WRC-12 Agenda Item 1.19:
Regulatory Considerations for Software Defined and Cognitive Radio Systems

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As I reported at the 2009 Digital Communications Conference in Elk Grove, Illinois, the agenda for what was then the 2011 World Radiocommunication Conference includes an item of potential concern to Amateur Radio experimenters:

*1.19 to consider regulatory measures and their relevance, in order to enable the introduction of software-defined radio and cognitive radio systems, based on the results of ITU-R studies, in accordance with Resolution **956 (WRC-07)**;*

The WRC scheduled for 2011 has subsequently been moved to early 2012, from January 23 through February 17, 2012, in Geneva, Switzerland. The state of preparations for Agenda Item 1.19 as of the Conference Preparatory Meeting in February 2011 is reflected in the thirteen page CPM Report for the Agenda Item, which is attached. Among the results of the preparations are definitions for "software-defined radio" and "cognitive radio system," which are likely to clear the last hurdle to adoption at the 2012 Radio Assembly, scheduled for January 16-20, 2012:

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

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

The concern over Agenda Item 1.19 was that any regulations that would be implemented might, intentionally or inadvertently, hinder experimentation with and transportability of software defined and cognitive equipment used and made by Amateur Radio operators. In the final months before WRC-12, there is cause for much relief on this front. The debate on Agenda Item 1.19 has been relatively noncontentious, particularly on the SDR front. The attached CPM Report recommends no change to the ITU Radio Regulations with respect to SDR. As to cognitive systems, the options are generally favorable, all of them calling for no change to the Radio Regulations, and the most intrusive of the lot calling for a Resolution that would kick some issues down the road for future work.

The attachment fairly reflects the status of the work now. The outcome of a WRC is inherently uncertain, as a number of participating countries are not engaged until the conference begins. Nevertheless, on Agenda Item 1.19, the starting point for WRC negotiations is a favorable one, which will permit continues experimentation by radio amateurs and transportability of equipment to the extent it is currently permitted.

AGENDA ITEM 1.19

*1.19 to consider regulatory measures and their relevance, in order to enable the introduction of software-defined radio and cognitive radio systems, based on the results of ITU-R studies, in accordance with Resolution **956 (WRC-07)**;*

Resolution **956 (WRC-07)**: *Regulatory measures and their relevance to enable the introduction of software-defined radio and cognitive radio systems*

6/1.19/1 Executive summary

After the review and analysis of the agenda item, it was concluded that there is no need to modify the Radio Regulations for the implementation of software-defined radios (Method A). For cognitive radio systems, there were two views. The first view was that no changes were needed to the Radio Regulations (Method B1 Option A); however, there is an option to develop an ITU-R Resolution to provide guidance to the ITU-R for future studies on cognitive radio systems (Method B1 Option B). The second view (Method B2) supported the development of a WRC Resolution to provide guidance for future studies and guidance for the implementation of cognitive radio systems and with no further changes to the Radio Regulations. All methods support the suppression of Resolution **956 (WRC-07)**.

6/1.19/2 Background

Resolution **956** (**WRC-07**) resolves to invite the ITU-R to study whether there is a need for regulatory measures related to the application of software defined radio (SDR) and cognitive radio system (CRS) technologies.

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

The implementation of SDR and CRS may introduce specific and unique challenges of a technical or operational nature.

SDR technology is currently operating in some systems and networks in the LMS, MMS, BS, BSS, FSS and MSS. It offers flexibility in radio system design and may help with forward compatibility.

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

The implementation of CRS technology towards its full-fledged concept may progress stepwise due to a number of technical challenges coupled with the current state of the technology. The CRS technology may also provide additional capabilities to radiocommunication systems, such as dynamic spectrum access.

6/1.19/3 Summary of technical and operational studies and relevant ITU-R Recommendations

The following definitions for SDR and CRS have been proposed within the ITU-R and published in Report ITU-R SM.2152.

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

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

The studies have identified important aspects related to the introduction of SDR and CRS. In the case of LMS, spectrum is getting congested, e.g. due to the rapidly increasing Internet/data traffic and the need of broader bandwidth. CRS technologies may yield significant benefits by providing increased spectral efficiency of existing spectrum and mitigate the problem of congestion (e.g. capacity gain). IMT systems may, for example, in the future employ CRS and utilize the benefits of CRS such as mitigation of congested spectrum usage.

A common concern within the ITU-R is the protection of existing services from potential interference from the services implementing CRS technology, especially from the dynamic spectrum access capability of CRS.

In addition, a service using SDR and/or CRS should not adversely affect other services in the same band with the same or higher status. Thus, the introduction and operation of stations using SDR and/or CRS technologies in systems of any radiocommunication service should not impose any additional constraints to other services sharing the band.

For example, the introduction of SDR and/or CRS in a frequency band(s) shared between terrestrial and space services should not adversely affect either of these services by either imposing any additional constraints to the operation of terrestrial or space services.

Any system of a specific service using SDR and/or CRS in a frequency band allocated to that service should be operated in accordance with the provisions of the Radio Regulations and administration rules governing the use of the bands and the protection criteria defined in the relevant ITU-R Recommendations.

Relevant ITU-R Recommendations: ITU-R F.1094, ITU-R F.1108, ITU-R F.1190, ITU-R F.1495, ITU-R S.523, ITU-R S.671, ITU-R S.735, ITU-R S.1323, ITU-R S.1432, ITU-R M.1313, ITU-R M.1460, ITU-R M.1461, ITU-R M.1462, ITU-R M.1463, ITU-R M.1464, ITU-R M.1465, ITU-R M.1466, ITU-R M.1638, ITU-R M.1644, ITU-R M.1652, ITU-R M.1849, ITU-R BS.412, ITU-R BT.655, ITU-R BT.1368, ITU-R BO.1297, ITU-R BO.1444, ITU-R M.687, ITU-R M.1073, ITU-R M.1388, ITU-R SM.851, ITU-R M.1183, ITU-R M.1231, ITU-R M.1232, ITU-R M.1234, ITU-R M.1478, ITU-R SA.609, ITU-R SA.1157, ITU-R SA.1155, ITU-R SA.1396, ITU-R SA.363, ITU-R BO.1773, ITU-R RS.1263, ITU-R SA.514, ITU-R SA.1026, ITU-R SA.1160, ITU-R SA.1163, ITU-R RS.1029, ITU-R RS.1166, ITU-R RA.769, ITU-R BS.1660, ITU-R BS.216, ITU-R BS.1786, ITU-R

BT.1786 and ITU-R BS.560 and any other future relevant Recommendation providing new protection criteria being developed and in force at the time of consideration of SDR and/or CRS stations.
In reality, the obligation to respect an ITU-R Recommendation not incorporated by reference in the RR is dependent upon whether its text is reflected in the various national spectrum management policies.

Relevant ITU-R Reports: ITU-R M.2115, ITU-R M.2117, ITU-R SM.2152, ITU-R [LMS.CRS].

6/1.19/3.1 Issue A: SDR

Report ITU-R M.2117 identified two specific issues that appear to be independent of the type of the radiocommunication service:

i) An SDR station, part of any system in a radiocommunication service, can be remotely reprogrammed and can gain the capability to transmit within a frequency band in which there is no allocation to the radiocommunication services under which it normally operates or there is an allocation to the radiocommunication service under which it operates but there is no assignment[7] of radio frequency or radio frequency channel for this SDR station.

ii) Issues related to SDR software to ensure that the station operates within its allowable parameters (e.g. in-band and unwanted emission levels) to avoid harmful interference.

The above issues are related to the particular hardware and software implementation and software reliability and security.

Software reliability and security relate to the risk for harmful interference and/or unauthorized use of frequency bands resulting from intentional or unintentional behaviour of the software running on a SDR station. It is important to note that a risk of the same nature exists with hardware defined radio despite established national certification/licensing regime for radio stations, allowing the verification of the compliance with the existing rules (both national and international) post manufacturing and prior to the date of bringing into use of the radio station. SDRs allow a level of security against unauthorized manipulation comparable to that of previous generation radios. Moreover, relevant authorities will have to assess the risks associated with possibility of simultaneous unauthorized manipulation of multiple-SDR networks.

6/1.19/3.2 Issue B: CRS

Studies within the ITU-R consider various scenarios for the use of CRS technology.

Within ITU-R, Report ITU-R [LMS.CRS] is being developed. This Report includes descriptions of applications of cognitive radio systems and gives several possible deployment scenarios.

CRS may be implemented in radio systems in a specific radiocommunication service operating in a band or several bands or may be implemented in radio systems in a specific radiocommunication service that share the band with other radio systems in any radiocommunication service.

6/1.19/3.2.1 Deployment scenarios

The following possible scenarios for CRS, which are not exhaustive, nor mutually exclusive, have been identified:

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[7] In this context, assignment has the same meaning as the one given in RR No. **1.18**.

6/1.19/3.2.1.1 Use of CRS technology to guide reconfiguration of connections between terminals and multiple radio systems[8]

In this scenario, multiple radio systems employing different radio access technologies are deployed on different frequencies to provide wireless access.

Two possible examples of this scenario are identified.

In one example, some terminals are reconfigurable and can adjust their operational parameters and protocols to use different radio access technologies. Such terminals can autonomously make decisions on these adjustments based on obtained knowledge required for making these decisions. Also, radio systems may assist terminals in obtaining knowledge and guide terminals in their reconfiguration decisions (e.g. using Cognitive Pilot Channel (CPC)).

In another example, some terminals have the capability to communicate with different radio systems, e.g. based on the subscriptions, but they cannot reconfigure their operational parameters and protocols to use different radio access technologies. Additional stations can be deployed to serve as a bridge between multiple radio systems and terminals. Such stations can obtain knowledge about the operational environment, and adjust their operational parameters and protocols to connect to one or more different radio systems simultaneously while providing connection to terminals using one radio access technology.

6/1.19/3.2.1.2 Use of CRS technology by an operator of radiocommunication systems to improve the management of its assigned spectrum resources[8]

To illustrate this scenario, consider an operator who already owns a network and operates in assigned spectrum and decides to deploy another network, based on a new generation radio interface technology in the same or other assigned spectrum, covering the same geographical area. Taking into consideration the non-uniform nature of radiocommunication needs within this area, an operator having more than one network based on different radio technologies could dynamically and jointly manage the deployed resources, in order to adapt the configuration of the networks to maximize the overall network capacity.

6/1.19/3.2.1.3 Use of CRS technology as an enabler of cooperative spectrum access[8]

In this scenario, information on spectrum use is exchanged amongst the systems in order to avoid mutual interference.

Two examples are identified for cooperative spectrum access:

– Example one: there may be variations in the occupancy of the assigned spectrum in a specific location at a specific time. Thus, in order to improve the efficiency of the spectrum use, it may be possible to take advantage of parts of the unused spectrum resulting from these variations. The capability to predict these variations in advance or to exchange information amongst systems/networks on the usage of their respective assigned spectrum may allow operators to share their respective assigned spectrum resources.
– Example two: in a network (public or private), the base stations are deployed according to the operator plan; such plan in many cases leaves coverage holes and areas lacking capacity. These cases may be solved by deploying additional base stations using CRS

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[8] The extent to which this scenario can be implemented is dependent on the national and international regulations governing the use of the spectrum.

technology managed by the same operator or by new entrant operators, when allowed by regulator body. In fact such networks may suffer from mutual interference due to the fact that they are using the same frequency band. The CRS technology may allow collaboration between these networks to resolve the interference issue.

6/1.19/3.2.1.4 Use of CRS technology as an enabler of opportunistic spectrum access[8]

In this scenario, information on spectrum use aimed to avoid mutual interference is not exchanged amongst the systems.

Compared to example one of the previous scenario, in this scenario there is no "*a priori*" determination of the spectrum to be eventually accessed by an interested party. In this scenario CRS may access parts of unused spectrum in bands shared with other radio systems without causing harmful interference. In this case, the selection of the spectrum to be eventually accessed is made on a real time basis following, amongst other things, a radio scene analysis.

6/1.19/3.2.2 CRS challenges and opportunities

Administrations considering the introduction of CRS technology to enable dynamic spectrum access may benefit from detailed considerations of operating characteristics of the incumbent stations. In particular the protection requirements for stations of any radiocommunication service and the RAS with an allocation in the targeted band should be considered to ensure an environment free of harmful interference, especially when the CRS technology only relies on a spectrum sensing technique to identify the use of the band(s).

Some concerns were expressed with respect to the use of the CRS technology to dynamically access the spectrum.

Spectrum exclusively allocated to passive services, where stations are only receiving could be a concern when considering the use of CRS for dynamic spectrum access. Another concern expressed by satellite operators in the EESS using passive sensors is the possibility of CRS attempting to operate in bands not exclusively allocated to passive services (RAS, SRS (passive) or EESS (passive)) on a worldwide basis, as such systems could identify those bands as free of any other active system and therefore ideal for usage. Furthermore, the SRS and EESS operate satellite links in frequency bands shared with other services. If one of these services plans to implement CRS technology, it will be necessary to take into account the regular but quasi sporadic operation of these links. For example, an EESS earth station may track a satellite in a low-Earth orbit. The satellite would then start transmitting towards the Earth station as soon as it has reached an elevation of typically 5 degrees above the local horizon. Any CRS station operating as part of the other services sharing the frequency band may have sensed that the particular frequency channel of the satellite link is unused and have occupied it. CRS stations might still cause harmful interference to the EESS station sharing the same frequency band. Similarly, some administrations have established local quiet or coordination zones around their radio astronomy stations, restricting emissions at frequencies outside the usually-allocated passive service bands. CRS relying on spectrum-sensing alone might misinterpret the lack of signal in locally-protected radio astronomy bands. Therefore, CRS may require both geo-location capabilities and knowledge of local spectrum regulations. In addition, all emissions, including those of CRS stations, are prohibited in passive bands listed in RR No. **5.340**.

CRS using dynamic frequency search operations in the FSS or BSS bands will need to consider that many earth terminals do not transmit continuously or are receive-only terminals and the downlink signals are at low power flux-densities. The detection of FSS and BSS receivers by a CRS may represent technical issues that may need to be studied. The use of data bases that would contain the locations and frequencies of the earth terminals could be a solution, especially in countries where the number of earth stations is not very large and the required information could be collected. However, in countries where the deployment is ubiquitous and where the location of an earth station may be temporary, the use of database is challenging. Furthermore, the data base may need to contain information that an FSS/BSS operator would consider sensitive and not want to disclose.

Other satellite services (e.g. EESS, RDSS, MetSat and MSS) that use downlink receive-only terminals or have low power signals will also need special consideration and studies for the implementation of CRS. In addition it should be noted that RNSS is fully operational at all times in all locations on Earth and CRS devices that dynamically search for spectrum do not appear to be appropriate for use in RNSS frequency bands.

The BS could be susceptible to interference resulting from the application of CRS technology. The BS is often planned on a noise-limited basis. As such, broadcast receivers are expected and are frequently called upon to operate at or near noise limits. Consequently, the non-detection of a broadcast signal by a sensing device in one location may not indicate that a frequency allocated to the BS is available for other users. Furthermore, broadcast receivers are particularly sensitive to interference from signals in adjacent, multiple adjacent, local oscillator and image channels. However, some administrations have demonstrated compatibility and authorized the use of available spectrum in the UHF bands through licence-exempt devices which operate on a non-interference and non-protection basis. The use of a geo-location capability and capability to access a database enables CRS to avoid interference with other users in the TV UHF band.

Frequency bands allocated to the BS are also utilized by electronic news gathering (ENG) systems such as wireless audio and video transceivers. The use of cognitive techniques to locate these ENG devices and to avoid their operating frequencies may be difficult. However, these difficulties may be addressed by administrations.

Any use of SDR or CRS technologies in bands used for safety-of-life operations needs careful consideration.

Fading and shadowing effects may result in the hidden node problem, in which CRS stations/terminals may not be able to detect the presence of a protected station, and hence bring interference to them. A database solution, in which the location information of the protected stations as well as other data will be employed, is one of the possible choices to avoid the hidden node problem.

These issues need to be addressed by further ITU-R studies on the deployment and use of CRS.

In response to these concerns and as per its definition, CRS is a policy-based adaptive radio system. With respect to implementation, the term means that policies including national and international regulations are translated into radio behaviour controls. For instance, despite the fact that receive-only bands (e.g. the bands covered by RR No. **5.340**) may appear as vacant spectrum, CRS will not only be aware that these bands cannot be accessed for transmissions, but appropriate radio behaviour controls will ensure that no transmissions occur. It is also important to note that one of the implicit assumptions made in the various concerns expressed above is the absence of a need for a CRS station to obtain the proper authorization from the relevant Administration prior to the use of the spectrum. In fact, RR Article **18** (RR No. **18.1**) and national regulations do not permit any unauthorized access to the spectrum, even when unused.

6/1.19/3.2.3 CRS capabilities and their applicability to facilitate coexistence in shared bands

The ITU-R has identified a basic, but not exhaustive, range of capabilities of CRS that may facilitate coexistence with existing systems. The following elements could be considered as examples of capabilities of CRS:

– spectrum sensing capability including collaborative and cooperative sensing;

– positioning capability of the transmitters and receivers (geo-location);

– access to information on the spectrum usage, local regulatory requirements and policies, e.g. through access to a database or access to a logical or physical cognitive pilot channel;

– capabilities to adjust operational parameters based on the obtained knowledge.

It is important to note that these CRS capabilities do not prevent CRS to be operated as any other existing systems under a predetermined allocation and assignment regime.

In fact, these capabilities of CRS may help improve coexistence amongst radiocommunication systems deployed under the current regulatory regime (predetermined allocation and assignment). For example, in bands allocated to both active services and RAS, CRS technology can be incorporated in a RAS station (receive-only station) taking advantage of any intermittent emissions from the stations of the active services. The RAS also makes increasing use of interference mitigation techniques. In bands shared with active services, some techniques rely on knowing the nature of the signals that they are attempting to mitigate and could be thwarted by changes in modulation scheme. For such circumstances radio astronomy interference mitigation algorithms may fail, or work with significantly degraded effectiveness.

There are already examples where CRS features have been employed.

In the MS, the radio local area networks (RLAN) in 5 GHz use spectrum sensing capability in the form of dynamic frequency selection (DFS), as described in Recommendation ITU-R M.1652, Report ITU-R M.2115 and Resolution **229 (WRC-03)**, to allow the system to obtain knowledge of its environment, in order to avoid interference to RLS using the same band.

Some administrations are authorizing license exempt devices to access the bands below 1 GHz shared with BS. A set of CRS capabilities is needed to ensure sharing with BS without causing harmful interference.

In conclusion, there are challenges to sharing through cognitive technologies that should be considered before administrations authorize them in particular services. However, the capabilities of cognitive radio systems, particularly with devices querying a database in which parameters (such as locations, frequencies, regulations and policies, etc.) for protected stations are registered, not only have the potential to make more efficient use of spectrum, but to also offer more versatility and flexibility, through the increased ability to adapt their operations based on internal and external factors. Cognitive radio systems may have a profound effect on many aspects of communications, including interoperability, as well as on spectrum utilization and allocation.

6/1.19/3.2.4 Relationship between SDR and CRS

SDR is recognized as an enabling technology for the CRS. SDR does not require characteristics of CRS for operation. Either technology can be deployed/implemented without the other.

In addition, SDR and CRS are at different phases of development, i.e., radiocommunication systems using applications of SDR have been already utilized and CRS are now being researched and applications are under study and trial.

6/1.19/4 Analysis of the results of studies

6/1.19/4.1 Issue A: SDR

With SDR technology, users/operators would be in a position to download and install software making the reconfiguration of a radio station only dependent on the availability of software and the user/operator interest. It is important to note that the application of ITU regulatory mechanisms will continue to depend essentially upon the capability of administrations to be aware of the spectrum use within their borders and provide the relevant information in a timely manner to the ITU. It also should be noted that a change of assignment due to reconfiguration of a radio station is possible and provisions in the Radio Regulations already account for this (see for example RR No. **8.1.1**).
The response to the issue of software reliability issue may be found in the modernization of the equipment certification and licensing regime which fall under national prerogatives. Furthermore, the issue of software reliability or security does not fall under the purview of the ITU-R.

6/1.19/4.2 Regulatory implications for SDR

Any radio station that has been reconfigured must continue to meet the regulatory requirements in the Radio Regulations applicable to the radio service in which the radio station belongs. Whether the reconfiguration is made by hardware or software means does not negate that requirement. Therefore it becomes clear that the existing Radio Regulations can encompass the implementation of SDR without any modification to the Radio Regulations. For implementation issues within a radiocommunication service, appropriate ITU-R Recommendation or Reports can be developed to address these individual issues. The study concluded that there is no need for modification of the Radio Regulations for the introduction of SDR technology.

6/1.19/4.3 Issue B: CRS

The potential benefits and applicability of CRS technologies to various radiocommunication services is recognized as well as the fact that CRS would be introduced in some services.

From the scenarios considered in section 6/1.19/3.2.1, it has been recognized that the implementation of CRS will have to be in accordance with the Radio Regulations but also with national regulations. Whether CRS technology is used as an enabler of cooperative spectrum access amongst system operators or of opportunistic spectrum access, administrations issue the authorization for a station to use a radio frequency or radio frequency channel under specified conditions (see RR No. **1.18**).

As shown in section 6/1.19/3.2.2 there are open issues and specific concerns related to several radiocommunication services that need further studies. Especially, the applicability of the CRS capabilities and the feasibility of deploying CRS in the bands shared between several services needs to be studied.

There would be a need for further studies on CRS technology, addressing especially dynamic and/or opportunistic spectrum access.

6/1.19/4.4 Regulatory implications for CRS

The use of CRS in some bands used by particular radiocommunication services may require the development of ITU-R Recommendations and Reports to address these issues. However, the study concluded that there is no need for modification to the Radio Regulations for this agenda item for the introduction of CRS technology.

6/1.19/5 Methods to satisfy the agenda item

6/1.19/5.1 Issue A: SDR

The method to satisfy the agenda item related to SDR is as follows:

6/1.19/5.1.1 Method A

No change to the Radio Regulations.

Under this method, technical and operational considerations related to the SDR technologies implemented in any stations of a radiocommunication service would be addressed in ITU-R texts as appropriate.

Advantages

– Allows administrations to facilitate implementation of SDR.

Disadvantages

– None.

6/1.19/5.2 Issue B: CRS

The methods to satisfy the agenda item related to cognitive radio systems (CRS) are as follows:

6/1.19/5.2.1 Method B1

No change to the Radio Regulations.

6/1.19/5.2.1.1 Option A: No change to the Radio Regulations

Under this method, technical and operational considerations related to the CRS technologies implemented in any systems of a radiocommunication service could be developed in ITU-R Recommendations and Reports as appropriate.

Advantages

– Allows administration to facilitate implementation of CRS.

Disadvantages

– Does not provide guidance for the studies and provisions for the implementation of CRS.

6/1.19/5.2.1.2 Option B: No change to the Radio Regulations and an ITU-R Resolution providing guidance for further studies on CRS

Under this method an ITU-R Resolution[9] is developed to provide a framework in order to facilitate studies on technical and operational considerations related to the implementation of CRS technologies

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[9] Resolution ITU-R [CRS] is contained in Annex 6 to Document 1B/267.

to ensure coexistence and sharing among radiocommunication services are addressed leading to ITU-R Recommendations and Reports as appropriate.

Advantages

– Allows administrations to facilitate implementation of CRS.

– Resolution provides a framework for guidance on further studies.

Disadvantages

– Does not provide provisions for the implementation of CRS.

6/1.19/5.2.2 Method B2

Add a WRC Resolution providing guidance for further studies and guidance for the use of CRS and no other changes to the Radio Regulations.

Under this method a WRC Resolution is developed to provide a framework for guidance of the studies on technical and operational considerations related to the CRS technologies implemented in any systems of a radiocommunication service leading to ITU-R Recommendations and Reports as appropriate as well as guidance to administration for use of the CRS. This method does not propose a new agenda item at the next conference.

Advantages

– Allows administrations to facilitate implementation of CRS.

– Resolution provides a framework for guidance on further studies.

– Provides guidance to administrations for the use of CRS.

Disadvantages

– Does not provide provisions for the implementation of CRS.

6/1.19/6 Regulatory and procedural considerations

6/1.19/6.1 Issue A: SDR

6/1.19/6.1.1 Method A

NOC to the Radio Regulations.

SUP

RESOLUTION 956 (WRC-07)

Regulatory measures and their relevance to enable the introduction of software-defined radio and cognitive radio systems

6/1.19/6.2 Issue B: CRS

6/1.19/6.2.1 Method B1 (Options A and B)

Same text as in section 6/1.19/6.1.1.

6/1.19/6.2.2 Method B2

Same text as in section 6/1.19/6.1.1 plus a draft Resolution **[A119-CRS-METHOD-B2]** on "Studies on deployment and use of cognitive radio systems (CRS)", an example of which is provided below.

ADD

DRAFT RESOLUTION [A119-CRS-METHOD-B2] (WRC-12)

Studies on deployment and use of cognitive radio systems (CRS)

The World Radiocommunication Conference (Geneva, 2012),

considering

a) that a cognitive radio system is defined as *a radio system employing technology that allows the system to obtain knowledge of its operational and geographical environment, established policies and its internal state; to dynamically and autonomously adjust its operational parameters and protocols according to its obtained knowledge in order to achieve predefined objectives; and to learn from the results obtained* (Report ITU-R SM.2152);

b) that pre-cognitive technologies employing some cognitive features, such as RLANs in the 5 GHz spectrum bands utilizing dynamic frequency selection are already in use (Recommendation ITU-R M.1652 and Resolution **229 (WRC-03)**);

c) that cognitive radio systems are expected to provide additional flexibility and improved efficiency to the overall spectrum use;

d) that ITU-R is studying such radio technology, its functionalities, technical characteristics, requirements, performance and benefits in the mobile service (Question ITU-R 241-1/5);

e) that international standards organizations have initiated related work on CRS;

f) that the implementation of CRS technology in systems under a specific radiocommunication service may require studies on this technology;

g) that the range of capabilities of CRS may facilitate coexistence with existing systems and may allow sharing in bands where it was previously considered as not feasible;

h) that a particular set of capabilities may need to be employed specific for the services with which the band is shared,

recognizing

a) that CRS is a technology, not a radiocommunication service;

b) that there are plans to employ CRS in some radiocommunication services;

c) that there are concerns about the feasibility of the deployment of CRS in some shared bands;

d) that a service using CRS should not adversely affect other services in the same band with the same or higher status;

e) that studies need to take into account challenges associated with the capability of CRS to dynamically access frequency bands, for example bands shared with passive services;

f) that further studies are needed for the implementation of CRS within a radiocommunication service and in bands shared with other radiocommunication services,

resolves

1 that any radio system implementing CRS technology within any radiocommunication service shall operate in accordance with the provisions of the Radio Regulations applicable for that specific service in the related frequency band;

Some administrations support the following text for *resolves* 2:

2 to urge administrations when authorizing operation of CRS within a service, to take all possible measures to avoid harmful interference in bands shared with radiocommunication services with equal or higher status, such as space services (space-to-Earth), radiodetermination service, passive services (radio astronomy, Earth exploration-satellite service and space research service) and safety services,

Other administrations support the following text for *resolves* 2:

2 to urge administrations when authorizing operation of CRS within a service, to take all possible measures to avoid harmful interference in bands shared with radiocommunication services with equal or higher status,

resolves to invite ITU-R

1 to study the implementation and use of CRS in any radiocommunication service that intends to employ CRS, addressing requirements, technical characteristics, performance and benefits;

2 to study the applicability of the cognitive capabilities and technical conditions to facilitate sharing between the services intending to deploy CRS and other radiocommunication services and the radio astronomy service;

3 to develop relevant Recommendations and/or Reports based on the aforementioned studies as appropriate,

invites administrations

1 to participate actively in the studies by submitting contributions to ITU-R;

2 to take into account, in their bilateral and multilateral negotiations with the concerned administrations the results of ITU-R studies when implementing cognitive radio systems.