R study groups in the framework set by Radiocommunication Assemblies, on the technical characteristics and operational procedures for radiocommunication services and systems;
3) Coordinating activities to eliminate harmful interference between radio stations of different countries;
4) Maintaining the Master International Frequency Register (MIFR); and
5) Offering tools, information and seminars to assist national radio-frequency spectrum management.

World Radiocommunication Conference (WRC)

World Radiocommunication Conferences (WRCs) are held every four years. It is the job of the WRC to review, and, if necessary, revise the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum and the geostationary-satellite and non-geostationary-satellite orbits. Revisions are made on the basis of an agenda determined by the ITU Council, which takes into account recommendations made by previous world radiocommunication conferences.

The general scope of the agenda of World Radiocommunication Conferences is established four to six years in advance, with the final agenda set by the ITU Council preferably two years before the conference, with the concurrence of a majority of Member States.

Under the terms of the ITU Constitution, a WRC can:

– Revise the Radio Regulations and any associated frequency assignment and allotment plans;
– Address any radiocommunication matter of worldwide character;
– Instruct the Radio Regulations Board and the Radiocommunication Bureau, and review their activities; and
– Determine topics for study by the Radiocommunication Assembly and its study groups, as well as matters in relation to future Radiocommunication Conferences.

On the basis of contributions from administrations, the Radiocommunication study groups, and other sources concerning the regulatory, technical, operational and procedural matters to be considered by World and Regional Radiocommunication Conferences, the Conference Preparatory Meeting (CPM) prepares a consolidated report to be used in support of the work of such conferences. The last WRC was held in Geneva from 2 to 27 November 2015.

[1] For more detailed information, please consult: http://www.itu.int/itu-r.

Radiocommunication Assembly

Radiocommunication Assemblies (RA) are responsible for the structure, programme and approval of radiocommunication studies. They are normally convened every three or four years and may be associated in time and place with World Radiocommunication Conferences (WRCs).

The Assemblies:

- Assign conference preparatory work and other questions to the study groups;
- Respond to other requests from ITU conferences;
- Suggest suitable topics for the agenda of future WRCs;
- Approve and issue ITU-R Recommendations and ITU-R Questions developed by the study groups; and
- Set the programme for study groups, and disband or establish study groups according to need.

The last Radiocommunication Assembly was held in Geneva from 26 to 30 October 2015. The Radiocommunication Assembly in 2015 maintained the structure of the ITU-R study groups without change.

ITU-R Structure

The Radiocommunication Assembly (Geneva, 2015) maintained the ITU-R study groups structure with six study groups.

ITU-R Workshops

The Radiocommunication Bureau (BR) organizes, in Geneva, world seminars on spectrum management every two years, as well as regional seminars aiming in particular at the needs of developing countries. The main objectives of BR seminars and workshops are: to give assistance to Member States in spectrum management activities, through training, information meetings, seminars, development of handbooks and the provision of tools for automated spectrum management; to expand the assistance offered to Member States in coordinating and registering frequency assignments and in applying the Radio Regulations, with special attention to developing countries and Member States that have recently joined the Union.

The BR also organizes, upon request, individual training in Geneva. This training is usually held in conjunction with important ITU-R meetings and the BR tries to regroup them over a one-week period.

For more information, please consult the following web site: http://itu.int/ITU-R/index.asp?category=conferences&rlink=seminars.

ITU-R Recommendations

The ITU-R Recommendations constitute a set of international technical standards developed by the Radiocomunication. They are the result of studies undertaken by Radiocommunication study groups on:

- The use of a vast range of wireless services, including popular new mobile communication technologies;
- The management of the radio-frequency spectrum and satellite orbits;
- The efficient use of the radio-frequency spectrum by all radiocommunication services;
- Terrestrial and satellite radiocommunication broadcasting;
- Radiowave propagation;

– Terrestrial and satellite systems and networks; and

– Space operation, Earth exploration-satellite, meteorological-satellite and radio astronomy services.

The ITU-R Recommendations are approved by ITU Member States. Their implementation is not mandatory, excepting those incorporated by reference in the Radio Regulations.

The most recent versions of the ITU-R Recommendations in force are published and available at: http://www.itu.int/pub/R-REC.

ITU-R Reports

An ITU-R Report is a technical, operational or procedural statement prepared by an ITU-R Study Group on a given subject related to a current ITU-R Question or the results of ITU-R studies. The ITU-R Reports are published and available at: http://www.itu.int/pub/R-REP.

ITU-R Handbooks

An ITU-R Handbook is a text which provides a statement of the current knowledge, the present position of studies, or of good operating or technical practice, in certain aspects of radiocommunications, which is addressed to a radio engineer, system planner or operating official who plans, designs or uses radio services or systems, paying particular attention to the requirements of developing countries. The ITU-R Handbooks are published and available at: http://www.itu.int/pub/R-HDB.

Radiocommunication Advisory Group (RAG)

The Radiocommunication Advisory Group (RAG) is tasked to:

– Review the priorities and strategies adopted in the Sector;

– Monitor progress of the work of the study groups;

– Provide guidance for the work of the study groups; and

– Recommend measures to foster cooperation and coordination with other organizations and with the other ITU Sectors.

The RAG provides advice on these matters to the Director of the Radiocommunication Bureau (BR). Radiocommunication Assemblies (RAs) may refer specific matters within its competence to the RAG. The RAG may be authorized to act on behalf of the RA between two Assemblies.

Coordination Committee for Vocabulary (CCV)

The CCV is responsible for the coordination and approval in close collaboration with the Radiocommunication study groups, the General Secretariat (Conferences and Publications Department) and other interested organizations (mainly the International Electrotechnical Commission (IEC)), concerning:

– Vocabulary, including abbreviations and initials;

– Related subjects (quantities and units, graphical and letter symbols).

Conference Preparatory Meeting (CPM)

The CPM normally holds two sessions during the interval between WRCs. The first session is to coordinate the work programmes of the relevant ITU-R study groups, to prepare a draft structure for the CPM Report, based on the agenda for the next two WRCs, and to take into account any directives which may have come from the previous WRC.

The second session prepares a consolidated report to be used in support of the work of World Radiocommunication Conferences, based on:

– Contributions from administrations, the Radiocommunication study groups, and other sources concerning the regulatory, technical, operational and procedural matters to be considered by such conferences; and

– The inclusion, to the extent possible, of reconciled differences in approaches as contained in the source material, or, in the case where the approaches cannot be reconciled, the inclusion of the differing views and their justification.

1.1 ITU-R Study Group 1 – Spectrum management

Scope

Spectrum management principles and techniques, general principles of sharing, spectrum monitoring, long-term strategies for spectrum utilization, economic approaches to national spectrum management, automated techniques and assistance to developing countries in cooperation with the Telecommunication Development Sector.

Structure

Three Working Parties (WPs) carry out studies on Questions assigned to Study Group 1:

WP 1A:	Spectrum engineering techniques
WP 1B:	Spectrum management methodologies and economic strategies
WP 1C:	Spectrum monitoring

The goals of ITU-R Working Parties 1A, 1B and 1C activities are to develop and maintain ITU-R Recommendations, Reports and Handbooks relevant to spectrum engineering techniques, spectrum management fundamentals and spectrum monitoring, respectively.

Relevant Questions

Q.205-2/1:	Long-term strategies for spectrum utilization
Q.208-1/1:	Alternative methods of national spectrum management
Q.216-1/1:	Spectrum redeployment as a method of national spectrum management
Q.232-0/1:	Methods and techniques used in space radio monitoring
Q.235-0/1:	Spectrum monitoring evolution
Q.238-0/1:	Characteristics for use of visible light for broadband communications

All the ITU-R Questions assigned to Study Group 1 are published and available at: http://www.itu.int/pub/R-QUE-SG01/.

Relevant Recommendations

– **SM series: Spectrum management**

SM.1047-2:	National spectrum management
SM.1049-1:	A method of spectrum management to be used for aiding frequency assignment for terrestrial services in border areas

SM.1131-0:	Factors to consider in allocating spectrum on a worldwide basis
SM.1133-0:	Spectrum utilization of broadly defined services
SM.1265-1:	National alternative allocation methods
SM.1370-2:	Design guidelines for developing automated spectrum management systems
SM.1392-2:	Essential requirements for a spectrum monitoring station for developing countries
SM.1413-3:	Radiocommunication Data Dictionary for notification and coordination purposes
SM.1447-0:	Monitoring of the radio coverage of land mobile networks to verify compliance with a given licence
SM.1603-2:	Spectrum redeployment as a method of national spectrum management
SM.1682-1:	Methods for measurements on digital broadcasting signals
SM.1708-1:	Field-strength measurements along a route with geographical coordinate registrations
SM.1792-0:	Measuring sideband emissions of T-DAB and DVB-T transmitters for monitoring purposes
SM.1880-1:	Spectrum occupancy measurement
SM.1896-0:	Frequency ranges for global or regional harmonization of short-range devices (SRDs)
SM.2039-0:	Spectrum monitoring evolution

All the most recent versions of the ITU-R Recommendations in force in the SM series are published and available at: http://www.itu.int/rec/R-REC-SM/.

Relevant Reports

SM.2012-5:	Economic aspects of spectrum management
SM.2015-0:	Methods for determining national long-term strategies for spectrum utilization
SM.2093-2:	Guidance on the regulatory framework for national spectrum management
SM.2130-0:	Inspection of radio stations
SM.2153-5:	Technical and operating parameters and spectrum requirements for short-range devices
SM.2255-0:	Technical characteristics, standards and frequency bands of operation for radio-frequency identification (RFID) and potential harmonization opportunities
SM.2256-1:	Spectrum occupancy measurements and evaluation
SM.2257-3:	Spectrum management and monitoring during major events
SM.2303-1:	Wireless power transmission using technologies other than radio frequency beam
SM.2351-1:	Smart grid utility management systems
SM.2353-0:	The challenges and opportunities for spectrum management resulting from the transition to digital terrestrial television in the UHF bands
SM.2356-0:	Procedures for planning and optimization of spectrum-monitoring networks in the VHF/UHF frequency range

All the most recent versions of the ITU-R Reports in force in the SM series are published and available at: http://www.itu.int/pub/R-REP-SM/.

Handbooks

- National Spectrum Management: this Handbook covers spectrum management fundamentals, spectrum planning, spectrum engineering, frequency authorization, spectrum use, spectrum control and automation for spectrum management activities. The Handbook describes the key elements of spectrum management and is intended for the use by administrations of both developing and developed countries. (Edition 2015).
- Spectrum Monitoring: this Handbook it covers all essential features of spectrum monitoring techniques and activities, including the establishment of monitoring facilities. The principles governing this handbook show that spectrum monitoring requires equipment, personnel and procedures. The handbook is an essential accessory for all administrations and spectrum monitoring agencies in the world, both for developing and developed countries. (Edition 2011).
- Computer-aided Techniques for Spectrum Management: this Handbook contains basic material and numerous models for developing efficient projects that will assist in implementing automated spectrum management. (Edition 2015).

Remarks

In response to WTDC Resolution 9 (Rev. Dubai, 2014), the Joint ITU-R/ITU-D Group on Resolution 9, which is co-chaired by and involves experts from ITU-D SG1 and ITU-R SG1, is continuing to assist developing countries in fulfilling their national spectrum management functions. With that aim, the Group is preparing a new Report to the next WTDC in response to the new issues mentioned in that Resolution.

1.2 ITU-R Study Group 3 – Radiowave propagation

Scope

Propagation of radio waves in ionized and non-ionized media and the characteristics of radio noise, for the purpose of improving radiocommunication systems.

The Study Group produces Recommendations (in the ITU-R P-series) containing (i) information on the basic propagation characteristics of the troposphere and ionosphere that affect radiowave propagation, and (ii) propagation prediction methods for use by the various radiocommunication services.

Structure

The following four Working Parties (WPs) carry out studies on the Questions assigned to Study Group 3:

WP 3J:	Propagation fundamentals
WP 3K:	Point-to-area propagation
WP 3L:	Ionospheric propagation and radio noise
WP 3M:	Point-to-point and Earth-space propagation

Relevant Questions

Q.201-5/3:	Radiometeorological data required for the planning of terrestrial and space communication systems and space research application
Q.203-6/3:	Propagation prediction methods for terrestrial broadcasting, fixed (broadband access) and mobile services using frequencies above 30 MHz
Q.206-4/3:	Propagation data and prediction methods for fixed- and broadcasting-satellite services
Q.208-5/3:	Propagation factors in frequency sharing issues affecting space radiocommunication services and terrestrial services
Q.211-6/3:	Propagation data and propagation models in the frequency range 300 MHz to 100 GHz for the design of short-range wireless radiocommunication systems and wireless local area networks (WLAN)

All the ITU-R Questions assigned to Study Group 3 are published and available at: http://www.itu.int/pub/R-QUE-SG03/.

Relevant Reports

P.227-3:	General methods of measuring the field strength and related parameters
P.228-3:	Measurement of field strength for VHF (metric) and UHF (decametric) broadcast services, including television

Relevant Recommendations

– **P-series: Radiowave propagation**

P.452-16:	Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz
P.453-12:	The radio refractive index: its formula and refractivity data
P.618-12:	Propagation data and prediction methods required for the design of Earth-space telecommunication systems
P.620-6:	Propagation data required for the evaluation of coordination distances in the frequency range 100 MHz to 105 GHz
P.679-4:	Propagation data required for the design of broadcasting-satellite systems
P.837-6:	Characteristics of precipitation for propagation modelling
P.1144-7:	Guide to the application of the propagation methods of Radiocommunication Study Group 3
P.1406-2:	Propagation effects relating to terrestrial land mobile and broadcasting services in the VHF and UHF bands
P.1410-5:	Propagation data and prediction methods required for the design of terrestrial broadband radio access systems operating in a frequency range from 3 to 60 GHz
P.1411-8:	Propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz
P.1546-5:	Methods for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3 000 MHz

P.1812-4:	A path specific propagation prediction method for point-to-area terrestrial services in the VHF and UHF bands
P.2001-2:	A general purpose wide-range terrestrial propagation model in the frequency range 30 MHz to 50 GHz

– **Handbooks**

- Curves for radiowave propagation over the surface of the Earth.
- Radiometeorology: this Handbook provides general information on radiometeorology and covers the following topics: physical characteristics of the atmosphere, atmospheric refraction, particle scattering, atmospheric gaseous attenuation and dispersion, hydrometeor attenuation, radio emissivity, cross-polarization and anisotropy and statistical aspects of atmospheric processes.
- Radiowave propagation information for predictions for Earth-to-space path communications: this Handbook supplies background and supplementary information on Earth-to-space propagation effects in order to assist in the design of different Earth-space communication systems.
- Ionosphere and its effects on radiowave propagation: this Handbook provides radioplanners and users with a guide on ionospheric properties and propagation effects in order to assist in the design of related radiocommunication systems
- Terrestrial land mobile radiowave propagation in the VHF/UHF bands: this Handbook gives the technical basis for predicting Radiowave propagation in terrestrial point-to-point, point-to-area and point-to-multipoint mobile networks.
- Radiowave propagation information for designing terrestrial point-to-point links: this Handbook supplies background and supplementary information on radiowave propagation effects, and serves as a companion volume and guide to the ITU-R Recommendations that have been developed by Radiocommunication Study Group 3 to assist in the design of terrestrial communication systems.
- ITU-R propagation prediction methods for interference and sharing studies: this Handbook provides technical information and guidance needed for sharing studies and interference assessments using selected ITU-R P-Series RF propagation models and prediction methods. The Handbook is intended to be used in conjunction with ITU-R P-Series Recommendations to assist in performing interference analyses and prediction methods on radiocommunication service systems.
- The Handbook on ground wave propagation is of special interest for communication, particularly broadcasting, at the lower frequencies where the propagation mode has been in use for more than 90 years. It deals with fundamentals and theory, wide-scale considerations and prediction methods used for compatibility assessments and planning procedures. Smaller scale variability, which may be of major importance in assessing the quality of services, is also treated. The topics of measurements and phase are also covered.

1.3 ITU-R Study Group 4 – Satellite services

Scope

Systems and networks for the fixed-satellite service, mobile-satellite service, broadcasting-satellite service and radiodetermination-satellite service.

Structure

Three Working Parties (WPs) carry out studies on Questions assigned to Study Group 4:

WP 4A:	Efficient orbit/spectrum utilization for the fixed-satellite service (FSS) and broadcasting-satellite service (BSS)
WP 4B:	Systems, air interfaces, performance and availability objectives for the fixed-satellite service (FSS), broadcasting-satellite service (BSS) and mobile-satellite service (MSS), including IP-based applications and satellite news gathering (SNG)
WP 4C:	Efficient orbit/spectrum utilization for the mobile-satellite service (MSS) and the radiodetermination-satellite service (RDSS) (WP 4C also deals with the performance issues related to RDSS)

Questions

Q.227/4:	Technical and operational characteristics of emergency communications in the mobile satellite service
Q.286/4:	Contributions of the mobile and amateur services and associated satellite services to the improvement of disaster communications
Q.290/4:	Broadcasting-satellite means for public warning, disaster mitigation and relief

All the ITU-R Questions assigned to Study Group 4 are published and available at: http://www.itu.int/pub/R-QUE-SG04/.

Recommendations

– **S series: Fixed-Satellite service**

S.1001-2:	Use of systems in the fixed-satellite service in the event of natural disasters and similar emergencies for warning and relief operations
S.1782-0:	Possibilities for global broadband Internet access by fixed-satellite service systems
S.1783-0:	Technical and operational features characterizing high-density applications in the fixed satellite service

– **BO Series: Satellite delivery**

BO.1774-2:	Use of satellite and terrestrial broadcast infrastructures for public warning, disaster mitigation and relief (Identical to Recommendation ITU-R BT.1774-2)

– **M Series: Mobile, radiodetermination, amateur and related satellite services**

M.1850-2:	Detailed specifications of the radio interfaces for the satellite component of International Mobile Telecommunications-2000 (IMT-2000)
M.1854-1:	Use of mobile-satellite service in disaster response and relief
M.2014-1:	Global circulation of IMT – satellite terminals
M.2047-0:	Detailed specifications of the satellite radio interfaces of International Mobile Telecommunications-Advanced (IMT-Advanced)

Reports

M.2149-1:	Use and examples of mobile-satellite service systems for relief operation in the event of natural disasters and similar emergencies

M.2176-1:	Vision and requirements for the satellite radio interface(s) of IMT-Advanced
S.2151-1:	Use and examples of systems in the fixed-satellite service in the event of natural disasters and similar emergencies for warning and relief operations
S.2278-0:	Use of very small aperture terminals (VSATs)
S.2361-0:	Broadband access by fixed-satellite service systems

Handbooks

- Satellite communications: this Handbook gives a comprehensive description of all issues relative to satellite communication systems operating in the Fixed-Satellite Service (FSS).
- Specifications of transmission systems for the broadcasting-satellite service.
- Terrestrial and satellite digital sound broadcasting to vehicular, portable and fixed receivers in the VHF/UHF bands, it describes the system and service requirements for Digital Sound Broadcasting (DSB) to vehicular, portable and fixed receivers, the related propagation factors, the techniques employed in the digital sound broadcasting systems, and considers relevant planning parameters and sharing conditions.
- Mobile-Satellite Service (MSS), provides brief survey and introduction to the field of MSS.
- Supplement Number 1, 2, 3 and 4 to Handbook on Mobile-satellite service:
  - Supplement 1: Systems aspects of digital mobile Earth Station.
  - Supplement 2: Methodology for the derivation of interference and sharing criteria for the Mobile-satellite services.
  - Supplement 3: Interference and noise problems for maritime mobile-satellite systems using frequencies in the region of 1.5 and 1.6 GHz.
  - Supplement 4: Technical aspects of coordination among mobile-satellite systems using the geostationary-satellite orbit.

1.4 ITU-R Study Group 5 – Terrestrial services

Scope

Systems and networks for fixed, mobile, radiodetermination, amateur and amateur-satellite services.

Structure

Four Working Parties (WPs) carry out the studies on Questions assigned to Study Group (SG):

WP 5A:	Land mobile service above 30MHz (excluding IMT); wireless access in the fixed service; amateur and amateur-satellite services
WP 5B:	Maritime mobile service including the Global Maritime Distress and Safety System (GMDSS); the aeronautical mobile service and the radiodetermination service
WP 5C:	Fixed wireless systems; HF systems in the fixed and land mobile services
WP 5D:	IMT systems

Questions

Q.7-7/5:	Characteristics of equipment for the land mobile service between 30 and 6 000 MHz

Q.48-7/5:	Techniques and frequency usage in the amateur service and amateur-satellite service
Q.77-7/5:	Consideration of the needs of developing countries in the development and implementation of IMT
Q.209-5/5:	Use of the mobile, amateur, and the amateur satellite services in support of disaster radiocommunications
Q.212-4/5:	Nomadic wireless access systems including radio local area networks
Q.215-4/5:	Frequency bands, technical characteristics, and operational requirements for fixed wireless access systems in the fixed and/or land mobile services
Q.229-4/5:	Future development of the terrestrial component of IMT
Q.235/5:	Protection criteria for aeronautical and maritime systems
Q.238-2/5:	Mobile broadband wireless access systems
Q.241-3/5:	Cognitive radio systems in the mobile service
Q.247-1/5:	Radio-frequency arrangements for fixed wireless systems
Q.248/5:	Technical and operational characteristics for systems in the fixed service used for disaster mitigation and relief
Q.250-1/5:	Mobile wireless access systems providing telecommunications for a large number of ubiquitous sensors and/or actuators scattered over wide areas as well as machine to machine communications in the land mobile service
Q.253/5:	Fixed service use and future trends
Q.256/5:	Technical and operational characteristics of the land mobile service in the frequency range 275-1 000 GHz
Q.257/5:	Technical and operational characteristics of stations in the fixed service in the frequency range 275-1 000 GHz
Q.258/5:	Technical and operational principles for HF sky-wave communication stations to improve the man-made noise HF environment

All the ITU-R Questions assigned to Study Group 5 are published and available at: http://www.itu.int/pub/R-QUE-SG05/.

Recommendations

– **M series: Mobile, radiodetermination, amateur and related satellite services**

M.819-2:	International Mobile Telecommunications-2000 (IMT-2000) for developing countries
M.1036-5:	Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations (RR)
M.1041-2:	Future Amateur Radio Systems
M.1042-3:	Disaster communications in the amateur and amateur-satellite services
M.1043-2:	Use of the amateur and amateur-satellite services in the developing countries
M.1044-2:	Frequency sharing criteria in the amateur and amateur-satellite services

M.1457-12:	Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)
M.1579-2:	Global circulation of IMT-2000 terrestrial terminals
M.1580-5:	Generic unwanted emission characteristics of base stations using the terrestrial radio interfaces of IMT-2000
M.1581-5:	Generic unwanted emission characteristics of mobile stations using the terrestrial radio interfaces of IMT-2000
M.1637-0:	Global cross-border circulation of radiocommunication equipment in emergency and disaster relief situations
M.1826-0:	Harmonized frequency channel plan for broadband public protection and disaster relief operations at 4 940-4 990 MHz in Regions 2 and 3
M.2009-1:	Radio interface standards for use by public protection and disaster relief operations in some parts of the UHF band in accordance with Resolution 646 (WRC-12)
M.2012-2:	Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications Advanced (IMT-Advanced)
M.2015-1:	Frequency arrangements for public protection and disaster relief radiocommunication systems in UHF bands in accordance with Resolution 646 (WRC-12)
M.2070-1:	Generic unwanted emission characteristics of base stations using the terrestrial radio interfaces of IMT-Advanced
M.2071-1:	Generic unwanted emission characteristics of mobile stations using the terrestrial radio interfaces of IMT-Advanced
M.2083-0:	IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond

– **F series: Fixed service**

F.701-2:	Radio-frequency channel arrangements for digital point-to-multipoint radio systems operating in frequency bands in the range 1 350-2 690 GHz (1.5, 1.8, 2.0, 2.2, 2.4 and 2.6 GHz)
F.755-2:	Point-to-multipoint systems in the fixed service
F.757-4:	Basic system requirements and performance objectives for fixed wireless access using mobile-derived technologies offering basic telephony and data communication services
F.1098-1:	Radio-frequency channel arrangements for fixed wireless systems in the 1 900-2 300 MHz band
F.1105-3:	Fixed wireless systems for disaster mitigation and relief operations
F.1111-1:	Improved Lincompex system for HF radiotelephone circuits
F.1242-0:	Radio-frequency channel arrangements for digital radio systems operating in the range 1 350-1 530 MHz
F.1243-0:	Radio-frequency channel arrangements for digital radio systems operating in the range 2 290-2 670 MHz
F.1335-0:	Technical and operational considerations in the phased transitional approach for bands shared between the mobile-satellite service and the fixed service at 2 GHz
F.1399-1:	Vocabulary of terms for wireless access

F.1400-0:	Performance and availability requirements and objectives for fixed wireless access to public switched telephone network
F.1401-1:	Considerations for the identification of possible frequency bands for fixed wireless access and related sharing studies
F.1402-0:	Frequency sharing criteria between a land mobile wireless access system and a fixed wireless access system using the same equipment type as the mobile wireless access system
F.1488-0:	Frequency block arrangements for FWA systems in the range 3 400-3 800 MHz
F.1490-1:	Generic requirements for fixed wireless access systems
F.1500-0:	Preferred characteristics of systems in the fixed service using high altitude platforms operating in the bands 47.2-47.5 GHz and 47.9-48.2 GHz
F.1501-0:	Coordination distance for systems in the fixed service (FS) involving high altitude platform stations (HAPSS) sharing the frequency bands 47.2-47.5 GHz and 47.9-48.2 GHz with other systems in the fixed service

Reports

M.1155-0:	Adaptation of mobile radiocommunication technology to the needs of developing countries
M.2074-0:	Radio aspects for the terrestrial component of IMT-2000 and systems beyond IMT-2000
M.2079-0:	Technical and operational information for identifying spectrum for the terrestrial component of future development of IMT-2000 and IMT-Advanced
M.2085-1:	Role of the amateur and amateur-satellite services in support of disaster mitigation and relief
M.2117-1:	Software-defined radio in the land mobile, amateur and amateur-satellite services
M.2242-0:	Cognitive radio systems specific for IMT systems
M.2243-0:	Assessment of the global mobile broadband deployments and forecasts for International Mobile Telecommunications
M.2291-1:	The use of International Mobile Telecommunications (IMT) for broadband Public Protection and Disaster Relief (PPDR) applications
M.2320-0:	Future technology trends of terrestrial IMT systems
M.2330-0:	Cognitive Radio Systems (CRSs) in the land mobile service
M.2373-0:	Audio-visual capabilities and applications supported by terrestrial IMT systems
M.2376-0:	Technical feasibility of IMT in bands above 6 GHz
M.2377-0:	Radiocommunication objectives and requirements for Public Protection and Disaster Relief (PPDR)
M.2378-0:	Operational guidelines for the deployment of broadband wireless access systems for local coverage operating below 6 GHz
M.2395-0:	Introduction to railway communication systems in certain countries

Handbooks

- Digital radio relay systems: this Handbook represents a comprehensive summary of basic principles, design parameters and current practices for the design and engineering of digital radio-relay systems.
- Land mobile (including wireless access): this Handbook provides an overview of principles and approaches to be considered in the evolution of existing and emerging systems towards IMT-2000.
  - Volume 1: Fixed wireless Access
  - Volume 2: Principles and approaches on evolution to IMT-2000/FPLMTS
- Deployment of IMT-2000 Systems.
- Land mobile (including wireless access): the purpose of this Handbook is to assist in the decision-making process involving planning, engineering and deployment of wireless-based land mobile systems, especially in developing countries.
  - Volume 1: Fixed wireless Access.
  - Volume 2: Principles and Approaches on Evolution to IMT-2000 FPLMTS.
  - Volume 3: Dispatch and Advanced Messaging Systems.
  - Volume 4: Intelligent Transport Systems.
  - Volume 5: Deployment of Broadband Wireless Access Systems.
- Amateur and Amateur-Satellite Services: this Handbook provides general information about the amateur and amateur-satellite services. It also includes a compendium of existing ITU texts of relevance to the amateur and amateur-satellite services.
- Frequency-adaptive communication system and networks in the MF/HF bands: this Handbook is published to assist planners and decision-makers in the deployment of adaptive MF/HF systems in the fixed service, for both commercial and government users in developed and particularly developing countries.
- Global Trends in IMT: this Handbook identifies International Mobile Telecommunications (IMT) and provides the general information such as service requirements, application trends, system characteristics, and substantive information on spectrum, regulatory issues, guideline for the evolution and migration, and core network evolution on IMT. This Handbook also addresses a variety of issues related to the deployment of IMT systems.

1.5 ITU-R Study Group 6 – Broadcasting service

Scope

Radiocommunication broadcasting, including vision, sound, multimedia and data services principally intended for delivery to the general public.

Broadcasting makes use of point-to-everywhere information delivery to widely available consumer receivers. When return channel capacity is required (e.g., for access control, interactivity, etc.), broadcasting typically uses an asymmetrical distribution infrastructure that allows high capacity information delivery to the public with lower capacity return link to the service provider. This includes production and distribution of programmes (vision, sound, multimedia, data, etc.) as well as contribution circuits among studios, information gathering circuits (ENG, etc.) primary distribution to delivery nodes, and secondary distribution to consumers.

The Study Group, recognizing that radiocommunication broadcasting extends from the production of programmes to their delivery to the general public, as detailed above, studies those aspects related

to production and radiocommunication, including the international exchange of programs as well as the overall quality of service.

Structure

This Study Group was created by decision of the Radiocommunication Assembly 2000 to merge the former Study Group 10 (Sound broadcasting) and Study Group 11 (Television broadcasting) into one Study Group. The Radiocommunication Assembly of 2007 decided to transfer the RF spectrum and system aspects of the Broadcasting Satellite Service to Study Group 4.

Three Working Parties (WPs) carry out studies on Questions assigned to Study Group 6:

WP 6A:	Terrestrial broadcasting delivery
WP 6B:	Broadcast service assembly and access
WP 6C:	Programme production and quality assessment

Questions

All the ITU-R Questions assigned to Study Group 6 are published and available at: http://www.itu.int/pub/R-QUE-SG06/.

Recommendations

BT.1774-2:	Use of satellite and terrestrial broadcast infrastructures for public warning, disaster mitigation and relief
BT.2036-1:	Characteristics of a reference receiving system for frequency planning of digital terrestrial television systems

Reports

BT.2140-9:	Transition from analogue to digital terrestrial broadcasting
BT.2301-2:	National field reports on the introduction of IMT in the bands with co-primary allocation to the broadcasting and the mobile services
BT.2343-2:	Collection of field trials of UHDTV over DTT networks
BT.2382-1:	Description of interference into a digital terrestrial television receiver
BT.2383-1:	Characteristics of digital terrestrial television broadcasting systems in the frequency band 470-862 MHz for frequency sharing/interference analyses
BT.2389-0:	Guidelines on measurements for digital terrestrial television broadcasting systems

Handbooks

- Handbook on Digital Terrestrial Television Broadcasting networks and systems implementation.
- Television systems used around the world.
- Book of Antenna Diagrams.
- Digital television signals, coding and interfacing within studios.
- Subjective assessment methodology in television.

1.6 ITU-R Study Group 7 – Science services

Scope

"Science services" refer to the standard frequency and time Signal, Space Research (SRS), space operation, Earth Exploration-Satellite (EESS), Meteorological-Satellite (MetSat), Meteorological Aids (MetAids) and Radio Astronomy (RAS) services.

The systems linked with Study Group 7 are used in activities that are a critical part of our everyday life such as:

- Global environment monitoring – atmosphere (including greenhouse gases emissions), oceans, land surface, biomass, etc.;
- Weather forecasting and climate change monitoring and prediction;
- Detection and tracking of many natural and man-made disasters (earthquakes, tsunamis, hurricanes, forest fires, oil leaks, etc.);
- Providing alerting/warning information; and
- Damage assessment and planning relief operations.

SG 7 also encompasses systems for the study of outer space:

- Satellites for studying the sun, the magnetosphere and all the elements of our solar system;
- Earth and satellite-based radioastronomy to study the universe and its phenomena.

Study Group 7 develops ITU-R Recommendations, Reports and handbooks that are used for development and ensuring non-interference operation of space operation, space research, Earth-exploration and meteorological systems (including the related use of links in the inter-satellite service), radio astronomy and radar astronomy, dissemination, reception and coordination of standard-frequency and time-signal services (including the application of satellite techniques) on a worldwide basis.

Structure

Four Working Parties (WPs) carry out studies on Questions assigned to Study Group 7:

WP 7A:	Time signals and frequency standard emissions: Systems and applications (terrestrial and satellite) for dissemination of standard time and frequency signals
WP7B:	Space radiocommunication applications: Systems for transmission/reception of telecommand, tracking and telemetry data for space operation, space research, Earth-exploration satellite, and meteorological satellite services
WP 7C:	Remote sensing systems: active and passive remote sensing applications in the Earth exploration-satellite service and systems of the MetAids service, as well as space research sensors, including planetary sensors
WP 7D:	Radio astronomy: radio astronomy and radar astronomy sensors, both Earth-based and space-based, including space Very Long Baseline Interferometry (VLBI)

Questions

None due to the particular scope of this Study Group.

All the ITU-R Questions assigned to Study Group 7 are published and available at: http://www.itu.int/pub/R-QUE-SG07/.

Recommendations

- **RS Series: Remote Sensing Systems**

RS.1859-0:	Use of remote sensing systems for data collection to be used in the event of natural disasters and similar emergencies

Handbooks

- Radio astronomy: this Handbook is concerned with aspects of radio astronomy relevant to frequency coordination, i.e. the management of radio spectrum usage in order to minimize interference between radiocommunication services. It covers areas such as radio astronomy characteristics, preferred frequency bands, special radio astronomy applications, vulnerability to interference from other services, as well as issues associated with the sharing of radio spectrum with other services.
- The selection and use of precise frequency and time systems: this Handbook describes basic concepts, frequency and time sources, measurement techniques, characteristics of various frequency standards, operational experience, problems and future prospects.
- Space research communications: this Handbook presents the basic technical and spectrum requirements for the many different space research programmes, missions and activities. It discusses space research functions and technical implementations, factors that govern frequency selection for space research missions, and space research protection and sharing considerations.
- Use of radio spectrum for meteorology: Weather, water and climate monitoring and prediction, this hand book was developed in cooperation with the Steering Group on Radio Frequency Coordination of the World Meteorological Organization (WMO) and provides comprehensive technical information on the use of radio-based devices and systems, including meteorological and Earth exploration-satellites, radiosondes, weather radars, wind profiler radars, spaceborne remote sensing for weather and climate monitoring and forecasting.
- Satellite time and frequency transfer and disemination: this Handbook provides detailed information on the applied methods, technologies, algorithms, data structure and practical use of frequency and timing signals provided by satellite systems.
- Earth exploration satellite service, this Handbook describes the Earth Exploration-Satellite Service (EESS), its technical characteristics, its applications, its spectrum requirements, as well as its benefits and provides full and comprehensive information on the development of EESS systems. Specifically, it provides basic definitions, sheds light on the technical principles underlying the operation of systems and presents their main applications to assist administrations in the spectrum planning, engineering and deployment aspects of these systems.

2 CHAPTER 2 – ITU-T Questions of particular concern to developing countries

ITU-T mission

The ITU Telecommunication Standardization Sector (ITU-T) in one of the main ITU three sectors and it is the oldest sector.[2] The ITU-T fulfils the purposes of the ITU relating to telecommunications standardization by studying technical, operating and tariff Questions and adopting on them relevant Recommendations with a view to standardizing telecommunications on a worldwide basis.

Today priority work areas include ensuring the needs of developing countries are taken into account in the roles of Standardization Sector; accessibility; adopting international standards to ensure seamless global communications and interoperability for Next Generation Networks (NGN); building confidence and security in the use of ICTs; emergency communications to develop early warning systems and to provide access to communications during and after disasters and the reduction of the impact of ICTs on climate change as well as create better understanding of how ICTs can mitigate its effects.

ITU-T structure

The World Telecommunication Standardization Assembly (Hammamet, 2016) maintained the ITU-T study groups' structure with 11 study groups and suppress the ITU-T Review Committee.

ITU-T publications

A list of all ITU-T publications can be found at: http://itu.int/en/ITU-T/publications.

ITU-T Recommendation: An ITU-T Recommendation is a normative text approved under the Traditional Approval Process (TAP) of WTSA Res.1 (Revised, Hammamet, 2016) or the Alternative Approval Process (AAP) of Rec. ITU-T A.8.

ITU-T Supplement: A Supplement is a non-normative text that contains material that is supplementary to and associated with the subject matter of one or more Recommendations but is not essential to their completeness or understanding and implementation.

ITU-T Handbook: A handbook is an ITU-T publication providing practical guidance on the application of one or more thematically related ITU-T Recommendations.

ITU-T Technical Paper and Technical Reports: An ITU-T Technical Paper as well as an ITU-T Technical Report is a non-normative publication agreed by study groups. They contain technical information that provide early public access to current studies in the study group, or complement existing ITU-T Recommendations to further their understanding.

World Telecommunication Standardization Assembly (WTSA)

The World Telecommunication Standardization Assembly (WTSA) is held every four years and defines the next period of study for ITU-T. The duties of the World Telecommunication Standardization Assembly are set forth in Article 18 of the ITU Constitution. Article 13 of the ITU Convention provides that the World Telecommunication Standardization Assembly shall be convened "to consider specific matters related to telecommunication standardization".

The Assembly will also review working methods including approval processes, the work programme and the structure of study groups.

The 2016 World Telecommunication Standardization Assembly (WTSA-16) was held in Hammamet, Tunisia from 25th October to 3rd November 2016. Preparations for WTSA-16 took place throughout 2016

[2] For more detailed information, please consult: http://www.itu.int/en/ITU-T/Pages/default.aspx.

notably in regional preparatory meetings. WTSA-16 maintained the eleven ITU-T study groups and approved its mandates.

ITU-T workshops

ITU-T organizes since 2001 a series of workshops and seminars, which are of great value to developing countries. The events cover a wide array of topics in the field of Information and Communication Technologies (ICT) and attract high-ranking experts as speakers, and attendees from engineers to high-level management from all industry sectors.

In addition, ITU-T organizes standalone webinars and offers remote participation facilities for many of its workshops. In this way, remote participants can profit from audio, video, power point slides and the possibility to ask presenters questions. Archives are also made available.

For more information, please consult the following web sites:

– http://itu.int/en/ITU-T/Workshops-and-Seminars
– http://itu.int/en/ITU-T/techwatch
– https://www.itu.int/ITU-T/climatechange/publications.html

Telecommunication Standardization Advisory Group (TSAG)

TSAG's work is to act as an advisory body to the study groups, membership and staff of ITU-T, keeping in mind the needs of all members, from developed and developing countries, and from industry and governments. It is responsible for the working procedures defined in the A-series Recommendations and the organization of the ITU-T work programme. It performs an extremely important function within ITU-T in following up on the implementation of the work programme and advising the Director of ITU-T's secretariat.

ITU-T Study Groups

Standardization work is carried out by the technical study groups (SGs) in which representatives of the ITU-T membership develop Recommendations (standards) for the various fields of international telecommunications.

The SGs drive their work primarily in the form of study Questions. Each of these addresses technical studies in a particular area of telecommunication standardization. Each SG has a SG Chairman and a number of vice-chairmen appointed by the World Telecommunication Standardization Assembly.

As a result of the last World Telecommunication Standardization Assembly (Hammamet, 2016) the eleven ITU-T study groups were maintained.

2.1 ITU-T Study Group 2 – Operational aspects of service provision and telecommunications management

Scope

Study Group 2 is the lead study group for service definition (including all types of mobile services) and for numbering, naming, addressing, identification and routing. Study Group 2 has a responsibility for creating principles of service and operational requirements, including billing and operational quality of service/network performance. Service principles and operational requirements are also developed by SG2 for current and evolving technologies. Study Group 2 is also the lead study group on telecommunications for disaster relief/early warning, network resilience and recovery, and telecommunication management.

Responsible for studies relating to:

- Numbering, naming, addressing and identification requirements and resource assignment, including criteria and procedures for reservation, assignment and reclamation;
- Routing and interworking requirements;
- Principles of service provision, definition and operational requirements;
- Operational and management aspects of networks, including network traffic management, designations, and transport-related operations procedures;
- Operational aspects of interworking between traditional telecommunication networks and evolving networks;
- Evaluation of feedback from operators, manufacturing companies and users on different aspects of network operation;
- Management of telecommunication services, networks, and equipment via management systems, including support for Next Generation Networks (NGN), cloud computing, Future Networks (FN), Software-Defined Networking (SDN), IMT-2020, and the application and evolution of the Telecommunication Management Network (TMN) framework;
- Ensuring the consistency of the format and structure of Identity Management (IdM) identifiers;
- Specifying interfaces to management systems to support the communication of identity information within or between organizational domains; and
- The operational impact of the Internet, convergence (services or infrastructure) and new services, such as Over-The-Top (OTT), on international telecommunication services and networks.

Specific areas of study

- Lead study group for numbering, naming, addressing, identification and routing;
- Lead study group on service definition;
- Lead study group on telecommunications for disaster relief/early warning, network resilience and recovery;
- Lead study group on telecommunication management.

Aspects of interest to developing countries:

The following topics are of interest to developing countries:

- Calling Party Number Delivery (CPND), Calling Line Identification, Origin Identification (OI);
- E.164 Shared Country Codes (non-geographic resources) and Identification Codes;
- E.212 Shared Mobile Country Codes (non-geographic resources) and Mobile Network Codes;
- Globally Harmonized Numbers;
- Numbering misuse;
- Availability of routing information;
- ENUM (Telephone Number Mapping);
- Emergency telecommunication Services and Cell Broadcast;
- Telecommunication for Disaster Relief & Network Resilience and Recovery;
- IP address allocation and facilitating the transition to and deployment of IPv6 as of WTSA Resolution 64; and
- Telecom Finance.

Study Group 2 structure

ITU-T SG2 structure is available at:

http://www.itu.int/net4/ITU-T/lists/sgstructure.aspx?Group=2&Period=16.

Questions

Q1/2:	Application of numbering, naming, addressing and identification plans for fixed and mobile telecommunications services (continuation of Q1/2)
Q2/2:	Routing and interworking plan for fixed and mobile networks (continuation of Q2/2)
Q3/2:	Service and operational aspects of telecommunications, including service definition (continuation of Q3/2)
Q5/2:	Requirements, priorities and planning for telecommunication management and OAM Recommendations (continuation of Q5/2)
Q6/2:	Management Architecture and Security (continuation of Q6/2)
Q7/2:	Interface specifications and specification methodology (continuation of Q7/2)

General comments

- Pursuant to Resolution 182 (Guadalajara, 2010) regarding climate change and the protection of the environment, it was agreed that SG2 meetings will be conducted paperless.
- Pursuant to Resolution 2 (Rev. Hammamet, 2016) which guided both Study Group 2 and Study Group 3 to hold their meetings back-to-back, ITU-T SG2 agreed to hold its meeting back-to-back with ITU-T SG3.
- ITU-T SG2 agreed to create an ad hoc group on developing country issues.
- ITU-T SG2 agreed to create an ad hoc group and an associated correspondence group to pursue the studies and the implementation of the parts of WTSA Resolution 64 relevant to SG2.

ITU-T Study Group 2 Recommendations are listed in Annex 1.

Related Groups:

- ITU-T SG2 Regional Group for the Arab Region (SG2-RG-ARB).
- ITU-T SG2 Regional Group for East Africa (SG2RG-EA).
- ITU-T SG2 Regional Group for the Americas (SG2RG-AMR).
- Joint Rapporteur Group on Cloud Computing Management (JGR-CCM).

Handbooks

- Instructions for the international telephone service.
- Quality of service & network performance.

2.2 ITU-T Study Group 3 – Tariff and accounting principles and international telecommunication/ICT economic and policy issues

Scope

Study Group 3 provides a unique global forum to improve the understanding of the financial and economic aspects associated with the growth of ICT, particularly with respect to the shift to IP-based and NGN/Future Networks and the exponential rise in mobile wireless communications. Key traditional

mandates of SG3, which date back to the early days of the Union, include interconnection, the improvement of daily operations and the settlement of accounts.

Responsible for studies relating to:

ITU-T Study Group 3 is responsible, inter alia, for studying international telecommunication/ICT policy and economic issues and tariff and accounting matters (including costing principles and methodologies), with a view to informing the development of enabling regulatory models and frameworks. To this end, Study Group 3 shall in particular foster collaboration among its participants with a view to the establishment of rates at levels as low as possible consistent with an efficient service and taking into account the necessity for maintaining independent financial administration of telecommunications on a sound basis. Additionally, Study Group 3 will study the economic and regulatory impact of the Internet, convergence (services or infrastructure) and new services, such as OTT, on international telecommunication services and networks. The needs of developing countries are an important focus of the group. In particular, an Ad-Hoc Group on developing country issues has met frequently during the Study Period. In addition, regional groups play a key role across the globe for the development of regional tariff policy and cost models: there are 5 active regional groups for SG3, namely SG3RG-AFR (Africa), SG3RG-AO (Asia and Oceania), SG3RG-ARB (Arab Region), SG3RG-RCC/CIS, SG3RG-LAC (Latin America and the Caribbean). These regional groups meet at least once a year and are preceded by Regional Standardization Forums for Bridging the Standardization Gap (BSG) or seminars on costs and tariffs, in collaboration with the ITU-D.

Study Group 3 structure

ITU-T SG3 structure was confirmed during its first meeting planned 5 to 13 April 2017 in Geneva.

Questions

Q1/3:	Development of charging and accounting/settlement mechanisms for international telecommunications services using the Next Generation Networks (NGNs) and any possible future development, including adaptation of existing D-series Recommendations to the evolving user needs
Q2/3:	Development of charging and accounting/settlement mechanisms for international telecommunications services, other than those studied in Question 1/3, including adaptation of existing D-series Recommendations to the evolving user needs
Q3/3:	Study of economic and policy factors relevant to the efficient provision of international telecommunication services
Q4/3:	Regional studies for the development of cost models together with related economic and policy issues
Q5/3:	Terms and definitions for Recommendations dealing with tariff and accounting principles together with related economic and policy issue
Q6/3:	International Internet Connectivity including relevant aspects of IP peering, regional traffic exchange points, cost of provision of services and impact of transition from IPv4 to IPv6
Q7/3:	International Mobile Roaming issues (including charging, accounting and settlement mechanisms and roaming at border areas
Q8/3:	Alternative calling procedures and misappropriation and misuse of facilities and services including calling line identification (CLI), calling party number delivery (CPND) and origin identification (OI)
Q9/3:	Economic and regulatory impact of the Internet, convergence (services or infrastructure) and new services, such as OTT, on international telecommunication services and network

Q10/3:	Definition of relevant markets, competition policy and identification of operators with significant market power (SMP) as it relates to the economic aspects of the international telecommunication services and networks
Q11/3:	Economic and policy aspects of big data and digital identity in international telecommunications services and networks

ITU-T Study Group 3 Recommendations are listed in Annex 1.

Related Groups

- Regional Group for Asia and Oceania.
- Regional Group for Africa.
- Regional Group for the Arab Region.
- Regional Group for Latin America and the Caribbean.
- Regional Group for RCC-CIS.

Handbooks

- Costing methodologies.
- Technical Paper – Guide for NRAs on International Mobile Roaming Cost analysis.
- Technical paper (in progress) Economic Impact of OTTs.

2.3 ITU-T Study Group 5 – Environment, climate change and circular economy

Scope

The name and the mandate of Study Group 5 were changed by WTSA (Hammamet, 2016). The title of the study group is "Environment, climate change and circular economy".

Study Group 5 is the ITU-T Study Group responsible for studying ICT environmental aspects of electromagnetic phenomena and climate change.

Study Group 5 will also study issues related to resistibility, human exposure to electromagnetic fields, circular economy, energy efficiency and climate change adaptation and mitigation.

Responsible for studies relating to:

- Protection of telecommunication networks and equipment from interference and lightning;
- Electromagnetic Compatibility (EMC), particle radiation effects, and assessment of human exposure to Electromagnetic Fields (EMF) produced by ICT installations and devices, including cellular phones and base stations;
- The existing copper network outside plant and related indoor installations;
- Achieving energy efficiency and sustainable clean energy in ICTs;
- Methodologies for assessing the environmental impact of ICT, publishing guidelines for using ICTs in an eco-friendly way, dealing with e waste issues (also including the environmental impact of counterfeit devices), enhancing rare-metal recycling and energy efficiency of ICT, including infrastructures;
- Responsible for studies on how to use ICT to help countries and the ICT sector to adapt to the effects of environmental challenges, including climate change in line with the Sustainable Development Goals (SDGs); and

– It is also identifying the needs for more consistent and standardized eco-friendly practices for the ICT sector (e.g., labelling, procurement practices, standardized power supplies/connectors, eco-rating schemes).

Specific areas of study

– Lead study group on electromagnetic compatibility, lightning protection and electromagnetic effects;

– Lead study group on ICTs related to the environment, climate change, energy efficiency and clean energy; and

– Lead study group on circular economy, including e-Waste.

Study Group 5 structure

ITU-T SG5 structure will be confirmed during its first meeting planned 15 to 24 May 2017 in Geneva.

Questions

The following Questions were approved by WTSA-16.

Q1/5:	Protection of information and communication technology (ICT) infrastructure from electromagnetic surges
Q2/5:	Equipment resistibility and protective components
Q3/5:	Human exposure to electromagnetic fields (EMFs) from information and communication technologies (ICTs)
Q4/5:	Electromagnetic compatibility (EMC) issues arising in the telecommunication environment
Q5/5:	Security and reliability of information and communication technology (ICT) systems from electromagnetic and particle radiations
Q6/5:	Achieving energy efficiency and sustainable clean energy
Q7/5:	Environmentally sound management of e-waste and information and communication technology (ICT) eco-friendly design, including dealing with ICT counterfeit devices
Q8/5:	Adaptation to climate change and low cost and sustainable resilient information and communication technologies (ICTs)
Q9/5:	Assessment of sustainability impacts of information and communication technology (ICT) to promote the Sustainable Development Goals (SDGs)
Q10/5:	Guides and terminology on environment and climate change

ITU-T Study Group 5 Recommendations

The detailed list of Recommendations under Study Group 5 responsibility can be found at:

https://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=05.

– **K series:** Protection against interference.

– **L series:** Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plants.

The main Recommendations on Green ICTs issues can be found at: https://www.itu.int/net/ITU-T/lists/standards.aspx?Group=5&Domain=28.

The main Recommendations on EMF issues can be found at: https://www.itu.int/net/ITU-T/lists/standards.aspx?Group=5&Domain=40.

Related Groups

- Study Group 5 Regional Group for Africa (SG5 RG-AFR)
- Study Group 5 Regional Group for the Arab Region (SG5 RG-ARB)
- Study Group 5 Regional Group for the Americas (SG5 RG-AMR)
- Study Group 5 Regional Group for Asia and the Pacific (SG5 RG-AP)

Handbooks

- CCITT Directives concerning the protection of telecommunication lines against harmful effects from electric power and electrified railway, and its volumes.
- Mitigation measures for telecommunication installations Handbook.
- Earthing and bonding Handbook.
- Application of surge protective devices.
- Guide to the use of ITU-T publications produced by SG 5 aimed at achieving electromagnetic compatibility and safety.
- Interference measuring techniques.
- Terminology Handbook.
- Preservation of Wooden Poles Carrying Overhead Telecommunication Lines.
- Over voltage protection guide.

Technical Papers

- Monitoring of electromagnetic field levels in Latin America.
- Sustainable management of waste electrical and electronic equipment in Latin America.
- Partnering for solutions: ICTs in Smart Water Management.
- Resilient pathways: the adaptation of the ICT sector to climate change.
- The scientific and societal case for the integration of environmental sensors into new submarine telecommunication cables.
- Network infrastructure best practices.
- Case study of reduction of air-conditioning energy by optical fibre based thermometry.
- Rationale for minimum data set for evaluating energy efficiency and for controlling data centre equipment in view of power saving.
- Potential for primary energy savings in TLC/ICT centres through free cooling.
- Validation test of a data centre cooling method using renewable energy in a cold region.
- Verification experiments related to increase of efficiency of air-conditioning and control technologies at a data centre.
- Verification test and feasibility study of energy and space efficient cooling systems for data centres with high density ICT devices.
- The case of Korea the quantification of GHG reduction effects achieved by ICTs.
- Experimental studies on plates and ducts installed at equipment inlets and outlets.

- Toolkit on Environmental Sustainability for the ICT Sector.
- Sustainable ICT in Corporate Organizations.
- Sustainable Products.
- Sustainable Buildings.
- End of Life Management for ICT Equipment.
- General Specifications and KPIs.
- Assessment Framework for Environmental Impacts of the ICT Sector.
- Greening ICT Supply Chains – Survey on Conflict Minerals Due Diligence Initiatives.
- An Energy-aware Survey on ICT Device Power Supplies.
- Review of Mobile Handset Eco-Rating Schemes.
- Guidance on Green ICT Procurement.
- Boosting Energy Efficiency through Smart Grids.
- Climate Change Adaptation, Mitigation and Information and Communications Technologies (ICTs) – The Case of Ghana.
- Using submarine cables for climate monitoring and disaster warning – Opportunities and legal challenges.
- Using submarine cables for climate monitoring and disaster warning – Strategy and roadmap.
- Using submarine cables for climate monitoring and disaster warning – Engineering Feasibility Study.

Supplements

- K Suppl. 1 ITU-T K.91 – Guide on electromagnetic fields and health.
- K Suppl. 2 ITU-T K.52 – Calculator for equivalent isotropic radiated power as described in Recommendation ITU-T K.52.
- K Suppl. 3 ITU-T K.20, K.21, K.45, K.82 – Additional criteria to protect telecommunication cabling during a power cross event.
- K Suppl. 4 ITU-T K.91 – Electromagnetic field considerations in smart sustainable cities.
- K Suppl. 5 ITU-T K.81 – Estimation examples of the high-power electromagnetic threat and vulnerability for telecommunication systems.
- K Suppl. 6 ITU-T K.115 – Measuring shielding effectiveness using normalized site attenuation in free space.
- L Suppl. 1 ITU-T L.1310 – Supplement on energy efficiency for telecommunication equipment
- L Suppl. 2 ITU-T L.1410 – Case studies.
- L Suppl. 3 ITU-T L.1430 – Guidance on practical application of ITU-T L.1430 to a real-time navigation service.
- L Suppl. 4 – Guidelines for developing a sustainable e-waste management system.
- L Suppl. 5 – Life-cycle management of ICT goods.
- L Suppl. 6 ITU-T L.1300 – Supplement on a validation test of a data centre cooling method using renewable energy in a cold region.
- L Suppl. 7 ITU-T L.1300 – Supplement on rationale for minimum data set for evaluating energy efficiency and for controlling data centre equipment in view of power saving.

- L Suppl. 8 ITU-T L.1300 – Supplement on potential for primary energy savings in TLC/ICT centres through free cooling.
- L Suppl. 9 ITU-T L.1300 – Supplement on case study of reduction of air-conditioning energy by optical fibre based thermometry.
- L Suppl. 10 ITU-T L.1300 – Supplement on verification experiments related to increase of efficiency of air-conditioning and control technologies at a data centre.
- L Suppl. 11 ITU-T L.1300 – Supplement on verification test and feasibility study of energy and space efficient cooling systems for data centres with high density ICT devices.
- L Suppl. 12 ITU-T L.1300 – Supplement on experimental studies on plates and ducts installed at equipment inlets and outlets.
- L Suppl. 13 ITU-T L.1410 – Case study: A hybrid approach-based comparative analysis of the environmental impact of a baseline data centre and an energy-efficient data centre.
- L Suppl. 14 ITU-T L.1500 – Standardization gap analysis for smart water management.
- L Suppl. 15 ITU-T L.1500 – Requirements for water sensing and early warning systems.
- L Suppl. 16 Superseded* ITU-T L.1500 – Smart water management in cities (in force now as Y.Suppl.36 to Y.4550-Y.4699).
- L Suppl. 17 Superseded* ITU-T L.1600 – Definition for smart sustainable city (in force now as Y.Suppl.37 to Y.4050-Y.4099).
- L Suppl. 18 Superseded* ITU-T L.1600 – Smart sustainable cities: an analysis of definitions (in force now as Y.Suppl.38 to Y.4050-Y.4099).
- L Suppl. 19 Superseded* ITU-T L.1600 – Key performance indicators definitions for smart sustainable cities (in force now as Y.Suppl.39 to Y.4900).
- L Suppl. 20 – Green public ICT procurement.
- L Suppl. 21 – Implementation guidance for ICT SME supply chains due diligence for conflict minerals.
- L Suppl. 22 ITU-T L.1700 – Low-cost sustainable telecommunication for rural communications in developing countries using fibre optic cable.
- L Suppl. 23 ITU-T L.1700 – Low-cost sustainable telecommunications for rural communications in developing countries using microwave and millimetre radio links.
- L Suppl. 24 ITU-T L.1500 – Overview of climate change effects and possible impacts.
- L Suppl. 25 ITU-T L.1502 – Best practices for infrastructure adaptation to climate change.
- L Suppl. 26 ITU-T L.1410 – Case Study: the assessment of greenhouse gas emission of a hybrid satellite broadband system over its life cycle.
- L Suppl. 27 – Supplement on success stories on e-waste management.
- L Suppl. 28 – Circular Economy in Information and Communication Technology; definition of approaches, concepts and metrics.
- L Suppl. 29 ITU-T L.1700 – Low-cost sustainable telecommunication for rural communications in developing countries using Cellular Radio Technologies.
- L Suppl. 30 ITU-T L.1700 – Setting up a low-cost sustainable telecommunications network for rural communications in developing countries using cellular network with capacity transfer.
- L Suppl. 31 ITU-T L.1700 – Setting up a low-cost sustainable telecommunications network for rural communications in developing countries using satellite systems.

- L Suppl. 32 – Supplement for eco-specifications and rating criteria for mobile phones eco-rating programmes.
- L Suppl. 33 – Assessment of Energy Consumption of ICT Services.
- L Suppl. 34 ITU-T L.1700 – Example of hybrid LCA of the aggregated second order effects of selected ICT services.

The list of all ITU-T Study Group 5 Supplements can be found at: https://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=5.

2.4 ITU-T Study Group 9 – Television and sound transmission and integrated broadband cable networks

Scope

ITU-T Study Group 9 carries out studies on the use of telecommunication systems for broadcasting of television and sound programs and furthermore the use of CATV networks to provide interactive video services, telephone and data services, including Internet access. Developing countries will benefit by SG9 Recommendations to implement their cable networks.

Responsible for studies relating to:

- Use of telecommunication systems for contribution, primary distribution and secondary distribution of television, sound programmes and related data services including interactive services and applications, extendable to advanced capabilities such as ultra-high definition, 3D, multiview and high-dynamic range television, etc.; and
- Use of cable and hybrid networks, primarily designed for television and sound-programme delivery to the home, as integrated broadband networks to also carry voice or other time-critical services, video-on-demand (e.g., Over-The-Top (OTT)), interactive services, multiscreen services, etc. to Customer Premises Equipment (CPE) in the home or enterprise.

Specific areas of study

- Lead study group on integrated broadband cable and television networks.

Study Group 9 structure

Questions

Q1/9:	Transmission of television and sound programme signal for contribution, primary distribution and secondary distribution
Q2/9:	Methods and practices for conditional access, protection against unauthorized copying and against unauthorized redistribution ("redistribution control" for digital cable television distribution to the home)
Q3/9:	Digital programme delivery controls for multiplexing, switching and insertion in compressed bit streams and/or packet streams
Q4/9:	Guidelines for implementations and deployment of transmission of multichannel digital television signals over optical access networks
Q5/9:	Software components application programming interfaces (APIs), frameworks and overall software architecture for advanced content distribution services within the scope of Study Group 9
Q6/9:	Functional requirements for residential gateway and set-top box for the reception of advanced content distribution services

Q7/9:	Cable television delivery of digital services and applications that use Internet Protocol (IP) and/or packet-based data over cable networks
Q8/9:	The Internet protocol (IP) enabled multimedia applications and services for cable television networks enabled by converged platforms
Q9/9:	Requirements, methods, and interfaces of the advanced service platforms to enhance the delivery of sound, television, and other multimedia interactive services over cable television network
Q10/9:	Work programme, coordination and planning

ITU-T Study Group 9 Recommendations

- ITU-T J-series (Cable networks and transmission of television, sound programme and other multimedia signals), except those under the responsibility of Study Group 12 and Study Group 15.
- ITU-T N-series (Maintenance: international sound programme and television transmission circuits).

All the Recommendations of this Study Group are addressed to the Industry for manufacturing. They can be accessed at: http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=9.

Technical Report (TR):

- TR of the Focus Group on Smart Cable Television.

Related Groups

- Video Quality Experts Group (VQEG).
- Intersectoral Rapporteur Group (IRG) on Audiovisual Quality Assessment (IRG-AVQA) [on-going establishment].
- Intersector Rapporteur Group Audiovisual Media Accessibility (IRG-AVA).
- Joint Coordination Activity on Internet of Things and Smart Cities and Communities (JCA-IoT and SC&C).

2.5 ITU-T Study Group 11 – Signalling requirements, protocols, test specifications and combating counterfeit products

Scope

Study Group 11 is the 'signalling and protocols' group within ITU-T. It produces ITU-T Recommendations that define how telephone calls and other calls such as data calls are handled in the network. Study Group 11 is home to Signalling System 7 (SS7), which paved the way for the efficient operation of international telecommunication networks and is currently engaged in standardizing Software-Defined Networking (SDN).

One of the recent focus of SG11 aims to address the growing problem of counterfeited telecommunication/ICT products and devices, which is adversely affecting all stakeholders in the ICT field (vendors, governments, operators and consumers). Cooperation among ITU-T study groups, between ITU-T and ITU-D as well as with external bodies outside the ITU (in particular with SDOs), will be required to gather a complete information in this regard. See for more information the related webpage.

Conformance and Interoperability (C&I) studies are taken in high consideration by SG11. The research of SG11 in C&I area encompasses the development of requirements and the relevant test suites for different key areas like: NGN, USN, IoT, QoS/QoE/NP, benchmarking, ICT services, etc. In addition

SG11 is engaged in developing Recommendations to allow Internet speed measurement and testing. Following SG11's latest results and activities in the testing area, SG11 was designated by WTSA-12 Lead Study Group on test specifications, conformance and interoperability testing, responsible for implementation of the ITU C&I Programme. More information is available at www.itu.int/go/citest.

Under the auspices of SG11 operates the Conformity Assessment Steering Committee (ITU-T CASC) which was established in April 2015 to elaborate detailed procedures for the implementation of a test laboratory recognition procedure in ITU-T. The ITU-T CASC works in accordance with the ITU-T SG11 Guideline "Testing laboratories recognition procedure" which describes the procedure for recognition of Testing Laboratories that have competence for testing against ITU-T Recommendations. For more information see the related webpage.

The outcomes of SG11 on C&I are directed to assist developing countries in implementing ICT equipment, at national and international level, which will be compatible with the existing operator's infrastructure and will be fully compliant with ITU-T Recommendations. A living list of key technologies which are suitable for C&I testing are being maintained by SG11, which is also looking for several projects on conformity against ITU-T Recommendations.

All related information will be distributed among all interested parties via the C&I Portal including the relevant ITU Databases (TLs Database and ICT Product conformity Database).

Responsible for studies relating to:

Responsible for studies relating to signalling-system architecture, signalling requirements and protocols, for all types of networks and technologies, Future Networks (FN), Software-Defined Networking (SDN), Network Function Virtualization (NFV), cloud-computing networks, VoLTE/ViLTE-based network interconnection, virtual networks, IMT-2020 technologies, multimedia, Next-Generation Networks (NGN), flying ad-hoc networks, tactile Internet, augmented reality and signalling for legacy network interworking.

Study Group 11 is also responsible for studies to combat counterfeiting products including telecommunication/ICT and mobile device theft.

Study Group 11 will also develop test specifications for testing conformance and interoperability (C&I) for all types of networks, technologies and services, a testing methodology and test suites for standardized network parameters in relation to the framework for Internet-related performance measurement, as well as for existing technologies (e.g., NGN) and emerging technologies (e.g., FN, cloud, SDN, NFV, IoT, VoLTE/ViLTE, IMT-2020 technologies, flying ad-hoc networks, tactile Internet, augmented reality, etc.).

In addition, Study Group 11 will study a way to implement a testing laboratory recognition procedure in ITU-T through the work of the ITU-T Conformity Assessment Steering Committee (CASC).

Specific areas of study

- Lead study group on signalling and protocols, including for IMT-2020 technologies;
- Lead study group on establishing test specifications, conformance and interoperability testing for all types of networks, technologies and services that are the subject of study and standardization by all ITU-T study groups;
- Lead study group on combating counterfeiting of ICT devices;
- Lead study group on combating the use of stolen ICT devices.

Study Group 11 structure

Study Group 11 structure includes three Working Parties (WPs), CASC and two Regional Groups:

WP 1/11: **(Qs 1,2,3,4,5)**	Signalling requirements and protocols for emerging telecommunications networks
WP 2/11: **(Qs 6,7,8)**	Control and management protocols for IMT-2020
WP 3/11: **(Qs 9,10,11,12,13,14,15)**	Conformance and interoperability testing, combating counterfeit ICT and mobile device theft
CASC	Conformity Assessment Steering Committee
SG11RG-AFR	ITU-T SG11 Regional Group for Africa
SG11RG-RCC	ITU-T SG11 Regional Group for RCC

Questions

Q1/11:	Signalling and protocol architectures in emerging telecommunication environments and guidelines for implementations
Q2/11:	Signalling requirements and protocols for services and applications in emerging telecommunication environments
Q3/11:	Signalling Requirements and Protocols for Emergency Telecommunications
Q4/11:	Protocols for control, management and orchestration of network resources
Q5/11:	Protocol procedures supporting services provided by broadband network gateways
Q6/11:	Protocols supporting control and management technologies for IMT-2020
Q7/11:	Signalling requirements and protocols for network attachment including mobility and resource management for future networks and IMT-2020
Q8/11:	Protocols supporting distributed content networking and information centric network (ICN) for future networks and IMT-2020, including end-to-end multi-party communications
Q9/11:	Service and networks benchmark testing, remote testing including Internet related performance measurements
Q10/11:	Testing of emerging IMT-2020 technologies
Q11/11:	Protocols and networks test specifications; frameworks and methodologies
Q12/11:	Testing of internet of things, its applications and identification systems
Q13/11:	Monitoring parameters for protocols used in emerging networks, including cloud computing and software-defined networking/network function virtualization (SDN/NFV)
Q14/11:	Cloud interoperability testing
Q15/11:	Combating counterfeit and stolen ICT equipment

ITU-T Study Group 11 Recommendations are listed in Annex 1.

Technical Reports

– Technical report on counterfeit ICT equipment (2015).

Technical Papers

– Impacts of M2M communications and non-M2M mobile data applications on mobile networks.

Related Groups

– Conformity Assessment Steering Committee (ITU-T CASC).
– ITU-T SG11 Regional Group for Africa (SG11 RG-AFR).
– ITU-T SG11 Regional Group for RCC (SG11 RG-RCC).
– Software-Defined Networking (JCA-SDN).
– Internet of Things (JCA-IoT SC&C).
– Identity Management (JCA-IdM).

Related groups that have concluded their activities

– IPTV Global Standards Initiative (IPTV-GSI).
– Focus Group on Machine-to-Machine Service layer (FG M2M).
– Conformance and Interoperability Testing (JCA-CIT).

Special Topics

– Combat counterfeiting;
– Internet speed measurements;
– SIP-IMS Conformity assessment;
– Conformity and Interoperability Portal;
– Software-defined networking (SDN).

Handbooks

– Deployment of packet-based networks.
– Handbook on testing.
– Guidelines for preparing and conducting field trials of digital switching equipments.
– ISDN field trial guidelines.

2.6 ITU-T Study Group 12 – Performance, QoS and QoE

Scope

ITU T Study Group 12 is responsible for Recommendations on performance, quality of service (QoS) and Quality of Experience (QoE) for the full spectrum of terminals, networks, services and applications ranging from speech over fixed circuit-based networks to multimedia applications over networks that are mobile and packet based. Included in this scope are the operational aspects of performance, QoS and QoE; the end-to-end quality aspects of interoperability, and the development of multimedia quality assessment methodologies, both subjective and objective.

The Questions on Operational aspects of telecommunication network service quality (Q12/12), Performance considerations for interconnected networks (Q11/12) and Performance of packet-based networks and other networking technologies (Q17/12) tend to be of particular interest to delegates from developing countries.

Recent SG12 outputs of relevance to developing countries include approval of Recommendation ITU-T G.1028 on "End-to-end QoS for voice over 4G mobile networks" (read more here), consent of Recommendation ITU-T E.847 on "QoS norms for time-division multiplexing (TDM) interconnection between telecom networks", consent of Recommendation ITU-T Y.1545.1 on a "Framework for monitoring the QoS of IP network services", consent of Recommendation ITU-T E.811 on "Quality measurement in major events" such as international sport tournaments, consent of an amendment to Recommendation ITU-T E.802 on a "Framework and methodologies for the determination and application of QoS parameters". The amendment provides guidance on the selection of representative samples in the measurement of QoS parameters. The guidance takes into account these technical (statistical) and operational (practical QoS data collection) conditions by proposing a simple random sampling methodology.

Specific areas of study

- Lead study group on quality of service and quality of experience;
- Lead study group on driver distraction and voice aspects of car communications;
- Lead study group on quality assessment of video communications and applications.

Study Group 12 structure

PLEN	Three Working Parties (WPs) carry out the studies on Questions assigned to Study Group 12. Two Questions are reporting to the SG12 Plenary
Q1/12:	SG12 work programme and quality of service/quality of experience (QoS/QoE) coordination in ITU-T
Q2/12:	Definitions, guides and frameworks related to quality of service/quality of experience (QoS/QoE)
WP1/12	**Terminals and multimedia subjective assessment**
Q3/12:	Speech transmission and audio characteristics of communication terminals for fixed circuit-switched, mobile and packet-switched Internet Protocol (IP) networks
Q4/12:	Objective methods for speech and audio evaluation in vehicles
Q5/12:	Telephonometric methodologies for handset and headset terminals
Q6/12:	Analysis methods using complex measurement signals including their application for speech and audio enhancement techniques
Q7/12:	Methods, tools and test plans for the subjective assessment of speech, audio and audiovisual quality interactions
Q10/12:	Conferencing and telemeeting assessment
WP2/12	**Objective models and tools for multimedia quality**
Q9/12:	Perceptual-based objective methods for voice, audio and visual quality measurements in telecommunication services
Q14/12:	Development of models and tools for multimedia quality assessment of packet-based video services

Q15/12:	Parametric and E-model-based planning, prediction and monitoring of conversational speech quality
Q16/12:	Framework for diagnostic functions
Q19/12:	Objective and subjective methods for evaluating perceptual audiovisual quality in multimedia services
WP3/12	**Multimedia Qos and QoE**
Q8/12:	Virtualized deployment of recommended methods for network performance, quality of service (QoS) and quality of experience (QoE) assessment
Q11/12:	Performance considerations for interconnected networks
Q12/12:	Operational aspects of telecommunication network service quality
Q13/12:	Quality of experience (QoE), quality of service (QoS) and performance requirements and assessment methods for multimedia
Q17/12:	Performance of packet-based networks and other networking technologies
Q18/12:	Measurement and control of the end-to-end quality of service (QoS) for advanced television technologies, from image acquisition to rendering, in contribution, primary distribution and secondary distribution networks

ITU-T Study Group 12 Recommendations are listed in Annex 1.

Technical Papers

- Objective Perceptual Assessment of Video Quality: Full Reference Television.
- How to increase QoS/QoE of IP-based platform(s) to regionally agreed standards.

Related Groups

- **Quality of Service Development Group (QSDG).** The primary aim of QSDG is to improve the quality of the international service, to the benefit both of the subscribers and Administrations. More information is available here.
- Regional Group of SG12 on QoS for the Africa Region. The ToR of the Regional Group include:
  - To encourage active participation of African administrations, regulators and operators in the work of ITU-T;
  - To boost discussions on QoS challenges facing administrations, operators and regulators in the continent;
  - To encourage participation of African countries in Rapporteur's meetings, workshops and other ITU-T Study Group 12 events;
  - To encourage African countries to contribute to the development of new/revised ITU-T Recommendations;
  - To encourage the African countries to actively participate in the Quality of Service Development Group (QSDG) and other QoS related meetings;
  - To ensure that ITU-T provides relevant information on QoS standards applicable to telecommunication networks, including test equipment for QoS monitoring and measuring, and assists in their implementation;
  - To act as liaison body between African telecommunication administrations/ operators/ regulators and ITU-T in matters relating to QoS standards;

- More information is available here.

Handbooks

– Quality of service and network performance.

– Practical procedures for subjective testing.

– Handbook on Telephonometry.

2.7 ITU-T Study Group 13 – Future networks, with focus on IMT-2020, cloud computing and trusted network infrastructures

Scope

Study Group 13 leads ITU's work on standards for Next Generation Networks (NGN), mobility management, future networks, cloud computing and software-defined networking.

Of particular interest for the developing countries might be the work on migration scenarios to NGN and their enhancements, IMT and IMS implementation, m-commerce, cloud computing solutions, energy efficiency of networks and emergency communication.

Responsible for studies relating to:

ITU-T Study Group 13 is responsible for studies relating to the requirements, architectures, capabilities, and APIs as well as softwarization and orchestration aspects of converged Future Networks (FN), specifically focusing on IMT-2020 non-radio related parts. This also includes IMT-2020 project management coordination across all ITU-T study groups and release planning and implementation scenarios. It is responsible for studies relating to cloud-computing technologies, big data, virtualization, resource management, reliability and security aspects of the considered network architectures. It is responsible for studies relating to FMC, mobility management, and enhancements to existing ITU-T Recommendations on mobile communications, including the energy-saving aspects. Furthermore, Study Group 13 responsibility includes studies on emerging network technologies for IMT-2020 networks and future networks, such as Information Centric Networking (ICN)/Content Centric Networking (CCN). Study Group 13 is also responsible for studies relating to standardization of concepts and mechanisms to enable trusted ICT, including framework, requirements, capabilities, architectures and implementation scenarios of trusted network infrastructures and trusted cloud solutions in coordination with all study groups concerned.

Specific areas of study

– Lead study group on future networks such as IMT-2020 networks (non-radio related parts);

– Lead study group on mobility management;

– Lead study group on cloud computing;

– Lead study group on trusted network infrastructures.

Study Group 13 structure

Three Working Parties (WPs) carry out the studies on Questions assigned to Study Group 13:

WP	Title	Questions
1	IMT-2020 Networks and systems	Q6/13: Quality of Service (QoS) aspects including IMT-202 networks
		Q20/13: IMT-2020: Network requirements and functional structure
		Q21/13: Software-defined networking, network slicing and orchestration
		Q22/13: Upcoming network technologies for IMT-2020 and future networks
		Q23/13: Fixed-mobile convergence including IMT-2020
2	Cloud computing and big data	Q7/13: Big data driven networking (bDDN) and deep packet inspection (DPI)
		Q17/13: Requirements, ecosystem, and general capabilities for cloud computing and big data
		Q18/13: Functional architecture for cloud computing and big data
		Q19/13: End-to-end cloud computing management and security
3	Network evolution and trust	Q1/13: Innovative services scenarios, deployment models and migration issues based on future networks
		Q2/13: Next-generation network (NGN) evolution with innovative technologies including software-defined networking (SDN) and network function virtualization (NFV)
		Q5/13: Applying networks of future and innovation in developing countries
		Q16/13: Knowledge-centric trustworthy networking and services

Questions

Q1/13:	Innovative services scenarios, deployment models and migration issues based on Future Networks
Q2/13:	Next-generation network (NGN) evolution with innovative technologies including software-defined networking (SDN) and network function virtualization (NFV)
Q5/13:	Applying networks of future and innovation in developing countries
Q6/13:	Quality of service (QoS) aspects including IMT-2020 networks
Q7/13:	Big data driven networking (bDDN) and Deep packet inspection (DPI)
Q16/13:	Knowledge-centric trustworthy networking and services
Q17/13:	Requirements, ecosystem, and general capabilities for cloud computing and big data
Q18/13:	Functional architecture for cloud computing and big data
Q19/13:	End-to-end Cloud computing management and security
Q20/13:	IMT-2020: Network requirements and functional architecture
Q21/13:	Software-defined networking, network slicing and orchestration
Q22/13:	Upcoming network technologies for IMT-2020 and Future Networks
Q23/13:	Fixed-Mobile Convergence including IMT-2020

ITU-T Study Group 13 Recommendations are listed in Annex 1.

Technical Papers

- Requirements for Telecommunication Networks for Africa (2015).
- Applications of Wireless Sensor Networks in NGN (2014).
- Migration scenarios from legacy networks to NGN in developing countries (2013).
- How to increase QoS/QoE of IP based Platform (2013).
- Mobility Management in ITU-T: Its Current development and Next Steps Heading Towards Future Networks (2013).
- Multiconnection (2012).

Relevant Groups

- ITU-T SG13 Regional Group for Africa (SG13RG-AFR), established by WTSA-12 (Dubai).
- IPTV Joint Coordination Activity (JCA-IPTV).
- IDM – Joint Coordination Activity for Identity Management (JCA-IdM).
- Internet Protocol Television – Global Standards Initiative (IPTV-GSI).
- Software-Defined Networking Joint Coordination Activity (JCA-SDN).
- IMT-2020 Joint Coordination Activity (JCA-IMT-2020).

Handbooks

- Future Networks (2012).
- Deployment of IMT-2000 Systems (2003 and its 2nd edition under consideration).

2.8 ITU-T Study Group 15 — Networks, technologies and infrastructures for transport, access and home

Scope

The international standards (ITU-T Recommendations) produced by Study Group 15 detail technical specifications giving shape to global communication infrastructure. The group's standards define technologies and architectures of optical transport networks enabling long-haul global information exchange; fibre- or copper-based access networks through which subscribers connect; and home networks connecting in-premises devices and interfacing with the outside world.

ITU-T Study Group 15 is responsible for the development of standards on optical transport network, access network, home network and power utility network infrastructures, systems, equipment, optical fibres and cables, and their related installation, maintenance, management, test, instrumentation and measurement techniques, and control plane technologies to enable the evolution toward intelligent transport networks, including the support of smart-grid applications. This encompasses the development of related standards for the customer premises, access, metropolitan and long-haul sections of communication networks, as well as for power utility networks and infrastructures from transmission to load.

Further information is available at http://www.itu.int/en/ITU-T/studygroups/2017-2020/15/Pages/default.aspx.

Specific areas of study

- Lead study group on access network transport (see ANT Standards Work Plan and ANT Standards Overview for details);
- Lead study group on home networking (see Home Network Transport Standards Overview and Work Plan for details);
- Lead study group on optical technology (see OTN & Technologies Work Plan for details);
- Lead study group on smart grid (see Smart Grid Work Plan for details).

Study Group 15 structure (to be confirmed at its first SG meeting in June 2017)

Three Working Parties (WPs) carry out the studies on Questions assigned to Study Group 15:

WP 1/15:	Transport aspects of access, home and smart grid networks (Q1, 2, 4, 15, 18 and 19)
WP 2/15:	Optical technologies and physical infrastructures (Q5, 6, 7, 8, 16 and 17)
WP 3/15:	Transport network characteristics (Q9, 10, 11, 12, 13 and 14)

Questions

WP1/15	Transport aspects of access, home and smart grid networks
Q1/15:	Coordination of Access and Home Network Transport standards
Q2/15:	Optical systems for fibre access networks
Q4/15:	Broadband access over metallic conductors
Q15/15:	Communications for Smart Grid
Q18/15:	Broadband in-premises networking
Q19/15:	Requirements for advanced service capabilities over broadband cable home networks
WP2/15	Optical technologies and physical infrastructures
Q5/15:	Characteristics and test methods of optical fibres and cables
Q6/15:	Characteristics of optical systems for terrestrial transport networks
Q7/15:	Characteristics of optical components and subsystems
Q8/15:	Characteristics of optical fibre submarine cable systems
Q16/15:	Optical physical infrastructures
Q17/15:	Maintenance and operation of optical fibre cable networks
WP3/15	Transport network characteristics
Q3/15:	Coordination of optical transport network standards
Q9/15:	Transport network protection/restoration
Q10/15:	Interfaces, Interworking, OAM and Equipment specifications for Packet based Transport Networks

Q11/15:	Signal structures, interfaces, equipment functions, and interworking for optical transport networks
Q12/15:	Transport network architectures
Q13/15:	Network synchronization and time distribution performance
Q14/15:	Management and control of transport systems and equipment

ITU-T Study Group 15 Recommendations are listed in Annex 1.

Also see http://www.itu.int/en/ITU-T/publications/Pages/recs.aspx for further information.

Technical Papers

- Technical Report on Optical fibres, cables and systems (2015).
- Operation of G.hn technology over access and in-premises phone line medium (2015).
- Guide on the use of ITU-T L-series Recommendations (2014).
- Wireline broadband access networks and home networking (2011).
- Applications of ITU-T G.9960, ITU-T G.9961 transceivers for Smart Grid applications: Advanced metering infrastructure, energy management in the home and electric vehicles (2010).

Relevant Groups

See contribution 1 of SG15 (SG15-C.1) at https://www.itu.int/md/T17-SG15-C-0001/en for related groups to each Question.

Handbooks

- Optical Transport Networks from TDM to Packet (2010).
- DSL story (2010).
- Optical fibres, cables and systems (2009).
- Protection of telecommunication buildings from fire (2001).
- Handbook on Transmission Planning (1993).
- Outside plant technologies for public networks (1992).
- Optical fibre system planning guide (1989).

2.9 ITU-T Study Group 16 – Multimedia coding, systems and applications

Scope

Study Group 16 leads the ITU-T work on multimedia (MM) coding, terminals, systems and applications, including the coordination of the studies among the various ITU-T SGs. It is also the lead study group for ubiquitous applications ("e-everything", such as eHealth and e-Business), and for telecommunication/ICT accessibility for persons with disabilities.

SG16 is active in all aspects of MM standardization, including terminals, architecture, protocols, security, mobility, interworking and quality of service. It focuses its studies on telepresence and conferencing systems; IPTV; directory services; speech, audio and visual coding; PSTN modems and interfaces; facsimile terminals; ICT accessibility, etc.

As more services and systems become transport-agnostic, an increasing number of them are defined on the higher network layers, which is the standardization domain of ITU-T SG16. This consideration is of particular for cross-sector standardization topics, such as IoT, eHealth and e-Government.

Responsible for studies relating to:

ITU-T Study Group 16 is responsible for studies relating to ubiquitous multimedia applications, multimedia capabilities for services and applications for existing and future networks. This encompasses accessibility; multimedia architectures and applications; human interfaces and services; terminals; protocols; signal processing; media coding and systems (e.g., network signal processing equipment, multipoint conference units, gateways and gatekeepers).

Specific areas of study

- Lead study group on multimedia coding, systems and applications;
- Lead study group on ubiquitous multimedia applications;
- Lead study group on telecommunication/ICT accessibility for persons with disabilities;
- Lead study group on human factors;
- Lead study group on multimedia aspects of Intelligent Transport System (ITS) communications;
- Lead study group on Internet Protocol Television (IPTV) and digital signage;
- Lead study group on multimedia aspects of e-Services.

Study Group 16 structure

Three Working Parties (WPs) carry out the studies on Questions assigned to Study Group 16:

WP 1/16:	Multimedia content delivery
WP 2/16:	Multimedia e-services
WP 3/16:	Media coding and immersive environments

Questions

PLEN	Plenary
Q1/16:	Multimedia coordination
WP1/16:	**Multimedia content delivery**
Q11/16:	Multimedia systems, terminals, gateways and data conferencing
Q13/16:	Multimedia application platforms and end systems for IPTV
Q14/16:	Digital signage systems and services
Q21/16:	Multimedia framework, applications and services
WP2/16:	**Multimedia e-services**
Q24/16:	Human factors related issues for improvement of the quality of life through international telecommunications
Q26/16:	Accessibility to multimedia systems and services
Q27/16:	Vehicle gateway platform for telecommunication/ITS services and applications

PLEN	Plenary
Q28/16:	Multimedia framework for e-health applications
WP3/16:	**Media coding and immersive environments**
Q6/16:	Visual coding
Q7/16:	Speech/audio coding, voiceband modems, facsimile terminals and network-based signal processing
Q8/16:	Immersive live experience systems and services

ITU-T Study Group 16 Recommendations are listed in Annex 1.

Technical Papers

- Accessibility
  - FSTP-TACL – Telecommunications Accessibility Checklist.
  - FSTP-ACC-RemPart – Guidelines for supporting remote participation in meetings for all.
  - FSTP-AM – Guidelines for accessible meetings.
  - FSTP-UMAA – Use cases for assisting persons with disabilities using mobile applications.
- Advanced Multimedia Systems (AMS)
  - HSTP-AMSR – AMS Requirements.
- Audio and speech coding
  - GSTP-ACP1 – Selection Test Results for G.718 Baseline and Qualification Phase Test Results for G.729.1.
  - GSTP-G7291 – Performance of ITU-T G.729.1.
  - GSTP-GSAD – Generic Sound Activity Detector.
  - GSTP-GVBR – Performance of ITU-T G.718.
  - GSTP-G.711AppIII – Performance of ITU-T G.711 Appendix III (Audio quality enhancement toolbox).
- EHealth and telemedicine
  - FSTP-RTM – Roadmap for Telemedicine.
  - HSTP-H810 – Introduction to the ITU-T H.810 Continua Design Guidelines.
  - HSTP-H810-XCHF – Fundamentals of data exchange within ITU-T H.810 Continua Design Guideline architecture.
- Firewall and NAT Traversal Problems in H.323 Systems
  - HSTP-FNTP – Firewall and NAT Traversal Problems in H.323 Systems.
  - HSTP-NFWT – Requirements for Network Address Translator and Firewall Traversal of H.323 Multimedia Systems.
- H.323 Multimedia mobility
  - HSTP-H.510M – Usage of the H.510 protocol for the support of H.323 based Multimedia Services within GPRS/IMT2000 networks.
  - HSTP-MMSM – Technical Paper on Service Mobility for new Multimedia Service Architecture.

– Intelligent transportation systems
  - HSTP-CITS-Reqs – Global ITS Communication Requirements (Version 1).
– IPTV
  - HSTP-MCTB – Media coding toolbox for IPTV: Audio and video codecs.
  - HSTP-CONF-H.701 – Conformance testing specification for H.701.
  - HSTP-CONF-H721 – Conformance testing specification for H.721.
  - HSTP-CONF-H.761 – Conformance testing specification for H.761.
  - HSTP-CONF-H762 – Conformance testing specification for H.762.
  - HSTP-CONF-H770 – Conformance testing specification for H.770.
  - HSTP-IPTV-AISC – Access to Internet-sourced contents.
  - HSTP-IPTV-AM101 – Introduction to the ITU-T H.741-series – A new video engagement audience measurement standard.
  - HSTP.IPTV-Gloss – Glossary and terminology of IP-based TV-related multimedia services.
  - HSTP-IPTV-ISPF – IPTV retail service provider model.
  - HSTP-IPTV-PITD – Delivery and control protocols handled by IPTV terminal devices.

Relevant Groups

– Joint Coordination Activity on Internet of Things and Smart Cities and Communities (JCA-IoT and SC&C);
– Intersector Rapporteur Group Audiovisual Media Accessibility;
– Intersector Rapporteur Group Audiovisual Quality Assessment;
– Intersector Rapporteur Group Integrated Broadcast-Broadband;

Handbooks

– GSAD test methodology Handbook.

2.10 ITU-T Study Group 17 – Security

Scope

Within ITU-T, Study Group 17 coordinates security-related work across all study groups. SG17 is the Lead study group on security, Identity Management (IdM) and languages and description techniques.

Responsible for studies relating to:

Responsible for building confidence and security in the use of Information and Communication Technologies (ICTs). This includes studies relating to cybersecurity, security management, countering spam and identity management. It also includes security architecture and framework, protection of personally identifiable information, and security of applications and services for the Internet of things, smart grid, smartphone, IPTV, web services, social network, cloud computing, mobile financial system and telebiometrics. Also responsible for the application of open system communications including directory and object identifiers, and for technical languages, the method for their usage and other issues related to the software aspects of telecommunication systems, and for conformance testing to improve quality of Recommendations.

Specific areas of study

- Lead study group on security;
- Lead study group on identity management (IdM); and
- Lead study group on languages and description techniques.

Aspects of interest to Developing Countries

While all activities of SG17 are of potential interest to developing countries, the following topics are believed to be of particular interest:

- Security architecture;
- Cybersecurity;
- Countering spam;
- Cloud computing security;
- Identity management; and
- Child online protection.

Study Group 17 structure

ITU-T SG17 structure will be confirmed during its first meeting planned 22 to 30 March in Geneva.

Questions

Q1/17:	Telecommunication/ICT security coordination (Continuation of Q1/17)
Q2/17:	Security architecture and framework (Continuation of Q2/17)
Q3/17:	Telecommunication information security management (Continuation of Q3/17)
Q4/17:	Cybersecurity (Continuation of Q4/17)
Q5/17:	Countering spam by technical means (Continuation of Q5/17)
Q6/17:	Security aspects of ubiquitous telecommunication services (Continuation of Q6/17)
Q7/17;	Secure application services (Continuation of Q7/17)
Q8/17:	Cloud computing security (Continuation of Q8/17)
Q9/17:	Telebiometrics (Continuation of Q9/17)
Q10/17:	Identity management architecture and mechanisms (Continuation of Q10/17)
Q11/17:	Generic technologies to support secure applications (Continuation of Continuation of Q11/17, Q12/17, Q15/17 and the ODP part of Q13/17)
Q12/17:	Formal languages for telecommunication software and testing (Continuation of part of Q13/17, and part of Q14/17)

ITU-T Study Group 17 Recommendations are listed in Annex 1.

Handbooks

- 1993 Introduction to CHILL.
- 1986 CHILL User Manual.

- 1982 CHILL Formal Definition – Volume I, Parts 1, 2, 3.
- 1982 CHILL Formal Definition – Volume II, Part 4.
- 2010 Object identifiers (OIDs) and their registration authorities.
- 2012 Security in Telecommunications and Information Technology.
- 2009 Security in Telecommunications and Information Technology.
- 2006 Security in Telecommunications and Information Technology.
- 2004 Security in Telecommunications and Information Technology.
- 2003 Security in Telecommunications and Information Technology.

2.11 ITU-T Study Group 20 – Internet of things (IoT) and smart cities and communities (SC&C)

Scope

The title and mandate of ITU-T Study Group 20 were approved by WTSA-16. The title of SG20 is "Internet of Things (IoT) and Smart Cities and Communities (SC&C)".

Study Group 20 is responsible for studies relating to Internet of Things (IoT) and its applications, and Smart Cities and Communities (SC&C). This includes studies relating to big data aspects of IoT and SC&C, e-services and smart services for SC&C.

Specific areas of study

- Lead study group on Internet of Things (IoT) and its applications;
- Lead study group on smart Cities and communities (SC&C), including its e-services and smart services;
- Lead study group for Internet of things identification.

Study Group 20 structure

Study Group 20 structure includes two Working Parties (WPs), and four Regional Groups.

Questions

Study Group 20 structure includes two Working Parties (WPs), and four Regional Groups:

WP1/20	
Q1/20:	End to end connectivity, networks, interoperability, infrastructures and Big Data aspects related to IoT and SC&C
Q2/20:	Requirements, capabilities, and use cases across verticals
Q3/20:	Architectures, management, protocols and Quality of Service
Q4/20:	Internet of things (IoT) applications and services including end user networks and interworking
WP2/20	
Q5/20:	Research and emerging technologies, terminology and definitions
Q6/20:	Security, privacy, trust and identification

Q7/20:	Evaluation and assessment of Smart Sustainable Cities and Communities
SG20RG-AFR:	ITU-T SG20 Regional Group for the Africa Region
SG20RG-ARB:	ITU-T SG20 Regional Group for the Arab Region
SG20RG-EECAT:	ITU-T SG20 Regional Group for Eastern Europe, Central Asia and Transcaucasia
SG20RG-LATAM:	ITU-T SG20 Regional Group for the Latin American Region

ITU-T Study Group 20 Recommendations

The detailed list of Recommendations under Study Group 20 responsibility can be found at: https://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=20.

Related Groups

– Joint Coordination Activity on Internet of things and smart cities and communities (JCA-IoT and SC&C).

– Focus Group on Data Processing and Management (FG-DPM).

Supplements

Y Suppl. 27 ITU-T Y.4400 series:	Smart Sustainable Cities – Setting the framework for an ICT architecture
Y Suppl. 28 ITU-T Y.4550 series:	Smart Sustainable Cities – Integrated management
Y Suppl. 29 ITU-T Y.4250 series:	Smart Sustainable Cities – Multi-service infrastructure in new-development areas
Y Suppl. 30 ITU-T Y.4250 series:	Smart Sustainable Cities – Overview of smart sustainable cities infrastructure
Y Suppl. 31 ITU-T Y.4550 series:	Smart Sustainable Cities – Intelligent sustainable buildings
Y Suppl. 32 ITU-T Y.4000 series:	Smart sustainable cities – A guide for city leaders
Y Suppl. 33 ITU-T Y.4000 series:	Smart Sustainable Cities – Master plan
Y Suppl. 34 ITU-T Y.4000 series:	Smart Sustainable Cities – Setting the stage for stakeholders' engagement
Y.Suppl. 42 ITU-T Y.4100 series:	Use cases of User-Centric work Space (UCS) Service

During WTSA 2016, Resolution 98 – Enhancing the standardization of Internet of things and smart cities and communities for global development was approved.

2.12 United for Smart Sustainable Cities (U4SSC)

In May 2016, ITU and UNECE launched the United for Smart Sustainable Cities (U4SSC) initiative in response to the Sustainable Development Goal 11: "Make cities and human settlements inclusive, safe, resilient and sustainable". The U4SSC is a global initiative which advocates for public policy to encourage the use of ICTs in enabling the transition to smart sustainable cities. The U4SSC global

initiative is open to all United Nations agencies, municipalities, industry, academia and other relevant stakeholders.

Currently the U4SSC enjoys the support of 16 other United Nations agencies and programmes. The UN Agencies supporting this initiative are: 1) International Telecommunication Union (ITU), 2) United Nations Economic Commission for Europe (UNECE), 3) Convention on Biological Diversity, 4) Economic Commission for Latin America and the Caribbean (ECLAC), 5) Food and Agriculture Organization (FAO), 6) UN Women, 7) United Nations Convention to Combat Desertification (UNCCD), 8) United Nations Economic Commission for Africa, 9) United Nations Environment Programme – Finance Initiative (UNEP Finance Initiative), 10) United Nations Environment Programme (UNEP), 11) United Nations Framework Convention on Climate Change (UNFCCC), 12) United Nations Human Settlements Programme (UN Habitat), 13) United Nations Industrial Development Organization (UNIDO), 14) United Nations University (UNU-IAS), 15) World Meteorological Organization (WMO), 16) World Trade Organization (WTO).

Within the U4SSC initiative an Advisory Board for Smart Sustainable Cities was created in order to review and refine the ITU-UNECE KPIs for smart sustainable cities. Currently several pilot projects to assess the smartness and sustainability of cities using the ITU-UNECE KPIs for smart sustainable cities are being carried out worldwide (e.g., Dubai, Singapore, Wuxi, Guangshan, Valencia, Manizales, Buenos Aires, Montevideo, Santiago de Chile and many others).

More information on the U4SSC can be found at: http://www.itu.int/en/ITU-T/ssc/united/Pages/default.aspx.

2.13 ITU-T Focus Groups

ITU-T Focus Groups are an instrument created by ITU-T that augment the Study Group work programme by providing an alternative working environment for the quick development of specifications in their chosen areas. The procedures for such groups are found in Rec. ITU-T A.7. ITU-T Focus Groups are now widely used to address industry needs as they emerge, and when they are not covered within an existing Study Group. The key difference between study groups and Focus Groups is the freedom that they have to organize and finance themselves. Focus Groups can be created very quickly, are usually short-lived and can choose their own working methods, leadership, financing, and types of deliverables.

Currently, no new Focus Groups are being considered for creation.

The following page contains information on the Focus Groups that concluded their activities: http://itu.int/en/ITU-T/focusgroups/Pages/concluded.aspx.

FG DFS – Focus Group on Digital Financial Services

The Focus Group on Digital Financial Services (FG DFS) was established by TSAG at its meeting of June 2014. The Focus Group held its first meeting on 5 December 2014 and completed its work in December 2016.

The Focus Group aimed to:

- Foster collaboration and increase dialogue between financial services and telecommunications regulators, clarify their respective roles and responsibilities in the DFS field to minimize the risk of regulatory arbitrage or legal void;
- Address some of the key regulatory and policy issues currently preventing the development of an open, secure and interoperable DFS ecosystem with a particular (though not exclusive) focus on areas where financial services and Telco regulators overlap;
- Leverage the voice and expertise of a large number of key actors in the DFS value chain;

– Provide policy and decision makers in developing countries with additional tools to advance the financial inclusion agenda and fast track policy reform.

The Focus Group has produced 28 technical reports and 85 recommendations which offer solutions to overcome the challenges faced by policymakers and DFS providers. 23 technical reports were initially published and the remaining reports were published by end of February 2017. The technical reports which have been published are listed below:

– The Regulator's Perspective on the Right Timing for Inducing Interoperability
– DFS Vendor Platform Features
– DFS Glossary
– Review of DFS User Agreements in Africa: A Consumer Protection Perspective
– Security Aspects of Digital Financial Services (DFS)
– Identity and Authentication
– Over the counter transactions: A threat to or a facilitator for digital finance ecosystems?
– Impact of Social Networks on Digital Liquidity
– B2B and the DFS Ecosystem
– Bulk Payments and the DFS Ecosystem
– Payment System Interoperability and Oversight: The International Dimension
– Payment System Oversight and Interoperability
– Impact of Agricultural Value Chains on Digital Liquidity
– Merchant Data and Lending
– Role of Postal Networks in Digital Financial Services
– Access to payment infrastructures
– Cooperation frameworks between Authorities, Users and Providers for the development of the National Payments System
– Review of National Identity Programs
– Enabling Merchant Payments Acceptance in the Digital Financial Ecosystems
– QoS and QoE Aspects of Digital Financial Services
– Regulation in the Digital Financial Services Ecosystem
– Commonly identified Consumer Protection themes for Digital Financial Services
– The Digital Financial Services Ecosystem

The technical reports and recommendations were submitted to TSAG at its meeting on 1-4 May 2017 for consideration by ITU-T study groups. More information on the Focus Group Digital Financial Services is available at: http://www.itu.int/en/ITU-T/focusgroups/dfs/Pages/default.aspx.

FG IMT-2020 – Focus Group on IMT-2020

The Focus Group on network aspects of IMT-2020 was established in May 2015 to analyse how emerging 5G technologies will interact in future networks as a preliminary study into the networking innovations required to support the development of 5G systems. The group took an ecosystem view of 5G research of development and published the analysis in a Report to its parent group, ITU-T Study Group 13.

In December 2015, the Focus Group received an extension to its lifetime. New Terms of Reference called for the group to engage open-source communities, influencing and taking advantage of their work by introducing them to the challenges that telecoms players must overcome in the development of the 5G ecosystem. At the end of 2016, the group submitted 9 draft Recommendations and Technical Reports to ITU-T Study Group 13:

- Draft Terms and definitions for IMT-2020 in ITU-T (O-040).
- Draft Technical Report: Application of network softwarization to IMT-2020 (O-041).
- Draft Recommendation: Requirements of IMT-2020 from network perspective (O-042).
- Draft Recommendation: Framework for IMT-2020 network architecture (O-043).
- Draft Recommendation: Requirements of IMT-2020 fixed mobile convergence (O-044).
- Draft Technical Report: Unified network integrated cloud for fixed mobile convergence (O-045).
- Draft Recommendation: IMT-2020 network management requirements (O-046).
- Draft Recommendation: Network management framework for IMT-2020 (O-047).
- Draft Technical Report: Application of information centric networking to IMT-2020 (O-048).

The nine Deliverables and the Chairman's Report are compiled in this ZIP-file.

ITU-T standardization activity based on the findings of the Focus Group will prioritize the alignment of 5G deliverables with those of ITU-R, ensuring that standardization work on the network aspects of 5G is informed by the progression of its radio-transmission systems.

More information about the Focus Group is available at http://www.itu.int/en/ITU-T/focusgroups/imt-2020/Pages/default.aspx.

FG AC – Focus Group on Aviation Applications of Cloud Computing for Flight Data Monitoring

ITU-T Focus Group on Aviation Applications of Cloud Computing for Flight Data Monitoring (FG AC) was established by TSAG in June 2014 in response to a special meeting on Global Flight Tracking of Aircraft organized by the International Civil Aviation Organization (ICAO), and an Expert Dialogue on Real-time Monitoring of Flight Data, facilitated by ITU.

The objective of FG AC was to explore how ICTs, including cloud computing and big data analytics, can support aviation applications, such as real-time monitoring of flight data, and to identify the requirements for related ICT/telecommunication standards.

FG AC held five face-to-face meetings in the period from December 2014 to December 2015. TSAG endorsed the four Deliverables of the Focus Group in February 2016. The deliverables are structured as follows:

- Existing and Emerging Technologies of Cloud Computing and Data Analytics [PDF];
- Use Cases and Requirements [PDF];
- Avionics and Aviation Communications Systems [PDF];
- Key findings, recommendations for next steps and future work [PDF].

More information about the Focus Group is available at http://itu.int/en/ITU-T/focusgroups/ac/.

FG SmartCable – Focus Group on Smart Cable Television

ITU-T Focus Group on Smart Cable Television (FG SmartCable) was established by ITU-T SG 9 at its meeting in Geneva, 30 April- 4 May 2012. The objective of this Focus Group is to collect and analyze information from existing relevant activities as well as to develop deliverables that would assist the

future development of ITU-T Recommendations to support "Smart Cable Television" including requirements, use cases, technical methods, etc. The webpage of the group is found at http://itu.int/en/ITU-T/focusgroups/smartcable.

FG Innovation – Focus Group on Bridging the Gap: from Innovation to Standards

ITU-T Focus Group on Bridging the Gap: from Innovation to Standards (FG Innovation) was established by ITU-T TSAG at its meeting in Geneva, 10-13 January 2012. The objective of this Focus Group is to document and analyse successful cases of ICT innovations and identify relevant standardization gaps which can lead to new study items for ITU-T. The group webpage is found at http://itu.int/en/ITU-T/focusgroups/innovation.

FG DR&NRR – Focus Group on Disaster Relief Systems, Network Resilience and Recovery

ITU-T Focus Group on Disaster Relief Systems, Network Resilience and Recovery (FG-DR&NRR) was established by the ITU-T TSAG meeting in Geneva, 10-13 January 2012. The objective of the Focus Group is to collect and document information and concepts that would be helpful for the work on disaster relief systems/applications, network resilience and recovery from a telecommunication perspective. Its parent group was changed from TSAG to ITU-T SG2 by the TSAG meeting in Geneva 4-7 June 2013. The group webpage is found at http://www.itu.int/en/ITU-T/focusgroups/drnrr.

FG M2M – Focus Group on M2M Service Layer

ITU-T Focus Group on M2M Service Layer (FG M2M) was established by ITU-T TSAG at its meeting in Geneva, 10-13 January 2012. The objective of this Focus Group is to develop technical reports to support the progress on M2M APIs and protocols to support M2M services and applications. The group webpage is found at http://itu.int/en/ITU-T/focusgroups/m2m.

FG AVA – Focus Group on Audiovisual Media Accessibility

ITU-T Focus Group on Audiovisual Media Accessibility (FG AVA) was proposed by ITU-T Study Group 16 (Geneva, 14-25 March 2011) and established after consultation of ITU-T study groups and membership. The Focus Group objective is to make audiovisual media accessible for persons with disabilities. The group webpage is found at http://itu.int/en/ITU-T/focusgroups/ava.

FG DPM – Focus Group on Data Processing and Management

The Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities was established by ITU-T Study Group 20 at its meeting in Dubai, 13-23 March 2017.

The Focus Group objectives are:

- To study, review and survey existing technologies, platforms, guidelines and standards for data processing and management including data format in support of the mandate of SG20;
- To recognize and highlight the various perspectives for the future of data driven eco-environments;
- To promote security and trust within data management frameworks;
- To identify and study data protection techniques;
- To facilitate cross-cutting data interoperability issues and point the way to the development of efficient and scalable approaches to managing systems data;
- To study meta-data;
- To study trust in data management frameworks including digital identification and certification;
- To investigate the role of emerging technologies to support data management and emerging trends including blockchain;

– To identify challenges in the standardization activities for data processing and management.

– To establish liaisons and relationships with other organizations which could contribute to the standardization activities for data processing and management.

The group webpage is found at:

http://www.itu.int/en/ITU-T/focusgroups/dpm/Pages/default.aspx.

The list of ITU-T Focus Group publications can be found in Annex 2.

Abbreviations and acronyms

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

Abbreviation/acronym	Description
AMS	Americas Region
AO	Asia and Oceania
API	Application Programming Interface
APP	Alternative Approval Process
ARB	Arab Region
ASN.1	Abstract Syntax Notation One
bDDN	Big Data Driven Networking
BDT	Telecommunication Development Bureau
BR	Radiocommunication Bureau
BSG	Bridging the Standardization Gap
BSS	Broadcasting-Satellite Service
C&I	Conformance and Interoperability
CAP	Common Alerting Protocol
CATV	Cable Television
CCIT	International Telegraph and Telephone Consultative Committee, now ITU-T
CCN	Content Centric Networking
CCV	Coordination Committee for Vocabulary
CHILL	A high-level programming language for programming SPC telephone exchanges, developed by CCITT.
CIS	Commonweath of Independent States
CLI	Calling Line Identification
CORBA	Common Object Request Broker Architecture
CPE	Customer Premises Ee=quipment
CPM	Conference Preparatory Meeting
CPND	Calling Party Number Delivery
CPRI	Common Public Radio Interface
CRS	Cognitive Radio Systems
DPI	Deep Packet Inspection

Abbreviation/acronym	Description
DSB	Digital Sound Broadcasting
DTT	Digital Terrestrial Television
EA	East Africa
ECELAC	Economic Commission for Latin America and the Caribbean
EECAT	Eastern Europe, Central Asia and Transcaucasia
EESS	Earth Exploration-Satellite
EMC	Electromagnetic Compatibility
EMF	Electromagnetic Fields
ENUM	Telephone Number Mapping
ETS	Emergency Telecommunications Service
FAO	Food and Agriculture Organization
FG	Focus Group
FG AC	Focus Group on Aviation Applications
FG AVA	Focus Group on Audiovisual Media Accessibility
FG DFS	Focus Group on Digital Financial Services
FG DPM	Focus Group on Data Processing and Management
FG DR&NRR	Focus Group on Disaster Relief Systems, Network Resilience and Recovery
FG OCAF	Open Communications Architecture Forum Focus Group
FG SSC	Focus Group on Smart Sustainable Cities
FG SWM	Focus Group on Smart Water Management
FMC	Fixed Mobile Convergence
FN	Future Networks
FS	Fixed Service
FSS	Fixed-Satellite Service
GHG	Greenhouse Gas
GHz	Gigahertz
GMDSS	Global Maritime Distress and Safety System
GPON	Gigabit-capable Passive Optical Networks
HAPSS	High Altitude Platform Stations
HF	High Frequency

Abbreviation/acronym	Description
IC	Identification Code
ICAO	International Civil Aviation Organization
ICN	Information Centric Network
ICT	Information and Communication Technologies
IDL	Interface Definition Language
IdM	Identity Management
IEC	International Electrotechnical Commission
IEPS	International Emergency Preference Scheme
IMT	International Mobile Telecommunications
IoT	Internet of Things
IP	Internet Protocol
IPTV	Internet Protocol Television
IPTV-GSI	IPTV Global Standards Initiative
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
IRG	Intersectoral Rapporteur Group
IRG-AVA	Intersector Rapporteur Group Audiovisual Media Accessibility
IRG-AVQA	Intersectoral Rapporteur Group on Audiovisual Quality Assessment
ISDN	Integrated Services Digital Network
ITS	Intelligent Transport System
ITU	International Telecommunication Union
ITU-D	ITU Telecommunication Development Sector
ITU-R	ITU Radiocommunication Sector
ITU-T	ITU Telecommunication Standardization Sector
ITU-T CASC	ITU-T Conformity Assessment Steering Committee
JCA-CIT	Joint Coordination Activity on Conformance and Interoperability Testing
JCA-IdM	Joint Coordination Activity on Identity Management
JCA-IoT and SC&C	Joint Coordination Activity on Internet of Things and Smart Cities and Communities
JGR-CCM	Joint Rapporteur Group on Cloud Computing Management

Abbreviation/acronym	Description
KPIs	Key Performance Indicators
LAC	Latin America and the Caribbean
LATAM	Latin American Region
LTE	Long Term Evolution
M2M	Machine to Machine
MetAids	Meteorological Aids
MetSat	Meteorological-Satellite
MHz	Megahertz
MIFR	Master International Frequency Register
MM	Multimedia
MPLS	Multi-Protocol Label Switching
MSC	Message Sequence Chart
MSS	Mobile-Satellite Service
NFV	Network Function Virtualization
NGN	Next Generation Networks
NPI	Number Plan Interworking
OAM	Operations, Administration and Maintenance
OI	Origin Identification
OIDs	Object Identifiers
OTT	Over-The-Top
PON	Passive Optical Networks
PPDR	Protection and Disaster Relief
QoE	Quality of Experience
QoS	Quality of Service
QSDG	Quality of Service Development Group
RA	Radiocommunication Assemblies
RAG	Radiocommunication Advisory Group
RAS	Radio Astronomy
RCC	Regional Commonwealth in the field of Communications
RDSS	Radiodetermination-Satellite Service

Abbreviation/acronym	Description
RF	Radio-Frequency
RFID	Radio-Frequency Identification
RG	Regional Group
RoF	Radio-Over-Fibre
RR	Radio Regulations
SC&C	Smart Cities and Communities
SDGs	Sustainable Development Goals
SDN	Software-Defined Networking
SG	Study Group
SMP	System Management Population
SNG	Satellite News Gathering
SRD	Short-Range Device
SS7	Signalling System 7
TAP	Traditional Approval Process
TDM	Time-Division Multiplexing
TMN	Telecommunication Management Network
TR	Technical Report
TSAG	Telecommunication Standardization Advisory Group
TSB	Telecommunication Standardization Bureau
TTCN-3	Testing and Test Control Notation version 3
U4SSC	United for Smart Sustainable Cities
UCS	User-Centric work Space
UHDTV	Ultra-High Definition Television
UHF	Ultra-High Frequency
UNCCD	United Nations Convention to Combat Desertification
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UNU	United Nations University

Abbreviation/acronym	Description
UPT	Universal Personal Telecommunications
URN	User Requirements Notation
USN	Ubiquitous Sensor Network
VHF	Very High Frequency
VLBI	Very Long Baseline Interferometry
VoLTE	Voice over LTE
VQEG	Video Quality Experts Group
VSAT	Very Small Aperture Terminals
WDM	Wavelength Division Multiplexing
WLAN	Wireless Local Area Networks
WMO	World Meteorological Organization
WP	Working Party
WRC	World Radiocommunication Conference
WTDC	World Telecommunication Development Conference
WTO	World Trade Organization
WTSA	World Telecommunication Standardization Assembly
XML	Extensible Markup Language

Annexes

Annex 1: ITU-T Recommendations

ITU-T Study Group 2 Recommendations

– **E series: Overall network operation, telephone service, service operation and human factor**

E.101:	Definitions of terms used for identifiers (names, numbers, addresses and other identifiers) for public telecommunication services and networks in the E-series Recommendations
E.106:	International Emergency Preference Scheme (IEPS) for disaster relief operations
E.107:	Emergency Telecommunications Service (ETS) and interconnection framework for national implementations of ETS
E.117:	Terminal devices used in connection with the public telephone service (other than telephone)
E.118:	The international telecommunication charge card
E.129:	Presentation of national numbering plans
E.152:	International free phone service
E.153:	Home country direct
E.154:	International shared cost service
E.155:	International shared cost service
E.156:	Guidelines for ITU-T action on reported misuse of E.164 number resources
E.156:	Suppl1: Best practice guide on countering misuse of E.164 number resources (Approved 2007)
E.156:	Suppl2: Possible Actions to counter misuse (Approved 2011)
E.157:	International Calling Party Number Delivery
E.161.1:	Guidelines to select Emergency Number for public telecommunications networks
E.162:	Capability of seven digit analysis for international E.164 numbers at time T
E.164:	The international public telecommunication numbering plan (and Supplements 1,2,3,4,5,6) (amended and approved in 2010)
E.164.1:	Criteria and procedures for the reservation, assignment and reclamation of E.164 country codes and associated Identification Codes (ICs)
E.164.2:	E.164 numbering resources for trials
E.164.3:	Principles, criteria and procedures for the assignment and reclamation of E.164 country codes and associated identification codes for groups of countries
E.165.1:	Use of escape code '0' within the E.164 numbering plan during the transition period to implementation of number plan interworking (NPI) mechanism

E.166/ X.122:	Numbering plan interworking for the E.164 and X.121 numbering plans
E.168:	Application of E.164 numbering plan for UPT
E.168.1:	Assignment procedures for universal personal telecommunications (UPT) numbers in the provisioning of the international UPT service
E.169:	Application of E.164 numbering plan for universal international numbers for international telecommunications services using country codes for global service
E.169.1:	Application of Recommendation E.164 numbering plan for universal international free-phone numbers for international freephone service
E.169.2:	Application of Recommendation E.164 numbering plan for universal international premium rate numbers for the international premium rate service
E.169.3:	Application of Recommendation E.164 numbering plan for universal international shared cost numbers for the international shared cost service
E.190:	Principles and responsibilities for the management, assignment and reclamation of E-Series international numbering resources
E.191:	B-ISDN addressing
E.191.1:	Criteria and procedures for the allocation of the ITU-T International Network Designator addresses
E.193:	E.164 country code expansion
E.195:	ITU-T international numbering resource administration
E.212:	Network operational principles for future public mobile systems and services

– **F series: Non-telephone telecommunication services**

F.16:	Global virtual network services
F.902:	Interactive services design guidelines
F.910:	Procedures for designing, evaluating and selecting symbols, pictograms and icons

– **M series: Telecommunication management, including TMN and network maintenance**

M.60:	Maintenance terminology and definitions
M.2100:	Performance limits for bringing-into-service and maintenance of international PDH paths, sections and transmission systems
M.2101:	Performance limits for bringing-into-service and maintenance of international multi-operator SDH paths and multiplex sections
M.2110:	Bringing-into-service of international PDH paths, sections and transmission systems and SDH paths and multiplex sections
M.3000:	Overview of TMN Recommendations
M.3010:	Principles for a Telecommunications Management Network
M.3013:	Considerations for Telecommunication Management Network

M.3600:	Principles for the management of ISDNs
M.3610:	Principles for applying the TMN concept to the management of B-ISDN
M.3020:	Management interface specification methodology

ITU-T Study Group 3 Recommendations

Recommendations

– **D series: General tariff principles**

D.000:	Terms and definitions for the D-series Recommendations (Approved in 2010)
D.50:	International Internet connection (Amended and approved in 2011)
D.50 Supp1:	General Considerations for traffic measurement and options for International Internet Connectivity (approved in 2011)
D.50 Supp2:	Guidelines for reducing the costs of international internet connectivity (approved, 2013)
D.52:	Establishing and Connecting Regional IXPs to reduce the costs of International Internet Connectivity (Approved in 2016)
D.53:	International Aspects of Universal Service (Approved in 2016)
D.97:	Methodological principles for determining international mobile roaming rates (Approved in 2016)
D.98:	Charging in International Mobile Roaming Service (Approved in 2012)
D.120:	Charging and accounting principles for the automated telephone credit card service
D.140:	Accounting rate principles for international telephone services
D.155:	Guiding principles governing the apportionment of accounting rates in the intercontinental telephone relations
D.170:	Minimum amounts recommended for queries relating to monthly accounts, in the absence of a specific agreement (and Supplements 1,2,3 & 4) (Approved in 2010)
D.170 Supp5:	Guidelines for Fraud Mitigation (Approved in 2013)
D.190:	Exchange of international traffic accounting data between Administrations using electronic data interchange (EDD) techniques
D.195:	Time-scale for settlement of accounts for international telecommunication services (approved in 2012)
D.195 Supp1:	Credit Management Guidelines (approved in 2013)
D.195 Supp2:	DSO Management Guidelines (approved in 2013)
D.195 Supp3:	Prepayment Guidelines (approved in 2013)
D.201:	General principles regarding call-back practices

D.211 Supp1:	Guidelines for international short message service interconnection (Approved in 2010)
D.261:	Regulatory principles for market definition and identification of operators with significant market power – SMP (Approved in 2016)
D.271:	Charging and accounting principles for NGN (Revised in 2016)
D.280:	Principles for charging and billing, accounting and reimbursements for universal personal telecommunication
D.285:	Guiding principles for charging and accounting for intelligent network supported services
D.286:	Charging and accounting principles for the global virtual network service
D.300R:	Determination of accounting rate shares in telephone relations between countries in Europe and the Mediterranean Basin
D.301R:	as D.300R, but for telex
D.302R:	as D.300R, but for telegrams
D.303R:	as D.300R, but for circuits of sound and television programme transmission
D.306R:	as D.300R, but for public-switched data transmission network
D.307R:	Remuneration of digital systems and channels used in telecommunication relations between the countries of Europe and the Mediterranean Basin
D.310R:	Determination of rentals for the lease of international programme (sound and television) circuits and associated control circuits for the private service in relation between countries in Europe and the Mediterranean basin
D.400R:	Accounting rates applicable to direct traffic relations in voice telephony between countries in Latin America and the Caribbean
D.500R:	Accounting rates applicable to telephone relations between countries in Asia and Oceania
D.501R:	The same as D.500R, but for telex
D.600R:	Determination of accounting rate shares and collection charges in telephone relations between countries in Africa (revision)
D.601R:	The same as D.600R but for telex relations
D.602R:	The same as D.600R but for application of "sender pays transit" principle in transit relations
D.603R:	Minimizing collection charges on inter African calls
D.604R:	Preferential rates in telecommunication relations between countries in Africa

– **E series: Overall network operation, telephone service, service operation and human factors**

E.231/ D.103:	Charging in automatic service for calls terminating on a recorded announcement stating the reason for the call not being completed
E.232/ D.104:	Charging for calls to subscriber's station connected either to the absent subscriber's service or to a device substituting a subscriber in his absence

ITU-T Study Group 5 Recommendations

ITU-T Study Group 5 Recommendations can found at: https://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=05.

ITU-T Study Group 9 Recommendations

ITU-T Study Group 9 Recommendations can be found at: http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=9.

ITU-T Study Group 11 Recommendations

– **Q series: Switching and signaling, and associated measurements and tests**

Q.9:	Vocabulary of switching and signalling terms
Q.13:	International telephone routing plan
Q.500:	Digital local, combined, transitional international exchanges – introduction and field of application
Q.55:	Transmission – characteristics of digital exchanges
Q.601:	Interworking of signalling systems – general
Q.700-Q.799-series:	Specifications of Signalling System No. 7
Q.933:	Digital subscriber signalling
Q.1000:	Structure of the Q.1000 – series Recommendations for public land mobile networks
Q.1200-Series:	Intelligent Network
Q.1900-Series:	Bearer Independent Call Control
Q2931:	Digital subscriber signalling system
Q.3900-Q.4099-series:	Testing specifications
Q.3900-Q.3999-series:	Testing specifications for next generation networks
Q.4000-Q.4039-series:	Testing specifications for SIP-IMS
Q.4040-Q.4059-series:	Testing specifications for cloud computing

ITU-T Study Group 12 Recommendations

– E series: Overall network operation, telephone service, service operation and human factors

E.420-E.479:	Checking the quality of the international telephone service
E.800-E.809:	Terms and definitions related to the quality of telecommunication services
E.810-E.844:	Models for telecommunication services
E.845-E.859:	Objectives for quality of service and related concepts of telecommunication services
E supplements:	Supplements to the Series E Recommendations

– G series: Transmission systems and media, digital systems and networks

G.100-G.199:	International telephone connections and circuits
G.1000-G.1999:	Multimedia Quality of Service and performance – Generic and user-related aspects

– I.350-series (including ITU-T G.820/I.351/Y.1501), ITU-T I.371, ITU-T I.378, ITU-T I.381

– J.140-, ITU-T J.240- and ITU-T J.340-series

– P series: Telephone transmission quality, telephone installations, local line networks

– Y series: Global information infrastructure, Internet protocol aspects and next-generation networks

Y.1200-Y.1299:	Architecture, access, network capabilities and resource management
Y.1500-Y.1599:	Quality of service and network performance

ITU-T Study Group 13 Recommendations

– **Y series: Global information infrastructure, Internet protocol aspects and next-generation networks, Internet of Things and smart cities**

Y.1271:	Framework(s) on network requirements and capabilities to support emergency telecommunications over evolving circuit-switched and packet-switched networks
Y.2001:	General overview of NGN
Y.2011:	General principles and general reference model for next generation networks
Y.2085:	Distributed Service Networking Service Routing
Y.2262:	PSTN/ISDN emulation and simulation towards NGN
Y.2205:	Next Generation Networks Emergency Telecommunications – Technical Considerations
Y.2111:	Resource and admission control functions in next generation networks
Y.2112 A:	QoS control architecture for Ethernet-based IP access networks
Y.2171:	Admission control priority levels in Next Generation Networks
Y.2172:	Service restoration priority levels in Next Generation Networks
Y.2174:	Distributed RACF architecture for MPLS networks
Y.2175:	Centralized RACF architecture for MPLS core networks

Y.2320:	Requirements for virtualization of control network entities in next generation network evolution
Y.2321:	Functional Architecture for supporting Virtualization of Control Network Entities in Next Generation Network evolution
Y.2330:	Requirements of Next Generation Network evolution for supporting Freedata service
Y.2340:	Overview of Next Generation Network evolution phase 1
Y.2617:	QoS guaranteed mechanisms and performance model for Public packet Telecommunication Data Network (PTDN)
Y.2705:	Minimum security requirements for the interconnection of the Emergency Telecommunications Service (ETS)
Y.2723:	Support for OAuth in next generation networks
Y.2724:	Framework for supporting OAuth and OpenID in next generation networks
Y.2725:	Support of OpenID in next generation networks
Y.3001:	Future Networks: Objectives and Design goals
Y.3000:	family Recommendations
Y.3301:	Cloud computing- Framework and high-level requirements
Y.3302:	Functional architecture of software-defined networking
Y.3322:	Functional architecture for NICE implementation making use of software-defined networking technologies
Y.3504:	Functional Architecture for Desktop as a Service
Y.3522:	End-to-end Cloud Service Lifecycle Management Requirements

- Supplement 66 to Q.1740-series: Supplement on scenarios and requirements in terms of services and deployments for IMT and IMS in developing countries.
- Supplement 21 to Y.2000-series: NGN requirements for interworking with legacy IP-based networks.
- Supplement 26 to Y.2600-series: Scenario and requirements of reconfigurable networking based on minimum network functions & network polymorphism in future packet based network.

ITU-T Study Group 15 Recommendations

See http://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=15 for detailed information about ITU-T Study Group 15 Recommendations.

- **G series: Transmission systems and media, digital systems and networks**

G.984.x series:	Gigabit-capable passive optical networks (GPON) related Recommendations
G.987.x series:	10-Gigabit-capable passive optical network (XG-PON) related Recommendations

G.989.x series:	40-Gigabit-capable passive optical network (NG PON2) related Recommendations
G.992.x series:	ADSL related Recommendations
G.993.x series:	VDSL related Recommendations
G.9700:	Fast access to subscriber terminals (G.fast) – Power spectral density specification
G.9701:	Fast access to subscriber terminals (G.fast) – Physical layer specification
G.9901-G.9904:	Narrowband orthogonal frequency division multiplexing power line communication transceivers
G.996x series:	Unified high-speed wireline-based home networking transceivers related Recommendations
G.650 series:	Optical fibre cables
G.680-G.699:	Characteristics of optical systems including wavelength division multiplexing (WDM)
G.970 series:	Optical fibre submarine cable systems
G.709:	Interfaces for the optical transport network
G.709.1:	Flexible OTN short-reach interface
G.8000 series:	Packet over Transport aspects including Ethernet, MPLS-TP and synchronization
G.Suppl.55:	Radio-over-fibre (RoF) technologies and their applications
G.Suppl.56:	OTN transport of CPRI signals

– **O series: Specifications of measuring equipment**

O.201:	Q-factor test equipment to estimate the transmission performance of optical channels
O.211:	Test and measurement equipment to perform tests at the IP layer

– **L series: Construction, installation and protection of cables and other elements of outside plant**

L.38:	Use of trenchless techniques for the construction of underground infrastructure for telecommunication cable installation
L.51:	Passive node elements for fibre optic networks, General principles and definitions for characterization and performance evaluation
L.92:	Disaster Management for outside plant facilities
L.100-L.199:	Optical fibre cables
L.200-L.299:	Optical infrastructures

L.300-L.399:	Maintenance and operation
L.380-L.399:	Disaster management
L.392:	Disaster management for improving network resilience and recovery with movable and deployable ICT resource units
L.400-L.429:	Passive optical devices
L.430-L.449:	Marinized terrestrial cables

ITU-T Study Group 16 Recommendations

- ITU-T E.120 – ITU-T E.139 (except ITU-T E.129), ITU-T E.161, ITU-T E.180-series, ITU-T E.330-series, ITU-T E.340-series
- ITU-T F.700-series, except those under the responsibility of Study Group 20, and ITU-T F.900-series
- ITU-T G.160-series, ITU-T G.710 – ITU-T G.729 (except ITU-T G.712), ITU-T G.760-series (including ITU-T G.769/Y.1242), ITU-T G.776.1, ITU-T G.799.1/ Y.1451.1, ITU-T G.799.2, ITU-T G.799.3
- ITU-T H-series, except those under the responsibility of Study Group 20
- ITU-T T-series
- ITU-T Q.50-series, ITU-T Q.115-series
- ITU-T V-series, except those under the responsibility of Study Groups 2 and 15
- ITU-T X.26/V.10 and ITU-T X.27/V.11

– **F series: Non-telephone telecommunication services**

F.700:	Framework Recommendation for audiovisual/multimedia services
F.721:	Videotelephony teleservice for ISDN
F.723:	Videophone service in the Public Switched Telephone Network (PSTN)
F.742:	Service description and requirements for distance learning services
F.743:	Requirements and service description for visual surveillance
F.745:	Functional requirements for network-based speech-to-speech translation services
F.746:	Requirements of multimedia optimization control components
F.749.1:	Functional requirements for vehicle gateways
F.790:	Telecommunications accessibility guidelines for older persons and persons with disabilities
F.791:	Accessibility terms and definitions

– **H series: Audiovisual and multimedia systems**

H.222.0:	Information technology – Generic coding of moving pictures and associated audio information: System
H.310:	Broadband audiovisual communication systems and terminals
H.320:	Narrow-band visual telephone systems and terminal equipment

H.321:	Adaptation of H.320 visual telephone terminals to B-ISDN environments
H.323:	Packet-based multimedia communications systems
H.248 series:	Media gateway protocol (80+ Recommendations)
H.262:	MPEG2 Video compression
H.264:	Advanced Video Coding for for generic audiovisual services
H.265:	High-efficiency video coding
H.700 series:	IPTV multimedia services and applications for IPTV
H.810-H.850 series:	on personal health systems
H.860:	Multimedia e-health data exchange services: Data schema and supporting services
H Series supplement 1:	Requirements on video communication for sign language and lip reading

– **T series: Terminals for telematic services**

T.30 series:	for fax protocol (PSTN and IP)
T.80 series:	for JPEG and JBIG image compression
T.140:	General presentation protocol for text conversation
T.134:	Text conversation in the T120 data conferencing environment
T.800 series:	for JPEG 2000 image compression
T.830 series:	for JPEG XR image compression

– **V series**: Data communication over the telephone network

V.18:	Harmonization of text telephony
V.151:	Procedures for the end-to-end connection of analogue PSTN text telephones over an IP network utilizing text relay
V.152:	Procedures for supporting voice-band data over IP networks

ITU-D Question 2/2 will continue to cover all relevant activities, in particular for e-Health applications.

ITU-T Study Group 17 Recommendations

Recommendations

– **E series: Overall network operation, telephone service, service operation and human factor**

E.115:	Computerized directory assistance

– **X series:** Data networks, open system communications and security

X.500:	Information technology – Open Systems Interconnection – The Directory: Overview of concepts, models and services
X.501:	Information technology – Open Systems Interconnection – The Directory: Models
X.509:	Information technology – Open systems interconnection – The Directory: Public-key and attribute certificate frameworks
X.511:	Information technology – Open Systems Interconnection – The Directory: Abstract service definition
X.518:	Information technology – Open Systems Interconnection – The Directory: Procedures for distributed operation
X.519:	Information technology – Open Systems Interconnection – The Directory: Protocols
X.520:	Information technology – Open Systems Interconnection – The Directory: Selected attribute types
X.521:	Information technology – Open Systems Interconnection – The Directory: Selected object classes
X.525:	Information technology – Open Systems Interconnection – The Directory: Replication
X.660:	Information technology – Procedures for the operation of object identifier registration authorities: General procedures and top arcs of the international object identifier tree
X.667:	Information technology – Procedures for the operation of Object Identifier Registration Authorities: Generation of universally unique identifiers and their use in object identifiers
X.672:	Information technology – Open systems interconnection – Object identifier resolution system (ORS)
X.674:	Procedures for the registration of arcs under the Alerting object identifier arc
X.1032:	Architecture of external interrelationships for a telecommunication IP-based network security system
X.1034:	Guidelines on extensible authentication protocol based authentication and key management in a data communication network
X.1052:	Information security management framework
X.1054:	Information technology – Security techniques- Governance of information security
X.1057:	Asset management guidelines in telecommunication organizations
X.1080.1:	e-Health and world-wide telemedicines- Generic telecommunication protocol
X.1081:	The telebiometric multimodal model – A framework for the specification of security and safety aspects of telebiometrics
X.1090:	Authentication framework with one-time telebiometric templates
X.1091:	A guideline for evaluating telebiometric template protection techniques
X.1092:	Integrated framework for telebiometric data protection in e-health and telemedicines
X.1101:	Security requirements and framework for multicast communication

X.1153:	Management framework of a onetime password-based authentication service
X.1154:	General framework of combined authentication on multiple identity service provider environments
X.1156:	Non-repudiation framework based on a one time password
X.1164:	Use of service providers' user authentication infrastructure to implement public key infrastructure for peer-to-peer networks
X.1192:	Functional requirements and mechanisms for the secure transcoding of IPTV
X.1193:	Key management framework for secure internet protocol television (IPTV) services
X.1194:	Algorithm selection scheme for service and content protection descrambling
X.1195:	Service and content protection interoperability scheme
X.1196:	Framework for the downloadable service and content protection system in the mobile Internet Protocol television environment
X.1197:	Guidelines on criteria for selecting cryptographic algorithms for IPTV service and content protection
X.1198:	Virtual machine-based security platform for renewable IPTV service and content protection
X.1209:	Capabilities and their context scenarios for cybersecurity information sharing and exchange
X.1243:	Interactive gateway system for countering spam
X.1245:	Framework for countering spam in IP-based multimedia applications
X.1252:	Baseline identity management terms and definitions
X.1253:	Security guidelines for identity management systems
X.1254:	Entity authentication assurance framework
X.1255:	Framework for discovery of identity management information
X.1275:	Guidelines on protection of personally identifiable information in the application of RFID technology
X.1303:	Common Alerting Protocol (CAP1.1)
X.1311:	Information technology – Security framework for ubiquitous sensor networks
X.1312:	Ubiquitous sensor network middleware security guidelines
X.1313:	Security requirements for wireless sensor network routing
X.1500:	Overview of cybersecurity information exchange
X.1500.1:	Procedures for the registration of arcs under the object identifier arc for cybersecurity information exchange
X.1520:	Common vulnerabilities and exposures
X.1521:	Common vulnerability scoring system
X.1524:	Common weakness enumeration

X.1526:	Open Vulnerability and Assessment Language
X.1528:	Common platform enumeration
X.1528.1:	Common platform enumeration naming
X.1528.2:	Common platform enumeration name matching
X.1528.3:	Common platform enumeration dictionary
X.1528.4:	Common platform enumeration applicability language
X.1541:	Incident object description exchange format
X.1544:	Common attack pattern enumeration and classification
X.1570:	Discovery mechanisms in the exchange of cybersecurity information
X.1580:	Real-time inter-network defence
X.1581:	Transport of real-time inter-network defence messages

– **Z series: Languages and general software aspects for telecommunication systems**

Z.100:	Specification and Description Language – Overview of SDL-2010
Z.101:	Specification and Description Language – Basic SDL-2010
Z.102:	Specification and Description Language – Comprehensive SDL-2010
Z.103:	Specification and Description Language – Shorthand notation and annotation in SDL-2010
Z.104:	Specification and Description Language – Data and action language in SDL-2010
Z.105:	Specification and Description Language – SDL-2010 combined with ASN.1 modules
Z.106:	Specification and Description Language – Common interchange format for SDL-2010
Z.107:	Specification and Description Language – Object-oriented data in SDL-2010
Z.109:	Specification and Description Language – Unified modeling language profile for SDL-2010
Z.120:	Message Sequence Chart (MSC)
Z.150:	User Requirements Notation (URN) – Language requirements and framework
Z.151:	User Requirements Notation (URN) – Language definition
Z.161:	Testing and Test Control Notation version 3: TTCN-3 core language
Z.161.1:	Testing and Test Control Notation version 3: TTCN-3 language extensions: Support of interfaces with continuous signals
Z.161.2:	Testing and Test Control Notation version 3: TTCN-3 language extensions: Configuration and deployment support
Z.161.3:	Testing and Test Control Notation version 3: TTCN-3 language extensions: Advanced parameterization
Z.161.4:	The Testing and Test Control Notation version 3: TTCN-3 Language Extensions: Behaviour Types

Z.164:	Testing and Test Control Notation version 3: TTCN-3 operational semantics
Z.165:	Testing and Test Control Notation version 3: TTCN-3 runtime interface (TRI)
Z.165.1	Testing and Test Control Notation version 3: TTCN-3 extension package: Extended TRI
Z.166:	Testing and Test Control Notation version 3: TTCN-3 control interface (TCI)
Z.167:	Testing and Test Control Notation version 3: TTCN-3 mapping from ASN.1
Z.168:	Testing and Test Control Notation version 3: TTCN-3 mapping from CORBA IDL
Z.169:	Testing and Test Control Notation version 3: TTCN-3 mapping from XML data definition
Z.170:	Testing and Test Control Notation version 3: TTCN-3 documentation comment specification

ITU-T Study Group 20 Recommendations

ITU-T Study Group 20 Recommendations can found at: https://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=20.

Annex 2: ITU-T Focus Group publications

FG-SSC – Smart Sustainable Cities
2014 – Technical Report on "An overview of smart sustainable cities and the role of information and communication technologies"
2014 – Technical Report on "Smart sustainable cities: an analysis of definitions"
2015 – Technical Report on "Smart sustainable cities: a guide for city leaders"
2015 – Technical Report on "Master plan for smart sustainable cities"
2015 – Technical Report on "Setting the stage for stakeholders' engagement in smart sustainable cities"
2015 – Technical Report on "Overview of smart sustainable cities infrastructure"
2015 – Technical Specifications on "Setting the framework for an ICT architecture of a smart sustainable city"
2015 – Technical Specifications on "Multi-service infrastructure for smart sustainable cities in new-development areas"
2015 – Technical Report on "Cybersecurity, data protection and cyber resilience in smart sustainable cities"
2015 – Technical Report on "Intelligent sustainable buildings for smart sustainable cities"
2015 – Technical Report on "Smart water management in cities"
2015 – Technical Report on "Information and communication technologies for climate change adaptation in cities"
2015 – Technical Report on "Electromagnetic field (EMF) considerations in smart sustainable cities"
2015 – Technical Report on "Integrated management for smart sustainable cities"
2015 – Technical Report on "Anonymization infrastructure and open data in smart sustainable cities"
2014 – Technical Specifications on "Overview of key performance indicators in smart sustainable cities"
2015 – Technical Specifications on "Key performance indicators related to the use of information and communication technology in smart sustainable cities"
2015 – Technical Specifications on "Key performance indicators related to the sustainability impacts of information and communication technology in smart sustainable cities"
2015 – Technical Report on "Key performance indicators definitions for smart sustainable cities"
2015 – Technical Report on "Standardization roadmap for smart sustainable cities"
2015 – Technical Report on "Standardization activities for smart sustainable cities"
FG SWM – Smart Water Management
2015 – Technical Report on "Requirements for water sensing and early warning systems"

2015 – Technical Report on "Smart water management – Global initiatives and key stakeholders"
2015 – Technical Report on "Standardization gap analysis for smart water management"
2015 – Technical Report on "The role of ICTs in water resource management"
FG Cloud – Cloud computing Focus Group
2012 – Technical Report: Part 1: Introduction to the cloud ecosystem: definitions, taxonomies, use cases and high-level requirements
2012 – Technical Report: Part 2: Functional requirements and reference architecture
2012 – Technical Report: Part 3: Requirements and framework architecture of cloud infrastructure
2012 – Technical Report: Part 4: Cloud Resource Management Gap Analysis
2012 – Technical Report: Part 5: Cloud security
2012 – Technical Report: Part 6: Overview of SDOs involved in cloud computing
2012 – Technical Report: Part 7: Cloud computing benefits from telecommunication and ICT perspectives
FG Distraction – Driver Distraction Focus Group
2013 – Report on Situational Awareness Management
2013 – Report on Use Cases
2013 – Report on User Interface Requirements for Automotive Applications
2013 – Report on Vehicle-to-Applications Communications Interface
2013 – Final Report
FG DR&NRR – Focus Group on Disaster Relief Systems, Network Resilience and Recovery
2013 – Technical Report on Telecommunications and Disaster Mitigation
FG FS-VDSL – Full-Service VDSL Focus Group
2002 – Technical Specifications: Part 1: Operator Requirements
2002 – Technical Specifications: Part 2: System Architecture
2002 – Technical Specifications: Part 3: Customer Premises Equipment
2002 – Technical Specifications: Part 4: Physical Layer Specification for Interoperable VDSL Systems
2002 – Technical Specifications: Part 5: Operations, Administration and Maintenance & Provision aspects for FS-VDSL Services
FG IPTV – IPTV Focus Group
2008 – Proceedings
FG OCAF – Open Communications Architecture Forum Focus Group
2005 – Carrier Grade Open Environment Reference Model

Annex 3: Composition of the Rapporteur Group for Question 9/2

Question 9/2: Identification of study topics in the ITU-T and ITU-R study groups which are of particular interest to developing countries	**Name / Country / Organization**
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