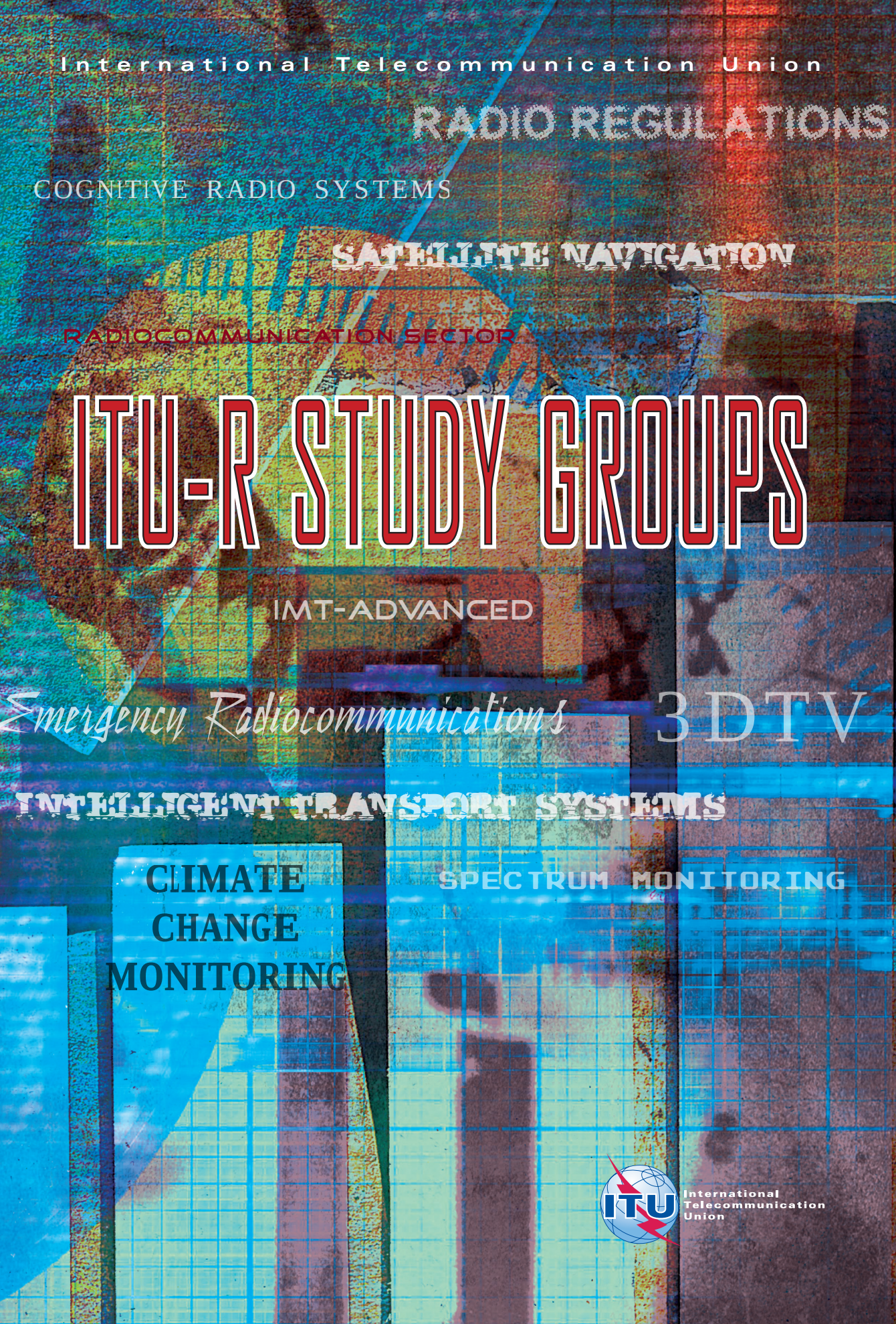

International Telecommunication Union
RADIO REGULATIONS
COGNITIVE RADIO SYSTEMS
SATELLITE NAVIGATION
RADIOCOMMUNICATION SECTOR
ITU-R STUDY GROUPS
IMT-ADVANCED
Emergency Radiocommunications
3DTV
INTELLIGENT TRANSPORT SYSTEMS
CLIMATE CHANGE MONITORING
SPECTRUM MONITORING
ITU
International Telecommunication Union

This ITU-R Study Group booklet was produced by the

Radiocommunication Bureau of the
International Telecommunication Union (ITU)
Place des Nations
CH-1211 Geneva 20
Switzerland

For a free copy of this brochure, please contact :

ITU-R Promotion Officer
Telephone: + 41 22 730 5810
Facsimile: + 41 22 730 5785
E-mail: brpromo@itu.int
www.itu.int/itu-r/go/promotion

International Telecommunication Union

ITU and Radiocommunications

June 2010
ITU Headquarters
Geneva, Switzerland

www.itu.int/net/about/vision.aspx

Committed to connecting the world

© ITU, 2010

International Telecommunication Union (ITU), Geneva

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

Denominations and classifications employed in this publication do not imply any opinion on the part of the International Telecommunication Union concerning the legal or other status of any territory or any endorsement or acceptance of any boundary. Where the designation “country” appears in this publication, it covers countries and territories.

Summary

THE ITU MISSION

Bringing the benefits of ICT to all the world's inhabitants

ITU is the leading United Nations agency for information and communication technology (ICT) and the global focal point for governments and the private sector in developing networks and services. Founded in 1865, the International Telecommunication Union (ITU) became a specialized agency of the United Nations in 1947, providing an international forum for over 190 Member States and more than 700 Sector and Associate Members to collaborate for the worldwide improvement and rational use of telecommunications and radiocommunications.

ITU fulfils this fundamental mission through its three Sectors: the Radiocommunication Sector (ITU-R), the Telecommunication Standardization Sector (ITU-T) and the Telecommunication Development Sector (ITU-D).

ITU's work in the sphere of radiocommunications is consolidated in the ITU-R Sector, which works towards a worldwide consensus in the use of space and terrestrial radiocommunication services and a vast and growing range of wireless services, including popular new mobile communication technologies.

ITU-R plays an essential custodian role in the management of the radio-frequency spectrum and satellite orbits, finite natural resources that are increasingly in demand from a large number of services such as fixed, mobile, broadcasting, amateur, space research, meteorology, global positioning systems, monitoring and communication services that ensure safety of life on land, at sea and in the skies.

Improving communications and the use of ICTs amongst the peoples of the world by harmoniously developing telecommunication and radiocommunication tools and processes lies at the heart of the work of ITU.

The ITU vision

By connecting the world and fulfilling everyone's fundamental right to communicate, we strive to make the world a better and safer place

For nearly 145 years, ITU has coordinated the shared global use of the radio spectrum, promoted international cooperation in assigning satellite orbits, worked to improve telecommunication infrastructure in the developing world, established the worldwide standards that foster seamless interconnection of a vast range of communications systems and addressed the global challenges of our times, such as mitigating climate change and strengthening cybersecurity.

ITU also organizes worldwide and regional exhibitions and forums, such as ITU TELECOM WORLD, bringing together the most influential representatives of government and the telecommunications and ICT industry to exchange ideas, knowledge and technology for the benefit of the global community, and in particular the developing world.

From broadband Internet to latest-generation wireless technologies, from aeronautical and maritime navigation to radio astronomy and satellite-based meteorology, from convergence in fixed-mobile telephony, Internet access, data, voice and TV broadcasting to next-generation networks, ITU is committed to connecting the world.

www.itu.int/newsroom/press_releases/aboutitu.html

The last decade of the 20th century has witnessed extraordinary growth in the use of wireless communication systems, from cellular and cordless phones and radio-based fleet management systems to radio and television broadcasting and next-generation 3D-TV, cognitive radio, spectrum monitoring and IMT-Advanced. At the same time, radio has become a vital technology for a growing number of essential public services such as satellite navigation and intelligent transport systems, global positioning systems, environmental monitoring (climate change and emergency radiocommunication systems, including amateur radio) and even deep-space research.

At the heart of this wireless world, the ITU Radiocommunication Sector (ITU-R) is mandated by ITU Membership to determine the technical characteristics and operational procedures for a huge and growing range of wireless services. ITU-R also plays a vital role in the preparation of standards presented in "ITU-R Recommendations" for the management of the radio-frequency spectrum – a finite natural resource that is increasingly in demand due to the rapid development of new radio-based services and the enormous popularity of mobile communications and future radio technologies.

In its role as global spectrum coordinator, the Radiocommunication Sector develops and adopts the "ITU Radio Regulations" – a voluminous set of rules that serve as a binding "international treaty" governing the use of radio-frequency spectrum and satellite orbits adopted by more than 190 Member States, and by some 40 different services around the world related to almost all terrestrial and space radio services and applications. The international treaty, known as the Radio Regulations, was revised and updated by the World Radiocommunication Conference 2007 (WRC-07) to achieve the global connectivity goals of the 21st century. These revisions included future generations of mobile telephony, aeronautical telemetry and telecommand systems, satellite services including meteorological applications, maritime distress and safety signals, digital broadcasting and the use of radio in the prediction and detection of natural disasters. The next WRC-12 will be held in Geneva from 23 January-17 February 2012.

The Sector also operates, through its Radiocommunication Bureau, as a central registrar of international frequency use, maintaining the "Master International Frequency Register" (MIFR) that currently includes around 1 265 000 terrestrial frequency assignments, 325 000 assignments servicing 1 400 satellite networks and another 4 265 assignments related to satellite earth stations.

In addition, ITU-R is responsible for coordinating efforts to ensure that the communication, broadcasting and meteorological satellites in the world's increasingly crowded skies can co-exist without causing harmful interference to one another's services. In this role, the Union facilitates agreements between both operators and governments and provides practical tools and services to help national frequency spectrum managers carry out their day-to-day work.

www.itu.int/itu-r/go/wrc/

Radiocommunication Sector

The Mission

www.itu.int/itu-r/

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

- holding World and Regional Radiocommunication Conferences to expand and adopt Radio Regulations and Regional Agreements covering the use of the radio-frequency spectrum;
- approving ITU-R Recommendations, developed by ITU-R Study Groups (SG) in the framework set by Radiocommunication Assemblies, on the technical characteristics and operational procedures for radiocommunication services and systems;
- coordinating activities to eliminate harmful interference between radio stations of different countries;
- maintaining the Master International Frequency Register (MIFR); and
- offering tools, information and seminars to assist national radio-frequency spectrum management.

The Radiocommunication Bureau (BR) is the executive arm of the Radiocommunication Sector, and is headed by an elected Director who is responsible for the coordination of the work of the Sector. The Director of the BR is assisted by a team of high-calibre engineers, computer specialists and managers who, together with administrative staff, make up the Radiocommunication Bureau.

The Radiocommunication Bureau:

- provides administrative and technical support to Radiocommunication Conferences, Assemblies and Study Groups, including Working Parties and Task Groups;
- applies the provisions of the Radio Regulations and various Regional Agreements;
- records and registers frequency assignments and also orbital characteristics of space services, and maintains the Master International Frequency Register;
- provides advice to Member States on the equitable, effective and economical use of the radio frequency spectrum and satellite orbits, and investigates and assists in resolving cases of harmful interference;
- coordinates the preparation, editing and dispatch of circulars, documents and publications developed within the Sector;
- provides technical information, organizes seminars on national frequency management and radiocommunications, and works closely with the ITU Telecommunication Development Bureau in assisting developing countries.

World Radiocommunication Conferences

www.itu.int/itu-r/go/wrc/

World Radiocommunication Conferences (WRCs) review and revise the Radio Regulations, the international treaty governing the use of the radio frequency spectrum and the satellite orbit. 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.

WRCs consider the results of the studies on options to improve the international spectrum regulatory framework based on the effectiveness, appropriateness and impact of the Radio Regulations with respect to the evolution of existing, emerging and future applications, systems and technologies. WRCs make decisions on the most profitable and efficient ways to exploit the limited resource of radio frequency spectrum and manage satellite orbits, which will be critical and increasingly valuable for the development of the global economy in the 21st Century.

WRCs also address any radiocommunication matter of worldwide character, instruct the Radio Regulations Board and the Radiocommunication Bureau, and review their activities, determine the Questions for study by Radiocommunication Assemblies and the Study Groups in preparation for future radiocommunication conferences.

Radiocommunication Assemblies www.itu.int/itu-r/go/ra/

Radiocommunication Assemblies (RAs) 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, and suggest suitable topics for the agenda of future WRCs. They also approve and issue ITU-R Recommendations and Questions developed by the Study Groups, set the programme for Study Groups and disband or establish Study Groups according to need.

Radiocommunication Advisory Group www.itu.int/itu-r/go/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;
- 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 BR. Radiocommunication Assemblies may refer specific matters within its competence to the RAG.

ITU Membership

The ITU membership represents a cross-section of the industry, from the world's largest manufacturers, carriers, operators and system integrators to small, innovative players of the new information and communication technology field. Since the creation of the Union and its opening to the private sector, Member States of ITU and Sector Members have been participating actively in the work of the Radiocommunication Sector.

Current Members include:

- Over 190 ITU Member States, which constitute the Union, set its mandate and contribute to the work of ITU as a whole;
- Over 560 ITU Sector Members, which participate in the work of a defined Sector (R, T or D). These include operating agencies, scientific or industrial organizations, financial and developmental institutions, other entities dealing with telecommunication matters, regional and other international telecommunication, standardization, financial or developmental organizations;
- Over 150 ITU Associates, which work within the framework of a specific Study Group.

In its efforts to ensure the widest participation in the enhancement of worldwide communications and that the interests of all stakeholders are taken into consideration, ITU encourages new entities and organizations to join the Union as Sector Members or Associates. In addition, ITU seeks to further develop intellectual cooperation with educational institutions and universities.

ITU-R Study Groups are established and assigned study Questions by a Radiocommunication Assembly (RA) to prepare draft Recommendations for approval by ITU Member States.

Compliance with ITU-R Recommendations is not mandatory. However, while some are incorporated by reference in the ITU Radio Regulations, all ITU-R Recommendations are developed by radiocommunication world experts, thereby enjoying a high reputation and worldwide implementation, getting therefore the status of international standards in their domain of application.

Studies focus on the following:

- efficient management and use of the spectrum/orbit resource by space and terrestrial services;
- characteristics and performance of radio systems;
- operation of radio stations;
- radiocommunication aspects of distress and safety matters.

When comparing technical or operational alternatives, economic factors can also be taken into consideration.

Furthermore, ITU-R Study Groups carry out preparatory studies for World and Regional Radiocommunication Conferences (WRCs, RRCs). On the basis of the input material from the Study Groups and the Special Committee on regulatory/procedural matters, alongside any new material submitted by ITU Member States, the Conference Preparatory Meeting (CPM) prepares a Report on the technical, operational and regulatory or procedural matters to be considered by a given Conference.

Study Groups accomplish their work in cooperation with other international radiocommunication organizations. Particular attention is paid to the radiocommunication needs of developing countries.

More than 1 500 specialists, representing ITU Member States and Sector and Associate Members throughout the world, currently participate in the work of ITU-R Study Groups

14 At present, there are six Study Groups specializing in the following areas:

SG 1 – Spectrum management

SG 3 – Radiowave propagation

SG 4 – Satellite services

SG 5 – Terrestrial services

SG 6 – Broadcasting service

SG 7 – Science services

In addition, the Special Committee on regulatory/procedural matters undertakes required studies in support of the Conference Preparatory Meeting (CPM) activities.

Subgroups, known as Working Parties (WP) and Task Groups (TG), are established to study the Questions assigned to the different Study Groups.

Study Group 1

Spectrum management

www.itu.int/itu-r/go/rsg1/

Spectrum management is the combination of administrative and technical procedures necessary to ensure the efficient utilization of the radio-frequency spectrum by all radio-communication services defined in the ITU Radio Regulations and the operation of radio systems, without causing harmful interference.

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.

In addition, inter-service sharing and compatibility (urgent studies by request), including the development of Recommendations(s) or Reports(s) to the Conference Preparatory Meeting in answer to those urgent Questions concerning inter-service sharing and compatibility requiring special attention.

Structure

Three Working Parties 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.

ITU-R Working Party 1A – Spectrum engineering techniques

Spectrum engineering techniques, including unwanted emissions, frequency tolerance, technical aspects of sharing, spectrum engineering, computer programs, technical definitions, Earth-station coordination areas and technical spectrum efficiency.

ITU-R Working Party 1B – Spectrum management methodologies and economic strategies

Spectrum management fundamentals, including economic strategies, spectrum management methodology, national spectrum management organization, national and international regulatory framework, alternative approaches, flexible allocations and long-term strategies for planning.

ITU-R Working Party 1C – Spectrum monitoring

Spectrum monitoring, including the development of techniques for observing the use of the spectrum, measurements techniques, inspection of radio stations, identification of emissions and location of interference sources.

National spectrum management comprises the structures, capabilities, procedures and regulations necessary for each country to fulfill its objective to control the use of the radio-frequency spectrum on its territory and within its geographical borders. Within the framework of international treaty agreements (Radio Regulations), each government has the flexibility and autonomy to regulate the spectrum and its usage. In this perspective, each administration must develop the relevant laws and carry out the duties of spectrum management. The usage of the frequency spectrum, which has increasingly important economic value, is best harmonized in an environment where a spectrum management system provides stability but, at the same time, facilitates user access to the spectrum.

Effective management of the limited spectrum resource encompasses the goals and objectives of a spectrum management system, a spectrum management structure and the spectrum management authority with responsibility to regulate spectrum use.

With a view to assisting ITU Members States in general and developing countries in particular, with their national spectrum management activities, Study Group 1 and its Working Parties developed a number of ITU-R Handbooks.

– The **Handbook on National Spectrum Management** 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. In addition to this handbook are the latest versions of Report ITU-R SM.2012, which describes the different economic approaches for spectrum management activities and contains information on administrations' experience regarding the economic aspects of spectrum management, and Report ITU-R SM.2093, which provides guidance on the regulatory framework for national spectrum management.

– A very popular work is the **Handbook on Spectrum Monitoring**. 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. In addition to this handbook is the latest version of Report ITU-R SM.2130, which presents an overview of Inspections Procedures and provides general guidelines for planning and performing inspection activities on various types of radio stations.

– A complement to both above-mentioned handbooks is the **Handbook on Computer-aided Techniques for Spectrum Management (CAT)**. The topic of national spectrum management has evolved and become the central hot spot in the activities of all telecommunication administrations. This is particularly true for developing countries, where the dramatic development of ICT technologies and their wide application have led to a heavy increase in related spectrum usage. This handbook contains basic material and numerous models for developing efficient projects that will assist in implementing automated spectrum management as soon as possible.

In response to Resolution 9 (Rev. Doha, 2006) the "Joint Group on Resolution 9", established after WTDC-98 as a joint ITU-R/ITU-D group, is continuing to assist developing countries in fulfilling their national spectrum management functions. To that aim, the Group has developed and distributed questionnaires on national spectrum management to Member States and to Sector Members with the key objective of identifying specific problems that developing countries experience in national spectrum management.

ITU-R Study Group 1 is responsible for the following Handbooks:

- Computer-aided Techniques for Spectrum Management (CAT)
- National Spectrum Management
- Spectrum Monitoring
- Supplement to Handbook on Spectrum Monitoring

Study Group 3

Radiowave propagation

www.itu.int/itu-r/go/rsg3/

Scope

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

Structure

The following four Working Parties 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

The principal aim of the Working Parties is to draft Recommendations in the ITU-R P Series for subsequent adoption by Study Group 3 and approval by the Member States. The Working Parties also develop Handbooks that provide descriptive and tutorial material, especially useful for developing countries. A further task of the Working Parties is to provide, through Study Group 3, propagation information and advice to other ITU-R Study Groups in their preparation of the technical bases for Radiocommunication Conferences. Such information typically concerns identifying relevant propagation effects and mechanisms and providing propagation prediction methods. The predictions are needed for the design and operation of radiocommunication systems and services and also for the assessment of frequency sharing between them.

ITU-R Working Party 3J – Propagation fundamentals

WP 3J provides information and develops models describing the fundamental principles and mechanisms of radiowave propagation in non-ionized media. Such material is used as the basis of propagation prediction methods developed by the other Working Parties. Recognizing the natural variability of the propagation medium, WP 3J prepares texts describing the statistical laws relevant to propagation behaviour and the means of expressing the temporal and spatial variability of propagation data.

Propagation over terrain and obstacles involves methods for calculating diffracted fields over smooth and irregular earth, and quantifying the effect of vegetation along the propagation path. Maps of ground conductivity are maintained, as they are important for prediction procedures applying to frequencies at medium frequency (MF) and below.

One of the principal areas of study in WP 3J concerns propagation through the neutral atmosphere, encompassing the propagation effects both in the clear air and when precipitation is present. To this end, the WP devotes much effort to the global mapping of radiometeorological parameters used for quantifying such effects for prediction procedures. Clear-air effects include atmospheric refraction and attenuation due to atmospheric gases, these in turn requiring vertical profiles of temperature and water vapour with their spatial and temporal variation. Similarly, for the assessment of attenuation and depolarization due to precipitation, precise global mapping of rainfall intensity is required, as well as models of specific attenuation of rain. WP 3J also studies the effects of cloud and fog.

Since an objective of Study Group 3 is to provide prediction procedures that are applicable worldwide, it is very important that any underlying radiometeorological data are representative of the different climates of the world and that their spatial and temporal resolution is adequate.

Working Party 3J developed and maintains the **Handbook on Radiometeorology**, which gives general information related to effects of the atmosphere and is based on scientific studies over a large period of time. It also provides guidance on the use of ITU-R Recommendations for those who need to evaluate the effects of the troposphere on radiowave propagation.

20 ITU-R Working Party 3K – Point-to-area propagation

WP 3K is responsible for developing prediction methods for terrestrial point-to-area propagation paths. In the main, these are associated with terrestrial broadcasting and mobile services, short-range indoor and outdoor communication systems (e.g. radio local area networks, RLAN), and with point-to-multipoint wireless access systems.

In the VHF and UHF bands, field strength prediction takes account of the effects of terrain in the vicinity of the transmitter and receiver, and of the refractive nature of the atmosphere. Allowance is also made for location variability for land area coverage prediction with account taken of local clutter surrounding the receiver. Consideration is also given to mixed paths crossing both land and sea. A consolidated prediction procedure has been developed – suitable for broadcasting, land mobile, maritime mobile and certain fixed services (e.g. those using point-to-multipoint systems) – that represents a major tool for the frequency planning of broadcasting and mobile services, particularly in the range 1-3 GHz, and for coordination when frequency sharing is involved.

At higher frequencies (typically from around 1 to 100 GHz), the emphasis is on short-range systems, either indoor or outdoor, as might be used by RLAN and personal mobile communications. The WP develops Recommendations that describe relevant propagation mechanisms such as reflection, scattering and diffraction associated with buildings, or with obstacles within buildings, all of which give rise to effects such as attenuation and multipath. The latter plays a vital part in the channel modelling of a radio link, with which an assessment of performance quality may be obtained. For outdoor situations, models are developed describing different types of environment (urban to rural) and expressions are developed for quantifying the resulting path loss.

With the growing interest in delivery of broadband services through local access networks, WP 3K studies the propagation effects associated with millimetric radio systems (e.g. operating around 20-50 GHz) used for point-to-multipoint distribution. Prediction of area coverage has to address the effects of buildings, their spatial distribution, attenuation and scattering from vegetation, and attenuation by rain. Methods to quantify the relevant propagation effects such as attenuation and distortion due to multipath are a key area of study in WP 3K.

WG 3K developed and maintains the **Handbook on Terrestrial Land Mobile Radiowave Propagation**. This Handbook gives the technical basis for predicting radiowave propagation in terrestrial point-to-point, point-to-area and point-to-multipoint mobile networks.

ITU-R Working Party 3L – Ionospheric propagation and radio noise

WP 3L studies all aspects of radiowave propagation in and through the ionosphere. Recommendations are maintained describing, in mathematical terms, a reference model of ionospheric characteristics and maximum usable frequencies associated with the various ionospheric layers. Short-term and long-term ionospheric forecasting, with guidance on the use of ionospheric indices, is addressed.

As regards propagation prediction methods, Recommendations are maintained containing prediction procedures for ionospheric propagation in bands from ELF to VHF. Those for computing skywave propagation at LF, MF and HF play an important role in frequency planning, both for quantifying the wanted signal as well as for interference assessment. At higher frequencies, there are also methods for computing the field strength due to meteor-burst propagation as well as propagation via sporadic E. Current studies of MF and HF ionospheric propagation prediction concentrate on the effects of the ionosphere on digitally modulated transmissions and try to extend the concept of performance reliability, already developed for analogue systems, to its digital counterpart.

With the increasing use of satellite systems, particularly those using low-Earth orbits, the effects of the ionosphere on slant propagation paths at VHF and UHF frequencies demand considerable attention. For example, the additional time delay associated with propagation through the ionosphere is of major concern for navigation satellite systems; likewise, trans-ionospheric scintillation can be a significant factor on the link budget of systems operating well above 1 GHz. WP 3L is improving methods to quantify such effects, taking into account their temporal and geographical variability.

In order to improve the accuracy of ionospheric propagation prediction, emphasis has been placed over many years on the collection and maintenance of measurement data with which predictions can be compared. In this respect, a method has been specified for acquiring HF field strength measurements from a worldwide network of dedicated transmitters. Guidance is also given on making meaningful comparisons between predictions and measurements. WP 3L also addresses the topic of radio noise arising from both natural and man-made sources and provides information to quantify the effect of noise on the performance of radio systems. WP 3L developed and maintains the **Handbook on the Ionosphere and its Effects on Radiowave Propagation**, which provides radioplanners and users with a guide on ionospheric properties and propagation effects in order to assist in the design of related radiocommunication systems.

22 ITU-R Working Party 3M – Point-to-point and Earth-space propagation

WP 3M addresses radiowave propagation over point-to-point terrestrial paths and Earth-space paths, both for wanted and unwanted signals. For terrestrial paths, prediction methods are developed for both line-of-sight and over-the-horizon links, taking into account the possible mechanisms that can give rise to fading and distortion of the wanted signal. The resulting predictions, generally expressed in terms of a statistical distribution of propagation loss or outage, provide vital information for terrestrial link planning in the fixed service (FS).

Similarly, propagation impairments on slant paths from satellites are treated by a series of Recommendations that contain prediction procedures that quantify the relevant effects and, in turn, provide an assessment of overall propagation loss, fading behaviour or signal depolarization. Recommendations are available that apply to the fixed-satellite service (FSS), the mobile-satellite service (MSS) and the broadcasting-satellite service (BSS).

In order to take proper account of the relevant propagation effects in the various prediction procedures – e.g. refractivity effects of the clear atmosphere, attenuation due to atmospheric gases and to precipitation – WP 3J provides basic radiometeorological data from which such effects can be quantified. Similarly, for predictions associated with the terrestrial fixed service, the diffraction model developed by WP 3J plays a major role, together with information on the terrain height distribution along the path. For those prediction procedures associated with satellite services, additional factors particular to the environment in the vicinity of the receiver may have to be considered, e.g. shadowing and blockage by buildings and absorption by building materials. Use is also made of trans-ionospheric information developed in WP 3L. In the case of mobile-satellite services, attention must be paid to the movement of the receiver, as well as to changes in the elevation angle when the satellite is in low-Earth orbit.

Preliminary studies are also under way on propagation prediction for optical communications on Earth-space paths, supported by information from WP 3J on the relevant atmospheric effects at optical frequencies.

In order to develop and test its prediction procedures, WP 3M relies on databanks of measurement data to develop and test its prediction procedures. Such databanks exist for terrestrial and Earth-space paths and are based on long-term measurements submitted by the membership. Considerable importance is paid to quality assessment of the data to verify their accuracy and statistical validity.

A further major responsibility of WP 3M is the prediction of signals likely to cause interference. These signals, typically propagating via short-term mechanisms such as ducting and rain scatter, can give rise to unacceptably high interference levels when frequencies are shared. Prediction procedures are developed and maintained whereby such signal levels may be quantified between two points on the Earth's surface for a desired percentage of time, or between a space station and a point on the Earth's surface. Again, the predictions rely on basic radiometeorological data to quantify the refractivity of the atmosphere, or the level of rainfall intensity. An important aspect of the studies associated with the propagation of these high-level signals is the provision of a method for determining the coordination area around an Earth-station – a physically defined area used by administrations in their planning and deployment of terrestrial and earth stations (in the FS and FSS respectively) when sharing the same frequency band. WP 3M is responsible for developing the propagation method upon which the currently accepted international method for determining the Earth-station coordination area is based.

One of the most important publications developed and maintained by WP 3M is the **Handbook on Radiowave Propagation Information for Predictions for Earth-to-Space Path Communications**, which supplies background and supplementary information on Earth-to-space propagation effects in order to assist in the design of different Earth-space communication systems.

ITU-R Study Group 3 is responsible for the following Handbooks:

- Curves for Radiowave Propagation over the Surface of the Earth
- Ionosphere and its Effects on Radiowave Propagation
- Radiometeorology
- Radiowave Propagation Information for Predictions for Earth-to-Space Path Communications
- Terrestrial land mobile radiowave propagation in the VHF/UHF bands
- Radiowave propagation information for designing terrestrial point-to-point links

Study Group 4

Satellite services

www.itu.int/itu-r/go/rsg4/

Scope

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

Structure

Three Working Parties 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).[1]

ITU-R Working Party 4A – Efficient orbit/spectrum utilization for the fixed-satellite service (FSS) and broadcasting-satellite service (BSS)

The major study areas of Working Party 4A are orbit/spectrum efficiency, interference and coordination and related aspects for FSS and BSS. Its work has significant relevance to the preparatory work for World Radiocommunication Conferences.

---

[1] WP 4C also deals with the performance issues related to RDSS

Current study topics include:

- Cross-polarization reference gain pattern for linearly polarized very small aperture terminals (VSATs) for frequencies in the range 2 to 31 GHz.
- Reference Earth-station radiation pattern for antennas used with closely spaced satellites in the geostationary-satellite orbit for use in coordination and interference assessment in the frequency range from 2 to 31 GHz.
- Reference radiation pattern of Earth-station antennas in the fixed-satellite service for use in coordination and interference assessment in the frequency range from 2 to 31 GHz.
- Use of systems in the fixed-satellite service in the event of natural disasters and similar emergencies for warning and relief operations.
- Methodologies for the calculation of worst-case interference levels from non-geostationary fixed-satellite service systems using highly elliptical orbits into geostationary fixed-satellite service satellite networks operating in the 10 to 30 GHz frequency bands.
- Methodology on the modelling of Earth-station antenna gain in the region of the antenna main lobe and the transition region between the minimum angle of the reference antenna pattern and the main lobe.
- Studies on compatibility of broadband wireless access (BWA) networks and fixed-satellite service (FSS) networks in the 3 400-4 200 MHz band.
- Variations in Earth-station off-axis e.i.r.p. due to antenna pointing errors caused by movement of the vehicle mounted platform.
- A methodology to compute interference levels resulting from variations in Earth-station off-axis e.i.r.p. due to pointing errors caused by movement of the vehicle mounted platform.
- Methodology for statistically calculating the interference received by the fixed service from space-to-Earth emissions for frequency bands above about 17 GHz.
- Methodologies for determining whether an IMT base station at a given location could transmit in the band 3 400-3 600 MHz without exceeding the pfd limits in Nos. 5.430A, 5.432A, 5.432B and 5.433A of the Radio Regulations.
- Technical characteristics of transmissions and receivers operating with BSS satellite networks in the band 1 467-1 492 MHz for use in sharing studies with respect to fixed services, mobile services (except aeronautical mobile service for telemetry) and broadcasting services.

- Permissible levels of interference into satellite transmissions of BSS geostationary networks operating in the band 1 467-1 492 MHz for use in coordination with fixed services, mobile services (except aeronautical mobile service for telemetry), broadcasting services and other BSS(S) geostationary satellite networks.
- Reference power flux-density for the broadcasting-satellite service in the band 21.4-22 GHz in Regions 1 and 3.
- Mitigation techniques for rain attenuation for broadcasting-satellite service systems in frequency bands between 17.3 GHz and 42.5 GHz.
- An interference reduction technique in telecommunication satellite networks using geostationary-satellite orbit.
- Application of DVB-S2 to small receiving antennas in the 3 700-4 200 MHz band.
- An interference reduction technique by adaptive-array earth-station antennas for sharing between fixed-satellite service (FSS) and fixed/mobile services.
- Guidelines that may be used by administrations in the design of their systems for C/(N+I) calculation for the FSS Plan allotments having links with high rain attenuation.
- Delta C/(N+I) criteria for the efficient use of GSO orbit/spectrum with small antennas in the FSS bands.
- System parameters of BSS between 17.3 GHz and 42.5 GHz and associated feeder links.

Amongst those items on which Working Party 4A is engaged in preparation for WRC-12 are the studies:

- on the use of the band 21.4-22 GHz for the broadcasting-satellite service and associated feeder-link bands in Regions 1 and 3; and
- on Resolutions 80 (Rev.WRC-07) and 86 (Rev.WRC-07).

ITU-R Working Party 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)

Working Party 4B carries out studies on performance, availability, air interfaces and earth-station equipment of satellite systems in the FSS, BSS and MSS. This group has paid particular attention to the studies of Internet Protocol (IP)-related system aspects and performance. It currently develops new and revised Recommendations and Reports on IP over satellite to meet the growing need for satellite links to carry IP traffic. This group has close cooperation with the ITU Telecommunication Standardization Sector.

Working Party 4B is also developing new Recommendations and/or Reports on integrated systems and hybrid satellite-terrestrial networks.

This group also deals with SNG, which entails the use of transportable and portable earth stations for temporary and occasional transmission of video and/or sound signals, data and auxiliary signals from remote locations.

Current study topics include:

- Performance enhancements of transmission control protocol (TCP) over satellite networks.
- Quality-of-Service (QoS) architectures, mechanisms and their provisioning in IP-based satellite networks.
- Cross-layer based QoS provisioning in satellite IP networks.
- Network architectures, applications and performance for integrated systems operating within the mobile-satellite service in the 1-3 GHz bands.
- Hybrid satellite-terrestrial network architectures, applications and performance.
- Terminology used for networks using both satellite and terrestrial links.
- Multi carrier-based multiple-access satellite systems and performance enhancement techniques.
- Impact of adaptive coding and modulation on availability objectives.

ITU-R Working Party 4C – Efficient orbit/spectrum utilization for the mobile-satellite service (MSS) and the radiodetermination-satellite service (RDSS) [2]

Studies conducted within Working Party 4C are aiming at a more efficient use of the orbit/spectrum resources by MSS and RDSS systems. This includes analyzing various interference situations between such systems but also with systems operating in other radiocommunication services, developing coordination methodologies, describing the potential use of MSS and RDSS systems for specific purposes like emergency situations, maritime or aeronautical telecommunications, time distribution, etc.

ITU-R Recommendations and Reports on these study items are elaborated and maintained by Working Party 4C, who also significantly contributes to the preparatory work for World Radiocommunication Conferences.

Current study topics include:

- Use of systems in the mobile-satellite service for early warning and relief operations in the event of disasters and similar emergencies.
- Satellite component of international mobile telecommunications.
- Methodology for the estimation of the aeronautical mobile-satellite (route) service spectrum requirements.
- Sharing studies between the mobile-satellite service and other radiocommunication services.
- Technical characteristics and protection criteria of systems in the radionavigation-satellite service and associated Earth stations operating in the bands 1 164-1 215 MHz, 1 215-1 300 MHz, 1 559-1 610 MHz, 5 000-5 010 MHz and 5 010-5 030 MHz.
- Modelling of the effects of pulsed interference into radionavigation-satellite service systems receivers in the 1 164-1 215 MHz, 1 215-1 300 MHz, 1 559-1 610 MHz and 5 010-5 030 MHz bands.

[2] WP 4C also deals with the performance issues related to RDSS

Amongst those items on which Working Party 4C is engaged in preparation for WRC-12 are the studies:

- to ensure long-term spectrum availability for the aeronautical mobile-satellite (R) service,
- to investigate the feasibility of a global primary allocation to the radiodetermination-satellite service in the frequency band 2 483.5-2 500 MHz (space-to-Earth), and
- to consider possible additional allocations to the mobile-satellite service.

ITU-R Study Group 4 is responsible for the following Handbooks:

- Mobile-satellite service (MSS)
- ITU-R SNG User's Guide
- Satellite Communications (FSS)
- Supplements No. 1, 2, 3 and 4 to Handbook on Mobile-satellite service (MSS)
- DSB Handbook – Terrestrial and satellite digital sound broadcasting to vehicular, portable and fixed receivers in the VHF/UHF bands
- ITU-R Special publication: Specifications of transmission systems for the broadcasting-satellite service

Study Group 5

Terrestrial services

www.itu.int/itu-r/go/rsg5/

Scope

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

Structure

Four Working Parties carry out the studies on Questions assigned to Study Group 5 and one Joint Task Group conducts studies on the use of the band 790-862 MHz by mobile applications and by other services:

- WP 5A – Land mobile service above 30MHz[3] (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 and other systems below 30 MHz in the fixed and land mobile services
- WP 5D – IMT systems
- JTG 5-6 – Studies on the use of the 790-862 MHz band by mobile applications and by other services

[3] including the exact frequency of 30MHz

ITU-R Working Party 5A – Land mobile service excluding IMT; amateur and amateur-satellite service

WP 5A is responsible for studies related to the land mobile service, excluding IMT and including wireless access in the fixed service, and is also responsible for studies related to the amateur and amateur-satellite services.

Mobility is becoming an ever-increasing requirement and characteristic of today's communications. In addition to commercial wireless access systems, including radio local area networks (RLANs), specialized land mobile applications such as intelligent transport systems (ITS) are becoming essential in improving the safety and efficiency of our roads and highways.

A key objective of WP 5A is to facilitate, through appropriate studies, equitable access to the radio spectrum by the land mobile and the amateur services, providing benefits that are made possible by implementing radio solutions to the communication needs. WP 5A is also very active in the development and standardization of new technologies for land mobile systems.

The amateur services continue to provide an opportunity for approximately 3 million duly authorized persons throughout the world to use radiocommunications for personal applications without any pecuniary interest. Activities include technical experimentation and communications between licensed amateurs and disaster communications. There have been more than 40 amateur-constructed low-Earth orbit and highly elliptical orbit satellites launched in the amateur-satellite service. Studies carried out by WP 5A on the amateur services concern technical and operational characteristics, sharing studies and, when requested, preparation for World Radiocommunication Conference agenda items.

Another important effort presently underway within WP 5A is the production of a series of volumes for the **Land Mobile Handbook**. The Handbook is being developed by a group of experts within WP 5A and covers all categories of land mobile applications such as cellular phone, broadband wireless access, fixed wireless access, dispatch and paging systems, and intelligent transport systems. Four volumes have already been published and others are in the process of being completed. The purpose of this Handbook is to assist the ITU membership in the decision-making process involving planning, engineering and deployment of land mobile systems around the world.

32 ITU-R Working Party 5B – Maritime mobile service including the Global Maritime Distress and Safety System (GMDSS); the aeronautical mobile service and the radiodetermination service

WP 5B is responsible for studies related to the maritime mobile service, including the Global Maritime Distress and Safety System (GMDSS), the aeronautical mobile service and the radiodetermination service, including both radiolocation and radionavigation services. It studies communication systems for the maritime mobile and aeronautical mobile services and radar and radiolocation systems for the radiodetermination service.

WP 5B is the lead group for developing and maintaining ITU-R Recommendations, Reports and Handbooks that enable effective operation and protection for different applications, including distress and safety applications of the above services, while permitting sharing of the limited spectrum resources with other services operating within the allocated bands.

The maritime mobile service, by the very nature of its remote operations, is critically dependent on radio spectrum for the conduct of its business activities, as well as providing a vital link to search and rescue authorities and ships and aircraft during distress incidents and other potentially dangerous conditions. In close cooperation with the International Maritime Organization (IMO), WP 5B also develops drafts of operational procedures for urgency, distress and safety communications and operation of systems belonging to the maritime mobile service, including the management of Maritime Mobile Service Identities (MMSSI).

With respect to the aeronautical mobile service, the provision of air traffic control and other communications related to safety and regularity of flight are dependent on radio spectrum. Therefore, Recommendations relating to protection and sharing criteria are studied by WP 5B on a continuous basis, with respect to proposed new sharing scenarios and to take into account innovations in technology. In accordance with its mandate, Working Party 5B carries out studies and develops Recommendations related to new aeronautical applications such as unmanned aircraft systems (UAS).

Different aspects related to the development and operation of applications belonging to the radiodetermination service (including radiolocation and radionavigation) are also part of the WP 5B agenda. Systems belonging to the radiodetermination service are being employed not only by the aeronautical, maritime and meteorological industries but to an ever-increasing degree by other industries as well as the general public. While these systems operate within the current frequency allocations, proposals for sharing with new systems that require significant new spectrum allocations are being made in preparation for future World Radiocommunication Conferences. This requires the development of specific Recommendations addressing the characteristics of all known radar systems, potential enhancements made possible by the introduction of new technology and standardized measurement and mitigation techniques for each proposed new sharing scenario.

Taking into account the increasing importance of climate monitoring, WP 5B pays special attention to the development and maintenance of ITU-R Recommendations related to the operation of ground-based meteorological radars employed for weather, water and climate monitoring and prediction. These radars play a critical role in the immediate meteorological and hydrological alert processes and represent the last line of detection of weather that can cause loss of life and properties in flash flood or severe storm events.

Working Party 5B maintains strong cooperation with the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO) and the World Meteorological Organization (WMO).

Working Party 5C – Fixed wireless systems; HF systems in the fixed and land mobile services

WP 5C is responsible for studies related to fixed wireless systems and HF systems in the fixed and land mobile services. It studies performance and availability objectives, interference criteria, RF channel/block arrangements, system characteristics and sharing feasibility. (Note that for fixed wireless access (FWA) systems, work related to public access systems for potentially large deployment coverage is carried out in WP 5A.)

Performance and availability objectives for fixed wireless systems are established with the aim of integrating these systems in the public network. Close coordination with ITU-T on this issue is required for consistency with relevant ITU-T Recommendations.

Establishing interference criteria for FS systems due to various sources of interference is essential in the preparation of technical texts for future radiocommunication conference items on frequency sharing with other radio services.

WP 5C also standardizes the RF arrangements (including those based on frequency blocks) in the various frequency bands allocated to the FS. These arrangements allow homogeneous patterns to be used, which is desirable for interconnecting systems on international circuits and to minimize mutual interference.

Study of characteristics of systems using high-altitude platform stations (HAPS) and interference between HAPS and other systems in bands around 47/48 GHz and 28/31 GHz is currently another of its major activities.

Fixed wireless system characteristics are also studied. Along with the interference criteria, knowledge of the system characteristics is vital for the work of WP 5C in assessing the impact of sharing with other services on a primary basis, in all the bands allocated to the FS.

The scope of WP 5C also covers use of frequency bands below 30 MHz by the fixed and land mobile services. Particular topics include adaptive HF systems, HF fixed service characteristics, including interference objectives and protection criteria, and interference evaluation in co-channel sharing feasibility studies.

34 ITU-R Working Party 5D – IMT Systems

WP 5D is responsible for the overall radio system aspects of International Mobile Telecommunications (IMT) systems, comprising the current IMT-2000 systems and the future IMT-Advanced systems.

For the last 20 years, ITU has been coordinating efforts of governments and the industry in the development of a global broadband multimedia international mobile telecommunication system, known as IMT. Since the year 2000, the world has seen the introduction of the first family of standards derived from the IMT concept: IMT-2000. There are currently more than a billion IMT-2000 subscribers in the world and this system is continuing to expand and evolve.

IMT-Advanced is the next phase in this development. It provides a global platform on which to build the next generations of mobile services – fast data access, unified messaging and broadband multimedia – in the form of exciting new interactive services.

WP 5D has the prime responsibility within ITU-R for issues related to the terrestrial component of IMT, including technical, operational and spectrum-related issues to meet the objectives of future IMT systems and works closely with Working Party 4C on issues related to the satellite component of IMT.

WP 5D is the lead group for the overall maintenance of existing, and the development of new, Recommendations on the terrestrial component of IMT. This activity also involves liaison with ITU-T on the network-related standardization activities of IMT and with ITU-D in relation to the application of IMT in developing countries. Strong cooperative efforts with external organizations and well-known standards development organizations are also maintained.

The ongoing work in WP 5D is illustrated on the following page.

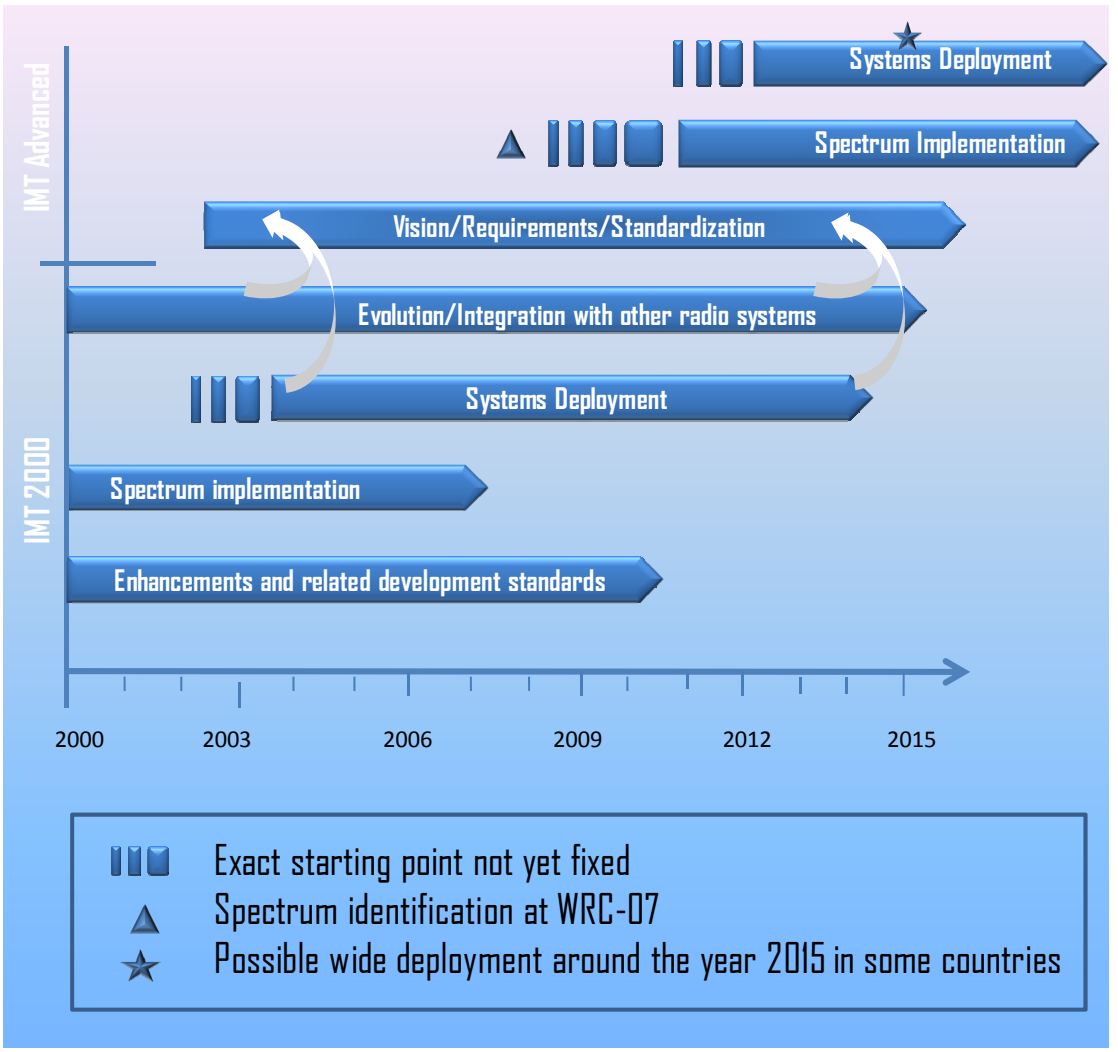
ITU-R Joint Task Group 5-6 – Studies on the use of the band 790-862 MHz by mobile applications and by other services

See page 39, Study Group 6, for more details.

ITU-R Study Group 5 is responsible for the following Handbooks:

- Amateur and amateur-satellite services
- Digital Radio-Relay Systems
- Frequency adaptive communication systems and networks in the MF/HF bands
- IMT-2000: Special Edition

- Land Mobile (including Wireless Access) Volume 1: Fixed Wireless Access
- Land Mobile (including Wireless Access) Volume 2: Principles and Approaches on Evolution to IMT-2000/FPLMTS
- Land Mobile Handbook (including Wireless Access) – Volume 3: Dispatch and Advanced Messaging Systems
- Land Mobile Handbook (including Wireless Access) – Volume 4: Intelligent Transport Systems
- Migration to IMT-2000 Systems – Supplement 1 to the Handbook on Deployment of IMT-2000 Systems



Development of International Mobile Telecommunications (IMT)

Study Group 6

Broadcasting service

www.itu.int/itu-r/go/rsg6/

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 at home, in cars or in portable use. 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 (by using the so-called converged terminals). In addition, it is to be noted that broadcast signals are increasingly received by end-user networks, i. e. gateways with local storage (home, car or body networks), which are also connected to interaction networks. The work of the Study Group encompasses the production and distribution of programmes (vision, sound, multimedia, data, etc.) as well as contribution circuits among studios, information gathering circuits (ENG, requirements for SNG, 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, studies those aspects related to production and radiocommunication end-to-end, including the international exchange of programmes as well as the overall quality of service.

Structure

Three Working Parties carry out studies on Questions assigned to Study Group 6 and one Joint Task Group (JTG) conducts studies on the use of the 798-862 MHz band by mobile applications and by other primary services:

WP 6A – Terrestrial broadcasting delivery

WP 6B – Broadcast service assembly and access

WP 6C – Programme production and quality assessment

JTG 5-6 – Studies on the use of the 790-862 MHz band by mobile applications and by other primary services

ITU-R Working Party 6A – Terrestrial broadcasting delivery

WP 6A covers the activities in the area of terrestrial system characteristics, channel coding/decoding, modulation/demodulation, frequency planning and sharing for sound, video, multimedia and interactivity, characteristics of transmitting and receiving antennas and evaluation methods of service areas, transmitter and receiver reference performance requirements, requirements for source coding for terrestrial emission and requirements for metadata in terrestrial broadcasting.

Much of the current work of the Working Party relates to the transition from analogue to digital broadcasting, both sound and television. The Working Party is also concerned with the protection of the broadcasting service from interference, particularly from unlicensed users of the broadcasting spectrum such as power-line telecommunications, short-range devices and ultra wideband devices. In addition, appropriate work is being undertaken to prepare for upcoming conferences and to advance studies in new areas such as three-dimensional television broadcasting.

WP 6A prepares handbooks and publications on terrestrial broadcasting that are useful to users in all parts of the world, including developing countries. A number of these handbooks have been prepared in the past such as the handbook on terrestrial and satellite digital sound broadcasting to vehicular, portable and fixed receivers in the VHF/UHF bands, a HF broadcasting system design handbook, an LF/MF system design handbook and a digital terrestrial television broadcasting handbook.

ITU-R Working Party 6B – Broadcast service assembly and access

WP 6B covers the activities in the area of interfaces in the production chain and via/to the various delivery media (terrestrial, satellite, cable, internet, etc.), source coding and multiplexing/demultiplexing of content, metadata, middleware, service information, and access control, for all broadcasting services including multimedia/interactive and converged services, both fixed and mobile terminals. WP 6B is also responsible for requirements for ENG and broadcasting satellite services. In other words, WP 6B is responsible for any areas bridging programme production and broadcasting emission.

In a digital broadcast scenario, the content to be broadcast consists of audio, video, data and metadata. Each of these media types possesses its own characteristics that need to be taken into account for an efficient technical and economic preparation of the broadcast emission. Consideration should also be given to characteristics in different parts of the broadcast chain and the delivery platforms, while taking into account various requirements.

Objectives of WP 6B are to study and seek harmonized systems for delivering multimedia content to receivers using terrestrial, satellite or Internet platforms and, through liaison with ITU-T Study Group 9, via cable platforms.

WP 6B also maintains a watch on emerging digital broadcast technologies utilizing ICT and on the issues surrounding the rights management of digital broadcast content.

ITU-R Working Party 6C – Programme production and quality assessment

WP 6C studies and develops issues associated with what is termed the "presentation layer" for radio and television broadcasting. This includes signal formats for the making and exchange of television and radio programmes, and also ways to evaluate picture and sound quality that are a critical element in the choice of the parameters for the "presentation layer" end-to-end.

Having common signal formats is vitally important for programme production, programme exchange and interchange, and for broadcasting itself. Developing efficient vision and sound formats for conventional quality television and radio, high-definition television and the television of tomorrow, which includes 3DTV and EHRI (extremely high resolution imagery) means better use of recording media and radio spectrum and higher quality for the viewer and listener.

Fundamentals of television and radio systems are also studied, including colorimetry – the way "primary colours" are combined in television pictures to yield the perfect colour results we see. The Working Party also studies the complex issues of audio and the way "loudness" is measured in the digital environment.

WP 6C also studies television and sound-programme recording for international programme exchange and archives. This includes the use of film in television.

The goals of WP 6C in this area are to specify the technical parameters to which such television and sound-programme recordings should comply, and the operating practices that broadcasters and programme – makers should adopt to allow the use of those recordings, their archiving and their international exchange.

WP 6C contributes and liaises with a number of other bodies such as the IEC/ISO JTC 1 MPEG group and the relevant departments of ITU-T.

The Working Party has launched studies in the three major areas of innovation of the media today. These are firstly "ultra high definition television", which provides images of extremely high detail and clarity. Secondly, the study of multi-dimensional sound systems that go beyond today's surround sound technology and allow the listener to pinpoint sound sources at any point in height, width or depth in the room. Thirdly, the development of new generations of "three dimensional" television technologies, where the scientific challenges are very great.

ITU-R Joint Task Group 5-6– Studies on the use of the 790-862 MHz band by mobile applications and by other primary services

The goal of JTG 5-6 is to conduct sharing studies for Regions 1 and 3 in the 790-862 MHz band between the mobile service and other services in order to protect the services to which the frequency band is currently allocated. The JTG was established by the Conference Preparatory Meeting (CPM 11-1) in order to deal with the studies required under agenda item 1.17 of the World Radiocommunication Conference (WRC-12), to be held in 2012.

ITU-R Study Group 6 is responsible for the following Handbooks:

- Book of Antenna Diagrams
- Conclusions of the Extraordinary Meeting of Study Group 11 on High-Definition Television
- Digital Television Signals: Coding and Interfacing within Studios
- DTTB Handbook - Digital terrestrial television broadcasting in the VHF/UHF bands
- HF Broadcasting System Design
- LF/MF system design
- Subjective Assessment Methodology in Television
- Technical Specifications of ITU-R Teletext Systems
- Television Systems Used around the World

Study Group 7

Science services

www.itu.int/itu-r/go/rsg7/

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;
- 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

WP 7A – Time signals and frequency standard emissions: Systems and applications (terrestrial and satellite) for dissemination of standard time and frequency signals;

WP 7B – Space radiocommunication applications: Systems for transmission/ reception of telecommanded and tele-metry data;

WP 7C – Remote sensing systems:for space operation and for space research;

WP 7D – Radio astronomy: remote sensing systems and applications for Earth exploaration meteorology and plantetary sensing.

ITU-R Working Party 7A – Time signals and frequency standard emissions

WP 7A covers standard frequency and time signal services, both terrestrial and satellite. Its scope includes the dissemination, reception and exchange of standard frequency and time signals and coordination of these services, including the application of satellite techniques on a worldwide basis.

The goals of WP 7A activities are to develop and maintain ITU-R Recommendations and Reports in the TF Series and Handbooks relevant to standard frequency and time-signal (SFTS) activities, covering the fundamentals of the SFTS generation, measurements and data processing. These ITU-R Recommendations are of paramount importance to telecommunication administrations and industry, to which they are first directed. They also have important consequences for other fields, such as radionavigation, electric power generation, space technology, scientific and meteorological activities and cover the following topics:

- Terrestrial SFTS transmissions (including HF, VHF, UHF broadcasts), television broadcasts, microwave link; coaxial and optical cables;
- Space-based SFTS transmissions/ (including navigation satellites) and communication satellites and meteorological satellites;
- Time and frequency technology, (including frequency standards and clocks), measurement systems, performance characterization, time scales and time codes.

The **Handbook on Selection and Use of Precise Frequency and Time Systems**, developed and maintained by WP 7A, describes basic concepts, frequency and time sources, measurement techniques, characteristics of various frequency standards, operational experience, problems and future prospects.

ITU-R Working Party 7B – Space radiocommunications applications

WP 7B is responsible for the transmission and reception of telecommand, tracking and telemetry data for space operation, space research, Earth exploration-satellite, and meteorological satellite services. It studies communication systems for use with manned and unmanned spacecraft, communication links between planetary bodies and the use of data relay satellites.

WP 7B enables both scientific studies and technology programmes by intelligent use of the radio-frequency spectrum.

WP 7B develops and maintains the Recommendations to enable sharing of the limited orbital and spectrum resources. The technical and operational characteristics of spacecraft are also studied, defining the preferred frequency bands, bandwidths required, protection and sharing criteria for spacecraft, and orbital locations for data relay satellites. The resulting SA Series ITU-R Recommendations and Reports assist administrations, national space agencies and industry in the planning of systems that share frequency allocations used by space radio systems.

Space research, by the very nature of its remote operations, is critically dependent on the radio spectrum for the conduct of its activities.

Extreme distances characterize deep space activities, with some current missions in excess of 11 billion km from the Earth. These extraordinary distances require the use of sophisticated communication equipment and advanced technologies to achieve reliable communication links.

The expansion of radiocommunications using the low-Earth orbit, coupled with the requirement for continuous communication, has led to the use of data relay satellites. Placed in geostationary orbit, a data relay satellite can provide continuous communication between a low-Earth orbiting spacecraft and a single earth station, and can support multiple spacecraft simultaneously with low to very high data rate requirements.

With respect to manned missions, the most challenging communication systems are those embedded in the space suits of astronauts engaged in space walks. The fact that the communication system must be integrated into the space suit severely limits the physical size and power consumption of such systems.

Further information on space research systems is documented in the **Space Research Communications Handbook**, which 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.

ITU-R Working Party 7C – Remote sensing systems

WP 7C covers remote sensing applications in the Earth exploration-satellite service (EESS), both active and passive, systems of the MetAids service, as well as space research sensors, including planetary sensors.

The objectives of WP 7C activities are to develop and maintain ITU-R Recommendations, Reports and handbooks relevant to remote sensing in Earth-exploration and meteorological activities. This includes the assessment of spectrum requirements and protection criteria for the above services and the establishment of sharing criteria with other services. The resulting RS Series ITU-R Recommendations are of paramount importance to administrations, international and national space agencies, as well as industry.

The Earth-exploration active sensors on-board satellites include systems such as altimeters, scatterometers and synthetic aperture radars to carry out:

- scientific and meteorological measurements of soil moisture, forest biomass, precipitation, surface winds, ocean topography, clouds structure, etc;
- measurements related to environmental protection and management of natural and man-made disaster situations (e.g. flooding, earthquakes, oil spills);
- Earth imaging at medium and high resolution for commercial and security applications.

The Earth-exploration passive sensors are used for a variety of terrestrial and atmospheric measurements, including important environmental data such as soil moisture, salinity, ocean surface temperature, water vapour profiles, temperature profiles, ocean ice, rain, snow, ice, winds, atmospheric chemicals, etc. Because of the required measurement accuracy down to fractions of one Kelvin, as well as the inability of the sensor to distinguish between natural and man-made radiation, a very high level of protection against interference from active services is necessary to obtain successful results.

The space research active and passive sensors are conceptually similar to the sensors used for Earth exploration, but are used either for the exploration of other planetary bodies of our solar system or for radio astronomical measurements from space.

The meteorological services comprise primarily the MetSat service and the MetAids service (the latter covering a variety of types of meteorological equipment), radiosondes, dropsondes and rocketsondes. MetAids are flown worldwide for the collection of upper atmosphere meteorological data for weather forecasts and severe storm prediction, collection of ozone level data, and measurement of atmospheric parameters for various applications.

WP 7C, in cooperation with the Steering Group on Radio Frequency Coordination of the World Meteorological Organization (WMO), developed and recently updated the **ITU/WMO Handbook on the "Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction**. This Handbook 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.

ITU-R Working Party 7D – Radio astronomy

WP 7D covers the radio astronomy service. Its scope includes radio astronomy and radar astronomy sensors, both Earth-based and space-based, including space very long baseline interferometry (VLBI).

The goals of WP 7D activities are to develop and maintain the RA Series ITU-R Recommendations and Reports relevant to radio and radar astronomy, covering their spectrum requirements, protection and sharing criteria. These Recommendations are of paramount importance to administrations, national and international space agencies and industries, to which they are first directed.

The **Handbook on Radio Astronomy** was developed by WP 7D and is concerned with those aspects of radio astronomy that are 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 search for extraterrestrial intelligence and ground-based radar astronomy are also considered in the Handbook.

ITU-R Study Group 7 is responsible for the following Handbooks:

- Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction
- Radio Astronomy
- Selection and Use of Precise Frequency and Time Systems
- Space Research Communications

Conference Preparatory Meeting (CPM)

www.itu.int/itu-r/go/rcpm/

The CPM shall prepare a consolidated report to be used in support of the work of World Radiocommunication Conferences, based on:

- contributions from administrations, the Special Committee, the Radiocommunication Study Groups (see also No. 156 of the ITU Convention), and other sources (see Article 19 of the ITU Convention) concerning the regulatory, technical, operational and procedural matters to be considered by such conferences;

- 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.

Publications

www.itu.int/publications/

With over 4 000 published titles, ITU is the main publisher of texts dealing with telecommunication technology and regulation, providing also general information in that regard. ITU-R's publications constitute an essential reference source for all those wishing to remain abreast of the rapid and complex changes occurring in the world of international radiocommunications such as State entities, public and private telecommunication operators, manufacturers, scientific or industrial bodies, international organizations, consultancies, universities, technical institutions, etc.

The IAP Department edits and publishes regulatory texts such as the Radio Regulations, the Final Acts of World Radiocommunication Conferences and the Rules of Procedure, as well as ITU-R handbooks, Reports and Recommendations drawn up by the Radiocommunication Study Groups.

Publications are available in paper format, on CD-ROM or online, in six languages (Arabic, Chinese, English, French, Russian, Spanish) or can be ordered directly from the ITU website: www.itu.int/ITU-R/go/publications.

To obtain a full catalogue or place an order by telephone, please contact the ITU Sales Service on +41 22 730 6141.

Why become an ITU Member?

www.itu.int/members/

ITU Membership represents a cross-section of the telecommunications and information and communication technology (ICT) industry, from the world's largest manufacturers and carriers to small, innovative new players working in revolutionary or new fields such as wireless communications (e.g. IMT-Advanced), television digital broadcasting (e.g. 3DTV) or future satellite systems (e.g. for remote sensing, emergency communications or intelligent transport systems).

Founded on the principle of international cooperation between government and the private sector, ITU represents a unique global forum through which government and industry can work towards consensus on a wide range of issues affecting the world's present and future communications industries.

ITU Membership represent an invaluable means of establishing a common understanding among potential business partners, national administrations and other ITU Members. There are currently three forms of ITU Membership:

ITU Member State

If the State is a Member of the United Nations, it can become a Member State of the ITU by acceding to its Constitution and Convention. If, however, a State is not a Member of the United Nations, then the application for membership needs to have a secured approval by two-thirds of the Member States of the Union.

ITU Sector Member

ITU Sector Members are entities and organizations which join one or more ITU Sector and benefit from the impartial, universal and global nature of the International Telecommunication Union and participate in creating the new environment needed to address the constantly changing and evolving telecommunication world.

ITU Sector Members receive the invitations with related documentation to all ITU events and thereby have access to various meetings at which decision-makers and potential partners are engaged in discussions that can result in business opportunities and joint ventures.

ITU Sector Members may be involved with the organization and co-sponsorship of seminars and workshops, providing experts and lecturers, training facilities, etc.

Associates

Associate Members are entities or organizations who join a single ITU Sector, for example the ITU-R Sector, and take part in the work of a selected single ITU-R Study Group and its subordinate groups. Associates take part in the process of preparing ITU-R Recommendations (standards) before their eventual adoption.

Associates can have access to all related documentation in their chosen ITU-R Study Group, as well as to other Study Groups, as required by the work programme. Associates are not involved in voting for, or in the approval of Questions and Recommendations.

An ITU-R Associate Member may also serve as Rapporteur within the selected ITU-R Study Group, except for liaison activities, which are to be handled separately.

Other ITU Membership benefits:

- Access to publications, documents, information and statistics;
- TIES (Telecom Information Exchange Services) accounts that allow members to access restricted databases, documents and technical databases;
- Discounts off the catalogue price for purchase of any ITU publication (except those available from the ITU Electronic Bookshop);
- Access to a large volume of restricted data such as draft documents, statistics, development plans, training modules, etc.

Complete information on ITU Membership benefits is available at
www.itu.int/members/

In today's fast-moving environment, membership of the ITU gives governments and private organizations a unique opportunity to meet and make important valued contributions to the technological developments rapidly reshaping the world around us!

Join the International Telecommunication Union

TO BECOME AN ITU MEMBER: Please contact ITU Membership or the ITU-R Study Group Department

E-mail: membership@itu.int or brsgd@itu.int

The ITU Membership brochure is also available for download from our website at www.itu.int/publications/brochurePromo/gs.html

Address and Contacts

Official correspondence should be sent to:

Radiocommunication
Study Group Department
International Telecommunication Union
1211 Geneva 20, Switzerland

E-mail: brsgd@itu.int
Telephone: + 41 22 730 5814
Facsimile: + 41 22 730 5806
www.itu.int/itu-r/go/address-contacts/

Head of Department: **Mr.Fabio LEITE (a.i.)**

ITU-R Study Group	Counsellor or Secretary	Chairman
SG 1 – Spectrum management	**Mr. Philippe AUBINEAU** philippe.aubineau@itu.int Tel. +41 22 730 5992	**Mr. Robin H. HAINES** rhaines@ntia.doc.gov Tel. +1 202 482 4096
SG 3 – Radiowave propagation	**Mr. Sergio BUONOMO** sergio.buonomo@itu.int Tel. + 41 22 730 6229	**Mr. Bertram ARBESSER-RASTBURG** bertram.arbesser-rastburg@esa.int Tél. +31 71 565 4541
SG 4 – Satellite services	**Mr. Nelson MALAGUTI** nelson.malaguti@itu.int Tel. +41 22 730 5198	**Dr. Veena RAWAT** veena.rawat@ic.gc.ca Tel. +1 613 949 0170
SG 5 – Terrestrial services	**Mr. Colin LANGTRY** colin.langtry@itu.int Tel. +41 22 730 6178	**Mr. Akira HASHIMOTO** hashimoto@nttdocomo.co.jp Tel.+81 3 5156 1150
SG 6 – Broadcasting service	**Mr. Nangapuram VENKATESH** nangapuram.venkatesh@itu.int Tel. +41 22 730 5552	**Mr. Christoph DOSCH** dosch@irt.de Tel. +49 89 3239 9349
SG 7 – Science services	**Mr. Vadim NOZDRIN** vadim.nozdrin@itu.int Tel. +41 22 730 6016	**Mr. Vincent MEENS**) vincent.meens@cnes.fr Tel. +33 5 6127 3808
CCV – Coordination Committee for Vocabulary	**Mr. Nelson MALAGUTI** nelson.malaguti@itu.int Tel. +41 22 730 5198	**Mr. Nabil KISRAWI** nabil.kisrawi@ties.itu.int Tel. +41 22 798 8451
CPM – Conference Preparatory Meeting	**Mr. Philippe AUBINEAU** philippe.aubineau@itu.int Tel.+41 22 730 5992	**Mr. Albert NALBANDIAN** albert.nalbandian@ties.itu.int Tel. +41 79 772 1180
SC – Special Committee	**Mr. Philippe AUBINEAU** philippe.aubineau@itu.int Tel.+41 22 730 5992	**Mr. Maurice GHAZAL** ghazal@ties.itu.int Tel. +961 3 392 392
RAG – Radiocommunication Advisory Group	**Mr. Fabio LEITE** fabio.leite@itu.int Tel. +41 22 730 5940	**Mr. Kouakou Jean-Baptiste YAO** kouakou.yao@ties.itu.int Tel. +41 22 717 0250

For contact details of the ITU R Study Group Chairmen and Vice-Chairman, please see:
www.itu.int/ITU-R/go/chairmen

Printed in Switzerland
Geneva, 2009