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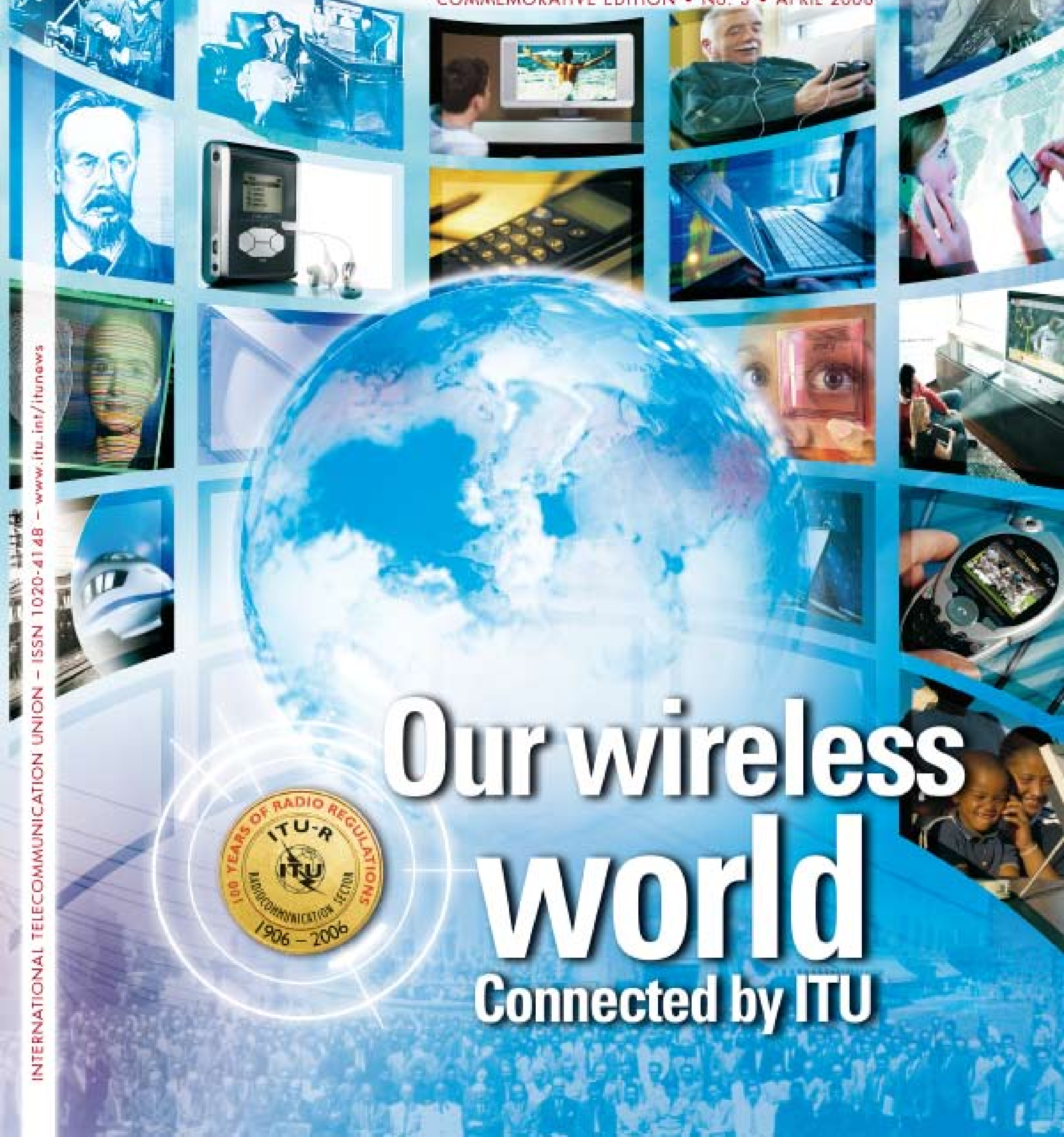

Our wireless world

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CONTENTS

No. 3 APRIL 2006

COMMEMORATIVE EDITION:

The centenary of the international Radio Regulations

One hundred years ago, an *International Radiotelegraph Convention* was signed in Berlin in 1906. Its annex contained the world's first set of rules that later came to be known as the *Radio Regulations*. The ITU membership has good reason to celebrate this centenary, which marks the foundation of an international treaty to govern the use of the radio-frequency spectrum and the geostationary-satellite and non-geostationary-satellite orbits.

The Radio Regulations are updated regularly in order to keep in step with the ever-expanding use of radio. This is achieved through ITU's world radiocommunication conferences. These meetings undertake often lengthy and challenging work to produce timely and effective international rules for the establishment of advanced new wireless services and applications, while safeguarding the interests and rights of existing radiocommunication users.

This commemorative edition of *ITU News* includes contributions from radiocommunication experts that give an overview of the past, the present, and the future in the world of wireless.

ITU-based processes and regulations will continue to play a central role in fostering the rapid evolution and expansion of wireless systems on a global scale.

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Council 2006
New times, new strategies

Times are constantly changing. And so must strategies in order to respond to new challenges. A key task for the Council when it meets in Geneva on 19–28 April 2006 will be to develop the Strategic Plan to guide the work of ITU in the years 2008–2011. It will do so, based on a chain of reports, covering mainly the outcomes of the two phases of the World Summit on the Information Society (WSIS), the work done to reform ITU, the Union's financial planning, the issue of working languages, internet activities, future events, and, of course, staff matters.

At the summit's first phase in Geneva in 2003, world leaders issued a *Declaration of Principles* and a *Plan of Action*. They gave a ringing endorsement to the ITU mandate of bridging the digital divide and to building the information society through radio spectrum management, standards development, international and regional cooperation and dissemination of information in support of policy-making.

The summit's second phase agreed on *The Tunis Commitment* and the *Tunis Agenda for the Information Society*. The Tunis Agenda tasked ITU with playing a leading facilitating role in the overall implementation of the WSIS Plan of Action, alongside the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Development Programme (UNDP). Furthermore, it called upon ITU to contribute its proven expertise to the Internet Governance Forum that will hold its inaugural meeting in Athens later this year.

ITU is also expected to play a leading role in the work of the United Nations Group on the Information Society that will be established to facilitate implementation of the WSIS outcomes. The group will be set up in April 2006 at a meeting of the Chief Executive Board (CEB), which is made up of executive heads of all UN agencies.

Meanwhile, the World Telecommunication Development Conference, organized by ITU in Doha in March 2006, has called upon all Member States and Sector Members to contribute towards the successful implementation of the WSIS outcomes. It is also gratifying to note that on 27 March 2006, the United Nations General Assembly endorsed the outcomes of WSIS, welcoming their strong development orientation and the progress achieved towards a multi-stakeholder approach to building a people-centred, inclusive and development-oriented information society.

Thanks to the multi-stakeholder approach, the private sector, civil society and international organizations, were all able to express their views, alongside governments, at virtually every stage of the WSIS process. There is growing evidence that this approach should be continued in ITU's processes, particularly as a result of wider responsibilities from WSIS.

Finally, as requested by the Tunis Summit, the United Nations General Assembly has proclaimed 17 May as World Information Society Day, to raise awareness each year of the importance of the internet as a global resource. The Council may wish to give its views on the role ITU, as the lead agency for ICT, should play, considering that 17 May has been traditionally commemorated as World Telecommunication Day.

The ICT revolution will continue to develop in ways that offer an ever-wider range of opportunities and challenges. Clearly, the strategies that the Council will develop and present to the Plenipotentiary Conference in Antalya (Turkey) on 6–24 November 2006 must be forward-looking to respond to new times.

The Editor

Doha Action Plan

The *Doha Action Plan* is the key outcome of the fourth World Telecommunication Development Conference, organized by ITU in Doha, Qatar, on 7–15 March 2006. The plan sets out six programmes covering: regulatory reform; information and communication infrastructure and technology development; e-strategies and ICT applications; economics and financing, including cost and tariffs; human capacity

building; and least developed countries, Small Island Developing States, and emergency telecommunications. Two cross-cutting activities were also reaffirmed, and deal with statistics and information on telecommunications/ICT and partnerships and promotion. In addition, five global initiatives were endorsed that focus on women, youth and children, indigenous people and communities, people with disabilities and communities living in rural and under-served areas.

The study group work programme has been expanded to include four new questions in the areas of access to telecommunication services for people with disabilities; the impact of telecommunication development on the creation of employment; securing information and communication networks, including best practices for developing a culture of cybersecurity; and ICT and space-based systems for disaster prediction, detection and mitigation. The plan includes a new regional approach to development where each region defines the framework of action for all stakeholders, based on region-specific priorities. Almost 1000 top-ranking officials from government, the private sector, as well as international and regional organizations attended the conference. More details will appear in the May 2006 issue of *ITU News.*

Geneva event focuses on RFID

Radio-frequency identification (RFID) enables data to be transmitted wirelessly by a tiny portable device, called a tag, that can be attached to almost any object. Analysts predict that RFID will revolutionize such areas of industry as supply chain management and mobile telecommunication services. ITU's Telecommunication Standardization Sector (ITU–T) organized a workshop on *Networked RFID: Systems and Services* in Geneva on 14–15 February 2006. The workshop concluded

that a unified approach is needed on RFID standards for the technology to progress on a global scale, and that ITU can play an important role in international standardization efforts, as well as in raising awareness of the new technology.

Call for global standards to shape the digital home

More and more, digital electronic information and media devices are being used in the home, along with remote control of home lighting, heating and security systems. International standards that allow interoperability and security in the field of home networking are seen as the key to bringing the full potential of these services to consumers: this was the key conclusion of a World Standards Cooperation (WSC)

workshop, held in Geneva on 2–3 February 2006, that brought together some 100 experts from industry, academia and standards development organizations. The purpose of WSC is to reinforce and promote the voluntary standards system that is formed by consensus among the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC) and ITU.

Date set for Internet Governance Forum

The inaugural meeting of the Internet Governance Forum (IGF) will take place in Athens on 30 October – 2 November 2006. This decision was reached following consultations with the Government of Greece and representatives of stakeholder groups at a February meeting in Geneva. The meeting discussed the IGF's scope of work and priorities, as well as its structure and functioning. The IGF is to be convened by the United Nations Secretary-General, under a mandate set out in the Tunis Agenda that resulted from the second phase of the World Summit on the Information Society last November. Its purpose is to act as a "new forum for multi-stakeholder policy dialogue" on questions of internet governance. ■

From radiotelegraphy to worldwide wireless

How ITU processes and regulations have helped shape the modern world of radiocommunications

By Valery Timofeev

A century's wave of progress

Experiments with radio transmissions started in the late nineteenth century. Then in May 1895, a Russian professor, Alexander Popov, reported sending and receiving a wireless signal across a distance of some 600 metres. In the same year, Guglielmo Marconi managed to transmit and receive radio signals at his parents' home in Italy. Two years later, Popov equipped a land station at Kronstadt and the Russian navy cruiser *Africa* with his wireless apparatus for ship-to-shore communications. In 1901, Marconi is reputed to have sent the first transatlantic radio signal from south-western England to Newfoundland.

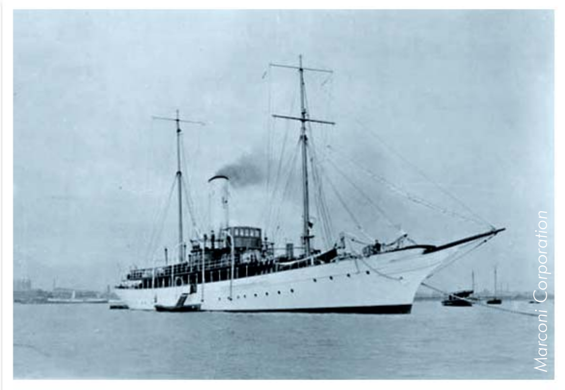
Radiotelegraphy soon came to be used extensively, and its various applications started to be developed quickly. For example, wireless signals proved to be effective in communications for ships in distress. By the early 1900s, a number of ocean liners had already installed wireless equipment.

As a consequence, in 1906 the first **International Radiotelegraph Conference** gathered 29 maritime States in Berlin to sign the *International Radiotelegraph Convention*, establishing the principle of compulsory intercommunication between land and vessels at sea. The annex to this Convention contained the first regulations governing wireless telegraphy. These regulations have since been expanded and revised by numerous radio conferences, and are now known as the *Radio Regulations*. Coincidentally, 1906 was also the year in which the Canadian, Reginald Fessenden, made the first radio broadcast of the human voice (see *ITU News* of December 2005).

A hundred years later, we are again witnessing another spectacular growth in the use of wireless communications. Innovative technological solutions using radio transmission are laying the foundations for a truly *wireless world*. Radio has become pervasive in our lives, from personal devices such as mobile phones, radio-controlled watches, radio headsets to equipment for home and office networking, radio positioning systems for navigation, intelligent transport systems (for example, toll control and collision avoidance), broadcasting through radio and television, and emergency communications and disaster warning systems.

Valery Timofeev, Director, ITU Radiocommunication Bureau

Poldhu wireless station in 1901 with the fan-shaped aerial which sent the first wireless signal across the Atlantic to Signal Hill, Newfoundland



Initial experiments on board Elettra

We are also seeing the development of such important new technologies as radio-frequency identification (RFID), which, for instance, uses tags that can be attached to almost any object and report back on its whereabouts.

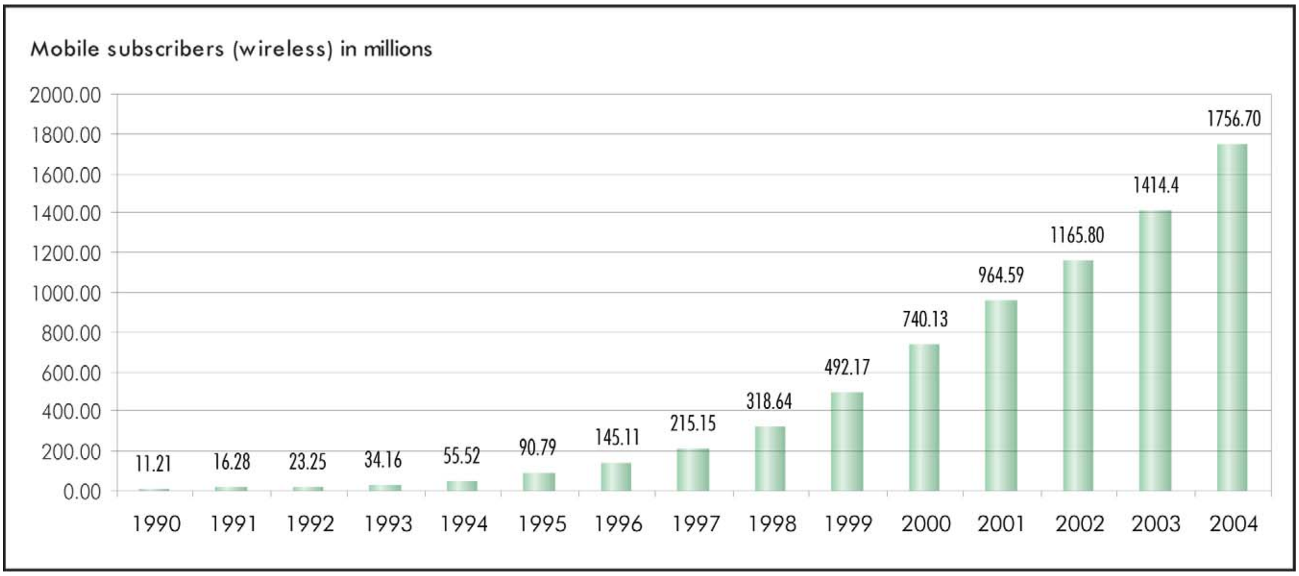
One striking example in the wireless revolution is the astounding growth of mobile communications since the service was initially deployed. In 1990, there were only about 11 million mobile subscribers worldwide. This number increased to over 300 million by the end of 1998, and at the end of 2004 it had boomed to 1.75 billion, according to ITU statistics (see Figure 1).

We are now witnessing the full deployment of third-generation (3G) mobile systems, based on ITU standards known as IMT-2000. According to industry data, more than 250 million users are enjoying the benefits of IMT-2000 services, and the number could rise to 1 billion by the end of this decade. The framework for the development of 3G was established in 1992 at ITU's World Administrative Radio Conference (WARC-92), where, among other regulatory provisions, the radio-frequency spectrum bands were identified on a global basis for use by countries when deploying IMT-2000 systems.

The international dimension

In order to function properly, all radiocommunication systems make use of appropriate radio frequencies. However, the propagation proprieties of radio waves ruled by laws of

Figure 1 – Growth of mobile communications



Source: *ITU World Telecommunication Indicators Database, 2005.*

physics mean that radio frequencies do not respect national borders. Sometimes, this is done intentionally in order to provide international radiocommunication services, for example, in the case of high-frequency broadcasting and satellite systems, or aeronautical and maritime communications. Consequently, as radio technology developed, the international community established a structure for coordinating activities related to the use of spectrum and preventing radio interference.

The **first Radiotelegraph Conference** (Berlin, 1906) established the international *Table of Frequency Allocations*, which allocated frequencies from 500 to 1000 kHz for public use in the maritime service, a frequency band (below 188 kHz) for long-distance communication by coast stations, and another band (188–500 kHz) for military and naval stations not open to public use. In order to facilitate and strengthen this international cooperation, organizational structures and procedures were developed.

In 1927, the Washington Radiotelegraph Conference established the **International Radio Consultative Committee (CCIR)** to study technical radio problems. In Madrid in 1932, the Plenipotentiary Conference decided to change the name of the International Telegraph Union to *International Telecommunication Union*. It also decided that ITU should be governed by a single *International Telecommunication Convention* and supplemented by *Telegraph Regulations*, *Telephone Regulations* and *Radio Regulations*. The new name, which came into effect on 1 January 1934, was chosen to better reflect the full scope of the Union's activities, which by then covered all forms of wireline and wireless communications.

Radio has become pervasive in our lives — for listening to the news, making phone calls, or networking the office and home with the latest wireless equipment. Radio is also an essential element of emergency communications, as well as systems for navigation and intelligent transport

The results of the Madrid Conference had several implications for radiocommunications. One was the division of the world into two Regions (Europe and other regions) for the purposes of frequency allocation. Another was the establishment of two technical tables (one for frequency tolerances and the other for acceptable emission bandwidths). The third was the setting of standards for the registration of new stations.

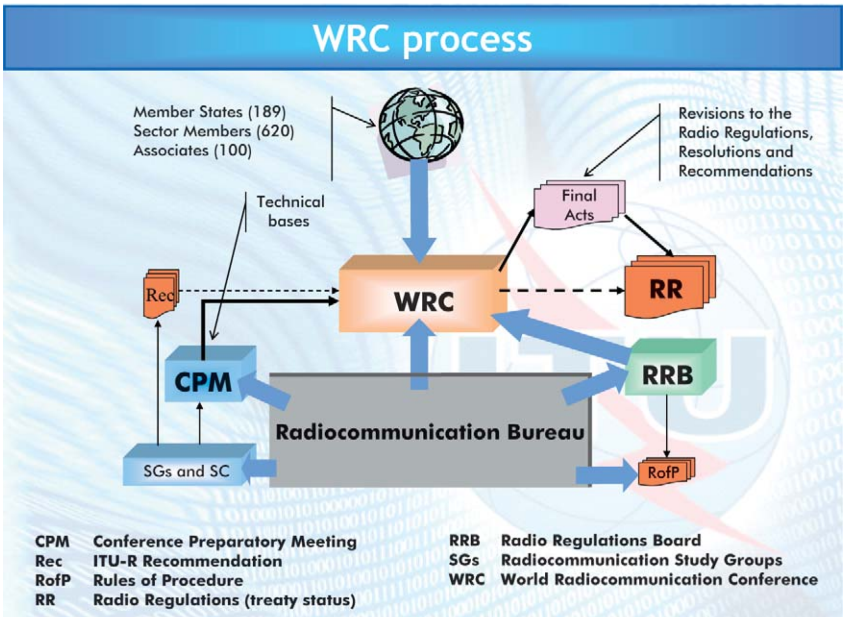
The **Plenipotentiary Conference** that followed in 1947 in Atlantic City (United States) had the aim of developing and modernizing ITU. Under an agreement with the United Nations, ITU became a UN specialized agency on 15 October 1947, with its headquarters in Geneva. ITU has continued ever since to play a vital role in the overall management of the radio-frequency spectrum and its activities have a significant impact on national spectrum management.

The WRC process

The dramatic rise in demand for frequency assignments from the 1940s onwards caused severe congestion in the lower frequency bands to the point where utilization of the upper frequency bands began to be explored in earnest. As far back as 1979, the need for additional frequency availability was recognized. As a consequence, the *ITU Table of Frequency Allocations* was thoroughly revised by the **World Administrative Radio Conference of 1979 (WARC-79)** — a diplomatic marathon, which lasted more than three months with the object, among others, of stimulating development of the upper frequency bands, especially above 20 GHz.

Since WARC-79, in view of the enormous demand for spectrum, the *Radio Regulations*, and particularly the *ITU Table of Frequency Allocations*,

Figure 2 – The WRC process



have been revised and updated almost regularly, in order to keep pace with the rapid expansion of existing systems and new, spectrum-hungry advanced wireless technologies. The **ITU World Radiocommunication Conferences (WRC)** are at the heart of this updating process, which constitutes the starting point for national spectrum management (see Figure 2).

In the 1980s, concern arose about ensuring equitable access to spectrum and orbital resources, particularly given the uneven needs of developed and developing countries in terms of quantity and timely access to those resources. As a consequence, the principle of *a-priori* planning of spectrum and orbit resources was introduced in ITU at a series of planning conferences that took place during that decade and involved mainly space radiocommunication services.

According to its Constitution, ITU is responsible for the allocation of spectrum and registration of frequency assignments, and of orbital positions and other parameters of satellites "in order to avoid harmful interference between radio stations of different countries". The international spectrum management system is therefore based on regulatory procedures for frequency notification, coordination and registration. This is an essential task for administrations to ensure their services obtain international recognition and are coordinated with the services of other administrations. ■

World radiocommunication conferences at a glance

The next conference

World Radiocommunication Conference 2007 (WRC-07) (Geneva, 15 October–9 November 2007)

This conference will consider some 30 agenda items, covering almost all terrestrial and space radiocommunication services. Many applications will also be discussed, including those of the third-generation International Mobile Telecommunications (IMT-2000) and systems beyond IMT-2000, high-altitude platform stations (HAPS), high-frequency broadcasting, and Global Maritime Distress and Safety Systems (GMDSS).

Notable achievements between 1995 and 2003

World Radiocommunication Conference 2003 (WRC-03)
(Geneva, 9 June–4 July 2003)

Siemens

- New frequency allocations were made to the mobile service in the bands 5 150–5 350 MHz and 5 470–5 725 MHz for wireless access systems, including radio local area networks (RLAN).
- ITU reaffirmed its support for the continuing deployment of mobile wireless communications by recognizing the need to provide a global vision for the future development of IMT-2000 and systems beyond IMT-2000. These include 3G systems and their enhancements, as well as WLAN-type, short-range connectivity, and broadcast systems. As part of its commitment, ITU is conducting technical and operational studies to develop Recommendations for the future development of these systems. The studies will take into account the particular needs of developing countries, including use of the satellite component of IMT-2000 for suitable coverage of these countries.
- A resolution was approved that paves the way for the deployment of new technologies for wideband and broadband **public protection and disaster relief communication applications**. The resolution lists specific frequency bands and ranges, which the conference identified for use in each region for advanced solutions for public protection and disaster relief. It strongly recommends that countries use these regionally harmonized bands to the maximum extent possible. The benefits of spectrum harmonization include increased potential for interoperability during disasters or emergencies (see article on page 16).
- A new resolution on the use of the band 108–117.975 MHz by **aeronautical services** was also approved. It recognizes the need for the aeronautical community to provide additional services in order to enhance navigation and surveillance systems as well as passenger access to e-mail and internet services through telecommunication data links. It also takes account of the need for the broadcasting community to provide digital terrestrial sound broadcasting.

World Radiocommunication Conference 2000 (WRC-2000)
(Istanbul, 8 May–2 June 2000)

Sony

- The results of this conference have enabled the industry to develop and deploy a host of sophisticated new radio-based communication systems. The conference was hailed as a success because of its ability to come to grips with ever more complex issues; in particular, how to share the radio-frequency spectrum (a limited resource) amidst the rapid growth of radio-based systems worldwide.
- An agreement was reached on **additional spectrum for IMT-2000**, effectively giving the green light to the mobile industry worldwide to deploy 3G networks and services. The decision provided for three common bands, available on a global basis for countries wishing to implement the terrestrial component of IMT-2000.
- A new **broadcasting-satellite plan** for Europe, Africa and Asia-Pacific was adopted to enable the delivery of direct satellite television broadcasting signals to a growing customer base.

World Radiocommunication Conference 1997 (WRC-97)
(Geneva, 27 October–21 November 1997)

ESA

- One major milestone was the replanning of the broadcasting-satellite service, which was experiencing rapid growth worldwide in delivering direct-to-home television services.
- An agreement was also reached between new mobile satellite service operators, paving the way for the development of new, global broadband satellite systems that can deliver internet and multimedia applications to homes and businesses anywhere in the world.

World Radiocommunication Conference 1995 (WRC-95)
(Geneva, 23 October–17 November 1995)

- Additional spectrum was allocated to the **mobile-satellite service (MSS)** for "little LEO" systems (operating below 1 GHz). These systems will be used to provide mobile data services.
- The debate over the approval of non-geostationary orbit fixed-satellite service systems, such as "Teledesic", ended with the agreement to allocate the system 400 MHz of spectrum in the 19 GHz and 29 GHz bands. The "Teledesic issue" was considered to have a potentially huge impact on the development of new "fibre-in-the-sky" systems.

Developing a plan for an all-digital broadcasting environment

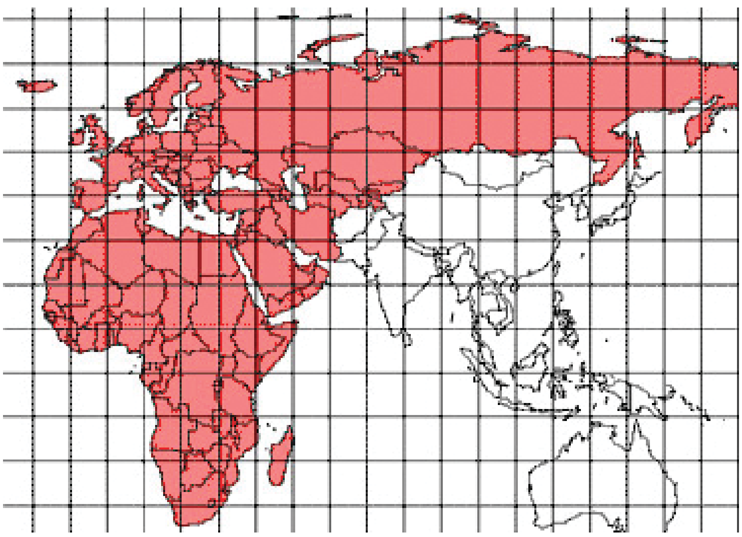
The end or the beginning of a process?

By Daniel Sauvet-Goichon

The two-step Regional Radiocommunication Conference

Digital terrestrial broadcasting is the subject of an ITU Regional Radiocommunication Conference, the second session of which will be held in Geneva from 15 May to 16 June 2006 (RRC-06). Its focus will be on completing the plan for the switch from analogue to an "all-digital" terrestrial broadcasting service (radio and television) for the countries of Europe and Africa (Region 1), as well as the Islamic Republic of Iran in Region 3, in the frequency bands 174–230 MHz and 470–862 MHz.

Figure 1 — Area covered by the Regional Radiocommunication Conference



Daniel Sauvet-Goichon
TDF (France)

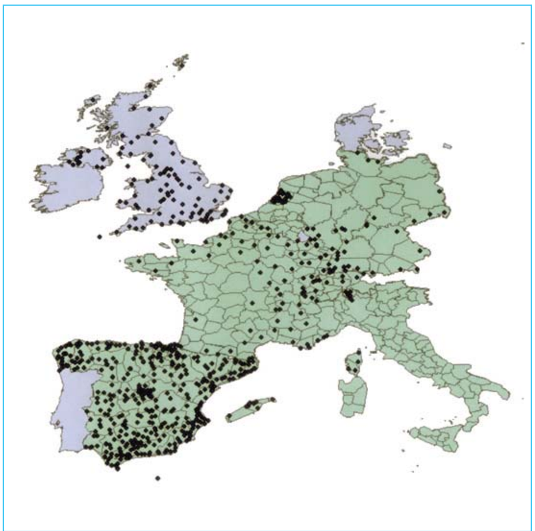
Terrestrial broadcasting in the European Broadcasting Area is regulated by the Stockholm Agreement of 1961 (ST61). This has proved to be flexible enough to meet the diverse requirements of broadcasters for the past 45 years. Initially, the ST61 Plan was designed to provide assignments for 5300 analogue transmitters in 38 countries, but has since been able to cope with over 80 000.

Planning arrangements for the VHF and UHF bands in African countries are regulated by the ITU Geneva Agreement of 1989 (GE89). Since then, most African countries have developed television services mainly in VHF, with only a few in UHF. Compared with Europe, this may be considered a more favourable situation for switching to digital terrestrial television.

European countries established multilateral agreements (Wiesbaden 1995, Chester 1997) to complement the Stockholm 1961 procedures and allow for the introduction of digital services. However, it soon became apparent that this was not sufficient and that a new ITU agreement was needed to replace the ST61 and GE89 Agreements. The process started in 2004 at the first session of the Regional Radiocommunication Conference (RRC-04), and is expected to end in June 2006 (at RRC-06) with the completion of a frequency plan for an all-digital broadcasting environment. At the same time, ST61 and GE89 will be revised as needed, keeping only the necessary regulatory sections that are not within the scope of RRC-06.

At RRC-06, administrations from 118 countries in Region 1 (except Mongolia), as well as the Islamic Republic of Iran are expected to agree on arrangements for digital radio and television broadcasting services in the frequency bands III (174–230 MHz) and IV/V (470–862 MHz).

Figure 2 — Example of Europe's requirements for the first planning exercise



Note — Green areas show allotments, while dark dots represent assignments.

Plan preparation

The first stage in planning for an all-digital environment began in June 2004, following the establishment by RRC-04 of the technical parameters and criteria for performing planning exercises in the intersessional period before RRC-06.

Administrations (from ITU Member States) were asked to submit their initial requirements by the end of February 2005. Based on these, ITU published the results of the first planning exercise in July 2005. The results provide an overview of initial country requirements, and indicate how feasible it will be to accommodate these requirements.

On 31 October 2005, administrations submitted their revised planning requirements, which were used to develop the draft plan published by ITU in February 2006. It is hoped that a final plan will be agreed at RRC-06, as a result of further analysis and bilateral or multilateral negotiations, including discussions at the conference itself.

Planning requirements

Traditionally, broadcasting requirements in previous plans have been submitted as precise assignments for each transmission unit. However, administrations could also submit their frequency requirements as allotments within wider areas, in order to enhance the flexibility of the plan.

When submitting an allotment, administrations do not need to detail the number of transmitters in a given area. Rather, they provide information on the type of network for a given area and its boundary. How coverage is provided within the area is then left to country planners to determine at a later stage. Administrations can select from four different reference network types, depending on the topography and the given network.

Figure 2 illustrates the requirements submitted by some European countries for the first planning exercise. For both assignments and allotments, administrations had to decide on the type of reception needed for each given service. Three types of reception modes are possible: fixed roof-top antenna reception, or portable outdoor and portable indoor reception. The higher field strength necessary for portable indoor coverage compared with roof-top antenna reception makes it more difficult to provide this type of coverage over large areas.

To make the plan even more flexible, administrations can declare compatibility with the service requirements of their neighbours. For example, when the real terrain and actual field strength are known, administrations may declare that they are prepared to accept the potential interference caused by their neighbour. These declarations help to reduce the number of incompatible service requirements between countries.

Too many national service requirements

For the initial planning exercise, administrations requested 43 000 allocations in the UHF band. However, only 26 000 allocations could be satisfied. The service requirements

Delivering television to mobile and handheld devices is an emerging broadcasting service that was not yet fully developed when preparations began for RRC-04 and RRC-06…

submitted had exceeded the amount of spectrum available.

Some countries had a high percentage of their requirements met, while others were less successful. In the second round of submissions, administrations actually increased their service requirements. Unless this proves to be simply a negotiation strategy, these excessive requests will make it even more difficult to reach an agreement at RRC-06.

Can a new frequency plan be completed?

It will indeed be a complex task for RRC-06 to achieve its aim of developing an all-digital radio and television broadcast plan in bands III and IV/V for 118 countries. The conference must overcome several challenges.

First, completion of a plan relies heavily on computer planning tools. A tremendous job has been done by ITU, the European Broadcasting Union (EBU) and experts in various fields, working together as the "Planning Exercise Team." However, as all frequency planners who have participated in past ITU conferences know, at some point, one must put computers aside and instead rely on colour pencils and imagination to find satisfactory solutions. RRC-06 seems unlikely to be any different.

The second challenge is that too many requirements have been submitted. It remains an open question whether administrations will reduce their requirements or whether the conference will find a way to accommodate them all in the plan. If it does not, then its Final Acts will need to provide administrations with methods that can ultimately satisfy their initial and future requests.

Finally, band III planning preparation seems to be less advanced than UHF planning. So, more work may have to be done after RRC-06 in order to reach a satisfactory solution.

Regardless of the planning difficulties, RRC-06 should succeed in developing a new, flexible digital plan, along with the rules that will provide a solid negotiation framework for further coordination among administrations in the future.

Is RRC-06 the end or the beginning of a process?

Some considerations are beyond the scope of the conference, but must not be overlooked when assessing its results. Here are just two examples:

Delivering television to mobile and handheld devices is an emerging broadcasting service that was not yet fully developed when preparations began for RRC-04 and RRC-06. If one looks at the technical parameters, which are the basis of the planning, none quite matches the needs of such a service. This type of discrepancy could become more prevalent in future, given the speed of technological development.

Broadcasting signal compression has raised awareness among regulators and administrations that some spectrum in the UHF range might be released for other services after analogue broadcasting is switched off. This is often called the "digital dividend". The fact that RRC-06 is developing a plan for the entire 470–862 MHz frequency range would seem to imply that future use of this dividend would be limited to broadcasting services. However, this is not the end of the story. The next world radiocommunication conferences, scheduled for 2007 and 2010, will probably review the topic, and examine the possibility of some frequencies being shared or reallocated.

Such examples as these show that this part of the frequency spectrum might, in the future, begin evolving towards known or unknown usages. The question remains: will the anticipated agreement at RRC-06 cope with such an evolution? Time will tell. ■

The transition from analogue to digital television

By Alfredo Magenta

One of the most important inventions of the twentieth century was broadcasting with analogue radio and television systems. The last few years, however, have seen the birth of digital broadcasting. Migration from analogue to digital techniques has started. There are a number of migration paths to choose from. Each country will follow its own switch-over path, often influenced by its broadcasting legacy. But much more than a technical migration will be involved. Considering the role of television and radio in modern society, the switchover can be a complex process with economic, social and political implications.

Changing from analogue to digital affects all links in the broadcasting value chain — content, production, transmission and reception — all of which require technical upgrading to support digital broadcasting. It is important to remember that, as in many other industries, changes are brought through the emergence and exploitation of new technologies, based on business demand. Market forces and consumer demand will eventually drive the digitization of broadcasting. With this in mind, it is worth first briefly examining the benefits that digitization offers.

Technical benefits of digitization

The primary benefit of digital television is greater control over channel performance. The overall performance of an analogue communications channel is dictated largely by the characteristics of the channel itself. The overall performance of digital systems is largely a factor of the quality of the conversion processes (analogue to digital and vice-versa), provided that the capabilities of the channel are not exceeded. As a result, the performance of analogue systems tends to deteriorate as the channel performance deteriorates, while digital systems remain as defined by the conversion process until they fail completely. Unfortunately, though, this means that the subjective effects of channel performance on digital systems are much more obtrusive when working close to the ultimate channel capacity.

The ability of digital systems to compress data into a smaller space is another relevant factor. In the broadcasting context, this means the use of compression coding techniques which allow relatively high sound and picture quality to be accommodated in a much smaller channel bandwidth. A related benefit is the ability to trade between quality (the degree of compression) and spectral occupancy, more or less at will.

Taking the two factors together, under certain conditions, approximately five digital terrestrial television channels (plus ancillary data) occupy the same amount of spectrum as one analogue channel. In addition, the transmitter power per channel is — in round figures — a tenth of that for an analogue channel.

Furthermore, digital systems facilitate the addition of ancillary data services,

Alfredo Magenta, Chairman, ITU Radiocommunication Study Group 6 (Broadcasting services)

allowing such features as automatic or semi-automatic tuning, conditional access, and the inclusion of supplementary (or even completely unrelated) data streams. Single-frequency networks and error correction are two other important features.

The choice of digital technology can be affected by the lack of compatibility between digital and analogue broadcast transmission systems. While this can cause some transition problems, it is generally advantageous, because the digital systems have been optimized against their own technical and financial considerations and are not compromised by having to be compatible with less advanced existing technologies.

From analogue to digital television

Considering that any technical transition strategy must work within certain commercial and regulatory imperatives, a simple solution can be to allocate a new band of spectrum to accommodate the new digital programmes. In the fullness of time, as migration takes place, the old spectrum can be given up. If necessary, and with careful equipment design, it would eventually be possible to transfer the digital services back to the original band. Eureka 147 DAB has been introduced in Europe in this way. The technical characteristics of the system even allow different frequency bands to be used in different countries.

Given the lower demands of digital systems in both bandwidth and power, there is scope for digital transmissions to fit into bands that are already occupied by other services. Where a digital transmission can be made to occupy the same amount of spectrum and have the same interference impact as an analogue channel, it might be possible simply to replace an existing analogue service with a digital one, or to use an existing but unused frequency allocation.

Commercial considerations

The major commercial advantage of digital services is the ability to offer a greater range and diversity of services at lower transmitter power, and without the need for additional spectrum. This capability is likely to be the most attractive aspect of digital television from the broadcaster's perspective.

New commercial opportunities will exist. However, there could also be commercial drawbacks. For any individual broadcaster, there is, for example, the cost of replacing equipment and it is unlikely that this will be offset by increased revenue (either through advertising or subsidies). It is also necessary to persuade the audience to invest in new receivers, or set-top boxes, at acceptable prices. To do this, it is necessary either to offer a wider range of high quality programming and improved formats, such as wide screen and high definition television. Warning consumers that the analogue service will disappear also stimulates demand. In certain cases the intervention of governments can be crucial. In some environments, spectral allocations are traded between broadcasters, including new entrants. The availability of more channels in such an environment will, in the short term at least, depress the value of the existing allocations.

Any commercial transition strategy will probably require that analogue versions of existing programme streams remain available until a high level of market penetration of digital receivers is achieved. Typically, this will mean that digital and analogue versions of the same programmes are present simultaneously during the transition period. Various technical strategies can be, and have been, deployed to achieve this.

The market forces and consumer demand that are driving the switchover to digital pose a major challenge to industry. It is also crucial to inform consumers about their options so that they know when to migrate to the new system. A successful switchover will be facilitated by coordinated action from the numerous players involved, including broadcasters, equipment manufacturers, retailers and governments.

Regulatory matters

The three ITU Sectors, each within its own sphere of competence, are responsible for activities and studies relating to broadcasting. In the first half of the twentieth century, these activities included standardization work for analogue television systems, and for digital systems in the latter part of the century.

ITU will continue to play a pivotal role in the regulation of spectrum usage and broadcasting technologies. A debate on spectrum aspects of the switchover to digital has already been launched among some administrations within their spectrum policy frameworks. The prime objective is to encourage efficient and flexible spectrum usage, while preserving the service mission of broadcasting. Among other things, the debate will address the economic value of spectrum allocated to terrestrial and satellite broadcasting services, and the transparency needed in setting this value.

ITU's broadcasting planning conferences are good examples of how system development is encouraged when flexibility is introduced into the international regulatory framework. For instance, the agreement forged at Stockholm in 1961 (ST61) has been accommodating the needs of analogue broadcasting in Europe successfully for almost four decades. And the Regional Radiocommunication Conference (RRC-04/06) is planning the transition from analogue to digital broadcasting for 119 countries.

It is not envisaged that ITU should be involved at the level of, for example, setting common switch-off dates or prohibiting sales of analogue receivers. However, national digital broadcasting markets and policies will continue to be monitored. Policy interventions by ITU Member States should be transparent, justified, proportionate, and timely, so as to minimize the risks of market distortion. They should also be formulated according to clearly defined and specific policy goals, and be non-discriminatory and technologically neutral. Achieving these aims requires careful assessment of the impact of policy changes, as well as monitoring of policy implementation and market evolution.

The Berlin TV Tower at Alexanderplatz

Consumers will decide

It is now becoming possible for just one device in the home to cover all broadcasting bands and all systems, at an acceptable price. And the more devices are sold, the lower the price will get. This will also encourage the expansion of services and applications, opening the door to the creation of a Universal Mobile Telecommunication System (UMTS) — or IMT-2000 — that is integrated with other services. Through technological convergence, truly new types of media will have been achieved.

There are many players during transition periods between one dominant technology and another, but the past has shown that the principal actors are the final users of new services. They will be the driving force behind the change from analogue to digital broadcasting, even while they are influenced by the policies of administrations, service providers and manufacturers. What is very important and urgent, however, is coordination among all these stakeholders. If consumers are ready to buy new equipment that manufacturers have produced, it is very important for administrations to have in place a frequency planning programme, and for broadcasters to have prepared attractive content. Coordination of these efforts will determine how fast the transition will be made, and will lead to wider consumer choice and enhanced competition.

When (through economies of scale) digital receivers become cheap enough to replace all their analogue predecessors around the world, then the real convergence between services will have come to fruition. That will be the basis for the complete development of UMTS (IMT-2000). People everywhere will be able to send and receive information anywhere, in any language, while at work, at home or on the move. The global information society will truly have arrived. ■

Radiocommunication for public protection and disaster relief

By Alan R. Jamieson

A major earthquake in South Asia, a devastating tsunami in the Indian Ocean, flooding and forest fires in Europe, hurricanes in the Americas, drought in Africa — natural disasters are, unfortunately, a part of life. And if this is not enough, disasters due to human activities, such as terrorist attacks or industrial accidents, also happen all too frequently around the world.

Whether natural or man-made, catastrophes can happen at any time, and with little or no warning. This creates major problems for public safety agencies set up by governments to provide for public protection and disaster relief (PPDR). The ability of these agencies to cope with unexpected disasters and emergencies of any scale is dependent upon the infrastructure and support that they have in place for their day-to-day operations. Radiocommunication facilities are a critical component of this infrastructure. The extra stress that such events place on infrastructure has to be taken into account when planning the capacity, performance and capabilities of radiocommunication facilities.

The challenge in recent times for ITU, and in particular for its world radiocommunication conferences (WRC), has been to put in place regulatory provisions, backed by technical studies, that provide the framework within which the radiocommunication needs of PPDR agencies can be satisfied. These studies are carried out at ITU's Radiocommunication Sector (ITU–R).

An important agreement concerning public protection and disaster relief was reached at the World Radiocommunication Conference in 2003 (WRC-03) in its Resolution 646. It paves the way for the deployment of new technologies for enhanced applications involving higher data rates, real-time full motion video and multimedia services that should facilitate the work of PPDR agencies around the world. In comparison to the mostly narrow-band solutions used today by these agencies, wideband applications are now made possible (with data rates in the range of 384–500 kbit/s), as well as broadband (1–100 Mbit/s).

Recognizing the need for new systems

Terminology differences between countries and regions in the scope and specific meaning of PPDR has led to an ITU definition for the purpose of discussing the issue. ITU–R has defined the term "public protection radiocommunication" as referring to

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radiocommunications used by agencies and organizations dealing with the maintenance of law and order, the protection of life and property and with emergencies. In a similar manner, the term "disaster relief radiocommunication" refers to radiocommunications for dealing with serious disruptions to the functioning of society that pose a significant and widespread threat to human life, health, property or the environment, whether caused by accident, natural phenomena or human activity, and whether developing suddenly or as a result of complex, long-term processes.

PPDR radiocommunication systems must be designed to meet several broad objectives. As well as providing vital means of communication in emergencies and disasters in each country, their other aim is to promote interoperability between cross-border networks, to make it easier for countries to cooperate in providing effective and appropriate humanitarian assistance when required. This means that when planning radiocommunication services for public safety agencies and organizations, it is necessary to take account of advanced services that will require higher data rates, along with video and multimedia capability, in addition to the voice applications commonly used now.

These advanced applications include ways to access the types of background information that may be needed quickly when responding to an emergency. As PPDR operations become more reliant on electronic databases and data processing, access to accurate and detailed data by staff in the field, such as police, firefighters and medical emergency personnel, is critical to improving their effectiveness. This information is typically held in office-based database systems and includes images, maps and architectural plans of buildings. The flow of information back from units in the field to operational control centres is equally important. During an emergency, authorities are required to make critical decisions that are affected by the quality and timeliness of information received from the field.

An emergency communications set up by Télécoms Sans Frontières in Indonesia following the tsunami in December 2004

In 2000, the World Radiocommunication Conference (WRC-2000) approved Resolution 645, inviting ITU–R to conduct studies with a view to harmonizing spectrum globally or regionally for these advanced solutions for public protection and disaster relief. WRC-2000 also called for studies to determine the technical and operational basis for global cross-border circulation of radiocommunication equipment in emergencies. The needs of developing countries for low-cost solutions are also recognized in Resolution 645.

Forging an agreement

ITU's global effort to harmonize PPDR communications is well documented in *ITU–R Report M. 2033.* The report defines the public protection and disaster relief objectives and requirements for implementing advanced solutions to meet the operational needs of PPDR agencies by 2010. It highlights the results of ITU–R's studies in the run-up to WRC-03. These results, together with the salient sections of the *Report of the Conference Preparatory Meeting*, provided the technical basis for WRC-03 to discuss PPDR issues. There was widespread interest in this agenda item, which called on WRC-03 *"to consider identification of globally/regionally harmonized bands, to the extent practicable, for the implementation of future advanced solutions to meet the needs of public protection agencies, including those dealing with emergency situations and disaster relief, and to make regulatory provisions, as necessary,* *taking into account Resolution 645 (WRC-2000)"* .

For many countries, globally harmonized frequency bands for the use of PPDR applications was seen as a priority because of the potential to offer the benefits of economies of scale. But many others held the view that such global harmonization was unnecessary, since the organizational responsibilities for public protection and disaster relief activities are matters for administrations to determine at the national level. And a third group of countries argued that new radiocommunication technologies, including software-defined radios and commercial mobile services such as IMT-2000 networks, should also be used to meet the needs of PPDR agencies.

It is hoped that victims of disasters will be able to benefit from faster and more effective rescue operations, thanks to the Tampere Convention

A further complication was the fact that PPDR agencies at the time of WRC-03 were largely reliant on traditional voice applications scattered over a wide range of frequency bands, usually in the VHF and UHF ranges of the spectrum. In view of the bandwidth requirements for the advanced solutions being contemplated for PPDR, and without any sign of a uniform approach to the use of frequency bands, it looked unlikely that a global solution on spectrum harmonization would emerge from the conference.


Inmarsat


UNHCR/H. Caux


UNHCR

Resolution 646 on public protection and disaster relief

Harmonization: While no common global band could be identified by WRC-03, an important breakthrough was the adoption of Resolution 646, which lists specific frequency bands and ranges that governments should consider when undertaking their national planning for PPDR. These bands are listed separately for each of the three ITU regions: Region 1 (Europe and Africa), Region 2 (the Americas) and Region 3 (Asia and Australasia).

Resolution 646 strongly recommends that countries should use the harmonized bands identified for use in each region for public protection and disaster relief, taking into account national and regional requirements. They are also requested to encourage PPDR agencies to use relevant ITU–R Recommendations in planning spectrum use and when implementing technology and systems to assist in the agencies' work.

The benefits of spectrum harmonization, even though restricted to a regional rather than a global level, include increased potential for interoperability in PPDR activities. It is also expected to create a broader manufacturing base, leading to economies of scale and cheaper, more readily available equipment. This, in turn, will give PPDR agencies better access to enhanced system capabilities built on uniform types of equipment. Ultimately, the winners will be the people whom the agencies serve at times of disaster.

Cross-border sharing: Resolution 646 also acknowledges the contributions of national and international humanitarian organizations in providing radiocommunications after large-scale disasters. Administrations are urged to facilitate cross-border sharing of radiocommunication equipment that is intended for use in emergencies and for disaster relief.

Regulatory barriers have often made it difficult for humanitarian organizations to import and use telecommunication equipment across borders. To help address this problem, ITU played an active role in drafting the *Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations,* which came into force on 8 January 2005, following its ratification by 30 countries. It is hoped that victims of disasters will now be able to benefit from faster and more effective rescue operations, thanks to the convention.

New technologies: Resolution 646 also says that administrations should encourage PPDR agencies to employ both existing and new technologies and solutions to satisfy interoperability requirements. This could also include the use of advanced wireless solutions where appropriate, to provide complementary support to PPDR activities.

The resolution highlights the example of a joint standardization project between the European Telecommunication Standards Institute (ETSI) and the United States Telecommunications Industry Association (TIA), known as *Mobility for Emergency and Safety Applications* (MESA). The goal of MESA is to develop advanced mobile broadband technical specifications that can be used to support the communication requirements of PPDR agencies. Another platform for coordinating harmonized standards is the Telecommunications for Disaster Relief (TDR) Partnership Coordination Panel, established under the auspices of ITU with the participation of governments, international telecommunication service providers, standards development organizations and disaster relief agencies.

Finally, Resolution 646 directs comments towards the manufacturers of PPDR systems and equipment. They are encouraged to take the resolution into account when designing equipment, and to consider the need for countries to operate within different parts of identified frequency bands.

Work continues

WRC-03 reached a conclusion on the spectrum requirements for PPDR, and also concluded that there was no need to place this topic on the agenda of a future conference. Nevertheless, it did recognize that studies are still needed in some areas and it requested ITU–R:

- to continue technical studies and make recommendations concerning technical and operational implementation of advanced solutions to meet the needs of PPDR applications for national and international operations, taking into account the capabilities, evolution and any resulting transition requirements of existing systems, particularly those of many developing countries;
- to conduct further technical studies in support of possible additional identification of other frequency ranges to meet the particular needs of certain countries in Region 1, especially in order to meet the radiocommunication needs of public protection and disaster relief agencies.

ITU 940049/Actualités suisses

Emergency communications assist fire fighting operations

Since WRC-03, studies have continued within Working Party 8A of ITU–R. These studies have focused on preparing a recommendation on a narrow-band application that uses data communication for the protection and tracing of property. A draft recommendation "Harmonized frequency channel plans for the protection of property using data communication" was considered by Study Group 8 at its meeting in November 2005. Additional studies in Working Party 8A are expected to result from work now under way in some countries in Region 1 on requirements for wide-band and broadband PPDR applications.

As well as the studies on PPDR, there are other programmes within ITU–R related to disaster relief operations. The humanitarian activities of amateur radio and amateur satellite services are highlighted in Recommendation ITU–R M.1042, which encourages the development of networks within these services that are capable of providing communications during disasters and relief operations. Moreover, Working Party 8D is developing a recommendation on applications in the mobile satellite service for disaster relief operations, while Study Groups 6 and 7 are working on systems to be used in support of disaster prediction and detection and for communicating warnings and alerts.

The needs do not diminish

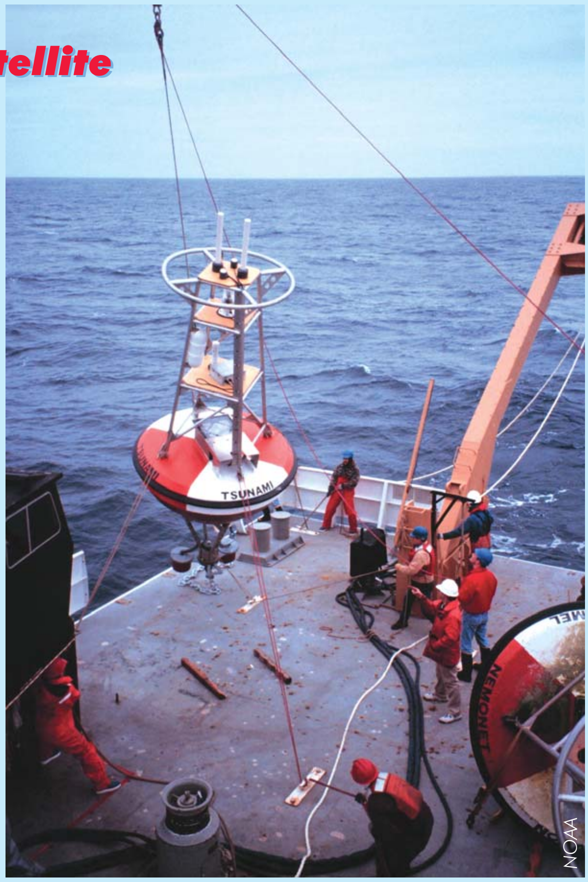
Around the world, the radiocommunication needs of PPDR users are not diminishing; they are growing at a rapid rate. The longer public safety agencies have to wait for effective PPDR solutions supporting advanced applications, the longer the current, ad hoc, uncoordinated and at times uneconomic approach will continue.

Through the decisions reached at WRC-03, ITU–R is working to resolve implementation issues in support of PPDR users as they discharge their responsibilities for humanitarian assistance and the restoration of normal life following disasters of every type. ■

Tsunami warnings via satellite

The massive tsunami that occurred in the Indian Ocean in December 2004 reminded everyone of the importance of warning systems for such natural disasters. The wave was caused by a huge earthquake off the coast of Sumatra in Indonesia, which was detected across the world at the *Pacific Tsunami Warning Center* in Hawaii. It is operated by an agency of the United States' government, the National Oceanic and Atmospheric Administration, more often known simply as NOAA. Within minutes, NOAA staff had been able to issue a bulletin to say that there was no danger of a tsunami in the Pacific. How was this done, and why was it not possible to warn of a tsunami in the Indian Ocean?

NOAA received data about sea levels in the Pacific from a system of coastal gauges and ocean buoys which, unfortunately, did not then exist in the Indian Ocean. Each buoy is the platform for a radio antenna that transmits data via satellite on conditions at the ocean surface and from sensors on the sea bed. These sensors — which can be 5000 metres deep — record changes in the weight of water above them, thus indicating wave heights.



NOAA deploys a buoy in the Pacific as part of its Deep-ocean Assessment and Reporting of Tsunami *(DART) system. Data is transmitted to a control centre via satellite*

The Indian Ocean tsunami strikes Thailand in December 2004

Following the 2004 tsunami, international efforts began to find ways to mitigate future disasters. As early as January 2005, discussions began in Kobe, Japan, at the United Nations' World Conference on Disaster Reduction. It is expected that a UN-led tsunami warning system will become operational in the Indian Ocean during 2006 — probably based on a network of buoys similar to those in the Pacific. This still leaves the challenge of how to respond on the coastline when a dangerous wave is detected at sea. More information systems and infrastructure will be required, and it is very likely that radiocommunications will be central in that work too. ■

WIRELESS COMMUNICATIONS

Controlling radiation to protect health

By Luiz Carlos Neves and Antonio Marini de Almeida

The boom in mobile telephony has triggered demand for more transparency in providing information to the public about the levels of electromagnetic radiation emitted by base stations of wireless communication systems. The long-term effects of electromagnetic radiation on human health are still under research. Nevertheless, a key question for many people worldwide is what controls are exercised over these radiation emissions.

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To address this concern, Brazil has developed a system that allows local authorities in a city to manage radiation levels produced by telecommunication infrastructure and gives the public access to this information through the internet. The system also offers objective information to validate and improve the criteria for planning the expansion of mobile telecommunication infrastructure. This article highlights Brazil's experience with this new approach to controlling electromagnetic radiation.

The example of Brazil

Telecommunication indicators for Brazil reveal just how important mobile technology has become: the five years between 2001 and 2005 saw a growth of 270 per cent in the number of mobile handsets. According to the *Indicators 2006* report from Brazil's National Regulatory Agency for Telecommunications (*Agência Nacional de Telecomunicações* — Anatel), by 2005 there were 86 million mobile subscribers nationwide, compared with 42 million fixed lines. This spectacular growth is associated with the significant expansion of the infrastructure for mobile telephony, including an increased number of radio base stations, antennas and towers installed in urban areas. Service providers try to optimize their investment by installing towers on small lots or in areas shared with residences, and even near schools. Increasingly, though, such changes to the environment have provoked reactions among local people regarding the location of radio towers, the impact on the landscape, and concerns about risks to human health.

Many Brazilian cities have now established rules that limit radio station installations in urban areas. Also, there is a national regulation establishing limits for electromagnetic emissions, based on the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines. However, due to the lack of a device to demonstrate that the levels of radiation are within permitted limits in the vicinity of a radio tower, the number of lawsuits has risen. Alongside municipal laws to slow down installations, this

A mobile communications base station in the city of Americana, Brazil

significantly complicates expansion projects.

To deal with this situation, a research-and-development project was launched in 2004, financed by the Brazilian Telecommunications Technological Development Fund (*Fundo para o Desenvolvimento Tecnológico das Telecomunicações* — FUNTTEL), and conducted by the Center for Research and Development in Telecommunications (CPqD). The aim was to find a way to disseminate up-to-date, trustworthy information on wireless communications.

Designing a solution

The situation in Brazil, as well as experience in other countries, shows that more must be done to tell people about the effects of technology, and to make procedures for monitoring these effects more transparent and understandable. This is also the recommendation of the World Health Organization. The Brazilian public was not sufficiently informed about changes in their environment, and, often, people did not receive a satisfactory answer when they did ask for details of new installations. At the same time, technical complexities prevented local authorities from demonstrating that the relevant legislation was being obeyed and that existing radio stations were being properly controlled.

The answer was to create a system that people can trust to provide them with accurate information they can understand. For a developing country especially, the system had to satisfy the following requirements:

- Personnel without a background in telecommunications must be able to manage the system.
- It must be possible to evaluate the radiation emitted by a group of installations, and the changes that would be produced by a new installation before authorizing its implementation.

A page on the internet site of the monitoring system, showing data from one radio station on a street map of Americana. By clicking on the station icon, a new window appears with details of its name, address, owner and construction type

- Local residents must have access to the system and information on control of radiation limits, in clear, easily understood language.
- The technological resources employed must require a limited amount of investment and must be easily maintained.

Online monitoring made possible

The monitoring system that was developed in Brazil performs continuous measurements and simulations of the intensity of non-ionizing radiation (NIR) produced by base stations of wireless telecommunication systems. The system allows users to see, via the internet, a map of actual electromagnetic emissions in their city, or to examine simulations of the emissions from changes to the wireless network.

Known as *CPqD NIR Monitoring*, the system has an internet server and database, a map server, an interface to control remote radiation monitoring units, and diverse clients. The data regarding radiation levels are graphically illustrated on maps as percentages of the permitted radiation limit. The software modules were developed using open-source tools, in order to create a system with low investment needs.

A device was developed to allow remote measurements. It is composed of an electromagnetic field sensor and a control module that performs periodic measurements and transmits them to the system via the mobile phone network itself.

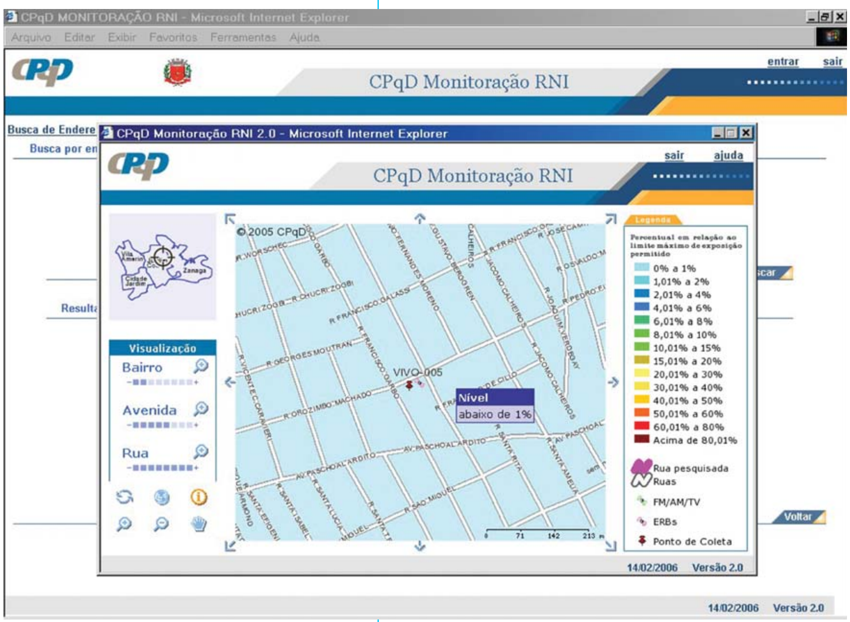
Pilot project in Americana

The system was tested in the city of Americana, in Brazil's state of São Paulo, in order to validate and improve it. Technical data and information on the location of radio stations was obtained from the city's authorities and from Anatel.

The layout of streets in Americana was obtained from a digital map that also includes information on railways, main highways, public squares, city districts and city landmarks. Photographs of the base stations for mobile communications were also provided. For each station, the system records its owner's name and address, the geographical coordinates, technical characteristics of the antennas (model, gain, height, azimuth and mechanical tilt), frequency and power of each of the installed transmitters, number of carriers, and losses in the means of transmission. Effectiveness of this simulation process was proved through field measurements carried out at all base stations in the city of Americana.

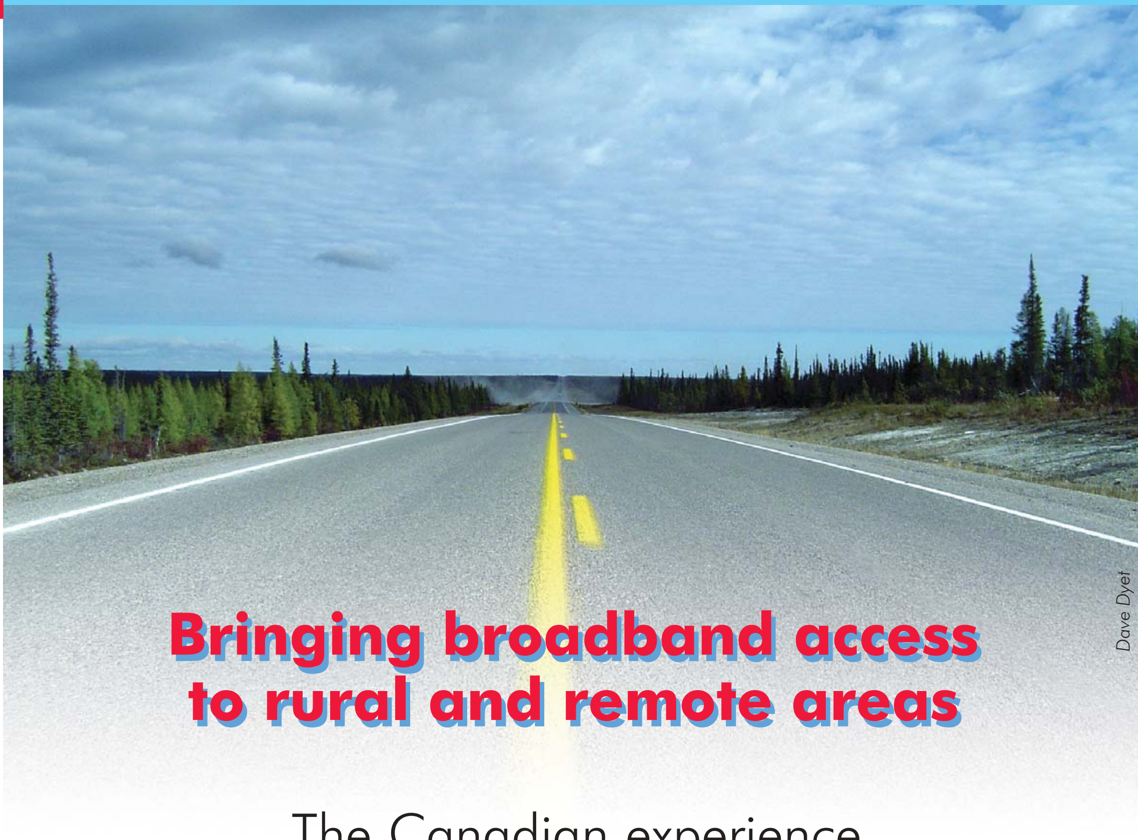
The system allows citizens to query existing installations in the city and to measure radiation emissions and simulated values of emissions by simply clicking a base station's location on a familiar street map. Access to the online system was made public in December 2004, via the websites of the local government and of CPqD.

Thanks to the new system, public authorities in Americana now have better control over the radio stations installed in the city, and local people can obtain information about the levels of radiation. The system has contributed significantly to lessening conflicts among interested parties, regulatory bodies and service providers of mobile communications. Americana is now considering a change in its municipal legislation, which would establish criteria for the installation of base stations.



The map shows icons of a base station, a remote measuring unit and an indicator of radiation levels. The colour chart on the right indicates bands of radiation limit percentage

The radiation monitoring system developed in Brazil seems to have demonstrated a successful way of maintaining a balance between allowing the expansion of wireless access technologies, while enabling the community to exercise control over possible adverse effects of the use of certain technologies on a broad scale.



Dave Dyet

Bringing broadband access to rural and remote areas

The Canadian experience

By Gérald Chouinard

Programmes to improve access

According to ITU's *World Telecommunication /ICT Development Report 2006,* Canada is sixth in the world for broadband access penetration. However, because of the country's huge size and often sparse population, special measures need to be taken to try reaching all Canadian citizens. One third of communities (where 5 per cent of the Canadian population lives) still have no access to broadband services. And even when a community is reached, not every resident has access to broadband. This is especially true in rural areas, where the population density, beyond a central town or village, may be too low to make broadband access cost-effective using current technologies.

The Canadian government has taken steps to improve broadband access with programmes offering communities subsidies for capital investment and satellite transmission capacity, provided that they have developed plans for sustainable broadband access services. In parallel with this, the Communications Research Centre Canada (CRC), an agency of Industry Canada, launched the Rural and Remote Broadband Access (RRBA) programme in April 2002. CRC conducts research, and develops and tests innovative and cost-effective broadband access technologies and systems that should allow the private sector to develop viable business models for the provision of broadband services to Canada's under-served areas.

The RRBA programme covers critical issues such as spectrum availability and interference, reach, and deployment flexibility and equipment standardization. It involves participation in international standards activities, with the aim of reducing the cost of broadband access equipment, as well as offering Canadian expertise and technologies to countries that face similar challenges.

What is the best delivery system?

Satellite communications can play a major role in reaching remote communities. Because of their large and even coverage, satellites can provide

Gérald Chouinard, Manager of the Rural and Remote Broadband Access programme, Communications Research Centre Canada

broadband access in various geographical settings, including rural, suburban and even urban. The only drawbacks may be the impact of the inherent 0.5 second signal propagation delay on some broadband applications and the centralized servers, and the cost of the terminals. However, CRC has worked to minimize these problems.

CRC assessed the various broadband access technologies, based on population density, and looked at their merits in relation to their perceived complexity and cost (see Figure 1). Special attention was given to the range between 1.5 person/km^2 (below which only satellite technologies make sense) and 60 person/km^2 (above which wired technologies, such as ADSL and cable, become cost-effective). Serving this range of population density begs for the development of new wireless broadband access technologies that will extend the reach to allow cost-effective coverage of rural areas. Figure 1 gives an indication of the size of this potential market in Canada, based on the 2000 census.

The most important factors to be considered when trying to extend the range of wireless technologies are depicted in Figure 2 as a function of the carrier frequency. Again, the impact of these various factors is illustrated in terms of their relative complexity and cost. The low UHF range, from 300 MHz to 1 GHz, comes out to be the best frequency range for broadband access systems in rural areas. The use of radio frequencies in this range can extend the reach of wireless broadband access systems, allowing for a larger subscriber base in sparsely populated areas and making broadband access economically sustainable. As a result of these findings, special attention has been given to this range of frequencies in the RRBA programme.

Satellite broadband access technologies

CRC's work on satellite broadband access concentrated on trying to reduce the cost and complexity of terminals operating with the new Canadian Anik-F2 satellite in the 20/30 GHz bands. The use of such high frequencies permits a reduction in terminal size and can provide an attractive solution for broadband access to remote communities, and even to individual households.

Figure 1 — Suitable broadband access technologies as a function of population density

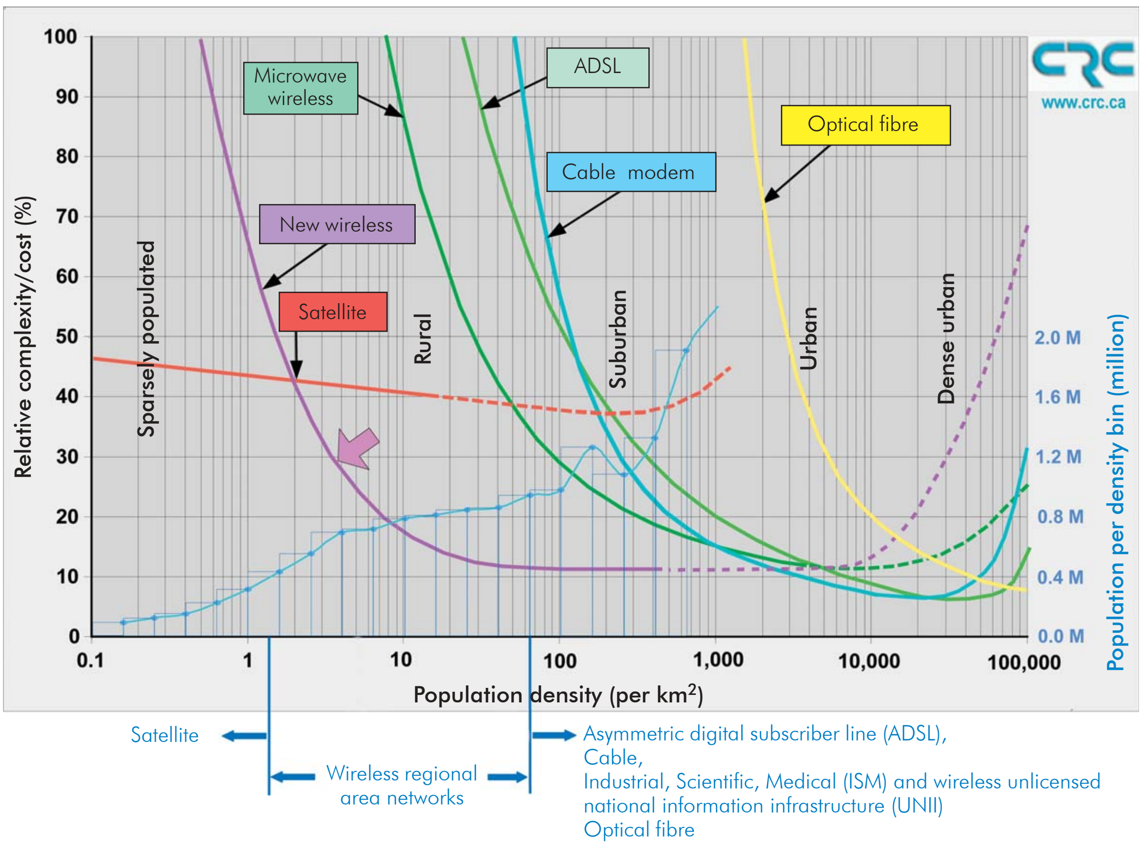
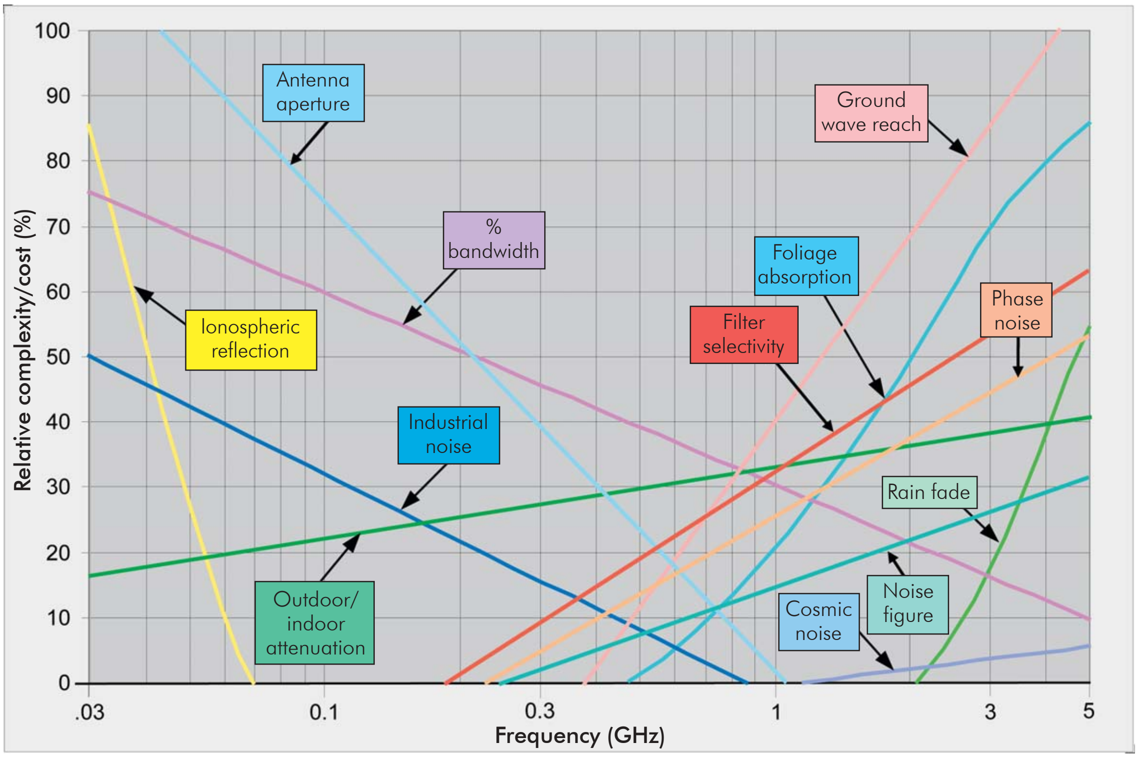
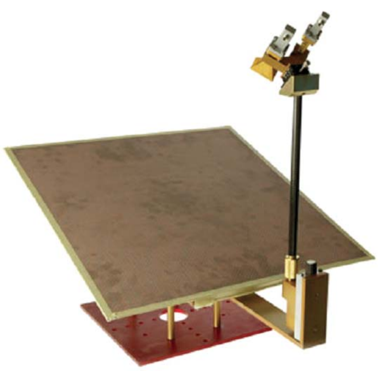


Figure 2 — Factors to be considered in the choice of the best frequency for wireless broadband access systems to serve sparsely populated rural areas



A 45-cm circularly-polarized reflect-array antenna was developed, with an offset feed with different focal points at 20 GHz and 30 GHz to avoid the need for a complex waveguide orthomode transducer. This design meets the gain mask recommended by ITU's Radiocommunication Sector (ITU–R) with respect to discriminating among geostationary satellites if the size of the antenna is greater than 70 cm.

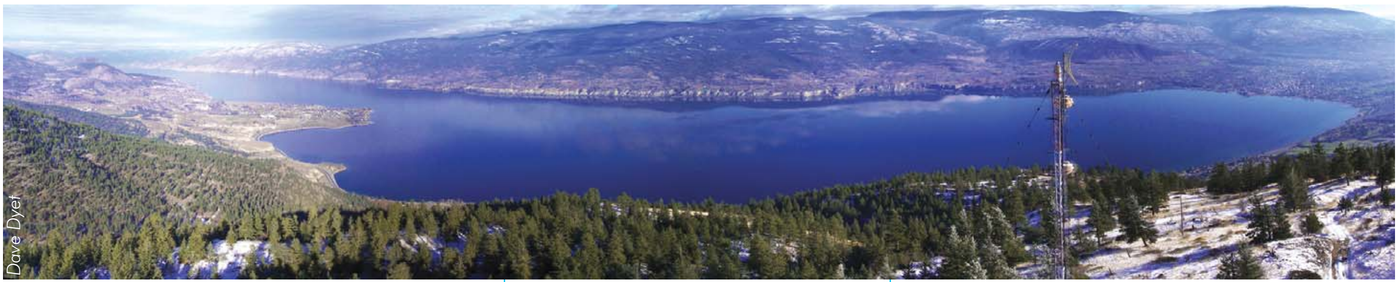


Offset-fed 30/20 GHz reflect-array

Direct transceiver architecture is used for the terminals, so as to simplify the hardware needed. Work was done on the miniaturization of a 30 GHz vector modulator with a coupler, amplifiers, and an envelope detector in a single package, in order to improve overall performance and reduce the cost of direct transceiver terminals.

CRC developed compensation techniques for receiver gain/phase balance, as well as for power amplifier linearization. A frequency synthesizer was developed, and meets the stringent requirements needed for systems operating with DVB-RCS (digital video broadcasting — return channel satellite) open standard. DVB-RCS was selected in order to use the Anik-F2 satellite capacity credit (in the 20/30 GHz band) for Northern Canada.

CRC completed a study on innovative transport, network and link protocols for the transmission of internet protocol (IP)-based broadband services over satellite circuits. The satellite transmission capacity is maximized through the concerted use of a link performance enhancer replacing the usual transmission control protocol (TCP) to reduce the link latency and dynamic satellite bandwidth allocation, while meeting specified levels of quality-of-service (QoS). It was found that the service latency could be cut by more than 70 per cent and the end-user traffic throughput could be increased by a factor of five. These improvements can be added through either an upgrade to current open-standard DVB-RCS terminals, or through a more optimized upgrade to future DVB-RCS terminals.



Panorama from a communications tower at Penticton, British Columbia, Canada

Wireless broadband access using frequencies below 1 GHz

Investigations of the use of frequencies below 1 GHz for future broadband access systems were carried out, with the aim of enhancing the coverage range at low cost. CRC developed prototypes of a duplex frequency converter between the 2.4 GHz band and 700 MHz. These prototypes were successfully used in a field trial with simple UHF antennas where Wi-Fi connectivity was established at 5 Mbit/s over a range of 5 km in a non line-of-sight point-to-point setup at 700 MHz. It was observed that the range of 802.11b/g WLAN operating at 700 MHz can double in non line-of-sight conditions and quadruple in line-of-sight, as compared to 2.4.GHz.

Antennas used for the Wi-Fi experiment at 700 MHz

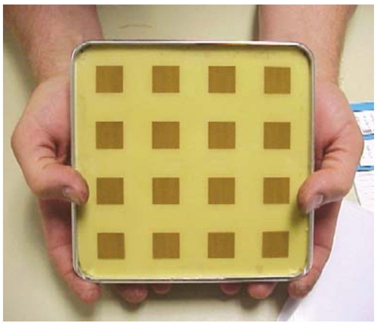
The MILTON system

CRC also completed the development of its 5 GHz multimedia wireless access system called MILTON (microwave-light organized network). As a last-mile solution that can interface with optical fibre and Gigabit Ethernet networks, this technology is well suited to cover dense portions of rural communities where the bulk

24-petal MILTON Hub antenna

of the population is within a 1.8-km radius (10 km^2 area). The system can reuse frequency up to six times by means of a 24-petal hub antenna.

Currently, the system provides up to 22 Mbit/s forward and 3.4 Mbit/s return capacity per subscriber and can serve up to about 700 homes. It includes low-cost subscriber terminals using double dielectric-layer patch antenna technology (20x20cm, 17 dBi gain) and a 24-petal rosette hub antenna. Cognitive radio functions that make cells highly adaptive



MILTON subscriber terminal

in the presence of interference were added to the hub and user terminals.

The MILTON system has been deployed for field trials in a suburb of Ottawa. One hub and six terminals have been in operation since September 2004. In December 2004, the Government of India made the MILTON technology a prime area of investigation for its Centre of Development of Telematics (C-DOT), and acquired the technology for field tests in Bangalore.

Broadband access through digital television broadcasting

Because of their wider coverage capabilities, broadcast transmission technologies can be effective in bringing broadband access to rural areas. For example, digital television (DTV) can carry about 20 Mbit/s of broadband capacity in a 6 MHz television channel over a coverage area of up to 70 km radius. CRC reviewed the three current DTV technology standards used across the world, and found them to be well suited for carrying broadband applications in the forward direction. CRC verified the extent of coverage in the field and confirmed that it can be improved and shaped using on-channel repeaters.

The concept of using DTV-ATSC in the forward direction and DVB-RCT for the return link was studied to provide two-way, high-speed data services for broadband access. DTV-ATSC is the digital television standard developed by the Advanced Television System Committee in the United States. The Digital Video Broadcasting Project in Europe has adopted the DVB-RCT (return channel terrestrial) standard.

An experimental DTV transmitter station is being upgraded in the Ottawa area to allow a full-scale demonstration of this bi-directional service. Researchers have demonstrated the feasibility of encapsulating IP data over the DTV transport stream, using a high-capacity data server that integrates multimedia applications and a prototype of a low-cost IP receiver. A bridge from the DTV IP receiver to Wi-Fi is also being developed.

In Canada as elsewhere, the transition from conventional analogue television to DTV offers the opportunity to use television bands more efficiently and free spectrum for other applications, such as broadband access. Distributed transmission networks using synchronized transmitters operating on a single channel could be implemented to carry the same television programming over large areas. Network planning studies were conducted, based on the TV Ontario network, to test the applicability of the distributed transmission concept on a large scale. TV Ontario uses different channels to broadcast the same programme across the province and consists of high and medium power transmitters and a large number of low-power frequency-translators distributed over the territory. It was found that common channels could be used in moderately congested areas by employing groups of low-power translators in a single-frequency network mode.

Alma's Harbor, New Brunswick, Canada

Using these technologies around the world

The use of the 20/30 GHz bands for satellite broadband access allows for small and potentially low-cost terminals that should make it easier to deliver services to any remote location where there is satellite coverage. The use of such high frequency bands will, however, limit the applicability of the technology to areas of the world with little precipitation because the signal tends to be heavily attenuated by rain. The MILTON system has potential in populated areas where no wired infrastructure exists.

With respect to the use of the low UHF range for wireless broadband access, this should have a global appeal – especially in developing countries where the UHF spectrum is not heavily used. In the transition from analogue to digital television broadcasting, broadcasters could take advantage of the data transmission capability of the new DTV systems to provide data services such as broadband access, as long as means are found to provide for the return channel.

With the development of new standards, such as the IEEE 802.22 wireless regional area network (WRAN) standard, low cost broadband access technology could become available and usable in television bands worldwide. The technology will include cognitive radio features that will allow sensing the presence of television broadcast signals in the area and avoid potential interference by automatically selecting an unused television channel for its operation. This could have a huge impact on efforts to create broadband access in large developing countries. Although best suited for sparsely populated rural areas, it could also be a cost-effective solution in more populated areas where some television spectrum remains unused. ■

The global framework for radiocommunications

By Robert W. Jones

The ITU Radio Regulations

Radio frequencies often propagate across national borders, either intentionally or unavoidably. This makes it necessary to ensure that signals do not interfere with each other. It is also important to harmonize the use of the radio-frequency spectrum internationally because many radiocommunication applications are used on the move; for example, radio equipment on board ships and aircraft, or mobile phones. International harmonization can reduce equipment costs and lead to economies of scale. The ITU Radio Regulations provide the international framework for such harmonization. Within this framework, which is fairly flexible, countries are able to develop and adopt their own national legislation and regulations for radio spectrum usage.

It is important to recognize that ITU is not a global regulator in the way that a national spectrum regulator is domestically. The Radio Regulations, the international treaty governing the use of the radio-frequency spectrum and the geostationary-satellite and non-geostationary-satellite orbits, are written and updated by ITU Member States at world radiocommunication conferences (WRC). These regulations also provide rules for the maintenance of registers of frequencies and satellite orbits in use by administrations. While ITU's Radiocommunication Bureau (BR) administers the Radio Regulations, conformity with this international treaty is ultimately based upon goodwill rather than on the kinds of regulatory sanctions found at the national level.

The World Radiocommunication Conference

The world radiocommunication conference is a key feature of one of ITU's core responsibilities; namely, ensuring the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using the geostationary-satellite or other satellite orbits.

The WRC is a part of ITU's Radiocommunication Sector (ITU–R) — the only Sector within the ITU that has, as one of its outputs, international treaty text. Other bodies that produce treaty texts are the Plenipotentiary Conference, world conferences on international telecommunications (WCIT), and regional radiocommunication conferences (RRC).

Robert W. Jones, former Director of the ITU Radiocommunication Bureau

From WARCs to WRCs

A High-Level Committee reviewed the structure and functioning of ITU in 1990–1991. One of its recommendations was that all of ITU's radiocommunication-related activities should be brought under a single sector. It also recommended that world administrative radio conferences (WARC) should become world radiocommunication conferences (WRC). These, and other recommendations of the committee, were adopted by ITU Member States at the Additional Plenipotentiary Conference in 1992.

World radiocommunication conferences are normally convened every two-to-three years. The general scope of the agenda of a WRC should be established four-to-six years in advance. As a first step, a WRC recommends to the ITU Council a preliminary agenda for a future conference, together with an estimate of the financial implications. The final agenda is set by the Council, preferably two years before the conference, with the concurrence of a majority of ITU Member States. This agenda also includes any matter which a plenipotentiary conference directs to be placed on it.

Broadly, a WRC can

- revise the Radio Regulations either partially or, in exceptional cases, completely;
- deal with any radiocommunication matter of a worldwide character within its competence;
- instruct the Radio Regulations Board and the Radiocommunication Bureau to carry out certain, specific activities and review those activities;
- determine topics for study by the Radiocommunication Assembly and ITU–R study groups;
- identify matters that the Assembly should consider in preparation for future radiocommunication conferences.

In addition, the conference considers and approves the report of the Director of BR on the activities of the Radiocommunication Sector since the previous WRC. It may also include in its decisions instructions or requests to the Secretary-General and the Sectors of the Union to undertake specific activities.

Good preparation is the key to success

The importance of good preparations for WRCs cannot be overstated. Preparations involve a large number of people and take place at many levels: national, sub-regional, regional and global.

Much of the preparatory work at the global level takes place in ITU–R's study groups (for technical and operational matters) and its Special Committee (for regulatory and procedural matters). These activities are managed by the Radiocommunication Assembly working through its Conference Preparatory Meeting (CPM), which prepares a consolidated report that is used in support of the work of a WRC. As much as possible, the report reconciles differences in the approaches contained in the input material. When this cannot be done, the differing views are included for consideration in the report to the WRC.

Table 1— Statistics of recent world radiocommunication conferences

	WRC-95	WRC-97	WRC-2000	WRC-03
Member States	140	142	148	145
Delegates	1223	1800	2043	2112
Observer organizations	30	37	94	83
Observers	83	143	261	179
Cost (millions of Swiss francs)	4.529	5.597	5.581	4.801
Pages of documentation (millions)	n/a	15.243	14.868	11.677

Typically, the CPM meets twice between WRCs, beginning with a session immediately after a WRC to plan the preparatory work for the next conference. This meeting assigns responsibility for specific studies to the appropriate study groups and the Special Committee. In the CPM's second meeting, it finalizes its consolidated report.

Regional and sub-regional telecommunication organizations play a key role in facilitating discussions of national proposals to an upcoming WRC. In this process, views are harmonized and, when consensus is achieved, it is reflected in "common proposals" that are submitted to the conference.

At the national level, most Member States have specific processes for gathering and harmonizing input from interested parties. Such processes can involve requests for written submissions, establishment of (and participation in) national preparatory committees, and the commissioning of studies. Each sovereign Member State then decides what proposals to put forward at the sub-regional, regional and global levels, including ultimately to a WRC.

The Challenges

In the past, the agendas of world administrative radio conferences usually focused on a specific radio service or services. Nowadays, WRC agendas cover almost every radio service and every frequency range. The thinking of the High-Level Committee was that the agendas of WRCs should respond to pressing radiocommunication issues across all radio services, but that they should be reasonably limited in their scope. However, what has transpired is that WRCs have very extensive agendas, with many issues being carried over from one conference to the next while new items are added. Clearly, this has presented many challenges for the ITU membership as well as its secretariat. For one thing, the size of WRCs has increased in recent years, as can be seen in Table 1. All of the conferences it details were four weeks in duration. With a greater reliance on electronic distribution of documentation at WRC-03, significant savings were achieved.

Such large conferences dealing with long agendas, covering many different and complex items, suggests that Member States should include in their delegations experts in many fields of radiocommunications. This can be a problem for reasons of cost, and because it may be difficult for these experts to be absent for four weeks from their normal responsibilities. Also, due to the large number of agenda items, there is the real possibility of a conference taking only partial or interim decisions and referring any outstanding aspects to a subsequent WRC. This practice can lead to further difficulties. And, while some ideas for dealing with the problem have been advanced, none has found general acceptance.

Conclusion

The ITU Radio Regulations provide the framework for global harmonization of the use of the radio-frequency spectrum. The WRC process for reviewing and updating these regulations has been an effective means of ensuring a timely and responsive mechanism to accommodate new and advanced radiocommunication applications, while respecting existing spectrum use. However, the challenge of an increasingly complex WRC has to be faced. Good preparation at the national, sub-regional, regional and global levels is the key to maintaining a successful WRC process. ■

Stop Press

Geneva to host ITU Telecom World 2009

ITU's flagship event is to return to Europe

Geneva is to host ITU Telecom World 2009. The decision was reached following an evaluation of bids from four cities (Birmingham, Dubai, Geneva and Paris), and was based on a recommendation of the ITU Telecom Board made at its meeting in March 2006. Six countries had originally applied to host the World event, but two withdrew their offer during the process.

ITU Telecom events are major meeting places for professionals in information and communication technologies (ICT) from around the world. They can bring considerable benefits to host cities, and all the candidates put forward competitive bids. "We were very impressed with the calibre of the offers received," said ITU Secretary-General Yoshio Utsumi. "The Geneva authorities have made rigorous efforts to underline their support for the event, and have provided the most cost-effective package for the exhibitors, participants and the organizer. We are pleased to award World 2009 to Geneva in recognition and acknowledgement of the positive commitments made in their offer."

Geneva's bid includes a mechanism to keep down the price of hotel rooms in the city. This was one of the 20 criteria used in making the decision to award the 2009 event to the city. Other factors included the overall costs to exhibitors and a series of technical requirements, such as the quality of infrastructure. The decision also takes into account the needs of the ICT industry by holding the event in another major market, following the 2006 ITU Telecom World in Hong Kong in December.

"All four candidates offered very attractive destinations for those attending our event, and I would like to take this opportunity to thank them for their efforts," said Fernando Lagraña, Executive Manager of ITU Telecom. "While only one can win, I am confident that the high-quality of their offers and the tight race to select the host of World 2009 will encourage the other candidates to bid for future ITU Telecom events," he added.

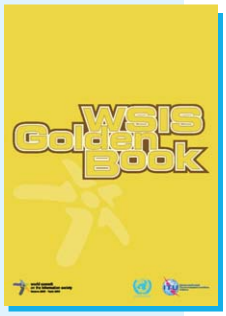
The Golden Book

Commitments made during the Tunis Phase of WSIS

The Golden Book is a record of work undertaken to implement the goals of the World Summit on the Information Society (WSIS). It was launched in Geneva on 24 February 2006 at a Consultation Meeting of WSIS Action Lines Facilitators/Moderators, convened by ITU, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Development Programme (UNDP).

The Golden Book provides examples of innovative projects to build infrastructure; promote information and communication technologies (ICT) in education, health and governance; to ensure fair access to ICT, and to enhance online security. It has been published by ITU as a permanent record of the new commitments pledged by stakeholders during the Tunis Phase of WSIS. The Golden Book also serves as a tool helping to coordinate implementation of the WSIS Plan of Action and avoid duplication of effort.

All stakeholders at the summit were invited to submit details for the Golden Book of their activities that have been planned or are already being undertaken to implement the WSIS Plan of Action. More than 375 submissions were made by governments, international organizations, non-governmental organizations, companies and individuals. ITU estimates that these activities announced during the Tunis Phase represent a total value of at least EUR 3.2 billion (USD 3.9 billion). Work on implementing the WSIS Plan of Action will be monitored through a multi-stakeholder process to be overseen by ITU, UNESCO and UNDP.



Around the world

AT&T grows bigger

On 5 March, United States' telecommunications company AT&T Inc. announced that it will merge with BellSouth to create a firm capitalized at USD 165 billion. The merger would give AT&T complete control of Cingular Wireless — America's biggest mobile phone company. It will allow for the closer integration of wireless, wireline and internet protocol networks that is needed as technological convergence continues. BellSouth was originally part of AT&T, but was spun off from its parent (along with other "Baby Bells") in the 1980s. AT&T was itself taken over in November 2005 by SBC Communications Inc.

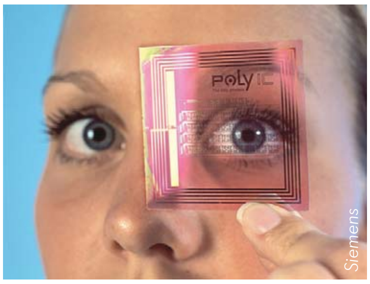
Mobile music, television and e-mail are found to be favourites

Siemens AG, of Germany, released on 8 March the results of a survey it had conducted of consumers to find out what people want from new wireless applications. The survey on "innovative wireless services," which questioned over 5300 mobile communication subscribers in Brazil, Canada, China, Germany, Italy, the Republic of Korea, the Russian Federation and the United States, found that mobile television and e-mail access on mobile phones are among the most popular applications. On average, 74 per cent of the surveyed users want to be able to send and receive e-mails on their wireless devices, while 59 per cent said they were interested in watching television. This rose to 90 per cent in the Republic of Korea, where mobile television is already on offer. The study shows that the ability to download music tracks to mobile handsets offers high potential as well, and 62 per cent of all respondents said they would download music files to their wireless devices.

Mobile television

EC consults public on RFID

On 9 March, the European Commission (EC), announced the launch of a public consultation project on the use of radio-frequency identification (RFID) technology. A series of workshops — being held in Brussels from March to June 2006 — will discuss RFID applications, end-user issues, interoperability and standards, and frequency spectrum requirements. The conclusions of the workshops will be used in a working document that will be published online by the EC in September. Feedback on the document will be integrated into a Commission Communication on RFID, to be adopted before the end of the year. As well as technical issues, the consultation process will deal with questions of privacy. The overall aim is to build a society-wide consensus on the future of RFID.



RFID chip

User-friendly websites for people with disabilities

The British Standards Institution (BSI) has completed guidelines on designing websites that can easily be used by people with disabilities. The *Guide to good practice in commissioning accessible websites* was the result of a study carried out by the UK's Disability Rights Commission (DRC) in 2004. This found that 81 per cent of British websites could not be accessed by people with disabilities. At the same time, firms are losing out by failing to contact a significant segment of consumers — people with disabilities in the United Kingdom are reported to spend about USD 139 billion (GBP 80 billion) every year. An accessible website is also easier for all people to use, and is thus likely to benefit both businesses and customers of all kinds. ■

Telegraphy and television —

Two fields of achievement for one pioneer

If things had happened differently, we might now be watching the screens of "electrical telescopes" in our living rooms. That was one of the terms coined a century ago for what, today, we call television sets. But when was the word "television" first used, and by whom? We asked that question at the end of last month's *Pioneers' Page*. In fact, it was as far back as 1900 that the word "télévision" first appeared, in a paper* (in French) by the Russian physicist Constantin Perskyi, presented at the first International Electricity Congress that was held alongside the Great Exhibition in Paris.

Perskyi was Professor of Electricity at the Artillery Academy in Saint Petersburg. His lecture in Paris simply reviewed the progress that had been made up to then in achieving the dream of viewing things at a distance. The debate in Paris at the "Palace of Electricity" was chiefly concerned with physics, rather than with the possible technology of television. Nevertheless, crucial steps had already been taken towards creating a practical device. One of the most important of these was the invention of the cathode ray tube (CRT).

The tube in the box

By the middle of the nineteenth century, it had been noticed that when a strong electric current was passed from one wire to another sealed within a glass tube, glowing light was produced inside that could be manipulated by waving a magnet over its surface. And when air was pumped out to create a vacuum, a patch of fluorescence appeared on the glass. This forerunner of the neon sign made a wonderfully showy effect, but in the 1870s it was also developed into a useful scientific instrument (the *Crookes Tube*) by Briton William Crookes, who wanted to investigate how electricity interacts with rarified gases. In 1876, the German physicist Eugen Goldstein gave the name "cathode rays" to the radiation that causes the fluorescence.

Karl Ferdinand Braun (1850 – 1918), invented the cathode ray tube and shared a Noble Prize with Marconi for work on wireless telegraphy

It was not until two decades later, in 1897, that J.J. Thomson at the University of Cambridge used the *Crookes Tube* in first discovering sub-atomic particles — electrons — and demonstrated that cathode rays are the same thing: a stream of what he called "corpuscles of negative electricity." In the same year, the "cathode ray indicator tube" was invented by Karl Ferdinand Braun, of Germany. Unlike earlier vacuum tubes, the *Braun Tube* allowed precise control of a narrow particle beam (using alternating voltage) that could trace patterns

*"*Télévision au moyen de l'électricité*" Exposition universelle internationale de 1900, Congrès international de l'électricité (Paris, 18–25 August 1900).

onto the fluorescent end of the device. This was initially developed as an oscillograph, but was also the origin of the CRT for the televisions and computer monitors of the future.

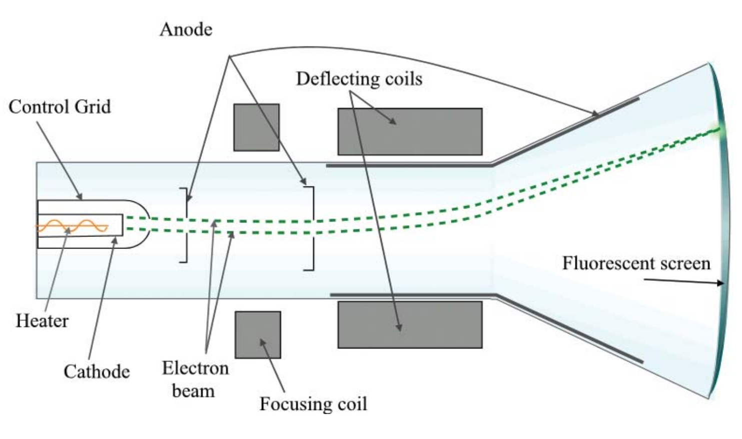
Long-distance messages

Thomson received the Nobel Prize in physics for his work in 1906 — the year, too, that ITU's *Radio Regulations* were born, governing a field in which Braun was also distinguished. In 1909, he shared a Nobel Prize with Guglielmo Marconi, for their contributions to the development of radio. Through introducing a closed circuit of oscillation, Braun overcame the "dampening" effect that weakened Marconi's original design for wireless telegraphy. The critical improvements that he made achieved a tenfold extension of telegraphy's range to some 100 kilometres, as well as adding the capacity to target transmissions more narrowly, by means of inclined beam antennae. This meant that people could send radio messages in greater privacy — a factor of major importance to business users, for example.

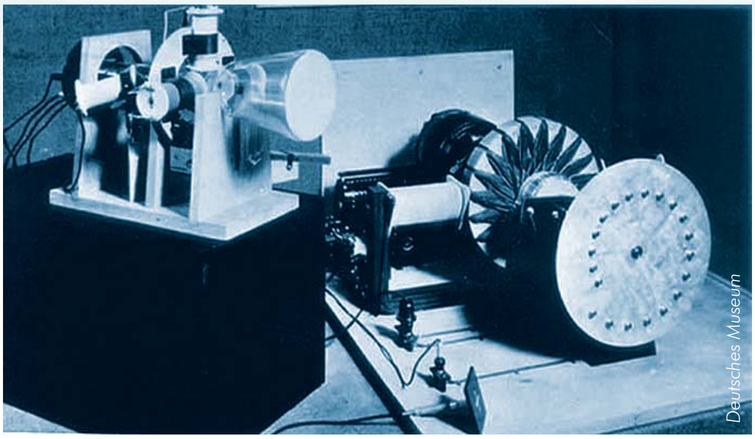
The achievement was recognized by Hans Hildebrand, Secretary of the Royal Swedish Academy, in the speech he gave upon presenting Braun with a Nobel Prize. Describing Braun's work as "inspired", Hildebrand noted that it was only through the German scientist's efforts that long distance telegraphy had become possible, and "that the magnificent results in the use of wireless telegraphy have been attained in recent times."

Just after the outbreak of the First World War, Braun travelled to New York to attend a court case over a patent claim. He was prevented from returning to Germany when the United States entered the war, and because he was by then seriously ill. He died in New York in April 1918, at the age of 67. The cathode ray tube that he invented has remained the technology upon which television receivers are based — until very recently. Nowadays, flat-screen plasma or liquid-crystal display (LCD) televisions are rapidly taking over. And the word "television," first heard more than a century ago, is now understood in almost every country of the world — in much the same way as the technology itself pervades our lives. ■

Diagram of a cathode ray tube



Source: Theresa Knott



Model of a 1906 cathode ray tube, designed by Braun

Question for next month

Who was the famous engineer who created not only the first video recording system...
...but also special, damp-proof socks?

From official sources

CONSTITUTION AND CONVENTION OF THE ITU (GENEVA, 1992); INSTRUMENTS AMENDING THE CONSTITUTION AND THE CONVENTION OF THE ITU (KYOTO, 1994; MINNEAPOLIS, 1998; and MARRAKESH, 2002)

The Government of the Republic of Iraq has acceded to the above Constitution and Convention. The instrument of accession was deposited with the Secretary-General on 8 February 2006. This accession applies to the Constitution and Convention as amended by the Plenipotentiary Conferences of Kyoto, 1994, Minneapolis, 1998, and Marrakesh, 2002.

INSTRUMENTS AMENDING THE CONSTITUTION AND THE CONVENTION OF THE ITU (MINNEAPOLIS, 1998; and MARRAKESH, 2002)

The Government of the Republic of San Marino has ratified the instruments amending the above Constitution and Convention. The instruments of ratification were deposited with the Secretary-General on 14 February 2006.

NEW MEMBERS

Telecommunication Standardization Sector

Canar Telecommunications Corporation Limited (Kanartel), (Khartoum, Sudan) and *Pirelli Broadband Solutions S.p.A. (Milan, Italy)* have been admitted to take part in the work of this Sector.

Telecommunication Development Sector

Autorité de Régulation de la Poste et des Télécommunications (ARPT) (Algiers, Algeria), Canar Telecommunications Corporation Limited (Kanartel) (Khartoum, Sudan), Consortium algérien des Télécommunications (CAT) (Algiers, Algeria), Maxis Communications Bhd (Kuala Lumpur, Malaysia), National Institute of Information and Communications Technology (Tokyo, Japan), National Telecommunication Corporation (Islamabad, Pakistan) and *Telenor Asa (Fornebu, Norway)* have been admitted to take part in the work of this Sector.

NEW ASSOCIATES

Radiocommunication Sector

Advanced Television Systems Committee (Washington D.C., USA) has been admitted to take part in the work of Study Group 6.

CHANGE OF NAME

Covaro Networks, Inc., a Sector Member of ITU–T, has changed its name to *IADVA Optical Networking, Inc. (Richardson, TX, USA).*

ITU conferences

2006

- 19–28 April (Geneva)
ITU Council annual session
- 15 May–16 June (Geneva)
Regional Radiocommunication Conference 2006 (RRC-06)
- 6–24 November (Antalya, Turkey)
ITU Plenipotentiary Conference
- 4–8 December (Hong Kong, China)
ITU TELECOM WORLD 2006 (Exhibition and Forum)

DIARY

Lack of space in this issue prevents us from listing forthcoming meetings of ITU. However, updated details of meetings can be checked on the ITU website at http://www.itu.int/events/index.asp