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Observations from WRC-03

By
Liching Sung[1]
Department of Communication & Center for Wireless Telecommunications
Virginia Tech
Blacksburg, VA 24061
Telephone: 540-231-6507; Fax: 540-231-9817; Email: sung@vt.edu

[1] Liching Sung is an Assistant Professor in the Communication Department and a Research Faculty member of the Center for Wireless Telecommunications at Virginia Tech. The author attended WRC-03 as a visitor. She would like to thank the WRC-03 delegates whom she interviewed for this article. However, the views expressed in this article are solely those of the author, and she assumes full responsibility for any errors.

Abstract

The 2003 World Radiocommunication Conference (WRC-03) was the largest radio spectrum allocation conference since 1992 and one of the largest WRCs ever held by the International Telecommunication Union (ITU). The conference was instrumental in facilitating the extension of broadband wireless networks from corporate offices to public spaces, and from land to the sky and the sea. It was also notable for a maturation of the regionalization trend, developed over past decade, in international spectrum diplomacy. Most significantly, this conference provides a window to understanding the tensions in contemporary international spectrum policy-making. The tensions came from three sources: (1) equitable access to space communication; (2) spectrum access as a component of international economic competition; and (3) potential paradigm shift in spectrum management. This paper reviews major decisions of this conference according to these three themes.

I. Introduction

The 2003 World Radiocommunication Conference[2] (WRC-03) that took place June 9-July 4 in Geneva, Switzerland, was the latest in a long series of international radio spectrum allocation conferences. With 48 agenda items and 2,334 participants, it was also the largest such event since 1992[3] and one of the largest radiocommunication conferences ever held by the International Telecommunication Union (ITU). The conference was instrumental in facilitating the extension of broadband wireless networks from corporate offices to public spaces, and from land to the sky and the sea. It did so by allocating 455 MHz of spectrum in the 5 GHz band range to wireless local area networks (WLANs), by approving the use of the 14-14.5 GHz band for in-flight high speed Internet service, and by authorizing the use of very small aperture terminals (VSATs) on moving ships for broadband and video services on the sea. These allocations and authorizations represented the commitment of the international telecommunication community to the notion of ubiquitous broadband communication.

This conference was also notable for a maturation of the trend that began in 1992,[4] of countries' working through regional telecommunications organizations in preparing positions and in negotiating agreements. Six regional groups[5] now encompass nearly all ITU member states. Regional bloc-voting, as a strategy in making international spectrum policy, is strongly encouraged by the ITU. At this conference, committee chairmen actively looked for opportunities to make progress toward consensus by encouraging action or compromise at the regional level, rather than country-by-country.

Most significantly, this conference provided a prism into the political and economic dynamics of international spectrum policy-making in the post-liberalization telecommunication world. Three themes ran through this conference. First, equitable access to space communication, an issue first debated 30 years ago, is once again on the WRC agenda. At this conference, it took the form of two debates. The first involves whether a time limit should be set for satellite frequency assignments, and the second concerns the strengthening of regulations to make it more difficult for satellite operators to exploit the 12 GHz band reserved for *national* satellite television service for *regional* or *sub-regional* systems.

[2] The WRC is the international forum where countries gather to revise the Radio Regulations, the binding international treaty that governs the worldwide allocation and use of the radio frequency spectrum by all radio-based services.

[3] Prior to 1992, the World Radiocommunication Conference (WRC) was known as the World Administrative Radio Conference (WARC). The renaming of the conference was done as part of the ITU restructuring effort in 1992. WRC-03 is the fourth WRC under the new ITU structure.

[4] For a discussion of the development of regional voting blocs in WRC processes, see Sung, L. (1992). WARC-92: Setting the agenda for the future, *Telecommunications Policy*, 16 (8), pp. 624-634.

[5] These six groups are: the Conference of European Postal and Telecommunications (CEPT) administrations; the Inter-American Telecommunication Commission (CITEL), the telecommunications arm of the Organization of American States (OAS); the Asia-Pacific Telecommunity (APT), the African Telecommunications Union (ATU); the Regional Communications Community (RCC), consisting mostly of former states of the Soviet Union; and the Arab Spectrum Management Group (ASMG).

Second, the emphasis of WRCs on addressing the radio spectrum needs of emerging technologies inevitably led major telecommunications powers to butt heads with each other. A tug of war between Europe and the United States, the two technology titans, has been a recurring affair at recent WRCs. The competition often took the form of different regulatory approaches to the use of the radio spectrum, with Europe favoring more formal and rigid regulation, while the U.S. advocates informal and flexible regulation. At WRC-03, their regulatory differences occupied the discussions of two radio technologies of significant commercial and strategic interests: satellite-based global navigation service and wireless local area networks.

Third, as radio services and technologies converge, ITU's rigid definitions of radio services are becoming irrelevant. The recent emergence of frequency-agile and interference-tolerant technologies further challenges ITU's century-old spectrum management framework. Yet, discussions of regulatory change have pitted developed countries against developing ones that hold fundamentally different views of radio regulation. Two issues addressed at WRC-03, the allocation of spectrum for high speed Internet service on airplanes and the authorization of VSAT operation on ships, provide a glimpse of developing countries' targeted resistance to regulatory change. This article reviews major decisions made by WRC-03 according to the three dynamics outlined above.

II. Equitable Access to Space Revisited

The issue of equitable access to space harks back to the late 1960s, when developing countries, which by then had formed a majority in ITU's membership, began to press for a reform of ITU's "first-come-first serve" policy in managing radio spectrum usage. Their reason for doing so was to prevent advanced countries from monopolizing satellite spectrum and orbital resources. The result of this debate, which would eventually span two decades, was the creation of two types of spectrum Plans for Broadcasting-Satellite Service (BSS) and Fixed-Satellite Service (FSS).[6] The Plans set aside satellite frequencies in select bands, as well as associated orbital positions, for every country in the world, thus guaranteeing, in practice, *equitable access* to the geostationary-satellite orbit. With the Plans allaying the concerns of developing countries, the long debate over equitable access was temporarily put to rest by the late 1980s. But the dramatic increase in demand for satellite communication in the 1990s, resulting from telecommunications liberalization, technological progress, economic globalization, and the popularity of satellite television, created a new situation that once again put developing countries at a distinct disadvantage in spectrum access vis-à-vis their developed counterparts, prompting them to reopen the equitable access debate.

[6] BSS is more commonly known as direct broadcast satellite (DBS), which uses specialized satellites to transmit television signals directly to homes equipped with very small antennas. Fixed service satellites are general-purpose satellites that provide point-to-point communications for voice and data and distribute radio and television signals to broadcast stations and cable headends. In recent years, fixed service satellites have also been used for television broadcasts to homes.

The renewed debate grew from a Colombian proposal[7] to restore the principle of equitable access to space by, inter alia, giving priority status in frequency assignment requests to countries that have no satellite operations. Although this proposal was soundly rejected, it revived the issue of the time limit of satellite frequency assignments, a contention left unresolved from the original equitable access debate.

Limiting the length of satellite assignments has been considered as a way to facilitate equitable access to space, since after expiration a frequency assignment and the satellite's orbital position would be returned to the pool for other countries to use. At WRC-03, some Arab group nations and Iran proposed to fix a time limit of 20-30 years on satellite assignments, but "national" systems could be exempted from this limit. The ensuing debate, which took place on the night before the close of the conference, was one of the most impassioned at WRC-03.

Since the last debate on equitable access in the 1970s and 1980s, a number of developing countries have established satellite operations. They now share the same concerns as developed countries. For any satellite operator, the demand to abandon providing service from a given orbital position after a number of years, and to abruptly end a long-standing service, is unreasonable. The impact is particularly acute in the case of Direct-to-Home (DTH)[8] satellite television service, where millions of customers could lose reception overnight. Consequently, at WRC-03 the time limit proposal was vehemently opposed not only by developed countries, but also by developing countries that operate satellite systems, including Brazil, Mexico, South Africa, Argentina, and Chile. Even user countries such as those in the Caribbean took the floor to speak against setting any time limit, arguing that it would add instability to the already fragile satellite industry today, and insecurity to satellite service for consumers. The proposal to exempt "national" systems was criticized as impractical by Australia with support from other countries: "[The] discrimination between sub-regional and national satellite systems is a regulatory nightmare. . . . This proposition is unworkable, unrealistic, and doesn't help the people it intends to help."

The time limit proposal was eventually defeated. To alleviate Arab countries and Iran's concerns, however, the conference declared that frequency assignments to satellite systems "shall not be considered perpetual," and invited the ITU to continue to study this issue. [9]

The equable access debate also took another form in WRC-03 discussions. Through the work of two previous WRCs in 1997 and 2000, the spectrum Plan for Broadcasting-Satellite Service (BSS) that governs Region 1 (Europe, Africa, the Middle East) and

[7] The Colombia proposal was submitted in response to Resolution 80: Due diligence in applying the principles embodies in the Constitution (Rev. WRC-2000).

[8] DTH refers to satellite television service provided by fixed service satellites using unplanned bands. The term is used to distinguish from satellite television service using the planned BSS bands.

[9] *See* Resolution 4: Period of validity of frequency assignments to space stations using the geostationary-satellite and other satellite orbits (Rev. WRC-03).

Region 3 (Asia-Pacific) countries was revised, or *replanned*. By assuming the use of digital video transmission, the new Plan increases the number of satellite television channels assigned to each country from five to 10 analog-equivalent channels in Region 1, and from four to 12 in Region 3. The stated intent of replanning was to make national BSS systems more attractive financially through increased capacity. But replanning was also an attempt by developing countries in the Arab World and by Iran to stem the tide of numerous filings from Western European countries and others wanting to modify national BSS assignments to create regional or sub-regional satellite television systems. Such modifications, many of which were speculative or "paper" satellites, have the effect of draining potential capacity from the BSS Plan.

The new R1 & 3 BSS Plan included several new regulatory provisions. However, some of the provisions were challenged by several Arab countries and Iran after WRC-2000 as unfairly benefiting developed countries. The provisions in questions were Sections 4.1.18-4.1.20 of Appendix 30/30A of the Radio Regulations which contain the BSS Plans. These provisions permitted modifications to the Region 1 & 3 BSS Plan to be implemented without completing coordination with countries whose un-built BSS assignments could be affected. At WRC-03, Arab countries and Iran proposed to remove these provisions, as they have the effect of allowing a country to force its way into an orbital location against the wish of another. They also proposed to eliminate the practice of "satellite grouping," which allows a country to file a group of different BSS system designs but leaves determination of which one will be implemented until a later date. The grouping concept is mainly used to provide flexibility for satellite operators, yet Arab countries and Iran claimed that it could lead to the "monopolization" of the spectrum.

European countries vehemently opposed both proposals, but due to the political sensitivity of the issues, they were forced to accept a compromise. The conference eventually ruled that a modified assignment could no longer apply Sections 4.1.18-4.1.20 to force its way into an orbital location against an assignment in the BSS Plan.[10] On the issue of satellite grouping, WRC-03 ruled that for existing and already planned BSS systems, a country is limited to filing up to five different designs. For new systems, only up to three designs can be submitted. These decisions are a defeat for European satellite interests, as they effectively constrain satellite operators' ability to exploit the planned BSS frequency band. Less implementation of BSS networks than would have been expected under the old provisions should be expected, and an inefficient usage of these frequency bands will likely result.

The strong opposition to European satellite interests from Arab group countries and Iran should not come as a surprise. Satellite spectrum in the planned bands is the most valuable political capital developing countries have in the ITU system. Both the BSS spectrum and the time limit of satellite frequency assignment debates at WRC-03 revealed the willingness *and* ability of developing countries, especially Arab countries and Iran, to flex their muscles to protect their political capital. Yet, such exhibit of

[10] These provisions can now only be applied against another already modified assignment.

strength is also a sign of frustration. This is because most satellite television services today are provided not from planned BSS bands, whose *national* coverage requirements and limited channel capacity have made them uneconomical to use, but from unplanned frequency bands allocated to Fixed-Satellite Service (FSS), which are not regulated in terms of coverage area and number of channels. As a result, satellite television has become a transnational phenomenon. For many satellite operators, the main attraction of the BSS band is to complement the ongoing FSS operations by adding more capacity. Indeed, some of the proposed regional or sub-regional BSS systems are to be combined with existing DTH operations. The lack of control over satellite television broadcasts has greatly frustrated socially conservative countries, particularly those in the Arab World and Iran. This frustration led them to put up regulatory barriers to constrain the use of BSS spectrum.

III. Rivalry between the U.S. and Europe

In radiocommunications, access to spectrum means access to the market place. Consequently, spectrum negotiations at WRCs have become a component of international economic competition. A second major dynamic at WRC-03 and previous WRCs, therefore, is the rivalry between Europe and the United States, the two biggest telecommunications powers, over allocations that are of substantial commercial and strategic interests. This rivalry is often exhibited in the form of different regulatory approaches, with the U.S. preferring a light regulatory touch while Europe favors a heavier regulatory hand. At WRC-03, the discussions of satellite radionavigation service (RNSS) and spectrum allocations for wireless local area networks (WLANs) at 5GHz are two such examples.

Spectrum for satellite radionavigation services has become coveted in the last few years as a result of the enormous success of the Global Positioning System (GPS), which was developed by the U.S. military. The previous conference in 2000 had allocated additional frequency bands for RNSS[11] in anticipation of the arrival of new systems, mainly Galileo, the European proposed competitor to GPS. WRC-2000 had also set tentative sharing conditions between RNSS and existing radio services in the bands. The main task for WRC-03 was simply to review and confirm these sharing conditions. But Europeans unexpectedly brought a new proposal to the conference, seeking formal satellite coordination procedure contained in Article 9 of ITU's Radio Regulations for all RNSS systems and applying them retroactively as of WRC-2000. This new proposal greatly upset Americans because, if accepted, it would give precedence to the Galileo system, which was filed at the ITU before the U.S. filed for the GPS upgrade.

The U.S. has long preferred informal consultation outside the ITU to resolve inter-operation problems between RNSS systems. Europeans argued that coordination among RNSS systems should be formalized within the ITU system to provide a clear regulatory

[11] The newly allocated RNSS bands are 1164-1215 MHz, 1260-1300 MHz, 1559-1610 MHz, and 5010-5030 MHz, which share with aeronautical navigation, radiodetermination, and radio astronomy services, respectively.

framework to ensure that *all* prospective RNSS systems can use the available spectrum on an *equitable* basis. There are other speculations as to why Europeans proposed formal coordination procedure for RNSS. First, the striking military and commercial success of GPS has invited imitators not only from Europe, but potentially also from China, Japan, and India. Coordination would allow Europeans to establish precedence over any other newcomer. Second, for military cooperation and commercial application reasons, the European Commission, which underwrites the project together with the European Space Agency, mandated that Galileo be made compatible with GPS. This gives GPS a substantial leverage in bi-lateral negotiations. In previous compatibility meetings, European negotiators for Galileo repeatedly experienced "cold shoulders" from their U.S. counterparts.[12] By formalizing frequency-sharing rules in the ITU, Europeans could attempt to reduce or even neutralize the GPS leverage, making Galileo more of an equal partner.

At WRC-03, Americans were adamantly against applying Article 9 retroactively, but were more receptive to applying it for a future date. After long and intense negotiations, a compromise was reached on the second to last business day of the conference. Coordination procedure will be applied *prospectively* to RNSS systems filed after January 1, 2005. To avoid coordinating with speculative or "paper" systems, a "realness" test was established to ensure that only viable RNSS systems will be coordinated.[13]

In addition to RNSS, another incident of transatlantic regulatory dispute concerned the allocation of spectrum at the 5 GHz range for wireless local area networks (WLANs). This was arguably the highest-profile agenda item for the conference due to the popularity of the IEEE 802.11b standard for WLAN that operates in the 2.4 GHz band. Many airports, hotels, coffee shops, restaurant chains, subways, and even city parks have been equipped with 802.11b networks, branded Wi-Fi, to provide high speed wireless Internet service. Because of the crowding of the 2.4 GHz band, the 5 GHz band is anticipated to be the spectrum home for the next generation of WLAN, which will provide higher speeds but with a shorter range.

WRC-03 was slated to allocate a total of 455 MHz of spectrum to WLAN in three sub-bands of 5 GHz: 5150-5250 MHz, 5250-5350 MHz, and 5470-5725 MHz.[14] Technically speaking, international allocations are not necessary for WLANs, which provide short-range (< 100 m) communications and typically operate on an unlicensed or license-exempt basis. However, the WLAN industry in Europe and the U.S. lobbied for such allocations in order to harmonize WLAN frequency use throughout the world, and to

[12] One of the most difficult negotiation points involves whether the Public Regulated Service (PRS), one of Galileo's proposed services to be used by police and security services, can overlap with the M-code, a proposed new military signal for GPS. Americans consider such overlay unacceptable because the U.S. military cannot jam Galileo signals without also jamming GPS signals. They have so far refused to talk to Europeans on this issue, delaying the conclusion of the bi-lateral talk indefinitely.

[13] This is achieved by requiring a new applicant to provide proof of satellite procurement and launch agreements, or evidence of guaranteed funding.

[14] These bands were formally allocated to Mobile Service by WRC-03 with a footnote indicating that the allocations were intended for the implementation of wireless access systems including radio local area networks.

legitimize unlicensed WLAN operations in developing countries, many of which are not yet familiar with the concept of unlicensed or licensed-exempt radio services.

The U.S. and Europe both supported the allocations, but they differed on the measures to protect existing services. The primary difference was whether to allow outdoor use of WLAN devices operating in the center band of 5250-5350 MHz. Outdoor use of WLANs, especially in rural areas, is a growing market segment currently led by U.S. manufacturers. The U.S. has an interest in promoting this market, and U.S. regulators were already committed to such outdoor use. An ITU agreement will allow the U.S. to align domestic regulations with international ones. The industry will also benefit from economies of scale in chip design for outdoor WLAN devices. Europe, on the other hand, wanted to protect earth-sensing satellites operated by the European Space Agency. Outdoor use in this band, which entails higher power output from WLAN devices, could potentially interfere with such operations.

This became one of the most contentious discussions of the entire conference. After a long stalemate, a compromise finally emerged during the last week of the conference. To placate European concerns of potential interference, the conference ruled that the 5250-5350 MHz band will be for "predominantly" indoor use. Outdoor use is not prohibited, but mitigation techniques, such as Dynamic Frequency Selection (DFS), a listen-before-talk mechanism, and Transmit Power Control (TPC), are required to prevent interference. Agreements on the other two sub-bands had been agreed upon prior to the conference. In the 5150-5250 MHz ban, an indoor restriction will be imposed to protect Mobile-Satellite Service. For the 5470-5725 MHz band, outdoor use is permitted as long as mitigation techniques are employed. Taken together, these decisions make available 355 of the 455 MHz allocated at the Conference for outdoor use, providing a substantial boost to the WLAN industry.

Both the WLAN and RNSS debates reflect the differences in regulatory approach between the U.S. and Europe in international spectrum management. The U.S. has traditionally preferred domestic rules to international regulations, while Europe is more comfortable with international regulations. However, regulatory approaches are only a means to an end employed by countries and regions to advance commercial and political objectives at WRCs, and as such, they are not set in stone. Europe and the U.S. are the two biggest telecommunications powers in the world and share many common interests as far as spectrum needs are concerned. Their squabbles at WRCs are about regulatory *styles*, rather than the *essence* of regulation, which they both want to be pro-technology and conducive to economic efficiency. Developing countries, on the other hand, have a fundamentally different view of the role of radio regulation. As will be seen in the next section, developing countries often use ITU regulations to put up barriers for the introduction of new technology in order to defend their interests.

IV. Radio Regulations out of Sync with Technology Trends

To be relevant, WRCs have to meet the spectrum demands of the industry. By and large, WRC-03 and its predecessors were responsive to the spectrum needs of emerging technologies, such as WLAN, by readily making spectrum available to them. However, all of these new spectrum needs were accommodated within the traditional spectrum management framework, which has remained essentially unchanged for almost a century. This framework segments radio frequencies into various bands, each of which is allocated to one or more well-defined radio services. These service definitions were developed when clear distinctions were apparent between radio services, and were deployed to ease the complexity of spectrum management. But the traditional, service-defined framework is being called into question more and more as radio services and new technologies increasingly converge. Service convergence is most apparent in the satellite services, where FSS networks used for DTH television service are virtually indistinguishable from BSS networks. At WRC-03, the allocation of Aeronautical Mobile-Satellite Service (AMSS) and the authorization of earth stations to operate aboard vessels (ESV) best illustrate the increasing disconnect of ITU's Radio Regulations with major trends in technology development.

To facilitate high speed Internet access aboard commercial and non-commercial airplanes, WRC-03 was slated to allocate the 14-14.5 GHz band for AMSS. The main proponent of the allocation is the Boeing Corporation, whose *Connexion by Boeing* project aims to use existing FSS satellites to provide high-speed Internet and related services aboard aircraft.[15] Most countries and regions were in favor of the allocation. Yet, the item encountered harsh resistance from Arab group countries, particularly Syria, and Iran who cited regulatory irregularity to stall the discussion at WRC-03.

Connexion by Boeing operates as a service provider and leases transponders from commercial FSS operators for its airborne Internet service. Such an arrangement is not in strict accordance with the Radio Regulations. In principle, FSS space stations can only communicate with earth stations that are located at fixed points on the ground. *Connexion by Boeing's* earth stations, however, are mounted on fast-moving airplanes. The "misuse" of FSS satellites for *mobile* service was the basis for Arab countries and Iran's opposition. But *Connexion by Boeing* is hardly the first provider to lease FSS transponders for mobile services. In 1985, *OmniTRAC* began leasing FSS transponders to provide trucking fleet control service. Such service is now commonplace in many parts of the world. In industry practice, a transmitter station of one service category oftentimes has to communicate with receiver stations of a different category. For example, in rural areas, mobile stations are often used as fixed access to the communication infrastructure. In the past, the ITU turned a blind eye to the mixing of service categories between the transmitter and the receiver, but the AMSS allocation brought the issue to the fore, forcing the international telecommunications community to face up to this regulatory inconsistency.

[15] *Connexion by Boeing* is scheduled to begin service in early 2004 in heavily trafficked Northern hemisphere trans-oceanic and trans-continental routes, with expansion to routes covering Mexico, Central America, the Caribbean and South America in mid-2005.

At WRC-03, the debate on AMSS allocation was long and arduous. After many unfruitful meetings, a solution was finally reached near the end of the conference. To satisfy Arab countries and Iran's demands, two safeguard measures were taken. One is a commitment by any AMSS provider that the characteristics of an aircraft earth station are within the characteristics of a typical FSS earth station published by the ITU. The other is to impose additional technical limits on AMSS, which has a secondary status in the 14-14.5 GHz band, above and beyond its obligations to protect primary services in the band. These measures add technical constraints to *Connexion by Boeing* and are likely to increase the complexity of its operations.

Earth stations on board vessels (ESVs) provide yet another example of industry practices not in sync with Radio Regulations. The purpose of the ESV agenda item was to provide an international regulatory framework for the operation of satellite earth stations on moving ships. Such ships can be commercial cruise ships or military vessels. Satellite communications for sea-going vessels have existed for almost three decades, but they are for narrowband voice and data services. Only in the last decade has it become practical for vessels to carry very small aperture terminals (VSATs), commonly used by large corporations with far-flung operations, for broadband and video communications. However, the use of VSAT, a part of Fixed-Satellite Service, on *moving* vessels is not compatible with the Radio Regulations.[16] In 1997, the U.S. initiated the call for revising the Radio Regulations to legitimize such use. The term "earth station on board vessels" (ESV) was coined for this debate to distinguish from traditional shipboard satellite communications, which are regulated as "Maritime Mobile-Satellite Service" (MMSS). While ESVs typically lease transponders from existing FSS operators, MMSS is provided exclusively from designated mobile-service satellites, operated by entities such as the Inmarsat.

Most countries and regions were amenable to making such an exception for ESV, provided that sufficient protection would be given to existing services sharing the bands. Arab group countries and Iran, again citing regulatory inconsistency, opposed the authorization. They insisted that as long as the ship is a moving platform, ESV must be regulated as a mobile service. They also fought vehemently against technical provisions that would allow ships to carry earth stations with antennas smaller than 1.2 meters. Since a smaller antenna would allow more vessels to carry ESVs, it would potentially lead to more interference to communications systems on land.

Despite numerous formal meetings and private consultations, Arab group countries held out their positions till the very end. However, they were outnumbered by countries that supported ESV. As a last resort, Arab countries excluded themselves from the final decision of the conference that approved ESVs to communicate with FSS satellites.[17]

[16] Prior to WRC-03, ESVs operated under Article 4.4 of the Radio Regulations, which allows communications systems not recognized by ITU regulations to operate on a non-interference basis without any protection.

[17] In 18 Arab countries, ESV will be regulated as MMSS on a secondary basis in both C-and Ku band. Iran did not exempt itself from the conference decisions on ESV.

Ships are allowed to carry antennas as small as 60 cm (in the Ku band only), as long as they do not create greater interference than that caused by larger antennas.

Underlying Arab countries and Iran's objections to AMSS allocation and ESV authorization is a perceived threat to a country's sovereign control of communications near and over its territories since the local government cannot shut down such foreign-owned operations. This fear led to their hard-line positions buttressed by an "orthodox" interpretation of the Radio Regulations. Their orthodox approach to regulation turned AMSS and ESV debates into 'theological" discussions of the Radio Regulations. Such debates, however, deflect the real issue. The issue implicit in the AMSS and ESV debates is this: As technology development accelerates due to digitization and convergence, the technology gap between developed and developing countries widens precipitously. In this context, the old guard's defense of the Radio Regulations is not just a benign effort to maintain the integrity of ITU regulations, but an attempt to slow down the progress of technology.

Still, hints of fundamental change to the Radio Regulations were present at WRC-03. The conference passed a resolution to study Ultra-wideband (UWB), a wireless technology for transmitting large amounts of digital data over a wide spectrum of frequency bands with very low power for a short distance. Because it spans many bands, UWB calls into question the traditional, service-defined spectrum management framework. WRC-03 passed another resolution that directly challenges the assumption that segregating bands for different radio services is the best way to achieve spectrum efficiency. Entitled "Options to improve the international spectrum regulatory framework,"[18] this resolution cites the convergence of radio technologies, other emerging technologies that allow for flexible use of the spectrum, and spectrum management reform under consideration by some countries, as reasons why it is timely for the ITU to examine the effectiveness of the current Radio Regulations and to identify ways for improvements.

One of the most touted emerging technologies is software-defined radio (SDR), which can be modified dynamically to operate with widely varying technical parameters, such as modulation, occupied bandwidth, and frequency. A newly formed topic within SDR is cognitive radio that "employs model-based reasoning and at least a chess-program level of sophistication in using, planning, and creating radio etiquettes."[19] These technologies have built-in mechanisms for mitigating interference, allowing greater spectrum sharing. A flexible regulatory approach is required to take full advantage of such emerging technologies. Some advanced countries, including the U.S., are considering mechanisms other than band allocation to accommodate frequency-agile and interference-tolerant technologies to allow for more efficient use of the radio spectrum.

If the development of radio technology is to continue without hindrance, the international framework for spectrum management must be examined to ensure that it is the most

[18] *See* Resolution 951 (WRC-03).

[19] *See* Software Radio - Cognitive Radio, Wireless Architectures for the 21st Century, at **http://ourworld.compuserve.com/homepages/jmitola/** (last visited January 29, 2004)

suitable framework. However, inertia will make any fundamental changes to ITU spectrum management framework difficult, if not impossible. This inertia arises from the large quantity of installed equipment and entrenched national regulations that are based on existing Radio Regulations. Yet, if the ITU is to remain relevant, fundamental changes to its spectrum management framework are inevitable.

VI. Conclusion

WRC-03 will be remembered as more than a routine radio spectrum allocation conference. The conference marked the extension of broadband wireless networks from office spaces to public places, and from the ground to the air and the ocean. It is also notable for the growth and maturation of the regionalization trends in negotiations. Further, this conference provides a window to understanding the tensions in contemporary international spectrum policy-making. The tensions came from three sources: (1) equitable access to space; (2) spectrum access as a component of international economic competition; and (3) potential paradigm shift in spectrum management.

The original BSS and FSS Plans formed in the 1970s and 1980s created an acceptable balance between developed and developing countries in terms of access to spectrum and orbital resources. In the view of some developing countries, however, this balance has shifted in favor of developed countries in recent years as the demand for satellite communications rose dramatically. The proposal for a time limit for satellite assignments and more stringent regulations for using BSS spectrum at WRC-03 are attempts by developing countries to restore the balance.

With an emphasis on meeting industry's need for spectrum, WRCs have become a battle ground for technology supremacy and economic competitiveness among telecommunications powers. At this conference, the high economic and strategic stakes of spectrum diplomacy is best illustrated by the rivalry between the U.S. and Europe over WLAN allocations and RNSS regulations.

The convergence of radio services and technologies in the past decade has challenged ITU's rigid definitions of radio services. Emerging technologies such as software-defined radio and cognitive radio portend a paradigm shift in spectrum management, and call into question ITU's radio regulation framework. Yet, any discussion of change will be agonizing, and will inevitably strain the relations between developed and developing countries as they hold fundamentally different views of radio regulation.