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World Radiocommunication Conference 2012

Sharing spectrum safely without interference

Satellites • Broadcasting • Mobile • Aviation • Maritime • Earth observation…

Great expectations in 2012

Dr Hamadoun I. Touré, ITU Secretary-General

ITU/P. M. Virot

We have certainly started 2012 on a high note. The Radiocommunication Assembly meeting in Geneva (16–20 January) agreed on global standards for the next generation of mobile broadband technology, known as IMT-Advanced. LTE-Advanced and WirelessMAN-Advanced are now officially designated as IMT-Advanced standards. In reaching this agreement, the Assembly has once again demonstrated the central role that the ITU Radiocommunication Sector (ITU–R) plays in the global development of information and communication technologies (ICT).

ITU is leading international standardization efforts forward from the first family of international mobile telecommunication (IMT) standards — IMT-2000 (or 3G), bringing mobile broadband to more than 1.2 billion people today. IMT-Advanced marks a huge leap forward in state-of-the-art technologies, which will make the present day smartphone feel like an old dial-up Internet connection. Access to the Internet, streaming videos and data transfers anytime, anywhere will be better than most desktop connections today. Clearly, additional spectrum will be needed to accommodate anticipated demand for mobile broadband services.

Just before the Assembly, on 12 January 2012, ITU received the prestigious Emmy Award from the United States National Academy of Television Arts and Sciences at the Consumer Electronics Show in Las Vegas for its new audio broadcast standard. The new standard should help put an end to irritating variations in sound volume when watching television — to the benefit of viewers who currently must repeatedly adjust the volume control to cope with sudden changes in sound level when they switch channels or when commercials are shown. The Emmy Award exemplifies the close relationship that ITU enjoys with its membership and partners. By working together, we are able to develop standards that enhance the quality of ICT and their accessibility to a worldwide audience.

Continuing on this path of success, we expect many decisions from the World Radiocommunication Conference 2012 (WRC-12), taking place in Geneva from 23 January to 17 February. This Special Edition of *ITU News* is devoted to this all-important event that will shape the future of ICT. It looks at many of the topics that the conference will discuss.

At WRC-12, we are looking forward to welcoming more than 3500 delegates representing ITU Member States, who will decide how best to use the radio-frequency spectrum and satellite orbit resources so that people everywhere are best served. The key to a successful outcome for WRC-12 will be found in building consensus on how to balance the demands of different services.

Within ITU, responsibility for ensuring the efficient use of the radio-frequency spectrum and interference-free operation of radio systems falls to ITU–R, which has the task of implementing

ITU receives Emmy Award for new audio broadcast standard

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the Radio Regulations. The radiocommunication landscape has changed considerably in the last four years, and so the onus is on WRC-12 to update the Radio Regulations accordingly.

Registering satellite networks and terrestrial systems with ITU gives Member States international recognition for their frequency assignments and the ability to protect them from harmful interference. Recording of frequency assignments in the Master International Frequency Register must ensure that spectrum and orbit resources are used in a rational, equitable, efficient and economic way.

Beyond WRC-12

Beyond WRC-12, ITU has a huge programme of work to accomplish this year in order to meet the expectations of its membership. We are preparing for various important events in 2012, including the Connect Arab Summit in Doha, Qatar, from 5 to 7 March, WSIS Forum in Geneva from 14 to 18 May, the annual session of the ITU Council from 4 to 13 July, and the Connect Americas Summit in Panama City, Panama, from 17 to 19 July. An awareness of gender is implicit in all ITU events, and will be celebrated explicitly on two special days this year — international "Girls in ICT Day" on 26 April, and World Telecommunication and Information Society Day (17 May), with the theme "Women and Girls in ICT".

The year will close with three events in Dubai, United Arab Emirates: ITU Telecom World; the World Telecommunication Standardization Assembly (WTSA-12) from 20 to 29 November; and the World Conference on International Telecommunications (WCIT-12) from 3 to 14 December.

All of the events that I have mentioned provide opportunities to open the door to the broadband revolution, so that people everywhere can gain affordable, equitable, high-speed fixed or mobile access to voice, video and data. The stakes this year are high and so are the expectations. Let us work together to build a better world for all.


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Satellite matters

Broadcasting

Digital dividend

Mobile broadband

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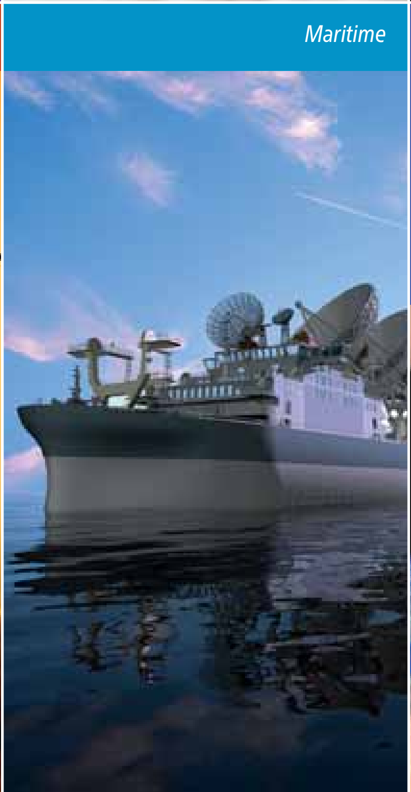
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Electronic news gathering

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World Radiocommunication Conference 2012
Global challenges, global opportunities

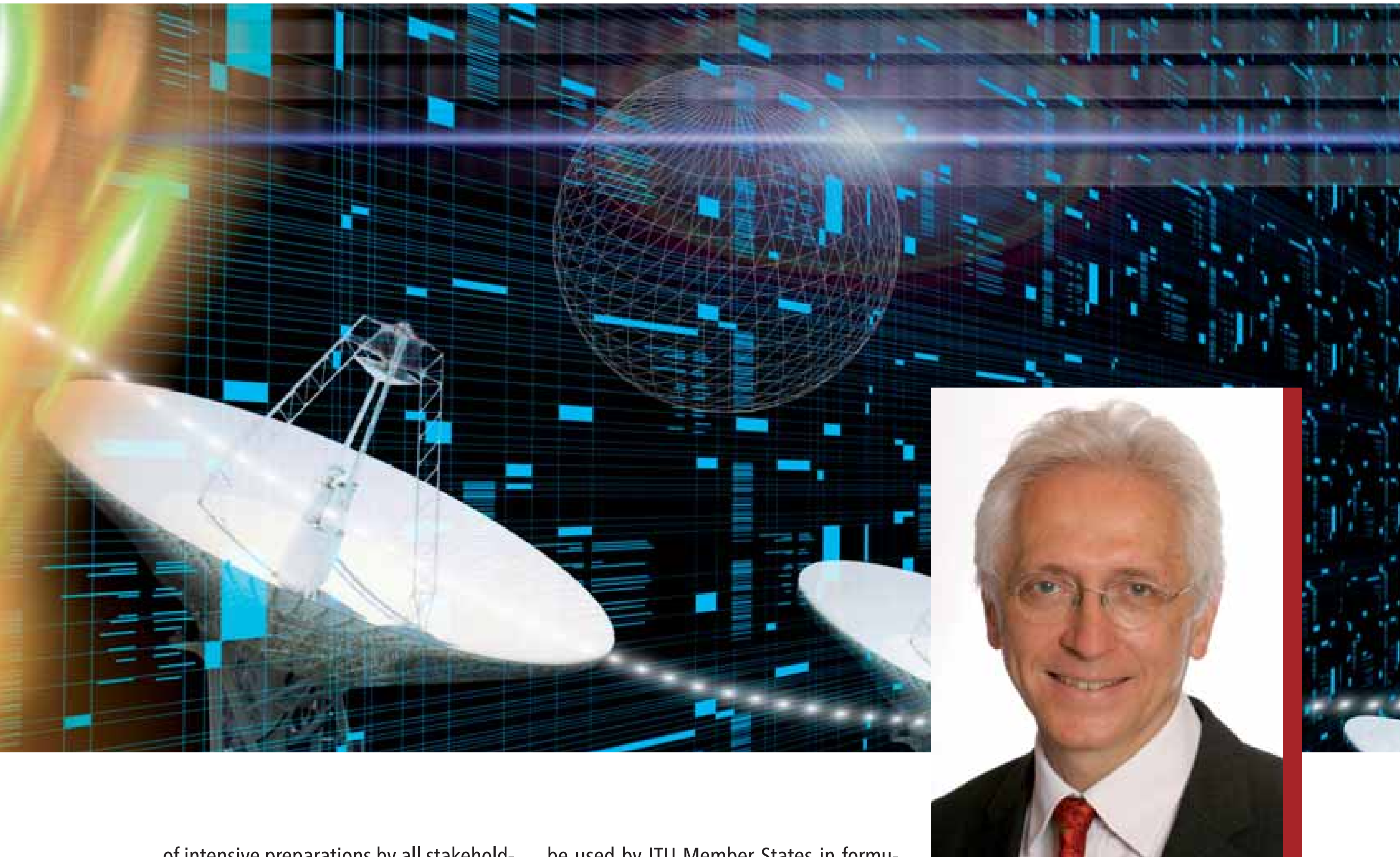
François Rancy, Director, ITU Radiocommunication Bureau

The World Radiocommunication Conference 2012 (WRC-12) will open in Geneva for almost four weeks, from 23 January to 17 February. More than 3500 delegates representing the ITU Member States are expected to participate in this long-awaited conference — the previous conference having taken place in 2007. Observers from the private sector and international organizations will also attend WRC-12.

ITU world radiocommunication conferences, held every three or four years, are mandated to review and revise the Radio Regulations, the international treaty governing the use of radio-frequency spectrum and satellite orbit resources. The agenda of a world radiocommunication conference may include any other question of a worldwide character within the competence of the conference.

The unprecedented number of proposals (more than 1700) addressing the various items on the WRC-12 agenda cover almost all radio services and applications, and illustrate the importance of this conference to governments and businesses.

The conference, which will pave the way for long-term investments in spectrum over the next 20 years, will be the culmination of an unprecedented effort to build consensus through four years



François Rancy
Director, ITU Radiocommunication Bureau

ITU/P.M. Virot

of intensive preparations by all stakeholders. These preparations will help to ensure that the decisions of the conference are agreed by all ITU Member States, and applied and enforced in all 193 countries of the Union.

Preparatory work

The preparatory effort by the ITU membership within the study groups of the ITU Radiocommunication Sector (ITU–R) concluded in February 2011 with the second and final session of the Conference Preparatory Meeting (CPM), which adopted the "CPM report on technical, operational and regulatory/ procedural matters to be considered by WRC-12". This 700-page comprehensive report contains the basis and background information to be used by ITU Member States in formulating their proposals to the conference. Each agenda item was analysed in detail by the relevant ITU–R groups, and the report suggests methods and options for addressing the subjects raised in the conference agenda.

Another essential background document for the conference is the "Report on the activities of the Radiocommunication Sector", prepared by the Radiocommunication Bureau. This reflects the Bureau's experience in applying the Radio Regulations, and includes a report on the activities of the Radio Regulations Board.

An intensive preparatory programme was conducted by the following regional telecommunication organizations: the Asia-Pacific Telecommunity (APT), the Arab Spectrum Management Group (ASMG), the African Telecommunications Union (ATU), the European Conference of Postal and Telecommunications Administrations (CEPT), the Inter-American Telecommunication Commission (CITEL), and the Regional Commonwealth in the Field of Communications (RCC). Coordinated proposals prepared by these regional groups have been submitted to the conference, and will greatly facilitate consensus building on the various issues to be discussed.

ITU organized three information meetings — in 2009, 2010 and 2011 — which gave participants the opportunity to exchange views, and get a better understanding of the draft common proposals and positions of the regional groups and other concerned entities, including international organizations such as the International Civil Aviation Organization, the International Maritime Organization and the World Meteorological Organization.

The diligent preparatory activities undertaken by administrations and regional groups, supported by international organizations, the private sector and the Bureau, are the building blocks that will help WRC-12 to successfully address the needs and concerns of spectrum users.

WRC-12 agenda

The scope and complexity of the WRC-12 agenda make it impossible to consider all the items in an article as brief as this. And in summarizing the main topics to be dealt with by the conference, the specific concerns and interests of some groups or entities will inevitably be neglected. With those caveats in mind, I would say that, among its 33 agenda items, WRC-12 will focus on:

- the review and possible revision of the international regulatory framework for radiocommunications, in order to reflect in the Radio Regulations the increasing convergence of radio services arising from the rapid evolution of information and communication technologies (ICT), and to adapt to new and potentially disruptive technologies such as software-defined and cognitive radio systems or short-range devices;
- the management of satellite orbits and associated spectrum resources, for which the increasing demand may soon exceed current availability;
- the allocation of scarce radio-frequency spectrum to provide new opportunities for radiocommunication services, including those for the safety and security of maritime and aeronautical transport, as well as those dedicated to scientific purposes related to the environment, and to disaster prediction, mitigation and relief;
- the introduction and development of mobile broadband and other advanced technologies, including the use of the digital dividend resulting from the switchover from analogue to digital terrestrial television broadcasting and the development of advanced digital satellite broadcasting applications.

Other topical subjects to be addressed include science, radiodetermination and radionavigation-satellite matters. The conference also has the task of identifying items for the agenda of the next conference, which is scheduled to take place in 2015.

Regulatory matters

Can the current international regulatory framework adequately meet the changing requirements for radiocommunication spectrum in a way that allows innovative technologies to be implemented in a timely manner? The conference is expected to answer that question. The corresponding agenda item aims at addressing changes to the Radio Regulations that will make them more responsive to new technological developments and convergence. Discussions on this subject started in WRC-03, and it is hoped that they will be concluded at WRC-12.

One of the most complex topics regarding satellite regulations that the conference is likely to encounter concerns a series of procedures, processes and provisions that no longer seem to be aligned with the principles on which they were based. This concerns, in particular, the principle of equitable access contained in Article 44 of the ITU Constitution. The procedures in the spotlight include those related to the processes for publication, coordination, notification, recording, bringing into use, suspension and due diligence applicable to satellite networks. Voluminous and intricate proposals are tabled, and each proposed change in the procedures could affect current and future satellite operations. This item is likely to occupy the conference throughout its duration, and the reports by the Radiocommunication Bureau and the Radio Regulations Board will help to move these discussions forward.

Alamy

The 22.0 GHz band is one of the most favourable frequency bands for advanced digital satellite broadcasting applications, which require larger bandwidth capacity than ever needed before. These applications include ultra-high definition television, three-dimensional television, digital multimedia video information systems, multi-channel high definition television, large-screen digital imagery, and extremely high resolution imagery. These applications have been extensively studied in ITU–R to enhance the broadcasting service. Despite the complexity of this area, the conference is likely to make permanent arrangements for use of the 21.4–22 GHz band by the broadcasting-satellite service, to facilitate use of this band for advanced digital satellite broadcasting applications which require larger bandwidth capacity.

Digital dividend

At WRC-07, the band 790–862 MHz was allocated to the mobile service in Region 1 (Africa and Europe), complementing previous allocations to that service in Regions 2 (Americas) and 3 (Asia and Australasia), and was identified for international mobile telecommunications (IMT) worldwide. At that time, concerns were raised about the protection of services (mainly broadcasting and aeronautical radionavigation services) that were already allocated in this frequency band in the event that neighbouring administrations would implement mobile service. WRC-12 will therefore consider the results of sharing studies in this band to ensure the adequate protection of the services involved, and take appropriate action.

In an unprecedented effort to resolve this difficult problem, the administrations of CEPT and RCC have adopted a pragmatic approach by developing and concluding a series of bilateral frequency coordination agreements that are expected to smooth out the opposing views which had initially been expressed on the compatibility between the mobile and the aeronautical radionavigation services in this band.

The studies and discussions on this agenda item have also highlighted the need in a number of Region 1 countries to urgently review the WRC-07 allocation to the mobile service in the UHF band to face the growing demand for mobile broadband. Pressure is therefore likely to grow in favour of a worldwide mobile allocation of the 700 MHz band, which is being considered in Regions 2 and 3 for the digital dividend.

Aviation and maritime safety

The aeronautical community is seeking to facilitate the introduction of new aeronautical mobile systems in the bands 112–117.975 MHz, 960–1 164 MHz and 5 000–5 030 MHz. These systems provide radio links that are critical for the safety and regularity of flights, and surface communications at airports. The ITU–R compatibility studies showed that sharing is generally possible.

The use of the 1.5/1.6 GHz bands by the aeronautical mobile-satellite (route) service has priority with regard to other mobile-satellite service systems. This is required to ensure interference-free communications with aircraft, taking into account the safety of life aspects of such links. At present, this priority is established through multilateral or bilateral frequency coordination meetings between mobile-satellite service operators. Proposals to WRC-12 suggest additional procedures to resolve concerns that have been expressed about the ability of this practice to accommodate aeronautical requirements.

WRC-12 will consider spectrum requirements and possible regulatory actions, including the identification of globally harmonized spectrum, in order to support the safe operation of unmanned aircraft systems in the non-segregated airspace used by civil aviation. Although unmanned aircraft systems have traditionally been used in segregated airspace where separation from other air traffic can be assured, administrations expect broad deployment of unmanned aircraft systems in non-segregated airspace alongside manned aircraft.

The development of unmanned aircraft systems is based on recent technological advances in aviation, electronics and structural materials, making the economics of unmanned aircraft system operations more favourable, particularly for repetitive, routine and long-haul and long-duration applications. The required spectrum will be used for command and control of unmanned aircraft, for relay of air-traffic control communications, and for relay of sense and avoid data. The unmanned aircraft systems will be composed of a terrestrial component (radio links between the unmanned aircraft and its control station) and a satellite component (radio links between satellite and unmanned aircraft control station, and between satellite and unmanned aircraft).

The main topic to be discussed under the terrestrial component is possible new allocations to the aeronautical mobile (route) service in all or some portions of the bands 5 000–5 150 MHz and 15.4–15.5 GHz. The main topics relating to the satellite component are, first, the use of communication links within existing allocations to the aeronautical mobile-satellite (route) service, and second, the use of existing fixed-satellite service, mobile-satellite service and aeronautical mobile-satellite service allocations for communication links between the unmanned aircraft and satellite, and between the unmanned aircraft control station and satellite. There is a general understanding of the pressing need for allocations for unmanned aircraft systems, particularly for the terrestrial component, and the discussion may well centre on the exact band and amount of spectrum.

Concerning maritime safety, WRC-12 is expected to adopt special measures to enhance maritime safety systems for ships and ports. Enhancements are proposed in three main areas to:

- provide satellite detection of signals from automatic identification systems on board ships (by adopting a new allocation to the mobile-satellite service around 156 MHz for satellite detection of automatic identification system signals, to provide global ship-tracking and enhance search and rescue);
- improve the broadcasting of safety and security information for ships and ports (by making a worldwide allocation to the maritime mobile service in the 495–505 kHz band as well as a regional allocation in 510–525 kHz band in Region 2 — which would enhance transmission of safety and security information in ports and coastal waters);
- improve VHF communications for port operations and ship movement (it is planned to revise Appendix 18 of the Radio Regulations in order to implement new digital technologies

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in the band 156–174 MHz and increase the number of simplex channels to make more channels available for the ports with heavy traffic where communications are congested).

Given the existing situation, the global maritime community has agreed on special measures to enhance maritime safety systems for ships and ports, recognizing that additional satellite channels may be required to enhance and accommodate global ship tracking capabilities. Everyone is keen to agree on the proposed methods and options.

Environment

Several WRC-12 agenda items are related to important environmental topics, in particular the use of ICT in combating climate change and mitigating its effects, and in predicting natural disasters and facilitating relief efforts.

Since the 1970s, interest in and use of oceanographic radar operating in the 3 to 50 MHz range has increased significantly. Preparatory work has identified potential spectrum allocations in terms of both compatibility with other users and effectiveness of ocean measurements. The need for additional data to mitigate the effects of disasters, including tsunamis, to understand climate change, and to ensure safe maritime travel has led to the consideration of the operational use of oceanographic radar networks on a global basis. Increased reliance on the data from these systems for maritime safety and disaster response, as well as for oceanographic, climatological and meteorological operations, has driven the need to improve the regulatory status of the spectrum used by oceanographic radars while taking into account the protection of existing allocated services. The ITU membership seems to fully support making allocations for this application.

Long-range lightning detection using observations near 10 kHz has been performed since 1939, originally with a labour-intensive system for measuring the direction from which signals were received. Since 1987, there has been an automated system to derive strike locations: a distributed network of ground-based sensors can locate the origin of the lightning strike, using the time differences between the arrival of the lightning emission at the individual sensor sites. The maximum spectral emissions from lightning strikes are between 9 and 20 kHz. At these frequencies, the sky waves reflected off the ionosphere propagate for long distances with relatively little attenuation. It is thus possible to receive the emissions from a lightning strike at thousands of kilometres from the strike location. The conference will consider the possibility of an allocation in the frequency range below 20 kHz for passive systems for lightning detection in the meteorological aids service.

Operational non-geostationary meteorological satellite (MetSat) systems now use the band 7 750–7 850 MHz to gather instrument data to dedicated earth stations with a bandwidth of up to 63 MHz. The measurements and observations performed by the MetSat systems provide the data used in operational meteorology, climate monitoring and detection of global climatic changes. The data have significantly improved operational meteorology, in particular with respect to numerical weather prediction.

The next generation of non-geostationary MetSat systems will have to provide continuity of data, aligned to the measurements and observations performed by the current systems. These future systems will also perform additional and higher-resolution measurements and observations of meteorological and climate parameters, requiring much higher data rates and bandwidth as compared to current systems. The necessary bandwidth for future non-geostationary MetSat systems to fulfil those requirements would be up to 150 MHz. The conference is expected to support the corresponding extension of bandwidth.

One of the most complex topics regarding satellite regulations that the conference is likely to encounter concerns a series of procedures, processes and provisions that no longer seem to be aligned with the principles on which they were based. This concerns, in particular, the principle of equitable access contained in Article 44 of the ITU Constitution. The procedures in the spotlight include those related to the processes for publication, coordination, notification, recording, bringing into use, suspension and due diligence applicable to satellite networks…

François Rancy, Director, ITU Radiocommunication Bureau

Advanced technology

The conference will consider the need for regulatory action to foster the development of advanced wireless systems and applications, such as software-defined radio, cognitive radio systems, short-range devices, fixed wireless systems above 71 GHz, gateway links for high-altitude platform stations, and electronic news gathering. The Radio Regulations, in their current form, are generally considered to provide an appropriate framework for the development of these systems and applications. Specific requirements can be addressed through the standardization work of the ITU–R study groups.

Goodwill and international cooperation

Previous world radiocommunication conferences have successfully provided for timely enhancements to the Radio Regulations to cope with technical and regulatory developments, and to address the needs of the ITU membership for the allocation, management and use of the radio-frequency spectrum and orbit resources. In keeping with the tradition of goodwill and international cooperation which has always prevailed under these circumstances, I am convinced that WRC-12 will be another successful milestone in the history of the Union.

ITU/V. Martin

Albert Nalbandian

ITU/V. Martin

Good preparations — the key to success

Albert Nalbandian, Chairman of the Conference Preparatory Meeting for WRC-12

Broadband access to information for everyone, anywhere and at any time — this is ITU's global mission for the near future.

Responsibility for ensuring the efficient use of the radio-frequency spectrum and interference-free operation of radio systems falls to the ITU Radiocommunication Sector (ITU–R), which has the task of implementing the Radio Regulations.

Circumstances change, and the Radio Regulations have to be updated in an efficient and timely manner. Revising the Radio Regulations is the prerogative of the ITU World Radiocommunication Conference (WRC).

Today, WRC agendas encompass a wide range of topics, relating both to spectrum (frequency bands in the range from 9 kHz to 3 000 GHz) and to radiocommunication services and applications (from analogue narrowband systems for maritime and aeronautical mobile communications and navigation, to digital wireless broadband access systems for the benefit of a wide range of users of information and communication technologies).

The ITU membership accords increasing importance to the WRC process to improve regulatory procedures, and to provide frequency and orbit resources for new technologies, as well as the technical framework for the operation of services.

Experience with WRCs has shown how regional preparatory work between conferences can help in building consensus on the many agenda items. This process involves both formal and informal cooperation. The inter-conference activity is based on Plenipotentiary Conference Resolution 80 (Rev. Marrakesh, 2002) on "World radiocommunication conference process", which resolves "to support the regional harmonization of common proposals" and "to encourage both formal and informal collaboration in the interval between conferences".

Inter-regional information meetings

One of the ways to achieve cooperation in preparing for WRCs is by organizing inter-regional information meetings. This is in line with WRC Resolution 72 (Rev. WRC-07) on "World and regional preparations for world radiocommunication conferences", which resolves "to invite regional groups to continue their preparations for WRCs, including the possible convening of joint meetings of regional groups formally and informally".

To help the ITU membership prepare for WRC-12, and in particular to respond to requests of ITU–R members to be informed on progress in the preparations for WRC-12, the Radiocommunication Bureau held a series of information meetings in 2009, 2010 and 2011 on the most important stages of the preparations. The six WRC regional organizations were well represented in these meetings: the Asia-Pacific Telecommunity (APT); the Arab Spectrum Management Group (ASMG); the African Telecommunications Union (ATU); the European Conference of Postal and Telecommunications Administrations (CEPT); the Inter-American Telecommunication Commission (CITEL); and the Regional Commonwealth in the Field of Communications (RCC).

Participants in the 2009 and 2010 meetings were not only informed on progress made in implementing the decisions of the first session of the Conference Preparatory Meeting (CPM), but also exchanged views on:

- possible methods to satisfy WRC-12 agenda items on the basis of results of the studies carried out by the competent ITU–R groups;
- preliminary positions of ITU–R members formulated on the basis of information from the draft CPM report for WRC-12, prepared by the CPM management team.

The third information meeting was held at ITU headquarters in Geneva on 7 and 8 November 2011. There were 267 participants representing 78 Member States and 25 ITU–R Sector Members, as well as international organizations. This was one of the last opportunities for ITU–R members to discuss WRC-12 issues before the conference.

Over the two days, at six sessions led by recognized experts, participants exchanged views on proposed methods to satisfy each WRC-12 agenda item, on the basis of the CPM report that was approved in February 2011, the report of the Director of the Radiocommunication Bureau, and common or individual proposals of ITU Member States.

WRC-12 has a full agenda, with many difficult problems to resolve. The information meetings held by the Radiocommunication Bureau have demonstrated how important all the opportunities are to meet formally and informally, exchange views, explain the complex matters that WRC-12 will deal with, and provide ideas for better preparation for the conference.

For many WRCs now, this preparatory process has been proving increasingly successful within and between the various regional groups. This highlights the great spirit of international cooperation that marks the ITU tradition of consensus building. So let us continue this good practice. The third information meeting showed that there is a clear requirement for such meetings for future WRCs.

Inter-regional information meetings to prepare for WRCs are important and useful for all ITU members. I hope that the meetings held over the past three years have been of assistance to ITU Member States in preparing for WRC-12.

Satellite matters

ESA/P. Carril

Satellite regulations: Improving the international satellite regulatory framework

Julie N. Zoller, Chairman of the Radio Regulations Board in 2011

Julie N. Zoller

Communication, navigation and broadcasting by satellite are expanding parts of our infrastructure. By registering satellite networks with ITU, Member States gain international recognition for their space-based frequency assignments and the ability to protect them from harmful interference. Every World Radiocommunication Conference (WRC) in recent memory has refined these registration procedures to ensure that they keep pace with technological advances, contribute to the orderly use of the radio-frequency spectrum and satellite orbits, and yield predictable and reliable results.

Member States file hundreds of satellite network registrations with ITU each year. Roughly one-third of the networks that start the registration process complete it. They are notified (notification is the final step of the registration process) and brought into use within the time limit.

Networks drop out of the process for a variety of reasons, some examples of which are given here. The project might be cancelled. Countries might file multiple orbital positions on the geostationary arc with the idea of letting go of all but the one orbital position for which the administration has successfully coordinated frequency usage. The filing might be suppressed based on an unfavourable technical finding. Or the filing might fail to meet the regulatory requirements, such as the requirement to be brought into use within the specified time limit.

Because frequency bands are congested, it is becoming more challenging for countries to register and coordinate new satellite systems. Some assignments recorded in the ITU Master International Frequency Register (MIFR) appear to be unused. This reservation of orbit and spectrum capacity without actual use adds to the difficulty of registering and coordinating new satellite systems.

Due diligence in applying the principles embodied in the ITU Constitution

Article 44 of the ITU Constitution calls upon Member States to bear in mind that the radio-frequency spectrum and satellite orbits are limited natural resources that "must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations, so that countries or groups of countries may have equitable access to those orbits and frequencies, taking into account the special needs of the developing countries and the geographical situation of particular countries." Member States are asked to limit the number of frequencies and the spectrum used to the minimum needed to

Satellite integration at spaceport before launch

ESA/S. Corvaja

provide the necessary services. The Preamble to the Radio Regulations establishes similar principles. Essentially, we are asked to be good stewards of the radio-frequency spectrum and satellite orbits.

Resolution 80, *Due Diligence in Applying the Principles Embodied in the Constitution,* was first adopted by WRC-97 and subsequently revised by WRC-2000 and WRC-07. Each version of Resolution 80 has instructed the Radio Regulations Board (the Board) to develop Rules of Procedure, conduct studies, or consider and review possible draft recommendations linking the principles contained in the Preamble to the Radio Regulations to the notification, coordination and registration procedures in these Regulations, and to report to a subsequent WRC. In the case of Resolution 80 (Rev. WRC-07), these linkages were extended to include the principles contained in Article 44 of the Constitution.

WRC-12 will contemplate changes to the satellite network registration procedures, under its agenda items 7 and 8.1. The basis for this work includes the Board's report on Resolution 80 and the report of the Director of the Radiocommunication Bureau (the Bureau) on the activities of the Radiocommunication Sector. WRC-12 has the opportunity to advance the implementation of important principles by improving the satellite regulatory procedures and the quality of the MIFR, thereby ensuring Member States' rights in the future.

Maintaining the Master International Frequency Register

Investigations based on "reliable information"

The Master International Frequency Register contains information about frequency assignments and, in the case of space services, orbit usage. Accuracy and transparency are important because favourable recording in the MIFR is the basis for international recognition and the right to protection from harmful interference.

The Bureau is responsible for maintaining the MIFR and improving its accuracy. No. 13.6 of the Radio Regulations (RR) enables the Bureau's review of assignments in the MIFR and their subsequent retention, suspension, or suppression. Proper application of RR No. 13.6 preserves Member States' rights with regard to their frequency assignments and the integrity of the data. Administrations, the Bureau, and the Board have increasingly applied RR No. 13.6 since WRC-07.

A review under RR No. 13.6 is initiated by "reliable information" that a recorded assignment was not brought into regular operation or is not being used in accordance with the notified characteristics. An administration may ask the Bureau to clarify the operation of another administration's frequency assignments. The administrations involved might also ask that the matter be brought to the attention of the Board. Other times, the Bureau initiates its own inquiry. These reviews are usually prompted by information posted on the websites of launch providers, satellite manufacturers or satellite operators; data elements from real-time satellite tracking databases open to the public; privately-collected monitoring data; or some combination of public and private data that reveals differences from the information in ITU records.

The Board considers such information to be "reliable" for the purpose of initiating consultation, but not definitive for the purpose of cancelling, modifying or retaining an entry in the MIFR. Not all information regarding a satellite network is public, and not all information that is public is accurate. The Board takes the response by the notifying administration to an inquiry about the status of its own satellite networks and frequency assignments to be "reliable" information and the appropriate basis for decisions regarding assignments in the MIFR. Noting that "reliable" in this context does not imply validated or verified, the Board is of the view that the Bureau may seek clarification regarding such information.

The conference may wish to modify RR No. 13.6 to specify time-frames for responding to a Bureau request to clarify satellite network operations, follow-up reminders, and action on the part of the Bureau and the Board in the case of network suppression.

What does "bringing into regular operation" mean?

The distinction between a frequency assignment recorded in the MIFR and actual satellite operation is an important one when it comes to understanding "bringing into regular operation." Data filed with ITU reflect the operations of real satellites, but there is not a one-to-one relationship between a satellite network filing and a particular physical satellite. In fact, a satellite network filing may relate to more than one physical satellite, either at the same time or over the lifetime of the filing. A satellite (or series of satellites) may have arrived at the notified orbital position directly from launch or after being moved from one location to another.

In order to bring a satellite network into use, a satellite (or series of satellites) capable of operating in the notified frequency bands must be deployed at the notified orbital location. Operation of a geostationary satellite network at a registered orbital location for a few months would generally be considered sufficient to declare the frequency assignments to be in "regular operation" in the absence of an anomaly or other relevant factors. Activation of multiple satellite network filings with a single satellite, however, may be seen as reservation of orbit and spectrum capacity without actual use, and as being contrary to the Union's basic principles.

The conference may wish to express its views on these matters, although establishing rigid criteria, such as a minimum number of days to meet the "regular operation" criterion, might be difficult at this juncture.

Suspending the use of a recorded assignment to a space station

No. 11.49 of the Radio Regulations allows the use of a recorded assignment to a space station to be suspended for up to two years. Suspensions under RR No. 11.49 may be declared by the notifying administration at its own initiative or in response to an inquiry made under RR No. 13.6. Nearly one-quarter of the

SpaceX/Chris Thompson

recent inquiries made under No. 13.6 resulted in suspensions under No. 11.49. In some cases, operation was actually suspended many months earlier but the Bureau was not informed until after the inquiry. Yet RR No. 11.49 requires that the notifying administration inform the Bureau "as soon as possible" of the suspension date.

The conference may wish to clarify RR No. 11.49 to minimize delays between the time that frequency assignments are suspended and the time that the Bureau is notified and provide greater certainty with regard to the actual date of bringing the assignment back into regular operation.

Harmful interference

The Board frequently treats requests for its assistance regarding harmful interference. Historically, these requests have mainly involved terrestrial services. But recently, such requests have increasingly involved space services. The Board and the Bureau have had no difficulties applying the interference procedures in Article 15 of the Radio Regulations. Nevertheless, the harmful interference persists in some situations, and this is cause for concern.

The Board has also addressed cases involving interfering signals that appeared to be of a nature that is forbidden under the Radio Regulations. For example, some interference of this type was reported to consist of a high-power carrier continuously sweeping the entire satellite transponder bandwidth and timed to coincide with specific broadcasts. Such transmissions can cause loss of service and possibly damage the satellite. Harmful interference reports of this type, commonly known as "jamming," have increased. Despite the application of the administrative procedures in the Radio Regulations, the harmful interference sometimes continues. This has given rise to the idea that something more might be needed to identify and eliminate the source of interference.

Given that ITU is the leading United Nations agency for the global management of the radio-frequency spectrum and satellite orbits, it is appropriate that problems of harmful interference or "jamming" should be treated and resolved within ITU through the diligent application of the Constitution, Convention and Radio

Regulations. From the outset, ITU has successfully relied upon Member States exercising goodwill and mutual assistance. But studies may be needed to determine what additional measures could be incorporated in the Radio Regulations to improve the protection of satellite networks and enable this type of harmful interference to be resolved expeditiously.

International monitoring system

Article 16 of the Radio Regulations concerns international monitoring. Stations that are recognized as part of the specially designated international monitoring system have historically focused on terrestrial monitoring. Measurements from such stations could assist the Bureau and the Board in reconciling conflicting information about satellite operations, although the data would only reflect operations at a particular instant in time or during a finite period of time and might not be conclusive. Monitoring stations would be particularly useful in helping to resolve harmful interference. Data from some stations capable of geo-locating sources of interference have already been of assistance to the Bureau in identifying the causes of harmful interference to space networks.

The Bureau does not have the capability to conduct monitoring, which requires substantial resources. A greater number of specially designated stations in the international monitoring system, particularly with the addition of satellite monitoring capabilities, would provide more options to locate interference sources and resolve harmful interference.

The conference may wish to consider modifying the harmful interference procedures not only to accelerate assistance from the Bureau, but also to expand the ability of administrations to seek support in identifying a source of harmful interference, which could include activating the international monitoring system. Developing countries would particularly benefit from access to these monitoring resources, which may ultimately lead to the more effective use of the radio-frequency spectrum and satellite orbits.

Article 44 of the ITU Constitution calls upon Member States to bear in mind that the radio-frequency spectrum and satellite orbits are limited natural resources that "must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations, so that countries or groups of countries may have equitable access to those orbits and frequencies, taking into account the special needs of the developing countries and the geographical situation of particular countries."

Julie N. Zoller, Chairman of the Radio Regulations Board in 2011

The challenge for WRC-12

Three conferences have considered Resolution 80, *Due Diligence in Applying the Principles Embodied in the Constitution.* The Board reported the results of its studies on Resolution 80 to WRC-2000 and WRC-03. These conferences took no action, but WRC-07 included some of the earlier work from the Board in the revisions to this resolution.

As WRC-12 considers changes to the satellite network registration procedures, it will also consider the Board's recommendations for linking the registration procedures for satellite networks to the principles contained in Article 44 of the Constitution and the Preamble to the Radio Regulations. These new concepts include ways to improve the MIFR and address harmful interference. The challenge for WRC-12 is to decide how to treat the Board's recommendations and ensure that the satellite regulatory procedures meet the evolving needs of the Union's members.

ESA/J. Huart

Serving the satellite community: Efficient use of the spectrum/orbit resource

Yvon Henri, Chief of the ITU Space Services Department

Yvon Henri

ITU/P. M. Virot

Efficient use of the spectrum/orbit resource is crucial in efforts to promote worldwide telecommunication development. The challenge for ITU, and thus for administrations and the satellite community, is to ensure that continuing the vital work of recording frequency assignments in the Master International Frequency Register (MIFR) results in frequencies and orbital positions being used in a rational, equitable, efficient and economic way.

The procedures for recording frequency assignments pertaining to space services are enshrined in the Radio Regulations. The question arises of whether, with existing procedures, ITU and the Radio

Regulations bring added value to administrations and the satellite community. More specifically, what mechanisms or strategies could be employed to ensure efficient use of the spectrum/orbit resource and to improve the current international system for managing satellite spectrum?

Conferences seek improvements

The need to improve satellite spectrum management has already exercised the minds of participants at the ITU Plenipotentiary Conferences in Antalya in 2006 and Guadalajara in 2010, as well as at the World Radiocommunication Conference held in Geneva in 2007 (WRC-07). In particular, WRC-07 invited administrations, satellite operators and industry to be forward-looking in seeking ways to improve the procedures governing access to orbits and frequencies in order to reflect the latest technologies (Resolution 86 (Rev. WRC-07)), as well as to develop concepts that enhance the Radio Regulations to meet the demands of current, emerging and future radio applications (Resolution 951 (Rev. WRC-07)). The Conference also invited the ITU Radiocommunication Sector (ITU–R) to carry out studies on procedures for the measurement and analysis of the application of the basic principles contained in Article 44 of the ITU Constitution (Resolution 80 (Rev. WRC-07)).

ITU workshops on the efficient use of the spectrum/orbit resource

To help respond to the challenges facing the satellite community in relation to the efficient use of the spectrum/orbit resource, the Radiocommunication Bureau (the Bureau) started discussing matters with interested parties. This began in 2008 when the Chairman of the EMC Symposium invited the Bureau to chair a one-day session on "Efficient use of spectrum/orbit by satellite systems" during the Symposium held that year in Wroclaw, Poland.

As a follow-up, the Bureau held a series of open workshops on the same topic. Each of these workshops attracted from 100 to 150 participants, including top-level representatives from administrations, satellite operators and industry, as well as others with an interest in the subject, such as ICT companies and different stakeholders. The discussions focused on practical regulatory approaches that could increase the accuracy and transparency of the MIFR and help in coordinating satellite networks. A workshop in Geneva on 6 May 2009 was followed by one in Singapore on 16 and 17 June 2010 at the invitation of the Infocomm Development Authority of Singapore. The Bureau then organized a panel debate on 15 September 2010 at the 20th international EMC Symposium in Wroclaw, and a one-day workshop in Almaty (Kazakhstan) during the International Seminar on Advanced Spectrum Management (12–16 September 2011).

Participants saw ITU's satellite recording process as the best example of the management of common international property to date. They also recognized that it was the only means in place today to ensure an interference-free and controlled environment for satellite operation. Participants in the workshops encouraged the Bureau to pursue its efforts to remove unused satellite frequency assignments from the MIFR and to continue to promote discussions on strategies to make the system more efficient. An obvious place to raise some of the ideas expressed during the workshops would be at the World Radiocommunication Conference to be held in Geneva from 23 January to 17 February 2012 (WRC-12), in the context of WRC-12 agenda item 7 dealing with Resolution 86 (Rev. WRC-07) and agenda item 8.1 on the Report of the Director of the Radiocommunication Bureau, particularly regarding the response to Resolution 80 (Rev. WRC-07).

Removing unused networks

Going from talk to action, ITU has taken a regulatory initiative to reduce the number of unused networks that clutter the spectrum/orbit and make entry difficult for newcomers. In

Satellite transfer to launch pad

ESA/M. Pedoussaut, 2011

Circular Letter CR/301 dated 1 May 2009, the Bureau requested all administrations to review the use of their recorded satellite networks, and to remove any unused frequency assignments and networks from the MIFR. In parallel, the Bureau used some provisions of the Radio Regulations (such as No. 13.6) to enforce the removal of unused frequency assignments from the MIFR where their use had not been suspended in accordance with the Radio Regulations. The Bureau's action along these lines has been pursued not only because some administrations identified cases to be examined, but also because the Bureau has attempted to verify the application of the relevant provisions of the Radio Regulations in some heavily used frequency bands.

The response has been fairly encouraging, and some administrations have requested the deletion of obsolete or unused entries from the MIFR. But these efforts by administrations to scrupulously and diligently apply the principles and provisions of the ITU Constitution, Convention and Radio Regulations do not appear to suffice. A survey undertaken by the Bureau in October 2009 compared the real occupancy of the geostationary orbit (GSO), based on reliable information available, with the GSO satellite networks recorded in the MIFR where the date of bringing into use had been confirmed by the responsible administration. There were still some possible discrepancies.

The Bureau has been carefully scrutinizing all the information available from external sources (GSO satellite databases, corporate websites and so on) as well as internal sources — Space Network Systems/Space Plans Systems/ and Space Network List (SNS/SPS and SNL) databases — and correspondence relating to confirmation of the bringing into use of satellite networks, No. 11.49 suspension, and Resolution 49 information). Concentrating its efforts on the most heavily used frequency bands, namely 3 400–4 800 MHz, 5 725–7 075 MHz, 10.70–13.25 GHz, 13.75–14.8 GHz, 17.3–20.2 GHz, 21.4–22 GHz, 24.75–25.25 GHz and 27–30 GHz, the Bureau identified around 325 satellite networks that might not correspond to any existing operating satellites.

There are, however, numerous factors and uncertainties to be considered. The Bureau does not have access to complete information, and some of its information may not fully correspond to reality. The Bureau therefore always requests clarification from the administrations involved.

By 1 January 2012, of the satellite networks investigated by the Bureau, the notifying administrations had provided clarifications and confirmed regular use for 142 satellite networks. In 21 of those cases, the notifying administration referred to Article 48 of the ITU Constitution, which allows Member States to "retain their entire freedom with regard to military installations", but also requires that "when these installations take part … in services governed by the Administrative Regulations, they must, in general, comply with the regulatory provisions for the conduct of such services". For 26 of the satellite networks investigated, the notifying administrations had provided clarifications and requested the application of No. 11.49 of the Radio Regulations. A total of 145 of the networks investigated had been suppressed either at the request of the administrations concerned or by the Bureau in the absence of information on the bringing into use and continuity of operation of the networks (more than 45 per cent of the investigated satellite networks!). Clarification is still pending for 12 satellite networks.

In its efforts to remove unused frequency assignments from the MIFR, the Bureau encountered difficulties in the application of the Radio Regulations, in particular No. 13.6 and various associated provisions contained in articles, appendices and resolutions. Some of these difficulties are outlined below.

What do "bringing into use" and "bringing into regular operation" really mean?

The concept of "bringing into use" originally seemed self-evident. Nowadays, the multiplicity of possible scenarios for bringing a satellite network filing into use (by launching a new satellite, by moving an existing satellite from one position to another, or by using a different satellite as a temporary stopgap), coupled with the persisting cases of fictitious frequency assignments recorded in the MIFR but not actually in operation, have made the need for a clearer understanding of the concept acute.

Also, there is no definition of the concept of "bringing into regular operation" in the Radio Regulations, and many of the current controversies related to satellite network filings are linked with this concept. In the early days of satellite network filings, the Bureau's application of provisions regarding bringing into regular operation was uncontroversial. Now, however, with the growing difficulties that administrations face in obtaining suitable new GSO positions and frequencies, the lack of a definition is causing problems.

In the context of defining "bringing into use" and "bringing into regular operation", the discussions during the workshops focused on the following questions. What should be on board a satellite at the time of confirmation of its bringing into use? What amount of the recorded frequency assignments should be in use? To what extent should the technical characteristics of the satellite in operation match the characteristics of the filed satellite network? How long should a satellite network be in use for a recorded assignment to be considered as being in regular operation?

Over the past two years, when examining the conformity of satellite networks with No. 11.44 and No. 11.47 of the Radio Regulations, the Bureau has looked for information available from external sources (for example, GSO satellite databases, Satellite Technical User Guide, and corporate websites) on the operating satellites, along with any available elements of information indicating the existence of payload in the frequency ranges of interest, in order to substantiate claims that a satellite network has been brought into regular operation. Whenever clarifications have been needed, the Bureau has contacted the notifying administration concerned and, based on the response, taken further action accordingly.

The Bureau now considers that, for operation to be qualified as "regular", a satellite should be present and operating at an orbital location for a minimum of three months. The Bureau nevertheless recognizes that the way it is applying the concept of "bringing into regular operation" is not explicitly specified in the Radio Regulations as they stand. The Bureau also recognizes that the duration of operation is not the only factor to be considered.

Vega VV01 ready to carry satellites into orbit

ESA/J. Huart, 2012

It may prove difficult to draw up satisfactory regulatory texts to clarify the application of provisions that refer to "bringing into use " or "bringing into regular operation", particularly as regards the type of information to be provided and the reliability of such information. But an ITU-agreed understanding is needed to ensure a clear and stable regulatory framework.

Should the Radiocommunication Bureau verify the reliability of information?

The role of the Bureau is to receive information on satellite networks from notifying administrations, and then to identify any inconsistencies in that information. If there are inconsistencies, the Bureau then requests clarification from the notifying administration concerned. ITU does not at present have the tools either to corroborate or to invalidate the factual information submitted by administrations.

Provision No. 13.6 of the Radio Regulations indicates possible actions that the Bureau can take within the framework of maintenance of the MIFR "whenever it appears from reliable information available that a recorded assignment has not been brought into regular operation". Because all formal information regarding the status of a frequency assignment is provided by the notifying administration of that assignment, the Bureau may find itself in the uncomfortable position of having to challenge such information.

Administrations and satellite operators have welcomed the Bureau's proactive approach under No. 13.6 of the Radio Regulations to question information on the operation of satellite networks whenever doubts exist about such operation. Indeed, administrations and satellite operators have encouraged the Bureau to pursue its actions along these lines. Given that the current role of the Bureau is to enforce — but not necessarily to investigate — the application of the Radio Regulations, WRC-12 may wish to consider mandating the Bureau to continue performing systematic, regular reviews of the MIFR with the aim of removing fictitious recorded frequency assignments. The Bureau would do this in addition to performing ad hoc case-by-case investigations at the request of administrations, as it does at present. Such a mandate would increase the efficiency of the process.

The reliability of information is obviously a crucial factor in the Bureau's processing of satellite network filings. If administrations provide accurate data, the process will be more efficient.

Could due diligence requirements narrow the gap between information and reality?

The information provided under Resolution 49 is intended to demonstrate administrative due diligence, in plain words a certain degree of reality behind a satellite network filing. Administrations are supposed to provide information before the satellite is launched and before the satellite network begins to operate. In fact, the information to be submitted refers to a contractual delivery window for the spacecraft manufacturer and a launch or in-orbit delivery window for the launch service provider. There is no provision today in Resolution 49 to compel administrations to update their due diligence information. Such an update might be provided, for example, post-launch to confirm the information already provided, or after a change of spacecraft to support frequency assignments already recorded, or when use of a satellite network is resumed following a suspension.

Possible improvements to Resolution 49 might include the requirement to submit due diligence information within a certain number of days following both the bringing into use and the resumption of operation of frequency assignments to a satellite network. This would make it easier to match up real satellites (and, where applicable, their launch dates) with the orbital location brought into use. Another possible improvement would be a formal requirement to renew the information whenever changes occur. This requirement would also need to be linked with suspension under No. 11.49 of the Radio Regulations.

At a very basic level, the Bureau has difficulty in identifying satellites from Resolution 49 information. This means that the Bureau cannot track a satellite already filed under Resolution 49, in order to avoid the same satellite being recorded as operational at several orbital locations simultaneously. One possible way to increase transparency in this context would be to give a specific ITU identification code to each satellite.

Along the same lines, in order to give the Bureau a better understanding of the satellite in place, more accurate information (including, for example, payload diagrams) might also be provided on the actual coverage, power capabilities and transponder frequency plans. This information could be required either under an extended version of Resolution 49 or as part of the notification information required under Article 11 of the Radio Regulations, or via both Resolution 49 and Article 11. The extra information could be provided along with the confirmation of bringing into use of the frequency assignments.

How did a fix become a fixture?

In an ideal world, new satellite networks would be fully coordinated with existing networks before being put into operation. The reality is, of course, less than perfect, and No. 11.41 of the Radio Regulations provides some flexibility for a satellite network to be notified and recorded without completing all required coordination. To some extent, therefore, No. 11.41 precludes "virtual satellites" (that exist only on paper) from blocking the recording of real new networks. This provision became even more important when the World Radiocommunication Conference in 2000 adopted No. 11.44.1, which introduced a deadline for submitting to the Bureau the first notice for the recording of satellite network assignments.

But what started out as a fix has now become mainstream. The MIFR shows that more than 80 per cent of satellite networks so far submitted for notification purposes will finally be recorded with a reference to No. 11.41 (missing coordination agreements).

The trend of recording satellite networks under No. 11.41 will result in a burden for administrations. The number of reported interference cases between such networks that are supposed to be in operation is surprisingly low. This may indicate that the characteristics used during the coordination of such networks are

Two in-orbit validation satellites are protected during their launch by a launch fairing. Once the launch vehicule has passed most of the way through the atmosphere, this fairing can then be ejected

ESA/P. Carril, 2011

more interference "aggressive" or "sensitive" than those actually used in operation. This, in turn, makes coordination between administrations unnecessarily difficult.

There is general agreement that provision No. 11.41 is necessary for the ITU recording procedure because it allows for coordination to continue beyond the regulatory deadline. But use of No. 11.41 presents the drawback of there being numerous missing coordination agreements. Are there any means to compel administrations to coordinate, in order to avoid misuse of No. 11.41? An administrative means of enforcement, for example by requiring the holding of coordination meetings, would be counterproductive and burdensome both for administrations and for the Bureau. A more effective approach would be to facilitate the completion of coordination.

One way of making it easier for administrations to coordinate would be to combat the practice of setting overly aggressive or sensitive parameters, which block coordination. Administrations could be encouraged to file satellite network characteristics that are more reasonable, and that better fit the required quality for the normal operation and delivery of expected services (even allowing for a flexibility factor to take account of forecast use). It would certainly help with coordination if administrations reviewed or deleted the existing unrealistically aggressive assignments recorded in the MIFR. Criteria for self-compatibility of a submitted satellite network (for example, in terms of orbital separation) might also help in facilitating coordination and warrant further study by the competent ITU–R study groups.

Another approach to resolving the problem would be to limit coordination requirements to genuine cases. By removing obsolete filings, reviewing current trigger values in order to shorten the coordination arc, preventing networks outside the arc from entering into coordination, and introducing coordination power flux-density limits, for example, it would be possible to avoid unnecessary coordination.

Finally, the Bureau could delete coordination data for which notification has been already filed. In fact, the Bureau intends to initiate that action during 2012.

Space monitoring

More administrations and satellite operators are establishing monitoring stations, and are expressing the wish that such facilities be used within the international monitoring system (in accordance with Article 16 of the Radio Regulations).

The primary goal of such systems is to assist administrations in the prompt elimination of harmful interference. But beyond that, WRC-12 may also wish to consider the possible use of the international monitoring system to ensure that the international regulatory framework is being properly applied. This idea was considered by WRC-97 under its Recommendation 36 on the role of international monitoring in reducing apparent congestion in the use of orbit and spectrum resources. WRC-12 might consider giving the Bureau authority for space monitoring, comparable to the authority already given to the Bureau for terrestrial monitoring. Collection and dissemination of information might be based on Recommendation ITU–R SM.1267 on the "Collection and Publication of Monitoring Data to Assist Frequency Assignment for Geostationary Satellite Systems".

Spectrum pricing

Economic theory and experience worldwide suggest that spectrum/orbit management for satellite systems could be improved by using economic methods to supplement the existing technical and regulatory approaches. The aim would be to make more efficient use of a limited common resource, not to secure financial gain for ITU or anyone else. One possibility would be to offer administrative incentives by introducing spectrum pricing.

Economic theory and experience worldwide suggest that spectrum/orbit management for satellite systems could be improved by using economic methods to supplement the existing technical and regulatory approaches. The aim would be to make more efficient use of a limited common resource, not to secure financial gain for ITU or anyone else. One possibility would be to offer administrative incentives by introducing spectrum pricing.

Yvon Henri, Chief of the ITU Space Services Department

The price of spectrum could be determined on the basis of the volume of spectrum used and the value of a unit of resource. For communication satellite systems, the effective volume of the resource used could be determined by means of technical coefficients characterizing each individual system in terms of its potential for causing and suffering interference. Obviously, technical and economic studies would be needed, and they could be entrusted to ITU–R study groups. The revision of Report ITU–R SM.2012-2 on economic aspects of spectrum management might provide some guidance in this respect.

Will WRC-12 meet these challenges?

The outcome of WRC-12 lies in the future and is unknown. Given the possibilities outlined in this article, however, there seems to be a real opportunity to make the use of the spectrum/orbit resource more efficient. With a concerted effort, we can surely reduce or even remove the obstacles that impede the development and bringing into operation of new satellite networks.

Broadcasting

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Radio spectrum needs for changing lives

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Christoph Dosch

ITU/V. Martin

David Wood

Administrations throughout the world need to decide how to use radio spectrum so that the public will be best served. In particular, they need to consider the future use of the frequency bands currently used for analogue television broadcasting, after television broadcasting goes digital.

Should we seek the best solutions for the short term? Or should we look to the long term? How important is "green" efficiency? How important are interoperability and flexibility? These and other dimensions need to be carefully weighed.

Broadcasts, the Internet, and telephony are all important to people. National broadcasts in particular help define national identity, enhance social cohesion, and are a gateway to knowledge, information and entertainment. Our lives today are unimaginable without both broadcasting and the Internet. And in future we may see hybrid broadcasting, bringing together broadcast and Internet services on the same television set. What is the most cost-effective way to provide these services, given the evolution of technology and the spectrum available?

Digital terrestrial broadcasting versus mobile broadband

The top candidate for the spectrum used today for analogue terrestrial broadcasting is digital terrestrial broadcasting. In 2006, ITU developed the Geneva 2006 (GE-06) Agreement for planning the digital terrestrial broadcasting service in parts of Regions 1 (Africa and Europe) and 3 (Asia and Australasia), in the frequency bands 174–230 MHz and 470–862 MHz. Under this agreement, all of the frequency bands used for analogue television broadcasting would be used for digital television broadcasting containers (multiplexes).

The 2007 World Radiocommunication Conference (WRC-07) made an allocation in the upper part of the UHF broadcast

Getty Images/Bloomberg

band for the mobile service, to accommodate international mobile telecommunications (IMT) in Region 1 in the range 790 to 862 MHz, to take effect at the time of the transition to digital. Little information was available on how to share IMT with the broadcasting service, and the ITU Radiocommunication Sector (ITU–R) was charged with studying this. These studies were carried out by the Joint Task Group 5–6, whose report will be considered by WRC-12 under agenda item 1.17.

Under discussion now is whether IMT services should extend further into the former analogue broadcast bands. As explained, the broadcast band 790–862 MHz is already planned for IMT in some countries of Europe. This so-called 800 MHz band is earmarked in Europe for the mobile service, specifically for IMT, after the digital switchover. Should we use more of our broadcast spectrum for IMT in future?

A case being made for increasing the bands for wireless broadband is that it would bring Internet services to rural areas, where the cost of wired Internet services per user would be high. Technology that could help achieve this efficiently is being developed and tested. It might be possible to introduce such services in the current analogue broadcast bands without disturbing digital broadcasting by using the so-called white spaces. This would be a win-win situation both for broadcasting and for the additional services, provided agreed compatibility rules are observed.

In some countries, for example Germany, where the switchover from analogue to digital television had already taken place, planning for IMT in the form of the "older" long-term evolution (LTE) system in the band 790–862 MHz has started.

This allocation is set for use by IMT, but the Joint Task Group 5–6 has not yet considered all cases of interference, so some problems remain unresolved, in particular:

- The LTE uplink affects the broadcasting service below 790 MHz; LTE handsets operating near a television receiver can block television reception;
- Because of the small guard band (of 1 MHz) between the broadcasting and the mobile services (from 790 MHz to

791 MHz), there are no adequate, economically viable filters to provide sufficient attenuation of out-of-band emissions of mobile service IMT signals, so channel 60 cannot be used for mobile television services, if at all.

- Strong LTE downlink signals in the vicinity of a mobile service IMT base station may cause a severe degradation of the television picture quality in areas where the DVB-T signal is relatively weak in comparison to the LTE signal.
- There are thousands of licence-exempt wireless microphones in the hands of the public that operate in the range 790–862 MHz on a secondary (that is, non-interfering) basis, and that now need to be relocated in other frequency bands. The proposed relocation of these wireless microphones to frequencies below 790 MHz is problematic as this band is already used for professional applications ancillary to broadcast production — the so-called programme-making special event systems — that also operate on a secondary basis.

Criteria for a complex choice

Radio spectrum is a resource that belongs to nations, so what is in the interests of the public at large? Should we try to provide the greatest choice for the public, the highest transmission efficiency, the highest quality, or the lowest cost? Should we provide the most valued services to the largest number of people?

Should we consider the long-term interests of the industry and the nation? If so, we will need to understand the likely growth in demand and to anticipate the evolution of technology.

Another criterion could be to minimize the environmental load associated with making and delivering services. This would involve assessing the total end-to-end energy consumption associated with various options, and choosing systems with the highest green efficiency.

The need for terrestrial television broadcasting

In Europe, people on average watch standard-definition television broadcasts for more than four hours per day, and viewing time is increasing annually.

Although television broadcasting can be provided by satellites or cable, and they serve the public well, terrestrial broadcasting is important for most countries of the world. In the European Union, 50 per cent of households rely on terrestrial broadcasting. Among the many reasons for this are:

- convenience for viewers, with reception possible on fixed, portable or handheld receivers;
- facility for adjusting services to local needs and coverage;
- ease of rectifying breakdowns (the repair team cannot go to a satellite);
- national control of distribution infrastructure;
- often the only accessible medium in national emergencies;
- for many consumers, the most cost-effective way of receiving television.

Factors affecting spectrum needs

One of the factors affecting the amount of spectrum a service needs is the technical quality it offers. Digital technology allows for a range of television picture qualities, so programme providers can choose how technically attractive to make their programmes. Other things being equal, the higher the sound or picture quality, the longer the time the viewer will watch (or listen to) a given programme. The choice of picture quality also affects the cost of providing the service, and the number of different programmes that can be accommodated in a given spectrum space.

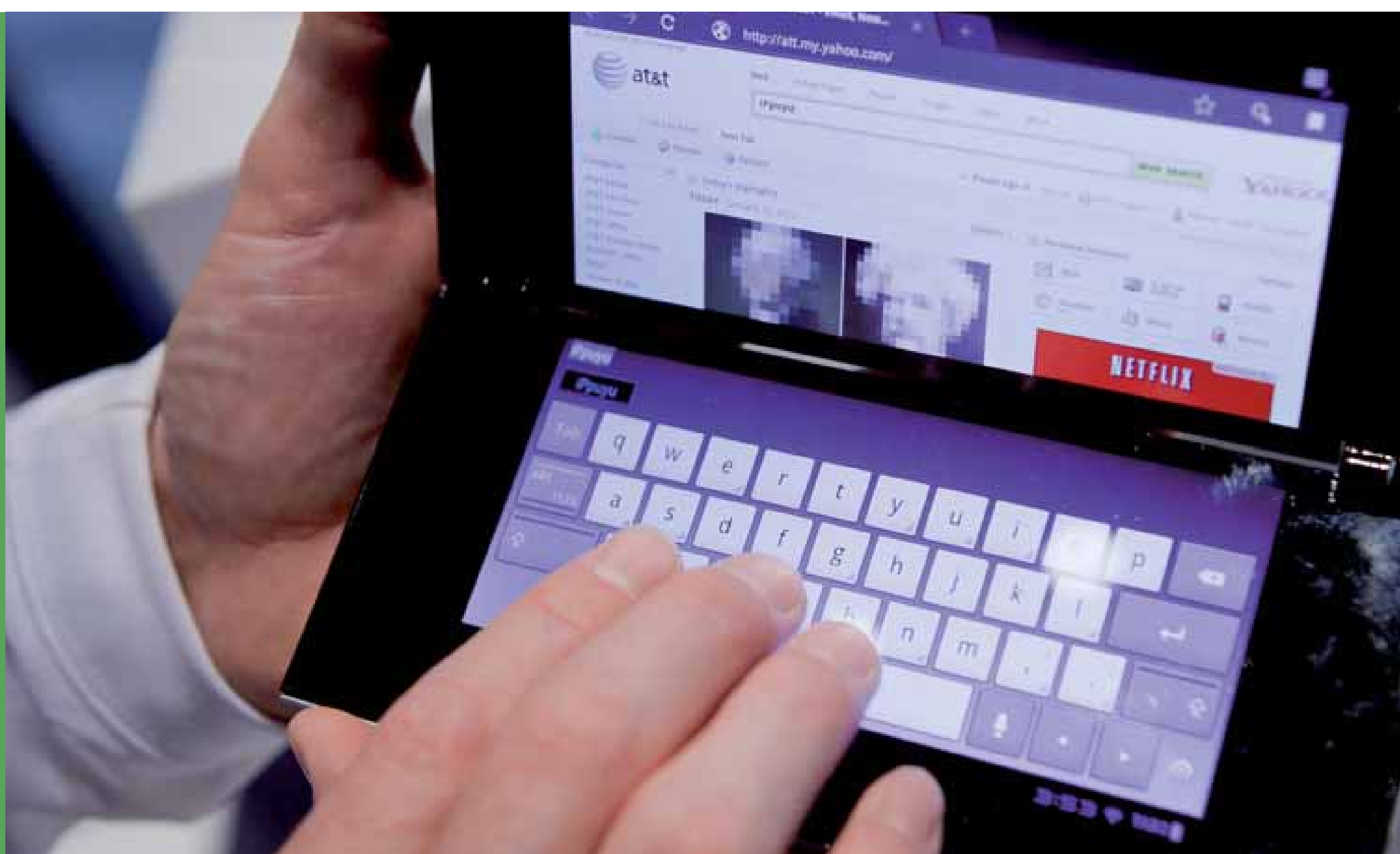
Another of the major factors affecting the amount of spectrum a service needs is the quality efficiency of the transmission system. This is the technical quality delivered relative to the bit rate needed to do so. Quality efficiency is affected by the combination of modulation and compression technology used. It is improving with time, and this can be taken advantage of when new systems are introduced.

Quality efficiency is an important factor in understanding the difference between delivering media by broadcasting, by Internet or by combined systems. Multi-purpose systems with modes allowing for broadcasting or wireless broadband could be developed but — like a vehicle designed for both land and sea — would be more complex technically and less efficient than systems developed for a single mode of use.

Television broadcasting today uses the radio spectrum in three bands. Digital mobile phones have traditionally used radio frequency bands above those used for broadcasting. The advanced forms of digital mobile phone networks — the 3G systems that can provide Internet — have also used frequency bands above the broadcast bands.

Different frequency bands have different advantages and disadvantages. The lower the frequency band, the larger the receiving antenna needed, and the lower the capacity available for transmission. But the lower the frequency band, the fewer the number of transmitters needed to cover a given area and the more easily the signals will pass through the walls of buildings.

Higher bands (above those used today for broadcasting) offer higher capacity and smaller antenna, and are thus very suitable for services via handheld devices with high-capacity broadband Internet. Higher bands offer greater isolation to other broadband



Getty Images/Bloomberg

Internet cells and therefore increase transmission efficiency. Lower bands, such as those used formerly for analogue broadcasting, are particularly suitable for digital broadcasting or for low-capacity ("second class") Internet.

In broadcasting, the service area is independent of the number of receivers that are switched on, and so is the service quality. Television service areas can thus be large (up to 100 km in diameter), and are ideal for services to large populations. In contrast, mobile Internet services can only accommodate a certain number of users simultaneously. Service areas are small — often limited in cities to a few hundred metres, to cope with high traffic demand. Quality of service is not guaranteed but is provided on the basis of "best effort".

Consumer demand for digital television

Digital technology allows for greater flexibility and larger numbers of television channels in the same spectrum space. It also provides a route to services which offer a better and richer viewing experience.

Broadcasting needs growth potential. Over the next 40 years, a series of quality steps will take television from standard definition to high definition, then on to three-dimensional, ultra high definition and object wave television. If television broadcasting does not follow the available technology it will eventually be spurned by the public — as the public would today spurn the dim black and white television pictures of the past. A service that is not allowed to evolve is sentenced to die.

The higher spectrum efficiency of digital transmissions provides the basis for this growth potential — provided there is adequate spectrum. Digital modulation and compression technology are evolving over time. Coupled with the evolution in chip density (Moore's law) in consumer electronics, this makes possible systems that have greater capacity and can offer a better experience to the viewer.

Consumer demand for Internet capacity

In the developed world there has been spectacular growth in consumer demand for Internet capacity (bit rate). The capacity delivered to Internet users has risen more than 20-fold in 15 years. Domestic demand in the developed world is predicted to rise to 100 Mbit/s per user in the next 20 years. Demand in the developing world will follow suit.

Over the past ten years, the trend in the developed world has been to ever higher quality multimedia on Internet as a source of entertainment. This has meant not just the demand for higher bit rates, but also for prolonged usage times. Demand for many hours of use per day, with peak usage times, looks likely to emerge as the pattern in countries where it can be achieved.

As an example, if a future Internet service carries an entertainment service, it will need to be able to deliver bit rates of 8–12 Mbit/s simultaneously and independently to the national population between 7 p.m. and 10 p.m. each day. Technically, this kind of service cannot be provided by wireless broadband in the broadcasting bands, however much of the current analogue television broadcast bands are given over to carrying that amount of data. Delivery by means such as optical fibre or higher bands will be required. Wireless broadband in the current broadcast bands will be limited to providing second class Internet services that will probably not have a long-term future.

Performance of broadcasting versus Internet

Internet has the advantage of direct interaction with the user and the potential for a greater degree of personalization. But delivery capacity is limited by the available infrastructure, and there is a financial cost for each additional user. Also, Internet reception is not anonymous, in that the State or service provider is able to track its use.

H. Inuzuka

Broadcasting has inexhaustible capacity and zero marginal cost with respect to the number of simultaneous users. The number of users who take up a broadcast can be infinite in a given service area, and there is no cost for an additional user. And broadcast reception is anonymous (at least for free-to-air emissions).

Multi-purpose systems that offer both broadcast and Internet

Wireless Internet delivery systems can have broadcast modes, but those developed to date are less efficient than systems developed specifically for digital broadcasting. No mobile network operator has yet introduced such a system.

Possibly for commercial reasons, the mobile telephone community has been unwilling to work with digital broadcasters to develop an efficient single receiver system that allows reception of both wireless broadband and digital broadcasting.

Environmental load of broadcast and Internet

Studies by the British Broadcasting Corporation confirm that the environmental load associated with broadcast and wireless broadband depends on the number of users. For services where there are a large number of users for the same content, broadcasting is the more environmentally friendly mode of delivery. Only for services with a very small number of users is wireless broadband more environmentally friendly.

Options for wireless broadband delivery

Wireless broadband services could be provided by selling allocations of spectrum space to wireless broadband operators to use "older" systems such as LTE, which may be inefficient.

With a newer approach — cognitive radio or white space devices — the broadcast allocations could remain. A network operator providing a wireless broadband service would calculate on which frequencies such services could be transmitted, at any given time, without interfering with broadcast services.

Ultra-high definition television

AFP

The old and new approaches can be compared in terms of a car park. The old approach — where network operators are given continuous allocations of channels for wireless broadband — is to pre-assign all the parking spaces, whether there are any cars there or not. The new approach — where network operators apply cognitive radio for wireless broadband — is to look around the car park to see where the spaces are and take them up as needed. Such a system, if proven, could make much more efficient use of the public's radio spectrum.

The national and public interests

Broadcasters hope that all necessary studies will be completed before another part of the UHF broadcasting spectrum is considered for allocation to the mobile service. If WRC-12 does include, under its agenda item 8.2, potential allocations for consideration by a future WRC, ITU–R must be tasked to carry out and complete these studies, which should include capacity considerations, service concepts and, especially, the complete compatibility considerations with the existing broadcasting service (and the secondary usage of the band).

People will certainly need all three kinds of service in the years ahead: broadcast, broadband, and digital telephony. The national interest is to arrange spectrum use so that it is proportional to the benefits and needs of each kind of service. The public interest is to achieve Internet for everyone — with a capacity that will take account of future demands — without jeopardizing the future of terrestrial broadcasting. To meet future capacity demands in a sustainable way, the provision of fixed fibre-lines to off-load data traffic from mobile networks seems inevitable. The most efficient technology for wireless broadband, where needed, is likely to be cognitive radio.

The case for extending wireless broadband further into the current broadcast bands appears to be based more on short-term profit than on long-term public interest. It does not take into account the quality evolution of television, the increasing public demand for Internet data capacity, or the latest thinking in wireless broadband delivery technology.

Digital dividend

Getty Images/Bloomberg

Exploiting the benefits of UHF spectrum — what future allocations are needed?

Mobile broadband and terrestrial television jostle for spectrum

One of the most prominent changes to spectrum allocation worldwide in recent years has been the addition of mobile allocations to parts of UHF bands IV and V. This decision, taken at the World Radiocommunication Conference in 2007 (WRC-07), allocates the 698–862 MHz band in most of the Americas and Asia, and 790–862 MHz in most of Europe and Africa, to mobile services on a co-primary basis with terrestrial television.

The decision to introduce these new allocations was prompted by the switchover from analogue to digital terrestrial television broadcasting, and a recognition that the "digital dividend" frequencies released by the switchover are highly valuable for use by a variety of services, including mobile broadband networks and a range of other applications (for example, public safety communications, programme making and additional television programming). The new allocations therefore provide flexibility for countries to allocate digital dividend frequencies to mobile services, based upon market demand.

* *This article was written by Analysys Mason, a consultancy and research firm with a focus on telecommunications, media and technology.*

AFP/Image Source

At the time the decision was made at WRC-07 to allocate parts of the UHF spectrum for mobile services, the process of switching from analogue to digital terrestrial television transmission was well under way in many countries, and had been completed in some. The WRC-07 decision prompted government action in many countries around the world to re-farm UHF frequencies (previously planned for digital terrestrial television use) for mobile services.

While this action resulted in additional costs for the replanning of spectrum for digital terrestrial television networks, the underlying rationale is that the benefits of making spectrum below 1 GHz available for use by mobile broadband services would outweigh the cost of replanning digital terrestrial television networks; that is, a change in the use of the identified frequencies would provide a net benefit to the national economy. The existence and amount of this net benefit will vary from country to country, depending on national market conditions, with the key variables being the relative importance of digital terrestrial television in the broadcast market of each individual country relative to other viewing platforms, and the demand, competition and pricing that exists within the mobile sector, as well as the need for additional frequencies either to accommodate growth in existing networks or to enable new networks to be rolled out.

Since WRC-07, the UHF band has been the focus of an intense harmonization effort around the world, to enable it to be used for mobile services. Its value for mobile use (and the reason it has received so much attention) is because UHF spectrum has one particular characteristic that makes it far more valuable than spectrum above 1 GHz: it propagates well over long distances and through barriers, and so provides better rural and deep indoor coverage.

As a result of this harmonization effort, a number of national regulators in Asia and the Americas have now allocated licences to use 698–806 MHz ("the 700 MHz band") for mobile broadband services, and regulators in Europe and Africa are also allocating 790–862 MHz spectrum ("the 800 MHz band") for mobile broadband use. As a result, mobile broadband devices that use the 700 MHz or 800 MHz bands are becoming widely available, although with marked differences in terms of the availability by region. Commercial services have been launched in a number of countries, and many more are expected to follow over the next year or two.

Since WRC-07, the telecommunications industry has moved on remarkably, with superfast broadband connectivity (providing speeds of 30 Mbit/s or more) now high on government agendas worldwide. A new wave of mobile services are now being delivered over a vastly improved range of devices, including advanced smartphones and tablet computers, and this is driving growth in mobile data traffic. Furthermore, government targets set in a number of countries to bring new superfast broadband services into widespread use have highlighted the fact that fibre broadband services will not be available in all regions, and that wireless services — including mobile broadband and satellite — will be increasingly important in delivering universal broadband service. A combination of these factors is creating demand in some countries for national regulators to release further spectrum for mobile services, in addition to spectrum that was made available as a result of the WRC-07 decision.

Accordingly, the need to identify additional spectrum for mobile services is high on the agenda for many governments. Estimates from some countries (including Australia, the United Kingdom and the United States) are that around 500 MHz of additional spectrum might be needed over the next ten years to accommodate anticipated demand for spectrum for wireless and mobile broadband services. This additional demand is both to accommodate the peak mobile data traffic being carried by mobile networks in some environments, and to provide improved network coverage and quality. This suggests that a combination of additional high (above 1 GHz) and low (below 1 GHz) frequencies will be needed to accommodate demand, depending on the particular network and user environments.

Given that spectrum is a finite resource, identification of this additional spectrum will inevitably involve re-farming of frequencies already occupied by other services, which will be difficult and costly to achieve. Re-farming of spectrum that is currently reserved for government use is one option that is being considered in some countries. Another option could be a second digital dividend — a further release of UHF spectrum for mobile use. With political debate on the balance of use of UHF spectrum already under way in some countries, it is expected that a future WRC (perhaps WRC-15) might be required to make further changes to spectrum allocations in the UHF band. Different stakeholders — notably the mobile sector and the broadcasting sector — have diverse views on the appropriate balance of spectrum between mobile and broadcasting in the UHF band, despite general agreement that mobile broadband services will grow significantly, and will also converge with the broadcasting sector by facilitating media services on the move.

From a mobile perspective

From a mobile perspective, a second digital dividend could provide further access to valuable frequencies below 1 GHz, which would have numerous benefits, such as increasing the speed, capacity and coverage of mobile broadband, enabling worldwide roaming, or potentially providing new harmonized mobile spectrum to accommodate the needs of specialist users such as public safety services. A second digital dividend could also help to align frequency bands released from the first digital dividend across different regions of the world, since the decision of WRC-07 placed new mobile allocations from the first dividend in different parts of the UHF band (790–862 MHz in Europe and Africa, 698–806 MHz in Asia and the Americas). Therefore, the creation of a second digital dividend in Europe and Africa, in the 700 MHz band, offers the prospect of alignment with other world regions.

However, offset against these benefits is the fact that there are already many non-UHF frequencies available for use by mobile network operators. In particular, the 2.5 GHz band (identified for IMT systems at WRC-2000) provides ideal capacity to accommodate the highest peaks of mobile broadband traffic demand anticipated in dense urban areas. The use of UHF spectrum, by contrast, is particularly suited to areas outside of dense urban environments, where peak traffic loads do not typically occur.

AFP

Demand for mobile spectrum is particularly high in countries where the use of mobile broadband has grown rapidly in the past few years. Worldwide, it has been estimated that mobile traffic volumes in 2010 were seven times higher than those previously forecast in 2005, in preparation for WRC-07, in ITU–R Report M.2072, *World mobile telecoms market forecast**. Both the volume and composition of mobile traffic have evolved considerably compared to industry expectations when ITU prepared M.2072. Despite regional variations, industry analysts are in broad agreement that global mobile traffic will continue to grow strongly, as a result of the combination of rising device penetration in emerging regions and take-up of secondary devices in developed regions. This growth represents a challenge for operators, who will need to adapt their existing networks to meet the new capacity requirements.

It should be noted, however, that one of the drivers of demand for mobile services is the availability of new devices such as smartphones and tablet computers, which consumers increasingly use to access a range of applications — including media — in the home. Video applications are widely expected to be one of the main content types consumed on devices connected to mobile networks, as illustrated in Figure 1. But within the home environment, where many of these applications are often used, there are typically alternative connection types (such as Wi-Fi), so the traffic generated by mobile applications in the home is not always carried over the mobile operator's network.

It should also be noted that various market supply-side factors influence how users access mobile data services, including the affordability of mobile data services, and bundling of services. There are various techniques that can be used within mobile networks both to increase the efficiency of accommodating mobile data traffic and to reduce the cost of its carriage (the cost per bit). These include small cells (such as femtocells), adaptive antenna systems, video compression and optimization.

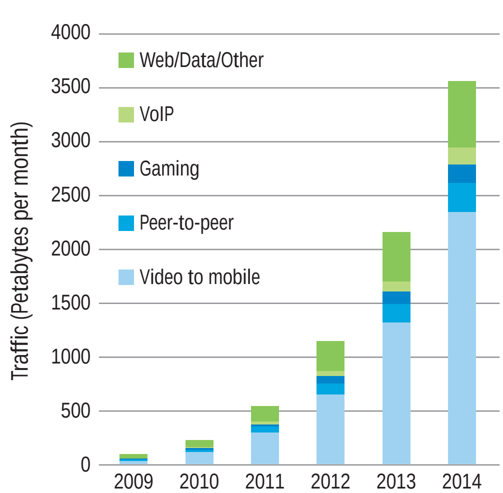
* *The estimated ten-fold increase is based on a white paper published by the GSM Association, http://www.gsmamobilebroadband.com/spectrum/*

Taken together, this suggests that there will be significant regional and national variations in the need for additional spectrum for mobile services, primarily depending on: how demand for different mobile data services varies according to price and operator pricing policies; the cost that mobile operators incur to meet future traffic demand; and the availability of alternative solutions to reduce cost (such as offloading onto Wi-Fi).

From a broadcasting perspective

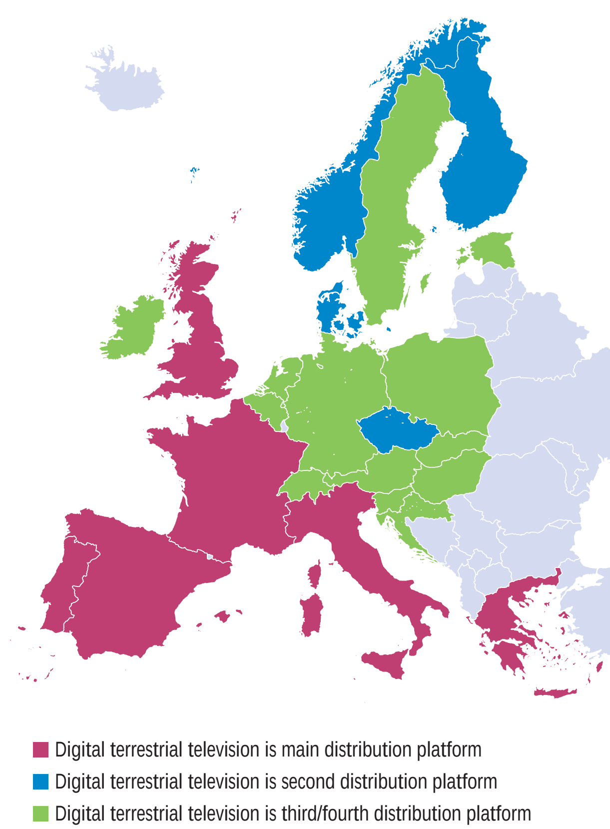
From a broadcasting perspective, a second digital dividend will be particularly problematic for digital terrestrial television channels, platforms and transmission/network providers, and in some cases may be costly to implement (if it is feasible at all). This is because many digital terrestrial television systems have already been replanned once to make way for the first dividend, and although there are options to improve the capacity of digital terrestrial television networks — such as the use of MPEG-4 coding and migration from DVB-T to DVB-T2 (the newer generation of digital terrestrial television technology) — access to UHF spectrum is still essential in maintaining existing digital terrestrial television networks and enabling services to expand (for example, by creating more multiplexes to carry additional digital channels).

Figure 1 — Mobile data traffic, by application



Source: Cisco

Figure 2 — Position of the digital terrestrial television platform in selected European countries



Source: Ofcom, EAO and national regulators

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A second digital dividend would be particularly problematic in countries where terrestrial television is the most important television distribution platform. Despite the availability of other platforms, terrestrial television remains a key platform for delivery of media services in many countries in Europe and the Americas, and in some countries there is evidence of demand for additional digital terrestrial television services to accommodate a growing number of national and local programmes and to exploit the availability of new technologies such as high-definition television and converged devices (including connected televisions that enable viewing via both digital terrestrial television and broadband networks). Digital terrestrial television is the key delivery platform for television in many European countries (see Figure 2), as well as in countries such as Brazil and Mexico (the two most populous countries in the Americas after the United States). In those countries, deployment of a wider range of digital terrestrial television services could require additional spectrum to be used.

It should also be noted that ancillary broadcasting services (often referred to as programme making and special events, or PMSE) currently make use of frequency gaps between UHF channels allocated for digital terrestrial television in many countries, by coordinating their transmissions with those of the television networks. Therefore, any replanning of UHF frequencies will affect the future availability of spectrum for those services, which include wireless microphones and other applications used in theatres, sporting events and media events.

There are a limited number of other frequencies that could be used by terrestrial broadcasting systems — VHF band III being the main alternative. It is not clear what alternative frequencies exist for use by PMSE. Although some countries have decided to use spectrum in VHF band III for the provision of additional digital terrestrial television services, others either already use VHF band III or plan to use it for other broadcasting services (such as digital radio), and so it is unavailable for digital terrestrial television (unless allocations to digital radio were to be reconsidered, and the spectrum reallocated to digital terrestrial television).

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In contrast, television viewing using terrestrial platforms is relatively limited in some regions, particularly the United States, and some countries in Europe and the Middle East. Also, there are many countries in both the Middle East and Africa where analogue broadcasting switch-off may not occur for another five or more years.

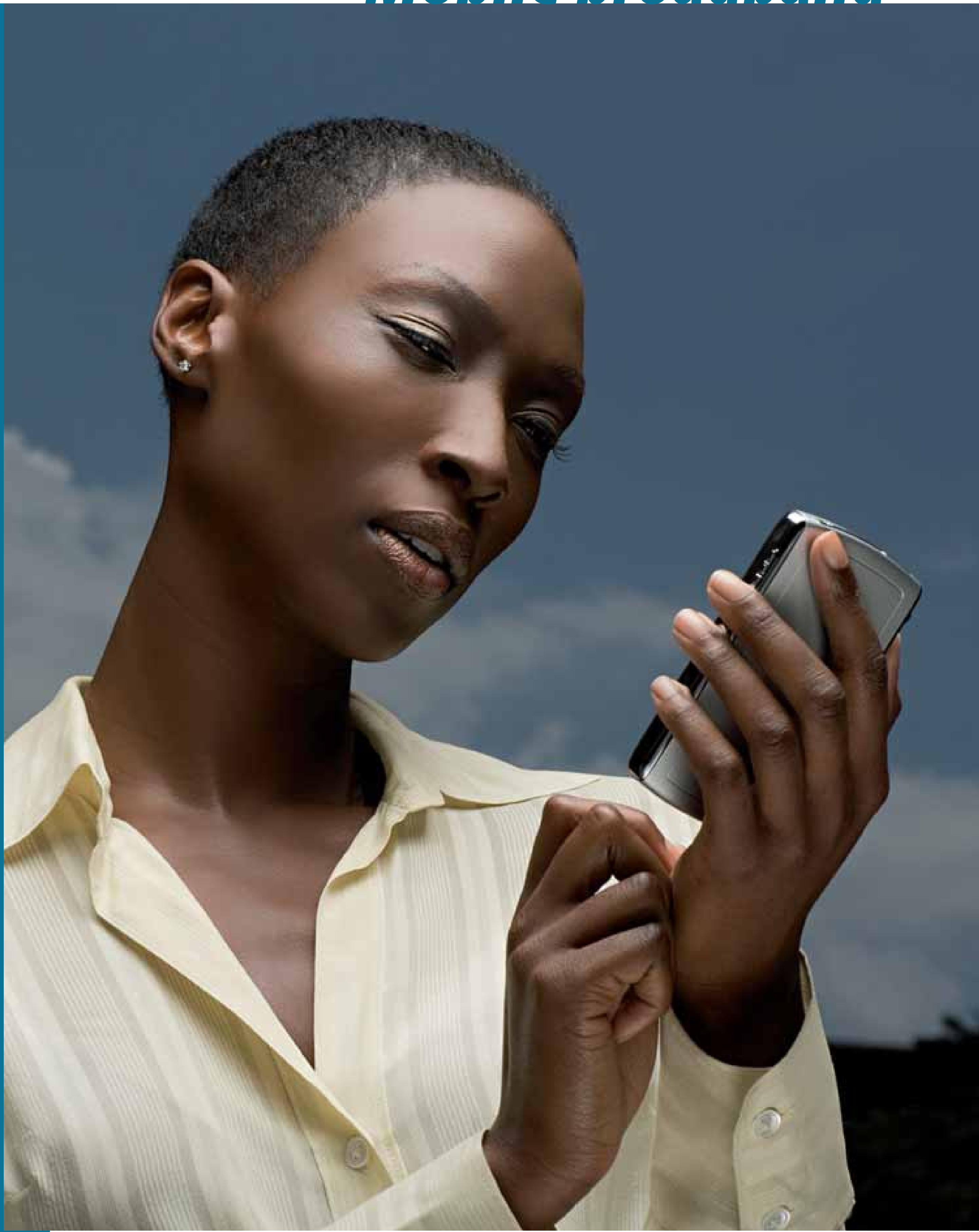
Technical leadership and expertise from ITU

In the light of these very diverse national situations, any proposal for a second digital dividend is likely to be controversial. There would be a need for technical leadership and expertise from within the study groups of the ITU Radiocommunication Sector (ITU–R) to reconcile conflicting views from the different industry sectors and provide governments with a solid basis for policy development. Any policies that are developed must give national regulators sufficient flexibility to award valuable UHF spectrum for the appropriate services, based upon national demand.

Evidence-based spectrum policy, and regional and international coordination are critical. In particular, international harmonization of spectrum for mobile communications and content services has been shown to bring significant benefits to consumers through wider availability of a range of low-cost terminals and a greater variety of new and compelling mobile data services. Steps in this direction will be taken by WRC-12 delegates, who will determine the agenda for WRC-15, including the potential to consider allocating more spectrum for mobile broadband use.

Ultimately, ITU will play a key role in facilitating this debate, and providing guidelines for where the dividing line is drawn between the amount of spectrum retained by broadcasting services and that released for use by other services, including mobile. This is a decision which will have profound implications for the telecommunications and broadcast industry — and its consumers — for many years to come.

Mobile broadband



AFP/ImageSource

The future of mobile

Roberto Ercole, Senior Director of Spectrum, GSMA

The World Radiocommunication Conference 2012 (WRC-12) is able to start a three-year period of debate, research and decision-making that will shape the face of mobile broadband for decades to come. Agenda item 8.2 gives administrations the opportunity to support placing an item on the agenda of WRC-15 to plan the spectrum needs of the IMT sector through 2020 and beyond. At a time when broadband is regarded as crucial for socio-economic development GSMA is supporting the adoption of a new agenda item for international mobile telecommunications (IMT), with the correct mandate and supported by the right ITU working group.

IMT world

The importance of IMT and mobile broadband for continued economic growth and development, particularly in developing countries, is well known. Virtually all mobile broadband is IMT, and IMT will be the main way of accessing the Internet in many markets — particularly developing ones.

Globally, according to Wireless Intelligence Q4 2011, there are currently some 1.6 billion IMT connections. IMT includes all significant mobile broadband technologies, so the success of IMT is, in effect, the same as the success of mobile broadband. It is thus important that ITU–R and world radiocommunication conferences take the necessary steps to encourage IMT to develop. But for IMT and mobile broadband to reach their full potential, suitable and sufficient harmonized spectrum will have to be identified to cater for the projected growth.

While WRC-07 did identify more spectrum for IMT, the extra spectrum did not match the demand predicted in ITU studies. The spectrum that was identified, such as the UHF band at 700 or 800 MHz, is being awarded around the world, and many more assignments are expected in 2012. Almost all terrestrial spectrum identified at previous conferences is either heavily used (3G core bands) or is currently being awarded (2.6 GHz extension bands) in most markets. This has allowed economies of scale to develop for IMT technologies, which has spurred incredible global growth of mobile broadband.


Roberto Ercole

GSMA

There are nearly 670 million HSPA (high-speed packet access) subscribers today.

Spectrum 2020 and beyond

For the success of mobile broadband to continue offering the maximum benefit to consumers and economic development, GSMA believes that an important requirement is to ensure that sufficient and suitably harmonized spectrum is made available. Studies show that the transmission of data over mobile networks has grown rapidly during the past few years, with seven times greater traffic in 2010 than was predicted by ITU back in 2005.

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WRC-12 offers the opportunity to ensure that the spectrum needs of mobile broadband can be considered at WRC-15. This requires that WRC-12, when approving the agenda for WRC-15 under agenda item 8.2, includes an agenda item for IMT. The backing of administrations will be needed to ensure that such an agenda item is agreed.

It is important that the IMT agenda item allows for the allocation of spectrum to the mobile service. Within the Radio Regulations the term "mobile broadband" has no clear definition as a service, unlike "fixed" or "mobile" for example. In fact, "mobile broadband" is an application that can run over spectrum designated for mobile services.

The allocation of a band for the mobile service is, however, not sufficient. There are many bands in the Radio Regulations that have primary mobile allocations but are not available for mobile broadband applications because there is no suitable equipment ecosystem. Such ecosystems create economies of scale and lead to lower-cost devices. In order to create these ecosystems, an identification of spectrum for IMT is required. Such an identification gives confidence to the industry to develop standards and equipment. This in turn gives confidence to administrations to make the bands available using harmonized band plans, and in turn creates momentum that leads to more users and hence lower device costs — creating a virtuous circle.

The need for an IMT agenda item at WRC-15 has been widely supported in the regional groups, with positive proposals coming in different forms from all regions. At stake at WRC-12, and subsequently at the first Conference Preparatory Meeting for WRC-15, is to ensure that the details in the outcome documents support the roll-out of IMT, and that the work on identifying both the spectrum needs and the most suitable bands, is done by the appropriate ITU working party, namely ITU–R Working Party 5D.

IMT task of world radiocommunication conferences

GSMA is acutely aware that an allocation to the mobile service and identification for IMT at WRC-15 would imply that such spectrum might not become available until 2025 (or later in some markets). There are very long lead times between allocation and identification at a conference and the final use of the spectrum by consumers. Given the importance of mobile broadband applications to all consumers, actions must be taken now to approve an agenda item at WRC-12 for IMT, and ensure that work between WRC-12 and WRC-15 is carried out as efficiently, affordably and inclusively as possible.

GSMA believes that ITU and world radiocommunication conferences play a vital role in helping to ensure that spectrum is harmonized to the extent required to control radio interference, and allow for economies of scale to be realized by the industry. Such economies of scale have allowed GSM to go from a niche product to more than 6 billion mobile connections globally in around 20 years.

The need for widespread international harmonization has meant that the process of acquiring harmonized spectrum requires long-term planning. For example, the core spectrum for 3G/IMT (UMTS in Europe) was identified by the ITU World Administrative Radio Conference in 1992, and finally awarded around 2000; and fully available around 2004. This makes it important to ensure that the planning process for identifying spectrum takes place in good time, to allow for the long time horizons. The benefits of international harmonization are great for mass market services such as mobile.

Identification of bands by a conference does not guarantee that allocations will be the same between different ITU regions, or that there will not be different regulatory restrictions and timings. Indeed, if there is no market demand for IMT/mobile broadband applications, then the spectrum will not be awarded for IMT use. The fact that identification for something exists does not guarantee success. Neither does identification for IMT force administrations to make the spectrum available to IMT. But low-cost devices and global availability do make the likelihood of success much higher, and the economic benefit that flows from this encourages administrations to make the bands available.

GSMA believes that ITU and world radiocommunication conferences play a vital role in helping to ensure that spectrum is harmonized to the extent required to control radio interference, and allow for economies of scale to be realized by the industry. Such economies of scale have allowed GSM to go from a niche product to more than 6 billion mobile connections globally in around 20 years.

Roberto Ercole, Senior Director of Spectrum, GSMA

Identifications by a world radiocommunication conference go a long way to giving industry confidence to develop products, and help create the markets that will persuade administrations to implement what has been recommended. So while GSMA welcomes the outcome of WRC-07, it also proposes to continue the work in order to further maximize the scope and degree of harmonization of the frequency bands identified for IMT. The earliest this work can be done is at WRC-15.

Getting the work done in ITU–R Working Party 5D

There has already been significant support from the regional groups for a new agenda item to look into the future needs of IMT. Should this support result in the approval of such an agenda item, WRC-12 and the subsequent Conference Preparatory Meeting for WRC-15 will need to agree on some vital details. The wording of the associated resolution will be of paramount importance, the choice of working party even more so. There are a number of reasons for making sure that ITU–R Working Party 5D is charged with undertaking the necessary work,

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preparing reports and ultimately drafting the Conference Preparatory Meeting text that will go to WRC-15.

In its previous incarnation — as ITU–R Working Party 8F — ITU–R Working Party 5D has shown itself to be able to work on the development of IMT. The group has overseen the identification of harmonized IMT spectrum before, and is the one-stop group for the IMT representatives in each administration.

Resolution ITU–R 2 states that existing groups should be used for preparatory work and, where possible, a single group should be identified. The reasons for this are clear. Creating new groups takes time — which between WRC-12 and WRC-15 will be extremely short — and it takes additional effort from administrations in terms of finance and personnel.

The latter point is particularly important when it comes to the developing world. Creating a new group to discuss the future needs of IMT would oblige administrations to attend both ITU–R Working Party 5D and the new group. This would put pressure on all administrations in terms of additional budget, and this is likely to be most keenly felt in developing economies.

In order to achieve the best possible consensus on the future of IMT, it is vital that the broadest pool of administrations are able to attend. Creating a second IMT group outside of ITU–R Working Party 5D would limit the ability of the developing world to engage in the future of mobile broadband. Without the broadest possible consensus, the wide harmonization of future IMT spectrum would be jeopardized.

GSMA believes that the clearest path to ensuring that mobile broadband is harmonized as widely as possible, and is thus as affordable as possible, is to bring the debate under the roof of the IMT working group.

All parties, sectors and services are, of course, entirely welcome to attend. GSMA looks forward to joining in the discussion.

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IMT-Advanced standards for mobile broadband communications

Stephen M. Blust, Chairman, ITU–R
Working Party 5D (IMT Systems)

Stephen M. Blust

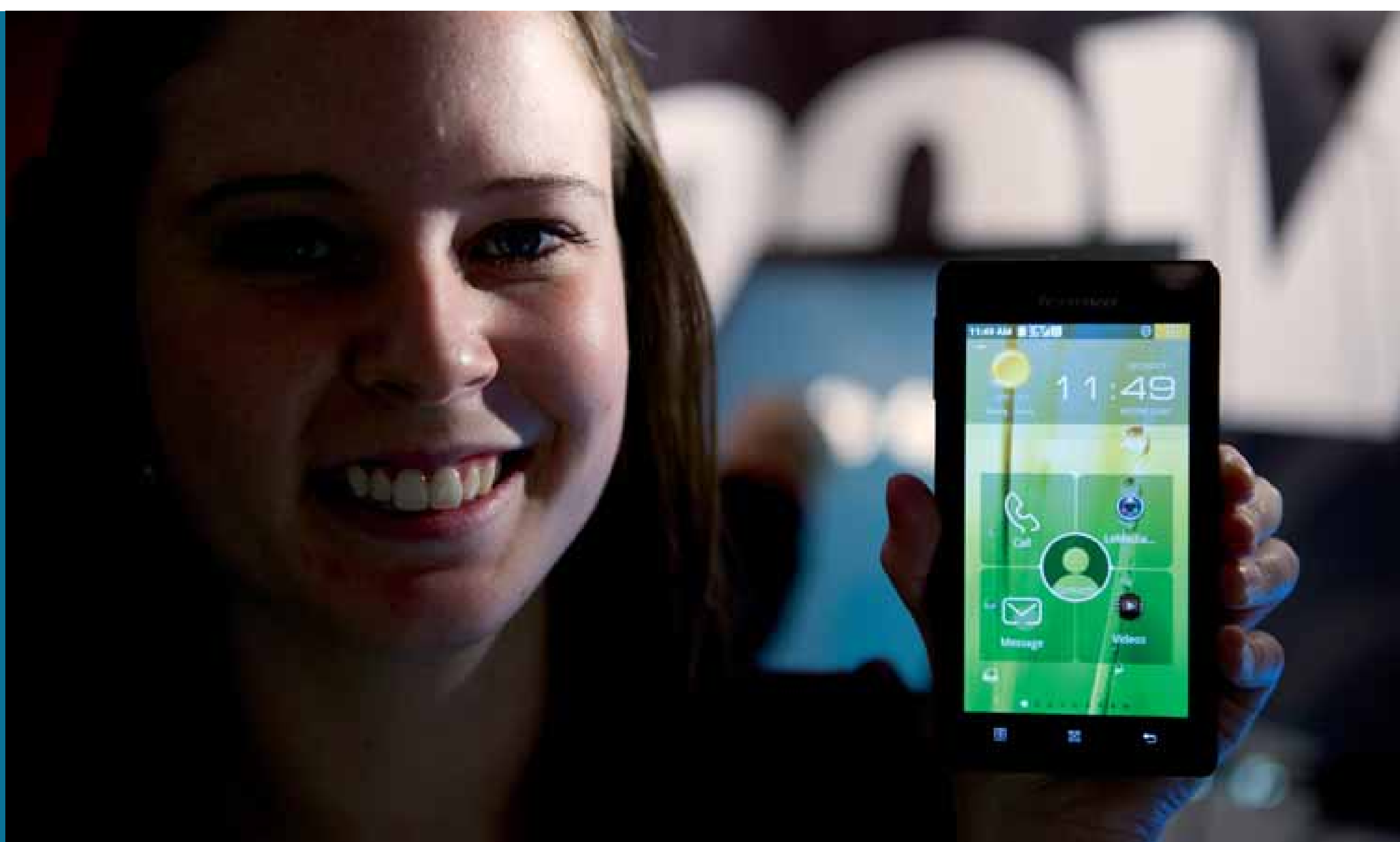
ITU started the development of radio interface standards for mobile communications on the eve of the initial deployments of the first digital cellular systems (known as 2G). This effort, led by governments and industry, gave birth to the framework of standards known as IMT — for international mobile telecommunications — which also includes the identification of radio-frequency spectrum and band arrangements. The IMT scope encompasses the well-established IMT-2000 and the newly developed IMT-Advanced.

Since 2000, the world has seen the introduction of the first family of standards derived from the IMT concept — IMT-2000 (commonly referred to as 3G). 3G is now widely deployed and being rapidly enhanced. IMT-2000 is the foundation for the personal mobile communications industry and is present in the pocket of almost everyone in the world.

Pursuing its initiative to lead international efforts to produce global standards for mobile communications, ITU's Radiocommunication Sector (ITU–R) completed in 2011 the assessment of candidate submissions for the next generation global mobile broadband technology, otherwise known as IMT-Advanced. Harmonization among these proposals has resulted in the choice of two technologies, LTE-Advanced and WirelessMAN-Advanced. These radio interface technology standards were submitted to the Radiocommunication Assembly 2012, held in Geneva on 16–20 January, for final endorsement by the ITU Member States and have been agreed.

ITU–R has also commenced the process of developing an ITU–R Recommendation for the satellite component of the IMT-Advanced radio interfaces, having recently invited the submission of proposals for candidate radio interface technologies.

IMT-Advanced brings major improvements, including increased spectrum efficiency — more users at higher data rates per radio channel and fully packet-based architecture — reduced costs, comprehensive support for broadband wireless data, lower latency — more responsive Internet and multimedia applications, and improved radio resource management and control — enhanced quality of service, and new capabilities for the physical layer of the radio interface — including wideband radio channels, multiple-input and multiple-output (MIMO) smart antennas and flexible deployment options.



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Among the critical technical features of IMT-Advanced technologies, the requirements for working in IMT frequency bands (see Table 1) is particularly important, as is interoperability with IMT-2000 to facilitate global roaming. To the extent possible, ITU has sought to harmonize the use of these IMT bands on a global basis, although in some of these bands and in some parts of the world such harmonization has not been able to be achieved because of the conflicting requirements of other radio services.

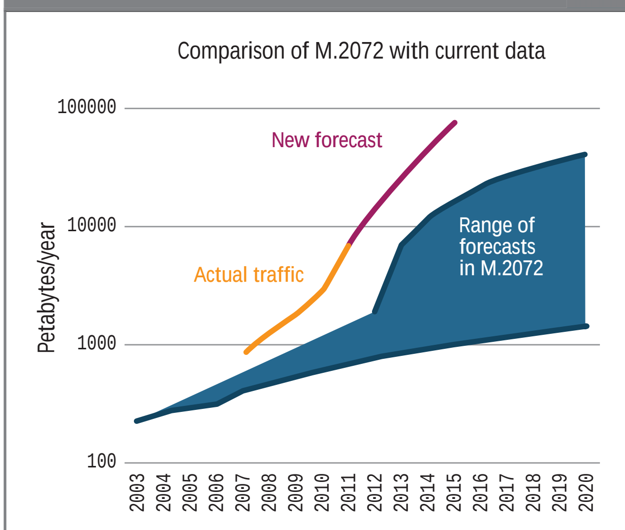
Table 1 — Frequency bands identified for IMT

Band (MHz)	Radio Regulations footnotes identifying the band for IMT
450–470	5.286AA
698–960	5.313A, 5.317A
1 710–2 025	5.384A, 5.388
2 110–2 200	5.388
2 300–2 400	5.384A
2 500–2 690	5.384A
3 400–3 600	5.430A, 5.432A, 5.432B, 5.433A

While voice traffic on mobile networks is growing at a relatively constant rate, there has in the past few years been a very rapid increase in the volume of data traffic. This increase is being further accelerated by the introduction of a growing array of advanced multimedia devices, including smartphones and tablets and their related applications. Comparisons of traffic demand estimates prepared in 2005 in Report ITU–R M.2072 with current assessments for 2020 from recently concluded ITU studies (see Figure 1) indicate that the earlier projections significantly understated the current and future levels of data carried on broadband mobile systems. Actual data traffic in 2010 was more than 5 times greater than some of the estimates prepared for Report ITU–R M.2072. Not only that, but in 2011 some operators even experienced a higher level of actual traffic than Report ITU–R M.2072 forecast for 2020.

Even with the significant leap in spectrum efficiency available in IMT-Advanced, it is apparent that the overall amount of spectrum currently identified for IMT might not be sufficient for the future. A number of ITU Member States are now considering proposals for WRC-12 to add an item to the WRC-15 agenda to address future spectrum requirements for IMT mobile broadband.

Figure 1 — Assessment of the global mobile broadband deployments and forecasts for IMT



Source: Reproduced from Figure 7 of Report ITU–R M.2243.

Aviation

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Global aviation

Not your average spectrum user

Loftur Jónasson, Technical Officer, International Civil Aviation Organization (ICAO)

Loftur Jónasson

The aviation sector is characterized by aeronautical and safety-related factors that distinguish it from other frequency spectrum users. This article discusses three WRC-12 agenda items which are of major interest to the global aviation community.

Modern airliners travel at speeds of up to 1000 km/h. In busy airspaces, aircraft are separated by distances which are covered in mere seconds. They travel over vast, often intercontinental distances. The equipment carried on board needs to be compatible with the services provided at airports around the world. Every kilo added to the weight of airborne equipment adds to the fuel consumption of the aircraft. For economic reasons, there is little room for redundant equipment.

Today's commercial aircraft are equipped with two to four VHF radios, voice and digital link. They may also carry two HF radios and a dual-redundant satellite communications link. There are also precision radionavigation and landing systems, radio altimeters, radar transponders, airborne collision avoidance systems, weather radar and so on.

There are approximately 30 antennas or more on an average-sized modern aircraft; a modern Boeing 747–400 has between 40 and 50 antennas fitted. Needless to say, for global and airborne communications, navigation and surveillance (CNS) operations to work effectively in the confined environment of these aircraft, careful consideration needs to be given to the spectrum used.

ICAO standardization

The Convention on International Civil Aviation is an international treaty providing the required provisions for flights over the territories of the 191 ICAO Member States and over the high seas. It includes measures to facilitate air navigation, including international standards and recommended practices (SARPs).

The ICAO standards constitute rule of law through the ICAO Convention and form a regulatory framework for aviation, covering personnel licensing, technical requirements for aircraft operations, airworthiness requirements, aerodromes, and CNS systems, as well as other technical and operational requirements.

Aeronautical CNS systems provide functions critical to the safety of aircraft and rely on the continued availability of appropriate frequency spectrum. Civil aviation administrations coordinate their positions on the agenda of world radiocommunication conferences (WRCs) through the development of a common ICAO position catering to the continued and evolving spectrum requirements of CNS services.

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Three spectrum concerns have been highlighted as high priority areas for the global aviation community during WRC-12: unmanned aircraft systems; aeronautical safety allocations; and requirements for the aeronautical mobile satellite (route) service.

Unmanned aircraft systems

The development of a standards framework for unmanned aircraft systems or remotely-piloted aircraft is perhaps the single most challenging standardization task that ICAO has undertaken in a long time.

Consider the following scenario: a remotely-piloted aircraft registered in country A flies over the territory of country B while being managed through a remote pilot station in country C. To make things even more complex, envisage the satellite control link being owned and operated by a satellite operator in country D.

How do you establish the airworthiness of such a composite scenario? In the case of operational problems or even an accident, who is responsible? And to relate to the radio regulatory aspect: how do you safely manage and mitigate an interference problem caused by a satellite operator in country E?

ICAO has recently undertaken the development of the international regulatory framework necessary for unmanned aircraft systems operations in civil airspace. This work will include the development of SARPs for the unmanned aircraft systems command and control link. This is a significant task and will take a number of years to complete.

The development of unmanned aircraft systems standards and recommended practices will always comply with the following fundamental principle: when introducing any new aircraft, system or service to civil airspace, the safety of any other airspace user or property on the ground must not be negatively affected.

Because of the safety aspects inherent in the provision of existing CNS services for the purpose of air traffic management, these services traditionally require appropriate safety allocations, such as the aeronautical mobile (route) service, aeronautical mobile satellite (route) service and aeronautical radionavigation service (as defined in the Radio Regulations).

One additional and unique new aspect required for unmanned aircraft systems is the command and control link used to remotely manage the unmanned aircraft while in flight. As this link provides the sole means to control the unmanned aircraft in real time, it not only requires protection through an appropriate aeronautical safety allocation, but also needs to be exceptionally robust.

Increased flexibility of aeronautical safety allocations to accommodate increased spectrum demands

Aviation is experiencing long-term growth at an annual rate of 4.6 per cent. In order to accommodate this growth, WRC-07 afforded aviation three new aeronautical mobile (route) service allocations in the frequency bands 112–117.975 MHz, 960–1 164 MHz and 5 091–5 150 MHz. These are to be shared with the existing aeronautical radionavigation service allocations in these bands.

A key to this new and flexible arrangement is the mutual recognition between ICAO and ITU that ICAO ensures compatibility for systems using the new aeronautical mobile (route) service through the development of SARPs for its systems.

The first two allocations were provisional, pending further studies within the ITU Rediocommunication Sector (ITU–R). These studies have now been finalized with a favourable outcome, indicating that sharing with the aeronautical radionavigation service in these bands is feasible.

In addition to the third allocation, the conference invited spectrum administrations and ICAO to assist ITU–R in studying whether aviation's needs could be fully met within the 5 091–5 150 MHz band. Unfortunately, the outcome of this study appears inconclusive; it has not addressed any of the number of constraints present in this band. No doubt there will be an interesting debate on this subject during WRC-12.

The development of a standards framework for unmanned aircraft systems or remotely-piloted aircraft is perhaps the single most challenging standardization task that ICAO has undertaken in a long time.
Consider the following scenario: a remotely-piloted aircraft registered in country A flies over the territory of country B while being managed through a remote pilot station in country C. To make things even more complex, envisage the satellite control link being owned and operated by a satellite operator in country D…

Loftur Jónasson, Technical Officer, International Civil Aviation Organization (ICAO)

Long-term spectrum availability and access to meet requirements for the aeronautical mobile satellite (route) service

ITU studies, supported by ICAO, have concluded that long-term aeronautical mobile satellite (route) service spectrum requirements up to the year 2025 can be accommodated within the existing 10 MHz wide 1.5 and 1.6 GHz frequency band allocations available for this service.

ICAO is of the view that further provisions need to be included in the Radio Regulations to clarify and facilitate coordination and assignment to the aeronautical mobile satellite (route) service in these bands, according to the priority given to the service, and to improve transparency in the coordination process.

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Aviation safety and efficiency

John Mettrop, Frequency and Spectrum Management, Technical Manager, Directorate of Airspace Policy

John Mettrop

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Aviation is a global industry that lies at the heart of modern, globalized economies. It has to take into account the interests of all airspace users — whether commercial, leisure or government — in a manner that maintains the safety and integrity of the airspace in which these diverse activities operate.

An economic study carried out in 2009 estimated that, in 2007, commercial aviation carried a total of 2.5 billion passengers and approximately 50 million tonnes of freight, directly employing more than 5.5 million workers, had a turnover of more than USD 1 trillion and generated USD 425 billion of gross domestic product (GDP) — indeed, if commercial aviation were a country it would rank 21st in terms of GDP. Taking into account other industries that depend on air transport would make these figures even more impressive. For example, just including air transport's contribution to tourism increases the number of jobs to more than 33 million jobs and GDP to USD 1.5 trillion.

For the aviation industry to continue to thrive and expand, the safety and integrity of the airspace must be maintained. This is becoming increasingly complex because of capacity demand, diversity of aircraft types and environmental constraints. A key element in ensuring the safety and integrity of the airspace is the maintenance of minimum separation standards through accurate navigation and the provision of air traffic control. Radio spectrum is the only available means of supporting communication and navigation (including surveillance) systems can use to enable aircraft to navigate and obtain air traffic information. Spectrum allocations that are appropriately protected are therefore critical to the industry.

Agenda item 1.3 of the World Radiocommunication Conference (WRC-12) addresses the spectrum needs, both terrestrial and satellite, for safety critical non-payload communication requirements (such as command and control, and the relaying of air traffic control messages). These communication links will effectively replace the wiring in the cabin between the pilot and the various systems required to fly an aircraft. Given the safety critical nature of such links, it is essential to ensure that the spectrum they will operate in is appropriately identified and protected.

The evolution of unmanned aircraft from little more than model aircraft to sophisticated remote-sensing platforms has resulted from advances in the fields of sensing, and command and control. Current applications include environmental monitoring, border patrolling, and fire-fighting. The command and control elements could eventually find their way onto commercial aircraft, reducing the number of pilots required on an aircraft.

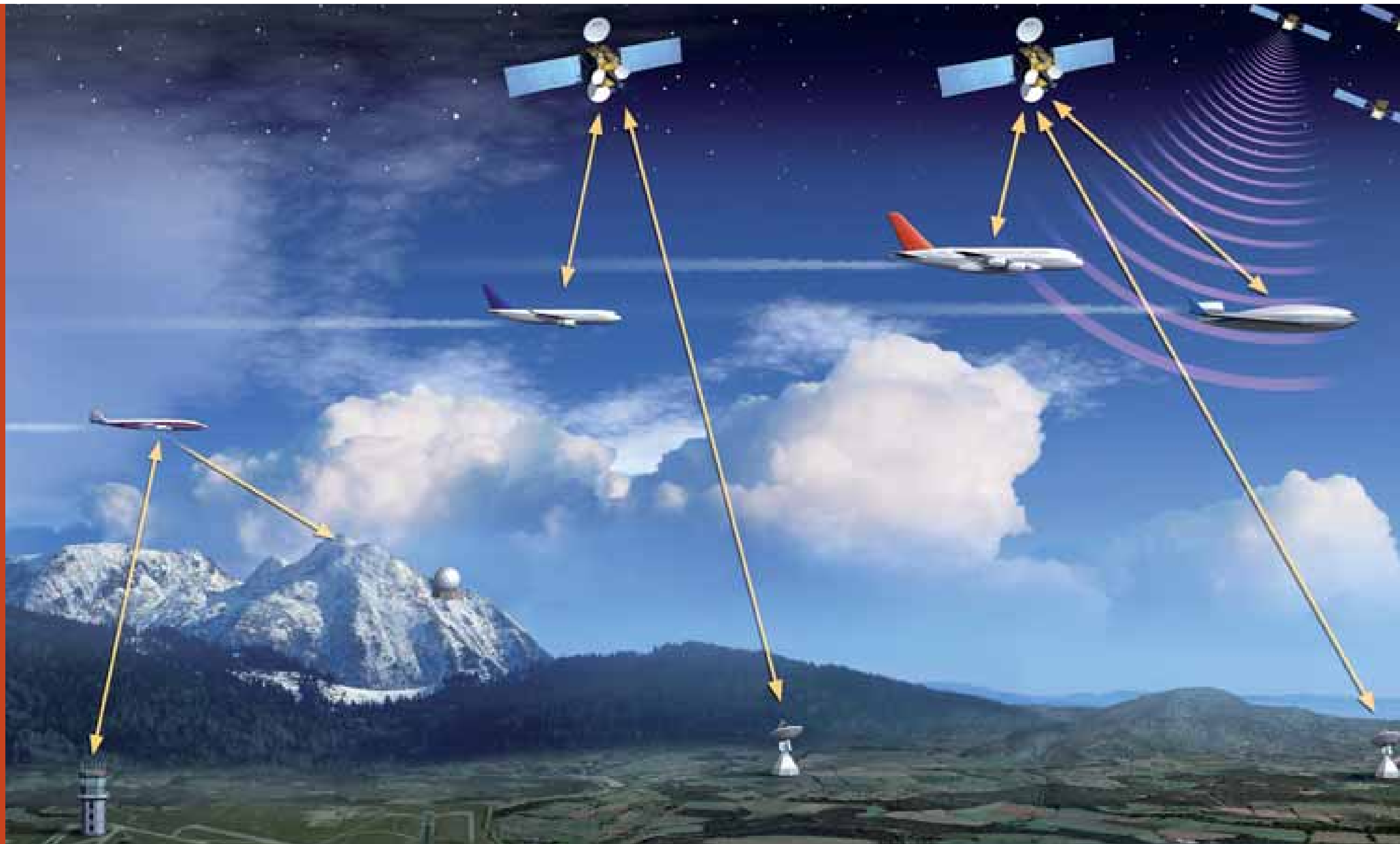
As the number and capabilities (in terms of size, endurance and payload capacity) of these unmanned aircraft have increased, so the demand to share airspace with manned aircraft has also increased. For unmanned aircraft to be allowed access to airspace where manned aircraft operate, the unmanned aircraft will have to demonstrate that they can operate in that airspace and interact, where necessary with air traffic control, in a manner that is comparable to that of manned aircraft.

Current proposals would suggest that there is sufficient satellite spectrum to meet the needs of unmanned aircraft for non-payload communications. It should be noted that other so-called payload communications that are associated with the commercial purpose of the flight rather than its safety (for example, sensor data for environmental monitoring, or radio relay for a communications platform) are not part of agenda item 1.3 and have not been assessed, but may need to be studied in the future. As far as the terrestrial component is concerned, studies have centred around the bands used by existing aeronautical systems, namely the 5 and 15 GHz bands currently allocated to aeronautical radionavigation services.

Having spectrum allocated and ensuring the appropriate level of protection for the systems that will operate in those bands are two different problems. How the conference resolves those problems will be the crux of the discussions under agenda item 1.3, and will involve having to weigh up commercial demands against safety requirements.

Aviation by its nature is a conservative industry, preferring to use tried and tested technology over the more advanced emerging technologies favoured by industries such as mobile communications. Nevertheless, the aviation industry is currently reviewing various worldwide programmes to enhance air traffic control communication systems through the introduction of a number of datalink services. These systems will enhance aeronautical communications capability and — in conjunction with more precise navigational capabilities — allow flight routing to be more efficient. If this can be achieved, then it will result in fewer delays, shorter flight times on average, lower fuel costs and reduced CO_2 emissions.

Agenda item 1.4 is the vehicle by which the aviation industry is seeking to finalize the work, started in preparation for WRC-07, to ensure that the necessary spectrum is available to allow for the introduction of these systems in a timely manner. The agenda item addresses three frequency bands (112–117.975 MHz,



ESA/P. Carril

960–1 164 MHz and 5 000–5 030 MHz) that are currently allocated on a worldwide basis to the aeronautical radionavigation service, and in the case of the first two bands were "provisionally" allocated to the aeronautical mobile (route) service by WRC-07.

Two problems have to be considered in regard to the frequency band 112–117.975 MHz, namely compatibility with in-band aeronautical radionavigation systems and compatibility with adjacent band broadcasting services. Analysis has shown that if the aeronautical mobile systems are built in accordance with International Civil Aviation Organization (ICAO) standards and limited to operating above 112 MHz, then compatibility with broadcast systems is guaranteed. Compatibility with aeronautical radionavigation systems operating in the same frequency band is ICAO's concern, because any interference will be with ICAO's own standardized systems. This is therefore not of concern to ITU.

Matters are a little more complex in the frequency band 960–1 164 MHz. Consideration has to be given not only to compatibility with existing aeronautical radionavigation systems (both ICAO and non-ICAO standardized) operating within the frequency band, but also to adjacent band satellite navigation systems, such as GPS and Galileo, that operate above 1 164 MHz. As with the frequency band 112–117.975 MHz, it is proposed that compatibility with existing ICAO systems is a matter for ICAO to address and therefore not of concern to ITU. It is further proposed to assure compatibility with other aeronautical radionavigation systems operating in the band, and with satellite navigation services operating above 1 164 MHz, through mandatory technical provisions included in a WRC Resolution and possibly in an associated ITU–R Recommendation that is incorporated by reference. Compatibility with adjacent band mobile systems was addressed by WRC-07.

In the frequency band 5 000–5 030 MHz, technical compatibility can be shown between the proposed airport surface aeronautical mobile systems and existing services in the frequency band 5 000–5 010 MHz, and adjacent band radio astronomy systems. No conclusions could be drawn with regard to the remaining part of the frequency band because of the uncertainty around a number of the operational and technical parameters. The main area of uncertainty is whether or not an additional allocation to the aeronautical mobile (route) service for airport surface communications is required.

Agenda item 1.7 addresses aviation's long-term access to spectrum allocated to the aeronautical mobile-satellite (route) service in the frequency bands 1 525–1 559 MHz and 1 626.5–1 660.5 MHz, as allowed for by footnote 5.357A in Article 5 of the Radio Regulations. This item has been debated by WRCs ever since the allocation was made generic at the 1997 conference.

As the aviation industry has expanded and aircraft have flown further, the need for and capacity of mobile communication links that can operate over the horizon have increased. The capacity and reliability of existing high-frequency communication links are no longer capable of supporting the traffic requirements of a modern air traffic control system. As a result, greater use of satellite networks is planned, especially over remote areas such as oceans. Improved communications allow aircraft to fly optimal routes that reduce flight time, fuel burn and hence CO_2 emissions.

If aviation cannot have access to appropriate satellite spectrum, then further advances in beyond line of sight communication systems — as foreseen in projects such as the European Union Single Sky initiative — are unlikely. The question that needs to be answered through the processes that are established as a result of agenda item 1.7 is how to allow aviation access to aeronautical mobile satellite (route) spectrum, as called for in footnote 5.357A, without unduly constraining current mobile satellite operations. The prescribed processes will have to be robust enough to ensure that all aeronautical requirements are justified. This will avoid any perception that requirements are being inflated or that the spectrum will not be used as efficiently as it could be, taking into account the various constraints.

Mobile communication is vital to aviation for ensuring that the airspace above our heads is kept safe. It can also act as an enabler to allow aviation to optimize the way in which the airspace is used, keeping flight times to a minimum, reducing fuel burn and CO_2 emissions. Discussions under WRC-12 agenda items 1.3, 1.4 and 1.7 will all be important in ensuring that the communication systems used by aviation preserve the integrity of the airspace and deliver efficiencies in use.

Aviation by its nature is a conservative industry, preferring to use tried and tested technology over the more advanced emerging technologies favoured by industries such as mobile communications. Nevertheless, the aviation industry is currently reviewing various worldwide programmes to enhance air traffic control communication systems through the introduction of a number of datalink services. These systems will enhance aeronautical communications capability and — in conjunction with more precise navigational capabilities — allow flight routing to be more efficient.

John Mettrop, Frequency and Spectrum Management, Technical Manager, Directorate of Airspace Policy

Maritime

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The maritime mobile service and safety systems for ships and ports

John Mettrop, Frequency and Spectrum Management, Technical Manager, Directorate of Airspace Policy

The maritime industry is a global transporter of the goods of modern globalized economies. It has to take account of the interests of all who use the sea — for commercial, leisure or government purposes — in a manner that ensures the safety of all. The industry is regulated by the International Maritime Organization, which is the United Nations specialized agency responsible for the safety, security and efficiency of shipping and the prevention of maritime pollution.

According to a 2008 estimate, commercial shipping transported about 80 per cent of all international trade, carrying more than 7.7 billion tonnes of goods. And it contributed USD 380 billion to the global economy — equivalent to about 5 per cent of total world trade.

Mobile communications are key to the success of the maritime industry because they provide the medium by which maritime safety information, ship position reporting and weather forecasts, as well as other information, can be passed to ships at sea. For a vessel in trouble, the accuracy and update rate of the reporting of the ship's position aids rescue, potentially avoiding the loss of the ship, saving the lives of the crew or preventing an environmental disaster.

Agenda items 1.9 and 1.10 are crucial for the maritime industry, including leisure craft, in enhancing the current maritime communication capabilities in a manner that enhances safety and security as well as increasing efficiency. Without a successful conclusion to these agenda items, the continuing efforts of the maritime industry to update its systems and react to new requirements, such as the need to enhance ship and port security, will be hampered.

Allowing new technologies for safety communications

Agenda item 1.9 addresses the use of the HF bands, which ships have traditionally employed extensively for long-distance safety and general communications, using Morse telegraphy, radio telex and radio telephony. The introduction of the Global Maritime Distress and Safety System (GMDSS) removed the dependence on Morse telegraphy by introducing a standard radio telex system known as narrow-band direct-printing.

The spectrum needs of the maritime mobile service in the HF bands are based on the introduction of new data exchange technologies as an alternative standard for radio telex, which is in rapid decline.

The International Maritime Organization has noted that narrow-band direct-printing is now used for the broadcasting of maritime safety information, ship reporting, weather forecasts and for business communications, for example by fishing fleets. Narrow-band direct-printing remains part of the International Convention for the Safety of Life at Sea (SOLAS) requirements for GMDSS for vessels sailing in sea areas that are beyond the range of MF and VHF coastal stations.

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From a technical standpoint, all these functions could be provided by alternative data communication technologies. But some administrations continue to use narrow-band direct-printing, not only for maritime safety information operations but also for public services. Also, narrow-band direct-printing is the only GMDSS-recognized system for providing maritime safety information to ships that are out of sight of coastal stations.

Within the maritime mobile service, agenda item 1.9 provides an opportunity to improve the utility of the allocated spectrum by allowing new more efficient digital technologies to use certain parts of the spectrum addressed by Appendix 17 of the Radio Regulations.

As stated above, narrow-band direct-printing remains a SOLAS carriage requirement, together with the possibility of using Inmarsat satellite systems. It remains an option for distress communications, in particular in the polar regions where there is no coverage from geostationary satellites. This functionality could be preserved using the HF distress and safety frequencies listed in Appendix 15 of the Radio Regulations.

Radio telex is an old and limited system, and is now rarely supported by coast stations around the world. At WRC-03, changes were made to the Radio Regulations that enabled the initial testing and possible future introduction of new digital technologies in the maritime mobile service covered by Appendix 17. These new digital technologies are becoming widely used.

How can the maritime industry implement new digital technologies, while protecting existing applications? Taking the following steps would allow the maritime industry to enter a new era of communications:

- reducing the current frequencies identified for narrow-band direct-printing use to core bands, which will include the GMDSS distress and safety requirement plus some other channels, in order to support current usage and to preclude the use of other technologies in these core bands;
- releasing, after a transition period, the narrow-band direct-printing frequencies not included in the core bands for use by new exchange technologies, while allowing administrations that choose to use these bands for narrow-band

direct-printing to continue to do so without claiming protection or causing interference;

- releasing the frequency bands designated for facsimile, wideband telegraphy and Morse telegraphy so that these bands can be used for digitally modulated emissions, while allowing administrations that choose to use the bands for facsimile, wideband telegraphy and Morse telegraphy to continue to do so without claiming protection or causing interference;
- keeping the frequency bands designated for duplex radiotelephony (under Appendix 25 of the Radio Regulations), and allowing stations to use digitally modulated data emissions in the radiotelephony bands, in accordance with the Appendix 25 allotment Plan;
- avoiding interference between digital and analogue technologies, to ensure the smooth introduction of digital data technologies through various regulatory measures.

Harmonizing the spectrum for safety communications

Agenda item 1.10 addresses the maritime communication requirements to support safety systems for ships and port operations in the global context of trying to ensure the safe and efficient operation of global shipping. In addressing agenda item 1.10, work has focused on the harmonization of maritime spectrum in the following four primary areas:

- protection in the Radio Regulations for the spectrum used by the automatic information system, because two of these frequencies are used to ensure navigational safety, vessel traffic management in congested ports, and vessel tracking;
- use of two additional automatic information system frequencies for improved satellite detection and tracking of vessels, to enhance maritime safety and security;
- harmonization of the maritime mobile service in the frequency band 415 kHz to 526.5 kHz for enhanced data rate transmissions for maritime safety information, future eNav applications, and security broadcasts;
- harmonization under Appendix 18 of the Radio Regulations (156 MHz to 162 MHz) of a band for VHF digital services, using advanced data transmission techniques for enhanced port operations, and additional simplex channels from existing duplex channel pairs.

The International Maritime Organization requires that implementing an automatic information system improves the safety of navigation by assisting in the efficient navigation of ships, protection of the environment, and operation of vessel traffic services. This is to be achieved by satisfying the following functional requirements: a ship-to-ship mode for collision avoidance; a means for littoral States to obtain information about a ship and its cargo; and a vessel traffic services tool for ship-to-shore traffic management.

Although these functional requirements clearly specify safety and surveillance functions, the Radio Regulations only recognize the automatic identification system-search and rescue transponder operation as having a safety function. Modifying the Radio Regulations to reflect the true use of automatic information system frequencies is critical to search and rescue, safety of navigation, and the safe movement and tracking of vessels, which are all vital to the future of maritime safety.

Operational procedures

Studies within ITU in response to WRC-12 agenda item 1.10 have identified a number of VHF channels in Appendix 18 which can be used for improved satellite detection of automatic information systems. Additionally, as a result of these studies changes have been made to Recommendation ITU–R M.1371 in order to introduce a new message 27 dedicated to the satellite detection of automatic information system messages. Modifying the Radio Regulations to reflect the satellite monitoring of vessels equipped with automatic information systems is critical to search

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and rescue, safety of navigation, and the safe movement and tracking of vessels. Specifically, 156.775 MHz (Appendix 18 Channel 75) and 156.875 MHz (Appendix 18 Channel 76) for improved satellite detection of automatic information systems using message 27 are proposed for WRC-12 adoption.

Article 33 of the Radio Regulations describes the operational procedures for maritime emergency and safety communications, including the transmission of maritime safety information. It is vital for the maritime community to have a globally harmonized primary allocation to the maritime mobile service in 415—526.5 kHz for maritime safety information, security related broadcasts, eNav applications, and data communication systems.

Recommendation ITU–R M.1842-1 provides examples of potential VHF data exchange systems and recommends the use of Appendix 18 channels to support future digital technologies in the maritime mobile service. Expansion of optional simplex use of duplex channels in Appendix 18 will provide further benefits to maritime radiocommunications by relieving current congestion in the VHF maritime mobile bands, in accordance with Recommendation ITU–R M.1084-4. Report ITU–R M.2010-1, a study on efficiency in the VHF maritime mobile band, concluded that this spectrum efficiency option expands the number of usable communication channels with the minimum of compatibility problems. The analogue VHF radio on board vessels that travel internationally would have access to both the original two-frequency channels and their single-frequency derivatives, thus allowing port operations on two or single frequency channels.

Safeguarding spectrum for maritime services

Hans van der Graaf, Senior Technical Officer, Secretary COMSAR Sub-Committee, International Maritime Organization


Hans van der Graaf

As the United Nations specialized agency with responsibility for the safety, security and efficiency of shipping and the prevention of marine pollution by ships, the International Maritime Organization (IMO) considers that the allocation and regulation of the use of spectrum for radiocommunication is of the utmost importance for the safe, secure, efficient and environment friendly navigation of ships.

The primary interest of the International Maritime Organization at the World Radiocommunication Conference 2012 (WRC-12) is to safeguard the current use of spectrum allocated to existing maritime services. The continuous growth in demand for spectrum by almost all radiocommunication sectors means that the maritime community has an interest in most of the WRC-12 agenda items. For instance, a proposed primary allocation to the radiolocation service in the frequency band 154–156 MHz under agenda item 1.14, if not properly regulated, could lead to out-of-band compatibility problems with the maritime mobile service operating in the frequency band 156–174 MHz. In such cases, IMO wants maritime services to be given an appropriate level of regulatory protection through measures to be incorporated in the Radio Regulations.

IMO also has an obligation to ensure that the conference has access to appropriate information on current and future maritime radiocommunication systems and technology. Two major projects, under consideration within IMO, will require amendments to the Radio Regulations in the near future: review of the Global Maritime Distress and Safety System (GMDSS); and the implementation of e-navigation.

From IMO's perspective, the most important items on the WRC-12 agenda are items 1,7, 1.9, 1.10, 1.23 and 8.2 as discussed below (see also the article "The maritime mobile service and safety systems for ships and ports").

The importance of the L-band for the maritime mobile-satellite service

Under agenda item 1.7, the conference will consider the long-term spectrum availability and access to spectrum necessary to meet requirements for the aeronautical mobile-satellite (route) service. Studies carried out on existing mobile-satellite service allocations have concentrated on the L-band, in which the maritime service has also a great interest. The L-band is currently already heavily used by the maritime mobile-satellite service for safety of life radiocommunication and increased usage is anticipated, as more operators become licensed to provide GMDSS services in the near future.

It is IMO's position that, in meeting the long-term requirements of the aeronautical mobile-satellite (route) service, "No Change" should be made to the existing allocation or regulatory and operational provisions of the designated bands 1 530–1 544 MHz (space to Earth) and

1 626.5–1 645.5 MHz (Earth to space) used for distress and safety purposes in the maritime mobile satellite service and for routine non-safety purposes. GMDSS distress, urgency and safety communications have priority in these bands.

New digital technologies for the maritime mobile service

Under agenda item 1.9, the conference is called upon to revise frequencies and channelling arrangements of Appendix 17 to the Radio Regulations in order to implement new digital technologies for the maritime mobile service.

There is significant interest in the use of the high-frequency bands by shipping. IMO has considered the potential for modern digital data exchange systems to replace narrow-band direct-printing and has noted that only certain core narrow-band direct-printing functions at high-frequencies need to be retained.

Today, more than 4500 ships are known to use digital systems, which automatically route messages to their destination, producing a million messages a month. New, highly efficient technology is being developed which in the next three years or so is expected to double this use.

IMO's view on agenda item 1.9 is that the frequencies currently allocated for use by the GMDSS need to be retained because at this time IMO has no intention of changing the requirements for narrow-band direct-printing and digital selective calling. According to IMO, these requirements should be retained in Appendix 15, which covers frequencies for distress and safety communications for the GMDSS. The frequencies for maritime safety information within Appendix 15 also need to be retained, recognizing their essential role in promulgating this information.

The major portion of the Appendix 17 bands would, however, become available for new digital technologies for the maritime mobile service because the spectrum that would have to remain dedicated to narrow-band direct-printing and digital selective calling in order to support the functional requirements of distress communications and the promulgation of maritime safety information, would only amount to a small fraction of the Appendix 17 bands.

The frequency bands allocated for Morse should remain available for use by the maritime community, without the need to claim protection. IMO recognizes that the channel bandwidths within Appendix 17 are only adequate for narrow band systems. Therefore IMO supports the creation of wide band sub-bands within Appendix 17 for new technologies.

Operation of safety systems for ships and ports

Under agenda item 1.10, the conference will examine the frequency allocation requirements with regard to operation of safety systems for ships and ports and associated regulatory provisions, in accordance with Resolution 357 (WRC-07). There is a global requirement to use radiocommunications to enhance ships and ports safety and security.

IMO notes that agenda item 1.10 refers to safety systems, but that Resolution 357 refers to safety and security systems. In the context of IMO, the term safety has to be interpreted as the safe movement and integrity of ships and security to ensure the provision of protection from threats.

At WRC-12, IMO aims to ensure that any allocation under agenda item 1.10 would not affect the frequencies used by the GMDSS. IMO wants regulatory protection for the frequencies used by automatic identification systems, taking the view that all operations on these frequencies should be regarded as having a safety function, not just search and rescue operations.

IMO supports an allocation to the mobile-satellite service (Earth-to-space) relating to the frequencies of Channel 75 and 76 of Appendix 18 to enhance the use of satellite detection of automatic identification systems.

Looking at possible future requirement for promulgating additional security-related information, as well as developments in regard to e-navigation and the forthcoming review of the GMDSS, IMO supports an exclusive primary allocation to the maritime mobile service in the band 495–505 kHz in Regions 1 (Africa and Europe), 2 (Americas) and 3 (Asia and Australasia) and a co-primary allocation in the band 510–525 kHz in Region 2. At the same time, the existing maritime mobile primary allocation in the band 415–526.5 kHz should be maintained, according to IMO.

IMO further supports a review of Appendix 18 for fulfilling additional requirements for VHF data services and the identification of more channels for availability as both single-frequency and two-frequency channels. It also supports joint IMO/ITU–R studies towards identification of a channel or channels for future applications, including man overboard (MOB) equipment.

New maritime mobile systems to be implemented in the 500 kHz band

Under agenda item 1.23, the conference will consider an allocation of about 15 kHz in parts of the band 415–526.5 kHz to the amateur service on a secondary basis. IMO has critical systems operating in this frequency range and is developing new requirements: (1) for the promulgation of additional security-related information, (2) for the implementation of e-navigation and (3) for reviewing the elements and procedures of the GMDSS. In this regard, an ITU–R Recommendation has been finalized in ITU–R Study Group 5, describing an MF radio system, named NAVDAT, for use in the maritime mobile service, operating in the 500 kHz band for digital broadcasting of maritime safety and security-related information from shore-to-ship.

IMO has concerns that, based on existing studies, a secondary allocation for the amateur service will cause harmful interference to existing and future systems and recommends that this allocation is not made.

Future requirements

When developing the agenda of the next World Radiocommunication Conference, IMO wishes to see WRC-12 include an item that would enable necessary amendments to be made to ITU Regulatory provisions, including consideration of additional allocation of spectrum, with respect to the review of the GMDSS and the implementation of e-navigation.

Earth observation

Getty Images/Jeremy Horner

Spectrum for Earth observations — A global challenge for ITU members

Philippe Tristant, Frequency Manager at Meteo France and EUMETNET

Philippe Tristant

From 2005 to 2010, Philippe Tristant chaired the Steering Group on Radio Frequency Coordination of the World Meteorological Organization (WMO) Commission for Basic systems and is still a member of this group

Information about climate, climate change, weather, precipitation, pollution and disasters is critically important for the global community. Earth observation activities make it possible to provide this information, which is required for daily and long-term weather forecasts, studies of climate change, protection of the environment, economic development, and safety of life and property.

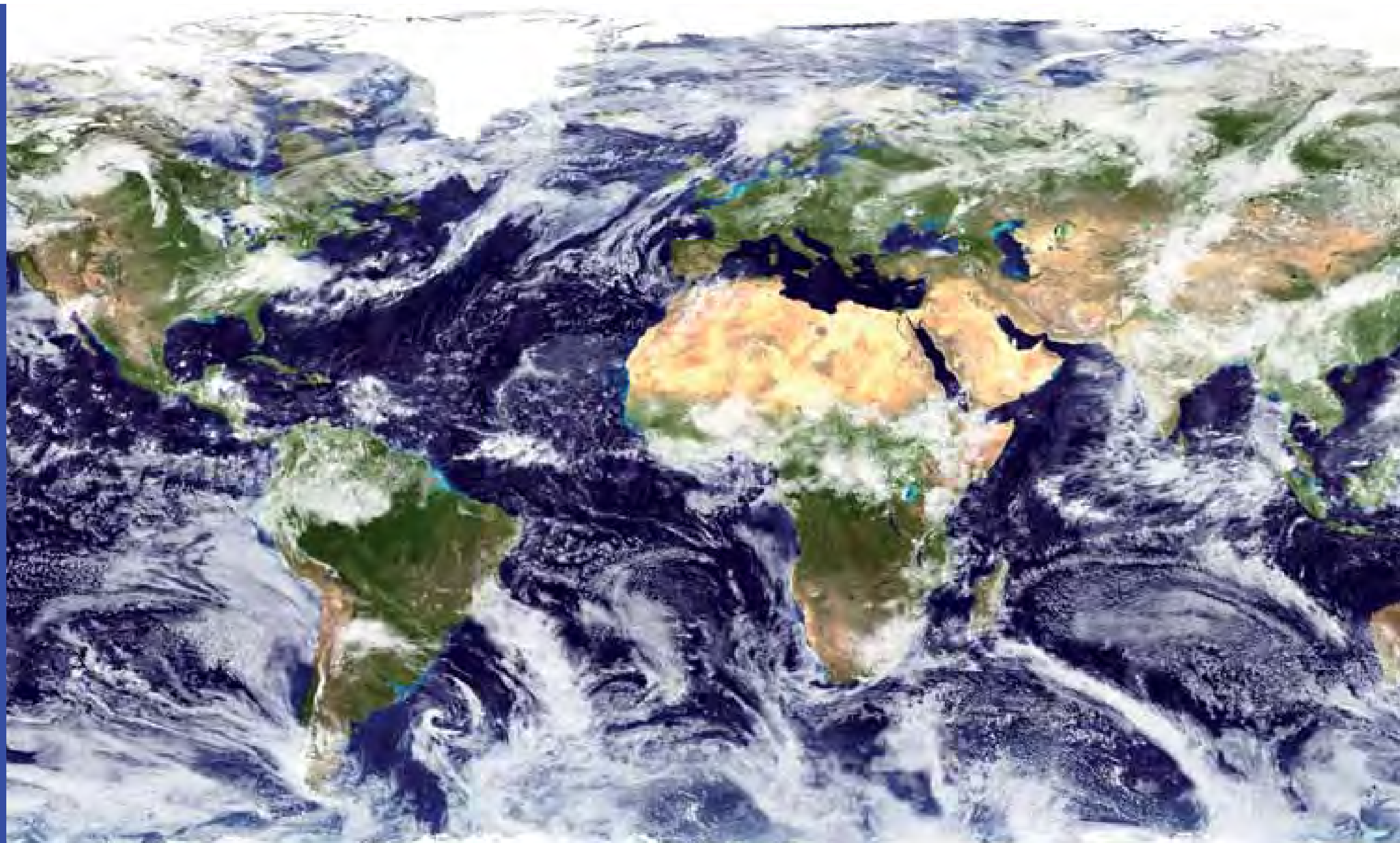
Earth observation applications are totally dependent on radio frequencies to measure and collect the data upon which analyses, predictions and warnings are based, and to disseminate this information to governments, policy-makers, disaster management organizations, commercial interests and the general public.

These applications are spread over the whole spectrum — from a few kHz to several hundred GHz — and make use of a large variety of radio technologies and services provided from the ground, in situ or from space. It is therefore not surprising to see agenda items related to Earth observation at all world radiocommunication conferences (WRCs).

Protecting "passive bands"

Among the many applications, the case of "passive bands" used for satellite remote sensing under the Earth exploration satellite service needs to be highlighted. The impressive progress made in recent years in weather and climate analysis and forecasts, including warnings for the dangerous weather phenomena (heavy rain, storms, cyclones) that affect all populations and economies, is to a great extent attributable to these "passive" observations and their incorporation in numerical models.

These applications, essential for meteorology and climate monitoring, involve the measurement of natural radiation at very low power levels and in frequency bands uniquely determined by physical properties (for example, molecular resonance). Low levels of interference (from in-band or out-of-band interferers) can degrade the effectiveness of passive sensors. Compatibility with the Earth exploration satellite service (passive) hence needs to be very carefully studied to avoid any risk of harmful interference that would render the corresponding bands unusable and definitively lost for the Earth observation community.



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Earth Observations at WRC-12

A number of items on the WRC-12 agenda are of direct interest to the Earth observation and meteorological communities. In particular, the conference will consider:

- agenda item 1.6 — identifying relevant bands for satellite remote passive sensing between 275 and 3000 GHz;
- agenda item 1.8 — potential out-of-band emission limits for the fixed service in order to ensure protection of the 86–92 GHz Earth exploration satellite service (passive) band;
- agenda item 1.15 — allocation of parts of the spectrum between 3 and 50 MHz for oceanographic radars;
- agenda item 1.16 — allocation of spectrum below 20 kHz for lightning detection applications;
- agenda item 1.24 — possible extension of the existing primary allocation to the meteorological satellite service (MetSat) in the band 7 750–7 850 MHz to the band 7 850–7 900 MHz.

Raising awareness of the importance of Earth observation

WRC-12 will also consider agenda item 8.1.1c, which aims to enhance recognition of the importance of Earth observations and to increase administrations' knowledge and understanding of the use and benefits of related applications. This item stems from Resolution 673 (WRC-07), and is not requesting any new allocation for, or protection to, services related to Earth observation.

For years, most members of the ITU Radiocommunication Sector (ITU–R) erroneously considered Earth observation radio applications to be unimportant, seeing Earth observations as being of scientific interest to just a few countries.

A lot of work has been performed in ITU–R since WRC-07 to respond to Resolution 673. Two Recommendations have been adopted: ITU–R RS.1859 on "Use of remote sensing systems for data collection to be used in the event of natural disasters and similar emergencies"; and ITU–R RS.1883 on "Use of remote sensing systems in the study of climate change and the effects thereof". And two reports have been published: the ITU–D report on "Utilization of ICT for disaster management, resources and active and passive space-based sensing systems as they apply to disaster and emergency relief situations"; and Report ITU–R RS.2178 on "The essential role and global importance of radio-spectrum use for Earth observations and for related applications".

These important reference documents show that:

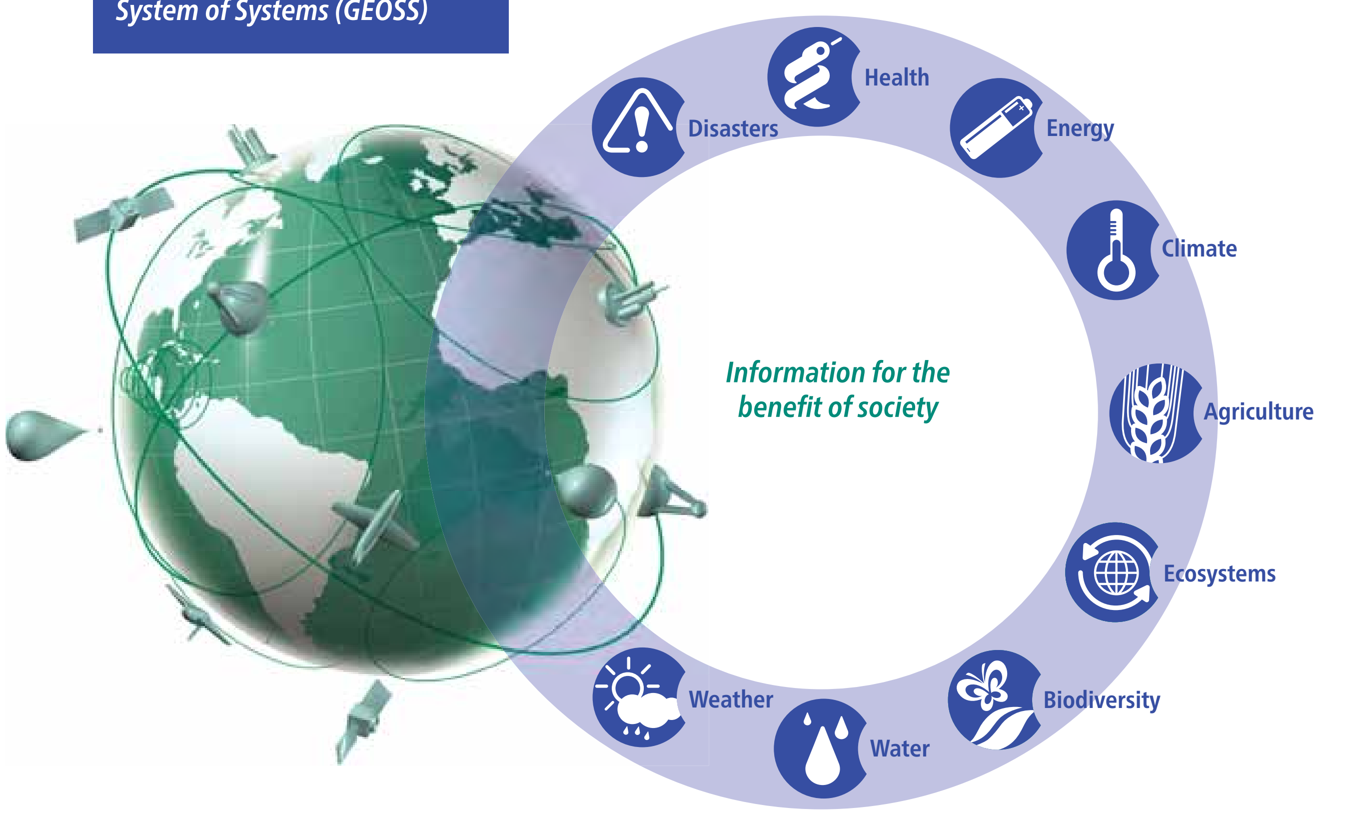
- Earth observation data are shared among all countries — generally at no cost — and directly benefit every citizen.
- The societal value of Earth observations outweighs the economic value of the radio-spectrum being sought.
- Most of this societal value relates to preventing mass loss of life or threats to socio-political stability and security.

Regional interest in Earth observation activities

All regions now recognize the need to maintain and improve Earth observation capabilities. Europe has been at the forefront of these activities with its Global Monitoring for Environment and Security programme. Europe also launched the initiative that resulted in the Group on Earth Observation (GEO), an intergovernmental organization that to date comprises 87 countries worldwide and more than 60 international organizations.

GEO is now leading a worldwide effort to build a Global Earth Observation System of Systems (GEOSS) to provide comprehensive and coordinated observations that will be transformed into vital information for the benefit of all within 9 different societal benefits.

Conceptual architecture of the Global Earth Observation System of Systems (GEOSS)



GEO recognizes radio frequency protection as being critically important, in particular in frequency bands where passive sensing measurements are performed. This was clearly stated in the Cape Town Declaration issued by the Earth Observation Ministerial Summit in November 2007.

Because of their complexity, the processes and phenomena that occur on Earth need to be observed continuously and over an extended time-frame. Also, the increasingly sophisticated observation instruments involve research and development efforts usually over a very long period of time. Earth observation activities therefore require the long-term availability and protection of radio frequencies to safeguard and secure these essential activities.

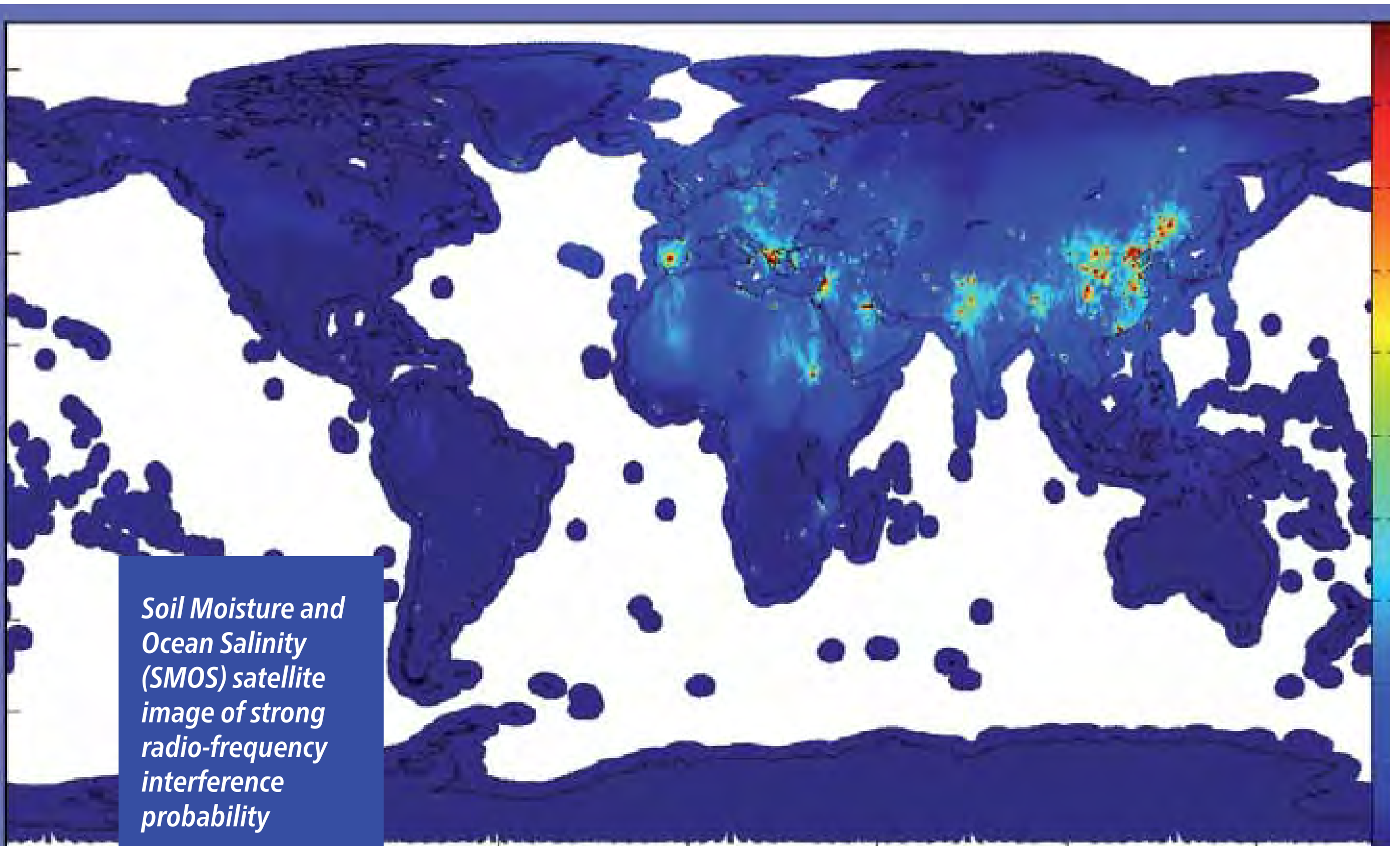
The Earth observation and meteorological communities sincerely hope that all ITU–R members will understand the use, benefits and requirements of Earth observation activities, and will give due consideration to proposals under WRC-12 agenda item 8.1.1c to improve recognition of the essential role and global importance of Earth observation radiocommunication applications.

Taking the long view

A number of new challenges in frequency management will obviously be considered at future WRCs, and one should hope that an understanding of the importance of Earth observation will not only prevail during the discussions among ITU–R members at WRC-12, but will also continue beyond that conference.

The frequency bands allocated to, and used for, Earth observation are to a great extent shared with other radiocommunication

ESA/P. Carril



Soil Moisture and Ocean Salinity (SMOS) satellite image of strong radio-frequency interference probability

services. As far as they go, the current conditions are satisfactory and should remain in place. The protection of purely "passive bands" covered by No. 5.340 of the Radio Regulations will require an increasing level of care and consideration. Clearly, future trends will probably lead to adding more and more new radio services in a spectrum that is already congested. This is bound to lead to an increase in cases of adjacent band potential interference and will justify the need to duly regulate unwanted emissions in the "passive bands".

The 1 400–1 427 MHz band is an example of a case in point. WRC-07 considered its protection from unwanted emissions produced by a large number of radio services but failed to agree on regulating the unwanted emissions — only recommended levels were proposed. In 2009, the European Space Agency (ESA) launched the Soil Moisture and Ocean Salinity (SMOS) satellite with a single instrument operating in this frequency band, and found that operations were experiencing unexpectedly high levels of interference. If the situation in this 1 400–1 427 MHz frequency band does not improve in the future, the possibility of using the band will be definitively lost for the Earth observation community, and with it the corresponding data that cannot be retrieved in other frequency bands.

More generally, avoiding the loss of essential data is the rationale for the strong involvement of the Earth observation and meteorological communities in the frequency management process. The global challenge for ITU members in the future is summed up in the simple ITU statement made at Cancún in December 2010 during the United Nations Climate Change Conference: "No spectrum, no global observations!"

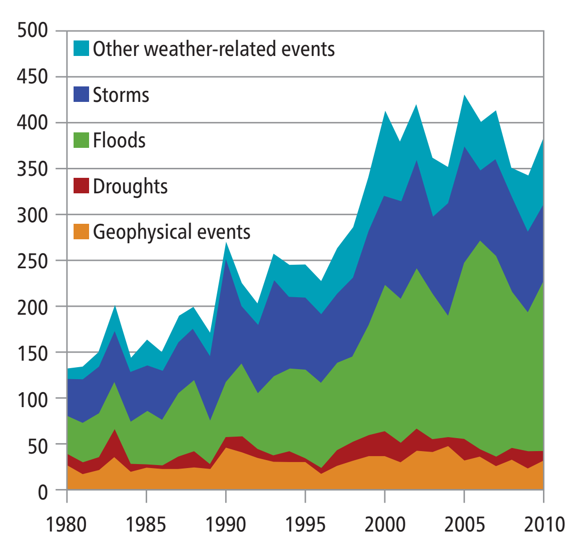
Natural disasters and climate monitoring

World Meteorological Organization

Trends in natural disasters

The number of natural disasters reported globally has increased considerably over the past three decades (Figure 1). Every year, disasters related to meteorological, hydrological and climate hazards cause significant loss of life, and set back economic and social development by years, if not decades. Between 1980 and 2005, nearly 7500 natural disasters worldwide took the lives of more than 2 million people and produced economic losses estimated at over USD 1.2 trillion. Hazards related to weather, climate or water — such as droughts, floods, windstorms, tropical cyclones, storm surges, extreme temperatures, landslides and wildfires — or health epidemics and insect infestations directly linked to meteorological and hydrological conditions caused 90 per cent of these natural disasters, around 73 per cent of the casualties and 75 per cent of the economic losses.

Figure 1 — Trends in number of reported natural disasters



Source: Steve Jennings, "Time's Bitter Flood" (http://reliefweb.int/node/405520).

Disasters and climate monitoring

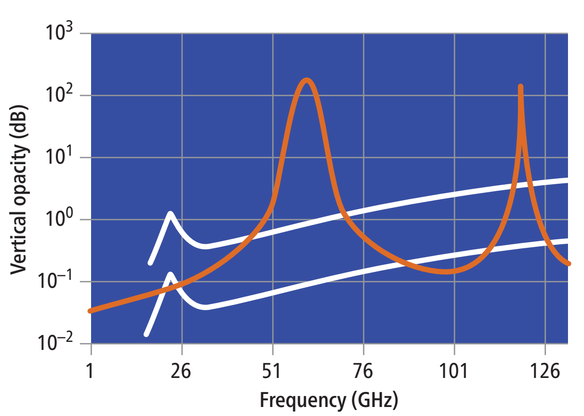
Progress in monitoring, forecasting and warnings of climate-related hazards, linked to effective emergency preparedness and response on the ground, saves lives. In the past five decades, globally, while the numbers of disasters and related economic losses have increased between 10 and 50 times, the reported loss of life has been reduced by a factor of 10. Climate forecasting and information allow us to plan our communities better so as to reduce the risk of disaster when extreme weather strikes. Better planning in health, agriculture, insurance and water resource management can help save livelihoods.

Nowadays radio-based remote sensors (active and passive) are the main tools for environment and climate monitoring, disaster prediction and detection, and for mitigating the negative effects of disasters. These sensors obtain environmental data by measuring the level and parameters of natural and artificial radio waves, which inherently contain information about the environment with which they have been in contact. Terrestrial and space-borne remote sensing applications form the backbone of the Global Climate Observing System (GCOS) of the World Meteorological Organization (WMO).

Global Climate Observing System

Radio-frequency spectrum and meteorological applications

Figure 2 — Oxygen vertical opacity (windows)



Source: Steve Jennings, "Time's Bitter Flood" (http://reliefweb.int/node/405520).

The relevant frequency bands for remote sensing applications are determined by fixed physical properties (molecular resonance) that cannot be changed and cannot be duplicated in other bands (see Figure 2 for an example). Therefore, these frequency bands are an important natural resource. Even low levels of interference received by a passive sensor may degrade its data.

Effective and prudent management of frequency bands allocated to different meteorological and Earth exploration-satellite services is paramount in maintaining and enhancing the quality and accuracy of environment and climate monitoring systems.

Importance of WRC-12 for the development and operation of monitoring systems

Successive ITU world radiocommunication conferences have taken into account the needs of the meteorological community to ensure the availability and protection of radio-frequency bands for observation tools such as radiosondes, weather and wind profiler radars and space-borne infrared and microwave sounders.

On the agenda of World Radiocommunication Conference 2012 (WRC-12), several items concern frequency bands or matters of prime interest for meteorology. These items may be divided into two groups:

- tems devoted to the further development of observation systems or applications;
- items that may have some effects on the operation of monitoring systems or applications.

Topics related to the environment and to the further development of climate monitoring systems include agenda items 1.6, 1.15, 1.16, 1.24 and 8.1.1.

One of the main directions for the future of Earth observation applications is the development of passive sensors flying on meteorological and environmental satellites that will operate in frequency bands between 275 and 3 000 GHz. These bands, to be discussed under agenda item 1.6, correspond in particular to water vapour and oxygen spectral lines that are important for ice cloud and precipitation measurements. Such measurements are

AFP

needed for storm monitoring and climate studies, so it is crucial for WRC-12 to update No.5.565 of the Radio Regulations on the basis of the conclusions reached by the Study Groups concerned.

Possible allocations in the range 3–50 MHz to the radiolocation service for oceanographic radar applications, to be discussed under agenda item 1.15, could be used for monitoring the sea surface for wave heights and currents, and for the tracking of large objects. Oceanographic radars have been successfully operating in the 3–50 MHz frequency range since the 1970s in some countries. The need for additional data to mitigate the effects of disasters (including tsunamis), understand climate change and ensure safe maritime travel calls for a global network. Such a network will support environmental, oceanographic, meteorological, climatological, maritime and disaster mitigation activities. WMO believes that WRC-12 will include the relevant allocations in the Radio Regulations.

Agenda item 1.16 will consider the needs of passive systems for lightning detection. Data provided by the lightning detection system contribute towards safety of life, both in terms of forecasting for public safety and for the safety of aviation operations, especially over the oceans and large areas of land where national lightning detection systems do not exist. As well as the dangers of the lightning strike itself, thunderstorms can result in intense precipitation with consequent flooding, severe icing, wind shear, turbulence and gusting winds. Recently, it has been shown that this system can also monitor volcanic ash cloud activity. Based on the successful results of studies carried out by the ITU Radiocommunication Sector, WMO expects that a new allocation for these applications will be included in the Radio Regulations.

Non-geostationary orbit (non-GSO) satellites are an important part of the space-based Global Observing System. The mission requirements for next-generation non-GSO meteorological satellites in terms of observations, instruments and user-services clearly show a need to transmit higher data rates compared to current systems. Extension of the existing allocation to the meteorological-satellite service in the band 7 750–7 850 MHz to the band 7 850–7 900 MHz will be discussed under agenda item 1.24. Technical studies have demonstrated compatibility in these frequency bands with systems of other services, and the proposed extension is viable without undue limitations on other services.

Peter Aloisio

ITU and WMO both recognize the crucial importance of radio-frequency spectrum and radio-based remote sensing systems and applications for meteorological and environmental observations for climate monitoring, disaster risk reduction, and adaptation to and mitigation of the negative effects of climate change. In the context of agenda item 8.1.1, WMO stresses the importance of Resolution 673 (WRC-07) in relation to Earth observation activities and the need to secure a long-term WRC Resolution on the subject.

From WMO's point of view, special attention also needs to be paid to agenda items 1.2, 1.5, 1.8, 1.19, 1.20, 1.22 and 1.25, because they may have some effects on the operation of meteorological monitoring systems or applications. These items relate to enhancing the international regulatory framework, electronic news gathering, the fixed-service systems in the frequency bands 71–238 GHz, use of software-defined radio and cognitive radio systems, emissions from short-range devices, and allocations to the mobile-satellite service. In discussing and taking decisions on these items, WRC-12 should bear in mind that:

- the protection of frequencies used for meteorological purposes is of direct and vital interest to the international meteorological community;
- timely warning of impending natural and environmental disasters, accurate climate prediction and detailed understanding of the status of global water resources, which are all provided by meteorological applications, are critically important for the global community every day.

WMO considers that it is especially important to introduce mandatory limits for unwanted emissions of fixed-service systems operating in the 81–86 GHz and 92–94 GHz bands for the protection of the 86–92 GHz Earth-exploration satellite services (passive) frequency band (under agenda item 1.8). This band is one of the most important passive bands for current and future sensors measuring clouds, ice, rain and snow.

Electronic news gathering

Electronic news gathering

The question of harmonizing tuning ranges and frequency bands

Roger Bunch, Director of Engineering, Free TV Australia and Vice-Chairman of ITU–R Working Party 6A

Roger Bunch

Electronic news gathering applications have been operating terrestrially in bands allocated to the broadcasting service (in the case of wireless microphones) and the fixed and mobile services (in the case of portable wireless cameras) for many decades.

Heightened public interest in international news has increased the need for coverage and, hence, the need for electronic news gathering applications. Because of this, the decisions taken at WRC-07 under Resolution 954 need to be updated.

Coverage of news events can involve several electronic news gathering crews attempting to cover the same situation in a geographic area. This requires several radio-frequency channels to operate simultaneously, often over the same radio path, because the timeliness of capture and delivery of content has become more critical in today's shortened news cycle.

Electronic news gathering is an activity that increasingly extends across national boundaries. Electronic news gathering equipment may be used in a range of situations. At one extreme, it may be used at known locations and scheduled times, for an estimated duration, in which case the details of the electronic news gathering coverage can be planned well in advance. At the other extreme, it may be used at very short notice at unknown locations for unknown durations, in cases such as breaking news or disaster.

With the growth in the use of frequency bands between 500 MHz and 10 GHz by several radiocommunication services, the possibility of increased congestion and interference in the same geographic area from other services may hinder electronic news gathering operations in some frequency bands. Co-siting requirements of multiple electronic news gathering links, while covering an event, need to be met.

Rationalization

Studies undertaken in the ITU Radiocommunication Sector (ITU–R) have resulted in four methods which may address harmonizing frequency bands for electronic news gathering. These fall into three groups:

- rationalization of the spectrum used by electronic news gathering;
- harmonization of tuning ranges within frequency bands for electronic news gathering;
- a combination of both rationalization and harmonization.

The terms are understood as follows:

- Rationalization means using available technology to maximize efficient and flexible use of frequencies. This

* *The author thanks John Lewis, Consultant in international spectrum management, for his advice.*

implies using standardized equipment and advanced technologies to ensure the most efficient use of frequencies when equipment is deployed. Obviously, the use of equipment must be in accordance with the administrative regulations.

- Harmonization means global or regional agreement to employ harmonized spectrum use in specific bands.

Some administrations consider that, depending on the specific electronic news gathering application, spectrum rationalization may be more productive because it will give foreign broadcasters or electronic news gathering operators knowledge of, and access to, the required spectrum in a given country or region.

Tuning range

The term "tuning range" for electronic news gathering means a range of frequencies over which radio equipment is expected to be capable of operating. Within this tuning range, the use in country A of radio equipment from country B will be limited to the range of frequencies identified nationally in country A for electronic news gathering, and the equipment will be operated in accordance with the related national conditions and requirements. This does not preclude the use of other applications in the same frequency range nor establish priority over any other use of these bands.

These tuning ranges are recommended good practice. They are preferred but not obligatory. The recommendations offer an important advantage in that they provide advice and guidance to equipment manufacturers. A table of preferred tuning ranges would include ranges that could be used in some countries but not in others. This is not a cause for concern — there is no need for access to all preferred tuning ranges to be possible in all countries. What would be important is that a country should seek to make available a number of channels in a preferred tuning range for each type of electronic news gathering application — both audio and video — for cross-border deployment by electronic news gathering crews.

Which tuning ranges could an administration propose for cross-border use by visiting electronic news gathering crews? One possibility would be to propose part of the spectrum resource assigned for use in national electronic news gathering. This would

imply the need to coordinate cross-border use by visiting crews with national use, most probably on a case-by-case basis. Another possibility would be to propose tuning ranges for cross-border use that would not be used for national electronic news gathering applications. This would imply coordination with other existing national users, again most probably on a case-by-case basis.

Official notice by an administration of the tuning ranges available for cross-border use by visiting electronic news gathering crews would necessarily include details of the relevant administrative and temporary licensing arrangements. What if guidance on these tuning ranges is "hidden" in an ITU–R Recommendation and is not easy to find? This is not a concern if administrations are aware of, and generally, follow ITU–R Recommendations.

A recommendation in the Radio Regulations (if that is the chosen solution) could refer to one or more ITU–R Recommendations. Such recommendations would not be mandatory.

Electronic news gathering applications are unfortunately assumed to be newcomers in the bands allocated to the broadcasting, fixed and mobile service. In practice, many administrations have been making assignments for electronic news gathering applications for many years. By now, electronic news gathering has become part of the audio-visual, security and entertainment landscape for many administrations.

Administrations make individual decisions about national assignments for electronic news gathering. At WRC-12 administrations also have the opportunity to identify preferred tuning ranges for cross-border deployment of electronic news gathering. Studies have focused on the bands already used for electronic news gathering applications. These studies have found that spectrum tuning range requirements to facilitate cross-border electronic news gathering may be considerably less than host administrations' national requirements.

It remains to be seen which frequency bands or tuning ranges administrations at WRC-12 will prefer for cross-border deployment of electronic news gathering.

Getty Images/Will Crocker

Software-defined radio and cognitive radio systems

Sergey Pastukh, Chairman, ITU–R Working Party 1B


Sergey Pastukh

ITU/V. Martn

A definition of adaptive systems was introduced into the Radio Regulations more than a decade ago. Adaptive systems are defined as being capable of modifying their parameters, including frequency and power, in order to improve the quality of reception. Today, such systems are limited to the medium and high frequency bands, where propagation conditions vary significantly. Regulatory provisions applicable to adaptive systems prohibit their operation in the bands used by safety services, as well as by the radio astronomy, radiodetermination, amateur and broadcasting services. Further technological developments have increased the capabilities of adaptive systems. Software plays an important role in this respect, making it possible to analyse the radio environment and adjust system characteristics to specific operational situations. Such a combination of radio equipment and software offers new solutions for resolving the problem of frequency congestion and improves the overall efficiency of spectrum use. With these technological advances, two new concepts have emerged: software-defined radio and cognitive radio systems (see box).

A common concern has been the protection of existing services from potential interference caused by software-defined radio and cognitive radio systems. That is why WRC-12 will consider regulatory measures and their relevance, in order to enable the introduction of software-defined radio and cognitive radio systems, as well as to facilitate, ensure and enhance coexistence and sharing among radiocommunication services, based on the results of ITU–R studies.

Software-defined radio and cognitive radio system technologies are expected to provide additional flexibility and offer improved efficiency to overall spectrum use. These technologies can be combined or deployed independently, and can be implemented in systems of any radiocommunication service. Any system that uses software-defined radio or cognitive radio technologies must operate in accordance with the provisions of the Radio Regulations.

Cognitive radio systems are a field of research activity, and applications are under study and trial. Systems that use some cognitive features have already been deployed, and some administrations are authorizing these systems (for example, dynamic frequency selection and white space devices). These administrations have national equipment approval processes to protect existing services from harmful interference. A radio system implementing cognitive radio technology may, however, have an impact on neighbouring countries and coordination may be needed. Where there are applications in which cognitive radio systems technology is implemented on a non-interference and non-protection basis, the concerned administration should ensure that interference will not actually be generated.

Software-defined radio technology is now operating in some systems and networks in the land and maritime mobile, broadcasting and broadcasting-satellite, fixed and mobile-satellite services. It offers flexibility in radio system design and may help with forward compatibility.

The full implementation of the software-defined radio and cognitive radio systems concept is likely to be realized gradually for a number of reasons, including the current state of the technology. The use of these technologies in some bands may pose specific and unique challenges of a technical or operational nature, which need to be carefully and comprehensively considered by ITU.

Definitions for software-defined radio and cognitive radio systems

Source: Report ITU–R SM.2152.

*"**Software-defined radio** is a radio transmitter and/or receiver employing a technology that allows the RF operating parameters including, but not limited to, frequency range, modulation type, or output power to be set or altered by software, excluding changes to operating parameters which occur during the normal pre-installed and predetermined operation of a radio according to a system specification or standard."*

*"**Cognitive radio system** is a radio system employing technology that allows the system to obtain knowledge of its operational and geographical environment, established policies and its internal state; to dynamically and autonomously adjust its operational parameters and protocols according to its obtained knowledge in order to achieve predefined objectives; and to learn from the results obtained."*

François Rancy, Director of the ITU Radiocommunication Bureau and Christoph Dosch of IRT and Chairman of ITU–R Study Group 6 receiving the Emmy Award

Printroom

ITU receives Emmy Award for new audio broadcast standard

Christoph Dosch, Chairman, ITU–R Study Group 6 (broadcasting service)

On 12 January 2012, the Director of the Radiocommunication Bureau, François Rancy, and I proudly received on behalf of ITU–R Study Group 6 (broadcasting service) the Emmy Award for Technology and Engineering for 2011 from the National Academy of Television Arts and Sciences, of the United States. The Emmy was awarded for the ground-breaking work relating to Recommendation ITU–R BS.1770-2 on the worldwide standardization of loudness metering for use in broadcast audio, which the Academy considered as outstanding and showing excellence in engineering creativity.

There are many applications where it is necessary to measure and control the perceived loudness of audio signals. Examples of this include television and radio broadcast applications, where the nature and content of the audio material changes frequently. In these applications, the audio content can continually switch between music, speech and sound effects, or some combination of these. It can also change between various audio or audio-visual sources, for example in international programme exchange. Such changes in the content of the programme material can result in significant changes in subjective loudness. Moreover, various forms of dynamics processing are frequently applied to the signals, which can have a significant effect on the perceived loudness of the signal. Of course, the matter of subjective loudness is also of great importance to the music industry where dynamic processing is commonly used to maximize the perceived loudness of a recording.

Recommendation ITU–R BS.1770 — Algorithms to measure audio programme loudness and true-peak audio level — was elaborated over a decade through the dedication of many specialists including Craig Todd (Dolby/United States), Gilbert Soloudre (CRC/Canada), and Spencer Lieng (ABC/Australia). It was eventually finalized during the most recent study period within ITU–R Working Party 6C, under the chairmanship of David Wood (European Broadcasting Union). The pertinent algorithm and the agreed parameters are now contained in the revision to the Recommendation, approved by the ITU Member States, giving worldwide guidance on loudness metering, which is considered an important advance in this area.

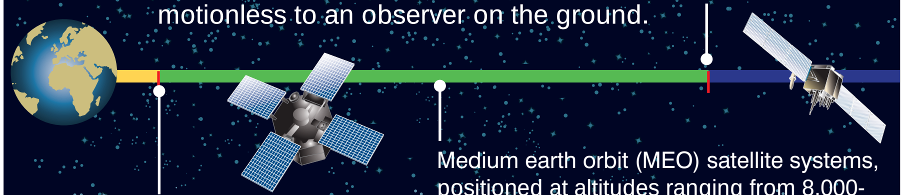
From left to right: François Rancy, Director of the ITU Radiocommunication Bureau; Christoph Dosch of IRT and Chairman of ITU–R Study Group 6; Craig Todd, Chief Technology Officer, Dolby Laboratories; Gilbert Soulodre, Camden Labs; Louis Thibault, Manager Advanced Audio Systems, Communication Research Center and Steve Lyman, Senior Staff Engineer, Broadcasting, Dolby Laboratories

Printroom

Messages from on high

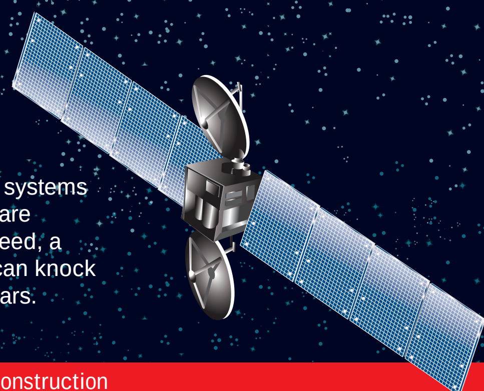
Over 500 satellites orbit the Earth delivering broadcasting; voice, internet and emergency communications; environmental and scientific monitoring; and global navigation and positioning systems for planes, ships and vehicles.

Most communication satellites are launched into an orbit 35,786km above the equator (Geostationary orbit, or GEO) and rotate with the Earth, appearing motionless to an observer on the ground.



Low Earth Orbit (LEO) satellites occupy orbits starting from a few hundreds of kilometers above Earth to around 1,000km. LEO constellations need even larger numbers of satellites to provide constant Earth coverage.

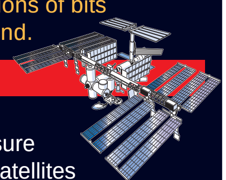
Medium earth orbit (MEO) satellite systems, positioned at altitudes ranging from 8,000-15,000km above the Earth, require a larger constellation of spacecraft – typically 10-15 satellites – to maintain coverage of the Earth.



Space debris is a growing problem. Disused satellites, discarded launch systems and fragments caused by collisions are putting satellites at risk. At orbital speed, a fragment measuring less than 1cm can knock out a satellite costing millions of dollars.

Construction

• Manufacture	Around 2 years
• Cost	Hundreds of millions of dollars to build, launch and operate
• Lifespan	Over 15 years for GEO satellites
• Capacity	Transmit trillions of bits of data/second.



Coordination

International cooperation and coordination is essential to ensure interference-free operation of satellites and their coexistence with ground-based services sharing the same radio frequency bands.

ITU is the UN agency charged with the global management of spectrum and associated satellite orbits, including GEO slots, helping bring modern communications to communities worldwide.

WORLD RADIOCOMMUNICATION CONFERENCE 2012

GENEVA, 23 JANUARY – 17 FEBRUARY 2012

www.itu.int/ITU-R/go/WRC-12